

Civil engineering practice essay



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Chapter Two Project Conception and Feasibility At this stage, the project is yet to advance to design nor has a design team been selected. The project could be awaiting financing, land acquisition, review agency approvals, feasibility studies, etc. Typically the only contact listed on a project at this stage will be the Owner or the Owner's Representative. 1. 1 PROJECT CONCEPTION Conception of any Civil Construction Project Is the Initial step In the process of defining the actual scope of the project.

As such, Project conception generally starts when there is a manifestation of a requirement or an opportunity that will be of infinite to the Promoter (as in the case of private individuals) or to the general public(as in the case of the government). Such conception becomes more rooted when evidence of its success (as to satisfying the Promoter's expectation) are increasingly available. The project conception Lies solely In the hands of the Promoter.

As he is the key member of any team engaged in a construction project and will need to establish means of acting efficiently within the team to ensure the success of the project. This period requires his close involvement. And generally, will ensure the greater proportion of the total pre-contract duration. 1. 1. 1 Stages of Project Conception: Initial conceptualization of a project has various degrees of complexity, depending on the nature of the specific project and the particular analysis and approval procedures used by the promoter.

In some cases, the promoters planning strategy may require formulations of programs involving several projects. Conception of the overall program should then precede conception of the individual specific projects. The

conceptual stage involves the following activities: 1 . Definition of a requirement or an opportunity that commands the Interests of the Promoter. 2. Formulation of a set of preliminary alternatives capable of fulfilling the initial requirement. 3. Election of alternative(s) that might satisfy the requirements in terms and conditions attractive to the Promoter. A brief description of each of these activities in a specific situation and in an organized environment follows: Definition of the Requirement of Opportunity: The continuity of efficient operations and the opening of the new business areas are the main drives for capital investments for industrial firms. Investment opportunities are detected through operational analysis of current performance and by forecasts of the most likely future scenarios.

Preliminary Formulation of the Alternatives: Project conception continues with development of alternatives capable of fulfilling the expressed objectives. The preliminary formulation of alternatives is important as it sets the pace of the subsequent definition and elaboration of the project scope. During this phase, the Promoter calls upon the experience and creative of Its technicians, manager and erectors to generate an adequate group of alternatives to fulfilled the expressed comparative analyses are made in order to select the most beneficial and to reject the least attractive.

The selection process employs a basic feasibility analysis of each alternative the establishment of criteria that will allow the identification of the most attractive options. At this point, further consideration of the rejected alternative is terminated along with the need to prepare elaborate definitions for them. The cost, schedule, profitability, and other salient advantages and

disadvantages of each of the elected alternatives are assessed in terms of order of magnitude.

Difference among the options is sought still without establishing precise project parameters. 1. 2 THE PROMOTER'S OBLIGATIONS Before a promoter can start on a civil engineering project it will be necessary to undertake a number of studies. And according to Alan Tort in ' Civil Engineering Project Management', these may comprise but not limited to: Market Demand Studies to define what are the needs the proposed project should meet; such as the size and quality of the project output or benefit; Economic And Financial Studies to decide for how long a period it is economic for the project to cater for the foreseeable demand, taking into account the cost involved and how the project is to be financed; Feasibility Studies to ensure the project is ' engineering practicable, confirm its probable cost, and decide what methods should be adopted for the design and construction; Legal Studies to ascertain what statutory or other powers must be obtained to construct the project, including environmental approvals.

These studies are all interconnected. For the market and financial studies, the promoter may appoint economic advisers because a major problem to be resolved is how large the project should be (in terms of output or capacity) and whether it would be economic to phase the construction in stages. The feasibility studies will need to investigate different options for providing the output, to ascertain how practicable it is to adopt phased construction, and what difference this would cause to capital outlays and their timing.

Legal advice will be necessary to obtain powers to purchase land, gain access, alter public rights of way, abstract water, discharge waste, gain landing approval, and meet environmental and other objections. A number of outside bodies may have to be consulted on these matters. Special procedures, including presenting the case for a project before a public inquiry or gaining parliamentary approval can be necessary for many types of work.

For projects internationally funded it will be necessary to meet the extensive requirements of funding agencies, such as the World Bank, Asian Development Bank, United Nations Fund, or European Community regulations. These requirements are often complex and may necessitate the employment of a firm of consulting engineers experienced in such work, together with financial and economic advisers. It can take 2 years or more on a major project to conduct all the studies required and negotiate the powers required for construction. Even on a small project these matters can seldom be completed in less than a year.

The design work for a construction project often begins with a feasibility study, a planning document that: Confirms and explains the owner's requirements, Identifies and evaluates alternative solutions, Recommends and defines a solution, Summarizes the proposed scope of work, and Provides a detailed cost estimate. For small and medium sized project, it is not legally required that a feasible study be conducted, even though some informal feasible study should be done . As a practical matter, however, you should complete a study for every major construction project.

If you have not determined the approximate size and optimal configuration of the new school building or determined the most cost-effective approach to improving the water treatment facility – in short, if you have not prepared a study – you are not ready to begin the design stage. In the long run, the problems created by inadequate planning can cost far more than the study. The study typically includes the following planning information: The program, a major product of a study, is a document that outlines the project requirements in terms of content, time, and cost.

The program should answer questions such as the following: What are the specific functions and requirements that the proposed project must meet? How many people will use a facility? How many and what types of vehicles will use a road? What is the peak demand going to be? What functions will the facility be required to accommodate? How much space will those functions require? What are the performance requirements or standards for each component of the facility and for the facility as a whole? What special equipment or construction is needed?

Preparation of a program for a major construction project usually requires meetings and discussions with public employees and citizens who will use the facility to assess their needs and concerns. Developing a program for either a building project or a public works project often requires meeting with state or federal regulatory or funding agencies and conducting an analysis of generic program specifications or regulations issued by those agencies.

Alternatives. What are the available alternatives for meeting the functional requirements of the project, and what are their relative costs and benefits?

For example, the study might review alternate sites or analyze the relative costs and benefits of new construction versus renovation. Surveys and field tests. The study may incorporate tests to obtain data on the cost and feasibility of various sites or design alternatives. Environmental impacts. What are the expected environmental impacts of the project and how can negative impacts be mitigated? For some projects, an environmental impact study will be required under state or federal statutes. Cost and financing. How much will the project cost to build?

How much will it cost to operate and maintain? Where will the money come from? 1. 3. 1 Importance of Feasibility Studies As explain by Alan Tort in his book titled ' Civil Engineering Project Management', Feasibility studies of an engineering nature are needed for most construction consulting engineer to check the technical feasibility and cost of the project. The consulting engineer should be able to bring extensive design and construction experience in the type of work the promoter needs, and be able to offer economic solutions to problems his experience tells him are likely to arise.

The value of an independent consultant is that he uses only his professional Judgment in deciding what will serve the promoter's interests best. Such a consultant should have no relationship with any commercial or other firm which could have an interest in favoring any particular kind of development. In the initial stages, the studies usually concentrate on various options for the location, design and layout of the project.

The studies may include different methods for producing the required results, such as the alternatives of building a dam or river intake or sinking boreholes

or buying water from an adjacent company to produce a new supply of water. Accompanying this work there will be data gathering and analysis, followed by the development and costing of alternative layouts and designs, so the promoter can be assisted to choose the scheme which seems most suitable. Site investigations are particularly important, and sufficient time and money should be spent on them.

Although they cannot reveal everything below ground, inadequate site investigations are one of the most widespread causes of construction costs greatly exceeding the estimate. On large or specialist projects, trial constructions or pilot plant studies may be necessary such as, trial construction of earthworks, sinking of test borings for water, setting up pilot plant to investigate intended process plant, or commissioning model tests of hydraulic structures. The feasibility studies should include a close examination of the data on which the need for the project is based.

Many instances could be quoted here large sums of money have been saved on a project by carrying out, at an early stage, a critical examination of the basic data the promoter has relied upon. This data has to be tested for accuracy, reliability, and correctness of interpretation. ' 1. 4 PROJECT DESIGN
Unless the promoter uses his own chief engineer for the design of the works, he will need to engage the services of some independent engineer- a consulting engineer. He will need to enter into a contract with the consulting engineer for the design and supervision of construction of the project.

In return for these services he will pay the consulting engineer a professional fee. At this stage the consulting engineer becomes designated as the

engineer for the project. The promoter agrees to accept the engineer's advice on matters of engineering. The role of the designer during the design stage of a design-bid-build project is to translate the functional requirements established in the program into a set of biddable construction documents. The design stage typically includes the following tasks and final products: Surveys and field tests to provide additional information about conditions at the site.

The ignited of this task will depend in part on the amount of field work done during the planning stage. Additional consultations with the project's users, abutters, and other affected individuals and groups. Preparation of sketches and schematic drawings, including site plans, floor plans, and fade drawings, which show the size foundations; structures; electrical systems; and heating, ventilating, and air conditioning systems. Preparation of final plans, specifications, and other bid documents. The plans are the construction drawings.

The specifications are the Ritter materials that prescribe the amount and quality of materials to be furnished, the construction techniques to be used, and other construction-related information. Updated project cost estimates, based on the final plans and specifications. The design stage on major projects is often divided into three phases: preliminary or schematic design, design development, and preparation of construction documents. During each phase, the designer is required to prepare and submit for approval specific deliverables. Major project decisions are made during the preliminary or schematic design phase.

After the preliminary or schematic design has been developed and approved by the owner, the designer proceeds with the detailed design development. After the owner has approved the design development documents, the designer prepares the construction documents. The construction documents include 100 percent complete plans and specifications that competing contractors will use to prepare their bids and that the selected contractor will follow in constructing the project. A well-developed and complete set of plans and specifications should generate reliable bid prices and enable the construction process to proceed smoothly and efficiently.

Conversely, flawed or incomplete plans and specifications can lead to a host of headaches ranging from excessive and expensive construction change orders to life-threatening construction defects. If you have assigned an owner's project manager to the project, this person will assist you in reviewing the design deliverables produced by the project designer at the end of each design phase. If you plan to hire or contract with a construction manager to oversee the construction stage of the project, we recommend that you bring this errors or firm on board before the plans and specifications are finalized and put out to bid.

A "constructability review" of the construction documents by a knowledgeable construction manager may identify potential problems that can and should be corrected or opportunities that should be considered by the designer.

1. 4. 1 Employment of Consulting Engineer Consultants/client advisers provide the foundation on which a successful project is constructed. Depending on the client's in-house resource, selected consultants could provide the following functions: I.) Design services- His organization is

responsible for all design duties, it.) Project Management (including cost management) iii. Value management, risk management, partnering facilitator, facilities management (may be included in project management. The principle advantages of the employment of a consulting engineer are that his judgment and advice are independent of all outside influences and that he is a specialist spending most of his time on the design and construction of new works. For large scale construction, to apply for the service of a consulting engineer, one Selecting consultants The consultant's brief should describe the services that the consultant is required to array out precisely.

These are dictated by the strategy adopted and whether the services are to be provided individually or in combination. The project sponsor must also ensure that any authority delegated to the project manager is carefully defined particularly in connection with the following: _ Order variations and make changes; Certify interim payments; Grant extensions of time; Expressions of Interest Preliminaries Detailed design 1. 5 TECHNIQUE FOR COMMENCING DESIGN AND CONSTRUCTION 1. 5. 2 Options for Design The following shows the principal design options commonly adopted.

A) Design by Promoter or a Consultant The whole of the design, including all drawings and specifications, is completed before construction tenders are sought – except for drawings not needed for tendering purposes, such as for concrete reinforcement. A promoter may have sufficient staff to undertake design work 'in house' or he may put all design out to a consultant, or divide the design work between them. On schemes involving different types of

engineering, design may be let out in separate ‘packages’ to different specialist consultants.

For instance the design of an industrial estate may be cadged into – roads and drainage; water supply and sewerage; power supplies, and landscaping. For large schemes the promoter may appoint an overall consultant with wide experience to co-ordinate the inputs of the specialist design consultants. Some elements of design may be left for the construction contractor or his sub- contractors to undertake, such as the design of heating and ventilating systems, or the cladding for a building. Specialist suppliers may need to design their product or services to suit the project.

Advantages are: The promoter can check all aspects of the design to ensure they meet his acquirement before construction starts. Competitive tenders for construction are obtained on a clearly defined basis encouraging construction contractors to submit lowest prices. The risk of having to make alterations to the work during construction is minimized, giving a better chance of the project cost not exceeding the tendered price. The promoter is not committed to proceed with construction until he sees tendered prices and accepts a tender. B) Outline Designs Provided With Detailed Design by Others The promoter draws up outline designs and a specification of his requirements. He engages a management contractor to co-ordinate both the detailed design and the construction. This type of arrangement can be seen in some management contracts (see Section 2. 5). (C) Layout Design by Promoter; Detailed Design by Contractor The promoter specifies functions and design standards, and supplies layout plans. The contractor then undertakes the detailed design before proceeding with construction.

The works may be relatively small, such as the design of a retaining wall; or fairly extensive such as the design of an intake and drainage pumping station, or the structural and enforced concrete design for a water tower.

Advantages are: The contractor can adopt designs suiting his constructional equipment and his usual construction methods, enabling him to tender his lowest price. The cost of making design alterations during construction do not fall on the promoter. Disadvantages are: The design may tend to suit the contractor more than the promoter. Control over design details is lost to the promoter. The contractor must increase his price to cover design risks. (D)

Functional Specification by Promoter: Design by Contractor The promoter specifies the functions the project is to perform, for example the size, quality and performance criteria for the intended works. He also provides drawings showing the location of the intended works and draft layouts for them, and may specify standards for design. The works required may be extensive, such as design of a road, or the civil works and plant for sewage treatment works.

The contractor undertakes the layout and detailed designs to the standards required. This is the basic set-up for design and build (D) contracts where most of the design responsibility is held by the contractor. 1. 5. 3 Options for Construction a) Direct labor construction The promoter uses his own workforce to carry out construction. This gives the promoter full control of the work and flexibility to alter it. However, with no competition on prices, costs can be high unless management of the work is efficient. Direct labor construction was common for works in Nigeria.

It has continued to find its application in areas where sufficiently experienced local contractors are not available. Direct labor construction can be undertaken by consulting engineers on behalf of the promoter. The consultants hire the necessary labor and plant, and order the necessary materials, using money provided by the promoter. Given a small team of engineers and some skilled foremen to guide local labor under a resident engineer with strong managerial capacities, direct labor under the control of a consulting engineer has often been notably successful in keeping a project to time and budget. B) Construction divided into trades A practice often followed in developing countries is to split construction work into packages by trade, for example, brickwork, carpentry, etc. Because local contractors often provide only one type of trade work. The same approach on a larger scale is moieties adopted for complex building projects, with a management contractor ancillary services Most civil engineering works incorporate services of an electrical or mechanical kind, such as for heating, lighting, ventilation and plumbing.

It is usual to permit the contractor to choose the sub-contractors who provide such services, subject to the approval of the promoter. The promoter, however, must make provision in the design to accommodate such services. An advantage to the promoter is that co-ordination of the sub-contractors then rests with the contractor, and if they delay him, that is his responsibility. A disadvantage is that if the promoter specifies (I. E. 'nominates') some particular supplier of services or goods, the promoter then becomes responsible for any delay caused to the civil contractor by the nominated firm. D) Civil contractor constructs; promoter orders plant

separately. When major plant such as generating plant, pumps, motors, or process plant has to be incorporated in civil engineering works, there is an advantage in the promoter letting separate contracts for such plant. This may be essential in cases where plant is on such long delivery time that it must be ordered before the construction contract is let. Advantages to the promoter are that he has direct access to the plant supplier to specify his requirements and agree all technical details.

He can receive plant drawings in good time to complete the structural designs. A disadvantage is that, if the plant supplier is late on his promised delivery, the promoter may have to pay the contractor for delay. To guard against this, plant delivery times quoted to the civil contractor can allow a 'safety margin' on the plant supplier's quoted delivery time. The majority of all projects incorporating major plant are managed satisfactorily on his basis.

E) Civil contractor orders all plant. On a large and complex project there may be an advantage in requiring the civil contractor to order plant, as specified and pre-agreed by the promoter with the plant supplier – provided the time for construction is long enough for plant to be delivered in time. Advantages are: The civil contractor can be left to arrange delivery of pieces of plant to suit his construction programme. The civil contractor has direct contact with the plant supplier to agree to the details of any storage or lifting requirements. The promoter voids the risk of delaying the contractor by not getting the plant supplier to deliver in time. Disadvantages are: The plant supplier will not start manufacture until the civil contractor places his order. To complete the civil works design, the promoter may have to pay the plant supplier a fee for providing layout drawings in advance. If the promoter asks

for some alteration to the plant, or a Works test' on the plant shows the need for some amendment, delivery may be delayed causing the civil contractor to claim for delay. The plant supplier may increase his charges if he thinks his risks will be increased by having to rely on the civil contractor for payment. (f) Plant supplier arranges building design and construction Where the supplier of process plant exerts a dominating influence on the design of a project, the promoter may ask him to employ a civil engineering contractor as sub-contractor to construct the works to accommodate the plant. The plant supplier may then use some firm to suppliers, however, will not agree to this procedure, on the basis that either they have no experience of construction work or do not wish to be involved in it. . 5. 4 Construction using forms of management contracting An alternative to the promoter or his consultant drawing up and letting contracts for construction of a project, is for the promoter to use a ' management contractor' to do this. There are two main forms of management contracting. (a) Construction management This term is used to mean the arrangement under which the promoter appoints a manager with his own staff to organize the letting and supervision of construction contracts which are placed by the promoter.

Design may be by the promoter's staff, or can be placed as a separate design package or packages let by the promoter, but supervised by the manager. An advantage is that an experienced construction manager should be able to avoid or minimize the problems of coordinating contractors.

Disadvantages include the separation of the promoter's design requirements from construction supervision, and the extra cost of the manager and his staff. B) Management contracting This is an arrangement more commonly

adopted for complex building constructions rather than for civil engineering works. Under it the promoter appoints one contractor to manage all the construction inputs by letting contracts himself. These Works contracts' are effectively sub-contracts to the management contractor. Many may be labor-only contracts, while others are for 'supply and erect'. The promoter may retain rights to approve or disapprove appointment of a works contractor.

The promoter may also let a separate design contract, which is placed under the administrative charge of the management contractor. Advantages are that the promoter is relieved of the responsibility for the letting of the many sub-contracts used, and the co-ordination of their inputs to meet the design required. Disadvantages are that the speed of construction depends upon the ability of the management contractor to get efficient sub-contractors working for him. Some projects have been highly successful; others have suffered disastrous delays.

Also, if construction starts before designs are sufficiently complete, any design alterations found necessary later can result in delays and excessive cost over-runs. A tangle of legal claims and counter-claims can then arise as each of the parties involved - the promoter, management contractor, designers, and works contractors - tries to make others responsible for some or all of the cost over-run. The price risk to the promoter is relatively high, since the terms of a typical management contract permit extra costs ND risks to pass straight through to him from the works contractors.

Management contracting was initially much favored for large building developments with associated civil engineering work; but there has been

considerable debate concerning its merits and the number of jobs using the method has declined. 2. 5. 5 Design and build procedures and other options Contracts of this type are often for a lump sum which can suit a promoter who wants certainty of price, and who can be given a clear idea of what he is being offered. For instance, the contractor may be able to offer an 'off the shelf' design for a type of structure he has previously built and can show the promoter.

Where this is not the case, the promoter may provide a drawing of what he requires and stipulate design requirements, for example, design processes and parameters to be used. Advantages are: The promoter does not have to employ a separate designer. Construction can start before designs are complete and any consequent changes found necessary are the contractor's responsibility. Control of the design process permits the contractor to keep costs as low as possible by such measures as – using parts of previous designs, minimizing the need for complicated framework, and tailoring dimensions to suit the contractor's equipment. For uncomplicated or traditional civil engineering work, or repeat structures of a kind the contractor has done before, a turn-key contract can give a promoter a satisfactory job at lowest price. There is also a possible advantage that collaboration between design and construction staffs can foster innovative design which reduces costs. But if the tender period gives insufficient time for an innovative design to be fully worked out, the contractor may think it too risky to allow for it in his tender. If later, the innovation proves possible, the contractor benefits and not the promoters.

Disadvantages are: If the design has yet to be formulated, the promoter has to leave most details in the contractor's hands. If the promoter employs a consultant to check the contractor's design, he will only be able to insist on compliance with matters specified in the contract. The promoter may need to employ an inspector to watch the contractor's construction. Bidding costs for other than simple structures are expensive, so contractors may refuse to bid if more than three or four are invited to tender.