Program Management Basics

By Craig B. Smith
(An excerpt by R. Max Wideman, FPMI)[1]

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Introduction

While this is effectively a continuation of the book review of ***How the Great Pyramid was built*** that we published last month, we also came across an excellent ***Primer on Program Management*** that author Craig B. Smith provides as an Appendix.[2] In our view, it is so good that we decided to feature it this month specifically as a learning tool for our readers. It is for all those who are not at all clear on what Program Management is strictly all about, and how much work it should involve.

True, the following description is based on conducting a very large infrastructure project, such as the Great Pyramid of Egypt. Nevertheless, with appropriate adjustments to technical language, Craig's advice can be used to develop appropriate processes for any colossal assignment that involves a large number if interrelated projects each conducted by separate parties. Therefore, if you are responsible for overseeing a number of related projects, then you are not only undertaking a Program, you are also acting as a Program Manager.

Happily, Craig starts out his *Primer on Program Management* with a definition of program management so there can be no misunderstanding of what it is all about. Read carefully through the following pages – you will find it highly instructive and a valuable reference. Remember, much of the description that follows must have been used 4500 years ago. It's an excellent lesson, so here it is.

A Primer on Program Management

Definition

Program management is the science and practice of managing large private and public works projects. Typically, these involve complex engineering design and construction utilizing multiple contractors. The logistical issues - making certain everything comes together at the right time, in the right quantity, with the right quality--is one of the great challenges of these projects and becomes the major preoccupation of the program manager. Because the expenditure of public or private funds is involved, it is often necessary to engage an independent third party to represent and protect the interests of the owner.

Concepts

Any complex project involves the interrelationships of numerous "players": designers, contractors, suppliers, regulators, unions, customers, the public, government officials, and the project owner, to name a few. To achieve the best result tor the least cost there invariably will be one optimal way of planning and implementing the work. Normally the optimal approach is not obvious on a complex, multiyear project.

In addition, changes can disrupt the otherwise orderly flow of the work – a flood or other natural

disaster, a shortage of a critical component or material, an accident, delays in funding, and so on.

There is also a logical sequence to performing the work, which ensures that it will be completed in a timey, cost-effective manner. For example, while certain activities must be performed in sequence (forms must be built before foundations can be poured), other activities can go on in parallel (structural steel can be fabricated off-site while foundations are being poured).

Several decades ago it was both time consuming and labor intensive to track the various activities of a major project. This effort was performed by "clerks of the work", who kept records. Anticipation of problems and corrective action depended heavily on the judgment and experience of a field construction superintendent. Often he or she made decisions based on partial or incorrect information, because that was all that was available.

This situation began to change with the advent of digital computers, which permitted the tracking of complex operations through large databases. Then someone realized that the database could incorporate logic and that the computer could be used to simulate the various activities of a project to see how tong one approach might take compared to another. With the recent advances in inexpensive and powerful microcomputers it is now possible to locate this tool at the job site, where the program manager uses it and other techniques to keep complex undertakings on track.

The main benefit to the owner is that he or she has an independent professional support staff to assist and oversee complex projects. Since the program manager is not normally involved in design or construction, he or she is able to represent the owner's interests without bias. This system usually improves coordination, reduces the cost of the construction, saves time, and reduces claims that might otherwise arise.

What the Program Manager Does

Normally a project is divided into several phases: preconstruction, design, procurement, construction, and post-construction. It is preferable to have the program manager begin work during the preconstruction phase, but this is not always done.

If the program manager is brought into the project at the preconstruction phase, the owner benefits. The program manager can assist in preparing a project master schedule and master budget so the owner takes control of the project from the outset, rather than have the schedule determined by the convenience of the designer or the contractor. In another important activity that begins during the design phase of the project, the program manager conducts a series of "constructability reviews". These ensure that the project can be constructed as designed and that the proposed approach is the best one, given local conditions, avai1able materials, budgets, schedule, and so on.

Prior to construction – during the procurement phase – the program manager will assist the owner with the preparation of bid packages, prequalification of subcontractors, bid evaluation, and the award of contracts. It may be necessary to prepare project manuals and procedures for consistency in the work. Once construction contracts are awarded, the program manager will revise the project master schedule and master budget if necessary and update them on a monthly basis.

Once construction starts, the program manager will be responsible for inspection and testing and sometimes surveying, on behalf of the owner. He or she wi1l establish a document control system to record and archive the thousands of documents that are necessary for payment and other purposes. The

program manager a1so ensures that the contractors implement their quality assurance and safety programs.

When construction is complete, he or she will witness start-up and operational tests, review operations and maintenance manuals and as-built drawings, assess liquidated damages if applicab1e, and approve final payment requests and prepare project closeout documents. These tasks are summarized in the following sections.

Main Tasks for the Program Manager

Preconstruction phase

- Project management plan and procedures
- Management information system
- Work breakdown structure
- Project milestone schedule
- Project master schedule
- Project master budget
- Document control system
- Special technica1 studies if needed (master planning, site evaluation, infrastructure, etc.)

Design Phase

- Contract administration
- Design management procedures
- Design reviews
- Constructability reviews
- Value engineering reviews

Procurement Phase

- Construction plan
- Procurement support
- Bidder's conferences, pre-bid meetings, etc.
- Bid evaluation and award procedures

Construction Phase

- Weekly progress meetings
- Construction management plan
- Resident engineer's manual
- Construction safety manual
- Procedure for requests for information (RFIs) shop drawings, and submittals
- Construction observation, testing, and inspection
- Change order and claims management
- Test start-up plan

Post-construction Phase

- Prepare project punch list
- Coordinate and witness systems start-up, testing, and training (commissioning)

- Verify operations and maintenance manuals and warranty information
- Approve final invoices for payment
- Dispute/claims resolution
- Contract closeout

In all of these activities, the program manager functions as an extension of the owner's staff, or as the owner's representative. The program manager's goals are to ensure that contractors meet the schedule, cost, quality, and safety requirements of the owner. The program manager also advises the owner on the payment of contractor's bills and evaluates claims.

The Program Manager's Tools

Essential to the program manager's work is a series of tools that make possible the p1anning and tracking of comp1ex activities that are being performed simultaneously. Today, proprietary systems and many commercially available computer programs are used for this purpose. Most of them employ a series of "modules" that are used for each of the program manager's tasks.

Some flexibility with these modules is required, since some owners want the program manager's system to interface and communicate with their own project information system. Just as important as the tools are the data entered into the program manager's project control system. Clearly, the system is only as good as the accuracy and completeness of the data it contains.

The third key element is personnel. Ultimately, the quality, expertise, and experience of the program management team wil1 determine the success of the effort.

Work Breakdown Structure

The work breakdown structure is the subdivision of the work into all of the individual elements required to complete the project. It is normally prepared in a series of levels, each more complex than the preceding and each involving a greater amount of detail.

- Level 0 is normally the entire project, while
- Level 1 is the major sub-divisions (such as site acquisition, engineering design, construction, procurement, and so on).
- Level 2 consists of the sub-elements of work for each of the Level 1 items. For example, under design there might be civil, structural, architectural, mechanical and electrical; under construction there might be demo1ition, site preparation, civil works, structures, and so on.
- Level 3 goes to the next level of detail - for example, under electrical design there might be power systems, lighting, instrumentation and controls, te1ecommuication, and so on.

Logic Diagram

The logic diagram shows the 1ogical sequence and interrelationships of the different parts of the work. Examples are the logic ties between engineering design, procurement, construction, start-up, acceptance testing, and warranty support, as well as the ties between the different elements of each these, such as surveying, grading, excavation, and the other components of the civil work.

Time and Cost Control

Critical Path Scheduling

The project schedule incorporates information from the work breakdown structure and the logic diagram to establish a baseline schedule for doing the work. Using such commercially available programs such as Primavera Project Planner, the program manager's project controls staff will develop the schedule and then determine the critical path. The critical path consists of al1 of the elements of work that influence the project completion date.

In other words, tasks not on the critical path can be delayed or extended without delaying the project. The only way to accelerate the work, however, is to shorten the critical path. This can be done by shortening the completion time of items on the critical path or by changing the logic of the work to move a lengthy task off the critical path.

The current practice is to utilize resource-loaded critical path schedules for major projects. These schedules include the resources require to accomplish each task in the project database. Thus we not only know how long a particular task will take, but also how many labor-hours are planned to be expended. We also know the quantity (and value) of materials to be put in place during that task.

This is a powerful tool for securing accurate appraisals of work complete and work in progress, as well as for evaluating contractor c1aims and payment requests, particularly if they are based on the percentage of work complete.

Cost Control and Estimating

Cost control refers to tracking project costs, comparing them to project budgets, and evaluating and explaining variances. Cost control can also be used to forecast cash flow requirements for payments. Various systems are used far cost estimating.

In some cases it is merely a conventional "spread sheet" with experience data for a given region and type of construction. The database is continuously updated with current data to provide accurate and timely information. Commercial programs such as Timberline and other software are also available for cost estimating.

There are several different types of cost estimates. In one case, an estimator "takes off" quantities from drawings and specifications, determines the current prices, and compiles an estimate accordingly. This method does not work for certain types of projects, or for situations in which complete designs are not available.

Design-build jobs and renovations of existing buildings are good examples of not being suited to the "take off" approach. In these cases a much greater skill level is required because the cost estimator must have experience visualizing and recalling all elements of the work. We call this "conceptual cost estimating."

Project Management Information Control

Management Information System

Some means of collecting, recording, and providing access to all of the essential information is needed

in large public works projects, so the program manager assumes responsibility for establishing and maintaining a management information system.

This system incorporates budget and cost information from the master budget; schedule information; correspondence logs; status reports on safety, quality, and requests for information; project review schedules; and meeting minutes. The document contro1 process maybe incorporated into this system. The system can be equipped with a "firewall" that limits access to certain levels of information, depending on the requester's need for the information.

The trend today is to install the management information system on an Internet site so that all concerned parties can access the information. On major public works projects, portions of the information are even accessible to the general public. Examples include a description of the project, percentage complete, and pub1ic information bulletins (for example, notice of road closures). Passwords and various security measures control access to sensitive or private information such as workers' salaries.

Document Control

A major project involves thousands of documents. Most of these are critical, and if not properly handled can lead to additional expense to the owner. For example, the contractor may submit Requests For Information (RFIs) to the designer to clarify the designer's intent. If these requests are not handled promptly, the contractor may have to stop work on a particular task while waiting for information.

It is usual to establish a system by which every document is logged and tracked, and its receipt and eventual disposition is recorded. Documents requiring follow-up action are flagged in periodic reports. For example, if a change to the work is submitted, the resulting impact on the program budget and schedule are included in the cost forecast, and in the next update of the project schedule and critical path status.

The Document control system also interfaces with the cost and schedule modules.

Contract Change Management

Change orders can arise for several different reasons such as:

- regulatory code changes
- a request by the owner for additional work
- unforeseen circumstances, such as poor soil conditions
- an error on the part of the designer or the contractor, which causes some of the work to be redone or replaced
- a delay caused by some event outside the control of the owner or the contractor, such as an unusually severe storm
- or forced acceleration for some reason.

Any of these, or similar situations, will likely give rise to claims for additional compensation from the contractor, and/or additional time to perform the work. In each of these situations, the owner and the contractor will have certain claims to make upon each other. If we assume that both parties act in good faith, then if the owner requests the change, he or she wi1l be prepared to pay for it and extend the schedule if necessary to complete any additional work required.

However, in many situations, the full extent of responsibility for each party is not totally c1ear. For

example, the contractor may have performed part of the work incorrectly and faced with a need to make changes to correct the problem. At the same time, the owner may recognize this correction as an opportunity to improve or modify the work and therefore request that other improvements or modifications be made. In this situation each party now bears some responsibility for the added cost and the delay, and the only way to resolve each party's responsibility is through negotiation.

This is the actual situation more often than not, so the program manager will establish a formal process for handling any and all claims. Typically, after the contractor submits a request for a change, the program manager evaluates it and determines which category it falls into and whether or not it is justified. This may involve modification of the contractor's request in terms of the work that he will do, the payment that he or she will receive, and/or the schedule required to implement the change. After evaluating the request for change, the owner authorizes the contractor to proceed.

This authorization will ultimately take the form of a change order to the contract, which provides the contactor additional funds and direction for the performance of the work.

Conclusion

In author Craig Smith's compelling description of How the Great Pyramid Was Built,[3] it should be clear that this was a major program. It constituted a multi-year project involving a significant portion of the population of an entire country, and extensive use of natural resources and materials that had to be found and brought to the site on time.[4] In ancient Egypt, some 4,500 years ago, these management tasks, or some variation on them, had to have been employed to ensure a successful outcome. Of necessity they must have had some way to manage the program.

The records show that a gentleman by the name of Hemiunu was the mastermind behind the vision and responsible for the overall program. Therefore, in today's parlance, he was the ***Project Manager***.

On Hemiunu's team, scribes were the clerks of the work, keeping the essential payroll records on clay tablets or papyri that have long since been lost. Worker attendance, requisitions of stone blocks from the quarries, and other essential information had to be recorded and communicated in some manner. There is considerable evidence suggesting that the ancient Egyptians used program management techniques such as those described above.

For example, example, large stone blocks have identification numbers written on them, indicating they were cut to size and installed in accordance with a pre-arranged plan. The progress of the work, including future activities, had to be known to make sure the requisite number of laborers was on site at the right time, or conversely when laborers were ready to work, and that the right amount of materials were available for them. In addition, job administration records from later dynasties have been found. These records inc1ude dai1y attendance records, payroll information, and other data.[5]

Maintaining the schedule was important, because the project faced an irrevocable but uncertain end date – the pyramid had to be completed before the death of the pharaoh! Certainly no modern program manager has faced an assignment as challenging as this.[6]

R. Max Wideman
Fellow, PMI

[1] Regarding copyright: Unfortunately we were unable to contact either the author or the book's publisher. However, the copyright statement on p4 does permit extracting quotations for purposes of reviewing this book.
[2] Craig B. Smith, *How the Great Pyramid was built*, 2006, Smithsonian Books, HarperCollins Publishers, New York, Appendix 4, *A Primer on Program Management*, p252.
[3] As described in our book review last month
[4] Abstracted from the author's book, p260
[5] Ibid, pp260-261
[6] Ibid, p261