

The Application of Project Life Cycle Method to the Infrastructure Projects

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Abstract: This paper is written to introduce the application of the project management life cycle to the infrastructure projects (metro construction project as a case study). Metro construction should technically and economically be optimized to achieve maximum efficiency. In this regard, the selection of a project management life cycle methodology is very important to achieve these project objectives. Underground constructions in urban regions, such as metro construction, have been largely used for extending daily human life into underground spaces. Therefore, the recognition of the complex elements of a metro construction can play a significant role in its project management and planning. This study aims to investigate these complexities in subway construction. This may develop the possibility of high predictability for these challenges. As metro projects are also urban underground projects, both internal and external issues are studied, and their impacts on project management are discussed. It is concluded that exceptional differences in the management and planning of these constructions is that combined internal and external complexities are carried out simultaneously.

Keywords: Project life cycle, infrastructure, underground, metro.

I. INTRODUCTION

Infrastructure plays a vital role in metropolis. Explosive growth of cities in developing countries and, thus the demand for improved livability and environmental protection has created a strong demand for new underground development [1].

Metro with advantages such as high transportation capacity low pollution, reasonable incurred resources, and low energy consumption is a necessary infrastructure for metropolitan cities. It is also in conformity with the principle of sustainable development

At present, there are over 100 cities all over the world that have been operating metros. Large scale metro constructions are ongoing in many cities such as Tehran, Isfahan, Mashhad, Shiraz, Tabriz, Ahvaz, and Mumbai for instance [2].

The method of construction of the metro stations is very sensitive to the surrounding area and therefore selection of the construction method is very important for such type of the projects. Figure 1 depict the project life cycle.

There are two basic elements of subway construction constructing stations and their entrances, and constructing the tunnels running between the stations.

The project lifecycle, on the other hand, focuses on managing the work that is required to produce the deliverables and accomplish the objectives of the product. Generally speaking, the project lifecycle could be very similar for various types of projects and relates to the need to have established controls for confirming scope, managing and controlling the work, reporting performance, and other elements of management.

In this paper, the project life cycle methods are used to manage these types of projects, and projects phases are discussed in details.

II. PROJECT MANAGEMENT PHASES

An understanding of the infrastructure project life cycle is essential for all who are associated with the construction industry; every project goes around the typical pattern of the flow of the project work from its inception to its closeout and termination. Every project, not just those in the infrastructure industry, goes through a series of identifiable phases [3].



Figure 1, Project life cycle

A. Pre-Project Phase

An **infrastructure project** begins with an idea, a perceived need, and a desire to improve or add to productive capacity or the wish for more efficient provision of some public service. Whether the idea will be converted into a completed project will be decided during the planning and design phase. However, prior to that, among the first things the **owner** must do is to decide:

- What sort of **project delivery system** will be used?
- How will the various parties be related?
- Will the owner engage a design professional to prepare plans and specifications and then contract separately with a construction contractor?
- Will a single entity be responsible for the entire project?
- Other possible options include several separate specialty contractors, each related by contract with the owner, the use of a **infrastructure** manager as an advisor to the owner, the use of the owner's own **infrastructure** forces and the phasing of the project such that individual portions of the field work are commenced prior to the completion of all design work.
- The other primary decision required by the owner early in the project relates to the **type of contract** to be used with the contractor.
- Will the contractor be paid a specified fixed price, regardless of the actual quantities used in the project and regardless of the contractor's actual costs?
- Will the quantities of materials be measured and the contractor paid on the basis of those quantities and pre-agreed-upon unit prices for each material?
- Or, will the contractor be reimbursed for its actual costs, plus a fee, perhaps with an agreed-upon upper limit?
- The owner will also need to decide the basis upon which the design professional will be paid. Often these decisions are not made without consultation and advice.

- Depending upon the owner's expertise and experience in administering construction contracts, the owner may engage a professional engineer, an architect or a project manager during this pre-project phase to advise on these important decisions[4].

B. Planning and Design Phase

The project is fully defined and made ready for contractor selection and deployment during the planning and design phase. It is convenient to divide this phase into **three stages**:

- The goal of the **first stage** is to **define the project's objectives**, consider alternative ways to attain those objectives and ascertain whether the project is financially feasible. In this process of **planning and feasibility study**, a project brief will be developed, more details will be set forth in a program statement, various sites may be investigated, public input may be sought, a preliminary cost estimate will be prepared, funding sources will be identified and a final decision on whether to proceed with the project will be rendered.
- In the **second stage**, the design professional will use the **results of the planning efforts** to **develop schematic diagrams** showing the relationships among the various project components, followed by detailed design of the structural, electrical and other systems. This latter activity is the classical hard core engineering familiar to students in the design professions, in which various engineering principles are used to estimate loads and other requirements, select materials, determine component sizes and configurations and assure that each element is proper in relation to other elements. The output from this design development effort is used in the final stage,
- In the final stage, **contract documents are prepared** for use in contractor selection and installation work at the construction site. The design professionals prepare not only the detailed construction drawings but also written contract conditions containing legal requirements, technical specifications stipulating the materials and the manner in which they shall be installed and a set of other documents related to the process of selecting the contractor and finalizing the contract with the successful tenderer.

C. Contractor Selection Phase

In anticipation of selecting a contractor,

- the owner must decide whether an open invitation will be issued to all possible tenderers or whether only certain contractors will be invited to submit offers and whether any sort of pre-qualification process will be invoked to limit the number of tenders.
- On the other side, contractors will have to consider a number of factors in deciding on whether they will make the effort to assemble a proposal for a particular project.
- If a contractor finds the prospective project attractive, two major tasks will be required:

First, a series of planning steps will be carried out, including studies of various methods and equipment that would be employed and the development of a preliminary project program setting forth an approximate time schedule for each major activity.

Second, a priced proposal will be prepared, including the direct costs of labor, materials, plant and subcontractors, various overhead charges and a sufficient added amount for profit. The last step in this phase is the submittal, opening and evaluation of tenders, the selection of the successful contractor and the finalization of the construction contract.

D. Project Mobilization Phase

After the **contractor is selected**, a **number of activities must be completed before installation work** can begin at the project site:

- Various bonds,
- Licenses and insurances must be secured.
- A detailed program for the construction activities must be prepared.

- The cost estimate must be converted to a project budget and the system for tracking actual project costs must be established.
- The worksite must be organized, with provisions for temporary buildings and services, access and delivery, storage areas and site security.
- The process of obtaining materials and equipment to be incorporated into the project must be initiated and arrangements for labor,
- The other essential resources must be organized. With the completion of this phase, it is finally time to begin the actual field construction.

E. Project Operations Phase

In **presenting the contractor's activities on the construction site**, we will suggest, perhaps too simply, that the responsibilities involve three basic areas:

- Monitoring and control.
- Resource management and.
- Documentation and communication.

Five aspects of monitoring and controlling the work are important:

1. **Actual schedule progress** must be compared against the project program to determine whether the project is on schedule; if it is not, actions must be undertaken to try to bring the program back into conformance.
2. Likewise, the **cost status must be checked** to establish how actual performance compares with the budget.
3. An equally important part of monitoring and control is **quality management**, to assure that the work complies with the technical requirements set forth in the contract documents.
4. In addition, the contractor has an important role to play in managing the work safely and in a way that
5. Minimizes adverse environmental impacts.

In managing the project's resources, the contractor will,

- First, be concerned with assigning and supervising personnel and assuring that the labor effort is sufficiently productive to meet schedule, cost and quality goals [5].
- In addition, materials and plant must be managed so that these same goals are met.
- Because construction projects require large amounts of paperwork, a special effort is required to manage this documentation effectively. Examples include the various special drawings and samples that must be submitted to the owner or design professional for approval prior to installation, the frequent need to respond to requests for changes in the project after the on-site work has begun and the all-important process for periodically assessing the value of work completed and requesting payment for this work. Various on-line and other electronic means are available to assist contractors with document management and project communications [6].

F. Project Closeout and Termination Phase

Finally, as the **project nears completion**, a number of special activities must take place before the contractor's responsibilities can be considered complete. **There are the various testing and startup tasks:**

- The final cleanup.
- various **inspections** and **remedial** work that may result from them and the process of closing the construction office and
- Terminating the staff's employment.

- In addition, a myriad of special paperwork is required, including **approvals and certifications** that allow the contractor to receive final payment, a **set of as-built drawings** that include all changes made to the original design.
- Operating manuals.
- Warranties and
- A final report.
- The contractor will also be responsible for transferring and archiving project records and will conduct some sort of project critique and evaluation.
- Operator training may also be part of the contractor's contractual responsibilities.

III. PROJECT LIFE CYCLE

A project life cycle is the series of phases that a project passes through from its start to its completion. A project phase is a collection of logically related project activities that culminates in the completion of one or more deliverables [7].

The phases can be sequential, iterative, or overlapping. The names, number, and duration of the project phases are determined by the management and control needs of the organization(s) involved in the project, the nature of the project itself, and its area of application. Phases are time bound, with a start and end or control point (sometimes referred to as a phase review, phase gate, control gate, or other similar term). At the control point, the project charter and business documents are reexamined based on the current environment. At that time, the project's performance is compared to the project management plan to determine if the project should be changed, terminated, or continue as planned.

The project life cycle can be influenced by the unique aspects of the organization, industry, development method, or technology employed. While every project has a start and end, the specific deliverables and work that take place vary widely depending on the project. The life cycle provides the basic framework for managing the project, regardless of the specific work involved [8].

Though projects vary in size and the amount of complexity they contain, a typical project can be mapped to the following project life cycle structure, starting the project, organizing and preparing, carrying out the work, and closing the project. A generic life cycle structure typically displays the following characteristics:

- Cost and staffing levels are low at the start, increase as the work is carried out, and drop rapidly as the project draws to a close [9].
- Risk is greatest at the start of the project. These factors decrease over the life cycle of the project as decisions are reached and as deliverables are accepted.
- The ability of stakeholders to influence the final characteristic of the project's product, without significantly impacting cost and schedule, is highest at the start of the project and decreases as the project progresses.

IV. THE RULE OF THE PROJECT MANAGER FOR DEVELOPING ABOVE APPROACH

Usually, project managers apply a project management methodology to their work. A methodology is a system of practices, techniques, procedures, and rules used by those who work in a discipline.

The Project Management Institute has the Standard for Project Management, and is recommended as a reference for tailoring, because these standard documents identify the subset of the project management body of knowledge that is generally recognized as good practice. "Good practice" does not mean that the knowledge described should always be applied uniformly to all projects. Specific methodology recommendations are outside the scope of this guide.

Project management methodologies may be:

- Developed by experts within the organization,
- Purchased from vendors,
- Obtained from professional associations, or
- Acquired from government agencies.

The appropriate project management processes, inputs, tools, techniques, outputs, and life cycle phases should be selected to manage a project. This selection activity is known as tailoring project management to the project. The project manager collaborates with the project team, sponsor, organizational management, or some combination thereof, in the tailoring. In some cases, the organization may require specific project management methodologies be used.

Tailoring is necessary because each project is unique; not every process, tool, technique, input, or output identified in the PMBOK

Guide is required on every project. Tailoring should address the competing constraints of scope, schedule, cost, resources, quality, and risk. The importance of each constraint is different for each project, and the project manager tailors the approach for managing these constraints based on the project environment, organizational culture, stakeholder needs, and other variables [10].

In tailoring project management, the project manager should also consider the varying levels of governance that may be required and within which the project will operate, as well as considering the culture of the organization. In addition,

Consideration of whether the customer of the project is internal or external to the organization may affect project management tailoring decisions.

Sound project management methodologies take into account the unique nature of projects and allow tailoring, to some extent, by the project manager. However, the tailoring that is included in the methodology may still require additional tailoring for a given project.

V. CONCLUSIONS

An understanding of the infrastructure project life cycle is essential for all who are associated with the infrastructure projects. Design and engineering phases of a typical construction project produce considerable amount of details and specifications. In order to make our project highly successful, the project life cycle method must be applied. Studied about the construction methods and concept of underground metro station design. Compare the bottom up construction method the top down construction method is efficient and economical. Each project is unique and needs to be evaluated as to which method will be the best fit for the Owner to achieve company objectives and realize the greatest return on investment.

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