Project Management Information Systems for Construction of Thermal Power Plant : A Case Study with Special Reference to National Thermal Power Corporation Ltd.,India

Dr. D. K. Choudhury

Dean & Professor

Gitarattan International Business School, Delhi

(Affiliated to Guru Gobind Singh Indraprastha University, Delhi, India)

Abstract

In construction management, it is imperative to have an unique project management information system(PMIS) for completion of the project without any time and cost overrun. In this study, we have illustrated the project management models and PMIS suggested by different researchers. National Thermal Power Corporation Ltd.(NTPC) is the main power producer in India. The organisation has set up 16 thermal power plants in the country and most of the plants were set up within the scheduled time. A case study was conducted at NTPC to find out the PMIS used by the organisation for implementing their project and to what extent this PMIS fulfils the basic requirements laid down by different researchers. The second purpose of this study was to empirically assess the quality of the PMIS used by NTPC in the light of the evaluation parameters suggested by researchers and mentioned in this research paper.

Key words : Information, system, project, management

1. Introduction

A project is an endeavour to translate a plan into reality. Like every thing in life, each project has a lifecycle. Prior to the beginning is the pre-planning or conceptual stage of any project, followed by activity phase of project management. This is followed by the actual implementation including monitoring and control. And finally the project is wound up, audited and handed over to the client or end-user.A project consists of several activities. Each activity may be further divided into task and each task into sub-task. From the conception to implementation, a project passes through different phases : Pre-project activities, Project implementation, Project commissioning, and Project evaluation. For completion of any project without any time and cost overrun, it is most essential to have very effective project management information system.

Project management is the most significant development in organisational systems management. It is an organisational structuring concept designed to obtain more effective and efficient utilisation of company's resources of manpower, money, information, equipment, facilities and materials.

The project management must be backed up by effective project management systems such as planning, budgeting, analysis and control systems to assist the management in its function. If the management does not have this back up, the planning and budgeting will be too slow, and they will not be used to help the management organise and control the work.

All project managers have back up systems of one kind or another, ranging from the most elementary manual systems to extremely sophisticated computer based system. There may be from hundreds to thousands of activities involved in a large project with a tremendous amount of data produced which is analysed and filtered in a systematic manner to produce meaningful information for the project manager in a summerised way.

In project management, it is more important to have approximate information quickly than accurate information when it is too late to take any corrective action. The project manager must have information in a summerised form on slippages to schedule, variance from budget, delays in procurement and escalation of costs etc., otherwise he will not be able to manage and control his project. Important points should be highlighted automatically in a digestible form. Once a deviation is identified, the management must be able to trace it to its source and produce further information right down to the relevant raw data.

NTPC Limited is the largest thermal power generating company of India. It is a public sector company which was incorporated in the year 1975 to accelerate power development in the country as a wholly owned company of the Government of India. It has been observed that most of the thermal power projects of National Thermal Power Corporation Ltd. (NTPC) was successful implemented by the organisation within the scheduled time. NTPC expressed that their PMIS played key role in commissioning of Singrauli, Korba and Ramagundam Thermal Power Plants within the scheduled time [4]. The objective of this study is to present the project management system model and PMIS suggested by different researchers, the PMIS designed and used by NTPC for implementation of their thermal power projects and to assess the quality of the PMIS (used by NTPC) and its impact on project success.

For better exposition, the subject matter of this paper is divided into following 4 sections :

SECTION-A: This section gives the literature review and research methodology for conducting the study.

SECTION-B : This section explains the characteristic of project management information system(PMIS), information system structure and information system success.

SECTION-C : This section describes the development process of power plant project in the light of project life-cycle.

SECTION-D : This section presents the case study conducted at NTPC to find out the PMIS used by the organisation for implementation of thermal power projects.

SECTION-E : This section provides the evaluation technique used to ascertain the

quality of PMIS of NTPC and its impact on project success.

SECTION - A

2. Literature review

In project management literature, the definition of project has been discussed by numbers of literatures, for instance, PMI (2000)[12] define projects as a temporary (definitive beginning and definitive end) endeavour undertaken to create a unique (projects involve doing something that has not been done before) product or service.

Dave Cleland and Lew Ireland(2004) [5] describes a project as a combination of organisational resources pulled together to create something that did not previously exist and that will provide a performance capability in the design and execution of organisational strategies.

In project management, the decision making ability of project manager plays a very important role. Davenport and Harris (2007) [6] implies that there is research evidence suggesting that better use of information can improve decision making.

Some authors described Project Management tool as "software for project management"(Fox, Marry et al., 2003 [7]), while others view them as "systematic procedures or practices that project managers use for producing specific project management deliverables"(Akram Jalal Karim, 2011 [3]).. Thus the core of a PMIS is usually project management software which involves wide alteration, configuration or customization before it is applied.

Interdependence between information technologies and project management has reached its highest level since many years. It is perceptible in the increased number of project management packages and the adoption of various management solutions such as Executive Support System (ESS), Decision Support System (DSS), Knowledge Management System (KMS), Management Information System (MIS), Supply Chain Management (SCM), Business Intelligent Systems(BIS), virtual reality (VR), and risk management (RM) tools (Akram Jalal Karim, 2011 [3]).

Meredith and Mantel(2006)[10] found that utilising information technology (IT) has major impact in solving all difficulties, which may appear during project life cycle phases, by presenting a crucial computer application, project management software such as, which may help in decreasing the time and cost that are required to use precise clarifications for project planning, scheduling, monitoring, and controlling. Thus, retailers provided extra support for the key phases of the project life-cycle such as project risk management and created knowledge management to strengthen not only individual but the monitoring and controlling the whole organisation (Ahlemann, 2008 [1]).

Essentially, the risk of Project Management Information System (PMIS) has been described as "subsequent to the attainment of project goals and the implementation of project strategies", it provides project managers with "essential information on the cost time performance parameters of a project and on the interrelationship of these parameters"

(Raymond L.,1987[13]). Ahlemann(2008)[1] presented an extensive research about requirements of PMIS in which he recommends the M-model as a support for the requirement description in different phases of project life-cycle.

3. Research methodology

The project management and management information systems when clubbed together, the combination gives birth to a concept called project management information system(PMIS). Through literature review, the project management models generated and PMIS designed by different researchers were noted and presented in this paper. Next, the PMIS used by NTPC was collected from the report published by NTPC [4]. For assessing the quality of the PMIS (used by NTPC) and its impact on project success, the questionnaire survey was conducted at the corporate office and different sites of NTPC; the data were collected based on different criteria laid down by researchers with respect to quality of PMIS and its impact on project success. The data were analysed mathematically to draw the conclusion.

SECTION - B

4. Characteristics of project management information system

A system is an assembly of procedures, processes, methods and techniques united by some form of regulated interaction to form an organisational whole. But often, the term information system gets mixed up with concepts of information technology, and is understood to refer to a computer system. Computers certainly have a role in most project information systems, but they are merely one component of the system, a tool for speeding the handling of information. The system here refers more to a set of operational procedures for the collection of data from a range of different sources, the processing of that data to produce useful information, and the application of that information to improve the project outcomes. A more precise definition puts a system as a group of interacting, interrelated, or interdependent elements forming a complex whole. This system is formed by the different processes around information dimensions required to monitor a project. The information management process relates to the steps that a project needs to gather, store, analyze and report information, as well as identify type, sources and uses of information. A system may not be necessarily a computer based system but a set of related processes that form a whole[16] .

The project management information system (PMIS)should work as a reporting mechanism and serves as a management tool for taking decision on analysing the informations furnished to the project management manager. A good PMIS needs to contain the following characteristics:

a. The PMIS should incorporate both quantitative and qualitative data and feedback from the project management team through every phase of the project.

b. For project monitoring, the PMIS must provide with the necessary information and feedback so that potential problems are identified and solutions are implemented before the problems become constraints. The system is to be developed in such a way which is capable of generating enough information to initiate a corrective action.

5. Information system architecture

A conceptual information system architecture was developed by

Ahlemann(2009) [2] which is called M-Model (figure 1). The M-Model is the outcome of an examination of existing research results and an analysis of project management case studies. The M-Model embraces all tasks related to the initiation, planning, execution, and termination of projects. It describes the process of enterprise-wise project management (project life-cycle) and explains the management levels involved.

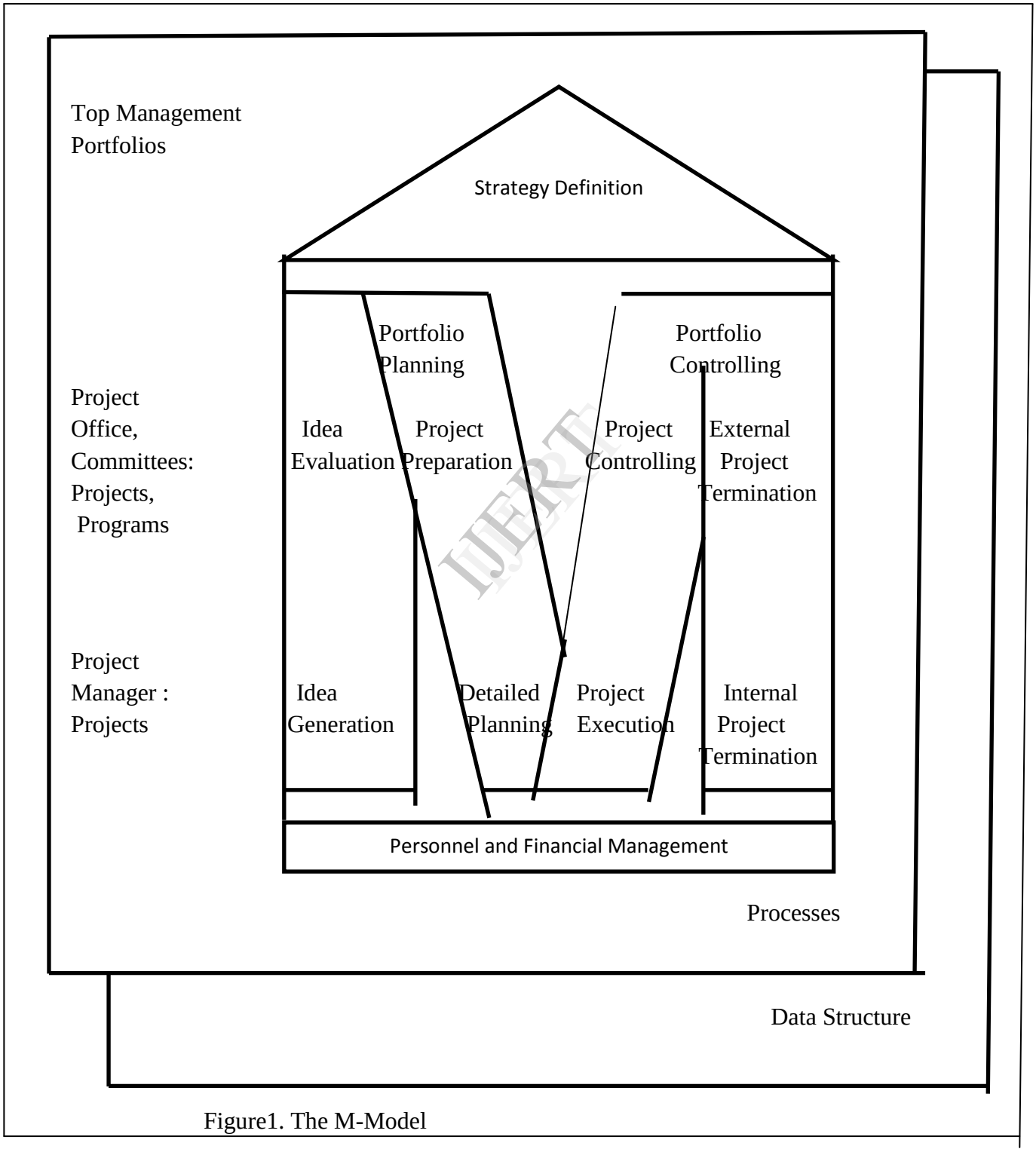

Figure1. The M-Model

6. Information system success

Project management information systems (PMIS) are meant to provide managers with the decision-making support needed in planning, organizing, and controlling projects. A successful PMIS should have satisfied users and effective use; it should facilitate project success in terms of adhering to the project budget, schedule, and specifications.

The basic function of a PMIS was to provide managers with essential information on the cost-time performance parameters of a project and on the interrelationship of these parameters. The nature and role of a PMIS within a project management system, as presented in Fig.2, have been characterized as fundamentally subservient to the attainment of project goals and the implementation of project strategies[14].

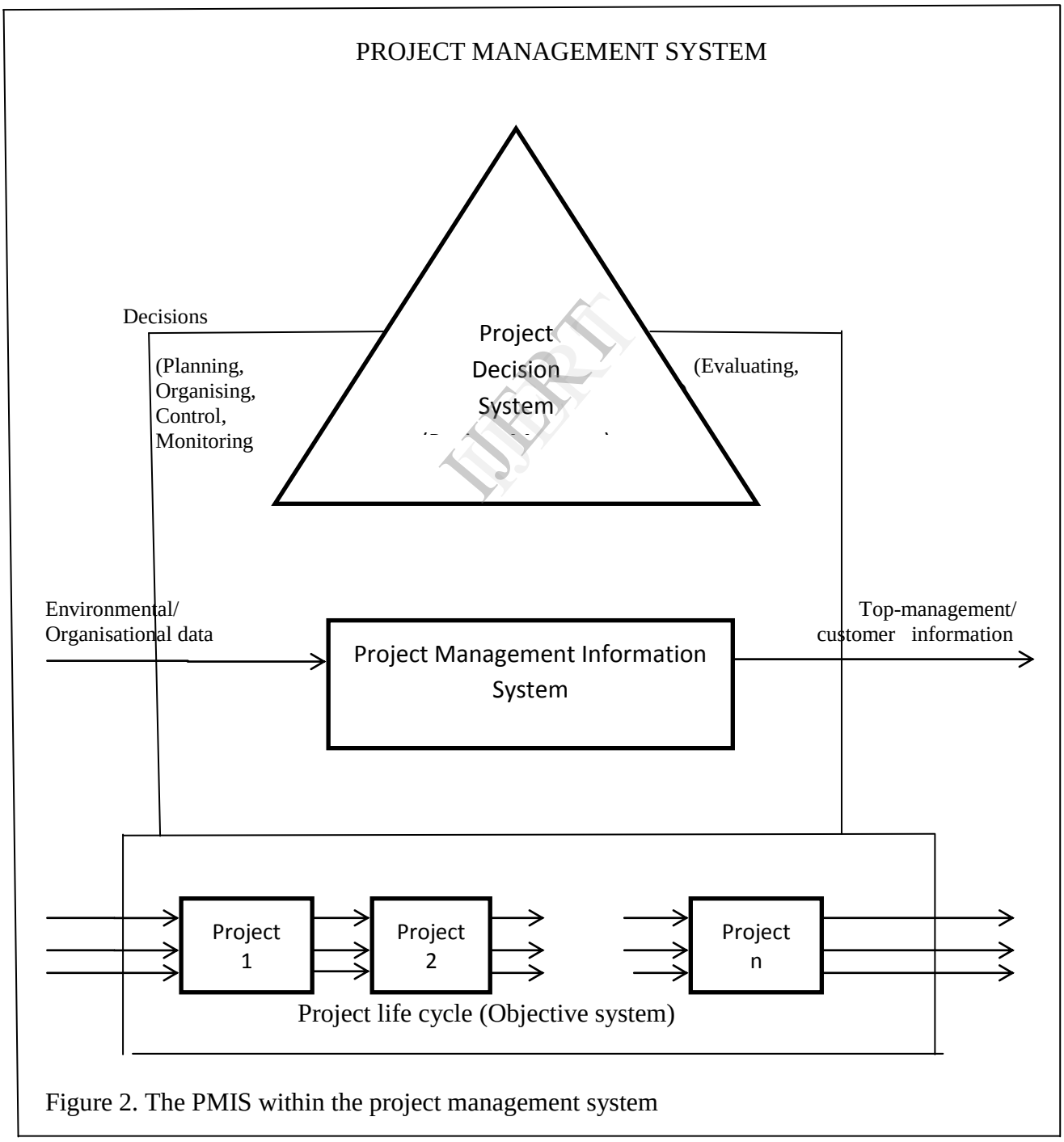

Figure 2. The PMIS within the project management system

The PMIS functions may be divided into five categories :

The planning function tools aim at preparing the overall project plan; they include work breakdown structure, resource estimation, overall schedule, Gantt, PERT, and CPM.

The monitoring function tools are used to regularly assess project progress; they are used for progress reports and curves, and to update operational reports such as completed tasks, percent project completed, effective schedule, remaining tasks and remaining days to complete.

The controlling function tools are used to make specific changes to the project; they allow the project manager to fine-tune forecasts, modify tasks, reassign resources to lower the costs, cancel tasks, and modify the cost of resources.

The evaluating function tools are targeted towards project auditing; these tools allow the identification of cost and schedule variations, and tracking the use of resources.

The reporting function tools give information on the most basic aspects of the project; they include an overview of the project as well as reports on work-in-progress, budget overruns and task and schedule slippages.

For testing the information system success model, Raymond L, Bergeron F (2008) [14] measured the quality of the PMIS with eight items: accessibility, response time, flexibility, ease of use, querying ease, learning ease, systems integration and multi-project capability ;they measured the quality of information with six items: availability, relevance, reliability, precision, comprehensiveness, and security. Shenhar AJ, Levy O, Dvir D (1997) [15] stated that the impacts of the PMIS on project success may be found out based on the perceived contribution of the PMIS with regard to three performance criteria: respecting deadlines, respecting budgets, and respecting quality specifications.

SECTION – C

7. Project life-cycle

Projects undergo a series of phases that constitute the project life-cycle (Ahlemann, 2009 [2]). At a high level of abstraction, this life cycle can be divided into following phases :

- Initiation : In the initiation phase, project ideas are generated, collected, recorded, and examined (Idea Generation). Their feasibility, profitability, and strategic impact are analysed so that a final decision can be made regarding their implementation (Idea evaluation). This phase ends with a formal go/no-go decision made by the man-management team (Portfolio Planning).
- Planning : In this phase, the project idea is translated into a project plan and the necessary resources (financial, human, and other resources) are provided (Project Preparation). The project manager also refines the project plan (Detailed Planning).
- Execution : In this phase, the project idea is realised through the resources assigned to the project (Project Execution). Information regarding the project execution is collected and analysed for controlling purposes (Project Controlling). Information is then aggregated to obtain an overall

view of the project situation (Portfolio Controlling).

- Termination : In the termination phase, the project results are submitted to the project sponsor (Internal Project Termination).In addition, the enterprise closes the project and endeavours to learn from the experiences (External Project Termination).

8. Development process of power plant project

In order to develop a PMIS, it is required to have complete knowledge of development process of power plant. While making a case study on the management of the development of a large-scale power plant, Ling YT and Lau BSY (2002) [9] reported that the development process of the project is divided into four stages : conception and feasibility studies; project planning; bidding and contracting; and project implementation (Table 1). For each phase, a specific task team is formed to carry out the required activities.

Table 1. Project development process

Phases	Activities	Task team
Conception and feasibility studies	1. Define the need for the development 2. Evaluate plant capacity 3. Analyse technology 4. Evaluate site(s) 5. Environment impact assessment 6. Obtain permits and regulatory approvals 7. Prioritise project objectives 8. Analyse project tasks 9. Prepare conceptual scopes and estimates 10. Prepare preliminary design options 11. Define project implementation approach 12. Establish project control approaches	Project development committee comprising : (a) Client – Management Group and Project Group (b) Project Manager
Project planning	1. Plan and develop project requirements 2. Process requirements and prepare design brief 3. Prepare conceptual design and	(a) Project development committee (b) Client's O&M Group provides inputs on specific requirements

	specification 4. Prepare bid documents and RFP 5. Establish pre-qualification evaluation criteria	
Bidding and contracting	1. Conduct pre-qualification exercise 2. Shortlist pre-qualified contractors for tender 3. Contractors submit bids and proposals 4. Evaluate bids 5. Negotiate contracts 6. Appoint contractors	Contract committee comprising : (a) Project development committee (b) Legal and other advisors
Project implementation	1. Administer contract 2. Contractors develop detailed design 3. Review design and give approvals 4. Approve sub-vendors and sub-contractors 5. Contractors proceed with construction and commissioning 6. Control quality on site 7. Commissioning 8. Training operators	Project Management Team comprising of : (a) Client's Project Group (b) Project Manager

The contractual relationship of the project participants is illustrated in figure 3. The client's organisation of the project under study was divided into several departments, and three entities were directly involved in the development of the new power plant; Management, Project Group and Operation and Maintenance (O&M) Group. The Management was the project sponsor, which provided project funding and made the relevant strategic decisions. The Project Group and the O&M Group provided specific inputs and comments to the design. The O& M Group also participated in the commissioning of the facilities.

The Management appointed a Project Management Consultant(PMC) to be its project manager. The roles of the PMC included performing feasibility studies, preparing the client's requirements, basic design and request for proposal (RFP), formulating contract strategy, obtaining and evaluating proposals, and advising the clients on the appointment of contractors. The PMC also reviewed designs and undertook the coordination of different

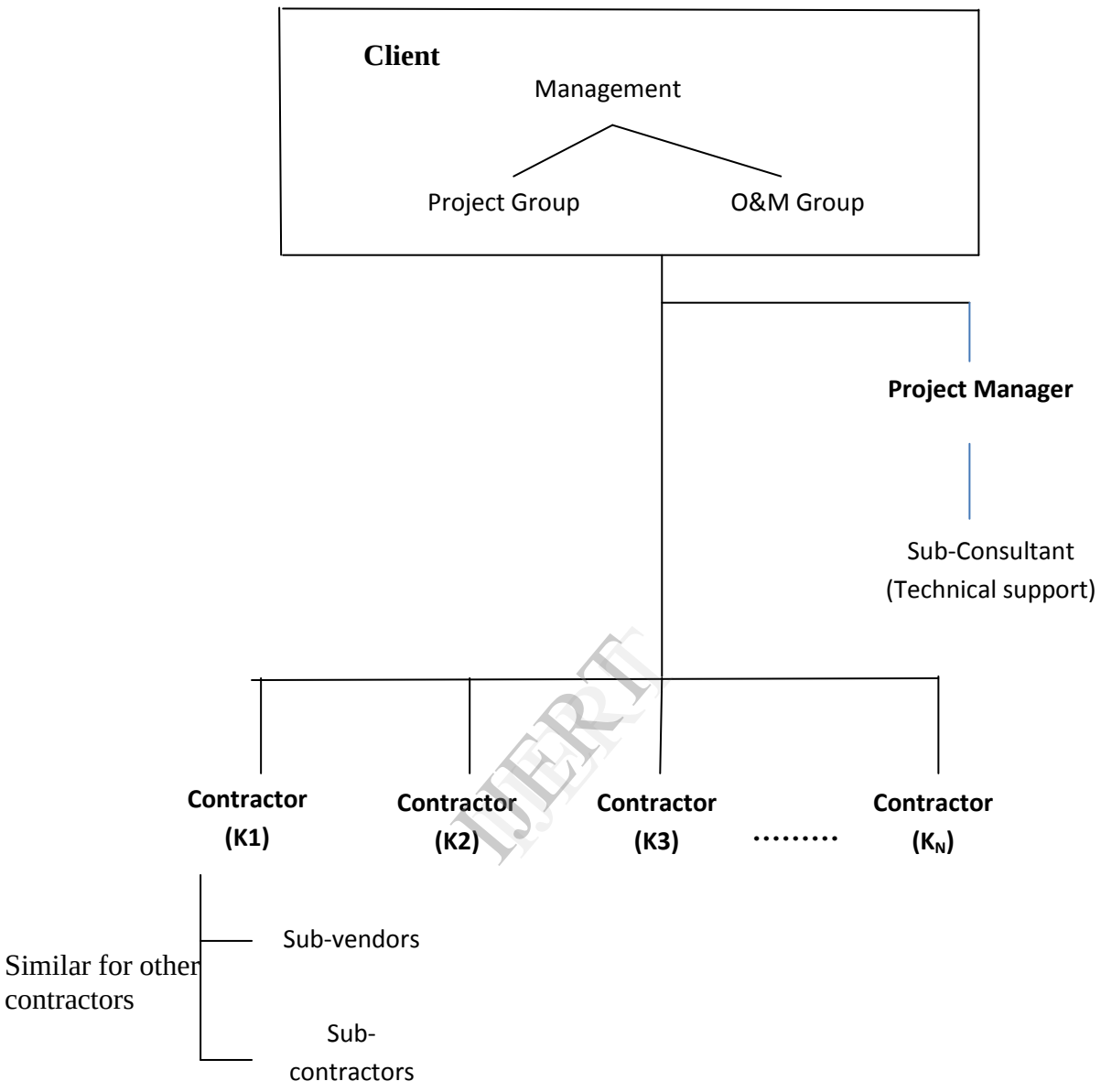

Figure 3. Contractual relationships of project participants

contractors. It was responsible for monitoring progress, budget and quality of the works. It was also responsible for project planning, co-ordinating and controlling the contractors.

SECTION - D

9. An overview of NTPC

NTPC Limited is the largest thermal power generating company of India. It is a public sector company which was incorporated in the year 1975 to accelerate power development in the country as a wholly owned company of the Government of India. NTPC's core business is engineering, construction and operation of power generating plants and also providing consultancy to power utilities in India and abroad. NTPC has set new benchmarks for the power industry both in the area of power plant construction and operations.

Present installed capacity of NTPC is 41,184 MW (including 5,364 MW through JVs) comprising of 23 NTPC Stations (16 Coal based stations, 7 combined cycle gas/liquid fuel based stations), 7 Joint Venture stations (6 coal based and one gas based) and 2 renewable energy projects.

By 2017, the power generation portfolio is expected to have a diversified fuel mix with coal-based capacity of around 27,535 MW, 3,955 MW through gas, 1,328 MW through hydro generation, about 1,400 MW from nuclear sources and around 1,000 MW from Renewable Energy Sources (RES). NTPC has adopted a multi-pronged growth strategy which includes capacity addition through green field projects, expansion of existing stations, joint ventures, subsidiaries and takeover of stations. .

Over the last three decades, NTPC has spearheaded development of thermal power generation in the Indian power sector. In this process, it has built a strong portfolio of coal and gas/liquid fuel based generation capacities. The company has made initial forays in the area of hydropower development and plans to have a significant share of hydro power in its future generation portfolio. Although NTPC is also offering technical services, both in domestic and international markets, through its Consultancy Wing, the generation business would continue to be the single largest revenue generator for NTPC.

Recognizing its excellent performance and vast potential, Government of the India identified NTPC as one of the jewels of Public Sector 'Navratnas'- a potential global giant. Inspired by its glorious past and vibrant present, NTPC is well on its way to realize its vision of being "A world class integrated power major, powering India's growth, with increasing global presence"[18],[17]).

10. PMIS followed by NTPC

The PMIS followed by NTPC during life-cycle of the project is reported below[4] :

(i) Conception and feasibility studies

The feasibility study of the projects are done by the PMC engaged by NTPC. The PMC submit their report to the Management which is put up for discussion by the project committee. The project proposal as discussed and agreed by the project committee is submitted to the Board of Directors for their approval. The project proposal duly approved by Board of Directors is submitted to the Ministry of Power for Government approval. Once the project is cleared by the Ministry of Power, Government of India, the project moves to the next phase of the project life-cycle.

(ii) Project planning and implementation

Once a project is approved after all the statutory, financial and other appraisals, it enters the realm of detailed planning where the work breakdown structure is developed, responsibilities for different tasks are decided upon, a timetable for doing various jobs is prepared, the resource requirements of men, machines, materials, and money are determined and suitable provisioning for the key resources is done so that implementation could be carried out. Project planning is the active phase of project management in which the project manager and his team have an opportunity to contribute their experience and learning in the development of a realistic project plan. A large number of networking techniques, analysis, simulations and analytical models can provide very suitable clues to some of the typical problems that a project manager may be facing at this stage. The major phases of the project planning and implementation can be classified as under :

- Design and engineering phase,
- Tendering and award phase,
- Inspection and expediting phase,
- Manufacturing and despatch phase,
- Construction phase, and
- Commissioning phase

NTPC developed system manual for each phase furnishing the detailed procedures to be adopted so that the best effort is made to achieve the end target. However, lot of conflicting activities were observed when it was considered in isolation. Thus the integrated project management and control system has been developed for project planning, scheduling, monitoring and control using PERT/CPM network as the basic management tool.

The system evolved keep in view all the requirements of effective working, flow of information, feedback communication, and organisation structure. It enables the involvement of all concerned in the development of an agreed project programme, while at the same time allowing total independence to each functional centre to schedule and control its own activities in greater details within the overall plan called the Master Network Schedule (MNS) or schedule at Level-1,consisting of about 600 activities, which identifies the milestone dates for each package in the areas of engineering, procurement, manufacturing, despatch, construction, erection, testing and commissioning, starting from the ordering of the main plant equipment as the zero date. The major control centres which have been identified pertain to :

- Engineering management,
- Bidding and contracts management
- Site construction and erection of equipments and structures

Even though the system permits total independence to each control centre for scheduling its respective activities, tying up the scheduling of interface events so as to adhere to the end goal set by central planning group located at corporate centre.

10.1 Engineering Management

For all NTPC projects, the basic engineering studies are identified as soon as feasibility report is submitted and all major technical parameters of the project are finalised and documented as part of the detailed project report (DPR) along with the detailed estimate of cost and quantities. The project management consultants (PMC) for the project are appointed well in time to take care of basic design, systems and equipment specifications, detailed design and drawings, scrutiny of construction drawings, field supervision, testing and commissioning.

Coordinated procedures between the consultants, in-house engineering centre, project sites and various other agencies are well documented indicating the formats in which informations are to be exchanged among them.

10.2 Engineering Planning

The engineering services plans and schedules the project engineering activities within the time frame specified for the engineering milestones in the finalised master network schedule(MNS). The engineering programme at level-2 shows the dates of data availability, tender drawing release, specification release, bid evaluation and construction drawing release etc. The schedule drawn up by each engineering discipline takes into consideration the assistance from external engineering consultants that can be advantageously supplemented to the internal resources depending on the complexity of an equipment system, the need for inducting latest available technology, the large quantum of fairly simple engineering work etc. The engineering manpower resources are allocated depending upon the priorities in the schedule of each engineering discipline. The IPMS of Engineering Services of NTPC is given in figure 4.

10.3 Engineering review, monitoring and control

Departmental reviews are conducted by the head of respective engineering disciplines. Work performed is compared with the detailed schedules and corrective actions within the scope of the departmental head are indicated and the plans are updated. The engineering status appraisals from the head of different engineering disciplines are then reviewed by General Manager (Engineering) to check the release of specifications and drawings of various areas against the target level-2 programme dates. If any delay is expected to affect the schedule of other control centres, the corrective action to rectify the situation by either reallocating priorities of internal resources, or by seeking the assistance of external engineering agencies is resorted to.

10.4 Contracts planning

The entire project work is broken into well defined contract packages. All contracts having long equipment delivery periods or requiring intense engineering coordination and specialised engineering and procurement knowledge are handled from corporate centre. For all the contracts identified by the Contract group, planning and control starts from the

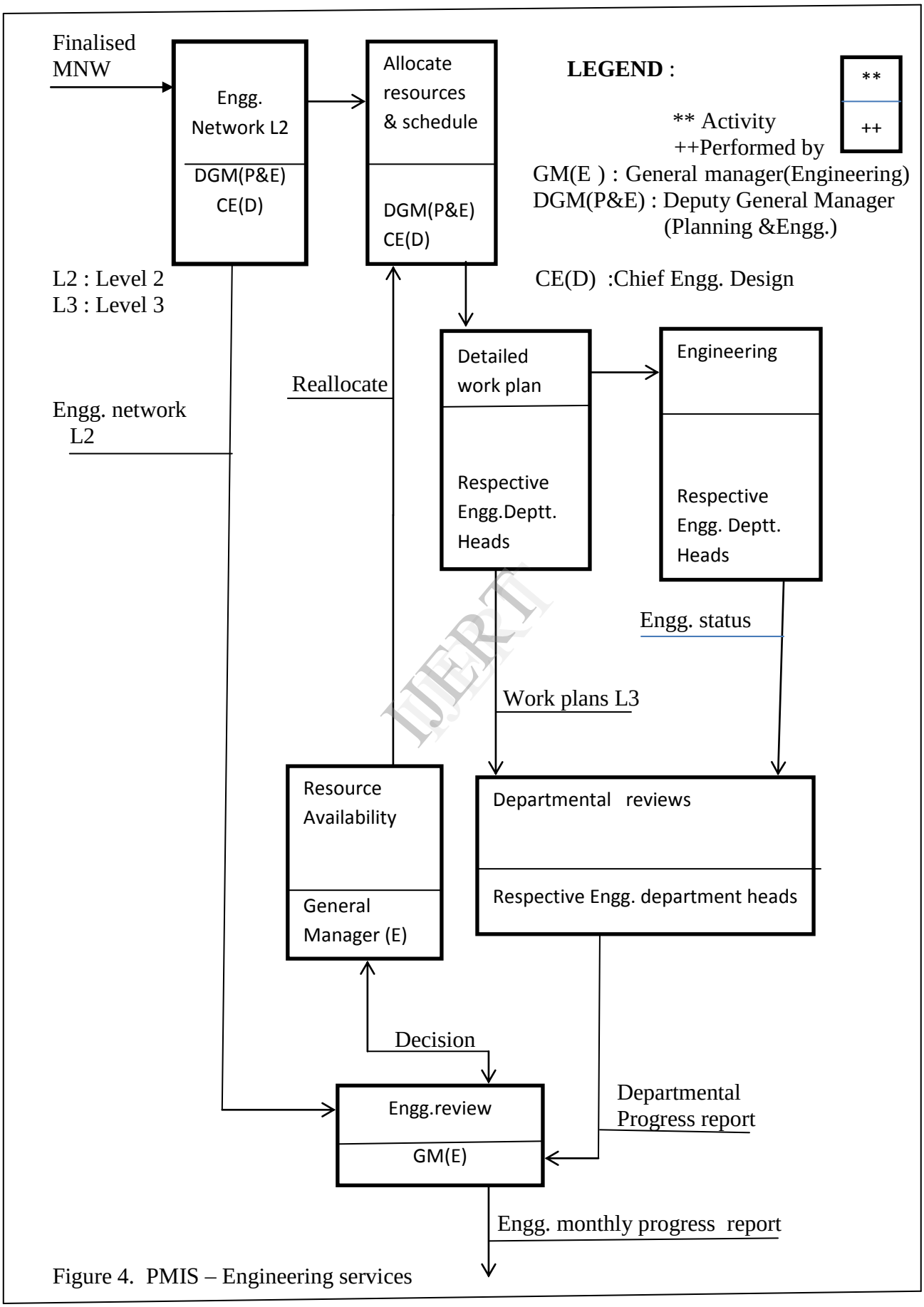

Figure 4. PMIS – Engineering services

pre-award contract planning stage i.e. from the preparation of specifications up to the stage the equipments/materials are delivered to the respective sites by the contractors.

Based on the key event dates in the master network schedule (MNS), detailed plan for pre-award activities up to award of every contract is finalised and monitored vigorously. At the time of each contract award, detailed manufacturing/field activities schedule are tied up with the contract for subsequent monitoring and control purpose; the networks so finalised become the level-2 network for controlling the respective packages.

10.5 Contracts monitoring and control

Contracts coordinators of each package monitor the progress for each work package against the schedules drawn up. Such evaluation indicates the cause of delay, if any, in meeting the schedule and suggest actions to be taken for rectifying this delay. Monthly progress reports on identified reporting heads reflect the corrective action taken in areas of delay. The IPMS of contracts services is given in figure 5.

10.6 Inspection and expediting

To expedite supplies from the vendors, expeditors are posted at work of major equipment suppliers or visits arranged periodically from corporation centre or regional office to ensure that the work progresses as per schedule and contract agreement. The manufacturing programme and the quality plans finalised at the time of contract award are utilised by the expeditors/inspectors for monitoring the manufacturing and quality status. Specified reports at regular intervals are submitted indicating the areas of schedule variance, if any, their likely impact on delivery status and any recommendation given to the contractor and/ or suggestions for implementation. The inspection report, apart from the inspection status, also indicates deviations, if any, from the quality plans. The expeditors are conversant with production planning and project engineering as well as manufacturing techniques. The expeditors ensure that the delivery of components and equipments are in the sequence of erection required at site.

The inspection reports are analysed and schedule variances are reviewed for decision on the course of action to be taken to achieve the overall project commissioning schedule.

10.7 Quality assurance

An independent quality assurance group for ensuring the quality during the project engineering, procurement and manufacturing has been organised in the corporate office. Before the award of any contract the Quality Assurance department discusses with the prospective contractors and finalises the mutually acceptable inspection programme and detailed quality plans. In the post contract stage, the inspection reports generated by the inspectors are reviewed to evaluate the quality status with respect to the specified levels and necessary coordination of all actions necessary to ensure the achievement of the required

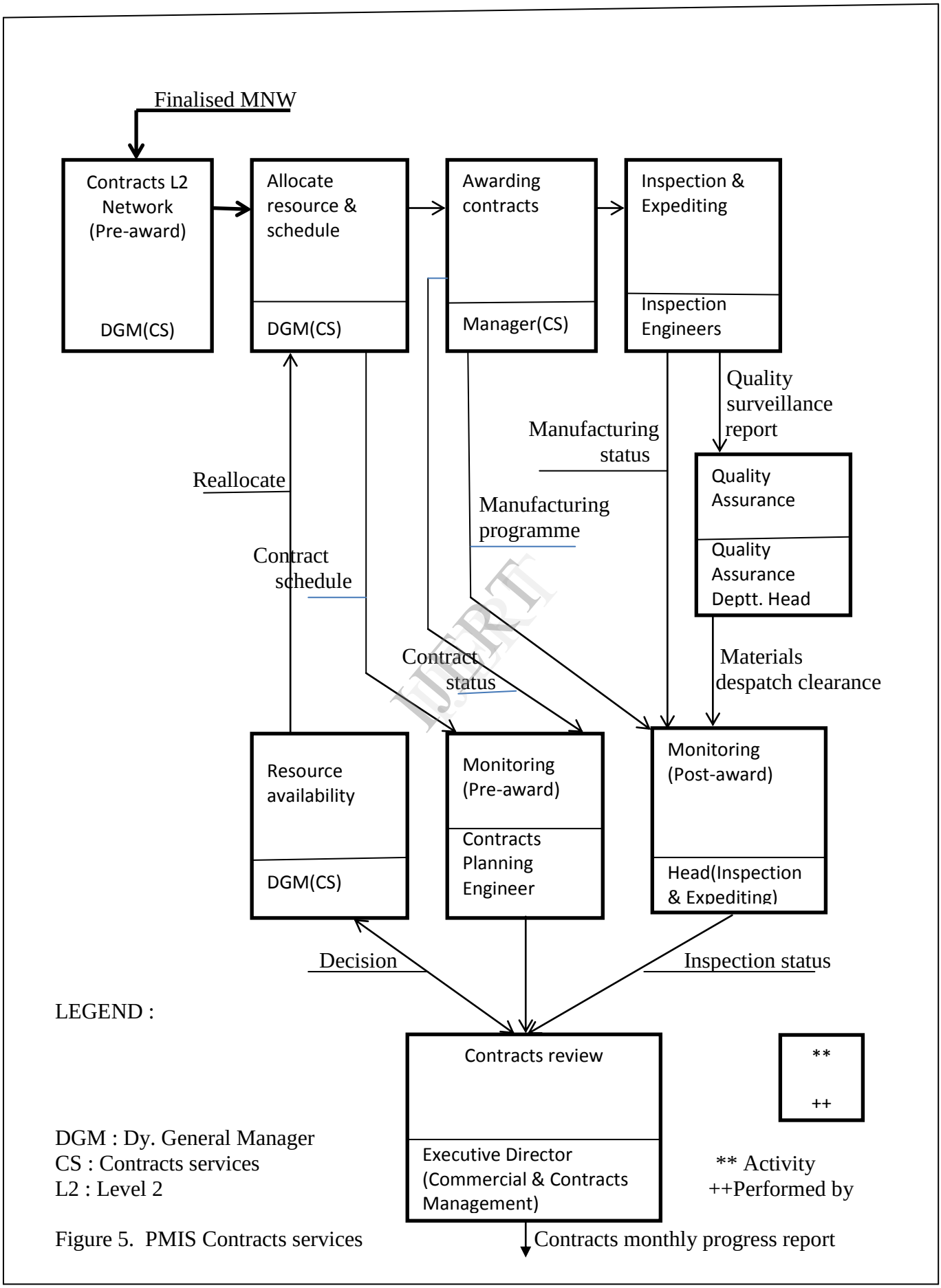

Figure 5. PMIS Contracts services

quality levels is taken by the department. The quality plans after discussion and finalisation form part of the contract document.

There is a close interaction among engineering, contract services, inspection, expediting and quality assurance groups and the project site in arriving at the quality plan and manufacturing and delivering programme.

To ensure that only technically competent parties are awarded the contract, including those for major civil works, a system of pre-qualification of contractors based on their technical competence, financial capabilities, past performance has been adopted by NTPC. The selection of qualified contractors assures the timely execution of projects as per construction schedules and attaining desired quality.

10.8 Construction management

Site activities start once the contract packages are awarded. As per previous record, around 57 major packages are identified for setting up of 3 x 200 MW units Power plants. As earlier mentioned, based on the Master Network Schedule (Level-1 network) during the award, level-2 network is finalised, keeping in view the interface events needed to be accomplished. Execution group at site starts interacting with the contractors/vendors soon after the receipt of the letter of award to establish the site office. Based on the level-2 network, site planning and site engineering groups interact with corporate engineering group to get the required drawings in the sequence in which they are required for continuous work for the next six months.

Major problems to be sorted out for smooth execution of work at site are identified and mentioned below.

- Sufficient drawings are made available in time
- Sufficient resources are mobilised by the contractor
- Sufficient work fronts are made available to contractors for uninterrupted progress of work at site
- Sufficient materials are brought by the suppliers in sequence

The IPMS at site is presented in figure 6 .

10.81 Monthly execution programme

As per the system developed, Planning Engineer at site, in consultation with Engineer-in-Charge and contractor, convene a monthly review meeting . Planning month starts on 26th of every month and ends on 25th of next month. Level-1 and level-2 network finalised at corporate centre by contract group indicates the monthly progress to be achieved for each activity. During the monthly meeting, around third week of each month, a three monthly execution programme is prepared. First month programme is normally firm according to the availability of drawing, material, manpower resources and site front clearance.

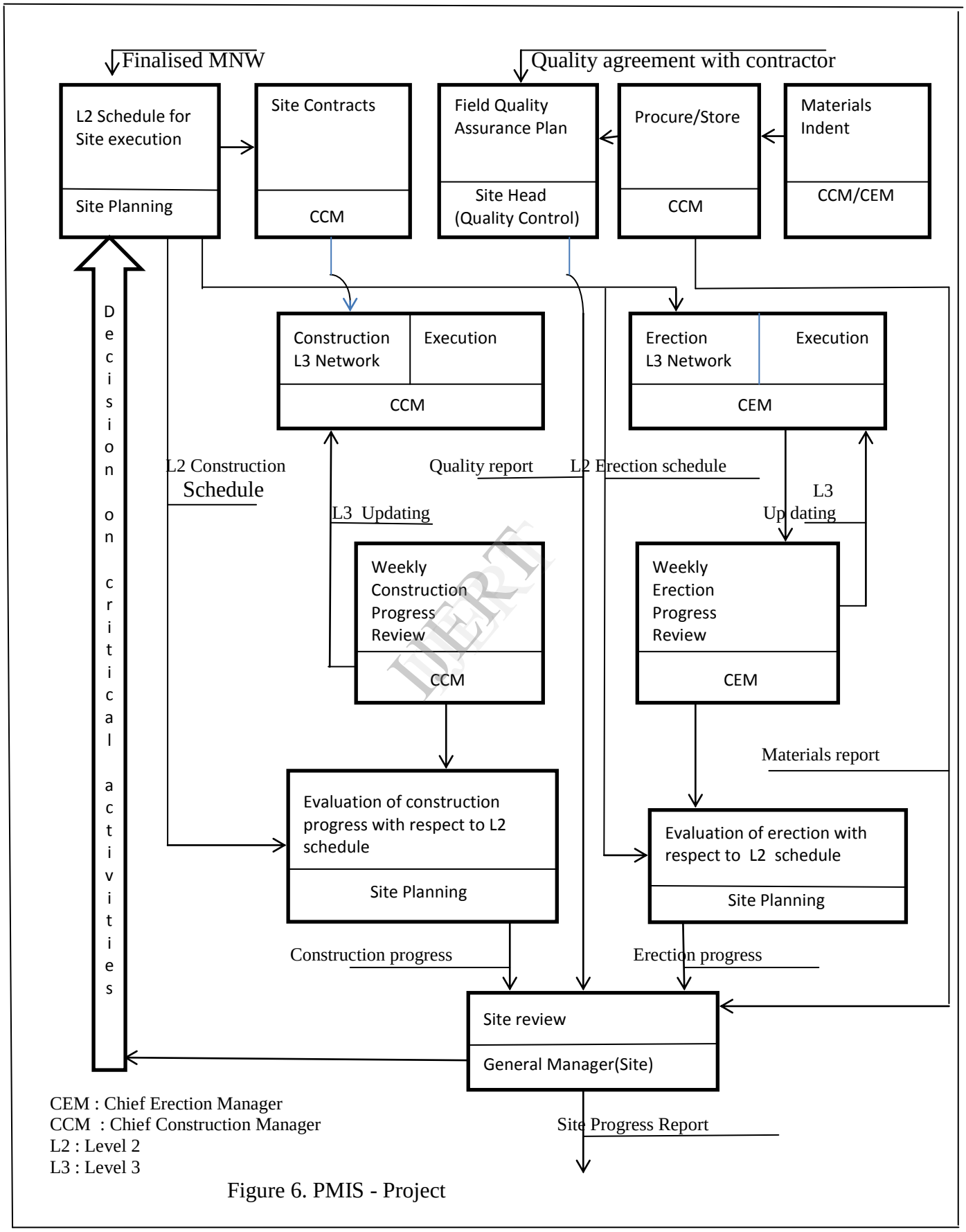

Figure 6. PMIS - Project

The programme for subsequent two months becomes tentative for initiating action for ensuring availability of required materials, equipments, and erection fronts to meet the schedule. One of the major reasons for delay of a project as experienced by NTPC is non-completion of civil work in time. NTPC keeps very frequent check on following to avoid such situation :

a. Required materials and manpower are made available in time by the civil contractor, and
b. The required drawings and site fronts are made available by project site authority so that the set targets are met without any difficulty.

Thus, the starting point for construction management at site is to prepare level-3 network for each major package.

10.9 Project monitoring

Monitoring is the process of routinely collecting, storing, analysing and reporting project information used to make decisions for project management. Monitoring provides project management and project stakeholders the information needed to evaluate the progress of the project, identify trends, patterns or deviations, keep project schedule and measure progress towards the expected goals. Monitoring information allows decisions regarding the use of project resources (human, material and financial) to enhance its effectiveness. When the right information is available at the right time and to the right people it can support decisions, like changes in the implementation strategies, that can help the project reduce costs and increase its outputs. Project monitoring is the continuous assessment of project implementation in relation to the agreed plans and the agreed provision of services to project beneficiaries. As such project monitoring provides valuable information to managers and other project stakeholders on the progress of the project and identifies potential successes or problems to facilitate timely adjustments to project operations.

Usually, the project managers do not have immediate access to accurate information on many aspects of the project. It is not always easy to find out "what is going on?" Records are frequently incomplete, in error or "somewhere else" when needed. It is important to ensure that all parties interested in the project have available, on a timely basis, the right type of information needed to exercise effective and efficient control over the project [15].

Hence the need to create an information system that gives project manager and executives/ decision makers wherever they be, the right information they need so as to make well informed, timely decision that will keep project performance as close as possible to project plan. First step in setting up any monitoring system is to identify the key factors to be controlled. Obviously the project manager wants to monitor performance, time and cost. Hence it is important to have or refer to a project action plan that describes what is being done, when and the planned level or resource usage for each task/work package/work unit in the project.

10.91 Project monitoring system at site

The monitoring and control at project site of NTPC is carried out in six ways as out lined below :

1.Site inspection - Fortnightly : Every Ist and 3rd Monday of each month

2.Weekly progress review : One fixed day of every week

3.Fortnightly progress review meeting : Every 2nd& 4th Friday of each month

4.Project review team monthly meeting : 3rd& 4th week of each month

An overview of project monitoring system is given in figure 7.

10.92Site inspection

The main purpose of this site inspection is to interact between various agencies at the work site to visualise the problem faced by each one due to number of activities going on simultaneously. By identifying the priorities, the General Manager at site takes a decision so that the target fixed a week back is not hampered. During this site inspection, the progress for the first week after the monthly execution programme is reviewed and shortfall, if any, are assessed and a decision is taken accordingly. Mostly, problems related to the facilities of workforce are discussed to improve upon wherever the problems are expected to arise. Thus, the management takes advance steps so that unwanted stoppages of work at site is eliminated and a peaceful atmosphere is created which in turn helps achieving targets. One of the major reasons attributed for non-compliances of schedules, is the labour unrest and union strike.

Very important point to be noted is that in all these meetings as stated above, are attended by representatives from personnel, finance and materials departments, other than various engineering disciplines. This enables the management to take spot decision instead of referring to various departments. Once the problems related to payment of bills, labour act, steel, cement, and other general material requirements are raised by the execution group.

10.93 Project review team meeting

During the third week/fourth week of every month, this meeting is conducted. This is chaired by the project head and participated by different departments of corporate centre and site. Depending upon the requirement, this meeting is conducted twice consecutively at site and the third meeting is held at corporate centre. Major problems such as non-availability of desired drawings, clarification on documents from various disciplines of corporate engineering group, non-receipt of required materials from various vendors, reasons for the same, remedial measures initiated, how much delays will affect the project progress and delay in awards are discussed.

Inter-departmental problems among engineering and contractor group, contract group and lnspection group, inspection group and engineering group, engineering group and site, contracts group and site are also reviewed and a suitable decision is taken to expedite the release of drawings, materials and such other requirements.

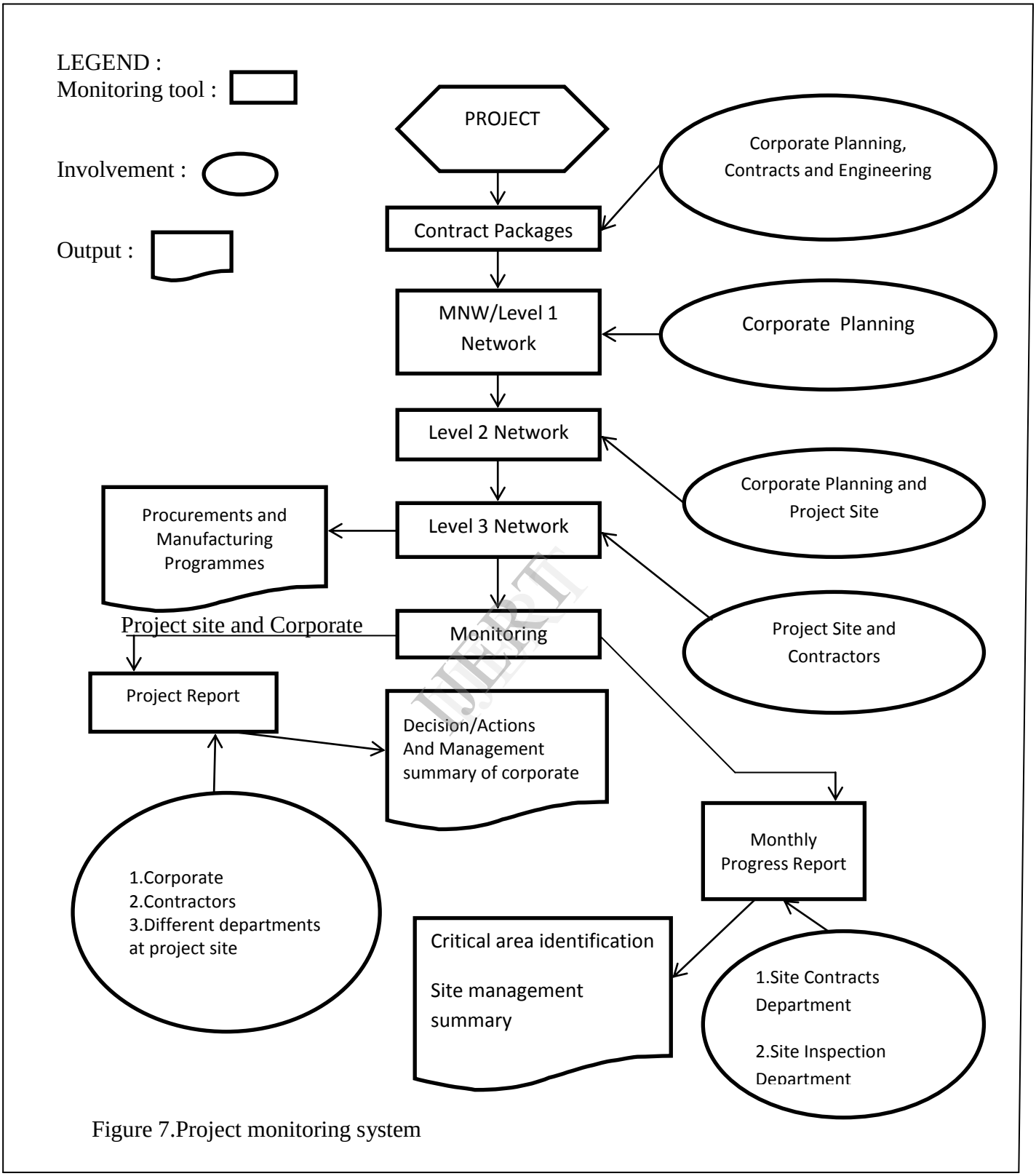

Figure 7.Project monitoring system

Pre-award status is also discussed covering the remedial measures needed and identifying the types of problems to be faced due to the delay, if any, so that a proper tie up with the vendor before award of contract can be taken up.

Budget review is also made during this meeting and shortfall, if any, is identified and responsibility centre is fixed to get the commitment.

10.94 Monthly progress report

As per the system, a monthly progress report is generated from site indicating the quantitative progress and physical progress achieved, shortfalls, reason for shortfalls, measures taken to overcome the shortfall, further help needed, if any, from top level, various achievements and targets and plans for the next month.

Very important point to be noted is the column "items requiring prompt attention" through which site expresses its difficulties for the management at corporate centre in achieving the proposed plan for the next and the help needed in overcoming the problem.

In this manner, monitoring and controlling of the project from the site is being done to identify and ascertain problems, which requires a timely solution from various control centres. The gravity of problems, their impact on project completion are identified well in advance so that management is able to tackle since sufficient time is available. Problems are escalated through various forums to take timely corrective action.

SEACTION – E

11. Evaluation of quality of PMIS and its impact on project success

For evaluation of quality of PMIS of NTPC, a survey was conducted at different project sites of NTPC. The feedback from 42 survey participants from both corporate and project site at different level and different functional area were collected and analysed in the following way.

The quality of the PMIS was measured with eight items: accessibility, response time, flexibility, ease of use, querying ease, learning ease, systems integration and multi-project capability. Each of the items was measured on a five-point scale (Very high quality : 5, High quality : 4, Moderately high quality : 3, Less than moderate quality : 2, and Low quality : 1). The result of the questionnaire survey is furnished in Table 2.Under ideal condition, maximum point to be earned against each characteristic is 220 [5(maximum point as per likert scale chosen) x 44(Number of survey participants)]. For total 8 characteristics, maximum points to be earned is 1760 (220 x 8). Total points gained as per questionnaire survey result is 1408.Therefore, the quality of PMIS is 80% effective as per the users' feedback.

The quality of information was measured with six items: availability, relevance, reliability, precision, comprehensiveness, and security. Each of these items was measured on a five-point scale (Very high quality : 5, High quality : 4, Moderately high quality :3, Less than moderate quality :2, and Low quality :1). The result of this evaluation has been presented in Table 3.Under ideal condition, maximum point to be earned against each characteristic is 220 [5(maximum point as per likert scale chosen) x 44(Number of survey participants)]. For total 6 characteristics, maximum points to be earned is 1320 (220 x 6). Total points gained as per questionnaire survey result is 1182. Therefore, the quality of information is 89.54% effective as per the users' feedback.

The impacts of the PMIS on project success was based on the perceived

contribution of the PMIS with regard to three performance criteria : respecting deadlines, respecting budgets, and respecting quality specifications [13], using a five-point scale varying from 1 (null contribution : 1, moderate contribution : 2, average contribution : 3, high contribution : 4, very high contribution : 5). The result of evaluation has been presented in Table 4.Under ideal condition, maximum point to be earned against each characteristic is 220 [5(maximum point as per likert scale chosen) x 44(Number of survey participants)]. For total 3 criterias, maximum points to be earned is 660 (220 x 3). Total points gained as per questionnaire survey result is 618. Therefore, the contribution of PMIS on project success is 93.83% effective as per the users' feedback.

Table 2. Evaluation of quality of PMIS

Criteria for measuring quality of PMIS	Very high quality (5)	High quality (4)	Moderately high quality(3)	Less than moderate quality(2)	Low quality(1)	Total Points = (No. of Respondents) x (point as per scale)
Accessibility	10	34	-	-	-	151
Response time	17	27	-	-	-	193
Flexibility	-	34	10	-	-	166
Ease of use	29	15	-	-	-	205
Querying ease	-	32	9	3	-	161
Learning ease	26	16	-	-	-	194
System integration	-	26	12	6	-	152
Multi-project capacity	12	30	2	-	-	186
					Total points :	1408

Note : Figure under each column (column No.2-6) indicates number of respondents opted against criteria mentioned in each raw.

Table 3. Evaluation of quality of information

Criteria for measuring quality of information	Very high quality (5)	High quality (4)	Moderately high quality(3)	Less than moderate quality(2)	Low quality(1)	Total Points = (No. of Respondents) x (point as per scale)
Availability	20	24	-	-	-	196
Relevance	30	14	-	-	-	206
Reliability	28	16	-	-	-	204
Precision	24	18	2	-	-	198
Comprehensiveness	12	26	6	-	-	182
Security	20	24	-	-	-	196
					Total :	1182

Note : Figure under each column (column No.2-6) indicates number of respondents opted against criteria mentioned in each raw.

Table 4.Evaluation of contribution of PMIS on project success

Criteria for measuring contribution of PMIS on project success	Very high contri-bution (5)	High contri-bution (4)	Moderately high contri-bution (3)	Less than moderate contri-bution (2)	Null contri-bution (1)	Total Points = (No. of Respondents) x (point as per scale)
Contributed to meet project deadlines	30	14	-	-	-	206
Contributed to meet the budget	28	16	-	-	-	204
Contributed to meet quality specification	32	12	-	-	-	208
					Total :	618

Note : Figure under each column (column No.2-6) indicates number of respondents opted against criteria mentioned in each raw.

12. Conclusion

This research paper identified and considered the project management models and project management information systems developed by researchers. To verify how these theoretical concept fit into the real life situation, the study was conducted in NTPC to find out how the organisation manages their projects, to what extent the project management system used by NTPC conforms to the project management model developed by researcher and what type of project management information system is used

by NTPC for monitoring and implementing their projects.

Based on researchers' recommendation, the criteria for assessing the quality of the PMIS followed by NTPC was done and the study reveals that the employees of NTPC strongly feel that their PMIS is very effective and successful for implementation of projects.

On a methodological level, the present study has demonstrated use of statistical survey for collection and processing of data both from corporate office and different project sites for obtaining mass feed back from all functional areas.

The outcome of this research paper is determination of unique project management information system which can be useful benchmark for any organisation for project implementation purpose.

References :

[1] Ahlemann F. (2008). Project management software systems requirements, selection, processes and products, 5th Edition, Wurzburg : BARC.

[2] Ahlemann F. (2009). Towards a conceptual reference model for project management information systems.International Journal of Project Management, 27, pp19-30.

[3] Akram Jalal Karim (2011). Project management information systems(PMIS) factors : An empirical study of their impact on project management decision making (PMDM) performance. Research Journal of Economics, Business and ICT, Vol.2, 2011, pp 22 – 27.

[4] Brief on construction, its management and monitoring system at Farakka Super Thermal Power Project, November, 1986, published by NTPC.

[5] Cleland, D.I., & Ireland, L.R.(2004). Project Management Strategic Design and Implementation, 4th Edition, McGrow-Hill, New York, NY.

[6] Davenport, T.H. and Harris, J.G.(2007). Competing on analytics : The new science of wining. Harvard Business School Press, Boston, MA.

[7] Fox, J. and Murray, C. (2003). Conducting research using web-based questionnaires : Practical, methodological, and ethical considerations. International Journal of Social Research Methodology, 6(2), pp 167-180.

[8] Frederik Ahlemann (2009). Towards a conceptual reference model for project management information system. International Journal of Project Management, 27, pp19 – 30.

[9] Ling YY, Lau BSY (2002). A case study on the management of the development of a large-scale power plant project in East Asia based on design-build arrangement. International Journal of Project Management, 20, pp 413-423.

[10] Meredith, J.R., & Mantel, S.J.(2006). Project management : A managerial approach, 6th Edition, New York : Wiley.

[11] Murdick R.G. and Ross J.E. (1982).Information systems for modern management, Prentice Hall of India Pvt. Ltd., New Delhi.

[12] PMI (2000). A guide to the project management body of knowledge, 4th Edition, Newton Square, PA : Project Management Institute.

[13]Raymond L. (1987). Information systems design for project management : A data modelling approach. Project Management Journal, 18(4), pp 94-99.

[14] Raymond L, Bergeron F (2008).Project management information systems : An empirical study of their impact on project managers and project success. International Journal of Project Management, 26, pp 213–220

[15] Shenhar AJ, Levy O, Dvir D (1997). Mapping the dimensions of project success. Project Management Journal, 28(2) pp 5–13.

[16] www.careclimatechange.org.accessed on 12.05.2013.

[17] www.en.wikipedia.org/wiki/NTPC_Limited accessed on 24.04.2013

[18] www.ntpc.co.in accessed on 24.04.2013