The Need for Systematic Project Management in the Construction Industry

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Abstract: Projects and project management are defined. The project management processes and knowledge areas as they apply to the construction industry are explained. The principles of value engineering as an essential part of construction project management are also briefly described. Some project management pitfalls are listed, and the pros and cons of project management by the owner and by an external project management organization are analyzed. The case for the separation of the design function from the project management function is also presented.

Projects

Before we can talk about project management, we need to have a clear and commonly accepted definition of a project. The Project Management Institute defines a *project* as " a temporary endeavour undertaken to create a unique product or service". The term *temporary* is essential in that a project must have a start and an end; it cannot be perpetual. Thus, manufacturing and canning a soft drink is not a project although development of the soft drink as a product must have been a project as is the establishment of the manufacturing facility. *Uniqueness* is understood as having at least one key feature that is only peculiar to that product, e.g. location, specifications, designer, contractor, owner, etc. The product may be a school designed by the same designer, built to the same specifications by the same contractor for the same client at many locations, but the school at a given location is still unique, because the location is unique, and thus each school is a project. An endeavour such as building many schools to a commonly administered budget and criteria is often called a *programme*.

A project does not have to be the construction of a facility. The following activities also fit the definition of a project: a feasibility study, development of a new product or service, review of an activity, development of a computer programme, running a campaign for election, developing a procedure, writing a book, carrying out research into a particular subject, a "kenduri", developing a new car model and so on. Unfortunately, the plan by the USA and Britain to attack Iraq also looks like it can be classified as a project. Thus not all projects are constructive.

A construction project is one where the objective is to build or extend or refurbish a visible and tangible facility that is of sufficiently large size as to require engineering

analyses and design to ensure that the facility will be fit for purpose and be able to safely withstand the physical forces that will be applied to the facility during its life. A facility that is constructed as such is called a *constructed facility*.

Project management

So, what is project management? The Project Management Institute defines project management as *"the application of knowledge, skills, tools and techniques to project activities to meet project requirements"*.

All of us, consciously or unconsciously, implement and manage projects almost on a daily basis. Most of these are small, simple projects with very few activities that we do almost intuitively without even thinking too much about, like making breakfast, washing the car, grocery shopping, etc. It is obvious that project management is not the exclusive domain of anybody. However, it is also obvious that as the level of complexity of projects increases, the level of the project management also becomes increasingly more complex and rigorous and will require the people who manage such projects to have certain knowledge, skills, experience, tools and resources. As projects get larger and more complex, the process gets more scientific and systematic, as it becomes necessary to coordinate and integrate various human inputs and physical components within the four fundamental constraints: scope, cost, time and quality.

Project management is mapped into process groups and knowledge areas by the Project Management Institute. The five key process groups are: *initiating, planning, executing, controlling and closing*. Most processes that we can think of will fall under these five basic processes, depending on who we are. For example, in the construction industry, budgeting, costing and estimating fall under planning. Design can fall under the process of planning if you are the project owner who adopts to procure the facility via a conventional contract, but it can fall under execution in a design-and-build contract. For the design consultant, the design component is the whole project, which can in turn be subdivided into the five processes. For the contractor, the bidding itself is usually treated as one project. If the bid is won, then a new project materializes and his processes will be different from that of the owner or the consultant. What is inescapable though, is that each party has to apply project management achieve its objectives.

The Project Management Institute also defines knowledge areas to support the five processes. These knowledge areas are: *project integration management, project scope management, project time management, project cost management, project quality management, project human resource management, project communications management, project risk management, and project procurement management.* In order to be more specific to the construction industry, I would add *project construction management* to the above list to cover specific knowledge required for managing construction activities on site.

Many disciplines contribute to each knowledge area and so there is no exclusivity of each knowledge area to any discipline. There is also significant interaction among the knowledge areas. In the construction industry, for example, project cost management involves mainly design, value engineering and optimization, estimating, cash flow management, contract administration, financing and cost control, but project scope management, project time management, project quality management and project procurement management will also have significant impacts, while the other knowledge areas will have impacts of different extents.

Project integration management

To my mind, out of the ten knowledge areas listed above, the least understood and hence often least valued project management knowledge area, as far as the construction industry is concerned, is that of project integration management. Project integration management is the knowledge area that involves putting all the pieces together. It encompasses high level strategic planning and synthesis of knowledge and inputs from multiple disciplines to enable decisions to be made regarding various aspects and issues affecting a project. The main prerequisites for integration management are leadership and experience that is wide enough for there to be awareness of what inputs from what disciplines are required and how these inputs should be brought together in a constructive way to add value to the project. Integration management is required from the time the project is conceived right to the closeout stage. This is where leadership is important. The various champions of the many disciplines, each usually claiming that his or her particular discipline is the most important and therefore deserving of the highest priority in terms of resources and resolution of issues, will need to be managed, integrated, balanced, refereed, motivated, controlled, cajoled and be made to contribute what is necessary to the team but not allowed to become *prima donnas* by virtue of any sense of indispensability. This is perhaps the most important aspect of project management, not only because the skill set is hard to define, but because there are not many people who can perform this function well.

Project scope management

This knowledge area, as the name implies, involves managing the scope or content of the project. Ideally, project scope should be defined and frozen as early as possible, but this does not always happen. Usually, it is the owner who controls the scope, but more often than not, it is also the owner who varies the scope. It is important that the scope is managed in a conscious and systematic way, with due regard to the aspects of cost, time and quality. In fact the four aspects of scope, cost, time and quality are intimately inter-related and need to be managed with equal emphasis. Each affects the others, and the failure of managing one aspect will jeopardize the whole project.

Project time management

This is perhaps the most widely studied and understood aspect of project management in the construction industry, to the point that some people misunderstand project

management as almost purely time or schedule management. Perhaps this is because it is one area that is amenable to systematic analysis using various well-developed tools. It is indeed a very important aspect of project management, but as I stated above, it should be given equal importance to the other key areas.

The main focus of project time management is often seen as bar charts showing the start and end dates of various activities. What is not often understood are the in-depth analyses and knowledge required to produce such implementation schedules. The breaking down of the project into practical work packages, called the work breakdown structure, needs to be done first. Then the activities have to be defined, together with their sequencing and durations. It is only then that the schedules can be developed and used for managing the time aspects of the project

Another aspect of time management that is often overlooked is the interface program. Interfaces, or points where one activity meets another, have to be determined in advance, priorities have to be decided, physical requirements agreed and dates fixed for those interfacing actions to happen. A project that has a well developed interface program will progress smoother than one that has no interface program or none at all.

Project time management also involves monitoring and correcting the plan as we go along, using field situations as feedback in what should be a closed-loop system.

Project cost management

Cost is usually the most important factor that everyone wants to control; although there are projects where time is the most controlling factor (to be completed by a certain date at any cost). However, compared to time management, the way cost management is practiced in the construction industry is less objective. Much depends on human skills in negotiating contracts, variations and claims. The procurement knowledge area, which will be described later, is also closely inter-related.

Modern tools such as Earned Value Management (EVM) are not used much in its true form in the construction industry, although the data that would be needed to apply the method is almost always collected. The S-curve that most people use to monitor financial and physical progress can easily be adapted to enable earned value analyses to be performed.

Project cost management includes project resource planning, cost estimating, cost budgeting and cost control. Cash flow management and project accounting are very important components of cost control. At any point, it should be possible to determine the projected final cost based on committed cost and projections of future cost taking into consideration the status and projections involving scope, time and quality.

Project quality management

In the construction industry, quality is often taken to mean the quality of the finished product and this is largely based on the specifications for the project. However, it is important to understand that there are quality aspects other than directly related to the construction processes that require attention and management. These comprise quality planning, which is the identification of the quality standards that are relevant to or desired for the project and the determination of how to satisfy the selected standards, including the organizational structure, responsibilities, procedures, processes and resources needed for quality management; quality assurance, which is the system for evaluating the overall project performance on a regular basis to provide confidence that the project will meet the desired quality standards; and quality control, which involves monitoring specific project results and test data to determine if they comply with specifications and standards and identifying ways to rectify defects or causes of unsatisfactory performance.

Quality management includes the quality planning, assurance and control of the consistency and uniformity of the design process, drawings, conditions of contract, bills of quantities, specifications, reports, presentations, communications, meetings, meeting notes, etc.

There are many aspects of quality management that are so specific to the physical construction process that I believe for the construction industry, these should be handled under the special knowledge area of construction management.

Project human resource management

As in any project, the implementation of construction projects depends largely on the mobilization and utilization of suitably skilled human resources at the right time. The first task in this area is to determine the appropriate project organization for the project in hand. It is then important to give the organization a leader as quickly as possible, so that he or she can be made responsible for building the team, including defining the job scopes of each individual in detail, selecting team members, recognizing their strengths and weaknesses, integrating them, motivating them and creating team spirit and a common sense of purpose.

The actual project organization depends on whether it is for a design-and-build contractor, a works contractor, a subcontractor, a design consultancy, a project management company or a supplier. Each will need a different organization structure that is suited to the unique position that the company is in. For example, a project management company that works for a client that is the project owner is likely to be organized and to behave differently from one that has as its client a design-and-build contractor. A design-and-build contractor is in turn organized differently from an ordinary works contractor, and design-and-build contractors may opt for one of several options, depending on the internal resources of the contractor: one is a managing

contractor type of organization where all or most of the works packages are subcontracted out and the main contractor manages and integrates all the contract packages; another is a total in-house type of organization where the designs are done by an in-house design team and then constructed using mainly internal resources; a construction management type of organization is where the main contractor subcontracts many small subcontracts in the form of trade packages (foundations, frame, roof, steelwork, cladding, plumbing and ironmongery, electrical, mechanical, etc.) and plays a much more intensive role in managing and integrating the various trade packages; there are also many cases where the main contractor adopts a role that is a combination of a managing contractor and a construction manager, and in many cases this happens without the main contractor being conscious of what is happening. In the last case, the organization structure can be extremely confusing and difficult to lead, manage and control.

Project communications management

Communications management includes the management of many things: meetings, drawings, reports, letters, brochures, verbal communication, electronic communication, document control, data storage and retrieval systems, presentations, public relations, etc.

Perhaps by nature of their training and daily work, many engineers are poor communicators, either verbally or in writing. Most expect their drawings to be self-explanatory to everyone, but this is far from the case in reality. Many engineers have difficulty composing sentences that are concise and easily understood by the reader, because few actually think of the reader when writing those sentences that make up reports or letters. I have seen many presentations made by engineers where use is made of computers and expensive projection equipment only to project images that they have scanned from their drawings! Yet, the communications aspect of project management is one that is the most crucial; it is the thread that knits all the processes and knowledge areas into a fabric that can be visualized, comprehended, analyzed, transmitted and acted upon. Decisions are made on the basis of reasons for and against those decisions; how well they are presented and understood by those that have to make the decisions will have a large influence on the decisions that are finally made.

True, engineers are factual people. They believe that their work, because it is based mainly on science, mathematical analyses, numerical data, standards and accepted practice, is beyond question and therefore does not need to be simplified for unenlightened people to understand. This is where the audience or the reader often gets confused or simply loses patience.

Project risk management

Risks arise due to uncertainties that are associated with various aspects of the project. These risks need to be identified as comprehensively as possible and a plan for managing and responding to these risks should be developed at the outset. Each

construction project will have its own set of risks, but the main risks are usually delays, cost overruns and substandard quality. These are in turn caused by some common risk factors such as the weather, shortage of materials, price fluctuations, shortage of skilled labour, currency fluctuations, interfacing issues, late payments, substandard materials, poor workmanship, etc; while risks that are less common but should not be discounted are natural disasters, accidents, fire, strikes, sabotage, etc. Legal and contractual risks also require special attention at the outset.

While some of the risks associated with physical damage and injury can be insured, there are those elements that affect time, cost and quality that are not normally insured, such as weather, shortage of materials, defective materials, shortage of labour, etc. These need to be dealt with by recognizing them as risks and managing them as risks. It is also most important to understand the tolerance levels of all stakeholders to different risks.

Risk management can be qualitative or it can be quantitative and highly sophisticated. In the construction industry, it usually suffices to do a largely qualitative risk analysis with some simple quantitative analysis; the main thing is to identify the risks, develop "trigger" thresholds and put in place response plans to mitigate or minimize the effects of those risks.

It is also important that the risk management plan identifies a crisis management team that will be activated in the event there is a crisis of any kind such as a major accident, a fire, a flooded site, etc.

Project procurement management

This discipline involves the processes required to acquire goods and services from outside the performing organization in order to deliver the project. It includes the appointment of external consultants, subcontractors, suppliers and other service providers.

The processes involved include procurement planning (what to procure and when), solicitation planning (defining requirements, preparing bid documents and identifying sources), solicitation (tendering; requesting for quotations, bids, proposals, offers, etc), selection, contract administration (managing the contract with the seller of the product or service) and contract closeout (completion and final settlement).

Many different disciplines are involved in the procurement management for a construction project—engineering, quantity surveying, project planning and scheduling, financial and legal. In most cases, decisions are made by high level committees when it comes to solicitation planning, selection and closeout.

Field construction management

As I reasoned out earlier, it appears more appropriate to introduce a knowledge area specific for the construction industry that groups together the unique field activities, and I shall call this knowledge area "field (or on-site) construction management".

This knowledge area covers all construction activities at the site, including, among many others, site planning and logistics; site facilities management; management of construction materials and plant; traffic management; interface management; quality control; safety, health and environmental management; management of field measurements and verification; progress measurement, monitoring, reporting and control; management of field trials and tests; troubleshooting and crisis management; management of human relations at the site, liaison with relevant authorities, management of site visits by various parties; record-keeping and document control; management of inspections, testing and commissioning; and management of project handover.

Field construction management is crucial because this is where the physical execution activities take place. It is the visible and tangible part of the project; indeed it is the only place where a visual assessment can be made of the state of the project. Good field construction management comes with thorough advance planning, clear delegations of contractual powers and authority, and the selection of experienced personnel to perform the task.

Value engineering as an essential part of construction project management

Value engineering is a much used term these days, but few really understand its meaning, its objectives and the processes involved.

Simply stated, value engineering is the organized application of knowledge from multiple disciplines in an integrated manner, coupled with a lot of common sense, directed at achieving the optimum ownership cost of a project. Value engineering does not always mean bringing down construction cost, although if one is the contractor, this is what the objective usually is. But if one is the project owner, the objective of value engineering should be to achieve the lowest ownership cost, which means not just capital cost, but the whole life cycle cost. What should be aimed for is the elimination of unnecessary costs, be they capital costs or operating costs, without compromising the owner's or users' expectations of the functionality of the product in terms of quality, reliability, performance and other critical factors.

Value engineering involves processes that demand creativity and openness in thinking. The starting point is to obtain and understand all the information about a project—what it is, its function, user expectations, the budget, the estimated cost, the location and its surroundings, site survey data, geological and geotechnical data, rainfall and drainage

data, access, materials available and specified, design or preliminary design drawings, specifications, design criteria and assumptions, owner's constraints, etc. Next, the whole concept and design are subject to scrutiny and brainstorming, where everything is challenged and nothing is prematurely criticized. Courage and imagination should come together with engineering and other technical knowledge to give rise to alternatives that can be evaluated and developed.

Value engineering must be planned. In developing a value engineering plan, it is worthwhile to bear in mind Pareto's 80:20 law of distribution: this means that 80% of the project's cost will be in 20% of the work—this will guide us where to start and how to prioritize the work. The value engineering plan should clearly map out the phases of value engineering, the objectives of each phase, the key areas to be looked at and questions to be asked, the techniques to be used, the tasks to be carried out and the allocation of those tasks and the time-table for the whole process.

Value engineering is an essential and a very important component of project management. It is an activity that encompasses project planning, project execution and project control and involves practically all the knowledge areas.

Project management pitfalls

Many developers, contractors and other project implementers often say "We do it all the time; we just don't call it project management". My answer to that is that if you don't do it consciously and systematically, you can't be "doing it all the time". There needs to be a proper understanding of the processes and knowledge, together with a strong infrastructure that is deliberately put in place, for systematic project management to be able to happen and to flourish.

Managing projects *ad hoc* has potentially serious pitfalls, some of which include:

- no driver, no haste, no sense of direction
- poorly defined lines of authority and communication
- lack of project information; poor flow of project information; information bottlenecks
- indecisiveness; fear of making decisions
- inadequate support infrastructure for good decision-making
- lack of focus on action-oriented processes; too much focus on administrative and bureaucratic processes
- internal politicking, bickering, fight for control and empire building
- passing the buck; passing responsibility to someone else becomes objective; false sense of achievement when responsibility is passed on
- poor monitoring and coordination
- monitoring-reporting-feedback-action loop doesn't close
- no control over scope, time, cost, quality

- incorrect surveys; inadequate subsurface investigation; inadequate wind, drainage and other data required for design
- poor designs; designs that are low in constructability; over-conservative designs; unsafe designs
- poor site planning and logistics; poor quality assurance and quality control
- inadequate resources; unbalanced resources
- poor cash flow management
- inappropriate form of contracts; poor specifications
- incorrect bills of quantities; wrong estimates
- poor documentation, poor project accounting, no audit trail
- poor project governance; no accountability
- leaks in estimates prior to procurement
- poor contract administration leading to many disputes and claims
- poor safety, health and environmental management; accidents and epidemics at site
- poor control and possible corruption in procurement

Design consultants as project managers?

In the construction industry, design consultants (architects, engineers) perform their tasks as consultants engaged by project owners or the design-and-build contractors (employers). Thus, as far as the designs are concerned, these consultants are independent and often fiercely guard their independence. However, when it comes to managing the overall project on behalf of the owner or the design-and-build contractor, their independent role as the designer makes it difficult for them to act objectively when it comes to representing the owner in reviewing and value engineering the designs, specifications and drawings produced by them and in monitoring and evaluating their own performance against the requirements and expectations of the employer. Besides, many of the project management processes involve the employer challenging and debating with consultants on various aspects during the course of the project. The employer needs on its side a project management team that is independent of design consultants and contractors or subcontractors. There is a clear case for separation of the design function from the project management function.

In addition, hard core designers don't usually think like project managers. Designers focus on specific technical issues in their area of expertise, concentrating on how to produce drawings and specifications that will result in a product that meets desired performance criteria. Project managers tend to be less specialized in specific issues, but have a greater sense of "ownership" of the project and a global view of the key aspects of scope, time, cost, and quality and know enough of what is required to achieve the total integrated objective. The designer may eat, live and dream the roof or the foundations or the air conditionin g, while the project manager eats and lives and dreams the whole project. The project manager must have all project information at his fingertips, know from whom to draw expertise, how to coordinate and control a group

of individuals or individual firms so that they function as a team, how to get resources and allocate them, the total expectations of the employer, who is performing and who is not performing, how to get information and what to do with it, how to resolve problems, issues and conflicts, and how to put it all together. It is difficult, although not impossible, to be both a very good designer and a very good project manager. This is why I believe project management must be provided either by the employer or by an independent pure project management organization.

Project management by the owner or by an independent project management organization?

Should the owner or employer manage its own project? The questions that should be asked by the owner or employer in making this decision include:

- What is the size of the project? How complex is it? How long do we have to do it?
- Have we done this before? Is this the first time we are doing a project of this size and complexity?
- Do we have internal resources capable of managing the project?
- Do we have too many projects in hand?
- How often do we do projects of this size and complexity?
- Do we want the project to be managed systematically?
- Do we understand what it takes to manage the project systematically?
- Do we want to establish, develop and maintain our own project management team?
- Do we have the time to set up the systems, establish the project management team, train them and integrate them?

In many cases, middle management would want to manage projects internally, either to prove their capability, or to strengthen their own positions. In many cases also, the people who champion internal project management do not have a deep understanding of project management. Unless the organization is one that is used to and is already handling projects of similar size and complexity, and is only building a new team for a new project, the result is often a project management organization that is built and structured based on the people that are available and their domination within the existing organization. External resources that are brought in later will be selected to be compatible with the personalities that form the initial nuclei within the organization, and may not be the most appropriate. The learning and integration processes become uneven and extremely difficult to manage.

Even if a decision is made to form an almost completely new team, allowance must be given for the establishment of systems and the integration of resources. It is very unwise to decide to start a completely new internal project management team without a template based on previous projects of similar magnitude after being awarded a large

and complex new project with a tight implementation schedule. In such a case, it may be best for the owner or employer to opt for an external project management consultant to manage the project on its behalf or to provide project management support services to a small internal team that retains the key executive powers over budget and procurement.

Using an independent external project management consultant has several advantages. There is immediate availability, instant startup, no need to establish a team and no problem of what to do with the team after the project. A good, sizeable project management consultant would have the infrastructure and systems in place that can be quickly adapted and customized to suit any project. It would also have fixed internal resources in the various knowledge areas and would need to acquire new resources only to complement what they already have in place, and when that is necessary, the training and integration is usually managed so that they happen smoothly, made possible by the infrastructure and systems that are in place.

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