



تدوین و تصویب برنامه زمان‌بندی اولیه (Baseline Schedule)

اصول + نکات حیاتی + چکلیست
(بر اساس سندی از AACE)

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What we will learn?

- ☐ Purpose
- ☐ Overview
- ☐ Applicability
- ☐ Recommended practice
- ☐ Overarching principles
- ☐ Baseline schedule submittal

What we will learn?

- ❑ Baseline schedule review process
 - ❖ Review introduction
 - ❖ Pre-analysis checks
 - ❖ Project analysis
 - ❖ Activity analysis
 - ❖ Activity description checks
 - ❖ Activity code analysis
 - ❖ WBS code analysis
 - ❖ Relationship analysis
 - ❖ Lag and lead checks
 - ❖ Cost analysis
 - ❖ Notebook or log review
 - ❖ Other baseline schedule checks
- ❖ Additional topics





Activity code analysis

☐ Items to be considered include:

❖ Activity ID codes. [Smart ID's]

- ❖ **Most contracts** do not specify how activity IDs should be identified but it is a **recommended practice** to create a consistent system for coding activity IDs.
- ❖ It makes them easier to find in listings and may be coded to indicate location or responsibility.
- ❖ This **optional coding** is usually referred to as, “**smart activity IDs.**”



Activity code analysis

☐ Items to be considered include:

❖ Activity codes.

- ✓ The **reviewer** should ensure that the baseline schedule contains, at a minimum,
activity code fields designating location and responsibility.
- ✓ The responsibility code should allow for entries for **owner-related issues** as well as **third parties** such as vendor representation for the installation of major equipment.
- ✓ **Schedulers** can group, sort, and/or select activities by area, responsibility, phase, or any other user- defined heading.



Activity code analysis

☐ Items to be considered include:

❖ Activity code definitions.

- ✓ **Once** the activity code fields are established,
the **reviewer** should ensure that their **fields** are populated.
- ✓ These codes should be defined and labeled with a **short description** that is **easily understood**.
- ✓ The **descriptions** should be unique to **avoid confusion**.



Activity code analysis

☐ Items to be considered include:

❖ Blank or ambiguous activity code definitions.

- ✓ **Examine** the activity code dictionary for **blank** or **ambiguous** descriptions.
- ✓ **Identify** any activities so coded and **request** the scheduler to assign an appropriate code.
- ✓ **All responsible parties** must be represented by a responsibility activity code field.



Activity code analysis

☐ Items to be considered include:

❖ **Duplicate activity code definitions.**

❖ **Examine** the activity code dictionary for duplicate or near-duplicate descriptions.

➤ This may lead to **errors later**,

allowing activities to be overlooked and under-reported.



Activity code analysis

☐ Items to be considered include:

❖ **Non-applicable activity codes.**

❖ **Unused activity codes** can **make selection** of the correct ones more time-consuming and thus consideration should be made of **deleting unused** activity codes.



WBS code analysis

❑ The reviewer should consider the following:

❖ **Missing WBS definitions.**

- ❖ Confirm that **all WBS levels** are fully defined and not blank.
- ❖ **Missing WBS definitions** will lead to confusion and possibly a **failure** to **correctly account** for work or costs properly.



WBS code analysis

❑ The reviewer should consider the following:

❖ Undefined WBS Summary Activities.

- ❖ A **WBS summary activity** is a special-use activity type that **automatically summarizes the time span of **all other activities** with the **same WBS code**.**
- ❖ **All WBS-type activities** should be identified with a WBS code.
- ❖ **WBS-type activities** with no corresponding activities with that WBS code will act like a **hammock** without assigned activities.
 - ✓ To find these, look for **zero-duration WBS** summary activities.



WBS code analysis

❑ The reviewer should consider the following:

❖ **Incorrectly coded summary activities.**

✓ **WBS summary activities automatically begin**

when the **first activity** with that WBS code begins and ends

when the last activity with that WBS code ends.

✓ **Activities coded as WBS summary activities typically should not have**
defined relationships to other activities.

WBS code analysis

☐ The reviewer should consider the following:

❖ Duplicate WBS names.



Relationship analysis

- ☐ The **reviewer** should examine and confirm that the logical relationships of the schedule submittal conform to CPM network principles.
- ☐ **Baseline schedules** should **only have**
 - a single activity without a predecessor relationship (representing project start)
 - and a single activity without a successor (representing project completion).
- ☐ **All other activities** should have both a predecessor activity and a successor activity.

This rule can be modified on a case-by- case basis only if a legitimate reason is presented.



Relationship analysis

- ❑ The reviewer should confirm that CPM network is in compliance with the scheduling specifications and in accord with good scheduling practice, and should consider the following:

- ❖ Summary activities.

- ✓ Check for proper coding of **summary activities** such as hammocks and level of effort.
- ✓ With the **exception** of WBS-type summary, **each summary activity** should have at least one start-to-start (SS) predecessor and at least one finish-to-finish (FF) successor.



Relationship analysis

- ❑ The reviewer should confirm that CPM network is in compliance with the scheduling specifications and in accord with good scheduling practice, and should consider the following:

- ❖ **Meaningful logic.**

Consider the **necessity** and **method** for including **start-up and/or completion activities** that occur outside the contract performance period, including:

- ✓ **Activities that logically occur before notice to proceed.**

- Normally, the **contractor** is not authorized to perform any **paid tasks prior** to the notice to proceed.
- Some contracts provide for an administrative or limited notice to proceed to provide for early planning, scheduling, and submittal work, including bonds and insurance documentation.



Relationship analysis

- ❑ The reviewer should confirm that CPM network is in compliance with the scheduling specifications and in accord with good scheduling practice, and should consider the following:

- ❖ **Meaningful logic.**

Consider the **necessity** and **method** for including **start-up and/or completion activities** that occur outside the contract performance period, including:

- ✓ **Activities that logically occur before notice to proceed.**

- Schedulers should **review** any activity that precedes the **NTP** to avoid authorizing early work or even unintended early NTP **unless** provided for in the contract.



Relationship analysis

- ❑ The reviewer should confirm that CPM network is in compliance with the scheduling specifications and in accord with good scheduling practice, and should consider the following:

- ❖ **Meaningful logic.**

Consider the **necessity** and **method** for including **start-up and/or completion activities** that occur outside the contract performance period, including:

- ✓ **Activities that logically occur after substantial completion.**

- Activities such as owner move-in activities, landscape maintenance and punchlist **normally occur after** substantial completion and not before.
 - In cases of activities scheduled after substantial completion, **check to see** if the contract requirements specify an **additional time restriction**.



Relationship analysis

- ❑ The reviewer should confirm that CPM network is in compliance with the scheduling specifications and in accord with good scheduling practice, and should consider the following:

- ❖ **Submittal activities without successor review activities.**

- ❖ Every submittal activity should normally be logically followed by a review/approval activity.
- ❖ The **review/approval activity** should have a fabrication/delivery successor followed by the actual installation successors.



Relationship analysis

- ❑ The reviewer should confirm that CPM network is in compliance with the scheduling specifications and in accord with good scheduling practice, and should consider the following:

- ❖ **Multiple, simultaneous near-critical path activities.**

- ✓ Under **normal circumstances**, CPM networks should not have multiple critical paths occurring at the same time without justification.
- ✓ It is possible to **adjust durations, logic, and lag factors** to artificially create multiple paths.
 - This **increases** the number of critical activities,
which in turn **increases** the potential that any owner-caused delay will appear to be a delay to the entire project.
- ✓ Many projects with **constrained intermediate milestones** will naturally **generate multiple critical paths**,
making **control of the entire project** more **difficult**.



Relationship analysis

❑ The reviewer should confirm that CPM network is in compliance with the scheduling specifications and in accord with good scheduling practice, and should consider the following:

❖ Start-to-finish relationships.

- ❖ Most scheduling programs recognize at **least four types** of logic relationships between activities.
- ❖ Finish-to-start (FS) is the **most common**, followed by start-to-start (SS) and finish-to-finish (FF.)
- ❖ It is highly unusual to use **start-to-finish (SF)** relationships in a schedule and their use should be **scrutinized**.



Relationship analysis

- ❑ The reviewer should confirm that CPM network is in compliance with the scheduling specifications and in accord with good scheduling practice, and should consider the following:

- ❖ **Multiple relationships between two activities.**

- ❖ Activities can **logically** have up to **four different relationships** between each other at the same time.
- ❖ **Only start-to-start** and a **finish-to-finish relationship** pairs are commonly used;
any other combination is unusual and should be examined.



Relationship analysis

- ❑ The reviewer should confirm that CPM network is in compliance with the scheduling specifications and in accord with good scheduling practice, and should consider the following:

- ❖ **Missing finish relationship.**

- ✓ It is recommended that that **all activities** have a finish relationship that defines the **requirements for completing that activity**.
 - This means that **all activities** should have a finish- to-start (FS) or finish-to-finish (FF) relationship with another successor activity.
 - **If not**, there will be **no CPM requirement for activity completion** once it starts (other than project completion).



Relationship analysis

- ❑ The reviewer should confirm that CPM network is in compliance with the scheduling specifications and in accord with good scheduling practice, and should consider the following:

- ❖ **Preferential or invalid relationship.**

- ✓ Check for activities that have predecessors or successors that are **not logical**.
 - For example, a **grading submittal review** that is **driving** the start of **electrical switchgear submittal** is not logical.
- ✓ Such activity relationships should require an accompanying justification or clarification.
- ✓ **Activity relationships** must be based on **logical sequences**, **not to assign planned or preferential start dates**.



Lag and lead checks

❑ While lags have **legitimate uses**, any such time interval over a threshold value should be **individually investigated**.

❖ However, they can also be used to

1. **Sequester** (reduce and hide) float or
2. Otherwise **artificially expand** a project schedule
without being visible in **graphics** or in **most reports**.



Lag and lead checks

- ❑ The following rules should be **followed** unless a **valid reason** exists on a case-by-case basis to not follow them:

- ❖ **SS and FF relationships should only have zero or positive lags.**



Lag and lead checks

❑ The following rules should be **followed** unless a **valid reason** exists on a case-by-case basis to not follow them:

❖ **Large lags** or **FS relationships** with **positive lags** can create gaps in the schedule; the **scheduler** should consider coding these as **separate activities**.

✓ **Lags cannot** be **statused** for progress in a schedule update.

✓ For **lags of long duration** (such as the delivery of a major piece of equipment),

it is better to **create an activity** that will show up on reports and can be statused every update.

✓ Generally, **lag values** in excess of **15 work days** (greater than one or two monthly update periods)

should be changed to **schedule activities** for better visibility, justification and statusing.



Lag and lead checks

- ❑ The following rules should be **followed** unless a **valid reason** exists on a case-by-case basis to not follow them:
 - ❖ **All relationships** that use a **lag factor other than zero** should be reviewed to determine that the **reason they exist** is valid.
 - ❖ The **use of negative lag** factors is typically discouraged, and should therefore be **explained and justified** in the baseline schedule narrative.



Constraint analysis

- ☐ **Constraints** can be used to force an adjustment or override to **computed CPM dates**.
- ☐ They may be **assigned** to an entire project or to an individual activity in a CPM schedule.
- ☐ This discussion of **constraints** only considers **their use** in overriding calculated dates; it does **not involve** logical, resource, or other types of “constraining” issues.



Constraint analysis

- ❑ As **constraints** can override the pure-logical relationships between activities, their use is **discouraged** in the baseline schedule
unless specifically required by **contract**.
- ❑ Some schedulers incorrectly use **constraints** to make activities
fall into pre-determined time periods as if they were preparing a **bar chart schedule**.
- ❑ **Constraints** should only be used to reflect contractual requirements and
should **not be used** to force the **early start date** of an activity equal to the
planned start date.



Constraint analysis

❑ The **reviewer** should list and review **all** assigned schedule **constraints**.

1. A **succinct listing** of all constrained activities with
2. Type of constraint and
3. Dates

serves as an **important reference point** in the schedule review process.

❑ From this list, the reviewer should look for consistency and for odd dates.

❑ A listing and explanation of **all non-contractual constraints** should be included in the baseline schedule narrative.



Constraint analysis

- ☐ **Baseline schedules** should be free of imposed or “mechanical” constraints that are **not required** by the contract.

- ☐ The owner and contractor **may agree** to **allow** for schedule constraints such as
 1. Zero free float, or
 2. Expected finishto be **inserted** into a baseline schedule after it has been **approved**.



Constraint analysis

- ❑ **Owners** should be **aware** that permitting a non-contractual constraint to be included in the baseline schedule **may signal** willingness to allow this **same constraint** to be considered in a **delay/time impact evaluation**.
- ❑ If the **reviewer believes** that a non-contractual constraint may remain in the original baseline schedule,
it is **advisable** to include a comment in the review report that such constraints must be removed **prior to performing** any delay analysis.
- ❑ If the **contractor wishes** to demonstrate a scheduling intention or plan,
then they should **state** this in the narrative and
not through the **use** of constraints.



Constraint analysis

- ☐ **Not all types of constraints** are found in every CPM scheduling **software package**.
- ☐ **Some software packages** label their constraints with different nomenclature but **act in a similar behavior**.
- ☐ The **use of any** constraints should be scrutinized for their effect upon the schedule calculations.



Constraint analysis

❑ The **following types of constraints** should be reviewed with extra scrutiny over **other types** of constraints, if present:

❖ **Zero free float constraints (also known as “as late as possible” constraints.)**

- ✓ Activities with an **assigned zero free float** constraint are scheduled as late as possible without delaying any **succeeding activities**.
 - This type of constraint is typically used to **postpone** the **scheduled delivery** of needed material until the ‘**last minute.**’
 - This constraint is frequently used in **manufacturing** to maintain a reduced inventory level.



Constraint analysis

❑ The **following types of constraints** should be reviewed with extra scrutiny over **other types** of constraints, if present:

❖ **Zero free float constraints (also known as “as late as possible” constraints.)**

- ✓ In construction, **contractors** prefer to delay material delivery to
 - (1) reduce storage costs
 - (2) reduce the chance for damage while being stored, and
 - (3) because a down payment is required and contractors usually benefit from delaying expenditures.



Constraint analysis

❑ The **following types of constraints** should be reviewed with extra scrutiny over other types of constraints, if present:

❖ **Zero free float constraints (also known as “as late as possible” constraints.)**

- ✓ Using a **zero free float constraint** for delivery activities can pose a project risk

because **any delay** in delivery will then delay successor work activities.

- **Special concern** is for owner-supplied material as the owner would then be at risk of **delaying the project**.

- ✓ The **reviewer** should verify the **reasonableness** of all such situations.



Constraint analysis

❑ The **following types of constraints** should be reviewed with extra scrutiny over **other types** of constraints, if present:

❖ **Zero total float constraints.**

- ✓ Activities with zero float constraints are artificially scheduled as **critical** without regard to **network logic**.
- ✓ **Delaying** this activity will **not necessarily** delay project completion.
- ✓ This **constraint** not only affects the coded activity but all preceding activities on the **same float path**.



Constraint analysis

❑ The **following types of constraints** should be reviewed with extra scrutiny over **other types** of constraints, if present:

❖ **Expected finish constraints.**

- ✓ Expected finish constraints compute the **remaining duration necessary to complete** an activity on a specified date,
regardless of what duration is **originally assigned** (as long as the **remaining duration** is a positive number.)
- ✓ The use of expected finish constraints **may** indicate an **attempt** to artificially inflate the duration of an activity to **use** all of the available time.
- ✓ The use of expected finish constraints is discouraged, and **if used**, they should be explained and justified in the baseline schedule narrative.



Constraint analysis

❑ The **following types of constraints** should be reviewed with extra scrutiny over **other types** of constraints, if present:

❖ **Mandatory constraints.**

- ✓ An activity **configured** in this manner will be scheduled to **start on the date** given even if all **predecessors** are **not complete**.
- ✓ Mandatory start and finish constraints completely override **network logic** and do not allow for **calculation of float**.
 - It is recommended that **if** a constraint **must be used**, then
 1. Start no earlier than,
 2. Start no later than, or
 3. Even a start on constraintbe used instead.



Constraint analysis

❑ The **following types of constraints** should be reviewed with extra scrutiny over **other types** of constraints, if present:

❖ **Start on constraints.**

- ✓ Start on constraints **control the start** of an activity in both the forward and backward direction.
 - However, unlike mandatory constraints, they **still obey CPM calculation rules** and will not start activities prior to **all predecessors being satisfied**.

- ❑ **CPM schedules** can allow the addition of **cost resources** to individual activities.
 - ❖ Quite often, these ‘**cost-loaded**’ **schedules** are used to determine progress payments due, or perform earned value analysis.
- ❑ Schedule cost analysis is **not “accounting”** but every reviewer should look for **logical errors or oddities** in the cost records, if present.
- ❑ A **more stringent level of control** is used when the schedule is used as a **payment mechanism** including the review of quantities and cost loaded line items versus **contract values**.

❑ Cost analysis includes the following checks:

❖ **Consistency with bid items or schedule of values.**

- ✓ The **cost-loading** must be **consistent** with the bid items and/or the contract schedule of values.
- 1. First check to ensure that the **overall budgeted cost** of the project **matches** the contract bid amount
minus any non-task specific amounts such as that allocated for **profit and overhead**.
- 2. Further, ensure that **quantities** loaded into schedule activities are **consistent** with those identified in the contract, if applicable.

❑ Cost analysis includes the following checks:

❖ **Front-end cost loading.**

- ✓ The assignment of **inappropriately high cost values** onto activities scheduled earlier in the project while **under-valuing cost assignments** on activities occurring late in the project can reflect an effort to collect larger progress payments than have been actually earned.
- ✓ The reviewer should examine the **cost histogram or S-curve**; a **curve** that starts up steeply and then flattens out by the middle of the project **may indicate** front-end cost loading.



Cost analysis

❑ Cost analysis includes the following checks:

❖ **Unused cost account codes.**

- ✓ Examine **account codes** that are defined but unused.
 - This condition can result from **oversight** but should be checked to ensure that **scope** has not been omitted.

❑ Cost analysis includes the following checks:

❖ **Negative cost values.**

✓ In order to **understand** the basics of schedule costs, schedulers need to evaluate **three categories**:

1. Budgeted costs
2. Earned value
3. Actual costs

None of these should be negative.

❑ Cost analysis includes the following checks:

❖ **Earned value.**

- ✓ Since the baseline schedule represents the start of the execution of work (or shortly thereafter) earned value should be **zero**.

❑ Cost analysis includes the following checks:

❖ Actual costs.

❖ Actual costs should be **zero** in the baseline schedule.

❑ Cost analysis includes the following checks:

❖ **Activities with adjustable durations/costs.**

- ✓ **Adjustable duration** activities such as level-of-effort, hammocks, or those **coded** with an expected finish constraint may have **costs assigned** to them.
 - These activity durations can change when **conditions** in the network **change**.
 - The change in duration is applied to the **original unit cost**, causing the **costs for these activities** to automatically adjust as well.
- ✓ The **total budgeted costs** might be in balance with the **baseline schedule** but could **vary** once status/progress has been **applied**.
 - For this reason, **some specifications** forbid the **cost loading** of adjustable duration activities.



Notebook or log review

- ☐ Some CPM software provides the ability to keep **activity notebooks** or **logs**.
- ☐ **Reviewers** should be **cautious** about activity logs or notebooks;
they can be considered a form of written notification from the **contractor** to
the owner about intent or understanding.
- ☐ It is therefore **prudent to review** and **comment** on any logs or notebooks
which **make statements** that may not reflect agreement by both parties.



Notebook or log review

- ❑ The **log or notebook** section of the schedule is an **excellent place** for the contractor to **further define** the **parameters of each task**.
- ❑ Here schedulers can describe planned resource usage, assumptions as to weather conditions, planned substitutions, and deviations from specifications.
- ❑ As this information is **not ‘visible’** in normal views and reports, it is **typical for a reviewer** to **neglect to look** at logs or notebook entries during a baseline review.
- ❑ Producing and reviewing a report listing all notebook entries is an excellent review practice.



Other baseline schedule checks

☐ There are **other items** reviewers should **check** that are not as quantifiable as the list above.

☐ **Before** a baseline schedule **review** is **complete**,
one should refer to the following documents and issues:

- CPM calculation report (sometimes called, "schedule log")
- Standard activity listing
- Standard logic listing
- Time-scaled network diagram graphic
- Constructability issues
- Site or facility access issues
- Resource availability
- Resource congestion
- Cash-flow histogram
- Seasonal considerations
- Special requirements defined by the contract documents, such as Leadership in Energy & Environmental Design (LEED)

Additional Topics



Resource leveled schedules

- ☐ Not **all contract specifications** require that a schedule be resource loaded.
- ☐ Schedules that are resource loaded **put a burden** on both the contractor and the owner because the owner may have to maintain independent records to confirm the loading.
- ☐ If **resource loading** is included in the baseline schedule, the **reviewer** should analyze it and it must be reasonable.
- ☐ **Resource loading** is **not** the same thing as **resource leveling**



Resource leveled schedules

- ☐ All schedules should account for **expected resource constraints**.
- ☐ This may simply entail having enough activity duration or float to accommodate resource difficulties.
- ☐ Many CPM scheduling software programs also have **routines to analytically** consider resource constraints when assigning computed dates.
 - ✓ This latter process is called automatic **resource leveling**.



Resource leveled schedules

- ❑ **Automatic resource leveling** is accomplished **after the CPM calculation** is made and is used as a forecasting tool by the contractor to **better plan requirements**.
- ❑ A **resource leveled schedule** results in activity scheduling changes that are either manually adjusted, automatically adjusted through software routines, or a combination of both.
- ❑ This RP refers to “**automatic resource leveling**” as delaying or constraining the scheduled start of activities for resource considerations without the use of logic.
 - ❖ This RP **neither advocates nor opposes** the use of automatic resource leveled schedules.



Resource leveled schedules

- ☐ **Ordinarily**, the first action that a reviewer performs after loading the schedule is to **recalculate the schedule** using the project '**as of**' **status date** (which is usually already set in the schedule software parameters.)
- ☐ This is done to **ensure** that **no latent information contradicting** the CPM calculations exists prior to commencing the review.



Resource leveled schedules

- ❑ The exception to this rule is when the reviewer is analyzing **automatic resource-leveled schedules**.

In this case, the **CPM calculations** should **not be made** on the original schedule.

- ❑ **Unwittingly** re-calculating the CPM and then reviewing an automatic resource leveled schedule might result in the **acceptance** of a schedule that **might otherwise** have been rejected.

- ✓ **Many reviewers** create a copy of the automatic resource leveled schedule,

- perform the **CPM calculation on the copy**, and

- then compare the two schedules.



Resource leveled schedules

- ❑ CPM scheduling software generally does **not indicate** if automatic resource leveling has been used,

which makes that **determination a problem** for the reviewer.

If it has been used, then the contractor should so state in their narrative.



Resource leveled schedules

- ❑ There is no **easy, definitive method** of checking to see if a **submitted schedule** has been automatic resource leveled.
 - ❑ Reviewing the leveling **set-up portion** of the software and noting the **lack of assigned resources** to be leveled and/or prioritization selections is a reasonable **sign that no leveling** has been performed.
- ❑ The **only true test** for both manual and automatic resource leveling is performed by
 1. Making copy of the schedule,
 2. Performing a CPM calculation against this copy, and
 3. Then making a date-by-date comparison against the original update schedule.
 - ❖ This **activity-by-activity comparison** is time-consuming process and is therefore seldom performed.



Resource leveled schedules

- ☐ If the **specification requires** a CPM schedule submittal, then an automatic resource leveled schedule does not meet that requirement
unless the owner allows this change.
- ☐ If the owner wishes to **accept automatic** resource leveled schedules, then it is the **responsibility of the contractor** to explain exactly **what changes** were made
in addition to the ones made during the actual CPM calculation process.



Resource leveled schedules

- ❑ If the **owner** does not wish to accept the automatic resource leveled schedule as meeting the requirement for submitting a CPM schedule,
a **possible alternative (other than rejecting** the submittal outright) is for the **reviewer** to
 1. Recalculate the CPM using the **exact CPM calculation settings** in effect for that schedule and
 2. Reviewing this re-calculated schedule as the submittal and stating so **clearly** in their **written review**.
- ❑ The **contractor** should object to **this procedure** in writing if they **do not wish to accept**
this **adjusted schedule** as their submittal;
they should understand that their objection **nullifies** the reviewer's acceptance.

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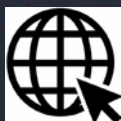
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