

The Advantages of Using Project Management tools in Industries

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ABSTRACT

Project management includes the process of planning, arranging, managing resources and procedures to achieve the organizational goals. Goals are set and achieved in the project management and it's all about processing and controlling. Project management is about the organizing and controlling how the organizational goals are met. Just like the business managers who supervise a specific business area, project managers supervise the overall project assigned to them and control cost and production matters within industries.

I. INTRODUCTION

Project management has wide acceptance these days. Up to a little extent, project management is practiced by everyone. Even farmers plan their working and the process of execution. (Norman, Brotherton, & Fried, 2010)

Without proper planning and execution, results cannot be achieved as desired. If one possesses strong management skills, it creates positive results and achievement of goals. Project management is like an art in business. Project management is a full time job. In the industries like construction, manufacturing, architecture and other developed businesses, the key employees are project managers. (Gudda, 2011)

Project managers have several opportunities to explore in business for growth prospective. It is the responsibility of project managers to introduce new products, develop latest technologies and ensure the compatibility of strategies with the organizational achievement. Banks and insurance companies employ project managers for the implementation of new practices and standards. In short, the progress and development of organizations in several industries is being explained by the use of project management. Projects may include building new offices, launching new product that need to be handled and managed with care in accordance with the organizational objectives. Project managers make sure the cost lie within the estimated value and there is no wastage of resources in the production processes.

II. PROJECT MANAGEMENT TOOLS & TECHNIQUES

The project management process typically includes four key phases: initiating the project, planning the project, executing the project, and closing the project. An outline of each phase is provided below. (umsl.edu)

Initiating the Project

The project management techniques related to the project initiation phase include:

1. Establishing the project initiation team. This involves organizing team members to assist in carrying out the project initiation activities.
2. Establishing a relationship with the customer. The understanding of your customer's organization will foster a stronger relationship between the two of you.
3. Establishing the project initiation plan. Defines the activities required to organize the team while working to define the goals and scope of the project.
4. Establishing management rocedures. Concerned with developing team communication and reporting procedures, job assignments and roles, project change procedure, and how project funding and billing will be handled.
5. Establishing the project management environment and workbook. Focuses on the collection and organization of the tools that you will use while managing the project.

Planning the Project

The project management techniques related to the project planning phase include:

1. Describing project scope, alternatives, and feasibility. The understanding of the content and

complexity of the project. Some relevant questions that should be answered include:

- What problem/opportunity does the project address?
 - What results are to be achieved?
 - What needs to be done?
 - How will success be measured?
 - How will we know when we are finished?
2. Divide the project into tasks. This technique is also known as the work breakdown structure. This step is done to ensure an easy progression between tasks.
 3. Estimating resources and creating a resource plan. This helps to gather and arrange resources in the most effective manner.
 4. Developing a preliminary schedule. In this step, you are to assign time estimates to each activity in the work breakdown structure. From here, you will be able to create the target start and end dates for the project.
 5. Developing a communication plan. The idea here is to outline the communication procedures between management, team members, and the customer.
 6. Determining project standards and procedures. The specification of how various deliverables are produced and tested by the project team.
 7. Identifying and assessing risk. The goal here is to identify potential sources of risk and the consequences of those risks.
 8. Creating a preliminary budget. The budget should summarize the planned expenses and revenues related to the project.
 9. Developing a statement of work. This document will list the work to be done and the expected outcome of the project.
 10. Setting a baseline project plan. This should provide an estimate of the project's tasks and resource requirements.

Executing the Project

The project management techniques related to the project execution phase include:

1. Executing the baseline project plan. The job of the project manager is to initiate the execution of project activities, acquire and assign resources; orient and train new team members, keep the project on schedule, and assure the quality of project deliverables.
2. Monitoring project progress against the baseline project plan. Using Gantt and PERT charts, which will be discussed in detail further on in this paper, can assist the project manager in doing this.
3. Managing changes to the baseline project plan.
4. Maintaining the project workbook. Maintaining complete records of all project events is necessary.

The project workbook is the primary source of information for producing all project reports.

5. Communicating the project status. This means that the entire project plan should be shared with the entire project team and any revisions to the plan should be communicated to all interested parties so that everyone understands how the plan is evolving.

Closing Down the Project

The project management techniques related to the project closedown phase include:

1. Closing down the project. In this stage, it is important to notify all interested parties of the completion of the project. Also, all project documentation and records should be finalized so that the final review of the project can be conducted.
2. Conducting post project reviews. This is done to determine the strengths and weaknesses of project deliverables, the processes used to create them, and the project management process.
3. Closing the customer contract. The final activity is to ensure that all contractual terms of the project have been met.

The techniques listed above in the four key phases of project management enable a project team to:

- Link project goals and objectives to stakeholder needs.
- Focus on customer needs.
- Build high-performance project teams.
- Work across functional boundaries.
- Develop work breakdown structures.
- Estimate project costs and schedules.
- Meet time constraints.
- Calculate risks.
- Establish a dependable project control and monitoring system.

Tools

Project management is a challenging task with many complex responsibilities. Fortunately, there are many tools available to assist with accomplishing the tasks and executing the responsibilities. Some require a computer with supporting software, while others can be used manually. Project managers should choose a project management tool that best suits their management style. No one tool addresses all project management needs. Program Evaluation Review Technique (PERT) and Gantt Charts are two of the most commonly used project management tools and are described below. Both of these project management tools can be produced

manually or with commercially available project management software.

CPM - Critical Path Method

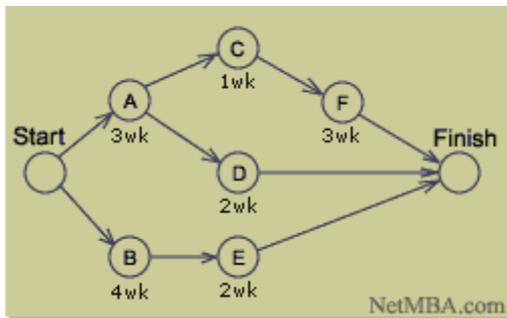
In 1957, DuPont developed a project management method designed to address the challenge of shutting down chemical plants for maintenance and then restarting the plants once the maintenance had been completed. Given the complexity of the process, they developed the Critical Path Method (CPM) for managing such projects.

CPM provides the following benefits:

Provides a graphical view of the project.
Predicts the time required to complete the project.
Shows which activities are critical to maintaining the schedule and which are not.

CPM models the activities and events of a project as a network. Activities are depicted as nodes on the network and events that signify the beginning or ending of activities are depicted as arcs or lines between the nodes. The following is an example of a CPM network diagram:

CPM Diagram



Steps in CPM Project Planning

Specify the individual activities.

Determine the sequence of those activities.

Draw a network diagram.

Estimate the completion time for each activity.

Identify the critical path (longest path through the network)

Update the CPM diagram as the project progresses.

1. Specify the Individual Activities: From the work breakdown structure, a listing can be made of all the activities in the project. This listing can be used as the basis for adding sequence and duration information in later steps.
2. Determine the Sequence of the Activities: Some activities are dependent on the completion of others. A listing of the immediate predecessors of each activity is useful for constructing the CPM network diagram.
3. Draw the Network Diagram: Once the activities and their sequencing have been defined, the CPM diagram can be drawn. CPM originally was developed as an activity on node (AON) network, but some project planners prefer to specify the activities on the arcs.
4. Estimate Activity Completion Time: The time required to complete each activity can be estimated using past experience or the estimates of knowledgeable persons. CPM is a deterministic model that does not take into account variation in the completion time, so only one number is used for an activity's time estimate.
5. Identify the Critical Path

The critical path is the longest-duration path through the network. The significance of the critical path is that the activities that lie on it cannot be delayed without delaying the project. Because of its impact on the entire project, critical path analysis is an important aspect of project planning.

The critical path can be identified by determining the following four parameters for each activity:

ES - earliest start time: the earliest time at which the activity can start given that its precedent activities must be completed first.

EF - earliest finish time, equal to the earliest start time for the activity plus the time required completing the activity.

LF - latest finish time: the latest time at which the activity can be completed without delaying the project.

LS - Latest start time, equal to the latest finish time minus the time required to complete the activity.

The slack time for an activity is the time between its earliest and latest start time, or between its earliest and latest finish time. Slack is the amount of time that an

activity can be delayed past its earliest start or earliest finish without delaying the project.

The critical path is the path through the project network in which none of the activities have slack, that is, the path for which $ES=LS$ and $EF=LF$ for all activities in the path. A delay in the critical path delays the project. Similarly, to accelerate the project it is necessary to reduce the total time required for the activities in the critical path.

6. Update CPM Diagram

As the project progresses, the actual task completion times will be known and the network diagram can be updated to include this information. A new critical path may emerge, and structural changes may be made in the network if project requirements change.

CPM Limitations

CPM was developed for complex but fairly routine projects with minimal uncertainty in the project completion times. For less routine projects there is more uncertainty in the completion times, and this uncertainty limits the usefulness of the deterministic CPM model. An alternative to CPM is the PERT project planning model, which allows a range of durations to be specified for each activity.

(<http://www.netmba.com/operations/project/cpm/>)

PERT

Complex projects require a series of activities, some of which must be performed sequentially and others that can be performed in parallel with other activities. This collection of series and parallel tasks can be modeled as a network.

In 1957 the Critical Path Method (CPM) was developed as a network model for project management. CPM is a deterministic method that uses a fixed time estimate for each activity. While CPM is easy to understand and use, it does not consider the time variations that can have a great impact on the completion time of a complex project.

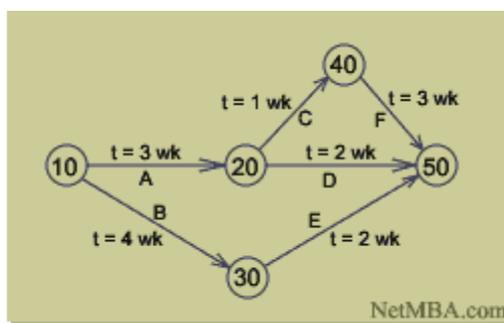
The Program Evaluation and Review Technique (PERT) is a network model that allows for randomness in activity completion times. PERT was developed in the late 1950's for the U.S. Navy's Polaris project having thousands of contractors. It has the potential to reduce both the time and cost required to complete a project.

The Network Diagram

In a project, an activity is a task that must be performed and an event is a milestone marking the completion of one or more activities. Before an activity can begin, all of its predecessor activities must be completed. Project network models represent activities and milestones by arcs and nodes. PERT originally was an activity on arc network, in which the activities are represented on the lines and milestones on the nodes. Over time, some people began to use PERT as an activity on node network. For this discussion, we will use the original form of activity on arc.

The PERT chart may have multiple pages with many sub-tasks. The following is a very simple example of a PERT diagram:

PERT Chart



The milestones generally are numbered so that the ending node of an activity has a higher number than the beginning node. Incrementing the numbers by 10 allows for new ones to be inserted without modifying the numbering of the entire diagram. The activities in the above diagram are labeled with letters along with the expected time required to complete the activity.

Steps in the PERT Planning Process

PERT planning involves the following steps:

1. Identify the specific activities and milestones.
2. Determine the proper sequence of the activities.
3. Construct a network diagram.
4. Estimate the time required for each activity.
5. Determine the critical path.
6. Update the PERT chart as the project progresses.

1. Identify Activities and Milestones

The activities are the tasks required to complete the project. The milestones are the events marking the beginning and end of one or more activities. It is helpful to list the tasks in a table that in later steps can be

expanded to include information on sequence and duration.

2. Determine Activity Sequence

This step may be combined with the activity identification step since the activity sequence is evident for some tasks. Other tasks may require more analysis to determine the exact order in which they must be performed.

3. Construct the Network Diagram

Using the activity sequence information, a network diagram can be drawn showing the sequence of the serial and parallel activities. For the original activity-on-arc model, the activities are depicted by arrowed lines and milestones are depicted by circles or "bubbles".

If done manually, several drafts may be required to correctly portray the relationships among activities. Software packages simplify this step by automatically converting tabular activity information into a network diagram.

4. Estimate Activity Times

Weeks are a commonly used unit of time for activity completion, but any consistent unit of time can be used.

A distinguishing feature of PERT is its ability to deal with uncertainty in activity completion times. For each activity, the model usually includes three time estimates:

- Optimistic time - generally the shortest time in which the activity can be completed. It is common practice to specify optimistic times to be three standard deviations from the mean so that there is approximately a 1% chance that the activity will be completed within the optimistic time.
- Most likely time - the completion time having the highest probability. Note that this time is different from the expected time.
- Pessimistic time - the longest time that an activity might require. Three standard deviations from the mean is commonly used for the pessimistic time.

PERT assumes a beta probability distribution for the time estimates. For a beta distribution, the expected time for each activity can be approximated using the following weighted average:

$$\text{Expected time} = (\text{Optimistic} + 4 \times \text{Most likely} + \text{Pessimistic}) / 6$$

This expected time may be displayed on the network diagram.

To calculate the variance for each activity completion time, if three standard deviation times were selected for the optimistic and pessimistic times, then there are six standard deviations between them, so the variance is given by:

$$[(\text{Pessimistic} - \text{Optimistic}) / 6]^2$$

5. Determine the Critical Path

The critical path is determined by adding the times for the activities in each sequence and determining the longest path in the project. The critical path determines the total calendar time required for the project. If activities outside the critical path speed up or slow down (within limits), the total project time does not change. The amount of time that a non-critical path activity can be delayed without delaying the project is referred to as slack time.

If the critical path is not immediately obvious, it may be helpful to determine the following four quantities for each activity:

- ES - Earliest Start time
- EF - Earliest Finish time
- LS - Latest Start time
- LF - Latest Finish time

These times are calculated using the expected time for the relevant activities. The earliest start and finish times of each activity are determined by working forward through the network and determining the earliest time at which an activity can start and finish considering its predecessor activities. The latest start and finish times are the latest times that an activity can start and finish without delaying the project. LS and LF are found by working backward through the network. The difference in the latest and earliest finish of each activity is that activity's slack. The critical path then is the path through the network in which none of the activities have slack.

The variance in the project completion time can be calculated by summing the variances in the completion times of the activities in the critical path. Given this variance, one can calculate the probability that the project will be completed by a certain date assuming a normal probability distribution for the critical path. The normal distribution assumption holds if the number of activities in the path is large enough for the central limit theorem to be applied.

Since the critical path determines the completion date of the project, the project can be accelerated by adding the resources required to decrease the time for the activities in the critical path. Such a shortening of the project sometimes is referred to as project crashing.

6. Update as Project Progresses

Make adjustments in the PERT chart as the project progresses. As the project unfolds, the estimated times can be replaced with actual times. In cases where there are delays, additional resources may be needed to stay on schedule and the PERT chart may be modified to reflect the new situation.

Benefits of PERT

PERT is useful because it provides the following information:

- Expected project completion time.
- Probability of completion before a specified date.
- The critical path activities that directly impact the completion time.
- The activities that have slack time and that can lend resources to critical path activities.
- Activity start and end dates.

Limitations

The following are some of PERT's weaknesses:

- The activity time estimates are somewhat subjective and depend on judgement. In cases where there is little experience in performing an activity, the numbers may be only a guess. In other cases, if the person or group performing the activity estimates the time there may be bias in the estimate.
- Even if the activity times are well-estimated, PERT assumes a beta distribution for these time estimates, but the actual distribution may be different.
- Even if the beta distribution assumption holds, PERT assumes that the probability distribution of the project completion time is the same as the that of the critical path. Because other paths can become the critical path if their associated activities are delayed, PERT consistently underestimates the expected project completion time.

The underestimation of the project completion time due to alternate paths becoming critical is perhaps the most serious of these issues. To overcome this limitation, Monte Carlo simulations can be performed on the network to eliminate this optimistic bias in the expected project completion time.

1) Gantt Chart

During the era of scientific management, Henry Gantt developed a tool for displaying the progression of a project in the form of a specialized chart. An early application was the tracking of the progress of ship building projects. Today, Gantt's scheduling tool takes the form of a horizontal bar graph and is known as a Gantt chart, a basic sample of which is shown below:

Gantt Chart Format

Task	Duration	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	2 mo.	■											
2	2 mo.			■									
3	2 mo.				■								
4	2 mo.						■						
5	2 mo.								■				
6	2 mo.										■		

The horizontal axis of the Gantt chart is a time scale, expressed either in absolute time or in relative time referenced to the beginning of the project. The time resolution depends on the project - the time unit typically is in weeks or months. Rows of bars in the chart show the beginning and ending dates of the individual tasks in the project.

In the above example, each task is shown to begin when the task above it completes. However, the bars may overlap in cases where a task can begin before the completion of another, and there may be several tasks performed in parallel. For such cases, the Gantt chart is quite useful for communicating the timing of the various tasks.

For larger projects, the tasks can be broken into subtasks having their own Gantt charts to maintain readability.

Gantt Chart Enhancements

This basic version of the Gantt chart often is enhanced to communicate more information.

- A vertical marker can be used to mark the present point in time.
- The progression of each activity may be shown by shading the bar as progress is made, allowing the status of each activity to be known with just a glance.

- Dependencies can be depicted using link lines or color codes.
- Resource allocation can be specified for each task.
- Milestones can be shown.

Gantt Chart Role in Project Planning

For larger projects, a work breakdown structure would be developed to identify the tasks before constructing a Gantt chart. For smaller projects, the Gantt chart itself may be used to identify the tasks.

The strength of the Gantt chart is its ability to display the status of each activity at a glance. While often generated using project management software, it is easy to construct using a spreadsheet, and often appears in simple ascii formatting in e-mails among managers.

For sequencing and critical path analysis, network models such as CPM or PERT are more powerful for dealing with dependencies and project completion time. Even when network models are used, the Gantt chart often is used as a reporting tool.

Alternative spellings: The name of this tool frequently is misspelled as "Gannt Chart". (<http://www.netmba.com/operations/project/gantt/>)

Time-Cost Trade-offs

There is a relationship between a project's time to completion and its cost. For some types of costs, the relationship is in direct proportion; for other types, there is a direct trade-off. Because of these two types of costs, there is an optimal project pace for minimal cost. By understanding the time-cost relationship, one is better able to predict the impact of a schedule change on project cost.

Types of Costs

The costs associated with a project can be classified as direct costs or indirect costs.

Direct costs are those directly associated with project activities, such as salaries, travel, and direct project materials and equipment. If the pace of activities is increased in order to decrease project completion time, the direct costs generally increase since more resources must be allocated to accelerate the pace.

Indirect costs are those overhead costs that are not directly associated with specific project activities such as office space, administrative staff, and taxes. Such

costs tend to be relatively steady per unit of time over the life of the project. As such, the total indirect costs decrease as the project duration decreases.

The project cost is the sum of the direct and indirect costs.

Compressing the Project Schedule

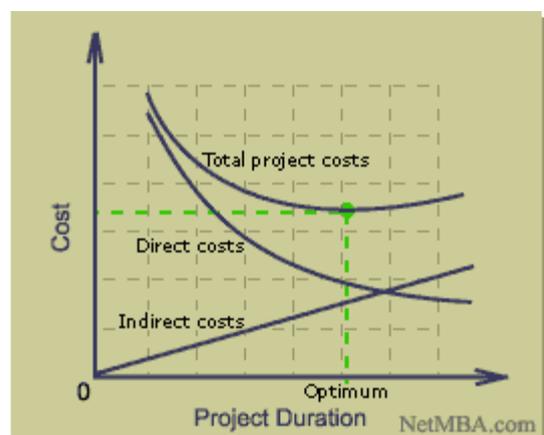
Compressing or crashing the project schedule refers to the acceleration of the project activities in order to complete the project sooner. The time required to complete a project is determined by the critical path, so to compress a project schedule one must focus on critical path activities.

A procedure for determining the optimal project time is to determine the normal completion time for each critical path activity and a crash time. The crash time is the shortest time in which an activity can be completed. The direct costs then are calculated for the normal and crash times of each activity. The slope of each cost versus time trade-off can be determined for each activity as follows:

$$\text{Slope} = (\text{Crash cost} - \text{Normal cost}) / (\text{Normal time} - \text{Crash time})$$

The activities having the lowest cost per unit of time reduction should be shortened first. In this way, one can step through the critical path activities and create a graph of the total project cost versus the project time. The indirect, direct, and total project costs then can be calculated for different project durations. The optimal point is the duration resulting in the minimum project cost, as show in the following graph:

Project Cost Versus Duration



Attention should be given to the critical path to make sure that it remains the critical path after the activity

time is reduced. If a new critical path emerges, it must be considered in subsequent time reductions.

To minimize the cost, those activities that are not on the critical path can be extended to minimize their costs without increasing the project completion time.

Time-Cost Model Assumptions

The time-cost model described above relies on the following assumptions:

The normal cost for an activity is lower than the crash cost.

There is a linear relationship between activity time and cost.

The resources are available to shorten the activity.

The model would need to be adapted to cases in which the assumptions do not hold. For example, the schedule might need to take into account the need to level the load on a limited resource such as a specialized piece of equipment.

Additional Considerations

There are other considerations besides project cost. For example, when the project is part of the development of a new product, time-to-market may be extremely important and it may be beneficial to accelerate the project to a point where its cost is much greater than the minimum cost.

In contract work, there may be incentive payments associated with early completion or penalties associated with late completion. A time-cost model can be adapted to take such incentives and penalties into account by modeling them as indirect costs.

Because of the importance of the critical path in compressing a project schedule, a project planning technique such as the Critical Path Method or PERT should be used to identify the critical path before attempting to compress the schedule. (<http://www.netmba.com/operations/project/time-cost/>)

Methods

Several methods are used by project managers to manage and implement different projects in the businesses. These methods include Total Quality Management, Six Sigma, Lean six-sigma, Just-in-time approach etc. A number of developed and developing

companies are using these methods to increase the productivity and sustainability of organization. (Maserang, 2002)

III. ADVANTAGES AND DISADVANTAGES:

Every organizational activity has some unique underlying characteristics that can be managed with different specific tools. Project management tools are the methods and strategies adopted to implement a project for achieving organizational goals. Specific issues or problems are solved by the implementation of different projects but to determine the feasibility of the projects is necessary. A project may have the following characteristics:

Every project is planned and executed for the achievement of a specific goal. Point in time regarded as the time when the project gets completed. However, several complexities may arise to reach the organization goals. From planning to execution, labor, capital and other resources play a vital role. These must be arranged, resourced and utilized in an accurate manner to avoid unnecessary cost and waste of resources. Information and Control Systems must be planned to solve the problems associated. However, if project managers do not possess skills to effectively utilize the project management tools, results can be negative.

IV. EXAMPLE

The graph below shows that there has been tremendous increase in the demand for project managers because of high benefits associated with them.



Use of project management tools have drastically increased over years. The construction industry has experienced high growth in the performance due to effective use of project management tools. The process

of project management was very complex in the past years. A huge effort was required for project planning and it's implemented as well as sourcing of relevant factors. However, the project management has now changed because of project management tools and their abundant advantages. Richard P. Olsen defined project management as a collection of tools applied to the resources for the achievement of tasks within time, cost and other quality matters. Every activity or task requires the use of several tools that fit to the task. (Heldman, 2011)

Use of project management tools reduces the distraction of business activities and problems associated with them. For project realization, a proper team commands all the skills, tools, technologies and the resources required for the project. Tools and skills required for the project depend on its specificity and type. To fulfill the objectives of project, an organization must possess minimum amount of adjustments to ensure the project success. Every project has a different combination of project management tools that en-sure the success and benefits of the organization. Traditionally, four important phases are included in the project management process. These phases include project initial phase, project planning, its execution and evaluation. (Griffin)

Techniques of project management that are lined with the initial phase of project management include the establishment of project team. A proper team is organized to carry out different activities in the project management. (Maserang, 2002)

V. CONCLUSION

A proper relationship is established with the customers and organization understands that it is important to strengthen this relation. Project initial plan is established and activities for carrying out different works for achievement of goals are defined. Management procedures are established with the adoption of project management tools and techniques. Different roles are assigned to different individuals and communication is strengthened among the team to bring out greater results of the industries. High growth profile is experienced by the industries as a result of using project management tools. Project initiation, planning, implementation and completion are the four phases of project lifecycle. For achieving good growth and performance, project

managers are hired and project management tools are used for the growth and productivity.

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