A project plan according to pmi education essay

A project plan according to PMI (2006) is “ a formal approved document that defines how a project is executed, monitored and controlled. It guides project execution, document planning assumptions, facilitates communication among stakeholders, and provides a baseline for measuring project performance”. Therefore, project planning is a system that includes setting objectives, developing work descriptions, developing a network diagram to identify dependencies, scheduling tasks, defining activities at the appropriate levels of detail, budgeting based on task identification and resource requirements, tracking performance and reporting progress, providing feedback, managing change, and eventually closing out the project (Meredith and Mantel, 2009).

Being a comprehensive activity, project planning analyses and models the project from a number of perspectives.

Hence, the report will define and describe some of the key tools and techniques which are available to the project manager to facilitate planning such as: WBS (Work Breakdown Structure), Gantt Chart, PERT (Program Evaluation and Review Techniques) which may use arrow diagrams methods but with probabilistic time forecasts related to the three point estimates and the Critical Path Analysis (CPA) for determining the critical path duration as well as identifying the critical activities that project managers need to consider when planning a project.

The report will also demonstrate how these tools and techniques may be applied in real world situations with appropriate diagrams and practical examples. To make it clear, tools and techniques have different meaning, a tool is a ‘ thing’ we use and a technique is how we ‘ use’ the thing.

WBS (Work Breakdown Structure)

Work Breakdown Structure has been defined by Wysocki (2003) as “ A deliverable-oriented hierarchal decomposition of the work to be executed by the project team. The WBS organises and defines the total scope of the project.”

The Importance of WBS as a Project Planning Tool

The WBS is considered to be the cornerstone of project planning because it provides a common framework from which the total program can be described as a summation of subdivided elements; planning can be performed; cost and budgets can be established; time, cost, and performance can be tracked; risk can be identified and objectives can be linked to company resources in a logical manner. In addition, WBS is also useful for scheduling and establishing status-reporting procedures, initiating network construction and control planning as well as establishing the responsibility assignments for each element.

Description of WBS

The WBS can be structured in a number of ways depending on the use to which it is to put. Common ways are by division of the product into major components which are then split into sub-assemblies and so on down to components, by a functional breakdown or by a cost centre code. A practical example of the WBS coding scheme is

The way chosen is related to the type of project and the industrial or public sector in which it is taking place.

An example of WBS for moving a set of offices and employees to a new building has been given below to have a better understanding of the description of the WBS in real life situation. Each branch encloses tasks which are broken down into components parts until manageable work packages have been identified.

A WBS is developed by first identifying the system or project end item to be structured, and then successively subdividing it into increasingly detailed and manageable subsidiary work products or elements.

Most of these elements are the direct result of work (e. g., assemblies, subassemblies, and components), while others are simply the aggregation of selected products into logical sets (e. g., buildings and utilities) for management control purposes.

In either case, the subsidiary work product has its own set of goals and objectives which must be met in order for the project objectives to be met. Detailed tasks which must be performed to satisfy the subsidiary work product goals and objectives are then identified and defined for each work product or element on which work will be performed.

Completion of an element is both measurable and verifiable by persons (i. e., quality assurance persons) who are independent of those responsible for the element’s completion. Because WBS element/product completion can be verified, a WBS provides a solid basis for technical, schedule and cost plans and status. No other structure (e. g., code of account, functional organization, budget and reporting, cost element) satisfactorily provides an equally solid basis for incremental project performance assessment.

Furthermore, in a nutshell, the WBS of a project consists of three levels of products/elements with associated work definitions. The three upper levels are defined below.

- Level 1 is the entire program/project.
- Level 2 elements are the major product segments or subsections.
- Level 3 contains definable components, or subsets, of the level 2 elements (achieved by the act of decomposition)

Level 1 and Level 2 normally operate under the 100 % rule. The rule states " that the WBS (at level 1 and 2) includes 100% of all work defined in the project scope statement and management plan", in addition, it must also detain 100% of " all the deliverables for the project including internal, external, and interim" Project Smart (2009). However, in real life situations, the WBS typically detains between 90-95%, and 100% is the project manager's goal. The example below shows how the 100% rule and the three WBS level are applied to a custom bicycle project.

Once, the first two levels are set, the project managers need to perform the act of decomposition. Decomposition is the breaking down of deliverables into consecutively smaller amount of work to be completed so that to accomplish a level of work that can reasonably be managed by both the project manager and completed within a given time frame by the team members, WBS Decomposition stops when activity is ' manageable'.

The report has used the example of the project of the Construction of a Gas Production Complex to the three levels as well as activities and sub-activities.

At the outset of a project, however, the work breakdown structure can usually be compiled in fairly broad terms. Many of the smaller items will remain unknown or ill-defined until the project has advanced well into its engineering design phase. In many cases, a detailed work breakdown will not be possible until long after the contract has been signed and everything has become a firm commitment. A fair degree of judgement or brainstorming is therefore necessary in deciding what should go into the earliest version of a project task list.

Gantt chart or Bar chart

The most common type of display is the bar or Gantt chart, named for Henry Gantt (1861-1919), who first utilised this procedure in the early 1900s in Frederick Taylor's systematic production department. The bar chart is a means of displaying simple activities or events plotted against time or dollars. An activity represents the amount of work required to proceed from one point in time to another. Events are described as either the starting or ending point for either one or several activities.

Project activities are listed vertically and time is measured horizontally from left to right. Each activity is plotted as a bar against time. The bar chart starts on the correct start day according to the sequence of activities determined using the precedence network and the length of the bar corresponds to the duration of the task

Importance of Gantt chart as a Project Planning Tool and Technique

Gantt charts are useful for displaying schedules, whether produced manually or automated within a tool such as Microsoft Project. In these cases the benefits follow from their effectiveness in presenting a great deal of information (what jobs run, when, on which machines, and for how long, and where idleness or congestion occurs). The method is highly adaptable and can readily focus on issues that concern managers. Gantt charts are not solution techniques but they facilitate communications between the analyst and user, and provide a powerful method for implementing interactive approaches to scheduling.

Gantt charts are most commonly used for exhibiting program progress or defining specific work to accomplish an objective. It also often includes such items as listing activities, activity duration, schedule dates, and progress-to-date.

For example, Gantt charts were applied in real production environments and were found to work reasonably well and to be the most effective solution. They endured as ‘‘ best practice” for decades, Porter (1929) and Alford (1945) showing their adaptation to increasingly varied production environments.

Gantt charts are advantageous in that they are simple to understand and easy to change. They are the simplest and least complex means of portraying progress (or lack of it) and can easily be expanded to identify specific elements that they are either behind or ahead of schedule.

Application of Gantt chart for the Furniture Project

To demonstrate how Gantt chart is applied to real life situations, the report will draw a Gantt chart for the furniture project. Eaton Sitright Limited is a company that manufactures good-quality furniture for sale to homes and offices. The company wishes to introduce a new design of table and chair to its standard range, and has started a project to design and make a small prototype batch for consumer appraisal and testing. In order, to draw the Gantt chart, Eaton Sitright Limited need to develop the furniture project list.

Task Number	Task Description	Duration (estimated in days)
01	Chair	15
02	Anatomical study for chair	5
03	Design Chair	6
04	Buy materials for chair seat	3
05	Make chair seat	5
06	Buy chair castors	10
07	Buy steel for	3
08		2
09		1
10		2

	chair frame	
	Make chair frame	
	Paint chair frame	
	Assemble chair	
	Apply final finishes to chair	
11	Desk	10
12	Design desk	10
13	Buy steel for desk frame	5
14	Make desk frame	2
15	Paint desk frame	5
16	Buy wood and fittings for desk	6
17	Make desk drawer	1
18		1
19		2

	Make desk top	
	Assemble desk	
	Apply final finishes to desk	
	General Activities	
20	Decide paint colours	10
21	Buy paint and varnish	8
22	Final project evaluation	5

After listing the activities and the time duration in days (and, starting and finishing time), we will therefore draw the Gantt chart using Microsoft Project tool.

The figure5 showsthe Gantt chart of the furniture project using Microsoftprojecttool

Bar charts or Gantt chart provide only a vague description of how the entire program or project reacts as a system, and have three major limitations which we can be related to the above example.

Although, with these limitations, Gantt chart do in fact serve as useful tools for program analysis.

PERT (Programme Evaluation Review Technique)

PERT is a network analysis tool and technique used to estimate project duration when there is a high degree of uncertainty about the individual activity duration estimates. PERT applies to the critical path method (CPM) to a weighted average duration estimate. This approach was developed about the same time as CPM, in the late 1950s for U. S. A Navy Polaries Project and also uses network diagrams mainly arrow diagrams known as Activity- On-Arrow (AOA), which are still sometimes, refer to PERT charts.

PERT charts are important in project planning as they are useful in revealing critical path, critical tasks and slack time. The figure below will show an example of PERT chart.

Table 1: tasks in creating a project schedule in an activity-arrow diagram, reference: https://engineering. purdue. edu/EPICS/Resources/Forms/Projects/projectPlanning. html[accessed date: 12th April 2010]

Importance of PERT as a Project Planning tool and technique

PERT uses probabilistic time estimates known as the Three Point Estimating: duration estimates based on using optimistic, pessimistic and most likely estimates of activity durations, instead of one discrete duration estimate, as CPM does.

- Optimistic completion time assumes that everything will go according to plan and with minimal difficulties. This should occur approximately 1 percent of the time.

- Pessimistic completion time assumes that everything will not go according to plan and maximum difficulties will develop. This should occur approximately 1 percent of the time.
- Most likely completion time is the time that, in the mind of the functional manager, would most often occur should this effort be reported over and over again.

By using PERT weighted average for each activity duration estimate, the total project duration estimates takes into account the risk or uncertainty in the individual activity estimates. Therefore, PERT is known for scheduling, decision making and risk identification in the project plan.

Application of PERT estimates in a Furniture Project

Step one and two of PERT scheduling begins with the project manager laying out a list of activities to be performed and then placing these activities in order of precedence, thus identifying interrelationships.

In the following example there are seven tasks. Some tasks can be done concurrently (activity number 1) while others cannot be done until their predecessor task is complete (activity number 3 cannot begin until activity number 2 is complete).

Each task has three time estimates: the optimistic time estimate (a), the most likely (m), and the pessimistic time estimate (b). The expected time (TE) is calculating using the formula mentioned above.

Activit	Task	Precedi	Time	Expect
y	descripti	ng	estima	

number	on	activities	tes a	M	B	ed time
01	Anatomical study of chair	None	2	4	6	4. 00 (2+(4*4)+6/6)
02	Design chair	01	3	5	9	5. 33 round up to 6
03	Buy material for car seat	02	4	5	7	5. 17 round up to 6
04	Make chair seat	03	4	6	10	6. 33 round up to 7
05	Buy chair castors	02	4	5	7	5. 17 round up to 6
06	Buy steel for chair	02	3	4	8	4. 50 round

	frame					up to 5
07	Make chair frame	06	3	5	8	5. 17 round up to 6

These values for TE(time expected) would then be used as the activity time between two efforts in the construction of a PERT chart. It should be noted that time estimates that the line managers provide are based on the assumption of unlimited resources because the calendar dates have not yet been defined.

Estimating Total Project Time

In order to calculate the probability of completing the project on time, the standard deviations of the expected time of each activity must be known and this can be found from the expression:

Another useful expression is the variance, v, which is the square of the standard variation. The variance is primarily useful for comparison to the expected values. However, the standard variations can be used just as easily, except that we must identify whether it is one, two, or three sigma limit deviation.

To demonstrate how the variance and standard deviation are applied to the real world situation, the example below shows a simple activity on arrow diagram (AOA) showing the critical path, together with the corresponding values from which time expected were calculated, as well as the standard deviation.

The figure shows the Expected time analysis for critical path events.

The total path deviation is calculated by the square root of the sum of the squares of the activity standard deviations, meaning the square root of the total variance for all activities.

The purpose of calculating total path standard deviation is that it allows project managers to establish a confidence interval for each activity and the critical path.

From statistics, using a normal distribution, we know that there is 68 % chance of completing the project within one standard deviation, a 95% chance within two standard deviation and a 99. 73% chance within three standard deviation.

From the example above: the standard deviation of the path is 1. 25 daysand the duration of the path is 15 days (3+7+5).

- Therefore, 68% confidence of delivery is within 17 days (15 + 1. 25)
- 95% confidence of delivery is within 18 days (15 +1. 25 + 1. 25)
- 99. 73% confidence of delivery is within 19 days (15+ 1. 25+1. 25+1. 25)

This type of analysis can be used to measure the risks in the estimates, the risk in completing each activity, and the risks in completing the entire project. In other words, standard deviation serves as a measurement of the risk. This analysis, however, assumes that normal distribution applies, which is not always the case. Furthermore, PERT activity estimates are somewhat subjective and depend on judgement. And in situations where the project manager does not have the past experience, the numbers may be only a guess thus, can create bias in the estimating.

Critical Path Analysis (CPA)

CPA is a tool and technique for determining the critical path through a network. When networked programmes are not provided, it requires a process of deduction to determine the critical activities in a programme by tracing the local sequence of tasks that directly affect the date of project completion.

When fully networked programmes are utilised, the critical path is determined by ways of CPM (Critical Path Method) calculations (forward or backward pass) to determine the early and late event times, and the total float available to each activity. Thus, it is a methodology or a management technique that determines a project critical path (John Keane, 2005).

Critical Path

“ A projects critical path is understood to mean that sequence of critical activities (and critical events) that connects the project’s start event to its finish event and which cannot be delayed without delaying the project” Meridith and Mantel (2009).

Besides, the critical path is the longest path through the project and it represents the duration of the project. All activities will be critical and furthermore, the critical path will have a float value of zero.

Importance of Critical Path Analysis as a Project Planning Tool and Technique

CPA is a very important tool for planning a project as it may be used as part of the decision making process and cash flow management. It also enables the project manager to plan and monitor operations by identifying the maximum efficiency in the use of time for an operation to be completed and identifying the potential problems in implementing operation. The CPA also identifies where and when resources (including human ones) are needed in order to improve efficiency and generate cost saving in the use of resources.

The Key Steps in the Critical Path Analysis

Overall, there are five key steps for determining the CPA. Step one is that we identify and place activities in order of precedence and in step two; we identify which activities must be done before others (it is the same first two steps mentioned for PERT planning). Step three is that project manager should draw those activities by using float charts or network diagrams such AOA (Activity-On-Arrow) or AON (Activity-On-Node). Step four is to determine the acitivity duration based on past experience, the estimates of well-informed persons or metrics. Step five is to identify the critical path by determining the four parameters for each activity which are as follows:

Moreover, the term ‘ float’ indicates the amount of leeway available for the starting and finishing an activity. There are various categories of float: Total Floatwhich is the time by which an activity can be delayed without impacting the project end date. To derive total float LF minus EF or LS minus ES can be used.

Free Float: The time by which an activity can be delayed without impacting the start time of any successor activity. And, independent float is “ the degree of flexibility which an activity has which does not affect the float available on any preceding or succeeding activities” Projectnet Glossary (April 1997).

The Forward Pass

A forward pass through a network determines the earliest times each activity can start and finish. It also determine the total duration of the project.

To demonstrate how the forward pass method is used in real life situation, we are going to show a precedence diagram for Activity A, B, C, D, E and F in the example below.

The example will set the ES (early start) of activities with no predecessors to 1 and calculate activity EF (early finish) by: ((ES + duration) – 1 duration unit) and will also calculate next activity ES by (latest EF of all preceding activities including lag + 1 duration unit).

Backward Pass

A backward pass through the network determines the latest times each activity can start and finish without delaying completion of the project. With this information we can determine where we can delay activities (have float) and where we cannot. To perform the backward pass we will demonstrate a practical example using precedence diagram. We will set the LF of the last activity to its EF and the example will calculate the activity LS by ((LF – duration) + 1 duration unit) and it will also calculate the previous activity LF by (earliest LS of preceding activities – activity lag – 1 duration unit).

Thus, in order to calculate the critical path, we need to calculate the total float for each activity by time available – time required. It is calculated for each activity as (LF – EF). The example below shows how to calculate the total float using precedence network.

As mention above, the critical path will have a total foat value zero. Therefore, the critical activities are A, B, D and F. The critical path duration is 28 days and is marked in the example above in red.

However, although software is available to produce networks, diagram can become unmanageable. Moreover, plan will only work if relevant staffs have been consulted for instance timescale need to be realistic. Besides, Gantt charts are preferred because they visually see the time-span of activities.

Conclusion

The report shows how project planning is important in project management. Project planning helps to meet the project management triangle constraints like, scope, schedule, and cost, affecting the quality of the project. Thus, to facilitate planning, there are several tools and techniques which are available to the project manager in order to meet the constraints of the project management triangle. The report has explained and discussed on the four key tools and techniques of project planning such as, WBS (Work Breakdown Structure), Gantt Charts, PERT (Programme Evaluation and Review Technique) and Critical Path Analysis (CPA). These tools and techniques have their pros and cons. Still, all of them are very useful as they help in meeting a number of perspectives that project planning include such as communication, risk, budget, decision making and so on.

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