project planning and management series

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ACKNOWLEDGEMENT

The Project Planning and Management Series consists of a set of manuals and associated modules presenting practical approaches, tools and techniques for project planning and management. (See list on back cover). A product of the Government of Jamaica/USAID National Planning Project (1976-1980), the series was developed by the Project Development Resource Team (PDRT) of PAMCO for use in "action-training" workshops and reflects extensive experience in training and project development. All present PDRT members are contributing authors and have worked together in writing, revising and publishing the series. Special credits are due to Dr. Merlyn Kettering for design and development of the series; Dr. Bruce Brooks for writing final versions of many modules; Mrs. Marjorie Humphreys for assuming primary editing and production responsibility and for organizing draft papers into more useful materials; Mr. Lascelles Dixon, head of PDRT since 1979, for designing the cover and improving many of the illustrations; and Mrs. Christina Hinds and Miss Linette Johnson for typing the drafts and final manuscripts. Any comments on the series and its usefulness are welcome.

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MODULE 42

EVALUATING AND FORECASTING PROJECT PROGRESS AND PERFORMANCE[1)]

Merlyn Kettering

A. *PREREQUISITES:*

Module 7 - Project Scheduling - Bar Charts
Module 8 - Bar Charting for Project Control/ Scheduling
Module 10 - Milestones Description Charts
Module 11 - Manpower/Resource Plans

References:

Module 37 - Report Writing for Projects
Module 41 - Design of a Project Management Control System

B. *DISCUSSION:*

Project control is based upon the early identification of significant deviations from project plans so that corrective actions can be taken to avoid difficulties, to minimize adverse impacts on the overall project, or to exploit unanticipated opportunities. The project manager is responsible to control the project. Detailed analytical techniques can be used to assist in operational control and decision-making. The project manager needs to summarize detailed information on various project activities to assess the project status and to indicate potential problem areas or opportunities.

Project status information falls into three basic management areas -- schedules, costs and resources. Data on performance is analyzed for informed decision-making. Analysis of project status is based on standardized and periodic reporting. Sets of formal reports summarizing and integrating activity level information must be prepared and presented to project

1) This module is a partially edited excerpt from UNIDO (Vienna), *The Initiation and Implementation of Industrial Projects in Developing Countries: A Systematic Approach*. United Nations, New York, 1975 pp. 37-69 (Sales No. E. 75, II, B. 2)

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executive management levels for decision-making.* The project reporting system should be well designed and maintained for sound project management.**

In later sections of this module, there is a discussion of the use of project data in comparison to project plans. Analysis of project status permits forecasting of the implications of present performance to the end of the project.

--Schedule Analysis (Section H)

--Cost Analysis (Section I)

--Resource Analysis (Section J)

--Value-of-Work Analysis (Section K)

--Project Status Index (Section L)

C. *PURPOSE:*

The purpose of the techniques introduced in this module fall into two general categories. First, project information is used for *analysis* of performance and as a basis for *evaluation* of project progress. This is discussed relative to Cost Analysis, Schedule Analysis and Resource Analysis. Second, project information and analysis is used to *forecast* trends of project performance for a measure of the overall impact of present status on total project performance. This involves such measurements as Value-of-Work and the Status Index.

The overall purpose for analysis, evaluation and forecasting is the objective use of systematic reporting to (a) provide the project manager with summary level information to assist in the primary responsibility of seeing that the project is finished within time and cost constraints, and (b) provide condensed project status information for the project executive levels.***

*Module 37 - Report Writing for Projects

**Module 41 - Design of a Project Management Control System

Manual I - Planning for Project Implementation, Chapter IX: Step Five Establishing the Project Information and Control System

***See Module 37 - Report Writing for Projects for a discussion of the project management hierarchy and the project management information pyramid and information chain.

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D. *USES:*

Project analysis, evaluation and forecasting techniques are used to compare actual performances on the project to planned performances. The comparisons identify significant deviations and potential problems or opportunities. Systematic reporting, analysis and evaluation permits the project manager to identify the impacts of deviations on all relevant project components or linkages. Managerial plans can be revised to reflect the realities of implementation. This improves the manager's capabilities to maintain project control. Schedule, cost and resource plans can be revised and corrective actions initiated in response to anticipated difficulties *before they reach a crisis level.*

Project trends analysis is used to forecast end-of-project *implications* on performances to present and actual deviations from plans in basic management areas of schedules, costs, resources, etc. Graphic illustrations, creatively and powerfully portray the long-term implications of present performances. Systematic analysis and summarization of project status information can be used persuasively by the project manager to call early attention to project problems and create support for corrective actions, such as additional funds, shifts in project resources or adjustments in the focus of scope of a project.

E. *DEFINITIONS:*

Project Status --- the relation of actual performance to expected or planned performance.

Trends Analysis -- a summary of performance and forecasts in a graphic display for analysis.

Schedule Analysis -- comparison of actual times for completion of project activities to planned or estimated times.

Cost Analysis -- comparison of actual project costs to planned costs.

Resource Analysis -- comparison of actual resource utilization to planned resource utilization, e.g., with respect to man-days, equipment hours, material or supplies application, etc.

Value-of-Work Analysis -- an integrated analysis of planned to actual performance with regard to costs and schedules which provides an estimate of the actual "value" or cost of work accomplished and is used to forecast end-of-project costs and times (i.e., cost and time overruns).

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Status Index -- an index relating actual progress and cost to the project plan which is used as an indication of project efficiency and can be used to forecast end-of-project cost.

F. *LIMITATIONS:*

There must be caution in the uses of forecasts based upon Value-of-Work and Status Indices as they merely indicate trends based upon a number of simplifying assumptions. For example, it is assumed that all basic factors in the plan remain unchanged. It is also assumed that the various units of costs and measures are comparable throughout the life of the project. This is often not true because of variances in administrative steps related to different work activities which have hidden cost, schedule or work values and are not explicitly accounted for in the project plan. Simplifying assumptions can seriously distort the forecasts. Project forecasts and trends analysis should be supplemented by thorough narratives based upon other systematic and objective data and observations.

Furthermore, project reports are based upon pre-determined sets of data and may not reflect all the characteristics of project performance which should be monitored to get a good picture of project progress, problems and opportunities. Because the reporting system is based upon identifying and analyzing deviations from plans, there is more focus upon problems of under-performance than upon the identification of creative potential opportunities. In addition, there also is an unhealthy tendency to make reports *appear* to *conform* to plans. This is especially true if the management and executive believe that project control means to enforce conformity to plans rather than to use plans as management tools for corrective decision-making.

ADVANTAGES:

Schedule, cost and resource analysis can be used along with Value-of-Work Analysis and Status Indices to obtain a complete picture of the overall project. The information and analysis must be kept current, so data must be available on a timely basis to ensure meaningful analysis and action.

The advantages of the techniques introduced for analysis, evaluation and forecasting, is that trouble areas can be predicted relatively early. Corrective actions can be initiated in time to avoid or minimize the impacts of the difficulties. This permits better control through planned management rather than crisis management. Trends analysis can also be used along with more substantial in-depth analysis of causes and implications to evaluate the implications of alternative recommendations for corrective action.

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G. *ASSUMPTIONS:*

Project forecasts based upon Value-of-Work Analysis or the Status Index make the simplifying assumption that the work values are comparable on various activities or for various milestones achievements. This is usually not true and forecasts can be distorted if not adjusted to the real situation. Appropriate use of these tools requires good judgement and intepretation.

Analysis, evaluation and forecasting are based upon the assumption that the appropriate information or data has been collected and that the analysis is timely as an input for decision-making. The use of these techniques can be quite time-consuming. Management must judge the usefulness of the tools and the information and be able to adapt to the constraints of the project team and management resources. The good project manager will use these tools for analysis at an appropriate level of detail to give useful information for problem solving and opportunity identification, but will recognize that these are just tools and must be accompanied by other managerial activities and judgements.

H. *SCHEDULE ANALYSIS*

Milestone events or Bar Charts are the core for schedule reporting. The number of milestone varies with the management level. Three basic management levels can be considered -- the activity level, the project level and the project management level. There will be more milestones on the activity level of a project, than on the project management level, and at the project management level than at the executive level. (SEE FIGURE 1).

The approximate proportions may be:

Symbol	Management Level	No. of Milestones
	Executive	10
	Project Management	30
	Activity	200

In organizing the project, approval authority is specified and related to the various management levels of milestones. For example, the accomplishment of an activity on "floor plan layout" may be the responsibility of a designated activity manager. That person has the authority to change the schedule for any of the milestones within that activity -- but the final milestone of completion will be the responsibility of the project management, and any changes in that milestone must involve the approval of the project manager.

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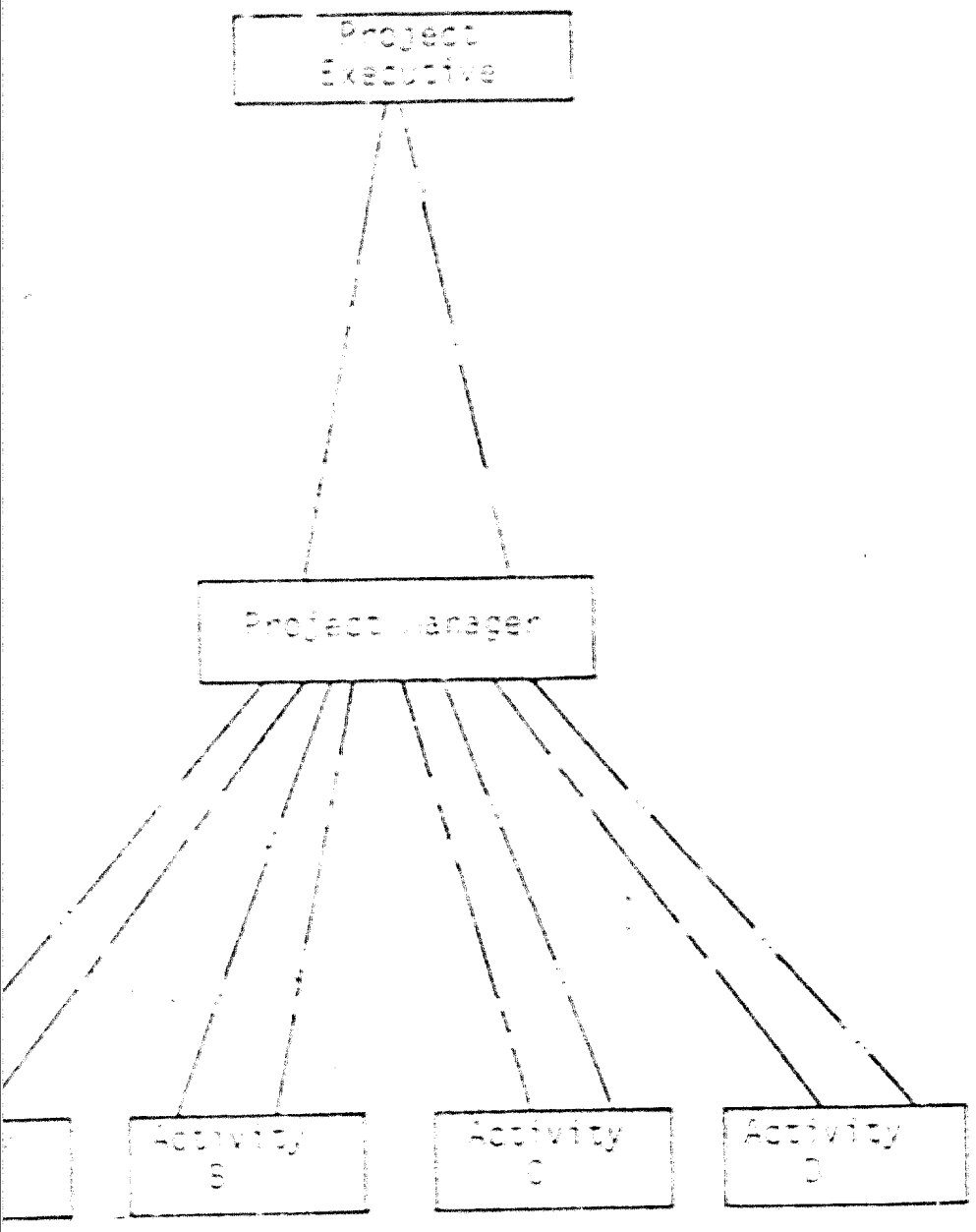

Executive Level Information

Summaries of project financial and physical progress. (e.g., monthly and quarterly reports)

Project Management Informatio

periodic monitoring and measur in summary form of performanc on activities to detect signi ficant deviations from plans. (e.g., weekly and bi-weekly reports).

Activity Level Information continuous and detailed data about direct use and control of resources and outputs.

- = Financial Information Links

- = Physical Information Links

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FIGURE 1: PROJECT INFORMATION PYRAMID

Project Executive

Executive Level Information

Summaries of project financial and physical progress, (e.g., monthly and quarterly reports)

Project Manager

Project Management Information

Periodic monitoring and *measuring* in *summary* form of performances on activities to detect significant *deviations* from plans, (e.g., weekly and bi-weekly reports).

Activity A | Activity B | Activity C | Activity D

Activity Manager

Activity Level Information

Continuous and *detailed data* about direct use and control of resources and outputs.

——— ÷ ——— = Financial Information Links

——— – ——— = Physical Information Links

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On a Project Master Schedule, milestones can be identified and coded as shown in Figure 2. A milestone status chart, as seen in Figure 3, lists all the project level and executive level milestones and their status. Activity managers should be expected to maintain a similar chart for specific activities. Status is indicated according to symbols designed for the project, such as those shown in Figure 2. Bar Charts make an excellent control instrument but must be updated regularly. This an important, but time-consuming task.

Project status is the relation of actual performance to expected or planned performance. A number of management tools can be used to show project status. In Figure 1, the techniques used in Bar Charts are illustrated. Bar Charts are constructed at the beginning of a project or set of activities and can be used to record actual performance. They must be systematically updated as performance is recorded.*

This use of a *Bar Chart* is illustrated in Figure 3. The task of building construction, for example, is late by two months, as indicated by the dashed lines. Approximately one and a half months of the work has been accomplished. The task remains two months behind schedule as indicated by the open bar before the "status date" line. The recommendation is for a change of the schedule to 15.5 months as shown by the code "X" within the triangle. This is an estimate of time-for-completion based upon present performance.

Trends Analysis shows a summary of performance and forecasts in a graphic form for display and analysis. The graphs are most useful with a narrative report giving a brief summary of project or activity status, potential problems with an analysis of causes, potential opportunities with recommendations for action, and a short analysis of controlling tasks for further completion. An example is shown in Figure 5. Such reports from the basis for project managers and project executives to make decisions for corrective actions on the project and to distribute information to other activity managers regarding implications for the performances of their responsibilities.

I. *COST ANALYSIS:*

Cost analysis begins with a financial plan. Figure 4 is a simple illustration of a plan in which the project is to receive allotments before expenditure which are to cover the planned costs. The allotments are shown by the dashed double bar, the planned expenditures are shown by the dashed

*See Module 8 - Using Bar Charts for Project Control

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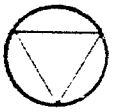
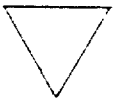
Milestones

All symbols in the following figures apply to all three levels but will be shown for the project level only.

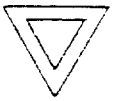


1. Executive level (or outside approval)

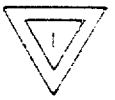
Project level



Task level

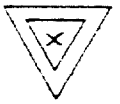


2. Scheduled completion date



3. First schedule revision

4. Actual completion date



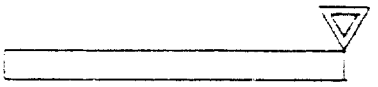
5. Rescheduling request

Note:
Open symbol indicates scheduled completion.
Solid, inverted symbol indicates actual completion.

6. Best estimate of completion date (from detail schedule system)

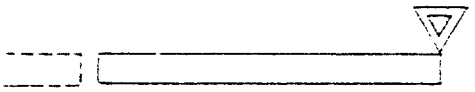
Activity bars

Activity initiation



Initiation on schedule

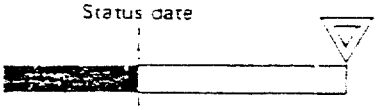
Late initiation



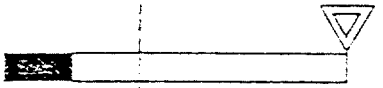
Early initiation

Status date

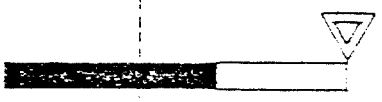
Activity progress towards completion



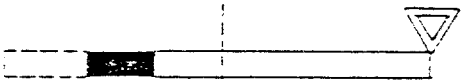
Activity on schedule



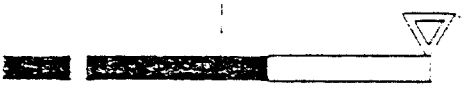
Activity behind schedule



Activity ahead of schedule



Late initiation — behind schedule



Early initiation — ahead of schedule

10

Figure 3. Milestone status chart

(Continue to include all project and executive milestones)

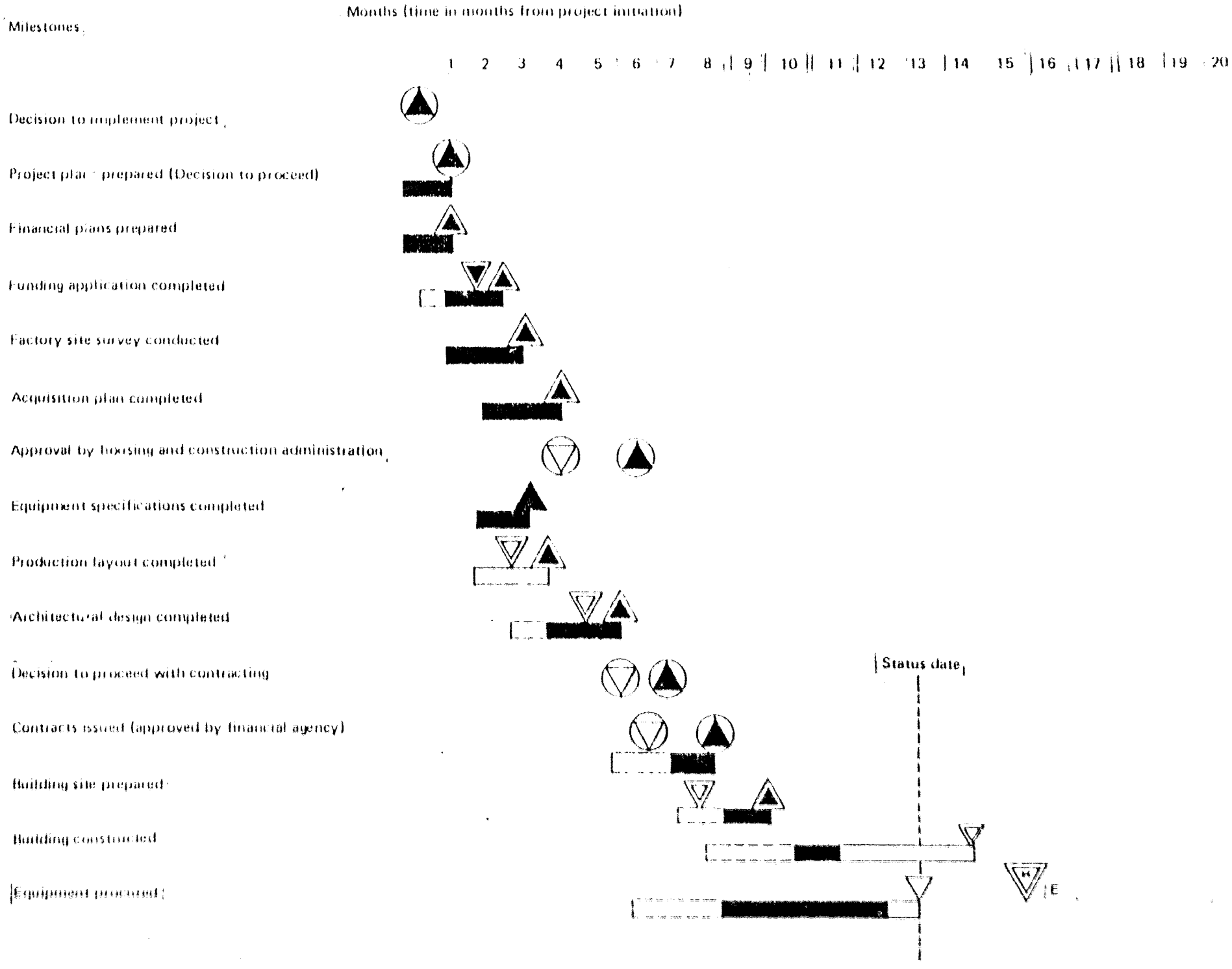
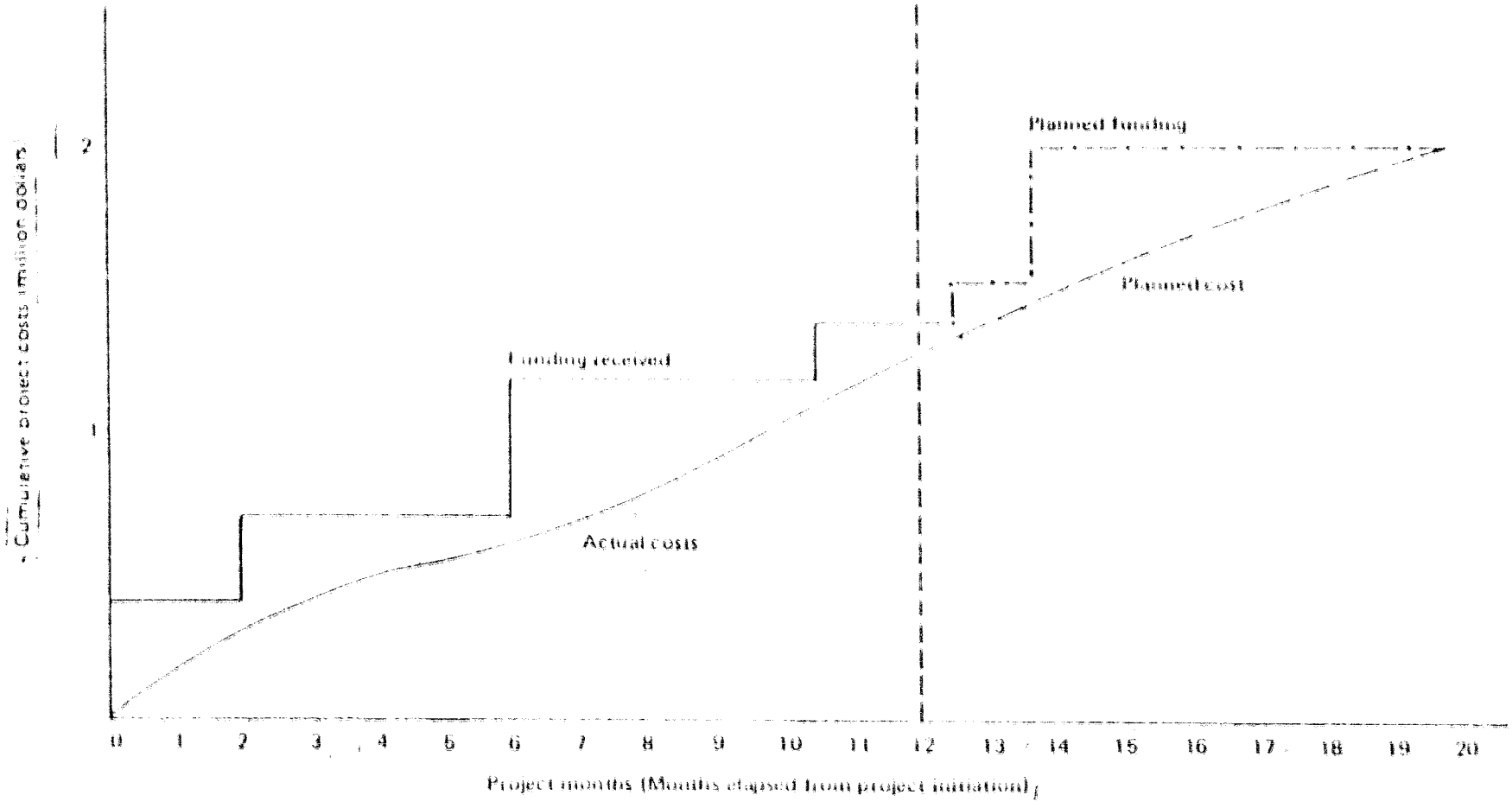


Figure 4 Master financial plan

Responsible: B. Frazer

MASTER FINANCIAL PLAN

Status as of _____ (Date)



single bar and the actual expenditure are shown by the solid single bar. In one graph the trend of project costs in comparison to actual costs and approved budget can be shown. The purpose of such a chart is to provide an overview of the history and outlook for project costs relative to funding.

J. *RESOURCE ANALYSIS:*

Similar presentation can be used in relation to other resources, providing the units are commensurate. For example, manpower analysis can be conducted showing man-hours, equipment-days, etc., required throughout the life of the project. This permits a comparison of planned with actual man-hours or other resource use. It would be necessary, of course, to isolate different types of manpower hours, e.g., labour, professional, administrative, etc. They cannot be lumped into a single chart. This analysis may be more useful for certain types of activities than others, for example, labour hours in clearing a certain acreage, or tractor driver hours for a cultivation activity. The usefulness of graphs is that deviations can be quickly detected and brought to the attention of management for analysis and determination of significance and corrective actions.

K. *VALUE-OF-WORK ANALYSIS:*

Value-of-Work Analysis provides an integration of actual performance on *schedule* and *costs* to get an overall picture of the project. The resources allocated over time to project execution are distributed among various activities and milestones.* The initial allocations of resources as planned becomes the "value" of the activities.

As a project progresses and activities (or milestones) are completed, they are credited with a pre-determined value, regardless of the specific activity cost. By comparing the actual cost incurred with the accumulated value for all finished activities and an appropriate percentage for activities in process, it is possible to obtain a relative measure of the efficiency of performance according to the plan.

*These would be based upon Activity Description Sheet, Milestone Charts and Resource and Budget Plans.
See Module 4 - Activity Description Sheets
Module 10 - Milestone Status Charts
Module 11 - Resource Planning and Budgeting

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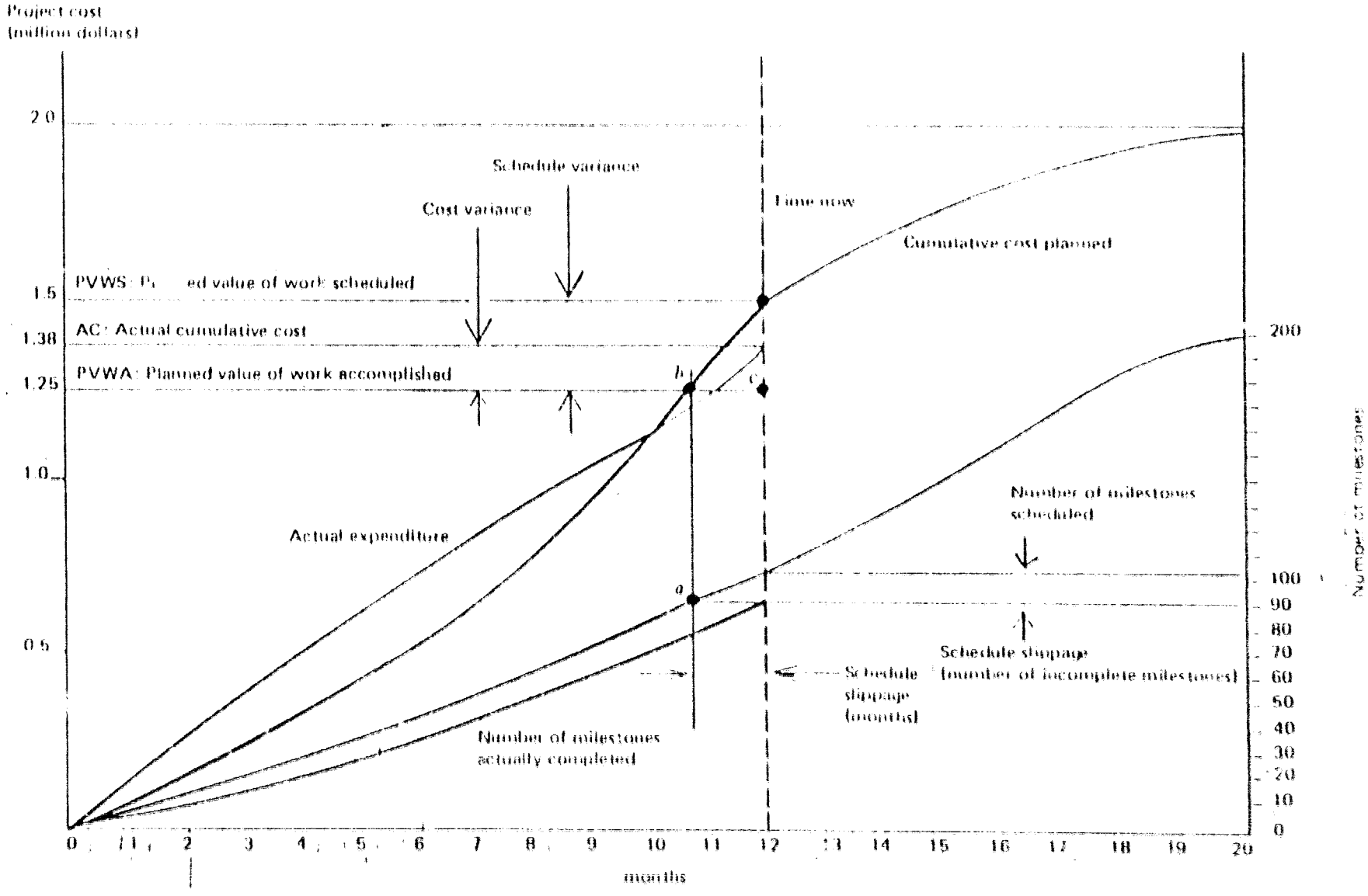
Figure 5 Value of work chart



A Value-of-Work Index can be calculated which can be used in forecasting to determine the significance of deviations. The assumption is that the value-of-work is similar on work and project expenditures up to and beyond a particular point of achievement. It is a simplifying assumption which must be adjusted to the real situation and requires good judgement and interpretation.

Value-of-Work Analysis can be quite complex, but should be encouraged for forecasting project needs based upon performance. A simplified illustration of its application in Figure 5 shows how the value of work can be measured using a milestone system correlated with a schedule and cost data to forecast end of project performance.

In Figure 5, two hundred milestones have been plotted in terms of planned costs and schedule. As work progresses, actual cost and schedule curves can be plotted. At the end of 12 months, the schedule has slipped 10 milestones as compared with the plan. By identifying the point on the number-of-milestones scheduled curve (point a in Figure 5) that compares with actual accomplishment, it can be seen that the schedule has slipped the equivalent of about 1½ months.

Since the cost plan has a direct relationship to the schedule plan (i.e., the budgets for activities/milestones were summed to determine the cost plan as a simplifying assumption), it is possible to determine the Planned Value of Work Accomplished (PVWA) by finding the point on the cost plan that relates to the Work Completed (point b). By projecting point b (PVWA) to the present time line (point c) for the purpose of comparing it with other data (planned value of work scheduled and Actual Costs (AC), the present cost variance can be estimated (i.e., the difference between PVWA and AC). The schedule variance can also be determined (i.e., the difference between PVWS and PVWA).

Using the Value-of-Work analysis discussed, it is possible to develop a Trend Analysis as illustrated in Figure 6 using an index. This evaluation chart can be included as part of the report to assist in project decision-making. In the illustration, the PVWA of $1,250,000 is divided by the actual cost of $1,380,000 to obtain a performance index of 90.6 percent. This is used to estimate the cost of the completion of the project at $2,208,000 or a cost overrun of $208,000. (SEE FIGURE 6). This gives the manager the information regarding the specific amounts which must be sought to complete the project long before project completion dates and avoids the sense of crisis. It also gives information for looking for trade-offs in the project to recoup some costs or to devise other contingency plans to deal with this deviation. It is important to analyze the values and significances of deviations if corrective actions are to be developed.

FIGURE 6: VALUE-OF-WORK ANALYSIS

$$\text{Performance Index} = \frac{\text{Planned Value-of-Work Accomplished}}{\text{Actual Cumulative Cost}}$$

$$= \frac{PVWA}{AC}$$

$$= \frac{\$1,250,000}{\$1,380,000} = 90.6 \text{ percent}$$

$$\text{Estimate at Completion} = \frac{\text{Project Value}}{\text{Performance Index}}$$

$$= \frac{\$2,000,000}{90.6 \text{ percent}}$$

$$= \$2,208,000$$

$$\text{Estimated contract overrun (underrun)} = \$2,208,000$$

$$= \$208,000 \text{ overrun}$$

L. *STATUS INDEX:*

Another status index that is relatively simple can be used to evaluate the status of a project. It also takes into account both schedule and costs. This index can be calculated for one activity or for the overall project. This technique is simple enough to enable necessary calculations to be performed by hand.

The index used to evaluate status is derived as follows:

$$\frac{\text{Progress}}{\text{Scheduled Progress}} \times \frac{\text{Budget}}{\text{Actual Expenditures}} = \text{Status Index Number}$$

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Basically, this status index is a means of relating actual progress and cost to the project plan. An index of 1.0 is par, and an index above 1.0 indicates better-than-expected progress for the money spent. Anything below 1.0 indicates leen-than-expected progress for the money spent.

The evaluation is made at any given time after the project is started. Consider a project on which 10 months of effort was to have been spent up to the present time when the evaluation is being made (scheduled progress = 10 months). Actual progress to the present is equivalent to only 7 mor of effort; that is, the project is 3 months behind the plan (progress = 7 months). Also, the original budget planned for the effort up to the present is $5 million (budget = $5 million). The actual expenditures on the project up until the present have been $6 million (actual expenditures = $6 million). The status index for this project would be calculated as follows:

$$\frac{7 \text{ months}}{10 \text{ months}} \times \frac{5 \text{ months}}{6 \text{ months}} = 0.58$$

This Status Index is a measure of the progress achieved for the money spent. It shows the basic relationship between the budget (input) and the progress (output). Consequently, the Status Index can be viewed as a ratio of the project output to the input and is a measure of project efficiency:

$$\frac{\text{Output}}{\text{Input}} = \frac{\frac{7}{10}}{\frac{6}{5}} = 0.58$$

This Status Index is merely a ratio or index for evaluation, and it is useful to indicate present status or status related to some prior period.

To determine where management attention is needed or to forecast performance, more than one calculation or index is required. A series of indexes on a number of key activities must be maintained and updated throughout the project. Progress can be examined, for example, in terms of the critical path or any stream of related activities whose progress is slow in relation to the other activities of the project.

Status Indices also can be used to forecast cost to completion, as shown in Figure 7. After initial fluctuations have subsided, the least squares method or a similar technique can be used in the projection. In Figure 7, 0.95 of the original estimated cost is projected to occur.

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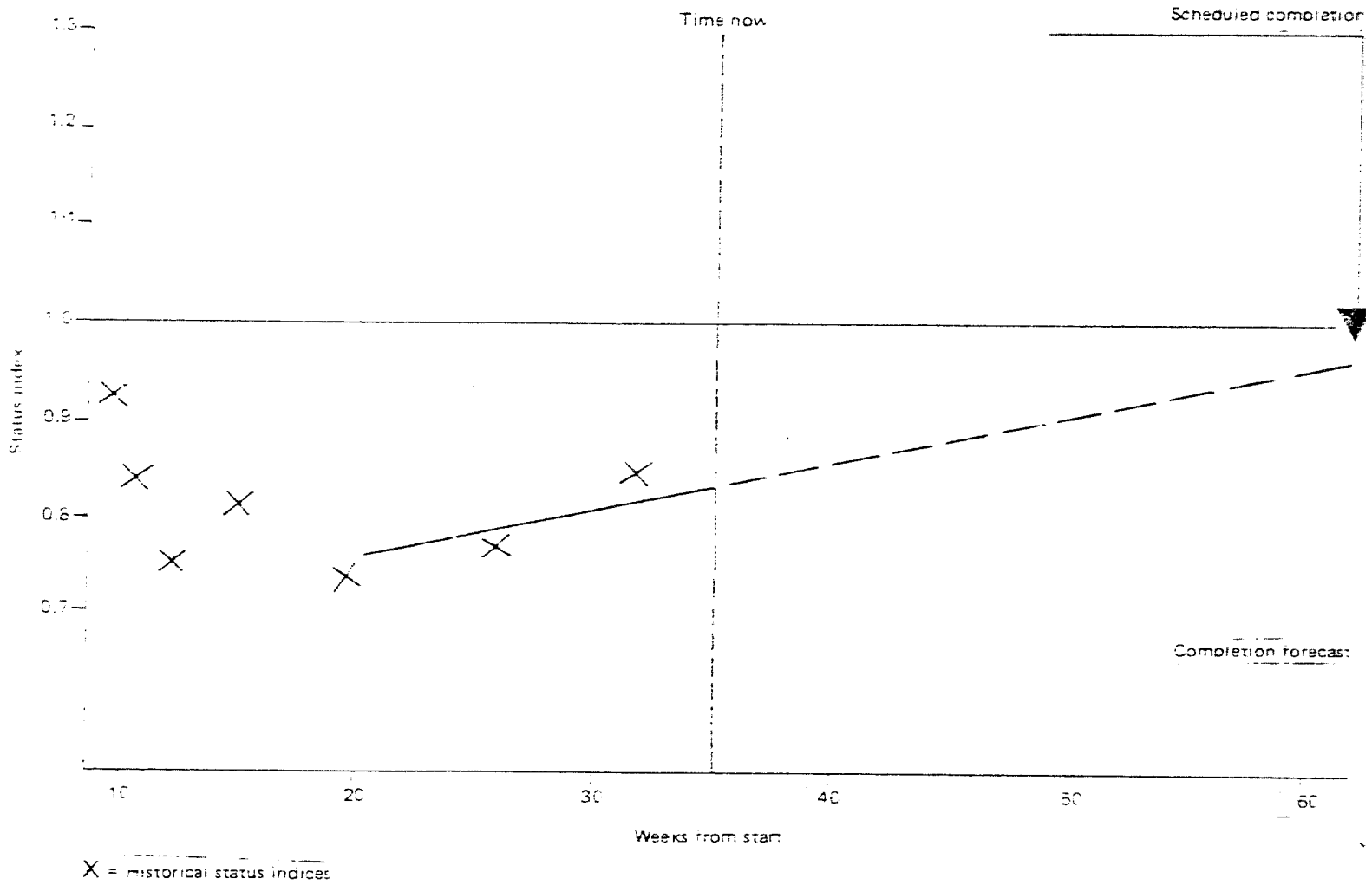
This is 105.3 percent of the estimated cost, or a projected overrun of 5.3 percent for the project.

FIGURE 7: FORECAST COST USING STATUS INDICES



Trouble areas can be predicted using this procedure. Historical comparison of the status index against the par performance index of 1.0 can be used to reveal how effective planning was or to reveal symptoms of performance deficiencies.

Trends analysis must be substantiated with more in-depth analysis of causes and possible implications or recommendations of action to get a

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complete picture of the project. Information must be kept current and available on a timely basis to ensure meaningful analysis and action. The good project manager will use these tools of analysis at an appropriate level of detail to give the necessary information for problem identification, analysis and evaluation.

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Project Planning and Management Series.

MANUAL - I Planning for Project Implementation
MANUAL - P Project Planning
MANUAL - M Project Management
MANUAL - PF Pioneer Farm Implementation Planning

MODULES

1. Defining Project Objectives (Objective Trees)
2. The Logical Framework
3. Work Breakdown Structure
4. Activity Description Sheets
5. Project Organization
6. Linear Responsibility Charts
7. Project Scheduling - Bar Charts
8. Bar Charting for Project Control/Scheduling
9. Project Scheduling - Network Analysis
10. Milestones Description Charts
11. Resource Planning & Budgeting
12. The Role of PAMCO
13. Project Technology Analysis
14. Demand Analysis
15. Market Strategy Analysis
16. Project Area Analysis
17. Project Costs & Benefits
18. Project Profile
19. Financial Analysis
20. Cash Flow Analysis
21. Discounting
22. Net Present Worth Analysis
23. Cost-Benefit Analysis
24. Benefit-Cost Ratio Analysis
25. Internal Rate of Return
26. Social Analysis of a Project
27. Economic Analysis of Projects (including Border Pricing)
28. Financial Statements & Ratios
29. Project Selection & Ratios Analysis
30. Brainstorming
31. Decision-making System for Projects
32. Project Institutional Environmental Analysis
33. Ecological Analysis for Projects
34. Introduction to Contracts, Jamaican Contract Document & Tendering Procedures
35. Selection & Use of Consultants
36. Project Documents for Planning & Implementation
37. Report Writing for Projects
38. Project Files
39. Formats for Pre-Feasibility & Feasibility Studies
40. Motivation of Employees and Personnel Evaluation
41. Design of a Project Management Control System
42. Evaluating & Forecasting Project Progress & Performance
43. Project Termination
44. Introduction to Lending Agencies
45. Organizing and Conducting Conference Meetings
46. Withdrawal of and Accounting for Loan Funds in the Financing of Projects