

**PROJECT MANAGEMENT TECHNIQUES
FOR
PERFORMANCE MONITORING**



International Service for National Agricultural Research

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WORKING PAPER NO. 13

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ISNAR

International Service for National Agricultural Research

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PROJECT MANAGEMENT TECHNIQUES FOR PERFORMANCE MONITORING

Agricultural research organizations are increasingly using a project management approach to ensure thorough project planning and to allocate scarce resources in a more transparent way. This working paper offers the research project manager some simple techniques for monitoring the performance of an activity, by tracking resources, outputs, and time. These techniques are only applicable where a workplan has been devised in advance, where targets or milestones have been identified, and where administrative reporting systems are reasonably operational. In this working paper four techniques are introduced which graphically depict project activities. They are:

- Task Lists
- Bar (Gantt) Charts
- Milestone (Deliverables) Charts
- Networks

These techniques can help the manager to develop project workplans, to monitor ongoing projects, and to be alert for cost overruns and delays in scheduling. They aid the manager in tracking the technical, time, and cost performance of the project. By synthesizing the diverse research activities which comprise a project, it is possible to more fully understand the management implications for technical backstopping, timely procurement, financial control, and administrative support. The techniques described can be applied to projects or a collection of projects which comprise the research program. Finally, they can even be applied to the national research organization to aid strategic planning and implementation.

This ISNAR working paper is one of a several which describe useful project planning and management techniques. Other working papers cover the use of the Logical Framework approach in research planning and evaluation, the development of project proposals and workplans, and monitoring and evaluation. The author has attempted to be as succinct as possible in this paper, realizing that researchers and research managers are busy people who need practical management techniques. These techniques are aimed to improve your research, not to make research management an end in itself.

TASK LISTS

This is the most common approach for displaying a research project plan. It consists of a listing of the tasks comprising a project, in a column down the left side of a page. It is possible to array most scheduling and cost data in the remaining parallel columns. For example, successive columns might represent start-up dates for the tasks, anticipated completion dates, elapsed time, person-days, total cost for labor, etc. (Figure 1).

The merits of this approach are that task lists are easy to compose and to read without special training in the interpretation of symbols. Their greatest drawback is that they do not show the relationships among tasks. For example, some tasks may be able to function simultaneously; whereas, the start of some may be dependent upon the completion of others. The information is available to deduce these kinds of relationships, but they are not obvious.

Figure 1. Task List of ActivitiesProject Title: Striga Suppression and Control in Maize

<u>Project Task</u>	<u>Start</u>	<u>End</u>	<u>Months</u>
1. Obtain IITA hybrid lines of Striga-resistant material	Mar 1	May 30	3.0
2. Multiply under irrigation	Jun 1	Sep 30	4.0
3. Score (IITA method) previously identified fields	Dec 1	Mar 15	3.5
4. Screen IITA & identified local lines	Nov 1	Mar 15	4.5
5. Field surveys to collect local tolerant lines	Dec 1	Mar 15	3.5
6. Harvest and measure grain yield	Mar 1	Mar 30	1.0
7. Test for milling quality	Apr 1	Apr 30	1.0
8. Analyze results	May 1	May 30	1.0
9. Write annual report	Jun 1	Jun 30	1.0
10. Quarterly progress reports	Mar 30	Jul 30	15.0

Task List advantages:

1. Specific tasks comprising the project.
2. Planned start-up dates for each task.
3. Planned completion dates for each task.
4. Planned elapsed calendar time per task.
5. Which tasks will be implemented at the same time.
6. Level-of-effort to complete tasks; e.g., person-days per task.
7. Costs associated with level-of-effort.

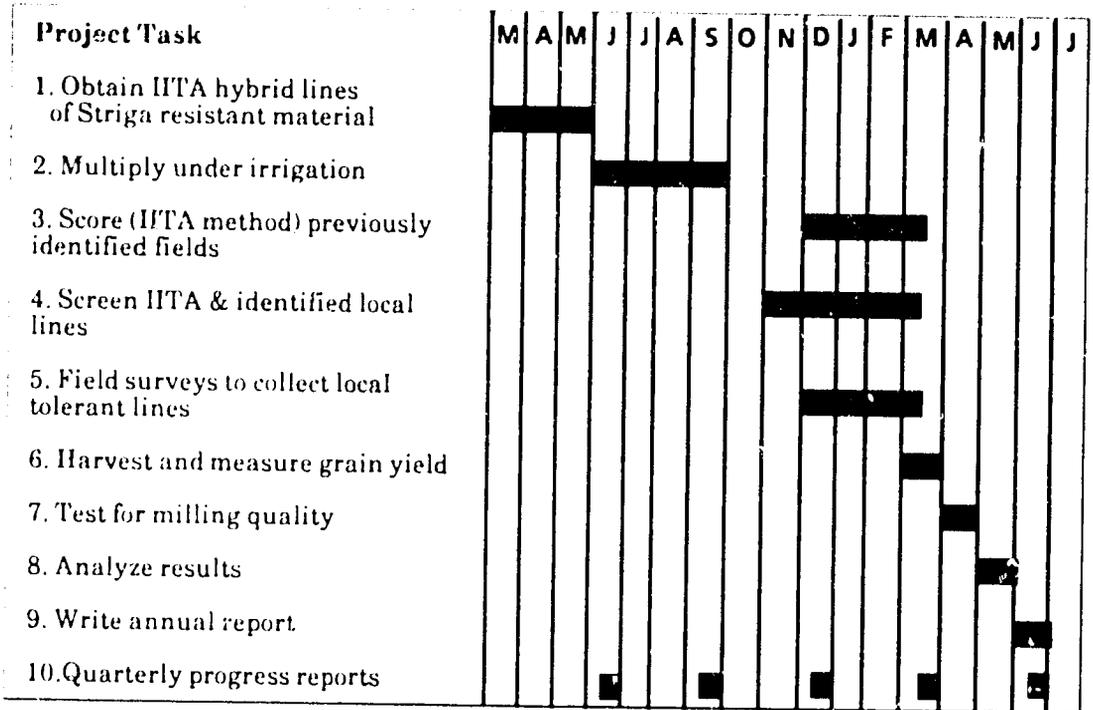
Task List disadvantages:

1. Critical relationships between tasks; for example, which must be done before others can start. And, which can operate concurrently without interfering with each other.
2. Slack time.
3. Activity bottlenecks.
4. Schedule of deliverables.

BAR CHARTS:

Many research managers use Bar Charts, also known as Gantt Charts. (Figure 2). Basically, they are two-dimensional charts with the tasks listed vertically on the left margin, and a time-line arrayed horizontally at the top. Then "bars" are used to indicate the start-up, duration, and completion times for each task. They are an improvement over the task list because they are more graphic; they show the time relationship of tasks to each other; and they accommodate a variety of information.

Figure 2. Bar Chart of Activities

Project Title: Striga Suppression and Control in MaizeBar Chart advantages:

1. The Bar Chart is simple to draft and is familiar to most people. It provides a graphic depiction of task duration. It is therefore, easier to comprehend the planned schedule of these events.
2. The Bar Chart shows the periods of time during which the lowest number of tasks are being implemented; it, therefore, provides a better estimate of probable slack periods.
3. The Bar Chart shows the periods of time during which the greatest number of tasks are being implemented; it, therefore, provides a better estimate of probable bottlenecks.
4. The Bar Chart does a better job of emphasizing those tasks which require the greatest, and least, duration--a useful observation even though it does not necessarily indicate level-of-effort or costs.

Bar Chart disadvantages:

1. The Bar Chart is oversimplified and still does not indicate the required sequence of tasks or the functional relationships among them.

2. It does not highlight particularly critical tasks.

3. It is difficult to update.

The standard Bar Chart can be improved by the addition of symbols for more information. The Milestone or Deliverables Chart is an adaptation of a Bar Chart.

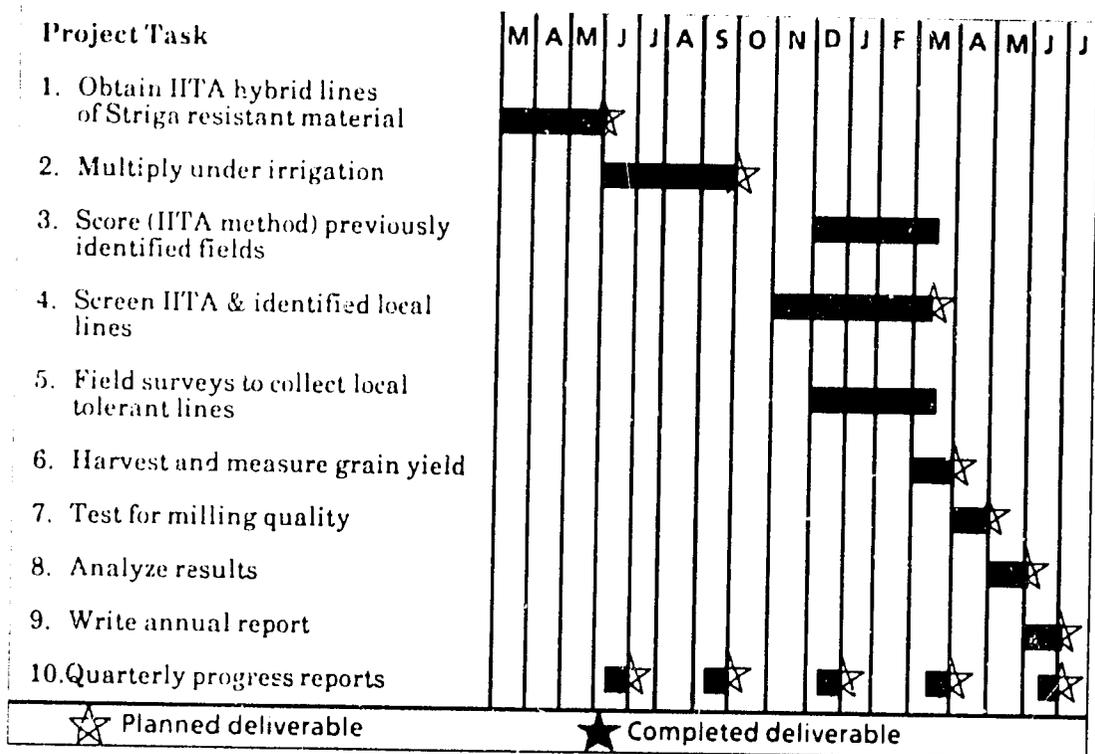
MILESTONE CHART:

The Milestone or Deliverables Chart (Figure 3) is an incremental improvement over the Task List and the Bar Chart. The milestone is a specific, significant checkpoint in the project that can be used for monitoring progress.

The open stars in the Milestone Chart indicate the most important tasks to be performed for the success of the project, and their target dates. The symbol represents a concrete, measurable output from these tasks, and is filled in when the task is actually completed. The difference between planned and completed activities are depicted with the open and closed symbols, respectively. This graphic presentation can give managers an overview of the schedule performance of the project. These milestones should be closely monitored by management.

Figure 3. Milestone Chart of Activities

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Milestone Chart advantages:

1. The Milestone Chart is simple to draft and is familiar to many people. It is easy to understand.
2. It identifies critical events and is time-scaled.
3. It provides a structure for reporting during implementation, having identified important events to monitor.

Milestone Chart disadvantages:

1. The Milestone Chart is oversimplified, and the inter-relationships among tasks are not indicated.
2. It does not provide information on the most efficient way to complete the project.
3. It is difficult to update.

Each research project manager should consider the degree to which more complex and comprehensive management techniques are necessary. A Network is a technique which can be used for complex projects. Mastering the various techniques of networking, however, requires time and practice. Therefore, managers should define for themselves the degree to which this is necessary and useful.

NETWORKS:

Networks were introduced in the 1950s for improving project planning and scheduling. Building upon the Milestone Chart, it eliminated the matrix format of the Bar and Milestone Charts, and replaced it with a free-form network which can be time-scaled. It permitted a graphic representation of the relationships between completed and started activities. And it introduced a formal means of calculating activity times, for analyzing project schedules, bottlenecks, and priorities for management.

The Network is a project plan in graphic form. There are many variations of Networks; the one presented here is the Critical Path Network. It consists of two symbols, circles, and arrows, called respectively, events (milestones) and activities (tasks). To construct a Network of a research project, it is necessary to know three things:

- the planned outputs from different tasks;
- how much time each task takes;
- which ones have to be done first (their relationship to each other).

Much of this information is already available from the Milestone Chart, such as the tasks and their timing. To construct a Network, the relationship between these tasks must be defined: Can they be done simultaneously? Or do certain ones depend on the completion of others before they can be achieved?

Since drawing a Network can be complicated and time-consuming, only those tasks which are imperative to making progress on the project are

included. For example, the quarterly progress report is relatively independent of project progress. This is not meant to imply that progress reporting is not important, only that it is not essential to the completion of the research itself. Since project progress does not depend on the quality or frequency of these reports, they are not included in the Network.

The first step in constructing a Network is the determination of a Work Breakdown Schedule. Figure 4 constructs a Work Breakdown Schedule of the previous example, listing the major project tasks, and the preceding tasks on which they depend.

Figure 4. Work Breakdown Schedule of Activities

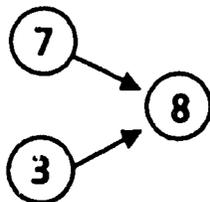
Project Title: Striga Suppression and Control in Maize

<u>Project Task</u>	<u>Duration</u>	<u>Preceding Tasks</u>
1. Obtain IITA hybrid lines of Striga-resistant material	90 days	--
2. Multiply under irrigation	120	1
3. Score (IITA method) previously identified fields	105	--
4. Screen IITA & identified local lines	135	2
5. Field surveys to collect local tolerant lines	105	--
6. Harvest and measure grain yield	30	4
7. Test for milling quality	30	6
8. Analyze results	30	3,5,6,7
9. Write annual report	30	8

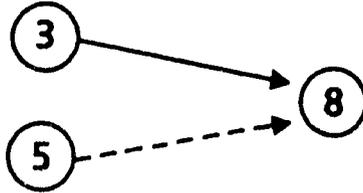
Drawing the Network: From this point drawing the network is relatively straightforward. First a symbol is chosen to depict our research project tasks, such as a circle with the task number inside it. Arrows are used to signify the relationships between tasks. If the two tasks are side-by-side, then progress on the project is indicated by an arrow between them which runs from left to right; like this:



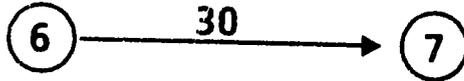
But if the two tasks can be done simultaneously, then they will appear one over the other; like this:



If there is not a significant functional relationship between tasks, then no arrow connects them. If information from one task is important for the progress of another task, but neither task ultimately depends on the completion of the other, then they are connected with a broken (or dotted) arrow; like this:



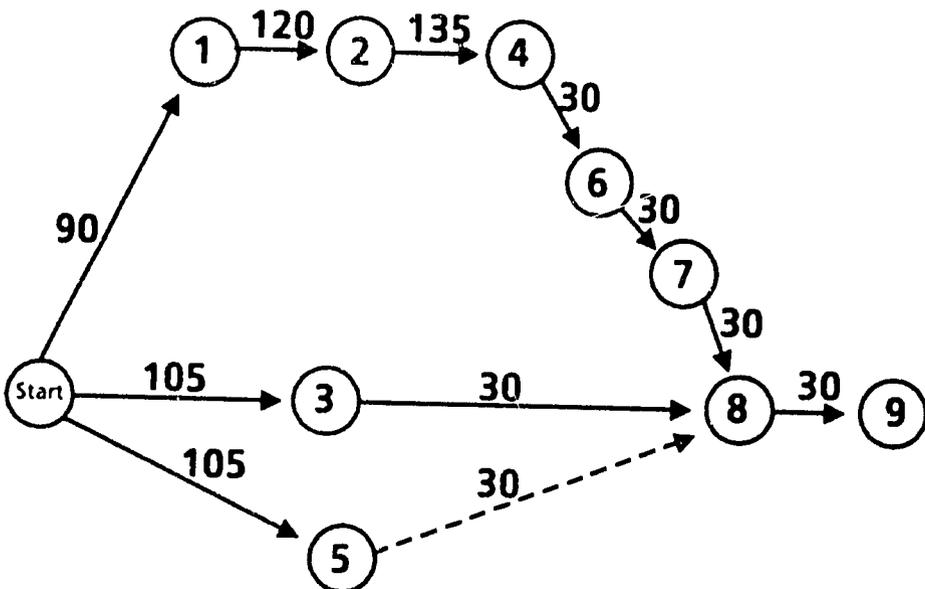
The last remaining instruction is to indicate the time needed to complete a task on the Network. This enables the manager to calculate the total time needed to complete the project. The time figure is inserted over the arrow connecting the tasks.



The circles represent the completion of the intermittent research task. That is why the Network does not start with the first task; it has to be initiated before the numbered tasks are drawn. Therefore, the Network begins with a circle labeled "Start". Figure 5 depicts the Network for the project example:

Figure 5. Critical Path Network

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Now it is time to interpret the Network. What information does it give, besides the chain of research project tasks? This is where a network proves to be a more powerful planning and management tool than either Task Lists, Bar Charts, or Milestone Charts. Networks can help us isolate that route to project completion which has the least amount of slack time in it. In other words, any delay along this particular route holds up the whole project.

The critical path is that path which takes the greatest amount of time to accomplish. It is critical because if any delays occur in it the whole project will be delayed. How is this vital or critical path determined? Which tasks will require the closest monitoring and control of resources in order to ensure that the project is completed on time?

To identify the critical path of the Network, consider each horizontal group of tasks from start to completion. Add the time required for each vertical set. In our example, the path Start-1-2-4-6-7-8-9 requires 465 days; the path Start-3-8-9 requires 165 days; and the paths Start-5-8-9 requires 165 days. Our critical path, then, is the one which takes the longest time to complete, the first one (465 days).

What does this mean in terms of research management? Using this example, it is imperative that no time delays occur in obtaining hybrid lines from IITA and in multiplying them before the proper growing season. Should this occur the only outputs from the year's research will be the scoring of previously identified fields (task 3) and the collection of tolerant local varieties (task 5). This Network also graphically indicates that tasks 3 and 5 can proceed independently of the other activities.

While a Bar or Milestone Chart is more valuable as a graphic calendar scheduling device, a Network indicates which tasks require the closest surveillance, and which might be eliminated in case of unforeseen budget constraints. If, for instance, this project lost some personnel or funds, task 5 could be postponed without influencing the outcome of the first track of activities. Likewise, while varieties could be screened without having formally scored fields for Striga, the analysis will be less complete without this step having taken place.

Network advantages:

1. In addition to the benefits provided from Bar and Milestone Charts, Networks simplify the scheduling of complex projects, by indicating the relationships, logic, and sequence among project tasks. They can, if dates are added to the network, indicate when a task is to be started or completed, and target dates for milestones. Networks help managers to anticipate bottlenecks and plan resource needs in advance.
2. Networks identify critical research project tasks and can reduce total project time by improving time control. They provide a basis for monitoring project technical, time, and cost performance. They reduce the possibility of overlooking important tasks in the execution of the project.

3. Likewise, Networks help managers anticipate slack time so that valuable resources, particularly personnel time, may be reallocated to other project tasks.
4. Networks require precision in planning and encourage collaboration in their design. They can clarify individual and joint project responsibilities.

Network disadvantages:

1. Networks are more complicated and time consuming to use than Task Lists, Bar Charts, and Milestone Charts. The technique is also less familiar to people.
2. Learning to design and use Networks may require short, formal training.
3. Also, in very changeable situations, where available resources fluctuate, maintaining a Network can be difficult.

SUMMARY

Whether lists, charts, or networks are used to plan and manage research project activities, the crucial challenge to research managers is to develop reasonable research proposals, stating precise inputs and outputs, and estimating as closely as possible the resources required to achieve them. Then the manager must monitor and control actual work performance against proposed activities, so that significant deviations in performance can be detected, and corrective actions taken.

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