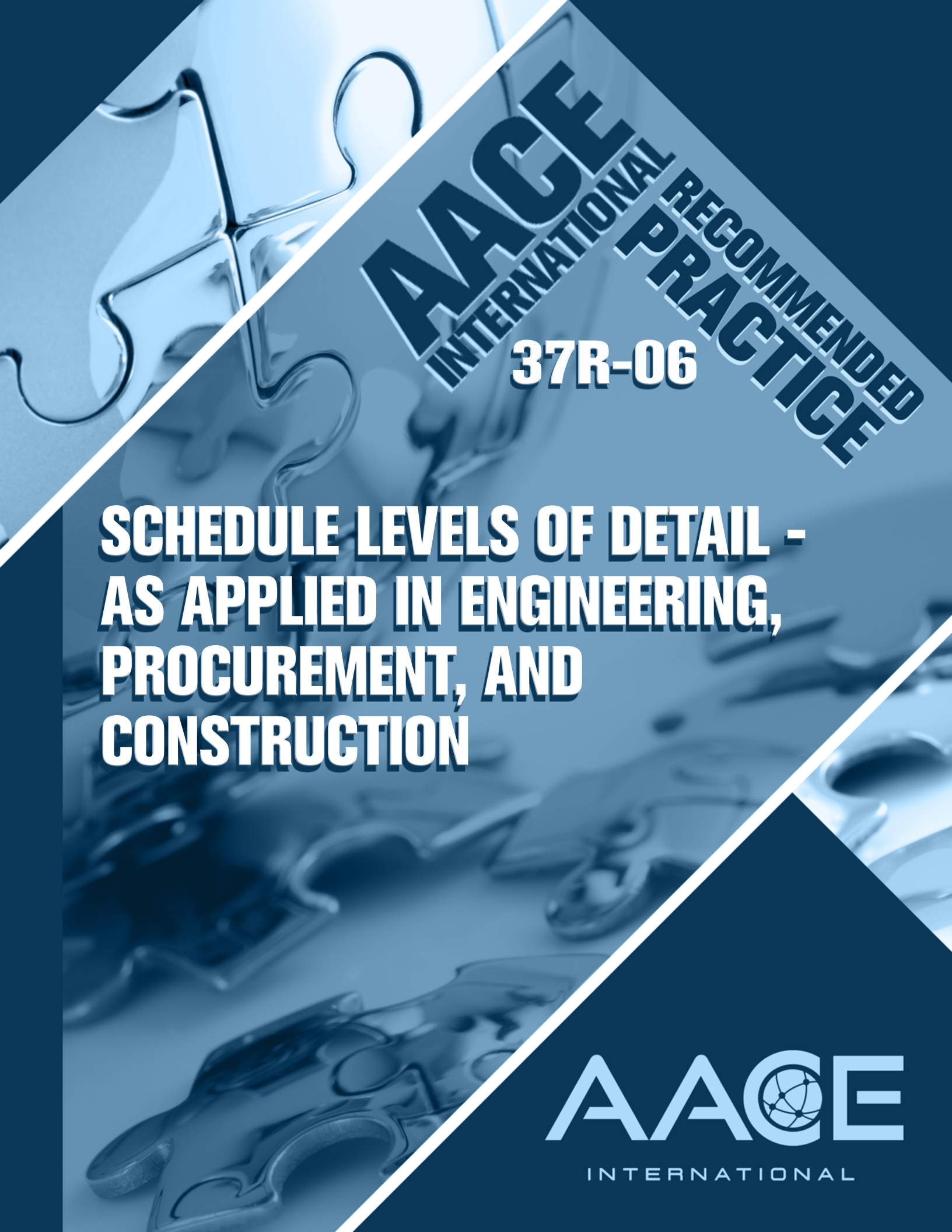

AACE INTERNATIONAL RECOMMENDED PRACTICE

37R-06

SCHEDULE LEVELS OF DETAIL - AS APPLIED IN ENGINEERING, PROCUREMENT, AND CONSTRUCTION

AACE INTERNATIONAL

AACE® International Recommended Practice No. 37R-06

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TCM Framework: 7.2 – Schedule Planning and Development

Rev. March 20, 2010

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Contributors:

Disclaimer: The content provided by the contributors to this recommended practice is their own and does not necessarily reflect that of their employers, unless otherwise stated.

Edward E. Douglas, III CCC PSP
(Primary Contributor)
Christopher W. Carson, PSP
Ricardo Garcia da Roza
Paul E. Harris, CCE
John K. Hollmann, PE CCE CEP
Donald F. McDonald, Jr. PE CCE PSP
Stephen E. Mueller, CCC EVP
Michael R. Nosbisch, CCC PSP
Anthonius Pramudhito
Arash Ranjbaran, PSP
Dr. Randy R. Rapp, PE CCE
H. Lance Stephenson, CCC
Ronald M. Winter, PSP

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PURPOSE

This recommended practice (RP) is intended to serve as a guideline, not a standard for owners and contractors to establish a common frame of reference and understanding when describing the level of detail for any construction project schedule. This RP identifies four schedule formats based on level of detail, and provides descriptions of schedule levels and the intended use of these schedules by project participants.

This recommended practice provides descriptions of the schedule levels methods with the intent to improve the understanding and communication among project participants and stakeholders involved with preparing and using project schedules. This recommended practice (RP) describes the schedule level methods that are prevalent in the construction industry today for reporting and communicating project schedule plans, results and forecast or "to-go" data to respective stakeholders. This RP excludes "turn-around projects", and does not necessarily apply to line of balance or linear scheduling applications.

INTRODUCTION

Project participants frequently misunderstand the definition of schedule levels, which limits the quality and value of the information provided to the stakeholders and project participants. Usually there is more than one level of schedule detail required and reported. Project participants and stakeholders require different types of data and levels of detail relative to their schedule usage.

The project owner or client is most likely to be interested in milestones and facility/feature start and completion dates at a higher or summary level. Contractors would monitor and control their subcontractors at an intermediate level and control their direct hire project efforts at a much greater level of detail. Subcontractors and vendors would typically monitor and control their own work at a task list level, even though they will be required to interface with other subcontractors or vendors and report to the construction manager or prime contractor at a higher level. Ultimately, the project contract documents, terms and conditions will determine the format and content of the project or program schedule levels.

Many scheduling specifications in the construction industry discuss "schedule levels" when referring to the volume of activity detail displayed in the project schedule, while other schedule requirements are defined with a descriptive title (e.g. "summary" vs. "control" schedules). The large engineering, procure and construct (EPC) contractors have developed systems within their organizations to describe levels of detail for their typical construction project schedules. Reporting requirements for schedule levels are routinely established in the project planning phase and ultimately incorporated into contract specifications using one of the generally accepted methodologies. There are a variety of accepted methods to describe or identify the levels of schedule details. This RP addresses and compares three generally acceptable methods:

1. Numeric Schedule Levels,
2. Engineering, Procurement, Construction (EPC) Schedule Levels, and
3. Descriptive Methodology.

The mixed use of the schedule levels methods often results in misunderstandings due to the inconsistent numbering systems or confusion regarding the descriptive terms. For example, a "summary schedule" and a "master schedule" are not the same thing. A master schedule is a consolidated schedule that incorporates multiple, related projects or parts of a project so that they can be monitored and controlled as a unit. This prompted the need to clarify the similarities and the distinctive characteristics of these schedule levels methods.

NUMERIC SCHEDULE LEVELS

Traditionally the schedule levels have been identified by a numeric designator such as the method described in Jelen's[5] and by the Construction Industry Institute (CII)[4]. This numeric method is related to the development of project or program approaches that have been documented within the construction industry. This numeric-based approach often correlates the schedule level to the project's work breakdown structure (WBS) but has not always been entirely consistent with the WBS. Both Jelen's *Cost and Optimization Engineering*[5] and the Construction Industry Institute's (CII's) Publication 6-5, *Project Control for Construction*[4] endorse the method that describes these numeric schedule levels:

Level 0: This is the total project and in effect is a single bar spanning the project time from start to finish. Functionally there is very little practical application for a schedule that is only a single bar other than to represent an element of a project or program time line. Level zero schedules normally will include the project or program major milestones and bars indicating key scope.

Level 1: This represents the schedule for the project by its major components. For example, a schedule for a process plant may be divided into process area, storage and handling area, services, site areas, and utilities. A Level 1 schedule is normally displayed as a Gantt or bar chart and may include key milestones.

To differentiate between program and project schedules: a Level 1 of a program schedule, for example, would be a combination of Level 0 schedules for each component project This would give program schedules at least one more level than the most detailed project schedule that constitutes the overall program.

Level 2: Each schedule component is further subdivided for Level 2. For example, utility systems are further subdivided into water, electrical, gas, storm drainage and sanitary systems, etc. In most cases Level 2 schedules can only be shown as a bar chart although key constraints may also be displayed. Milestones are normally included.

Level 3: The first level that a meaningful critical path network can be displayed and the CPM schedule can be used to monitor and manage (control) the overall project work. Level 3 is a good level for the overall project control schedule since it is neither too summarized nor too detailed.

Levels 4-X: The level of schedule subdivision continues to whatever is appropriate detail for the user. When operating at more detailed levels, the planners generally work with segments of the total schedule. Often the project "rolling schedule" includes a "look-ahead" period of time (30–180 days) and a "look-back" at recent completed work periods.

SCHEDULE LEVELS REQUIREMENTS

The various participants in a construction contract all have different requirements and levels of interest in the project schedule. The owner and the contractor's home office are interested in summary level schedules with key milestones. Project-level personnel are interested in more detail. Thus there are the various schedule levels requirements. There is no universal agreement as to the number of schedule levels and their format. Schedule levels descriptive methods correlate the communicating and reporting relationships to their respective audiences which allows the user to understand the amount of information desired for each level, such as project work area, work groups, work packages and activity/resource elements. The following provide further clarification:

- Schedule levels are determined by the detail required of the key project stakeholders. Since schedules are developed for the purposes of performing that specific phase of the work, all schedules therefore should roll-up from more detailed scope of the activities and tasks.
- It is intended that all of the levels of detail are derived by the "roll up" (summarized) or roll down (expanded detail) from a single "master" project schedule and are not developed as separate, fragmented versions of the project time phased plan.

- Ultimately, the purpose of the schedule is to support the successful time phased performance of each phase of work on the project.

The following describe the characteristics of each schedule level and includes an "end usage" to generally understand each intended use of the schedule level. Stakeholders and project participants who use the information from the various levels are identified. The schedule levels designated at Level 1 displays the highest or summary level of project information required by a select group of stakeholders, and Level 5 considers the most detailed breakout of the project scope. As stated above, this levels method is intended to be applied to projects of differing size and complexity, across almost all industries.

Level 1: Level 1 schedule is a high-level schedule that reflects key milestones and summary activities by major phase, stage or project being executed. This schedule level may represent summary activities of an execution stage, specifically engineering, procurement, construction and start-up activities. Typically represented in Gantt format and depending upon when and how developed, a Level 1 schedule may or may not be the summary roll-up of a more detailed CPM schedule. Level 1 schedules provide high-level information that assist in the decision making process (go/no go prioritization and criticality of projects). Specifically, a project may be considered part of a program of projects (whether completed, in progress, or not yet started). The level 1 schedule assists in defining the necessity of implementing actions and course correction (if warranted, it may be necessary for high level management to intercede in the execution of the project). Audiences for this schedule Level include, but are not limited to client, senior executives and general managers.

Level 2: Level 2 schedules are generally prepared to communicate the integration of work throughout the life cycle of a project. Level 2 schedules may reflect, at a high level, interfaces between key deliverables and project participants (contractors) required to complete the identified deliverables. Typically presented in Gantt (bar chart) format and rarely in CPM network format Level 2 schedules provide high-level information that assist in the project decision-making process (re-prioritization and criticality of project deliverables). Level 2 schedules assist in

identifying project areas and deliverables that require actions and/ or course correction. Audiences for this type of schedule include, but are not limited to general managers, sponsors, and program or project managers.

Level 3: Level 3 schedules are generally prepared to communicate the execution of the deliverables for each of the contracting parties. The schedule should reflect the interfaces between key workgroups, disciplines, or crafts involved in the execution of the stage. Typically presented in Gantt or CPM network format, and is generally the output of CPM scheduling software. Level 3 schedules provide enough detail to identify critical activities. Level 3 schedules assist the team in identifying activities that could potentially affect the outcome of a stage or phase of work, allowing for mitigation and course correction in short course. Audiences for this type of schedule include, but are not limited to program or project managers, CMs or owner's representatives, superintendents, and general foremen.

Level 4: Level 4 schedules are prepared to communicate the production of work packages at the deliverable level. This schedule Level should reflect interfaces between key elements that drive completion of activities. Typically presented in Gantt or CPM network format Level 4 schedules usually provide enough detail to plan and coordinate contractor or multi-discipline/craft activities. Audiences for this type of schedule include but are not limited to project managers, superintendents, and general foremen.

Level 5: Level 5 schedules are prepared to communicate task requirements for completing activities identified in a detailed schedule. Level 5 schedules are usually considered working schedules that reflect hourly, daily or weekly work requirements. Depending on these requirements, the Level 5 schedules are usually prepared a day or week in advance. Typically Level 5 schedules are presented in an activity listing format without time scaled graphical representation of work to accomplish. Level 5 schedules are used to plan and schedule utilization of resources (labor, equipment and materials) in hourly, daily or weekly units for each task. Audiences for this type of schedule include but are not limited to superintendents, general foremen and foremen.

ENGINEERING, PROCUREMENT, CONSTRUCTION (EPC) SCHEDULE LEVELS

The engineering, procurement, and construction schedule levels method developed and used by many of the larger EPC organizations is generally referred to as the "EPC model" and consists of only three formal levels, regardless of how large or complex the specific project being scheduled may be. The level of detail presented in an EPC model schedule is intended to be directly aligned with that particular phase of development for the project. In other words, the level of an EPC schedule detail would depend upon the detailed scope definition.

As the project moves into subsequent phases and more scope information becomes available, the schedule is revised to reflect this additional detail (which is sometimes referred to as a form of "rolling-wave" method of scheduling). For example, an EPC schedule early in the project could be developed to Level 3 in terms of the detailed engineering/design phase, but the procurement and construction phases might only be detailed to Level 1 or 2. This would be generally true at conceptual design, or at the basic (preliminary) design stage (or phase).

The **EPC Level 1** schedule summarizes the overall project for client and management. EPC Level 1 schedules show start and finish dates for the major project phases and key milestones (such as design, procurement, construction, and commissioning and start-up). Significant contract milestones and project-specific milestones or activities are included in EPC Level 1 schedules as required by the project execution plan.

EPC Level 2 schedules contain more detailed activities for each of the summary phases previously identified in the Level 1 schedule. This often includes a breakout of the various trades or disciplines responsible for the activities in each phase, the critical procurement activities, the major elements of construction, and general commissioning and start-up requirements. Generally in the EPC Level 2, this is the first level of scheduled detail where logical links or task relationships may be shown.

EPC Level 3 is the first level where the full use of critical path method (CPM) techniques could be shown effectively. In addition to start and finish dates for each grouping of deliverables or activities within each phase of the project, EPC Level 3 schedules include major review and approval dates as well. Most EPC schedule models are not developed below Level 3 in terms of CPM activity detail, with the intent to keep the schedule broad enough to be described for any specific project. EPC schedule levels are normally limited to Levels 1 through 3, however sometimes an "external" schedule data would be prepared and these external schedules are called "Level 4."

EPC Level 4 are detailed work schedules and generally would be prepared outside of the CPM software, with correlation to the CPM schedule activities and scope of work. The theory is, that if there is too much detail within the CPM network, the schedule would not only lose its flexibility as a value-added tool to manage the job, but schedule maintenance would become difficult, due to the greater effort needed to maintain the CPM logic after each progress update. A variety of software tools can be employed to develop work schedules at Level 4 and below: spreadsheets, databases, and word processing are all utilized.

DESCRIPTIVE LEVELS METHODOLOGY

The descriptive levels methodology that has been utilized by the construction industry uses descriptive words in place of numerical levels to identify the desired level of a schedule detail. Because of the varied background and confusion of the previously described mutually-exclusive schedule levels, that often results in misunderstandings due to the inconsistent numbering systems or confusion regarding many descriptive terms. For example, a "summary schedule" and a "master schedule" are not the same thing. A master schedule is a consolidated schedule that incorporates multiple, related projects or parts of a project so that they can be monitored and controlled as a unit. This method uses descriptive words to identify the desired level of schedule detail to clarify the similarities and the distinctive characteristics of these schedule levels descriptions as follows:

Program/ Project Summary Schedule

The summary schedule contains the least amount of detail and is a summary of the overall program or project timeline for client and upper management. Typically the summary schedule includes the major phases or functions and milestone objectives. The program or project owner provides the basic guidance of the project's scope to establish this schedule. The program summary schedule is a timeline of the various related projects. The value of this level is to provide an overview of the project from a conceptual view, allowing a general knowledge of the phases and areas of the project as well as key deliverables.

Milestone Schedule

Project milestone objective (target) dates are determined during the development of the project conceptual basis and are presented in this schedule. The milestone schedule can be either in a tabular or time scaled graphic format. This type of schedule normally contains only milestone events and is used to track major milestones for planning purposes or to monitor those milestones during execution phases. The value of this schedule is to coordinate other affected projects and tasks as well as to give an at-a-glance view of milestone completion goals and progress.

Project Level Schedule

The project level schedule is an activity and deliverable-centered schedule. Typically consisting of the major project phases and features of work, the project level schedule integrates the project's engineering, procurement and construction activities in time scaled network logic or bar charts. The CPM scheduling technique is used to develop the project level schedule and the project critical path can be identified. This schedule typically does provide some level of separation of work packages and can be used to monitor work package progress. The value of this schedule is to provide specific project delivery dates as well as show a detailed view of the integration of the different work packages and stakeholder commitments.

Project Control Schedule

The project control schedule is the detailed CPM schedule indicating the planned sequence to perform the work. The project control schedule clearly shows work by responsibility and is usually presented in bar chart or tabular format. The construction phase schedule indicates the planned sequence to perform the work, requirements for manpower and equipment, access and work space limitations, and reflect activities of subcontractors, equipment vendors and suppliers. Project control schedules include activities for key design documents to/from design consultants, subcontractors and key vendors, preparation of design calculations, construction and pre-commissioning documents, drawings, materials, and commissioning interface (by others) activities. Each of the responsible project participants is responsible to maintain and status the performance of their work activities. The project control schedule must include the entire project scope of work, identify interfaces and potential impacts to other contractors, operations and maintenance shutdowns, delays and disruptions, and is to be used for progress and performance measurement. This schedule is also used for analysis and what-if scenarios to determination the ramifications of delay events or project management decisions on the completion dates. The value of this schedule is to provide the regular monitoring and planning needs on the project along with establishing the basic model to be used for analysis.

Look ahead Schedule

The project master CPM schedule can produce a detailed look-ahead schedule in bar chart format showing activities for a period of time less than the total project duration. The look-ahead schedule highlights the near term priorities for each of the project team participants and is periodically reviewed at site meetings so responsibilities can be confirmed, actual dates and progress assigned, and potential conflicts and interferences prevented.

The look-ahead schedule would be developed with the relevant superintendent and field engineers for each trade or craft discipline and ultimately would integrate all of the crafts work schedules. A combined look-ahead schedule includes the past period actual or as-built performance as the first of a four-period schedule with the three-period look-ahead period. Routinely, look-ahead time periods are anywhere from two or three-weeks up to 90-days. Turn-around schedule activities used for refineries and process production plants outages are usually much more detailed and, thus, cover a shorter look-ahead time period. Turn-around schedule activities are measured in minutes or hours rather than days. The value of this schedule is to allow the on-site management and staff to plan and monitor daily work at the detail level necessary to coordinate production for each trade and specialty.

Task Lists

To manage daily work activities and provide the craft or crews with the proper tools and equipment when needed, individual or crew task checklists are often developed. These are non-CPM task or work lists that allow a project team to plan and document their work on a more detailed basis.

Supporting Data

An additional level of non-CPM detail would be project-supporting data that is usually compiled in spreadsheets or databases. These would be schedule narratives, project submittal registers, requests for information, punch lists, analysis reports, and similar collections of data that contain time-sensitive components.

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CONTRIBUTORS

Disclaimer: The content provided by the contributors to this recommended practice is their own and does not necessarily reflect that of their employers, unless otherwise stated.

Edward E. Douglas, III CCC PSP (Primary Contributor)
Christopher W. Carson, PSP
Ricardo Garcia da Roza
Paul E. Harris, CCE
John K. Hollmann, PE CCE CEP
Donald F. McDonald, Jr. PE CCE PSP
Stephen E. Mueller, CCC EVP
Michael R. Nosbisch, CCC PSP
Anthonius Pramudhito
Arash Ranjbaran, PSP
Dr. Randy R. Rapp, PE CCE
H. Lance Stephenson, CCC
Ronald M. Winter, PSP