فرآیند یکپارچه برنامه ریزی، زمانبندی و کنترل پروژه

بخش یازدهم:

استاندارد اجرایی: تنظیم، نظارت، کنترل و نگهداری Baseline در طول پروژه

ارائه دهندگان:

سید محمدرضا علوی‌پور

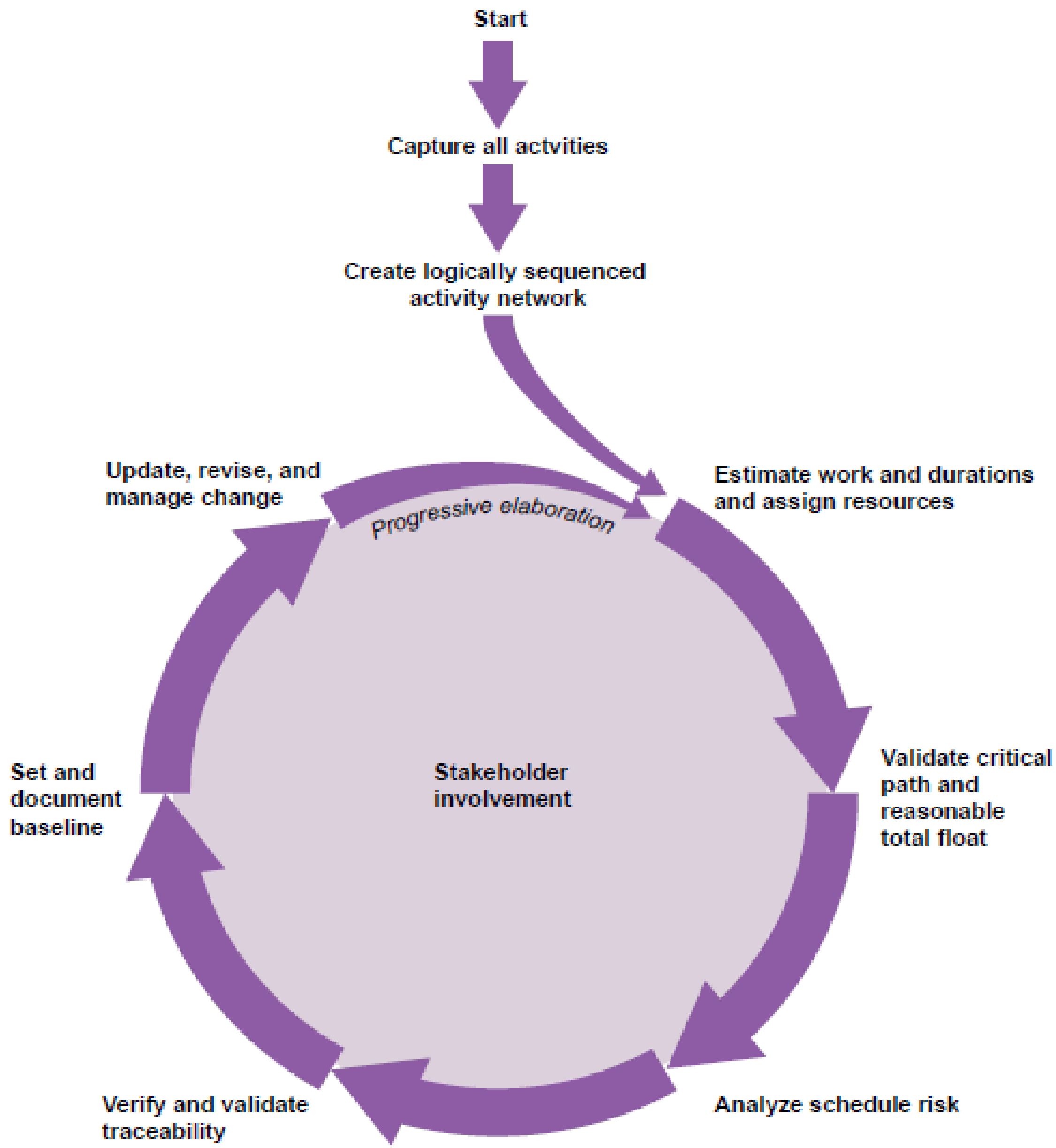
(PhD, PMP, CMIT)

What we will learn?

- Project Engineering planning and control
- Project Construction planning and control
- Setting a baseline
- Monitoring baseline
- Controlling and maintaining the baseline
- Checklist for a scheduler for setting, monitoring, controlling, and maintaining a baseline schedule
- An auditor’s key questions and documents for setting, monitoring, controlling, and maintaining a baseline schedule

A process for creating and maintaining reliable schedules

- ❑ This is a cyclic process
- ❑ Elaborated through rolling wave process.



A process for creating and maintaining reliable schedules

Process step	Corresponding action	Section
Capture all activities	Capturing all activities	3
Create logically sequenced activity network	Sequencing all activities	4
Estimate work and durations and assign resources	Allocating and leveling resources	5
	Determining and assigning durations to activities	6
Validate critical path and reasonable total float	Critical path determination, assessment, and validation	7
	Ensuring reasonable total float	8
Analyze schedule risk	Schedule constructability and risk analysis	9
Verify and validate traceability	Verifying that the schedule can be traced horizontally and vertically	10
Set and document baseline	Setting, monitoring, controlling, and Maintaining a baseline schedule	11
Update, revise, and manage change	Setting, monitoring, controlling, and Maintaining a baseline schedule	11
	Updating the schedule using actual progress and logic	12

Controlling and Maintaining the Baseline

(Project control and strategies for recovery and acceleration)

Monitoring and control

- **Project control** can be reduced to **two basic components.**

1. **Monitoring:**
   - Consists of a means of **understanding** **what is happening** on a project, **obtaining information** about the project **by some means**.
2. **Control:**
   - Consists of **action taken** in **response** to the **information**.

Thus, it is not sufficient to simply know what is happening on a project; knowledge carries with it the responsibility to respond to the available information.

Baseline analysis

- The **current schedule** is compared to the **baseline schedule** to track variances.

- **There are two deviations:**
  1. **Negative:** Changes in resource availability, late or early key deliveries, unexpected additional work activities, etc.
  2. **Positive:** Positive variances can indicate problems as well.
     - For example, **early starts** may cause issues with **out-of-sequence logic** and can **disrupt** the scheduling of **future resources**.

ACEMI

Baseline analysis

- A schedule variance does **not necessarily mean** program **delay**;
  - It means that work was **not completed as planned**.

- **Negative variances** should be **investigated** to see if effort is on the **critical path.**

- **Activities** that **vary significantly** from their baseline may create a **new critical path or near-critical path.**

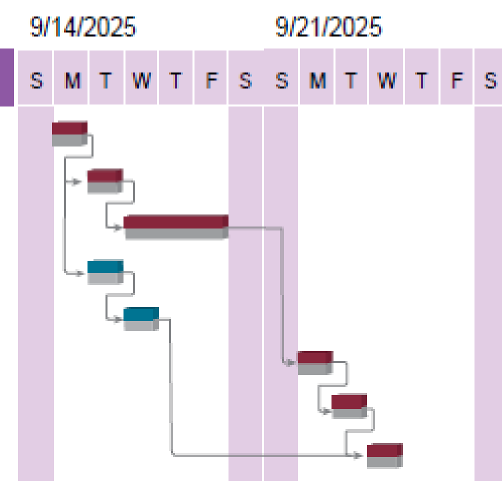
Baseline analysis – Example

- **Red activities** are forecasted to be **critical**
- **Blue activities** will have **4 days of total float** on their paths.
- **Gray bars** represent the **baseline start and finish** dates.

Before any progress is made on the project, baseline dates and forecast dates are the same.

Baselined Activities

Activity	Start	Actual start	Finish	Total float
Lay out and stake property and excavation	9/15	NA	9/15	0 days
Dig foundation and basement	9/16	NA	9/16	0 days
Lay out and form footings and pier pads	9/17	NA	9/19	0 days
Excavate for and install underground sewer	9/16	NA	9/16	4 days
Inspect underground sewer	9/17	NA	9/17	4 days
Install footing and pier rebar	9/22	NA	9/22	0 days
Inspect footing and pier rebar	9/23	NA	9/23	0 days
Pour footings and pads	9/24	NA	9/24	0 days



Source: GAO. | GAO-16-89G

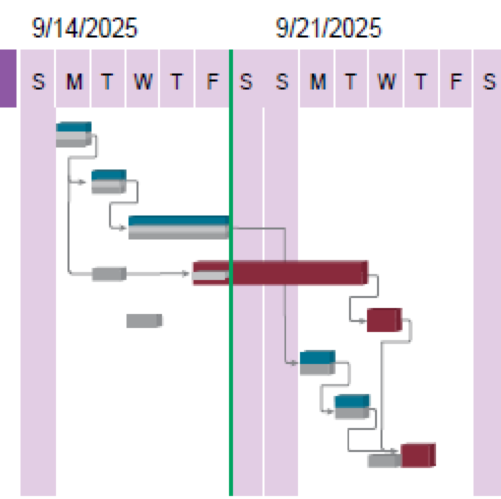
Baseline analysis – Example

- The **original plan** is to begin staking on **September 15** and to complete pouring footings and pads by **September 24**.
- **Green vertical line** represents the **current status date (Sep 19)**.
- **Gray horizontal bars** represent **progress** on **each activity**.
- Not only did the "**excavate for and install underground sewer" activity** start **3 days late**

  but also its effort is expected to **take 32 hours longer than originally planned**.

Updated Status Compared with Baseline

Activity	Start	Actual start	Finish	Total float
Lay out and stake property and excavation	9/15	9/15	9/15	0 days
Dig foundation and basement	9/16	9/16	9/16	0 days
Lay out and form footings and pier pads	9/17	9/17	9/19	0 days
Excavate for and install underground sewer	9/19	9/19	9/23	0 days
Inspect underground sewer	9/24	NA	9/24	0 days
Install footing and pier rebar	9/22	NA	9/22	1 day
Inspect footing and pier rebar	9/23	NA	9/23	1 day
Pour footings and pads	9/25	NA	9/25	0 days



Source: GAO. | GAO-16-89G

Baseline analysis – If activities started on or before its late start date

- As long as an activity:
    1. **Started** on or before its **late start date**

       and/or

    2. **Finished** by its **late finish date**

  the project itself will **not be delayed**.

- If **delay of the activity** from its scheduled start is **less than the available free float**,

  then the **project manager** need **not be concerned**,

  as absolutely **no other activity start dates** will have been **affected**.

Baseline analysis – If activities started on or before its late start date

- As long as an activity:
  1. **Started** after its **late start date**

     and/or

  1. **Finished** after its **late finish date**

     will cause a delay in the project.

- **DON'T FORGET THAT** a **different set of activities** may have become **critical** than was previously the case.

Before taking any action, perform delay analysis!

Baseline analysis – If activities started on or before its late start date

What should be done after analyzing delays?

1. If delays occur due to **owner's action**, **contractor** usually **do nothing** unless the **owner asks** to prepare **recovery schedule**.
2. If delays occur due to **general contractor's action**, he/she has several options to get the **schedule back on track,** this is called **recovery schedule** as well.

We will see these options

but

contractor must determine whether it is to their benefit to recover from delays

Should the contractor recover the schedule? – Trend analysis

- **Trend analysis** involves **collecting schedule measurement data** during each status period and plotting them over time.
  - A common way is to use **earned value management system (EVMS)**
    - ✓ **EVMS** measures the **schedule** and the **cost efficiency** of a project is through the use of **earned value**.

- The **construction industry** was an early **commercial adopter of EVM**. **Closer integration** of **EVM** with the **practice of project management** accelerated in the **1990s**.

Should the contractor recover the schedule? – Trend analysis

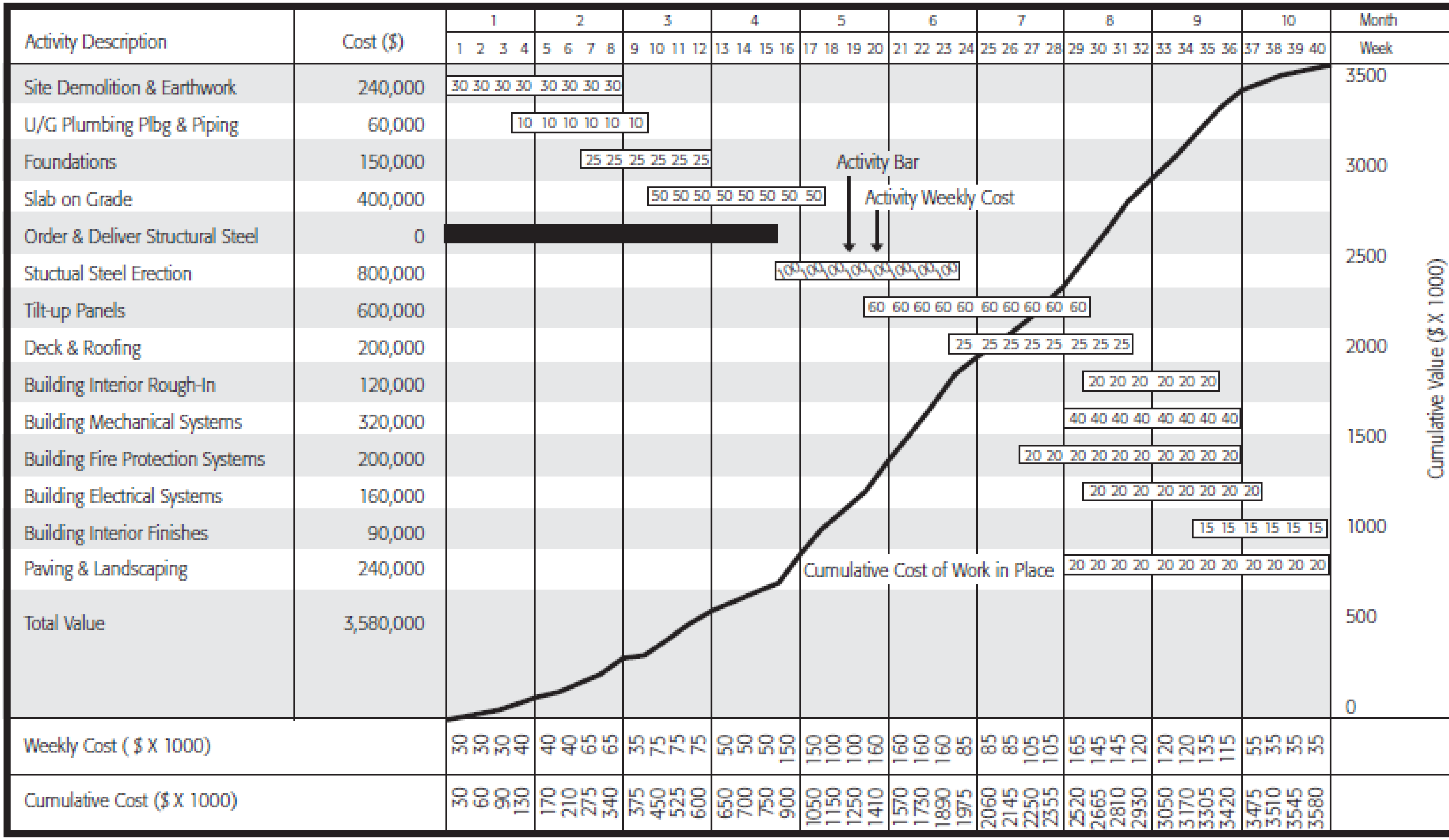
- EVMS compares the **physical work accomplished to date** with **both**
  1. **Actual cost** and
  2. **Planned work** to be accomplished.
- **Seven indexes** to measure the **performance** of a project:
  - Schedule performance index (SPI)
  - Cost performance index (CPI)
  - Schedule variance (SV)
  - Cost variance (CV)
  - Estimated cost at completion (EAC)
  - Estimated to complete (ETC)
  - To complete performance index (TCPI)
- **Four values** to calculate **seven indexes**
  - Actual cost of the work performed (ACWP)
  - Budgeted cost of the work scheduled (BCWS) or planned value (PV)
  - Budgeted cost of the work performed (BCWP) or earned value (EV)
  - Budgeted cost at completion (BAC)

Indexes are measured at the same date.

ACEMI

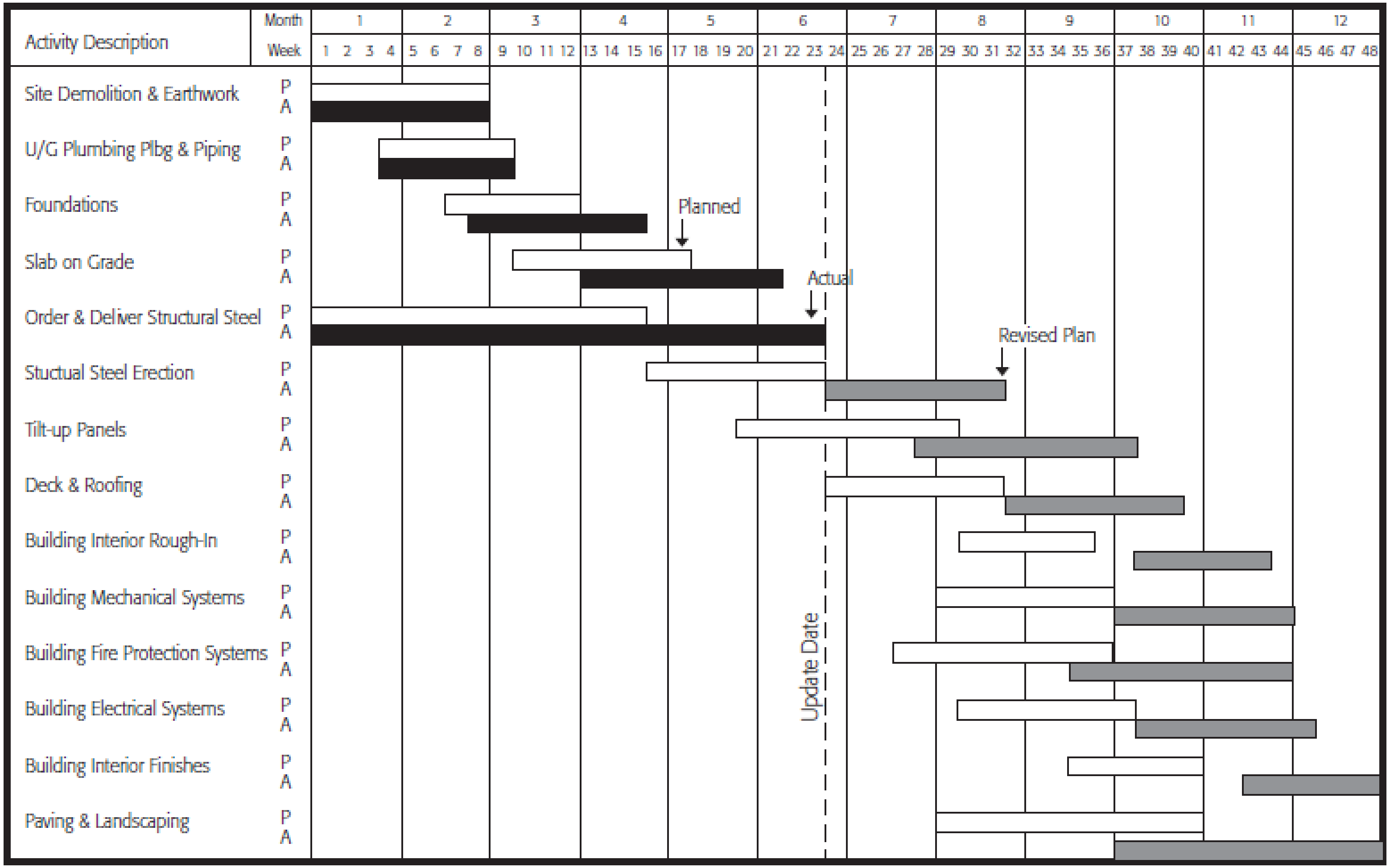
Should the contractor recover the schedule? – Trend analysis

- *Cost-Loaded as-planned schedule*



Should the contractor recover the schedule? – Trend analysis

- ***Schedule update***



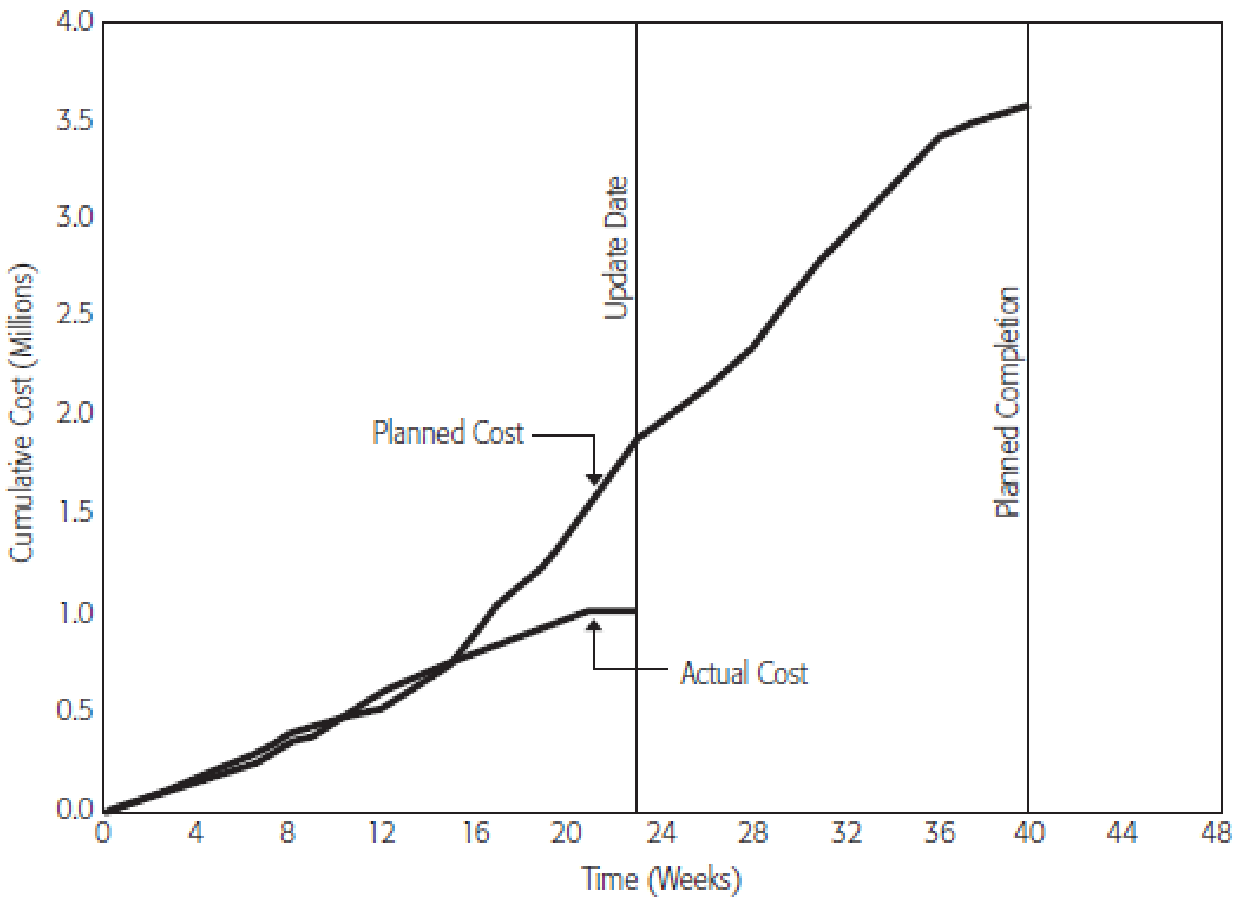
Should the contractor recover the schedule? – Trend analysis

- *Schedule update*

ACTIVITY	PLANNED BUDGET ($)	PCT COMP (%)	PLANNED BUDGET SPENT ($)	ACTUAL COST TO DATE ($)	COST VARIANCE TO DATE ($)
Site Demolition and Earthwork	240,000	100	240,000	320,000	(80,000)
Underground Plumbing and Piping	60,000	100	60,000	54,000	6,000
Foundations	150,000	100	150,000	240,000	(90,000)
Slab On Grade	400,000	100	400,000	405,000	(5,000)
Order and Deliver Structural Steel	N/A	100	N/A	N/A	N/A
Structural Steel Erection	800,000	0	0	0	0
Tilt-Up Panels	600,000	0	0	0	0
Deck and Roofing	200,000	0	0	0	0
Building Interior Rough-In	120,000	0	0	0	0
Building Mechanical Systems	320,000	0	0	0	0
Building Fire Protection Systems	200,000	0	0	0	0
Building Electrical Systems	160,000	0	0	0	0
Building Interior Finishes	90,000	0	0	0	0
Paving and Landscaping	240,000	0	0	0	0
Total	3,580,000	24	850,000	1,019,000	(169,000)

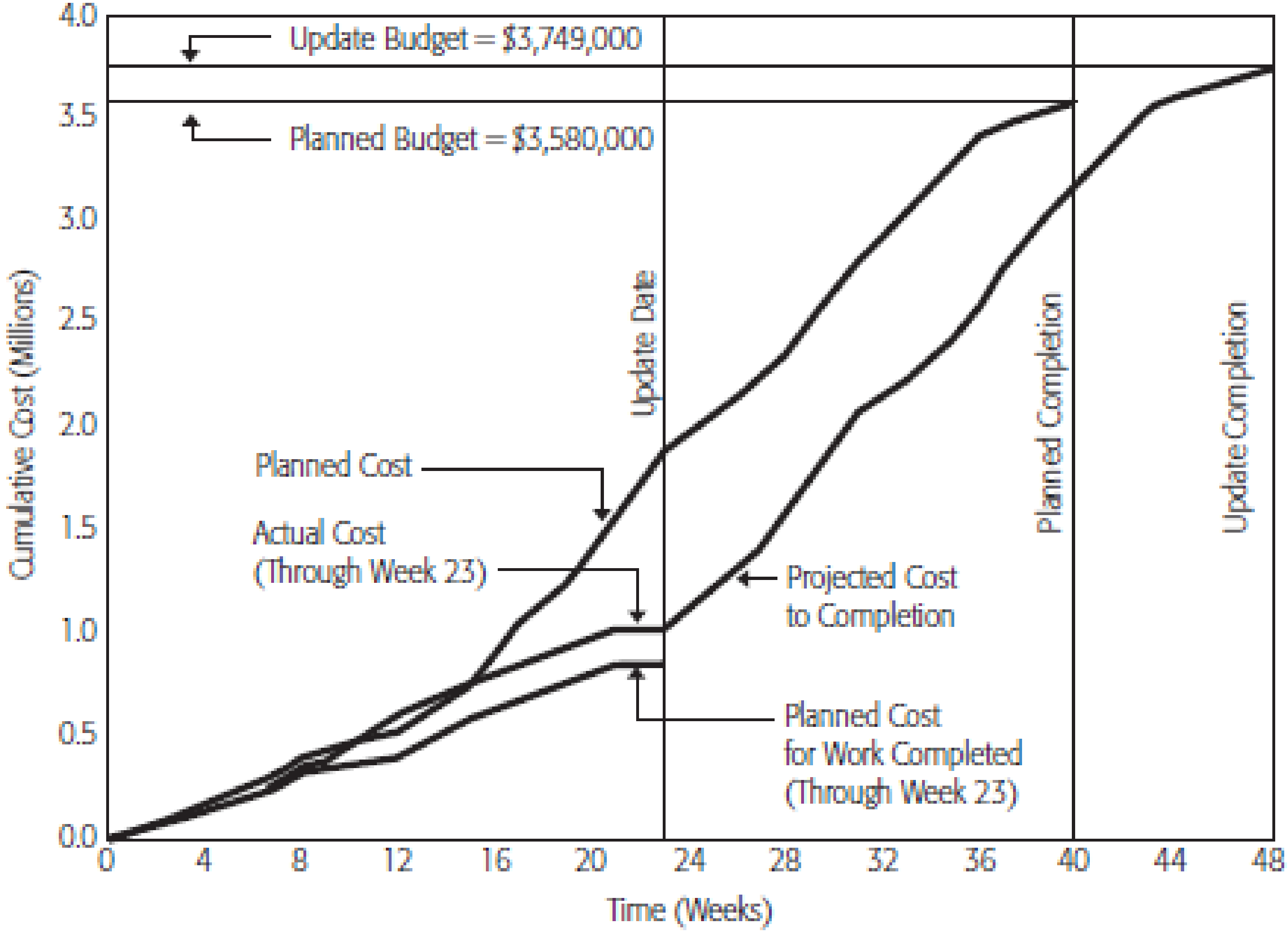
Should the contractor recover the schedule? – Trend analysis

- ***Project cost in place of update***



Should the contractor recover the schedule? – Trend analysis

- ***Project cost analysis***



Should the contractor recover the schedule? – Trend analysis

$$BCWS = (PS)(BCW)$$

Where: BCWS = Budgeted Cost of Work Scheduled
PS = Percent Scheduled
BCW = Budgeted Cost of Work

$$BCWP = (PC)(BCW)$$

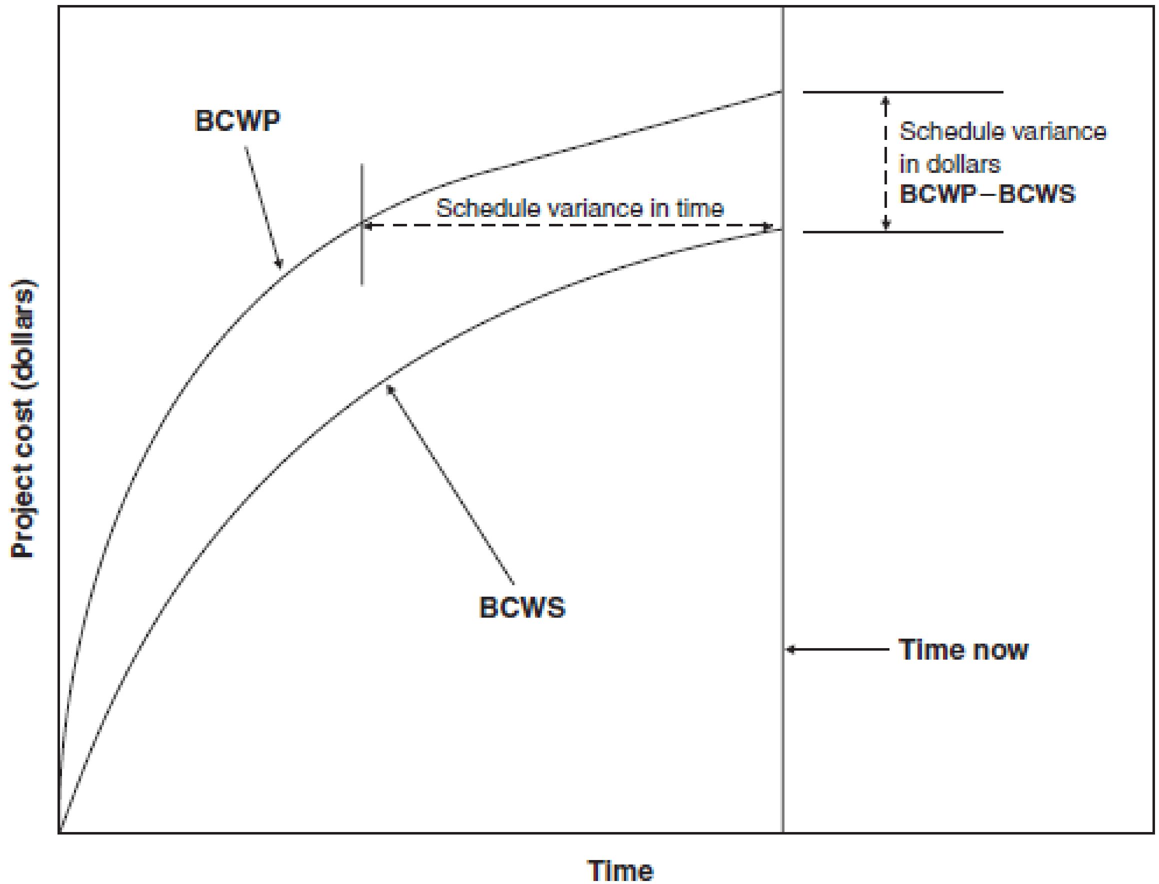
Where: BCWP = Budgeted Cost of Work Performed
PC = Percent Complete
BCW = Budgeted Cost of Work

Should the contractor recover the schedule? – Trend analysis

- **Budgeted Cost for Work Performed** (BCWP)
  - The value of completed work expressed as the value of the performance budget assigned to that work. This is equal to the sum of the budgets for completed work packages and the completed portions of open work packages.
  - Typically represents cumulative to date values, unless some other time period is specified.
  - Also referred to as the Earned Value (EV).
- **Budgeted Cost for Work Scheduled** (BCWS)
  - The sum of the performance budgets for all work scheduled to be accomplished in a given time period. This includes detailed work packages, Level of Effort (LOE) packages, apportioned effort, and planning packages.
  - Typically represents cumulative to date values, unless some other time period is specified.
  - Also referred to as the Planned Value (PV).

Should the contractor recover the schedule? – Trend analysis

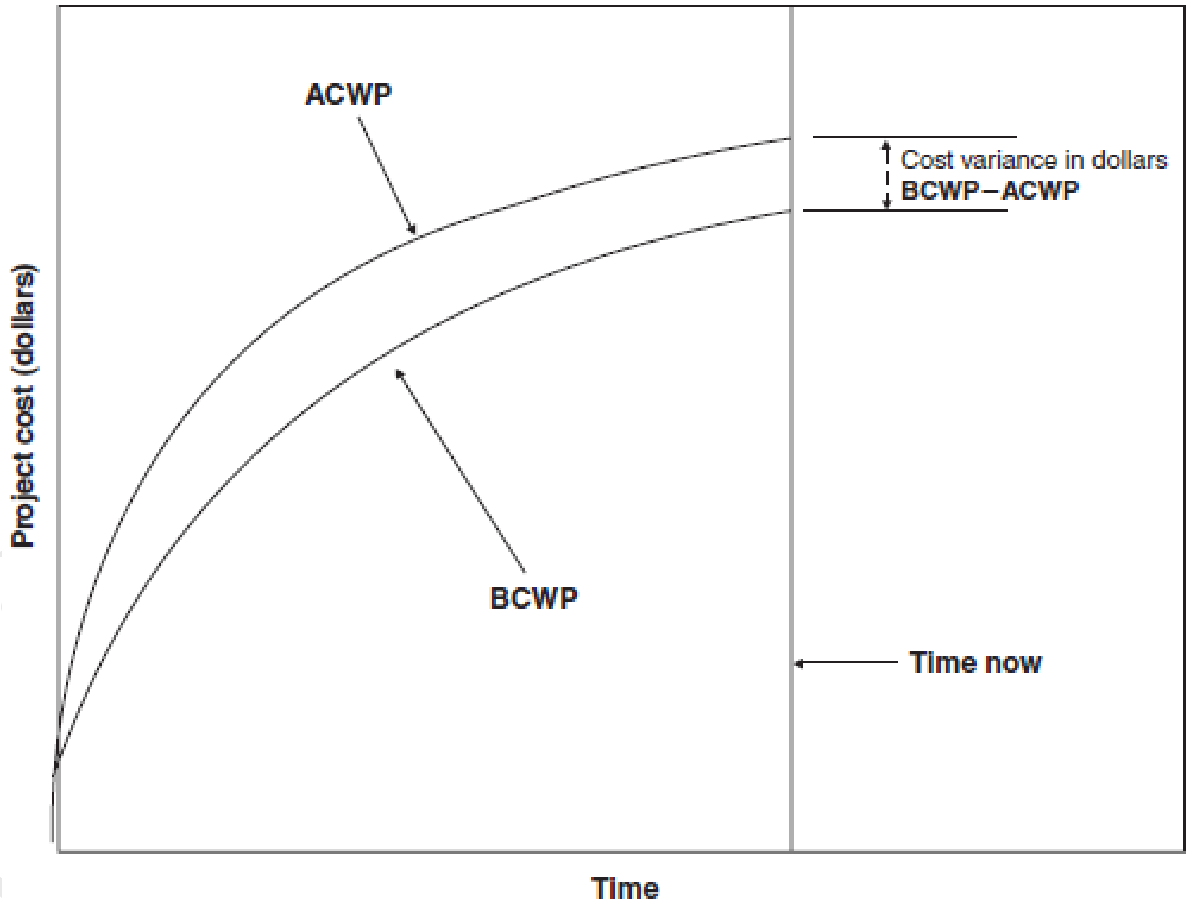
- Schedule variance (SV)



Earned Value Analysis Showing a Project that Is Ahead of Schedule.

Should the contractor recover the schedule? – Trend analysis

- Cost variance (SV)



Earned Value Analysis Showing a Project that Is Over Budget.

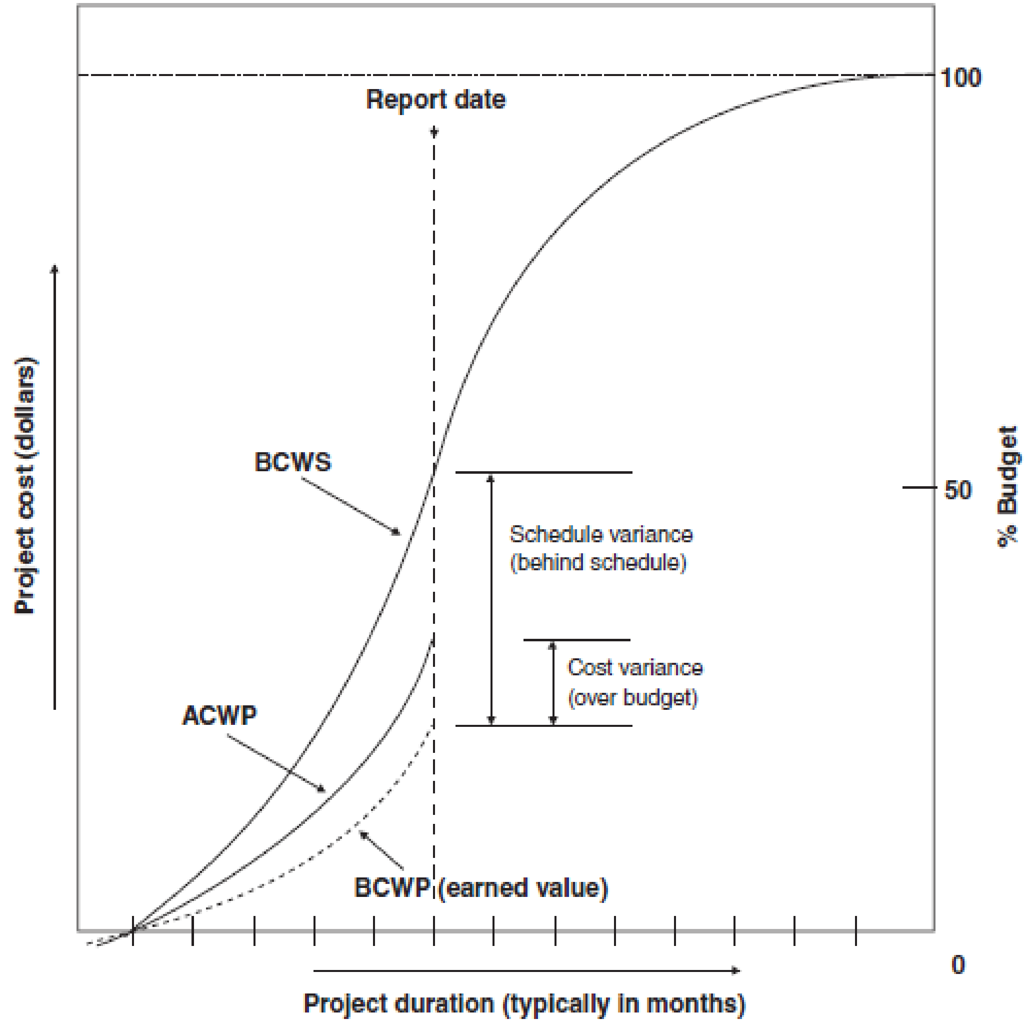
Should the contractor recover the schedule? – Trend analysis

- **Integrating cost and schedule**

- **Cost account** must represent a **unit** at which data can be collected on **both cost and schedule.**

- Likewise, the **unit** must relate to **the organizational structure of the company** such that reporting and management of **both cost and progress** can be expected from **company personnel**.

- **Expressing all work** in terms of a **single unit**, namely **work hours**, is **quite desirable**.
  - Work hours do **not carry some of the common problems** that are associated with budgeted costs.



General Concepts of Earned Value Analysis.

Should the contractor recover the schedule? – Trend analysis

- **Typical schedule measure data that can help managers are:**

1. Baseline execution index (BEI)
2. Total float and schedule contingency tracked by status period
3. Critical path length index (CPLI)

Should the contractor recover the schedule? – Trend analysis

- A measure known as the **baseline execution index (BEI)** is commonly used in **baseline analyses**.
  - *BEI = the number of detail activities that were completed to the number of detail activities that should have been completed by the status date.*
    - ✓ BEI = 1 indicates that the project is performing according to plan.
    - ✓ BEI < 1 indicates that, in general, fewer activities are being completed than planned;
    - ✓ BEI > 1 indicates that, in general, more activities are being completed than planned.

The BEI is an objective measure of overall schedule efficiency, however it does not take the importance of activities into account.

Solution?

Should the contractor recover the schedule? – Trend analysis

Note: While there may be exceptions under certain circumstances, programs typically exclude the following activity categories from BEI counts and calculations:

- Summary Tasks
- Level of Effort (LOE) Tasks
- Milestones (zero duration tasks)

  - Level-of-Effort (LOE) tasks are excluded from BEI calculations. The primary reason for this exclusion is to keep the LOE from "masking" the true state of the program.
  - LOE is generally included in the calculation of a program's SPI (although programs can exclude LOE). Much like BEI, the inclusion of LOE on SPI effectively dampens (skews toward 1.00) the true execution performance of a program.

Should the contractor recover the schedule? – Trend analysis

- The **use of total float over time** is a key measure for **monitoring the health** of the program.

- A **quick consumption** of total float **early** in the program may indicate that
  - **More serious schedule delays** will occur in the future
  - **More serious cost overruns** will occur in the future.

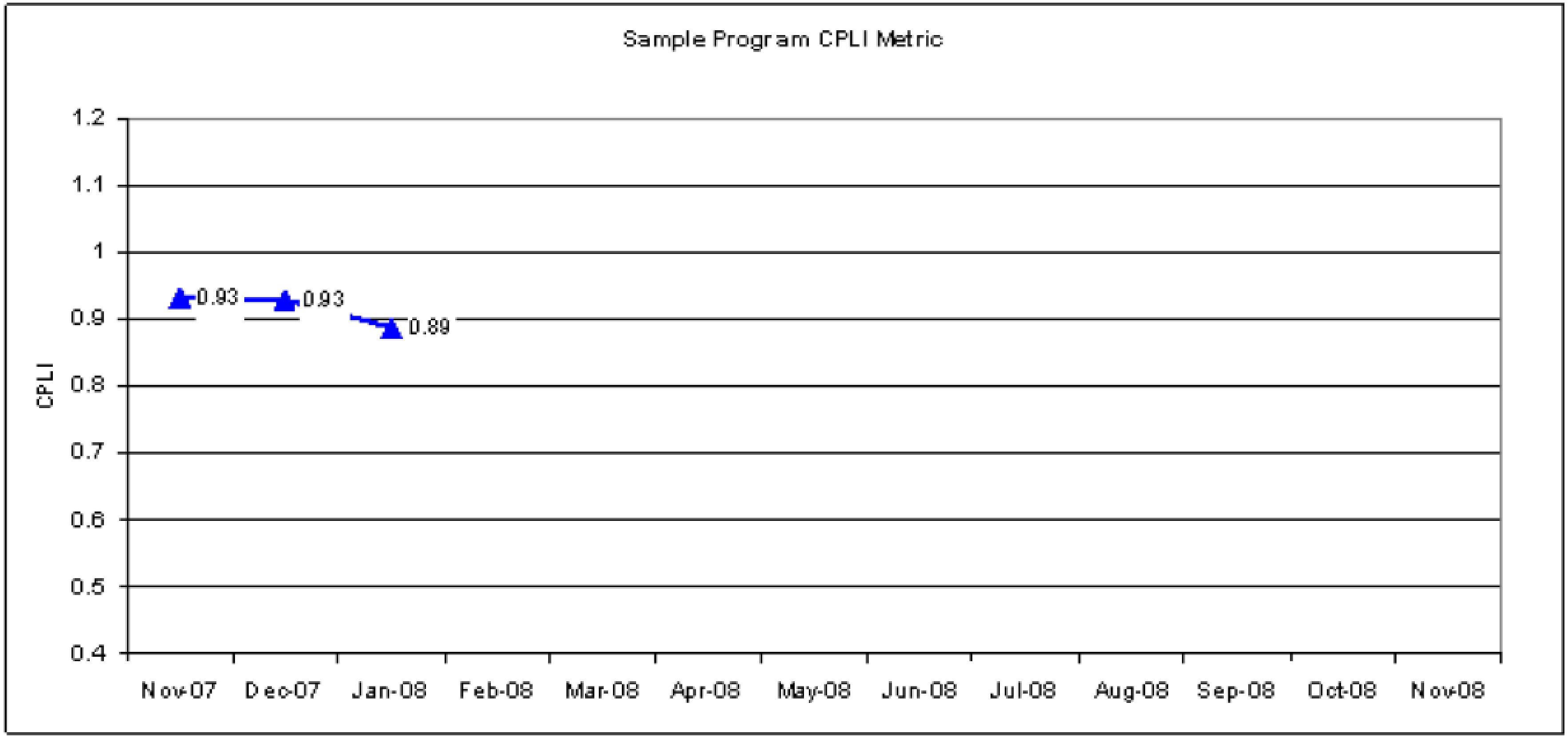
Should the contractor recover the schedule? – Trend analysis

Calculate CPLI using the following formula:

$$CPLI = \frac{\text{Critical Path Length} + \text{Total Float}}{\text{Critical Path Length}}$$

CPLI Value	*Implication*
> 1.00	**Favorable** - The Critical Path is ahead of a plan, Total Float is positive and program completion can still be achieved with an efficiency rate less than 100% going forward.
1.00	**On Target** - The Critical Path is on plan, Total Float is zero and an efficiency rate of 100% is required going forward.
< 1.00	**Unfavorable** - The Critical Path is behind plan, Total Float is negative, and an efficiency rate greater than 100% is required going forward to recover.

Should the contractor recover the schedule? – Trend analysis



Sample Program CPLI Metric, showing trend data for the CPLI calculation

Should the contractor recover the schedule? – Trend analysis

Schedule Metric	Full Name	Summary	Relationship to Other Metrics
SPI	Schedule Performance Index	Measure of demonstrated schedule performance, using traditional EV data, which can be used as a comparison for future projections	Similar to: BEI, SPI_t
BEI	Baseline Execution Index	Measure of demonstrated schedule performance, using task counts, which can be used as a comparison for future projections	Similar to: SPI, SPI_t
CPLI	Critical Path Length Index	Measure of the risk associated with meeting a downstream deadline	Similar to: TFCI
CEI	Current Execution Index	Measure of near-term schedule forecast accuracy	No close relationship
TFCI	Total Float Consumption Index	Measure of demonstrated schedule efficiency which can be used to predict a project completion date	Similar to: CPLI
SPI_t	Time-Based Schedule Performance Index	Measure of demonstrated schedule performance, using traditional EV data except from a time perspective, which can be used as a comparison for future projections	Similar to: SPI, BEI
TSPI	To-complete Schedule Performance Index	Measure of the future schedule efficiency that will be needed in order to not exceed the project's forecasted duration	Commonly compared to SPI_t
$IECD_{es}$	Independent Estimated Completion Date – Earned Schedule	A predicted project completion date, based on future schedule performance being consistent with past schedule performance	Based on SPI_t

All of these metrics have been taught in advanced level course!

Recovery schedule

- When **changes** to the **future** activities **alter** the **completion date** to an u**nacceptable time**, additional **changes** to the **schedule** will need to be made.
  - This is called **"Recovery Schedule."**
- **Sometimes** the **owner** asks for an **acceleration** to **deliver** the project at an **earlier time**.
  - The owner should pay the extra cost
- It is **subsequent** to an **update** on the schedule, with the **purpose** of **recovering lost time** in a project schedule while **minimizing** the **cost** of the project.
- This **process begins** with an **updated schedule**.
- **Recovery schedule** is **implemented** at a **cost**, and this cost must be a **serious consideration** when recovery schedules are prepared.

Recovery schedules versus updated schedule

- **Updated schedule** reflects the **reality** of the **current status** of the project with **no changes** being made to the **logic** or **durations** pertaining to the **activities** that are **yet to be completed**.

- The **recovery schedule** reflects **changes** in the **uncompleted portion** of the schedule.
  - **Changes** may be made to **logic**, **activity durations**, and **other things** to **deliver** project in a **shorter** period of time.

Who initiates the recovery schedule?

VERY IMPORTANT:

- If the **contractor generates** the **recovery schedule** **without** **advising** the **owner** of the **cost** and the **need** for a **change order**, this might constitute a **waiver** of the **contractor's right** to seek a

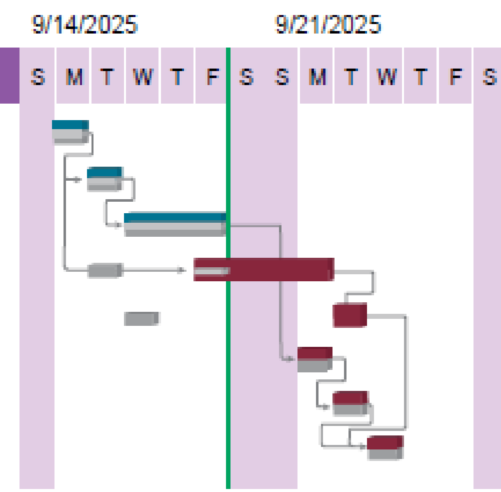
time extension + **delay** and/or **acceleration-related cost**.

Strategies for recovery schedule

- This figure shows the effect of the **general contractor's plan** to get the program back on track by **adding extra resources** to the install activity.
  - This **reduces the installation activity** by **1 day** and places the **"pour footings and pads"** activity back on its **originally planned date**.

Updated Status and Proposed Plan Compared with Baseline

Activity	Start	Actual start	Finish	Total float
Lay out and stake property and excavation	9/15	9/15	9/15	0 days
Dig foundation and basement	9/16	9/16	9/16	0 days
Lay out and form footings and pier pads	9/17	9/17	9/19	0 days
Excavate for and install underground sewer	9/19	9/19	9/22	0 days
Inspect underground sewer	9/23	NA	9/23	0 days
Install footing and pier rebar	9/22	NA	9/22	0 days
Inspect footing and pier rebar	9/23	NA	9/23	0 days
Pour footings and pads	9/24	NA	9/24	0 days



Source: GAO. | GAO-16-89G

Strategies for recovery schedule

- **Acceleration** is different with **recovery** in terms of **concept** (**not technique**)
- The focus for schedule recovery or acceleration should be on **critical activities** and, in particular, on **long-duration critical activities**.

Technique	Description	Side effects
Crashing	Add resources to time-dependent activities to complete work faster	Requires additional resources and thus increases costs; may also reduce quality if activities are executed faster and with less-experienced labor
Fast tracking	Reduce the sequential dependencies between activities to partial dependencies. For example, F–S logic is reduced to S–S logic to force parallel work	Resources may become overallocated; quality may also be reduced and risk introduced if activities ideally executed in sequence are now executed in parallel
Split long activities	Split long activities into shorter activities that can be worked in parallel	Resources may become overallocated
Review constraint and lag assumptions	Reassess assumptions related to forcing activities to begin on certain dates	If the original date constraint or lag is justified, removing the constraint or lag may not be realistic

Strategies for recovery schedule

- **Regardless** of what **combination of methods** is used for acceleration or recovery of variances, the schedule should be **archived before the change**.
- **After** the schedule is **modified**,
  1. **Techniques** used should be **documented**
  2. **Critical path** **recalculated**
  3. **Schedule** **assessed** for reasonableness.

Review duration estimates	Revisit duration estimates using progress records as actual effort is recorded	
Add overtime and reduce vacations	Review nonworking periods and assign overtime work	Costs will increase over standard labor rates; as overtime increases, morale decreases, eventually affecting the quality of the product negatively
Reduce scope	Decrease scope to reduce both duration and costs	Scope is the primary reason for performing the work, and it may not be possible to delete some requirements
Schedule contingencies	Allocate contingency to absorb delay in accordance with identified risk mitigation plans	Using contingency too early in a project reduces the likelihood of the program's completing on time, particularly if the reason for a delay was a risk that was not previously identified and quantified

Source: GAO and NDIA | GAO-16-89G.

As-Built schedule

- The **final version** of the **current schedule**—the "as-built" schedule—represents the **plan as executed to completion**.
  - Particular care should be taken to **archive** this **final version**.
- **Once** the project has been **completed**, the as-built schedule becomes:
  - **Database** of the **actual sequence** of events
  - Activity durations
  - Required resources
  - Resource productivity

These can be compared to the original plan for an assessment of lessons learned, and the data become a valuable basis of estimate input for schedule estimates of analogous projects.

ACEMI

Important notes about As-Built schedule

NOTE:

- The **most** widely recognized use is in the area of **claims**, especially **delay claims**.

- If the **as-built schedule** covers the **entire duration** of a project and shows **significant variations** from the **as-planned schedule** even when **no intervening events** took place

It may say the original plan has low creditability

Checklist For a Scheduler For Setting, Monitoring, Controlling, and Maintaining a Baseline Schedule

Checklist

- A **schedule basis document** is a single document that defines organization of the IMS;
  - describes the logic of the network;
  - describes the basic approach to managing resources;
  - provides a basis for all parameters used to calculate dates;
  - describes the general approach to the project;
  - defines how to use the schedule file;
  - describes the schedule's unique features;
  - describes the schedule change management process;
  - contains a dictionary of acronyms and custom fields;
  - gives an overview of the assumptions and ground rules, including justification for
    - calendars,
    - lags,
    - date constraints,
    - long activity durations, and
    - calendars and working times;

ACEMI

Checklist

- A **schedule basis document** is a single document that defines organization of the IMS;
  - describes the use and assignments of resources within the schedule in appropriate detail;
  - describes the critical risks prioritized in a schedule risk analysis as well as schedule contingency;
  - discusses the derivation of the critical paths, longest path, and total float for the program;
  - is considered a living document that reflects updates to the baseline schedule.

ACEMI

Checklist

- A **baseline schedule** is set promptly after the program begins;
  - is the basis for measuring performance;
  - represents the original configuration of the program plan and signifies the consensus of all stakeholders regarding the required sequence of events, resource assignments, and acceptable dates for key deliverables;
  - is compared to the current schedule to track variances from the plan.
- The **as-built version** of the schedule is planned to be archived and will represent the plan as executed to completion;
  - be compared to the original plan for an assessment of lessons learned;
  - become a valuable basis of estimate input for schedule estimates of future analogous projects;
  - become the basis for creating and validating fragnets where possible.
  - become a source of delay analysis

Checklist

- Changes to the baseline schedule are reviewed and approved according to the change control process.
- Schedule variances that exceed predetermined thresholds are reported to management, along with the cause and any corrective actions.
- Negative schedule variances are investigated to see if the associated effort is on the critical path.
- Schedule measures, such as the number of activities that have started or finished early, on time, or later than planned, are analyzed for the effect of any variances.
- Trend analysis is conducted regularly to examine measures such as decreasing float and schedule contingency erosion.
- The focus of any schedule recovery or acceleration techniques is on critical activities.

An Auditor’s Key Questions and Documents For Setting, Monitoring, Controlling, and Maintaining a Baseline Schedule

Key questions

1. Is the baseline schedule the basis for measuring performance?
2. Does a schedule basis document exist? Does the document

   a. describe the general approach to the program?

   b. describe the overall structure of the IMS, including the scope and purpose of projects, staff responsible for each project, the relationship between projects, a WBS dictionary, the status delivery dates for each project, and a list of key hand-off products and their estimated dates?

   c. describe the settings for key options for the scheduling software?

   d. provide an overview of the assumptions and ground rules, including justification for calendars and any lags, constraints, or long activity durations?

   e. Provide an appropriately detailed rationale for the basic approach to estimating key activity durations and justification of the estimating relationship between duration, effort, and assigned resource units?

Key questions

2. Does a schedule basis document exist? Does the document

   f. contain a dictionary of abbreviations, acronyms, and custom fields?

   g. describe the use of resources within the schedule?

   h. describe the critical risks prioritized in a schedule risk analysis as well as schedule contingency?

   i. discuss the derivation of the critical paths and longest path and justify excessive total float?

3. Are changes to the baseline schedule reviewed and approved according to the schedule change control process?
4. Is trend analysis performed, such as monitoring start and finish dates, available float, and available schedule contingency?

Key Documents

1. The designated baseline schedule.
2. A description of the schedule change control process.
3. The current schedule change control log.
4. The schedule basis document.

فرآیند یکپارچه برنامه ریزی، زمانبندی و کنترل پروژه

بخش دوازدهم:

استاندارد اجرایی: به روز رسانی با استفاده از Logic و Actual Progress

ارائه دهندگان:

سید محمدرضا علوی‌پور

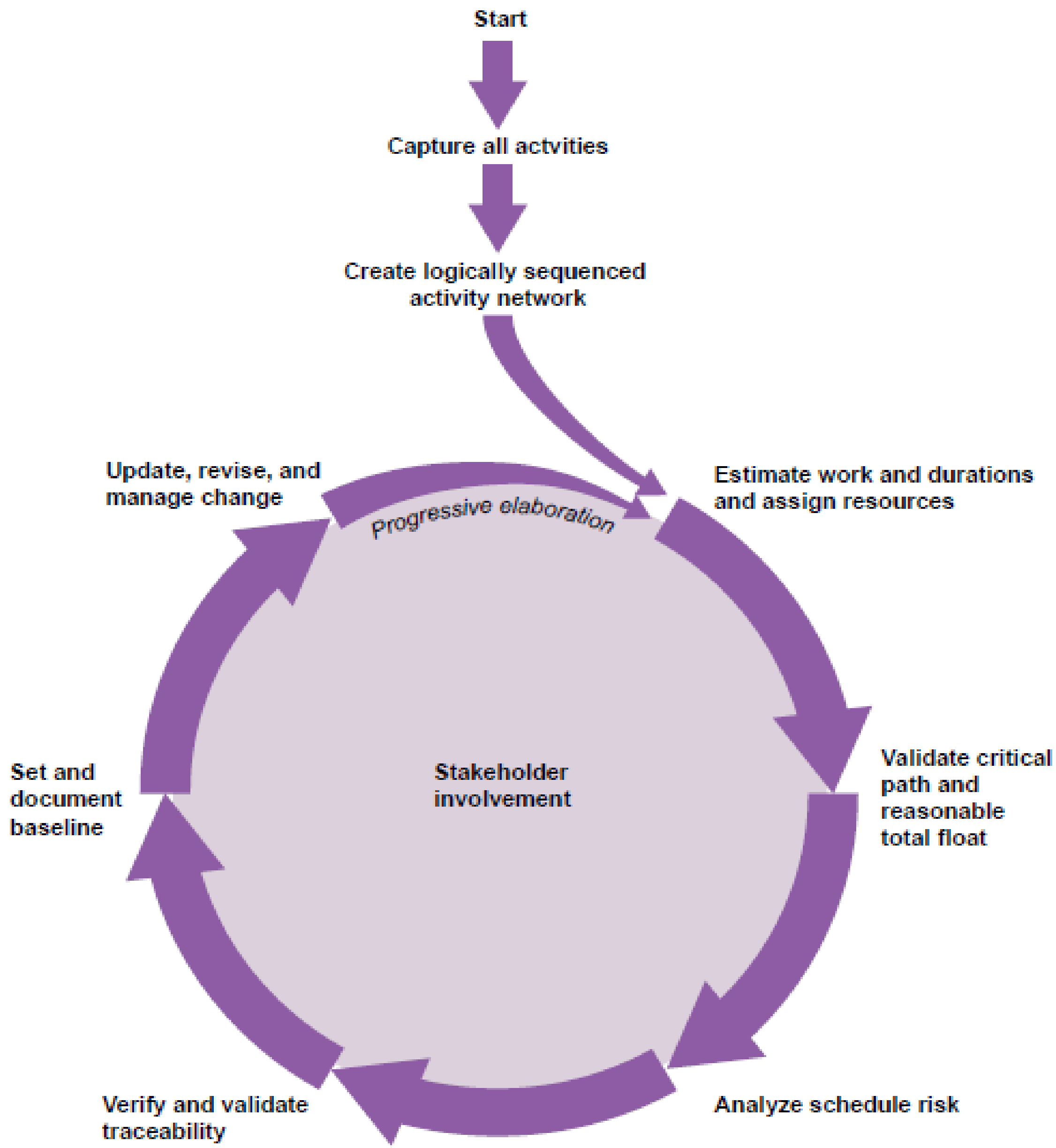
(PhD, PMP, CMIT)

What we will learn?

- Statusing
- Progress
- Checklist for a scheduler for updating the schedule using actual progress and logic
- An auditor’s key questions and documents for updating the schedule using actual progress and logic

A process for creating and maintaining reliable schedules

- This is a cyclic process
- Elaborated through rolling wave process.



A process for creating and maintaining reliable schedules

Process step	Corresponding action	Section
Capture all activities	Capturing all activities	3
Create logically sequenced activity network	Sequencing all activities	4
Estimate work and durations and assign resources	Allocating and leveling resources Determining and assigning durations to activities	5 6
Validate critical path and reasonable total float	Critical path determination, assessment, and validation Ensuring reasonable total float	7 8
Analyze schedule risk	Schedule constructability and risk analysis	9
Verify and validate traceability	Verifying that the schedule can be traced horizontally and vertically	10
Set and document baseline	Setting, monitoring, controlling, and Maintaining a baseline schedule	11
Update, revise, and manage change	Setting, monitoring, controlling, and Maintaining a baseline schedule	11
	Updating the schedule using actual progress and logic	12

Statusing

Statusing frequency

- **"Statusing"** is the **process of updating** a plan with **actual dates**, **logic**, and **progress** and **adjusting forecasts** of the remaining effort.

When to update status?

- Updated **less frequently** in the **beginning** of a program
- Updated **more frequently** as it **progresses** and as **more resources** begin working
- **More frequently than** the **reporting period**
  - *If reporting period is monthly, schedule progress should be updated weekly.*

Tracking progress at a lower level than the reporting period allows management insight into the causes of issues that are being reported before the end of the reporting period

Statusing frequency – Default condition

PMI Best practice

Default Condition

When developing the schedule model, the project team must consider two issues.

First, which day of the week does the update occur? The update will include reporting progress and other information to that date. Consideration must also be given to the time necessary to generate the project reports and analyze the project data. Sundays tend to be a good day for updates, since it is at the end of a weekend and could be utilized for recovery time, if needed. In addition, Monday starts a new week. We can then perform an analysis and generate reports on Monday, for review early in the workweek. We always strive to get data and reports out and into the user's hands as quickly as possible.

The second consideration is the length of the cycle itself. Once again, this varies from project to project, and also with discipline. If performing construction efforts, weekly updates are most appropriate, since many things can happen in a week's time in this environment. Conversely, if engineering is being performed, monthly cycles may be more appropriate. A facility outage (when every day that the facility is down is critical to the operation cycle and company profits), may require that a good cycle period be daily, or even performed each shift. Each project team should consider the issues and determine what cycle is most appropriate for the project.

Usually the update cycle is determined by the contract and the scheduling specifications prior to anyone doing anything with the schedule in terms of development.

Statusing frequency – Best practices

PMI Best practice

Best Practices

One of the essential elements that will need to be considered when developing a good schedule model is to establish the optimum update cycle for the project. The timing of this update has a bearing on other aspects of the project, such as activity durations, project review meetings, and payment cycles.

Therefore, the project team will determine two things, the actual day of the week that the update will occur through, and the period of time between updates (daily, weekly, biweekly, monthly, etc.).

Statusing responsibility

- **"Statusing"** is the **process of updating** a plan with **actual dates**, **logic**, and **progress** and **adjusting forecasts** of the remaining effort.
  - **Activity owners** provide these data to the **scheduler**.
  - **Responsibility** should be assigned to someone who has the **proper training** and experience in **CPM scheduling**.

Once an update has been made, management should assess its accuracy to verify that all finished work is in the past and all unfinished work is scheduled for the future.

Updating and revising the schedule are different!

Statusing the schedule involves updating it with actual data, while revising the schedule focuses on adjusting future work.

Statusing progress

- A **status date** that is also called **"data date"** denotes the date of the **latest update** to the schedule and thus defines the demarcation **between**
  - Actual work performed
  - Remaining work
- All work **before data date** and **through the status date** represents **completed effort**
- All work **beyond data date** represents **remaining effort**

Simply put:

- All dates before the status date are in the past
- All dates beyond the status date are in the future

No dates in the past should be estimated; no dates in the future are actual dates.

Statusing progress – EVM

PMI Best practice

Techniques for measuring work performed are selected during project planning and are the basis for performance measurement during project execution and control. Earned value (EV) techniques should be selected based on key attributes of the work, primarily 1) the duration of the effort, and 2) the tangibility of its product.

Product of Work	Duration of Work Effort	
	1-2 Measurement Periods	> 2 Measurement Periods
Tangible	Fixed formula	Weighted milestone Percent complete
Intangible	Apportioned effort Level of effort	

Table 4-1: Earned value techniques

Statusing progress – EVM

AACE TCM Framework

- TCM Framework (AACE International, 2012) also acknowledges in Section 9.2.2.2 these methods for monitoring progress.
- Various methods for Earned Value Management (EVM) include:
  1. Fixed formula
  2. Weighted milestone
  3. Percent complete
  4. Apportioned effort
  5. Level of effort
  6. Remaining duration

You will learn this in Financial Management Course!

Statusing progress – Engineering

CII P6-1

The determination of percentage completion on a single activity can usually be handled under one of the following four systems:

Units Completed. This method is suitable when the total scope of an activity consists of a number of equal or nearly equal parts, and the status is logically determined by counting parts completed and comparing that to the total number of parts included in the activity. Ideally, each unit is of relatively short duration. While this method has considerable application in the construction phase, it has limited use during engineering. A possible application is in the writing of a number of specifications of a given type where all specifications are considered to have essentially equal weight.

Statusing progress – Engineering

CII P6-1

Incremental Milestone. This method is appropriate for activities of significant duration which are composed of easily recognized, sequential sub-activities. Percentage completion values are established based on the effort estimated to be required at each milestone point relative to the total for the activity. This method is ideal for control of drawings and can be used in procurement. A typical example for drawing control is:

Start drafting	0%
Drawn, not checked	20%
Complete for office check	35%
To owner for approval	70%
First issue	95%
Final issue*	100%

**Only when no additional engineering is anticipated*

A typical example for procurement is:

Bidders list developed	5%
Inquiry documents complete	10%
Bids analyzed	20%
Contract awarded	25%
Vendor drawings submitted	45%
Vendor drawings approved	50%
Equipment shipped	90%
Equipment received	100%

Statusing progress – Engineering

CII P6-1

Start/Finish Percentages. This method is applicable to those activities which lack readily definable intermediate milestones, and/or the effort/time required is difficult to estimate. For these tasks, controllers credit 20-50 percent when the activity is started and 100 percent when finished. The reason that a percentage is assigned for starting is that this compensates for the long period between start and finish when no credit is being given. This method is appropriate for work such as planning, designing, manual writing, model building, and studies. It can also be used for specification writing.

Statusing progress – Engineering

CII P6-1

Ratio or Judgement. This method is applicable to tasks such as project management, constructability studies, project controls, and comparable activity which involves a long period of time, has no particular end product, and is estimated and budgeted on a bulk allocation basis rather than on some measure of production. It can also be used on those tasks for which the Start/Finish method is appropriate. Percent complete at any point in time is found by dividing hours (or dollars) spent to date by the current estimate of hours (or dollars) at completion.

Don't forget to use EVM at the last part!

You will learn of how to do in Financial Management Course!

Statusing progress – Construction

- Two parts:
  1. **Percent complete of in-progress activities**
  2. **Remaining duration**

Percent complete of in-progress activities

- Common methods:
  1. **Recording progress by updating duration**
  2. **Recording progress by updating work**
  3. **Recording progress by cost incurred**
  4. **Recording progress by updating resource consumption**

Percent complete of in-progress activities – Updating duration of work

1. **Recording progress by <u>updating duration</u>:**

*The scheduling software calculates **<u>percentage complete</u>** for the activity based on **<u>actual duration</u>** and **<u>planned remaining duration</u>***

$$\text{Percent Complete} = \left(\frac{\text{Time Expended}}{\text{Planned Activity Duration}}\right)(100)$$

$$\text{Percent Complete} = \left(\frac{\text{4 Workdays Expended}}{\text{12 Workdays Planned}}\right)(100) = 33\%$$

<u>This is not recommended! Why?</u>

Percent complete of in-progress activities – Updating duration of work

- Because it denotes **passage of time** from the start date, **not actual work accomplished**.
  - *For instance, an activity could have used up 80 percent of its scheduled time yet have accomplished only 10 percent of the work.*

Solution?

  - *This method of calculating activity percent complete* ***should only be used when the activity is based on time only***.
    - ✓ *Cure time for concrete deck*

What else?

Percent complete of in-progress activities – Updating duration of work

Solution?

Don't ask activity managers about % complete, instead

❖ Ask for **actual duration** and **remaining duration** of an activity.

So

❑ While **actual duration** is **recorded**,

❖ **Update** the **remaining duration** of activities considering the **physical effort**

The subjectivity of percentage complete estimates becomes more apparent the longer the activity's duration.

All unfinished activities that have **not started** should be **rescheduled** to occur **after the status date (data date).**

Percent complete of in-progress activities – Updating work

2. Recording progress by __updating work__:

- It is the best method of estimating percent complete.
- Some project managers may want to **__update work__** by **__resources__** or **__quantity__**.
  - ✓ This requires **more time** and is **more complex __than__ updating durations**,

    but

    it provides **__more accurate historical data__** and **__higher-quality forecasts__** of remaining effort.

$$\text{Percent Complete} = \left(\frac{\text{Work In Place}}{\text{Planned Work Quantity}}\right)(100)$$

$$\text{Percent Complete} = \left(\frac{\text{3,000 Cubic Yards Excavated}}{\text{6,000 Cubic Yards Planned}}\right)(100) = 50\%$$

Percent complete of in-progress activities – Cost incurred

3. **Recording progress by <u>cost incurred</u>:**

❖ The **accuracy** of calculating activity percent complete using costs as the basis depends on the **following two conditions** being met:

1. **<u>Actual resource productivity</u>** has **not varied significantly** from **<u>planned resource productivity.</u>**
2. **<u>Resource costs</u>** that include labor, materials, equipment, and subcontractors have **not varied substantially** from the **<u>estimated costs</u>**.

Variance from these two conditions will result in the calculation of a percent complete for an activity that does not accurately reflect the actual amount of work complete. This method of calculating percent complete would only be appropriate for an activity whose duration can be expressed as a function of cost.

$$\text{Percent Complete} = \left(\frac{\text{Cost Incurred}}{\text{Planned Activity Budget}}\right)(100)$$

Percent complete of in-progress activities – Updating resource consumption

4. **Recording progress by updating resource consumption:**
   - ❖ The **accuracy** of calculating activity percent complete using resource usage as the basis depends on the following **three conditions** being met:

   1. **Actual resource usage** has **not varied significantly** from the **planned resource amount.**
   2. The **resource usage** chosen to monitor activity progress is **used steadily throughout** the **performance of the activity**.
   3. The **resource usage** chosen to monitor activity progress **varies directly** with **activity progress**.

This method of estimating should only be used for an activity whose progress can be measured by the use of one predominant resource and meets the above conditions.

$$\text{Percent Complete} = \left(\frac{\text{Resource Used}}{\text{Planned Resource Amount}}\right)(100)$$

$$\text{Resource Used} = (450 \text{ Sheets})\,[(4 \text{ Feet})\,(8 \text{ Feet})] = 14{,}400 \text{ Square Feet}$$

$$\text{Percent Complete} = \left(\frac{14{,}400 \text{ Square Feet Installed}}{60{,}000 \text{ Square Feet Planned}}\right)(100) = 24\%$$

Percent complete of in-progress activities – CII

CII RS6-1

Measuring Work Progress

The work tasks required to complete a construction project vary from those required to clear and grade a site to the start-up and turnover of the completed facility. During the course of the project, those executing the construction will need to report periodically on the progress of each task. Six methods are described below for measuring this progress. All may find use on a given project.

The U.S. Departments of Defense (DOD) and Energy (DOE) have established what is known as the *Cost and Schedule Control Systems Criteria* (C/SCSC) for control of selected federal projects. While intended primarily for high-value, cost-reimbursable research and development projects, it may be applied to selected construction projects. This system is described in detail in Reference 5. Included within C/SCSC are various methods for measuring status; also, several terms are presented which have found some common usage within the construction industry. Certain useful features of C/SCSC have been incorporated within the system described in this publication.

This last part however will be taught in

Financial Management Course!

Percent complete of in-progress activities – CII

CII RS6-1

Method 1: Units Completed. This method is applicable to those tasks which involve repeated production of easily measured pieces of work, each piece requiring approximately the same amount of effort. Usually there is no included mix of subtasks; if there is a mix, these are accomplished simultaneously and one of the subtasks can be used as the reference task.

Wire pulling is a task whose accomplishment is easily measured in terms of units of length of wire pulled and a task for which the *Units Completed* method is applicable. For example, if 10,000 LF of wire is to be pulled and 4,000 LF has been pulled, the percent complete is found by dividing 4,000 LF by 10,000 LF to show 40 percent complete.

Placing and finishing of a reinforced concrete slab is a type of work with multiple tasks handled simultaneously (placing and finishing), but progress may be reported on the basis of volume of concrete placed and finished or upon area of finished surface.

This is like updating resource consumption!

Percent complete of in-progress activities – CII

CII RS6-1

Method 2: Incremental Milestone. This method is applicable to any control account which includes subtasks that must be handled in sequence. For example, the installation of a major vessel in an industrial facility includes the sequential tasks or operations listed below. Completion of any subtask or operation is considered to be a milestone, which when completed represents a certain percentage of the total installation. The percentage chosen to represent each milestone is normally based on the number of work-hours estimated to be required to that point in relation to the total. In the listing below, the attainment of each milestone has been judged to be equivalent to having completed the percentage listed of the total installation:

Received and inspected	15%
Setting complete	35%
Alignment complete	50%
Internals installed	75%
Testing complete	90%
Accepted by owner	100%

We didn't have this!

Percent complete of in-progress activities – CII

CII RS6-1

Method 3: Start/Finish. This method is applicable to those tasks which lack readily definable intermediate milestones and/or the effort/time required is difficult to estimate. Millwright work is often in this category. For example, alignment of a major fan and motor may take from a few hours to a few days depending upon the situation. Workers know when this work starts and when it is finished, but never know the percentage completion in between. Other examples include planning activities, flushing and cleaning, testing, and major rigging operations.

With the *Start/Finish* approach, one arbitrarily assigns a percent complete to the start of a task with 100 percent being recorded when it is finished. A starting percentage of 50 percent is equivalent to a task completed at a constant rate over time and is reasonable for fairly short duration, lower value tasks. For longer or higher value tasks, a contractor would probably have to use something less (20-30 percent), primarily because an owner will hesitate to recognize too much completion in advance since it directly affects progress payments. For very short tasks, the start/finish percentages are usually 0 percent/100 percent.

We didn’t have this!

Percent complete of in-progress activities – CII

CII RS6-1

Method 5: Cost Ratio. This method is applicable to tasks such as project management, quality assurance, contract administration, and project controls. These tasks involve a long period of time or are continuous over the life of a project, and are estimated and budgeted on bulk allocations of dollars and work-hours rather than on the basis of production.

With this method, percent complete is found as follows:

$$\text{Percent Complete} = \frac{\text{Actual cost or work-hours to date}}{\text{Forecast at completion}}$$

This is like cost incurred!

Percent complete of in-progress activities – CII

CII RS6-1

Method 6: Weighted or Equivalent Units. This method is applicable where the task being controlled is a major effort involving a long period of time and is composed of two or more overlapping subtasks, each with a different unit of work measurement.

Structural steel erection provides a good example for application of this method. Structural steel normally is estimated and controlled using tons of steel components as the unit of measure. As illustrated in the listing below of subtasks included in steel erection, however, each subtask has a different unit of measure. In such a case, each subtask is weighted according to the estimated level of effort (usually work-hours) that will be dedicated to that subtask. As quantities of work are completed for each subtask, these quantities are converted into equivalent tons and the percent complete calculated as illustrated. The weighting may be changed during the course of a task's completion to reflect quantity or unit rate variances within subtasks. If this is done, it is important that the earned values be recalculated for all subtasks (see following section for earned value principles).

We didn't have this!

Percent complete of in-progress activities – CII

CII RS6-1

Wt.	Subtask	U/M	Quan Total	Equiv Steel Ton	Quantity To-date	Earned Tons*
0.02	Run foundation bolts	each	200	10.4	200	10.4
0.02	Shim	%	100	10.4	100	10.4
0.05	Shakeout	%	100	26.0	100	26.0
0.06	Columns	each	84	31.2	74	27.5
0.10	Beams	each	859	52.0	0	0.0
0.11	Cross-braces	each	837	57.2	0	0.0
0.20	Girts & sag rods	bay	38	104.0	0	0.0
0.09	Plumb & align	%	100	46.8	5	2.3
0.30	Connections	each	2977	156.0	74	3.9
0.05	Punchlist	%	100	26.0	0	0.0
1.00	STEEL	TON		520.0		80.5

$$* \text{ Earned tons to date} = \frac{(\text{Quantity to date})(\text{Relative weight})(520 \text{ tons})}{(\text{Total quantity})}$$

$$\text{Percent Complete} = \frac{80.5 \text{ tons}}{520 \text{ tons}} = 15.5\%$$

We didn’t have this!

Percent complete of in-progress activities – CII

CII RS6-1

A variation of this approach utilizes equivalent units for each subtask. In the example above, each subtask item would be given a unit of measure that is an equivalent ton. For example, each beam would have an equivalent ton equal to:

$$\text{Beam Equivalent Ton} = \frac{(.11 \text{ weighting factor})(520 \text{ tons})}{(859 \text{ beams})} = .0666$$

We didn't have this!

Percent complete of in-progress activities

Regardless of whether a schedule's progress is marked by duration or work or etc.

team members and management should have consistent, documented definitions of what constitutes an activity's start, its finish, and its meaningful progress.

Is it only about calculating percent complete?

Remaining duration

Is it only about calculating percent complete?

- **Determining the percent complete** of an activity in progress is **just a measure of how much** of the planned work has been completed.

- The **second and equally important part** of the analysis of activity status is determining **how much longer it will take to complete** the activity.

.

Remaining duration

PMI Best Practice

- Activities that are **in-progress** should be updated by estimating the **remaining duration** of an activity for monitoring of time,

  <u>not</u> by estimating a percent complete,

  which is used to **monitor costs of performance**.

- **A superintendent** can easily determine **how much time** is remaining to complete a **scope of work**

  <u>versus</u> taking a **guess at the percentage** of the work that is complete or remaining.

Remaining duration

PMI Best Practice

- **In-progress activities** may need to be **adjusted** based on
  1. **Amount of resources committed** to the activity, or
  2. Based on the **current productivity** of the resources.

- **Remaining duration** should be based upon the **time necessary to complete** the work logically.

Therefore, it is important that **activity durations** are regularly reviewed and validated to ensure they are **in line with current** and **forecasted resources**.

Remaining duration

- This requires a **review of the productivity achieved** to date on the activity.
  - If the **productivity to date** on an activity **deviates significantly** from the planned activity productivity,

    then the **remaining activity duration** needs to be **adjusted to reflect** this **change in productivity**.

$$\text{Remaining Duration} = \left(\frac{\text{Remaining Work Quantity}}{\text{Anticipated Productivity}}\right)$$

$$= \left(\frac{\text{2,000 Ceiling Tiles}}{\text{500 Ceiling Tiles/Workday}}\right)$$

$$= \text{4 Workdays}$$

Remaining duration

- **Many scheduling programs** will calculate the **remaining duration** of an activity **automatically**

  based on the **activity's estimated percent complete**.

  - If this is the case, the **scheduler should review the remaining duration** calculated by the scheduling software to **determine if the remaining duration is reasonable**

    given the ***quantity of remaining work*** *and the* ***anticipated productivity rate*** *for completing the remaining work.*

Progress

Adjusting and revising schedules

PMI Best practice

Definitions

Adjusting and revising the project schedule is part of the updating process. The development of project schedule updates consists of a two-step process: (1) progress-related changes and (2) changes to the schedule. The first step (progress-related changes) consists of inserting the new update with the progress achieved on the project between the data date of the previous update and the new update. The second step (changes to the schedule) consists of adjustments or revisions to the project schedule. (See Section 4.4.3, Data Capture and Verification.)

Adjusting and revising schedules

PMI Best practice

Default Condition

Adjustments or revisions to the project schedule can and should be made to ensure that it depicts the most current plan for completing the project. The reasons for adjusting or revising the project schedule are: (1) the insertion of activities into the project schedule that represent new work added through a properly executed modification to the contract, (2) to delete activities from the project schedule that represent work that was removed from the contract by a properly executed modification to the contract, and (3) to change the schedule activities' durations and schedule's network logic to represent changes in the sequencing or means and methods of the work to match the current plan for completing the project.

Adjusting and revising schedules

PMI Best practice

Advisories

Owners should not allow contractors to constantly make changes to the project schedule without providing an explanation for the change. Constant changes undermine the reliability of the project schedule to accurately depict the sequencing of work and forecast the completion dates of the project. However, the owner must also recognize that the project schedule, in most cases, represents the contractor's plan to complete the project, and so should be weary of directing or mandating whether the contractor can change it. The owner, though, should not hesitate to scrutinize or question whether changes should or should not be made to the project schedule, to ensure that it is not being used as a project management tool that only protects the contractor's risk and interest.

ACEMI

Adjusting and revising schedules

PMI Best practice

Default Condition

Even without a major change or re-sequence, a project's schedule should be critically challenged at every update interval, which includes a review of the remaining durations and sequence of activities. Remember, the project schedule is dynamic, not static, thus the schedule must be evaluated continually due to its constant state of change.

Adding and deleting activities

Activities should not be deleted from a baselined schedule

- **Deleting** an activity may **disrupt schedule logic** and **complicate efforts** to compare the **current schedule** to the **baseline**.

So, what should be done if the activity is no longer valid?

- Its **duration** should be **zeroed out** and the **activity** marked as **completed**.

So, what should be done if some portion of the activity valid or completed?

- The **remaining duration** of the activity should be **zeroed out** and
- A **record** kept of the **completed portion**

*In addition, a **note** should be added to the schedule to **document why** the **activity's duration** or **remaining duration** was **removed**.*

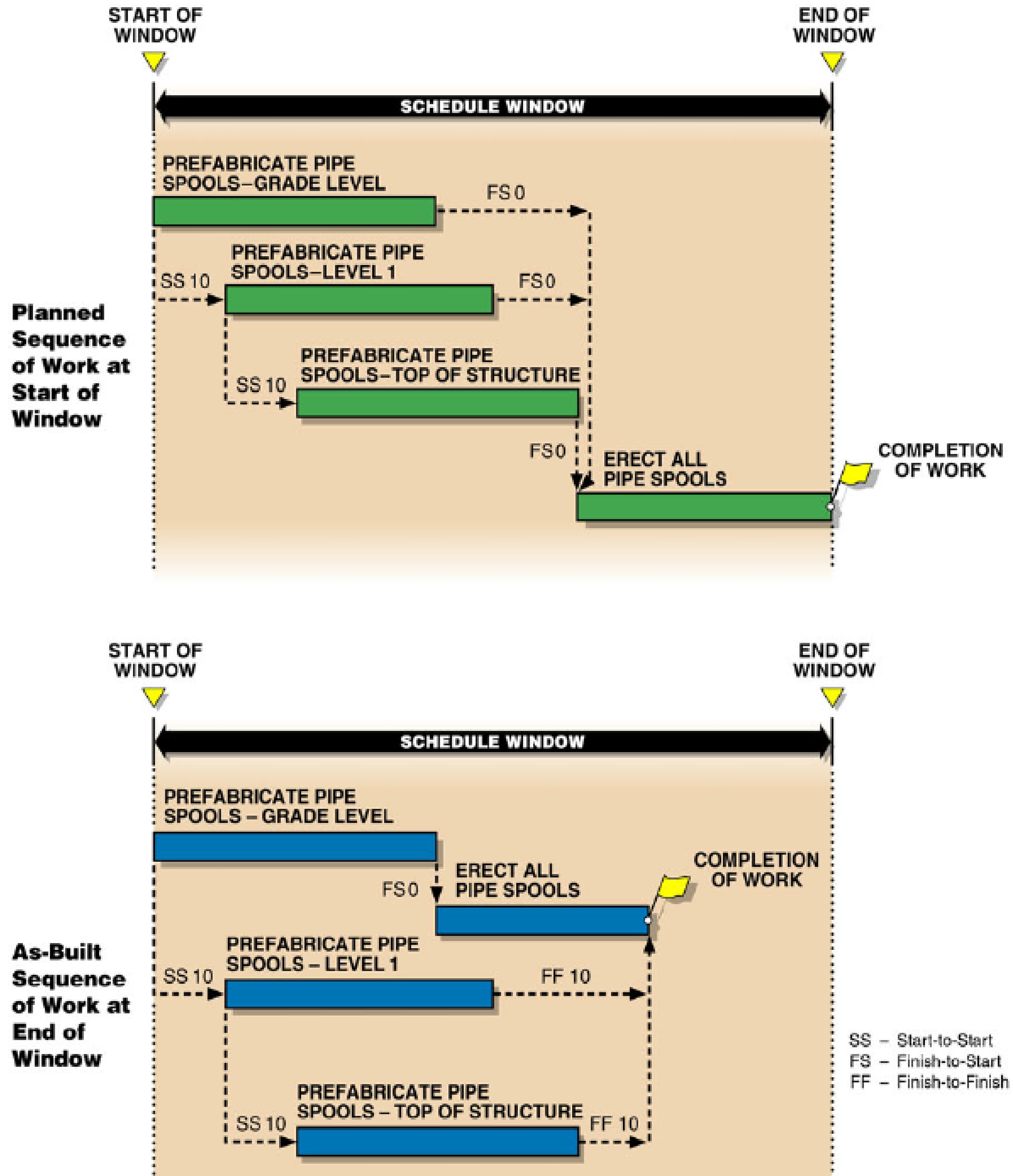
Out-of-sequence logic

- **Rescheduling activities** may require **adjusting** network **logic.**
- **Out-of-sequence logic** results from **progress** on an activity performed in a **different order** than **originally planned** such as
  - an activity starting before its F–S predecessor has finished;
  - an activity starting before its S–S predecessor has started; or
  - an activity finishing before its F–F predecessor has finished.

Out-of-sequence progress is common and should be expected.

Out-of-sequence logic

Logic Relationships at the Start of a Window May Change During the Window



Out-of-sequence logic

- When **out-of-sequence progress occurs**, managers and schedulers may **choose** to:
  1. **Retain** the existing network logic
  2. **Override** the existing network logic

- **Retained logic** and **progress override** are options in **scheduling software (Primavera)** that must be properly **set before updating** the status of the schedule.

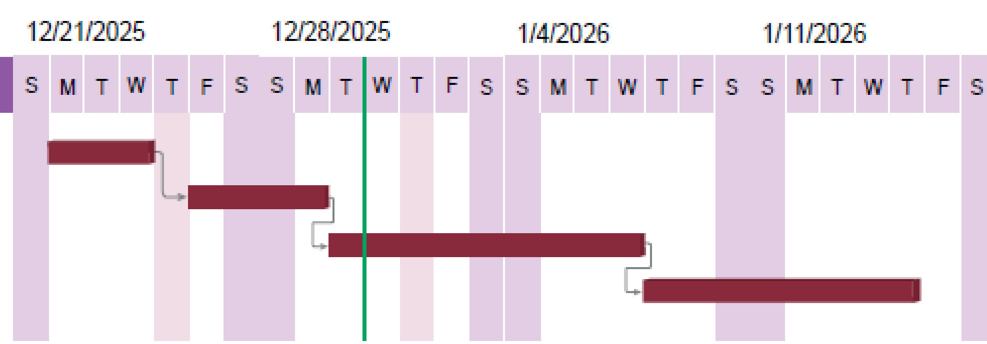
- **Each approach** represents a **different philosophy**, and they can have **vastly different effects** on **forecasted dates**.

Out-of-sequence logic – Example

- The figure represents the **original plan**, but:
  - We **assume that**:
    - ✓ The status date is December 30 (green line)
    - ✓ "Install tile in bathroom and kitchen" has completed on time
    - ✓ No progress was made on "install interior doors," so its start date is rescheduled for December 31.
      - o However, its successor activity "install interior door, window, and baseboard trim" did start on December 29 and two carpenters accomplished 32 hours of work.

The Original Plan for Interior Finishing

Activity	Start	Finish
Install tile in bathroom and kitchen	12/22	12/24
Install interior doors	12/26	12/29
Install interior door, window, and baseboard trim	12/30	1/7
Install carpeting and wood flooring	1/8	1/15



Source: GAO. | GAO-16-89G

Out-of-sequence logic – Example: Retained logic

- In the case of **retained logic**,

  work on the activity that began out of sequence is **stopped until** its **predecessor** is **completed** as much as possible of the **original network** logic is **preserved**

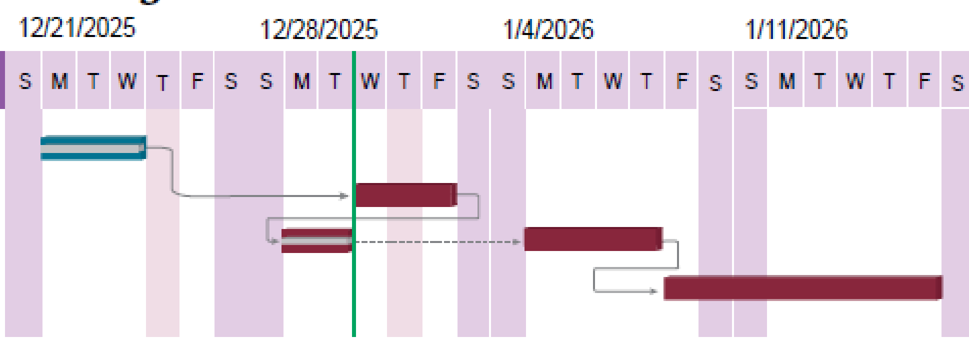
  - **because** the **remainder** of the out-of-sequence activity is **delayed** until the **predecessor finishes**, to observe its original sequence logic.

- **Gray bars** that represent **actual accomplished** effort.

This start-stop-resume approach may not be an efficient way to install interior trim but it may be important given the reliance of the trimming activity on the installation

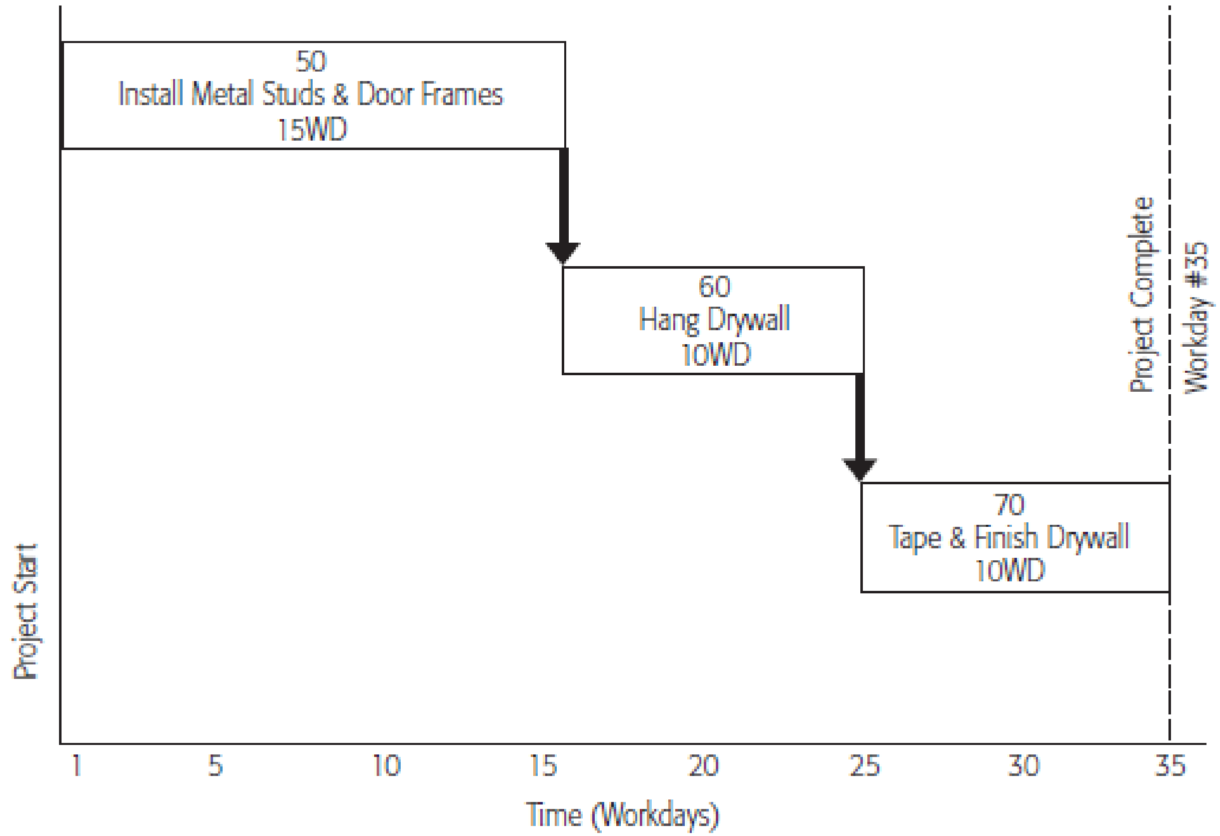
Retained Logic

Activity	Start	Finish
Install tile in bathroom and kitchen	12/22	12/24
Install interior doors	12/31	1/2
Install interior door, window, and baseboard trim	12/29	1/8
Install carpeting and wood flooring	1/9	1/16

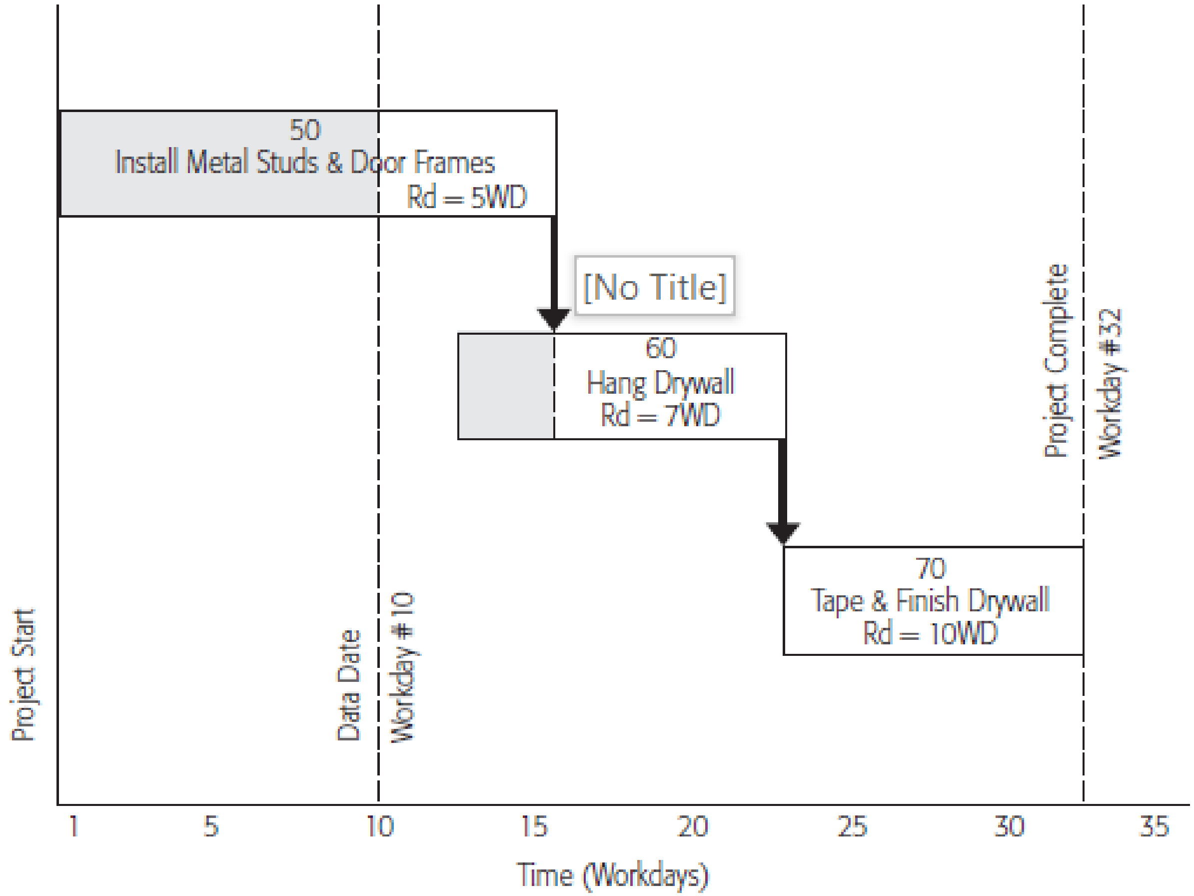


Source: GAO. | GAO-16-89G

Out-of-sequence logic – Example: Retained logic



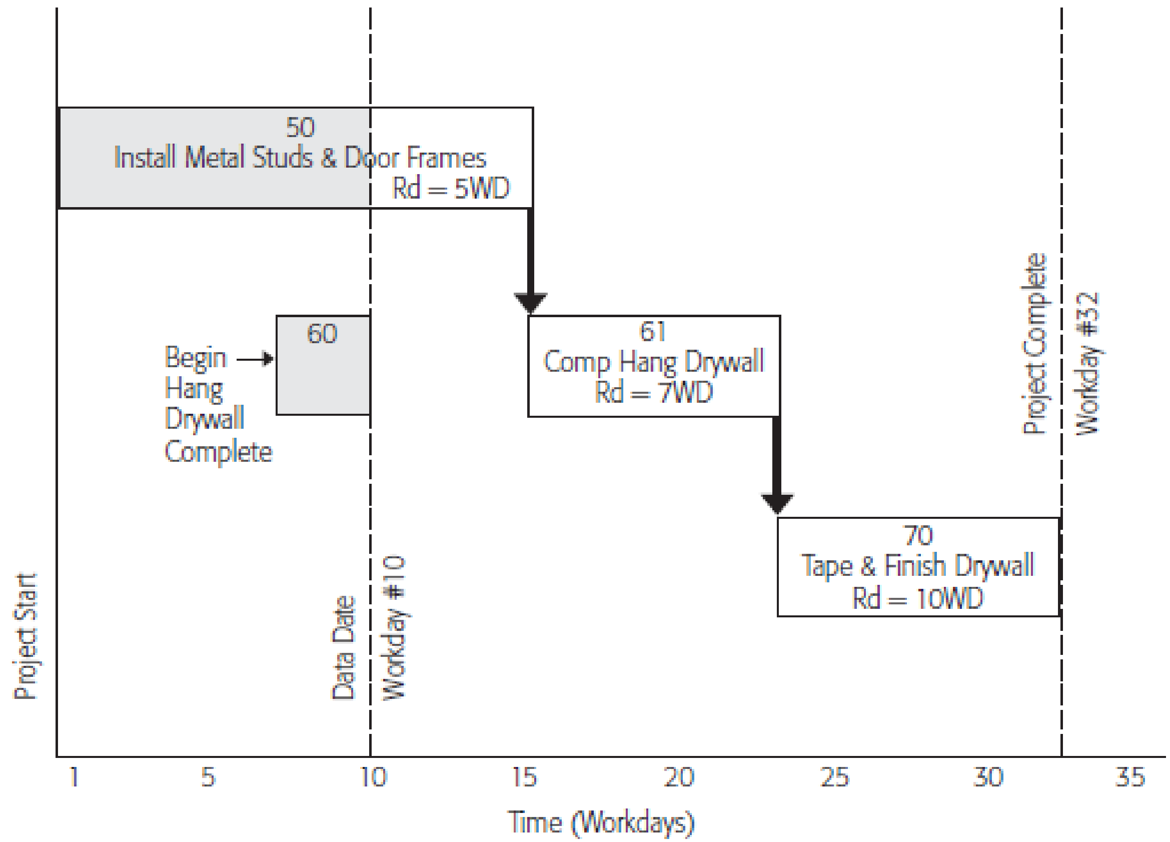
Out-of-sequence logic – Example: Retained logic



Out-of-sequence logic – Example: Retained logic

❑ Split the activity

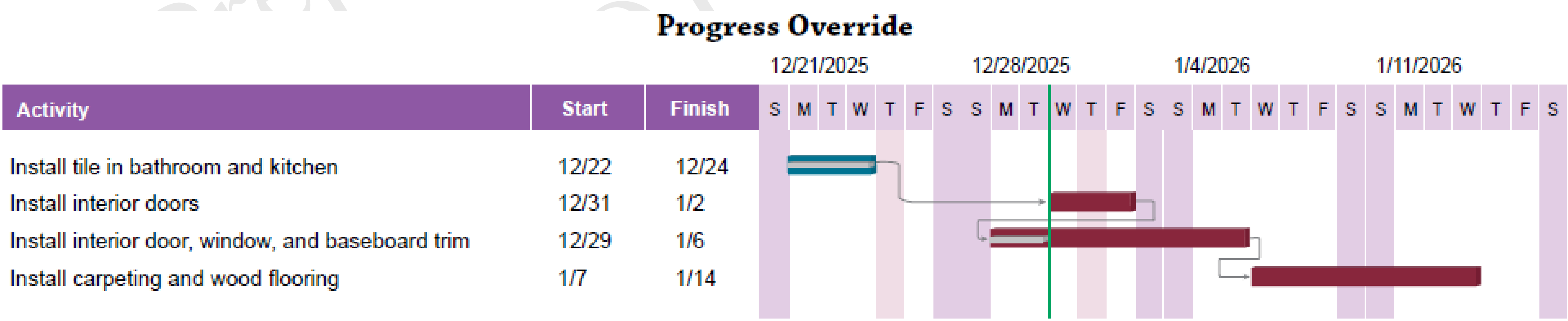
✓ What is the problem?



Out-of-sequence logic – Example: Override logic

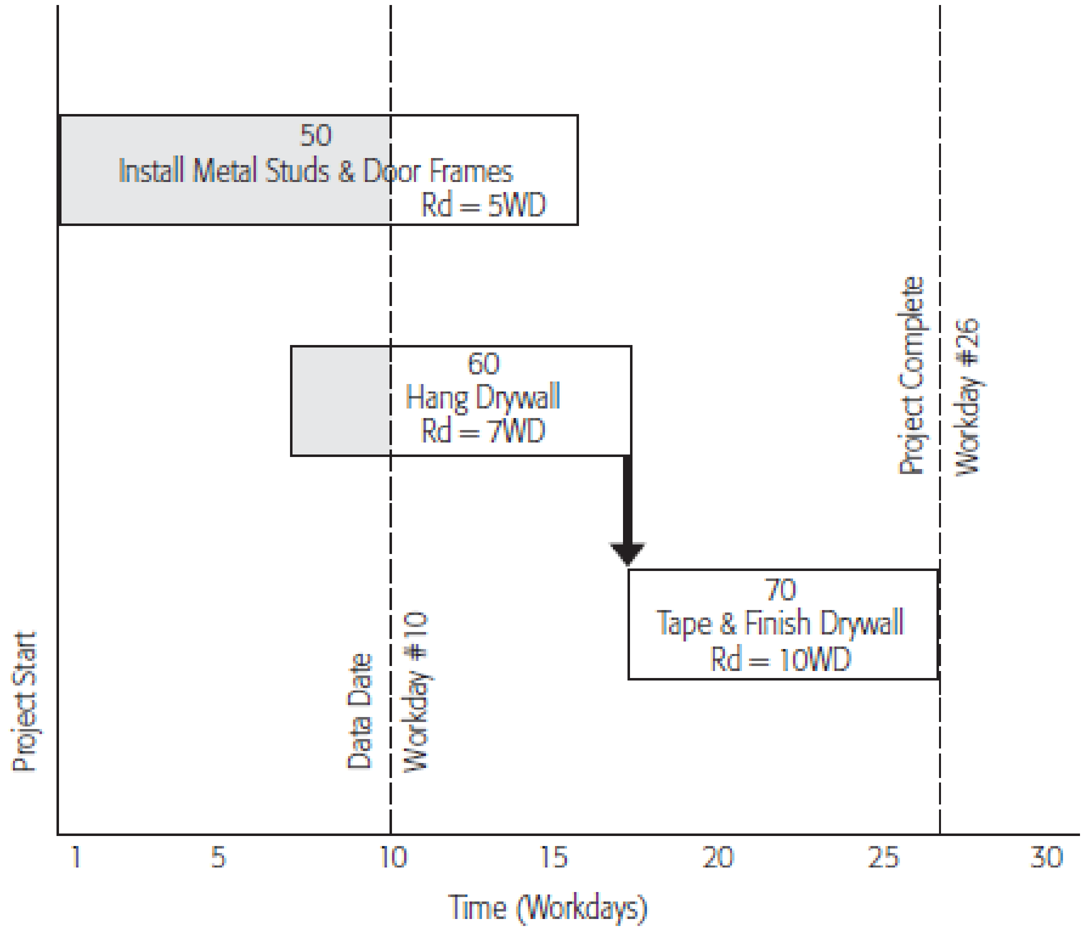
- In **progress override**, work on the activity that began out of sequence is **permitted** to continue, **regardless of original predecessor logic**.

- The **predecessor** and **successor** activities may now be executed in **parallel**.



Source: GAO. | GAO-16-89G

Out-of-sequence logic – Example: Override logic



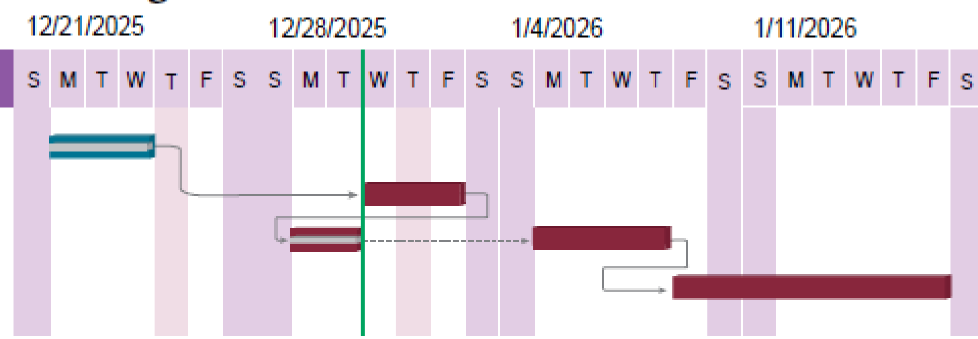
Out-of-sequence logic – Example: Override logic

While the progress override accelerates the overall construction schedule by 1 working day, the time savings may not be feasible for several reasons:

1. **It assumes no dependency**
2. **It assumes available resources on both activities where only two carpenters available who cannot be allocated simultaneously.**
3. **Carpeting cannot start earlier than planned due to resource availability**

Retained Logic

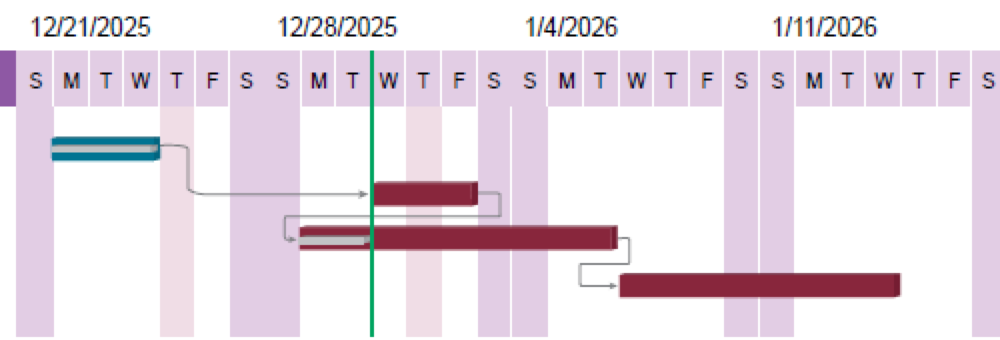
Activity	Start	Finish
Install tile in bathroom and kitchen	12/22	12/24
Install interior doors	12/31	1/2
Install interior door, window, and baseboard trim	12/29	1/8
Install carpeting and wood flooring	1/9	1/16



Source: GAO. | GAO-16-89G

Progress Override

Activity	Start	Finish
Install tile in bathroom and kitchen	12/22	12/24
Install interior doors	12/31	1/2
Install interior door, window, and baseboard trim	12/29	1/6
Install carpeting and wood flooring	1/7	1/14



Source: GAO. | GAO-16-89G

Out-of-sequence logic – Retained vs. Override

- **Retained logic** is a more **conservative approach** than progress override
- **Progress override** may show **better progress**, but it result in an **unrealistic plan**.

What is recommended approach?

Retained logic is preferred approach

BUT…

Out-of-sequence logic – Recommended approach

- It is **recommended** that the **scheduler examines** each instance of out-of-sequence progress **case by case**.
- **Although** out-of-sequence activities are **common**,
  - They should be **reported**,
  - An **analysis** of the **effect on key milestone** dates is recommended **before** out-of-sequence activities are **formally addressed**.

- **Regardless** of **how** management wishes to proceed with the work related to the out-of-sequence activity, the **logic relationship** between activities should be **repaired**.
  - **If left alone**, out-of-sequence activities may
    - ✓ **Complicate total float values**
    - ✓ **Cause** activities to become artificially critical.
    - ✓ **Represent risk** or potential **rework**

Out-of-sequence logic

PMI Best practice

Default Condition

The settings become important only when there is out-of-sequence work that does not match the original logic programmed in the network, and even then only when that out-of-sequence work affects the critical path. The use of the setting for retained logic versus progress override often depends on the scheduling specification of the governing contract. Most construction scheduling specifications require the use of retained logic; however, there are still many contracts that do not address the issue. Therefore, it is always a good idea to check which setting is being used when reviewing a schedule, or series of schedules. The "physical" location in the Primavera software for making a selection between the two options is under the schedule button and then the options button.

Out-of-sequence logic – Best practices

PMI Best practice

Best Practices

Using retained logic is preferable to progress override. Retained logic may give a pessimistic view of the project completion date, as it does not account for completed work between an unfinished predecessor and an incomplete successor, but it is a great indicator of where changes in the logic need to be made to reflect the reality of the project. Progress override ignores logic related to out-of-sequence work and can leave unstated activities out of the network calculations because a successor was started prior to the predecessor's actual start. These unstated activities calculate float values equal to the remaining duration of the project because project override ignores the established logical link, effectively making the unstated activities perform as open-ended activities. It is easy to miss these activities, as they do not show up on critical or near-critical paths and "ride" the data date. For this reason, progress override tends to give an overly optimistic view of the project completion date.

Correcting the logic of out-of-sequence activities to reflect the actual plan in the field for completing the project is the best way to solve the problem. Otherwise, it is important to use a consistent setting throughout the series of schedules because changing the settings in a series of schedules can impart significant changes in milestone completion predictions and the identification of the critical path.

ACEMI

Out-of-sequence logic – Advisories

PMI Best practice

Advisories

The two settings will likely have a significant effect on the critical path, with progress override showing a very optimistic prediction of completion. With the use of progress override, activity logic that has been ignored due to this setting will change the network calculations such that float values for those activities will not be dependable.

Changing the settings in between schedule updates can artificially show delay or mitigation gains, changing from retained logic to progress override can improve completion predictions, and changing from progress override to retained logic can show a delay to milestone completion.

A temporary use of the settings provides a diagnostic tool to assess how out-of-sequence work is affecting the job. The settings should be changed temporarily to see what happens. The total float values should be analyzed to ensure that work is not being ignored and riding the data date with an abnormally large total float value. Consult with field personnel to correct out-of-sequence progress and ensure the schedule accurately reflects the plan to complete the project.

If the schedule suffers from excessive out-of-sequence work, progress override may lessen the effects of the remaining incomplete work, driving other work that can or does start. If that out-of-sequence work contains critical path work, changing the settings may show variances to help flag the presence of that critical path work that needs to be analyzed.

Checklist For a Scheduler For Updating the Schedule Using Actual Progress and Logic

Checklist

- Schedule progress is recorded regularly and the schedule has been updated recently. Schedule status is updated with actual and remaining progress.
- Schedule status is based on progress records for the current time period; they include pertinent activity information such as name, unique ID, original and remaining durations, forecasted and actual start and finish dates, and float.
- The status date (or data date) denoting the date of the latest update to the schedule is recorded.
- At least one in-progress activity is critical.
- No activities precede the status date without actual start or finish dates and actual effort up to the status date. No activities beyond the status date have actual start or finish dates or actual effort.

Checklist

- ❑ Activities that are behind schedule by the status date have a remaining duration estimate, and the delay's effect has been assessed.
  - ❖ If the delay is significant, plans to recover the implied schedule slip have been evaluated and implemented, if so decided.
  - ❖ Resources are reviewed and may be reassigned, depending on schedule progress.
- ❑ Responsibility for changing or statusing the schedule is assigned to someone who has the proper training and experience in CPM scheduling.
- ❑ Changes that were made to the schedule during the update have been documented.
- ❑ New activities are reviewed for completeness of predecessor and successor logic, resource assignments, and effects on the critical path and float calculations.

Checklist

- ❑ Activities that have started out of sequence or have been completed out of sequence have been addressed using either retained logic or progress override to reflect the order in which they were carried out.
- ❑ Management reviews schedule updates to verify and assess effects on the plan. Significant variances between planned and actual performance, as well as between planned and actual logic, are documented and understood.
- ❑ The schedule structure is examined after each update to ensure that logic is not missing or broken, all date constraints are necessary, and no artifacts impede the ability of the schedule to dynamically forecast dates.
- ❑ The current schedule, once management approves it, is assigned a version number and archived.

ACEMI

Checklist

- A schedule narrative accompanies each status update and includes
  - the status of key milestone dates, including the program finish date;
  - the status of key hand-offs or giver and receiver dates;
  - explanations for any changes in key dates;
  - changes in network logic, including lags, date constraints, and relationship logic and their effect on the schedule;
  - a description of the critical paths, near-critical paths, and longest paths along with a comparison to the previous period’s paths; and
  - any significant scheduling software options that have changed between update periods, such as the criticality threshold for total float; progress override versus retained logic; or whether resource assignments progress with duration.

An Auditor’s Key Questions and Documents For Updating the Schedule Using Actual Progress and Logic

Key questions

1. Is progress recorded regularly? Has the schedule been updated recently as planned? Is the status date recorded?

2. Is at least one in-progress activity critical?

3. Do any activities have start or finish dates in the past without actual start or finish dates? Do any activities have actual start or finish dates in the future?

4. Is responsibility for changing or statusing the schedule assigned to someone who has the proper training and experience in CPM scheduling?

5. Were any activities started or completed out of sequence? If so, was the logic retained, or did the scheduler use progress override?

ACEMI

Key questions

6. Does a schedule narrative accompany each status update and include the following?

a. the status of key milestone dates, including the program finish date;

b. the status of key hand-offs or giver/receiver dates;

c. explanations for any changes in key dates;

d. changes in network logic, including lags, date constraints, and relationship logic and their effect on the schedule time;

e. a description of the critical paths, near-critical paths, and longest paths along with a comparison to the previous period's paths; and

f. a description of any significant scheduling software options that changed between update periods, such as the criticality threshold for total float, progress override versus retained logic and whether resource assignments are progressed along with duration.

Key questions

7. Is the schedule structure examined after each update to ensure that no logic is missing, constraints are necessary, and no activities impede the ability of the schedule to dynamically forecast dates?

Key Documents

1. The schedule narrative.
2. The schedule shows actual and planned dates, remaining duration for in-process activities, and the status date.
3. Copies of program management review (PMR) briefings are available to verify whether schedule status is discussed and consistent with the schedule.

موسسه مهندسی و مدیریت ساخت علوی پور (ACEMI)

دفتر آموزش

تهران، بلوار فردوس شرق، مجتمع آبگینه، طبقه سوم اداری، واحد C42

+۹۸ ۲۱ ۴۶ ۱۰۰ ۴۵۰

+۹۸ ۲۱ ۴۶ ۱۰۰ ۴۴۵

www.dralavipour.com

info@dralavipour.com

@acemi_social

@alavipour_pm

@IRANACEMI

@alavipour_pm