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Structured Approach to Project Execution, Monitoring and Control at Operational Level

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Abstract: Any real project is very complex. Many of the issues of project management are too difficult to be solved by mathematical programming. So the project tasks are very often undertaken on the basis of extremely informal planning. Project activities are also much non-routine in nature as compared to production. This poses problems to devise a structured method and to work in a structured way.

This paper presents a structured approach for execution, monitoring and control of project activities at operational level. Here we have proposed subjective evaluation as a means to determine index for activity criticality for selective monitoring and control, index for readiness level for starting execution of an activity, and a structured way to sort out issues for execution of activities. The scope of this paper is limited to operational aspects of task execution and does not include purchase of materials, recruitment of human resources, and finance.

Key words: Project management; Critical activity; Scheduling; Monitoring; Decision-making

1. INTRODUCTION

For purpose of planning and execution, a project is successively broken down into smaller manageable work elements called activities or tasks. Time-duration, resources and inputs are planned and assigned to individual activities for their execution. A schedule of activities is prepared based on time estimates and the precedence relationships between activities.

Once the project commences, review of project progress is done for the purpose of monitoring and control. Monitoring is collecting information concerning the progress of the project. Control involves using the data obtained through monitoring to bring actual performance into congruence with the plan (Meredith and Mantel, 1989). Some common factors affecting the amount of monitoring in a project are the cost of monitoring, total duration of the project, average time span of the tasks involved, the degree of completion of the project's groundwork, the urgency of the project, and exposure to delays due to unforeseen

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circumstances (Krupp, 1984). Yin [2010] has emphasized the need to recognize and rank the important factors affecting time and budget target. He has analyzed various methods of time and budget control and concluded that the managers should combine different control techniques to reach the success of a project.

Execution, monitoring and control processes are quite interlinked. Faniran et al. (1998) have observed that while much emphasis is given to development of plans for project implementation; hardly any emphasis is given to development of formalised plan for monitoring and controlling project progress. The control action may also lead to modification of plan. Caroline at el. [2009], have observed that project tasks are very often undertaken on the basis of extremely informal planning. They have stressed on structured decision-making process with regard to project management. This paper presents a structured approach for execution, monitoring and control of project activities at operational level. The scope of this paper is limited to operational aspects of task execution and does not include materials purchase, recruitment of human resources, and finance.

2. PROJECT EXECUTION PROCESS

The project work in any large or medium sized project is generally executed by a team. The team manager is assigned sizable amount of work to be done during a time duration ranging from three to six months. The work may pertain to single project or multiple projects. The work is successively broken down into smaller work elements called activities or tasks. Then a schedule of activities is prepared. The schedule is based on precedence relationship between activities and the estimates of their duration. The team manager assigns the work to different team members (officers/ supervisors) and contractors. We may refer to them as activity agents. The team manager selects the activities that should be done during a period, usually week, fortnight or month. At the end of each period, he compares this to the schedule and plans everything that will be done during the following period. Since there are constraints of resources and managers' time, he generally gives greater attention and priority to critical activities over others.

The activity agents check the availability of resources/inputs and other pre-requisites. If it is found that necessary resources/inputs and other pre-requisites to execute some activities are not available (or not likely to be made available during the period), effort is made to sort out the issues so that these activities can be taken up for execution in the next period. In general, when a delay happens in a specific period, it becomes necessary to compensate in the planning for the following period. During the re-planning the work schedule of a period, the activities that are brought forward from previous period are given priority.

The activity agents are bound by some form of obligation or contract to complete the activities within specified time and cost. Agents need support for execution of activities. They need facilities and inputs to execute the activities. The activity-agents at a higher level are also responsible for the activities that are assigned to activity-agents at their lower level. So they also have the responsibilities to sort out any issue/ problem that may crop up during execution of activities. The process of project execution, monitoring and control is shown in figure 1. It involves three essential steps.

Identification of the critical activities so that more attention or priority may be given to these activities. This involves rating of activities on some characteristics to differentiate between critical and non-critical activities.

Pre-review to check if the conditions and pre-requisites required for executing an activity are fulfilled or can be fulfilled.

Execution of activities and review. This involves organization all inputs, doing the work, and solving problems that crop up during execution.

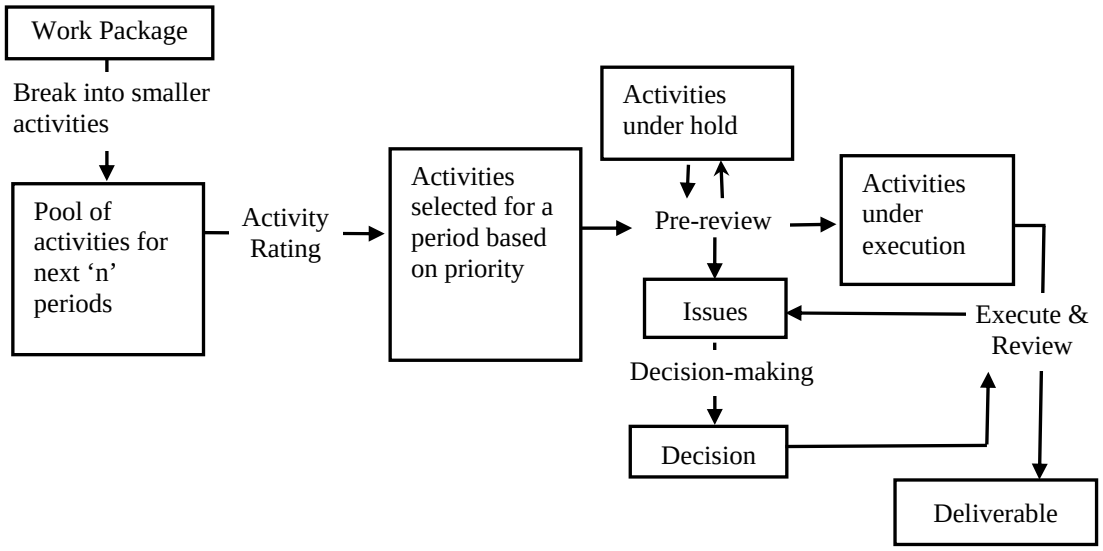

Figure 1: The Process of Project Execution, Monitoring and Control

The traditional CPM and PERT methods assume finish-to-start relationship between activities. But in practice, finish-to-start relationship between activities is not rigidly followed in most cases. There are other types of relationships as well, such as start-to-start, start-to-finish, and finish-to-finish. Sometimes due to unavailability of equipments, material or other problems, it becomes necessary to interrupt an activity and start another activity by deviating from the predetermined sequence. So in a real life project, the relationship among activities is sometimes quite fuzzy and complex. A number of software, information systems, and mathematical algorithms have been developed to match the complexities of project management. However gap still exists because many of the issues of project management are too difficult to be solved by mathematical programming. This is the reason why many project managers find structured approach as a hindrance rather than a useful aid.

However in order to be useful, the structured approach should be:

Simple and easy to follow

Data on activities, issues, decisions and implementation results be properly stored for decision making

Decision making model should permit subjective and qualitative evaluation of data

Based on above guiding principles, a structured approach has been proposed in this paper for execution of project activities at operational level.

3. ACTIVITY CLASSIFICATION AND PRIORITIZATION

The activities are generally planned and scheduled on daily or weekly basis. Periodic progress reporting and use of earned value concept are useful project monitoring tools for senior managers. But monitoring is also necessary at operational level, for which large numbers of activities have to be monitored. Practically it is difficult to thoroughly monitor each and every activity. The managers need to pay greater attention to critical issues associated with critical activities.

The current CPM framework only distinguishes activities with respect to their time-criticality and represents sequencing rationale using precedence relationships. But sometimes due to contingency situations, the project managers change the sequence of project activities. So there can be other criteria of criticality. Marcia Filipa Lopes Catarino at el [2009] used Delphi technique to identify the critical activities into several groups, ordered by their importance for the project success. Caroline at el. [2009] have

presented a model for project management using multi-criteria decision aid method, with the aim of ranking activities which deserve special attention. Bonsang [2006] has presented an activity classification scheme based on how rigidly an activity is bound with other activities.

So the criticality of an activity is determined from its process characteristics. Some of the characteristics of activities are as follows.

Effect on other activities: To what extent the delay in execution of a work-element affects other activities

Technology Content and Quality Requirement: To what extent technical expertise/ supervision is needed for executing the activity; and to what extent the quality of execution of activity affects the quality of the project

Requirement of Coordination: To what extent different functional departments/ sections are involved in execution of the project and to what extent coordination, conflict-resolution and teamwork is needed among them

Coordination with External Agencies: To what extent coordination/ liaison is required with government and other such external agencies

The activities can be rated on each process characteristic. Then criticality index of activity can be determined as under.

$C = c_1w_1 + c_2w_2 + c_3w_3 + c_4w_4$

Where c_1 , c_2 , c_3 and c_4 are rating of activity on different process characteristics and w_1 , w_2 , w_3 and w_4 are weights assigned to these characteristics.

The above list of characteristics is suggestive. Depending upon type of projects and project objectives some characteristics may be dropped or more characteristics can be included and suitable weights can be assigned accordingly.

4. PRE-REVIEW FOR ACTIVITY EXECUTION

Some amount of effort and preparatory work is needed for starting an activity. Last minute reschedule of an activity results in wastage of effort already made in preparatory work for starting the activity. This may result in considerable monetary loss and decrease in commitment of concerned project agent. Similarly stopping an activity mid-way causes delay and loss. Mohanty [2009] has emphasized the need for monitoring to check the availability of important inputs and resources before an activity is taken up for execution. He has presented a checklist for this purpose.

The status of preceding activities, availability of key materials, availability of key resource persons, and availability of key equipments / machines are some important parameters that should be evaluated to determine the level of readiness for executing an activity. Index to determine the level of readiness for executing an activity can be expressed as under.

$R = r_1w_1 + r_2w_2 + r_3w_3 + r_4w_4$

Where R is readiness index for executing an activity, r_1, r_2, r_3 and r_4 are rating of current preparation level for executing an activity on different parameters and w_1, w_2, w_3 and w_4 are corresponding weights assigned to these parameters.

So if readiness index for executing an activity is below a specified level, it may be preferable to reschedule the work rather than stop the work midway.

5. PLAN, ISSUES AND DECISIONS

Plans are design too. Plan contains design. Both may be considered as synonyms. The project plan specifies the following.

What is to be made? (Design)

How it is to be made? (Process/ methodology)

What will be needed? (Inputs)

When will it be made? (Schedule)

A plan is feasible if design is technically OK, methodology is appropriate, all inputs of desired attributes are available or can be made available and time duration specified in the schedule is adequate.

Success of project execution depends on its plan. If a plan is really good, no problem should crop up during its execution. But such ideal plans are generally not existent. Even if a plan is an ideal one, the changes in the environment may still create problem in its execution. Actually problems do crop up during execution of different tasks. The problems may be referred to as "issues" that need to be resolved for execution of tasks. Some common types of issues that crop up during execution of tasks are given in table 1.

Table 1: Common Issues during Task Execution

Typical Issues during Task Execution	Typical Decisions on Issues
Design is not clear or appears to be defective.	Clarification or modification in design
Methodology is not clear or appears to be inappropriate.	Clarification or modification in methodology
Particular inputs required as per plan is not available	Use of substitute inputs
Cost is higher than estimation	Approve higher cost or make certain cost trade-off
Schedule not feasible	Reschedule
Primary agent is not available	Assign to alternate agent

Decisions on minor issues may be taken by the activity agents at their own level and thus these issues may not be reflected. But when an issue cannot be resolved by the activity agent, it has be reflected and resolved by some other agent, who is generally higher to him in the organizational hierarchy. We may refer this agent as the "Decision Maker (DM)". An activity-agent at higher level may act as a decision-maker to issues raised at lower level. The DM may take decision by consulting his group members or some experts on the particular issues.

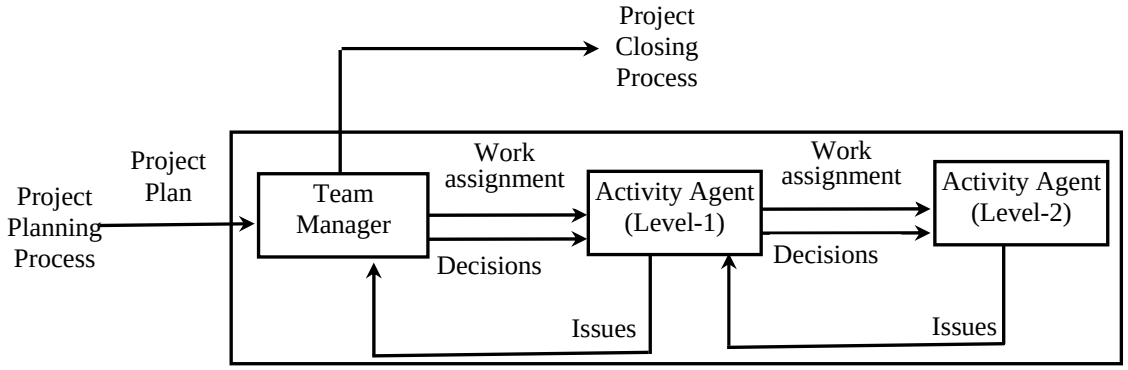

Figure 2: Managers' Role in Task Execution

Managers' role involves decision making to sort out issues that are encountered during execution of project plan as depicted in figure 2.

6. DECISION MAKING FOR ACTIVITY EXECUTION

Simon (1960) has proposed a well-known model for describing the decision making process. According to his model the decision making process consists of three phases as follows.

Intelligence Phase: Identification of situations requiring some decisions to be taken

Design Phase: Finding out the possible alternative decisions that can be taken in the given situation

Choice Phase: Selecting a decision or course of action from available alternatives

The Simon model is the fundamental model of decision-making process. However there are two aspects that need to be addressed in decision-making an organizational setup.

Decision-making activities in different phases such as intelligence, design and choice are generally done at different managerial levels

Decision-making is generally done as per certain formal procedures

Execution of project activities is carried forward through the decision making process. The managerial efficiency is derived from how fast the issues are identified and resolved through decision-making; and how fast the decisions are communicated and acted upon. The process of execution, monitoring and control are quite interlinked as depicted in figure 3.

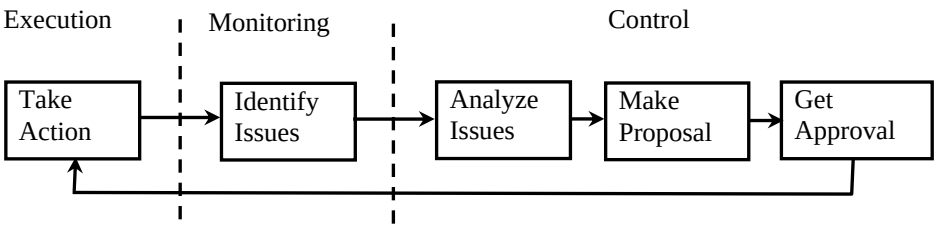

Figure 3: Relationship between Execution, Monitoring and Control

The activity agents raise requisitions to get necessary inputs such as resources, equipments, and material required for the activities. Next they direct the resources to get work done. But seldom, they get all the required inputs in time. The activity agents also face problem during task execution. Resolution of problems / issues involves three steps: (1) analyze issues to determine possible solutions, (2) select the best solution and make proposal to higher authority, (3) get approval from higher authority. The control actions are nothing but decisions that are taken either to resolve certain issues or to avail certain opportunities.

7. STRUCTURED DOCUMENTATION

Structured approach requires keeping records of all activities and their up-to-date status, issues and decisions. The structure of sample data-file for activity detail is given below.

I. Data-file: Activity detail

Activity ID. _____ Work Package ID. _____

Activity value: ____ (A - High / B - Medium / C – Low)

Work content: _____ in Man hours

Duration: _____ in days

Activity Criticality Index: ____ (A - High / B - Medium / C – Low)

Once an activity is scheduled and due for execution, it may be either under execution, or under hold for want of necessary pre-requisites, or under completion. Its status may be updated in activity status data-file. The structure of sample data-file for activity status is given below.

II. Data-file: Activity status

Activity ID. _____

Schedule start date: _____

Actual start date: _____

Activity Readiness Index at start: ____ (A - High / B - Medium / C – Low)

Present status: _____ (E – Under Execution / H – Under Hold / C – Completed)

The activities are executed by workmen. The managers' job is to identify issues and take decisions. Often the issues are resolved in informal manner. In a structured approach, it is desirable that the issues are listed serially so that the issues are not missed due to oversight. The issues may be initiated in a summary sheet form. A sample form for the purpose is given in box 1.

Issue Summary Sheet

Issue No. _____ Date: _____

Activity number (if issue pertains to specific activity): _____

Issue Type: Design / Equipment / Material / Human Resource / Time / Others

Description: _____

Issue referred to: _____ Date: _____

Proposal: _____

Date: _____Signature: _____

Proposal referred to: _____ Date: _____

Decision: _____

Date: _____ Signature: _____

Box 1: Sample form for Initiation of Issue

The status of issues may be properly recorded and updated in issue detail data-file. The structure of sample data-file for recording issue detail is given below.

III. Data-file: Issue detail

Issue Number: _____

Initiation date: _____

Importance: _____ (A - High / B - Medium / C – Low)

Issue Type: _____ (1. Design / 2. Equipment / 3. Material / 4. Human Resource / 5. Time / Others)

Present status: ____ (P – Under Proposal / D – Under Decision Approval)

By keeping records of activities and issues, the team manager will be able to generate information required for project execution at operational level, such as:

List of critical activities and their status

List of live issues by type, importance, date and their status

The progress report in a structured manner will also help in better control. A sample report is given in box 2.

ACTIVITY PROGRESS REPORT

Particulars	Number	Work content in man-hours
Activities completed before start of period	_____	_____
Activities completed during the period	_____	_____
Total:	_____	_____
Activities under execution at end of period	_____	_____
Activities under hold at end of period	_____	_____
Activities due for execution in coming period	_____	_____
Total:	_____	_____

Box 2: Sample form for Activity Progress Report

Similarly structured report on issues will also help in better control on resolution of issues. A sample report is given in box 3.

REPORT ON RESOLUTION OF ISSUES

Particulars	Number
Issues resolved before start of period	_____
Issues resolved during the period	_____
Total:	_____
Live issues at end of period	_____
Issues for which proposals have been made	_____
Issues that have been referred to external agency	_____
Total:	_____

Box 3: Sample form for Report on Resolution of Issues

Since quantitative data were not available for some parameters, qualitative assessment was used as a means for analysis.

8. CONCLUSION

Any real project is very complex. A number of software and information systems have been developed to match the complexities of project management. However gap still exists because many of the issues of project management are too difficult to be solved by mathematical programming. Project activities are also much non-routine in nature as compared to production. This poses problems to devise a structured method and to work in a structured way.

Due to above reason, it is very difficult to objectively determine many aspects related to project activities. So we propose that subjective review by technical experts can be an effective tool in a project execution scenario to determine:

Criticality index of each activity for selective monitoring and control

Readiness index of each activity (extent to which prerequisites necessary to execute an activity have been fulfilled) to initiate execution

We also propose that problems (issues) encountered during execution be listed and sorted out in a structured manner. The structured approach should make use of knowledge and intuitive judgement of managers and should not impose elaborate procedures. The structured approach should be simple and flexible so that it is not seen as a hindrance.

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