

Suitability Analysis of Project Management Techniques to Multi-disciplinary Student Project Plans

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Abstract: The present study was conducted to analyze the engineering students' ability to apply project management techniques in the projects planned using the concepts given by Project Management Institute (PMBOK). Selected student projects related to civil and multi-disciplinary nature are verified from project charter preparation. The techniques used are related to scheduling, Milestones, work breakdown structure, cost estimation methods and different management plans. Feedback is taken from the student batches regarding the applicability of techniques, time taken for project plans, charter document, difficulty levels and other aspects of suitability of techniques. Out of 100 projects analysed, 66% of student groups felt easy to apply PMI project management techniques. Bottom up technique is applied by 76% teams for cost estimation and second best technique is top down with 16% applicability. 69% teams used PERT technique for scheduling with second best as CPM for 19% projects

Keywords: Project Management, Network Analysis, Suitability of technique, Project planning techniques.

1. Introduction

Project management techniques are widely used by all branches of engineering. Construction projects need proper planning and execution for timely completion of project within the budget. This is due to number of physical activities, high cost associated and laborious work associated along with large material procurement, storage, conversion process. Several management processes are involved to control the operations.

Total project life cycle is divided broadly into three categories. The categories are Pre-Project stage, Implementation stage and post-project stage. Conceptualization, brainstorming sessions, documentation for planning, budget preparation, approval by the sponsor and designs and prototypes if applicable are some of critical elements in pre-project stage. During implementation stage, the design drawings, procurement, erection, fabrication, supervision of work packages, follow up of quality and deliverables, controlling workforce, performance issues etc., Post-project stage includes closing activities, testing and commissioning, handover of project to the client/customer, maintenance if necessary.

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The stakeholders list, justification for the project, roles and responsibilities of different team members are decided and allocated.

Several tools and techniques are recommended by PMI in the Project Management Body of Knowledge (PMBOK). Project charter is the main document at planning stage which includes Deliverable and milestones, work breakdown structure, Network analysis for scheduling, HR plan, Risk management plan, Communications management plan, Quality management plan and procurement plan. Scheduling of several activities are done using network diagrams either critical path method (CPM) or Program Evaluation Review Technique (PERT). Several techniques are used in the cost estimation calculations, like Top-down, Bottom Up, Expert advice, Parametric modeling etc.. These techniques are used based on the data available regarding individual components of costing for materials, man power, conversion process, transportation and other elements of cost. Where ever possible the costing teams get estimate quotations to calculate the total costs, which are termed as bottom-up method. The data is taken from work breakdown structure (WBS) and each element is estimating its cost. The work components are carefully disintegrated to segregate type of work package and sub-packages to create a WBS. The WBS is made based on certain rules given in PMBOK.

Scheduling is done using Gantt chart, CPM or PERT based on complexity of project, data available, linkages, predecessors etc., PERT is a probabilistic method where three time estimates are taken for calculation of total time of project and critical path. In case of CPM, the onetime estimate is used and which is termed as a deterministic method. Some of the series and parallel activities are identified and connected in the network diagram which is also called as arrow diagram. Critical path is calculated based on the longest path from first node to the last node of project. All combinations of paths are calculated and path which takes longest travel is decided as critical path. Project managers keep more focus, follow-up mechanism and resources on the activities which fall in critical path.

Quality management plan provided the need and requirements of quality in all aspects of project. Both quality control and quality assurance protocols are prepared in advance and suitable allocation is made for quality checks during implementation stage.

Quality charts, sheets are formed and implemented for compliance. Specifications compliance, meeting the standards specified in the design drawings/customer requirements. Where ever possible international standards like ISI, ISO, DIN or EN etc., are referred to for fixing the quality tests. The tests can be conducted at the suppliers premises before dispatch of materials/machines to be procured or upon receipt at the project site and/or before use. Tests are also conducted during erection/post-construction. The sampling plans with statistical quality control procedures are enforced for meeting the standards without spending unnecessary efforts and cost on inspection. Different quality control charts like Mean chart, Range chart, check sheets etc., are used to continuously record the quality data for monitoring and overall quality of project. The data is also used for future reference and corrective actions

Different organization structures are considered before choosing best structure for project work. Projectized structure, matrix structure, line structure, line and staff structure are some of the structures used. The authority and responsibility levels are considered for the formation of structure.

Several risk management strategies are used for dealing with unforeseen risks in projects. Both positive and negative risk strategies are well prepared in advance. Accepting, transferring and avoiding or mitigating is some of the negative risk strategies. Accepting, enhancing and transferring are some of positive risk management strategies to take the benefit of changes positively. Monitoring and controlling mechanisms must be in place for ensuring timely completion of work with quality. Suitable monitoring systems are designed to check the deliverables, milestones, performance of workmen, compliance of work with specifications, cost of execution with respect to budget approval. Corrective actions are taken for any deviations. Cost, time and scope are controlled during this monitoring and controlling stage. PMI refers these three as project triad.

Project preparation time and complexity of preparation are some of the concerns for preparation team. Depending on data available, expertise of the team dealing with the new project, kind and complexity involved in the preparation etc., are the constraints for charter preparation. Projects during implementation stage perform efficiently with proper planning in charter preparation stage. The project charter must give clarity on all critical components

through planning documentation [1].

In the past without knowing of project management techniques and tools number of prestigious projects done in the history with at most care and planning. Where the people come together and work coordinately to achieve some desired results is treated as project management. This scenario could be followed by people to construct big projects without any hurdle. Examples of such projects in the history like the pyramid of Giza, Great Wall of China and coliseum. There are numerous projects in the past fulfilled with project management knowledge but documentation of such techniques till 1950 was not done constructively. At present the trend focuses on the importance of project management. It is widely accepted by all type of projects. The specialized skills in project management are the need of the hour and in future the people with skills of project management mostly will be sought [2]. PERT and CPM techniques widely are using in construction, Information technology, defense related projects. These techniques are together helpful for projects and yields grate advantage for decision makers. By comparing two methods with their time and cost with the help of earned value techniques, there has been a lot of difference between these two PERT and CPM techniques. CPM and PERT both methods can be utilized with fuzzy logic for better completion of the projects accordance to schedule with in the minimum cost [3]. For large construction projects contemporary and traditional management tools both are essential to forecast cost and time of the project accurately. To check and connect project activities it is essential to observe finish to start, start to start and finish to finish activities. Contemporary technique Microsoft project alone not feasible to check all the activities and plan accordance to project schedule. Traditional method linear programming time /cost trade off method is helpful when the project is modeled in precedence chart. So both contemporary and traditional linear modelings are to be blended for better anticipation of time and cost of the project. In construction projects the best solution for time/cost trade off difficulties extended some of the activities duration to shorten the entire project [4].

Project evaluation and review technique (PERT) allocates distributions to corresponding activity times of the project. Critical path method (CPM) specifies activity times are constant but in real scenario that would not be. Process model simulation advanced than PERT and CPM techniques. It can project

activity times of the projects with diversity of distributions [5]. Over the last two decades importance of the project management increased. This is because all sort of emerging business applications. The business process as a project management now is in the position to maintain all sort business applications as projects. The projects like IT, product development, change development and software developments. The management of modern projects is indeed different from maintenance of traditional projects. PERT and CPM techniques made the project maintenance is easy. But new knowledge in this area still in cross roads. A considerable research has to be done in project management that can bring out a lot of new techniques and tools. This orientation would be helpful for all sorts of projects from small to bigger ones [6]. In distinction to PERT/CPM, Critical chain focuses on certain technical aspects of the project management. Critical chain dealt with price (subcontracting activities) but on lead time or reliability of the project management. It focuses on how senior management can observe behaviors of people while building project network and managing afterwards. It concerns to identify critical areas in project and make them as buffers over try to avoid mile stones of the projects [7].

Artificial intelligence is helpful to find out the opportunities for HRM offered by investigation have been acknowledged by bosses and associations; however there stays a colossal space for development in the territory and the investigation of the pertinence of examination inside the different classifications that fall under HRM. Effect of feasibility study, human resource management and impact of planning and managing project activities on project success are well documented. Planning the activities, identifying tasks and preparation of schedule impacted the success of projects. Successful projects found to have sufficient user involvement, good planning and estimations, right leadership along with technical skills of the team members [8-9].

Objectives:

The present investigation focuses on:

1. To identify different PMI techniques used in project planning documents.
2. To analyze the applicability and ease of use of these PMI techniques in project charter preparation.

2. Methodology:

100 students from project preparation teams were selected to conduct the research work. Each team was given the task to identify projects of multi-disciplinary nature. Project charter documents were developed by the five member team.

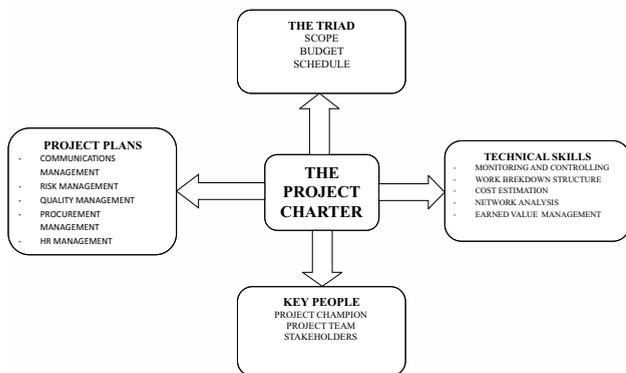


Fig 1 : Flow chart showing project charter elements

3. Analysis:

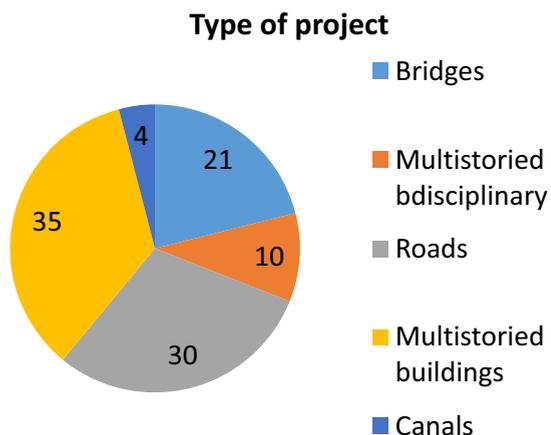


Fig 2. Type of projects

The students opted different projects to plan with the support of planning techniques what have been learnt in their project management course. The types of projects for planning were selected by students Viz. Bridges, Canals, Multistoried Buildings and disciplinary and roads.

Thirty five percentages of students selected Buildings and thirty percentages of students chosen roads projects to plan with different techniques. Canals, bridges and disciplinary projects picked by four, twenty one and ten proportion of students respectively.

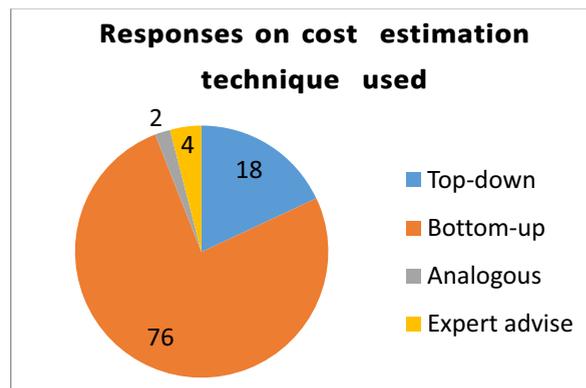


Fig 3: Details of cost estimation technique used

The students applied cost estimation techniques for those selected projects are top-down, bottom-up, analogous and expert advice. The responses of learners clearly specified that seventy six portion of the students utilized bottom approach technique for their cost estimation. Eighteen percentage of students got help from top down technique. Analogous and expert advice techniques have been taken in to account to cost estimation for those projects by two and four portion of the students respectively.

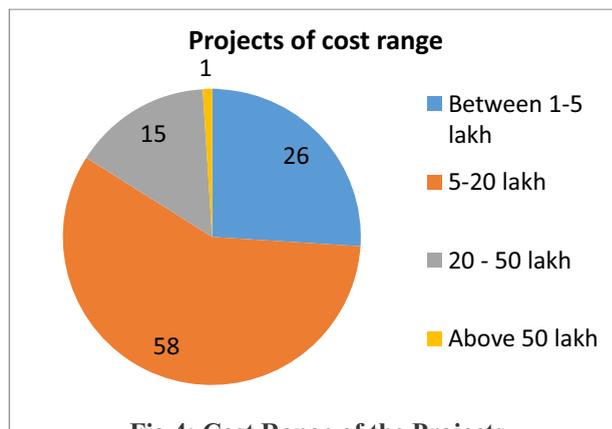


Fig 4: Cost Range of the Projects

Students planned those selected projects in the range between one to fifty lacks. Fifty eight percentage of students estimated their projects cost

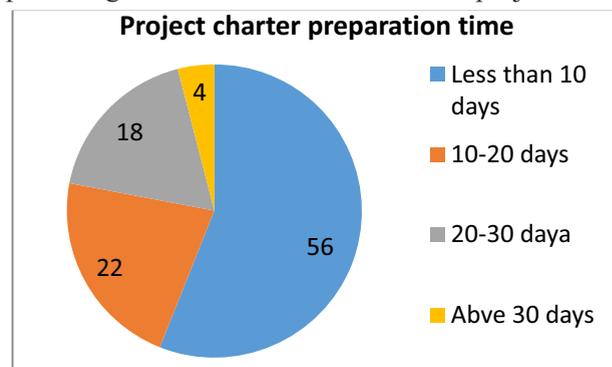


Fig 5: Time taken project charter preparation

within the range of five to twenty lacks. One to five , twenty to fifty and above fifty cost ranges fixed by twenty six, fifteen and one portion of the students respectively.

Based on responses of the respondents it is indeed understood that maximum number of students took less than ten days to project charter preparation. Twenty two portions of students have taken ten to twenty days to charter making plan. Twenty to thirty and above thirty days were taken by eighteen and four percentage of students for their project charter preparation.

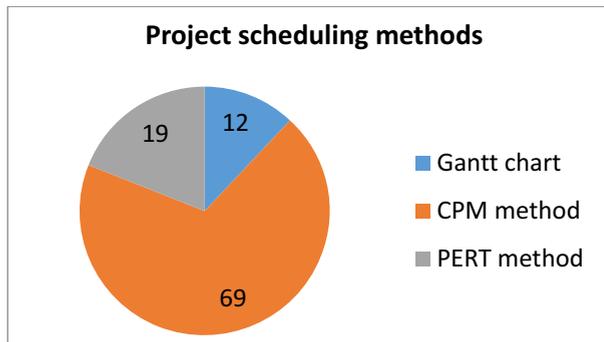


Fig 6: Details Of Scheduling Methods Used In Different Project Teams

From the above chart it is cleared that students opted Gantt, CPM and PERT methods for project scheduling. At maximum extent sixty nine percentage of students used CPM method for scheduling to those chosen projects. Nineteen and twelve percentages of the respondent students have taken PERT and Gantt methods respectively for their project scheduling.

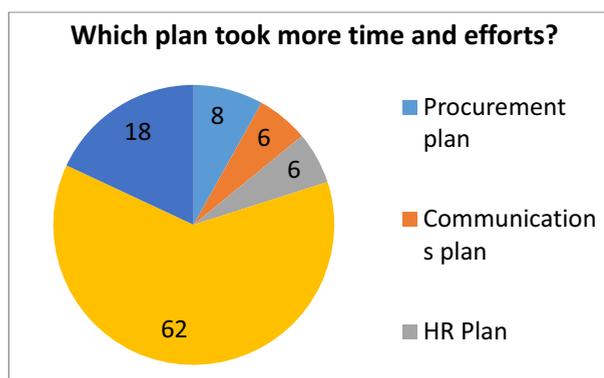


Fig 7: Relative Time Taken to Prepare Different Project Management Plans

Majority of students spent more time to plan risk management, it is evidently understood by students responses. Sixty percentage of students felt that they spent vast time on risk managemet exercise. Only few

percentage of students opined that they spent a lot of time to prepare procurment, communication and HR planfor their preferred projects.Cosiderable amount of students with eighteen percentages supposed that they were manged to spend some how more time on quality management than other plans.

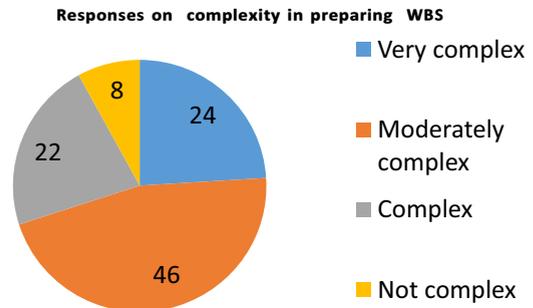


Fig 8: Complexity of Work breakdown structure

Mixed response have been solicited from students on work break down structure. The response from students on this WBS has been not clear. Only eight portion of the students felt not complex while preparig the structure of work break down.

Forty six percentage of students agreed that they were facing moderately complex when they were in break down tasks systematically. Twenty and twenty four percentages of students felt complex and very complex respectively whilst charting work break down structure.

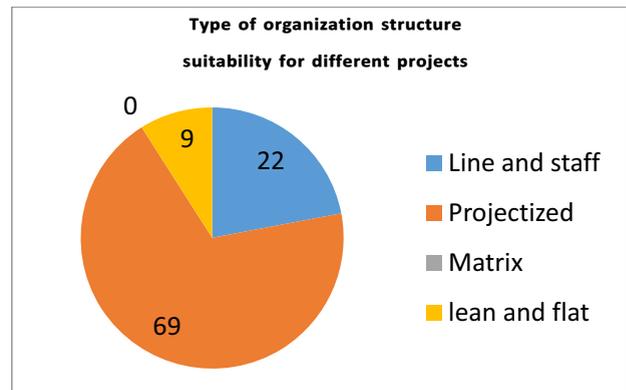


Fig 9: Type of organization structures developed based on suitability of projects

Based on projects respondents have identified suitability of the organization structures. Sixty nine portion of the students decided projectised structure for their projects. Line and staff and lean and flat organizational structures selected by twenty two and nine percentage of the students respectively for those chosen projects.

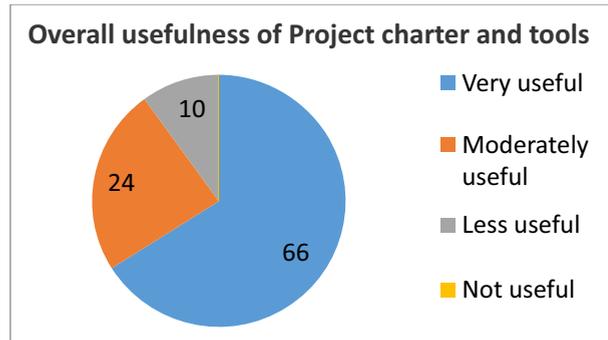


Fig 10: Overall usefulness of project management tools

The students expressed overall usefulness of project management course. In that course what they have learnt charter and tools indeed are helpful and very useful while they are in planning for those selected projects this is expressed by sixty six percentage of the students. Twenty portion of the students opined that those tools have been helpful moderately. Only ten percentages of the students highlighted that the tools in project management have been less useful.

Embracing Project Management Institute (PMI) techniques is particularly beneficial for overseeing diverse and intricate civil projects such as the construction of buildings, canals, and dams. In the case of canal projects, PMI's systematic approach, including detailed planning, risk management, and continuous monitoring, proves indispensable. For instance, when navigating the complexities of dam construction, adherence to PMI methodologies ensures meticulous project planning, efficient resource allocation, and the ability to address unforeseen challenges promptly. Similarly, in building projects, where diverse stakeholders and intricate engineering requirements abound, PMI techniques provide a structured framework for initiation, planning, execution, monitoring, and closure. This approach enhances overall project success by facilitating optimal resource utilization and proactive issue resolution. The incorporation of PMI techniques in these varied projects underscores their versatility and applicability, showcasing their effectiveness in managing the complexities associated with civil engineering endeavors.

The integration of Project Management Institute (PMI) techniques proves especially advantageous in navigating the intricacies of diverse civil projects such as the construction of buildings, canals, irrigation systems, and dams. In canal projects, PMI's systematic approach, encompassing meticulous

planning, risk management, and continuous monitoring, is pivotal for ensuring the successful implementation of waterway systems. Similarly, for irrigation projects where water distribution efficiency is paramount, PMI methodologies facilitate strategic planning and resource allocation to optimize agricultural productivity. When it comes to the construction of dams, PMI techniques ensure a comprehensive framework for managing complex engineering processes, adhering to timelines, and addressing unforeseen challenges promptly. Building projects, with their varied stakeholders and intricate engineering requirements, benefit from PMI's structured approach, guiding initiation, planning, execution, monitoring, and closure. The versatility and applicability of PMI techniques are evident in these examples, emphasizing their efficacy in addressing the unique challenges posed by a spectrum of civil engineering endeavors.

4. Conclusion:

Uses of project management tools are specified by Project Management Institute through project charter document are tested for applicability in the current investigation. Student project plans are evaluated after implementing the PMI charter tools. A structured survey is conducted to analyze the critical issues during charter document preparation for various projects. With respect to application of PMI project management techniques, 66 percent of project groups felt "very useful, 24% opined that "moderately useful" and 10% felt "less useful". 76% teams used bottom-up method for cost estimation and second best technique is top down with 16% applicability. PERT technique has been applied by 69 percent of teams for scheduling and CPM has been found to be applied for 19% projects. The opinion on different phases of students selected projects were mainly divided in between pre-project planning, implementation stages and post project phase. Fifty six percentage of students responded that they have been faced complicatedness by plan pre-project. Fourty fraction of students agreed that they faced difficulty in implementaton phase. Only four portion of the students highlighted that they could face complexity in post project phase.

In conclusion, the adoption of Program Evaluation and Review Technique (PERT) by students for their civil projects reflects a commitment to effective project management methodologies. PERT, known for its emphasis on critical path analysis and time

management, aligns with the principles advocated by the Project Management Institute (PMI). By incorporating PERT into their projects, students not only demonstrate a practical understanding of project scheduling but also adhere to industry-standard practices promoted by PMI. This integration enhances the overall project management skills of students, preparing them for the demands of the professional realm where adherence to established methodologies is crucial for success. In embracing PERT within the context of PMI's guidelines, students lay a solid foundation for their future endeavors in civil engineering projects and contribute to the cultivation of a disciplined and efficient project management culture

References:

- [1] Roger Warburton & Vijay Kanabar (2016). *The art & science of Project management* (RW Presss), New port, RI.
- [2] Seymour, T., & Hussein, S. (2014). The history of project management. *International Journal of Management & Information Systems (IJMIS)*, 18(4), 233-240.
- [3] Mazlum, M., & Güneri, A. F. (2015). CPM, PERT and project management with fuzzy logic technique and implementation on a business. *Procedia-Social and Behavioral Sciences*, 210, 348-357.
- [4] Hebert, J. E., & Deckro, R. F. (2011). Combining contemporary and traditional project management tools to resolve a project scheduling problem. *Computers & Operations Research*, 38(1), 21-32.
- [5] Simmons, L. F. (2002, December). Project management-critical path method (CPM) and PERT simulated with ProcessModel. In *Proceedings of the Winter Simulation Conference* (Vol. 2, pp. 1786-1788). IEEE.
- [6] Hall, N. G. (2012). Project management: Recent developments and research opportunities. *Journal of Systems Science and Systems Engineering*, 21(2), 129-143.
- [7] Rand, G. K. (2000). Critical chain: the theory of constraints applied to project management. *International Journal of Project Management*, 18(3), 173-177.
- [8] Ramesh E, Ramesh Babu D. Effect of project management techniques on the success of project management, *IJMET*, 2018, Volume 9(13), 237-247.
- [9] Dr. Gurunadham.Goli, chapala. Nageswara Rao. (2020). Application of Artificial Intelligence on HRM for Green Business. *International Journal of Advanced Science and Technology*, 29(06), 2898 -2905.