CHAPTER 2

LITERATURE REVIEW

2.1 GENERAL

The objective of literature review was to develop a framework for the Research study and it provided the complete understanding and information on the “Cost Management Processes and Techniques” for various “Construction Project Processes”. It also gave some methodology for the present research, highlighted by the past researchers.

In the Literature Review, some of the papers published by Youngsoo Jung and Sungk Wonwoo (2004), Albert P.C. Chan et al (2004) and Young Hoon Kwak and C. Williams Ibbs (2002) gave a hint for future research that the project cost management is the process that ensures all the factors and variables in all stages of project. So attention has been paid to CMP happening at various five project stages of

(i) Initiating
(ii) Planning
(iii) Executing
(iv) Controlling
(v) Completion stages.

The successful implementation of cost control depends importantly on the effective management tools, techniques, processes and practices and in specifically, on the role of Project Manager, who is the primary tool for the
Cost Management in Construction Projects, as per “Project management body of knowledge” publication.

CMP in different stages of Project is shown in Figure 2.1.

![Diagram of Cost Management Process]

**Figure 2.1 CMP in different stages of Project**

According to Young Hoonk Wak and Williams Ibbs (2002), ‘Cost Management is the process of controlling the expenditure on a construction project at all stages from initiation to completion, within the approved budget. Cost Management is crucial because cost overruns are common resulting in serious cost problems during project execution’.

### 2.2 COST MANAGEMENT PROCESS IN INITIATING STAGE

The project initiating process recognized that a project or phase should begin and the project management team is committed to do so. It includes developing a proposal for a potential project and analyzes and validates feasibility of the project.
Anderson S.D. and Lynn Cook E (1995), found, ‘if the total Cost conscious and other Management approach is adopted in the proposed initiation strategy itself to implement the scope of the Project, it will lead to the continuous improvement for the other processes of the Project. Further the end result will also be more cost effective’.

2.3 COST MANAGEMENT PROCESS IN PLANNING STAGE

The project planning process leads to the development and maintenance of a workable scheme to accomplish the business needs for the project. It includes defining overall scope, identifying planning strategy, developing the work breakdown structure for cost and schedule, refining estimates and analyzing commitments optimizing the project plan, developing risk management plans; and organizing the project team to establish a project – driven organization environment.

According to Young Hoon wak (2002), the project cost management includes scope planning, scope definition, resource planning, cost estimating and cost budgeting

Scope planning is the process of developing a written scope statement as the basis for construction project decisions including cost management.

Scope definition involves subdividing the major project deliverables into smaller, more manageable components in order to,

(i) Improve the accuracy of cost, time and resource estimates.

(ii) Define a baseline for performance measurement and control.

(iii) To facilitate clear responsibility assignments.

(iv) To do project success critically.
Resource planning involves determining what physical resources like (i) Men (ii) Materials (iii) Machinery (iv) Methods and what quantities of each should be used to perform project activities.

Cost estimating involves preparation of estimate for the Costs of the resources needed to complete project activities. Cost estimating differs from pricing. Cost estimating is an assessment of the likely quantitative result, how much it will cost the performing organization to provide the product or service involved. Pricing is a business decision as to how much the performing organization will charge for the product or service that uses the cost estimate.

Cost budgeting involves allocating the overall cost estimates to individual work items in order to establish a cost baseline for measuring project performance and for cost controlling.

As defined under Project Management Institute Standard Committee (PMI) (2000) and Royal Institution of Chartered Surveyors, (RICS) (1998), the Cost Information System will be useful for the CMP in project planning process.

The main cost information system in planning process is identified as,

(i) Cost Management Processes of Pre-Design stage:
Various preliminary studies are performed including a preliminary site investigation, a market analysis of similar projects, a study of probable financial risks etc.

(ii) Cost Management Processes of Detailed Design Stage :
It is essential that intermediate estimates be prepared. Design and specifications of items is moderated whenever
cost variance (CV) is identified finally details design drawings are documented.

(iii) Cost Management Processes of Bid and Award stage: Quotations from short listed vendors are invited keeping the BOQ from detailed design phase as a baseline.


According to Liang Liu, Scott A. Burns, Chung – Wei Feng, (1995), ‘in Cost Management planning process, construction planners must select appropriate resources, including crew size, equipment, methods and technologies, to perform the tasks of a construction project’.

Chan et al (2001) has adopted a research methodology for identifying critical success items for Design and Build Construction Project in Hong Kong.

Steven Trost Garold oberlendor (2003), observed that the accurate estimates during the early stages of capital projects such as

(i) Process design
(ii) Team experience
(iii) Cost information
(iv) Time allowed to prepare the estimate
(v) Site requirements
(vi) Bidding and
(vii) Labour climate are important.
Early project estimate represents a key ingredient in business unit decisions and often become the basis for a project’s ultimate funding.

Zohar Herbsman, Wei Tong Chen, William Epstein, (1995) found that “the innovative contracting methods in construction projects have been very successful in reducing construction time, while only increasing overall construction costs minimally, if at all.

‘If corporate resources, such as labour, material and equipment, are required to perform the individual activities, then an Activity – Based Costing (ABC) technique must be developed that can accommodate the inherent variability in a process if actual costs are to be accurately predicted. If process cycle time and process cost per cycle can be accurately predicted for complex, highly variable processes, companies are in a much better position to determine how proposed corporate initiatives for process improvement might actually impact overall process performance, say Edward Back, Donald A. Maxwell, Leroy J. Isidore (2000).

“Cost and schedule increases are common in engineering design projects. Analyse the cause effect relationship, trace responsibility, and improve performance for engineering design projects”, points out Andrew Shing - Tar Chang (2001).

“Analyse the key parameters that affect the cost structure of design firms, such as (i) direct salary costs (ii) indirect salary related cost (iii) direct non salary costs (iv) general and administrative costs. These design costs are usually summarized and presented as labour, overhead and direct non salary costs. A detailed analysis of the elements that comprise overhead and the key elements that affect overhead can be presented”, say Michel W. Hurley and Ali touran (2002).
“Quantitative data on the historical operating and maintenance costs of these facilities, along with knowledge of the factors affecting the costs were elicited through various sources. Cost prediction models developed, using neural networks, regression analyses, and random deviation detection methods. The system created may be used to assist and advise on certain aspects of facility management, such as the estimation of operating and maintenance costs, and the development of preventive and general maintenance plans for facilities similar to those investigated” say John Christian, Gillin, Amar Pandeya (1997).

“Identify the variables for integrated Cost and Schedule control in terms of reducing required work load. Potential variables including project delivery system, Contract type, level of outsourcing, degree of specialization, progress measurement methods, budget format, management detail, vertical integration and so on can be identified”, according to Iris Tommelein, Editor, Youngsoo Jung (2005).

“Reducing the cost of Construction is a primary concern for owners, designers, and builders of facilities. So identify the design constraints that limit constructor’s ability to perform construction operations effectively on-line computer tools that provide cost-specific constructability feedback to help project teams develop more cost-effective and constructable design” says Sheryl Staub - French (2003).

2.4 COST MANAGEMENT PROCESS IN EXECUTING STAGE

The CMP in project executing stage coordinates an organization and other resources to carry out the project effectively. As per PMI (2000) The executing processes include
(i) Project Plan Execution

(ii) Quality Assurance

(iii) Team Development

(iv) Information Distribution

(v) Solicitation

(vi) Source Selection

(vii) Contract Administration

Cost management processes are integrated programs where several processes like accounts, cost estimate, finance etc., are managed from a common database. The above processes are given in schematic Figure 2.2 and logical flow charts in Figure 2.3 as per Preetha G. Raman and Virendra kr. Paul (2006).
Figure 2.2 General Cost Management Processes
Figure 2.3 Cost Management Processes in Executing Stage
Some of the cost reduction factors suggested by various authors in their research study are given below:

According to the Director (Contract), Military Engineering Services, Ahmedabad (2006), “the total cost management of construction projects is possible only when all the players in the field i.e. the client, the contractor, the architect, the design engineer, the quantity surveyor and the site engineer / project manager are conscious of cost management of project and perform their functions effectively. A lapse on the part of any single component will result in delay of project and increase in cost”.

The Director (CEO), Britannia Academy of IT and Planning Ltd., London Cosmo College, Hanow, UK (2006), has revealed that normally the cost overruns occur if the project manager is unable to control the construction activity efficiently. Further he added that the savings in cost management are possible if Project Management team implements the construction with diligence and care by dropping the components of infrastructure that are otherwise valuable as social amenities.

D.S. Sachdev, (2006) has suggested that “the Fast Track completion is to be followed by increasing use of management techniques such as CPM/PERT, value analysis, standard costing, budgetary control etc., for improving the physical performance and reducing cost”.

Sachdeva and Umesh Sharma (2006), in their study, concluded that the materials management which includes procurement, inventory shop fabrication and field servicing needs special attention for cost reduction.
The study made by Rajiv Bhatt (2006) revealed that “the cost overrun happens due to (i) delayed payment from client or contractor, (ii) delayed supply of materials and decisions, (iii) delayed possession of site, (iv) inflationary increase in material rates, (v) Revised estimate”.

According to Uchechukwu Ellinwa and Silas A. Buba (1993), “the shortages and cost of materials, fluctuation in prices of materials, mode of financing and payment for completed works, fraudulent practices and kickbacks, poor contract management are the major factors for the cost overrun in the construction projects. Minimizing or totally eliminating communication problem on site will help in reducing construction costs. Decision that impact a project should be communicated to the affected parties in the field either in writing or through verbal communication directly to the affected party”.

The National Construction Policy has been launched in Nigeria (1991) to reduce the cost overrun in Construction Projects. The Nigerian Institute of Quantity Surveyors have suggested: “(i) Use a qualified and registered professional as a coordinator, Project Manager (ii) limit powers of the coordinator to issue variation orders likely to cause cost overrun without the express approval of the employer, and (iii) the insertion of the corruption clause, which empowers the employer to summarily terminate the employment of the contractor on grounds of proven corruption”.

Jaehoson and Kris G. Mattila (2004) say that “when an activity is started in the construction project, it cannot be stopped and restarted again, that is, it cannot be split. So the Resource levelling can be made by using Binary variable Model”.
Swee-Lean Chan and Nga-Na Leung (2004) have concluded that “web based documents and the displayed informations will be useful for construction cost management and the system retrieves useful data from the original documents and reorganizes the information according to specific tasks or users”.

In their study made by Youngsoo Jung and Sungkwon Woo (2004), they revealed that “the integrated cost and schedule control system with a flexible work breakdown structure (WBS) optimizes the overhead efforts by means of reducing the amount of data to be controlled”.

Mohammed Fadhil Dulaimi and David Langford (1999) concluded that “the psychological aspects and behaviour of the Construction Project Managers influence very much on the Cost Management”.

Leen S. Kang (1998) pointed out that “the construction information classification system (CICS) is useful for controlling a project with consistency in information management during construction. The CICS with four facets enables Project Managers to control a project with common information both for cost estimating and for schedule planning. CICS with such a common information system is helpful for connecting project cost for a project organizer with the Construction schedule for a site manager, and the connection between cost and schedule will make better information management for a construction Project”.

According to Thomas and Sanvido (1989), “the productivity loss at a construction site is due to inefficient Material management. So the integrated material management programme such as disruptions, work content, constructibility issues, construction methods, environmental conditions, management aspects etc., are to be considered and applied to construction site”.
John Christian and Daniel Hachey (1995) say that “the attention of management personnel should be focused on the sources and causes of delays. The breakdown of the ideal and waiting times is very important in order to direct the attention of management to the root causes of this non productive time”.

As per Iyer and Jha (2006), “over 40% of Indian Construction projects are facing time overrun ranging from 1 to 252 months. The analysis of responses of questionnaire will lead us to find the success factors by Factor Analysis method”.

According to Jeffrey S. Russel, Edward J. Jaselskis and Samuel P. Lawrence (1997), “the Project managers for owners, designers and contractors need real time information to assist them in managing projects, by continuous or time – dependent variables such as owner expenditures, Construction effort hours expended etc., to predict project outcomes from start to detailed design through construction completion”.

The study done by Joon H. Pack and Jong H. Ock (1996) revealed that “a modified up/down method that depends on more conventional construction techniques, but that can still result in significant construction time savings. Applying the method provides an easy and useful way for the contractor to shorten construction duration and, in the long run, reduce costs”.

Albert P.C. Chan, Daniel W.M. Chan Y.H. Chiang B.S. Tang Edwin H.W. Chan and Kathy S.K. Ho (2004) observed that “partnering is one of the most innovative developments in delivering a project efficiently and reducing construction disputes. In particular, the establishment and communication of a conflict resolution strategy, a willingness to share resources among project participants, a clear definition of responsibilities, a commitment to a win – win attitude, and regular monitoring of partnering
process were believed to be the significant underlying factors for partnering success. Such an identification of success factors could well formulate effective strategies for minimizing construction conflicts and improving project performance”.

In the study made by Mikhail chester and chris Hendrickson (2005), they have concluded that “construction cost goes up in a project with the seven different mismanagement scenarios, such as (i) delay (ii) Cost cutting (iii) resequencing of work (iv) acceleration (v) change of scope (rework) (vi) defective work (vii) strike”.

According to John G. Everett and Peter B. Frank (1996) construction is not a safe industry. One of the areas in which the cost can be reduced and productivity increased is the area of safety. The Business Roundtable (BR) 1979 determined the true costs of accidents and injuries in construction industry. The cost of workers compensation insurance have skyrocketed and there has been a rash of third-party lawsuits as a result of accidents on construction sites.

Navon (1996) observed that “a well developed cash flow management system will manage the cash flow of the company as a whole, and it is flexible and accepting projects with varying degrees of detailing levels, it requires no human involvement in cash flow generation, it is accurate, and it is a typical management tool”.

According to Shamil G. Naoum (1994), “ten factors identified to measure project performance are (i) Preconstruction time (ii) Construction time (iii) total time (iv) Speed of Construction (v) unit cost of building (vi) time overrun (vii) Cost overrun (viii) time (ix) Cost and (x) quality”.
Michael Bommer, Rence DeLaPorte and James Higgins (2002) say that “the skunk works project management teams was able to deliver the projects on time and particularly within budget by (i) adhering to clear focus on their mission (ii) including extensive up front planning efforts (iii) critically analyzing customer needs (iv) leveraging project overlaps (v) involving suppliers early (vi) empowering the team and (vii) breaking rules”.

According to Damodara U. Kini (2000), “the Construction Company will have to be very good in the basic project Management processes in planning, designing, scheduling, Controlling costs, and managing materials and construction. However the following six areas are crucial for the complete success of a project. (i) The company will need an organization that can match their expertise in a cost-effective manner to the needs of their global customers. (ii) They will need an information technology system that will permit fast, reliable transfer of data to any point of the world. (iii) The staffs of these companies will have to be able to think globally and to deligate design functions to engineers at distant locations. (iv) They will have to make effective use of suppliers anywhere is the world to benefit from lower manufacturing costs and proximity to a given construction site. (v) They will need to develop the knowledge to use local materials and construction techniques in such a way as to minimize costs and take full advantage of local existing facility. (vi) They will have to ensure that the required quality is achieved in the end product they deliver regardless of its location”.

Demos C. Angelides (1999) concluded that “good Technical Practices by themselves are not sufficient to produce and deliver good products/Services quickly and at a low cost. They must be integrated through good project management to achieve better product”.
Sayed H. Stoman (1999) observed that “a Project Manager needs to know, including management basics, accessibility and planning, staffing and job criteria, scheduling and milestones, clerical support, communication and continuous improvement for the successful Cost Management Processes”.

According to Gregory L. Magee (1996), “proper financial management requires a reporting system by a Project Manager that supplies both cash and accrual methods of accounting. Project accounting system and Cost accounting technique are also important for Cost Control”.

As per Ronald Gulezian and Frederic Samelian (2003), “the various ways of quantifying damages have been applied to productivity loss claims in Construction. So the measurement-based approach that can be used to establish a productivity baseline applied to construction productivity loss claims, based on the application of statistical methods as aided by a process control chart”.

In the study made by Richard H. Steen (1994), he observed that “disputes are reality in every Construction Project. The rising cost, delay and risk of litigating Construction disputes has prompted the construction industry to look for more efficient ways to resolve these disputes out side of the Courtroom. The following five steps will be useful for resolving disputes. (i) Contract provisions should be clear without any ambiguity in the contract documents. (ii) Equitable allocation of responsibilities and risks and procedures for dealing with Contract disputes. (iii) Team building such as partnering and establishing objective. (iv) A neutral forum to solve disputes through out the life of a project including Dispute Review Boards, mediation, rent-a-judge programs and mini-trials and (vi) as the last resort is binding ADR (Alternative Dispute Resolution), such as arbitration”.

Markus Liberda, Janaka Ruwan pura and George Jergeas (2003) say that “understanding the relationship between performance on the job site
and level of productivity is important to develop best and innovative practices to improve construction productivity. It is identified that the most critical aspects in terms of human, external and management issues that affect Construction Productivity”.

2.5 COST MANAGEMENT PROCESS IN CONTROLLING STAGE

The cost controlling process ensures that project objectives are met by measuring the financial progress and taking corrective actions when necessary. It includes collecting project progress status, analyzing variance, and communicating financial status.

The process of project control has been described by Kimmons and Loweree as “Having the necessary control plans, the need to establish baselines and standards to control against, the regular monitoring of work against these baselines, the evaluation of planned versus actual results, the early identification of problem areas, and the firm and positive action to resolve performance variances promptly are all key steps that the Project Manager should employ in controlling the project to a successful conclusion”.

2.5.1 COST CONTROL

Cost control includes

(i) Monitoring cost performance to detect variances from plan

(ii) Ensuring that all appropriate changes are recorded accurately in the cost baseline.

(iii) Preventing incorrect, inappropriate, or unauthorized changes from being included in the cost baseline.

(iv) Informing appropriate stakeholders of authorized changes.
The relevant research done earlier on this controlling processes are given below:

Yong – Woo Kim and Glenn Ballard (1998) revealed that “the earned value method (EVM) is a project control technique that provides a quantitative measure of work performance. It is considered the most advanced technique for integration of schedule and cost. Critique of earned-value method includes : (i) While each cost account or activity is assumed to be independent in the earned value method, they should be considered dependent. (ii) Managers can manipulate work sequences when releasing work to the field and it is possible to release work assignment that are not shielded from uncertainty (iii) In order to make cost variances (CV) positive, managers try to decrease the actual cost of work performed (ACWP) as much as possible”.

According to Khaled EI–Rayes and Amr Kandil (2005), “the traditional two-dimensional time-cost trade off analysis to an advanced three-dimensional time-cost-quality trade off analysis as a multi objective genetic algorithm provides the capability of quantifying and considering quality in construction optimization”.

The study made by Robert I. Carr (1993) revealed that “a unified nomenclature and parallel budgets, and variance structure allow integrating of cost and schedule control for projects that share common work breakdown structures. Budget, actual and variance values of cost, progress and time are combined in a single figure provide an integration at the activity/Cost account level”.

Tricia Varvel, Stephanie G. Adams, Shelby J. Pridie, and Bianey C. Ruiz Ullaa (2004) observed that “individuals training on the type of personality of team members helped them to improve communication, trust and interdependence, essential characteristics of an effective team. Therefore,
understanding and tolerance of individual’s behaviors and actions are the largest benefit”.

According to William C. Ibbs, Clarence K. Wrong and young Hoon Kwak (2001), “changes in projects are common, but it affects the cost, the scheduling and the duration of projects, both directly and indirectly. A comprehensive project change management system that is founded on five principle, (i) Promote a balanced change management system that is founded, (ii) recognize change, (iii) evaluate change, (iv) implement change, (v) continuously improve from lessons learned. By applying this project change management system, project participants can minimize deleterious change and promote beneficial change”.

Stefanie G. Brandenburg, Carl T.M. Hass F. and Robert W. Glover (2003) have concluded that “the shortage of skilled construction workers is a long term problem that at times may be alleviated slightly during a recession but will continue to worsen as time progresses. The reasons behind the shortage are numerous, ranging from a poor image of the industry, to declining real wages, to poor work environments and the lack of a stable of the solutions used to address the situation but are difficult to sustain without a comprehensive, long term strategy to support developed with senior industry consultants and researchers, so as a first stage the workers skills and productivity, creating a situations where the value of the workers, is to be increased. Then as a second strategy, the existing work force, regardless of its skill level, is to be managed efficiently. The focus is on organization, communication and utilization of field management”.

Khalfan, Bonchlaghem, Anumba and Carrillo (2003) observed that “managing knowledge is particularly important to the construction industry due to the unique characteristics of its projects such as multi-disciplinary teams, temporary team members, heavy reliance on experience, the one of
nature of the projects, tight schedules, limited budget etc. The C-sanD Projects, ie. creating, sustaining, and Disseminating knowledge for sustainable construction, is very essential for this current need”.

In their study made by Lauri Koskela and Glenn Ballard (2003) revealed that “it is not enough to adopt generic requirements for the production system in construction, but rather it is required that the peculiarities of construction, such as one-of-a kind production, site production and temporary organization are suitably accommodated. It is required that all parts and aspects of the production system are synergistically coupled : the total optimum is sought, rather than a sum of location optima”.

According to Elizabeth Kraft and Paul S. Chinowsky (2003), “in this evolutionary development, the dominant attitude within the construction industry has been that strategic business management and long term business planning did not apply to the construction industry due to the constantly changing nature of the projects. However, in the changing economic world, a resurgence of interest is occurring in the importance of organization management to the success of companies within the A/E/C industry”.

2.6 COST MANAGEMENT PROCESSES IN COMPLETION STAGE

As per PMI (2000) the closing processes consist of,

The completion process ensures formalizing acceptance of the project or phase and brings it to an orderly end. It includes contract close out, the lessons learned documentation, and administrative closure.

(i) Administrative Closure

(ii) Contract Close-out
2.6.1 Administrative Closure

The project, after either achieving its objectives or being terminated for other reasons, requires closure. Administrative closure consists of verifying and documenting project results to formalise acceptance of the product of the project by the sponsor, client or customer. Administrative closure activities should not be delayed until project completion. Each phase of the project should be properly closed to ensure that important and useful information is not lost.

2.6.2 Contract Close Out

Contract close out is similar to administrative closure in that it involves both product rectification (Whether all works are completed correctly and satisfactory) and administrative closeout (updating of records to reflect final results and archiving of such information for future use).

The administrative closure and contract closure may be further explained under (i) Inputs, (ii) Tools and Techniques, (iii) Outputs.

The relevant research done earlier on this closing processes are as follows:

According to Angela Palmer, John Kelly and Steven Male (1996), “the use of Value Engineering has grown significantly. It is needed that the holistic appraisal of Value Engineering as used in construction industry by investigating current theory and practice and evaluating the value Engineering projects and calculating the savings achieved by them. And it has to be analysed the nature of those savings also”.
From the experience he had, The Director (Contract), Indian Military Engineering Service, Ahmedabad (2006) revealed that final account and Audit Management is the most important stage of Cost Management. From this the contractor as well as client can know the lapses committed and how the improvement can be made so that same lapses are not committed in future projects.

According to Director (CEO), Britannia Academy of IT and Planning Ltd., London Cosmos College, Harrow (U.K) (2006), “public building projects in India suffered cost overrun and additional funds are provided to complete them. Cost management undermines social benefit cost values in building projects to minimize costs by axing first the social benefits. India has brilliant audit manpower in world. However, the quality of audit is poorest in the world. The stakeholders greed and averse to computer system have further deteriorated our audit quality in India. There is a vaccum of the role play by cost and works engineer in building projects as the Indian Department of Company Affairs appoints statutory auditors from non-technical field which supersede in audit objection. So Chartered Works and Cost Engineer must be appointed in all the large Projects”.

Virendra KR. Paul and Dr. V. Thiruvenkadom (2006) say that “Cost Related Processes after Practical completion should be done by the process owner ie. The Project Manger such as (i) Defect rectification and completion formalities, (ii) preparation of final account of time, (iii) updating lost cost report, (iv) preparing complete final account and issue relevant final certificate, (v) feed back on Cost performance assessment”.

According to Shampa Bhattacharya and Virendra Kr. Paul (2006), “Indian Construction Industry, generally maintains no specific records for the defects and deviations. There is a lack of consciousness towards the costs of defects and deviation which leads to non-availability of records and data.
Even when repair and rework possibilities could be identified, difficulty was experienced in obtaining data. No firm data was available regarding the general impact of modification in design on quality-related cost. But these surely will lead to some costs, arising out of wastage of time and deliberation over the changes between the parties, even if no rework or repair activities are necessitated.”