PROJECT SCHEDULE

Effort vs. Duration Slack and Overhead, Allocate resources ,Identify dependencies, Brook's law, Gantt chart, Milestone approaches, Critical path, Buffer, Baseline, Variance, Earned value management, Budgeted cost for IT projects

Lecturer. Tuyatsetseg Badarch, PhD. Associate professor

Mongolian National University

PROJECT SCHEDULING

Creating a succesfull project schedule is an important activity for a project's completion on time. In fact, most of the project managers suffer from poor schedules that lead wrong decisions. Unadequetly created project schedules always involve an insufficient number of activities and resources required to complete the tasks of a project.

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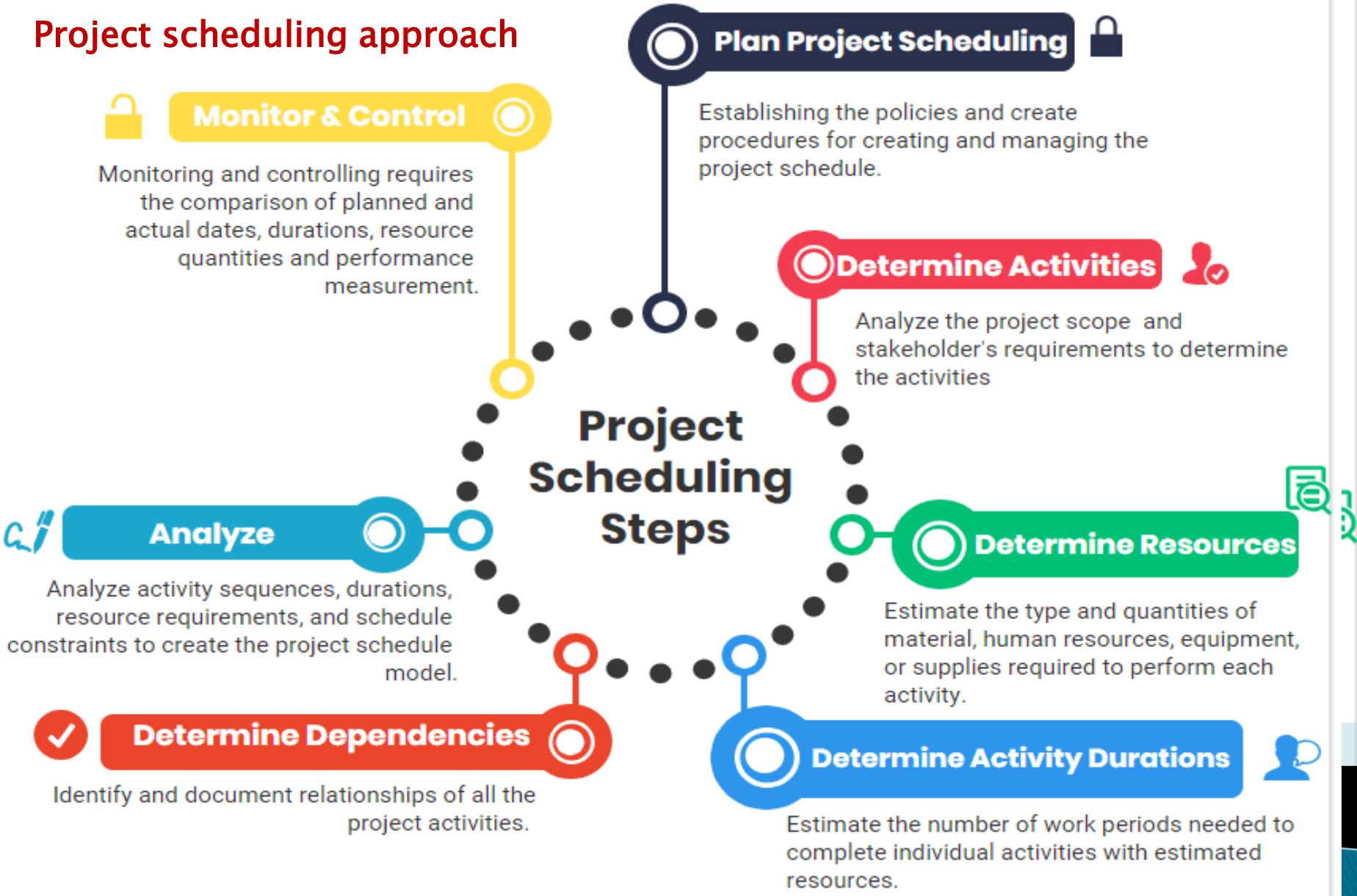
"Applied Software Project Management", Andrew Stellman published by OReily, 2010

https://www.projectcubicle.com/project-scheduling-steps/

Project scheduling approach



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PROJECT SCHEDULING STEPS

1. Analyzing the Project Scope and Create the Work Breakdown Structure (WBS)

2. Determine the Project Activities (stakeholder and project requirements, task dependent, milestone, level of effort, etc.)

3. Determine the Resources Required to Complete the Activities (labor, materials, equipment, subcontractors, employees, etc.)

4. Estimate Activity Durations (with tools such as Expert Judgement, Analogous Estimating, Parametric Estimating, and Three point estimation.)

5. Determine the Activity Dependencies (Activity Relationships for FS, SS, SF, FF)

6. Analyze the Project Schedule and Detail if Necessary (with resource leveling process)

7. Monitoring&Controling the Project Schedule (Earned Value Management techniques can be used for Schedule Performance Index (SPI), Schedule Variance (SV), Cost Performance Index (CPI) and Cost Variance (CV) for performance)

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SCHEDULING CONCEPTS: EFFORT VS. DURATION

Effort represents the work required to perform a each task of a project.

Effort is measured in person-hours (or person-days, person-weeks, etc.)

It represents the total number of hours that each person spent working on the task.

Duration is amount of time that elapses between the time the task is started and the time it is completed.

Duration is measured in hours (or days, weeks, etc.)

It does not take into account the number of people performing the task

Example

Effort Distribution

- A recommended distribution of effort across software process is often referred to as *40-20-40 rule*
  - *40%* allocated to analysis & design
  - *20%* allocated to coding
  - *40%* allocated to testing
- Use the above as a guideline only as each project dictates its own distribution effort

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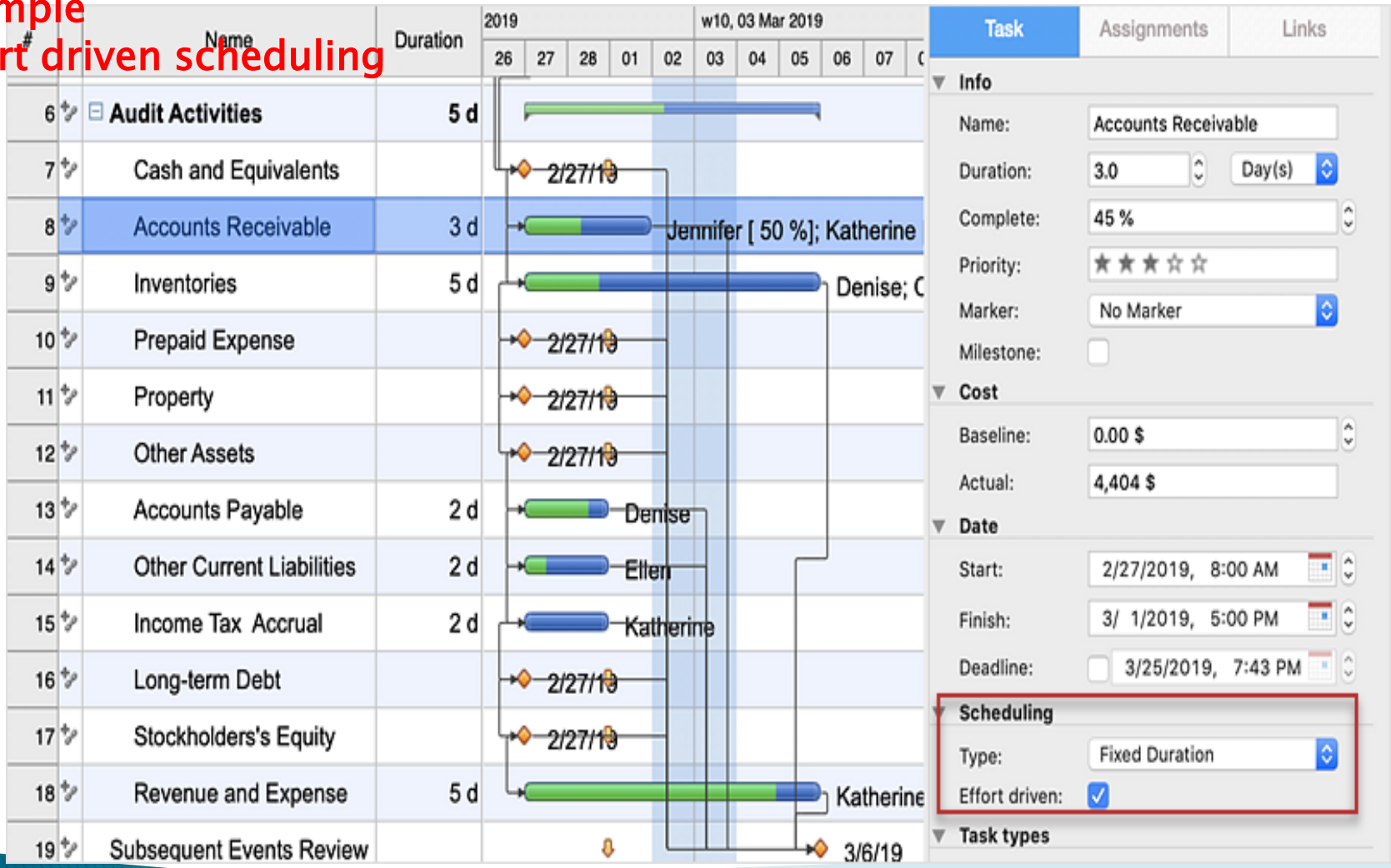
https://slideplayer.com/slide/7640481/

"Applied Software Project Management", Andrew Stellman published by OReily, 2010

Example
Effort driven scheduling



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https://www.conceptdraw.com/examples/project-management-schedules

"Applied Software Project Management", Andrew Stellman published by OReily, 2010

SCHEDULING CONCEPTS: SLACK AND OVERHEAD

Slack is the amount of time which any of the tasks can be delayed without causing the due date of the final task in the sequence to be delayed as well.

A tight schedule has very little slack; a delay in any task will cause a delay in the due date

Parkinson's Law: "Work expands so as to fill the time available for its completion."

Overhead is any effort that does not go to the core activities of the task but is still required in order for the people to perform it—a sort of "real world" cost of actually doing the work.

Two people performing a task will require more effort than one person doing the same task

Assigning two people to the task requires more effort, but the task has a shorter duration

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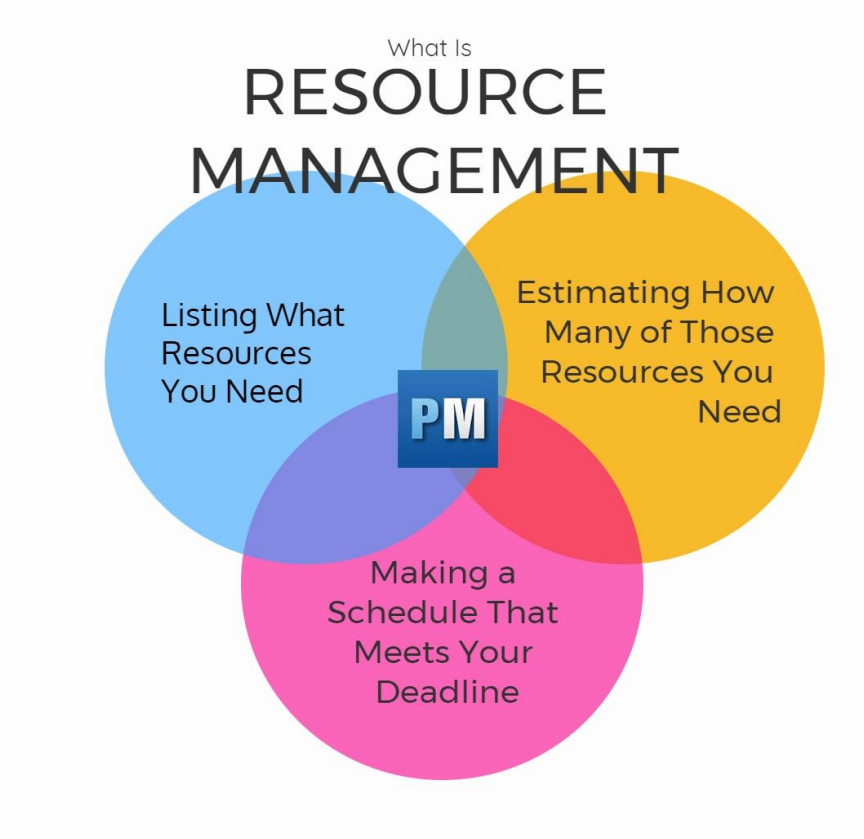
ALLOCATE THE PROJECT RESOURCES FOR SCHEDULING

Allocate resources

For each task in the WBS, one or more resources must be assigned

Choose person or people for each task based on qualifications, familiarity and availability

Take overhead into account when calculating the duration of each task



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"Applied Software Project Management", Andrew Stellman published by OReily, 2010

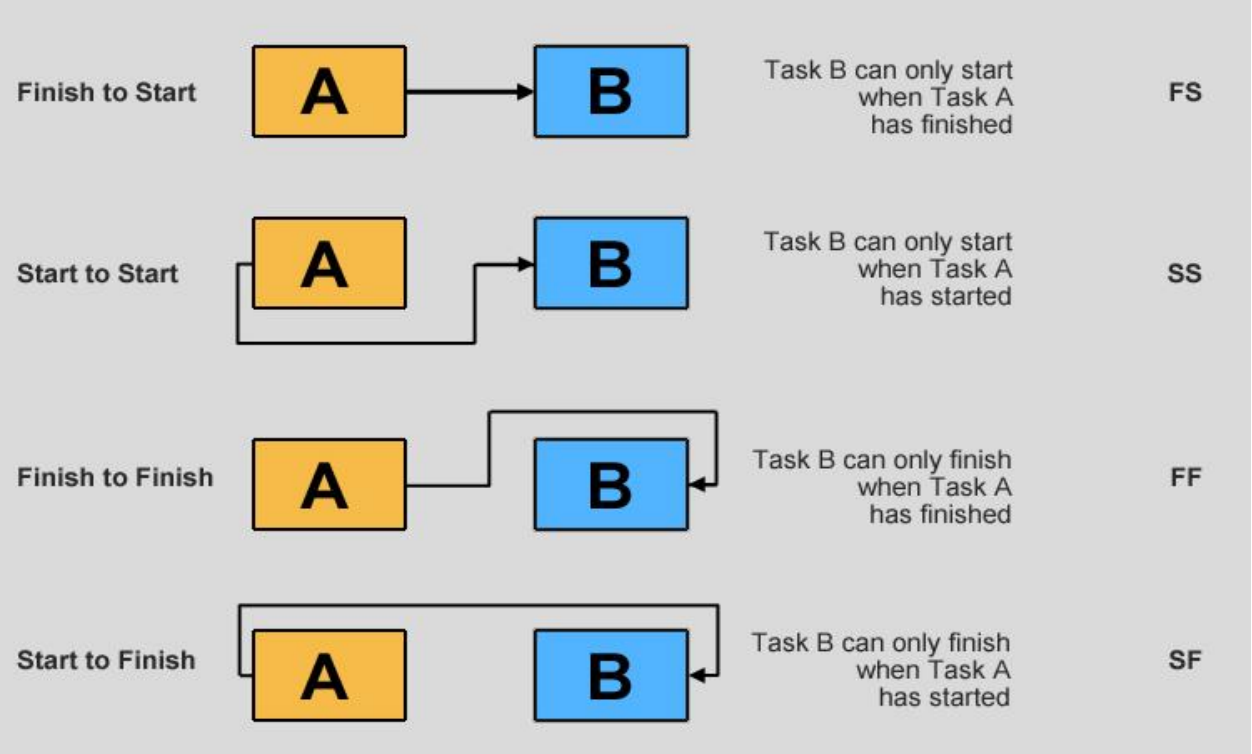
https://www.projectmanager.com/blog/quick-guide-resource-management

IDENTIFY THE PROJECT DEPENDENCIES FOR SCHEDULING

Identify dependencies

A task has a dependency if it involves an activity, resource or work product which is subsequently required by another task

Tasks may have dependencies because they require the same resource



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https://www.prince2.com/uk/blog/project-dependencies

TYPES OF PROJECT DEPENDENCIES FOR SCHEDULING

Identify dependencies (continued) : Every dependency has a predecessor

Identify the type of predecessor for each dependency

Types of dependencies, there are also dependency categories. These are resource-based:

1. **Logical dependencies, which are fundamental requirements.**
2. **Preference dependencies, which have several schedule options but are based on the preferred path.**
3. **Resource-based dependencies, which could be completed more quickly if additional resources were available.**

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https://www.prince2.com/uk/blog/project-dependencies

APPOACH OF THE PROJECT SCHEDULE BASED ON GANTT CHART

Create the schedule

Most project schedules are represented using a Gantt chart

The Gantt chart shows tasks, dependencies and milestones using different shapes

A Gantt chart is a simple to use framework that presents a visual representation of large projects, broken into smaller tasks or activities with each of these activities spread out over time.

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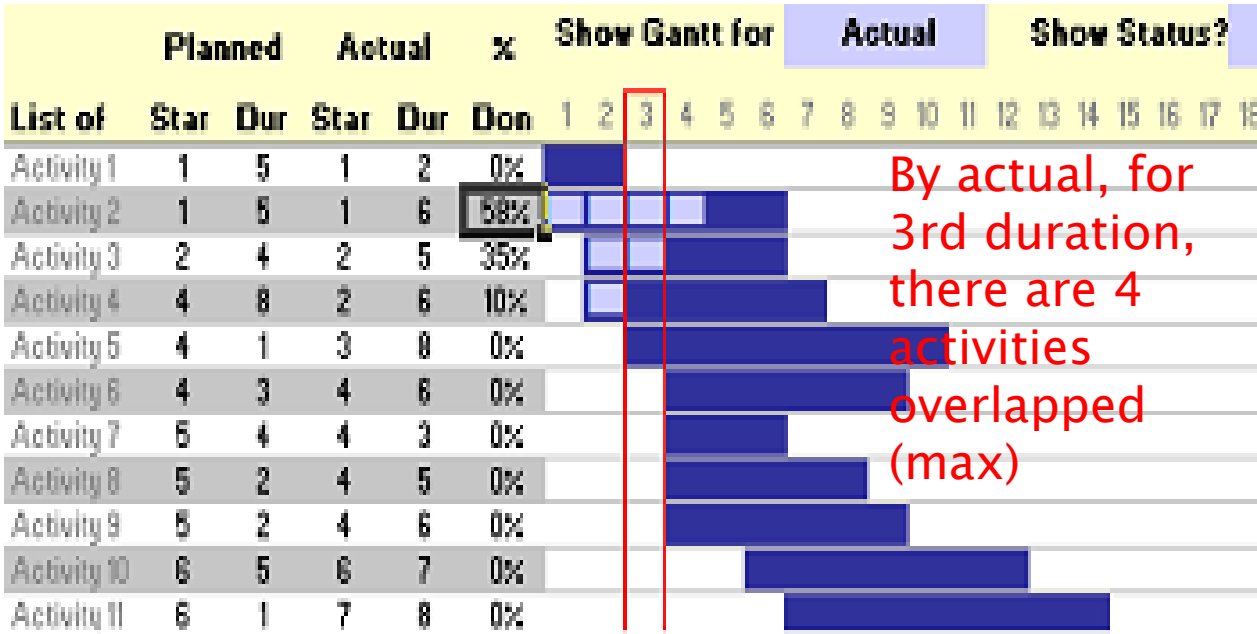
"Applied Software Project Management", Andrew Stellman published by OReily, 2010

https://study.com/academy/lesson/gantt-chart-in-project-management-definition-examples.html

TYPES OF PROJECT DEPENDENCIES FOR SCHEDULING

A Gantt chart includes developing a software prototype, planning a complex event, and writing a multi-parts report.

The chart shows individual activities, each should have start and end , if there is any overlap between activities, and how the project can be completed within a given time resources.



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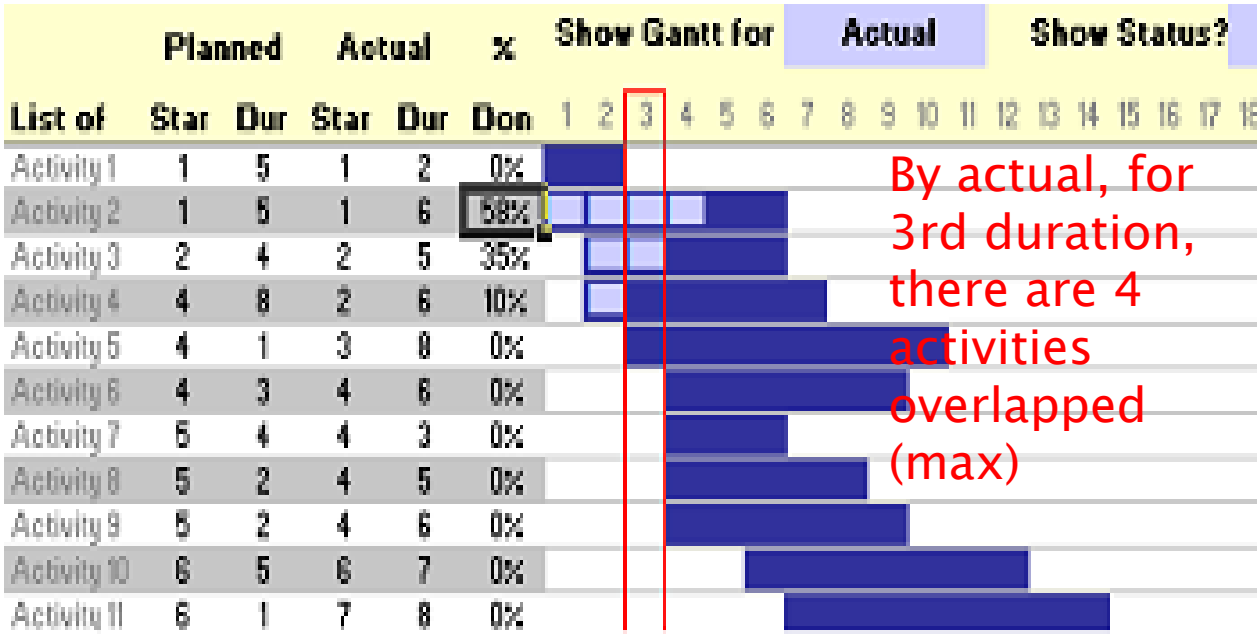

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GANTT CHART ADVANTAGES AND DISADVANTAGES

Advantages

1. **The ability to monitor the progress of a large project.**
2. **To reduce multiple meetings to share the same information.**
3. **To motivate the team for completion. The team won't get bogged down in figuring out what comes next.**
4. **To make easy alterations to a Gantt chart once a project has begun.**
5. **To enhance the efficiency to use of time such as other activities can be begun while waiting for responses or feedback from other team members.**

Disadvantages

1. **Too detailed and thus, cumbersome.**
2. **Gantt charts are difficult to indicate a high priority activity , even there is sufficient time**

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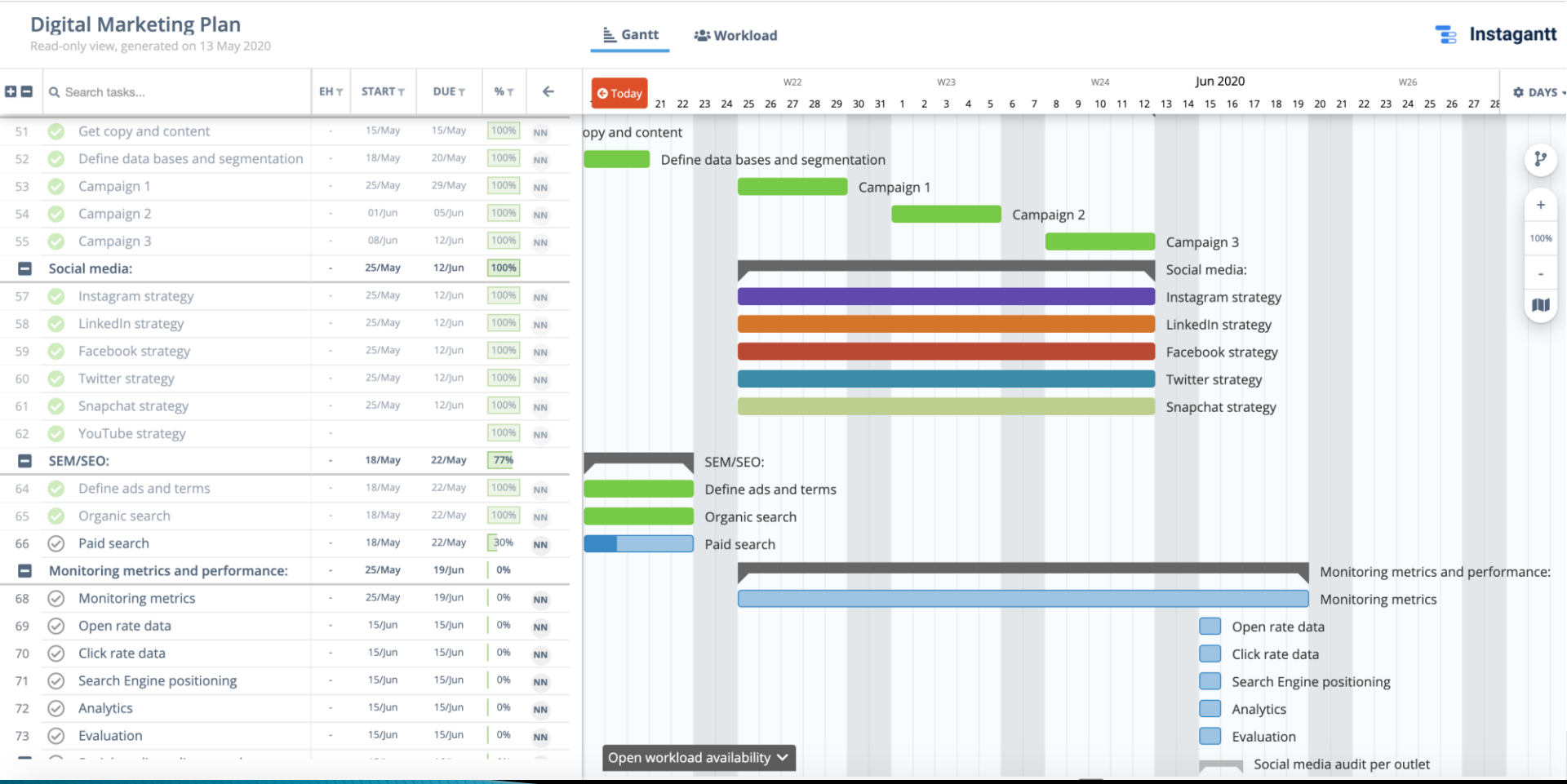
ON GANTT CHART USAGE EXAMPLE: DIGITAL MARKETING



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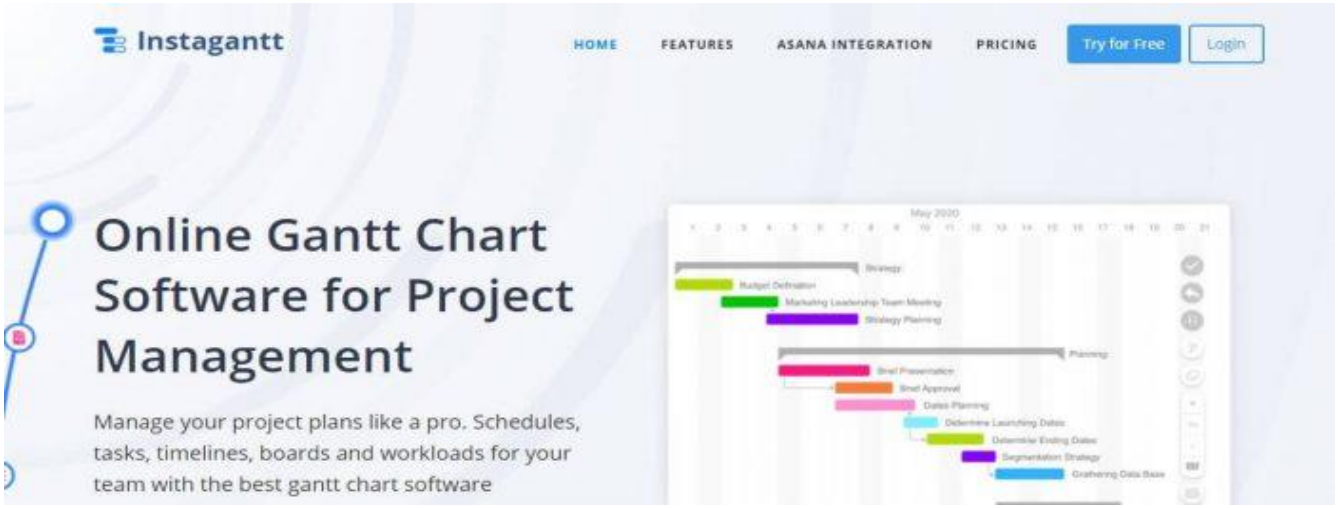
https://instagantt.com/digital-marketing-plan-template

TOP 10 GANTT CHART SOFTWARE FOR PROJECT MANAGEMENT IN 2021

1. **Instagantt**
2. **TeamGantt**
3. **ProofHub**
4. **Wrike**
5. **Smartsheet**
6. **GanttPRO**
7. **Microsoft Project**
8. **Click Up**
9. **Toggl Plan**
10. **Monday ...**

Gantt charts are flexible tools and allow people to really understand project task duration, resource use, and team workload.

There are also 36 Gantt chart online softwares:
https://www.ntaskmanager.com/blog/best-gantt-chart-software/



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https://instagantt.com/top-10-gantt-chart-examples-for-project-management

BROOKS' LAW:BUILDING THE PROJECT SCHEDULE

Reconcile the schedule with the organization's needs

Once resources are allocated to each task, a final date can be calculated

If this date is unacceptable, the project plan must change

Either additional resources must be allocated to the project or the scope must be cut down

Brooks' Law: "Nine women cannot have a baby in one month."

There is a minimum possible length of any project, and even a million developers applied to the problem can't get it done instantaneously. In other words, some tasks can only be done by one person, no matter how critical they are.

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"Applied Software Project Management", Andrew Stellman published by OReily, 2010

Project Management Institute, A Guide to the Project Management Body of Knowledge

REVIEW MEETINGS: BUILDING THE PROJECT SCHEDULE

Add review meetings to the schedule

The regular review of projects by individuals outside the direct project execution team is a core aspect of effective project management. Progress reviews are meetings held regularly to check the progress of a project versus it's scheduled progress.

Milestone reviews are meetings which the project manager schedules in advance to coincide with project events.

Milestones are pre-planned events or points in time at which a thorough review of status is conducted to understand how well stakeholder requirements are being met.The most common way for project managers to handle milestone reviews is to schedule them to occur after the last task in a project phase (such as the end of design or programming).

https://www.wibas.com/cmmi/pmcsp-17-conduct-milestone-reviews

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https://www.researchgate.net/publication/340949649_Effective_Project_Review_Meetings_Key_Points

"Applied Software Project Management", Andrew Stellman published by OReily, 2010

OPTIMIZE THE SCHEDULE: BUILDING THE PROJECT SCHEDULE

Optimize the schedule

The critical path is the sequence of tasks that represent the minimum time required to complete the project.

If a task is only on the critical path when delaying that task will delay the project.

Allocating resources to tasks on the critical path will reduce the project schedule; allocating them to other tasks will have less effect.

A resource is over-allocated if more than 100% allocated to multiple tasks simultaneously

If any resource is over-allocated, it means that there is a dependency between two tasks which was not discovered.

When this happens, the schedule is guaranteed to be inaccurate. Find and fix over-allocated resources.

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BUFFERS: BUILDING THE PROJECT SCHEDULE

Always think about buffers

A buffer is a task added to the schedule with no specific purpose except to account for unexpected delays.

This practice involves either adding extra tasks or padding existing tasks at strategic points in the schedule where overruns are "expected".

Buffers can be useful: for example, on a year-long project, every IT team will take two weeks of vacation

In the CCPM, for managing and observing the projects' performance, the buffers are frequently monitored

to protect the critical path as well as the project's completion time.This mechanism is called "Buffer Management", which can detect a potential problem and raise a warning signal to managers.

As the projects proceed, if a task elapses a longer time than expected, the task consumes the buffer on the corresponding path.

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Truc, Takei, Goto and Takahashi: Industrial Engineering & Management Systems Vol 11, No 4, December 2012, pp.397-405, © 2012 KIIE

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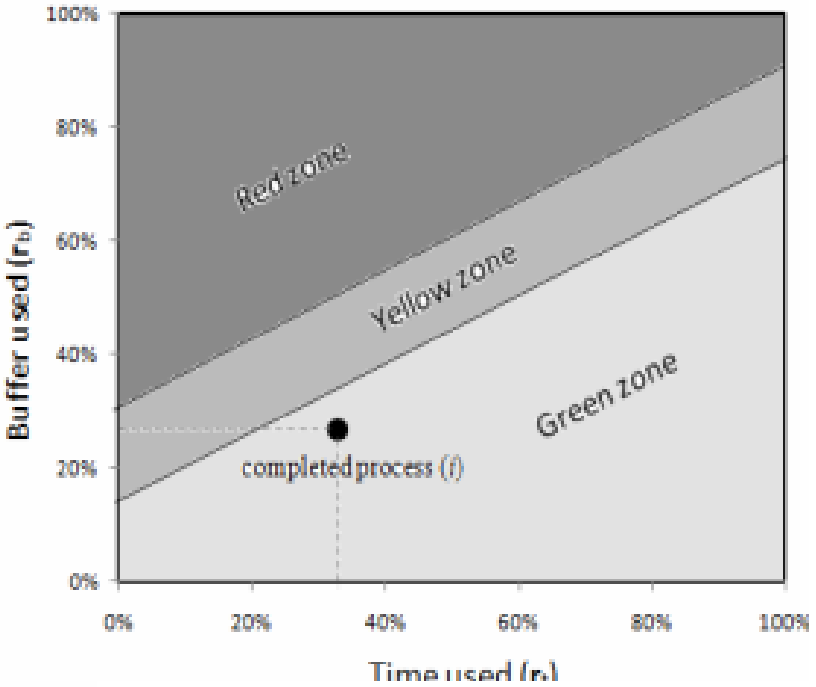
BUFFERS: BUILDING THE PROJECT SCHEDULE

This picture shows the relationship between buffer used (%) versus time used (%) through the completed processes. The chart is divided into three zones: green, yellow, and red, which are determined empirically by thresholds settings.

Project managers need to have a base on the thresholds of buffer settings proposed by Leach (2005).

Specifically, if the current status is in the green zone, the project is going well and the managers need not take an action. If the status is in the yellow zone, the project assesses a problem and needs a recovery plan to avoid further buffer erosion. If the status is in the red zone, the project will possibly be late and the managers should initiate the action.



Time used (%)	Buffer used (%)	
	Green to yellow transition (%)	Yellow to red transition (%)
0	15	30
100	75	90

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Leach, L. P. (2005), Critical Chain Project Management, Artech House, Boston, MA.

Truc, Takei, Goto and Takahashi: Industrial Engineering & Management Systems Vol 11, No 4, December 2012, pp.397-405, © 2012 KIIE

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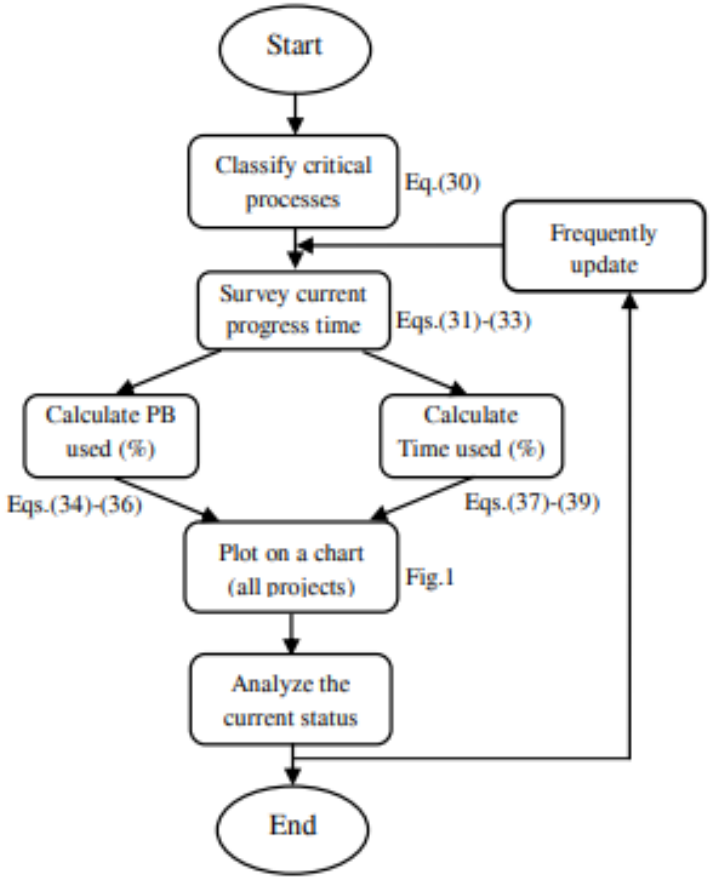
BUFFERS: BUILDING THE PROJECT SCHEDULE

The buffer management frequently compares two parameters: the consumption rate of the PB and the progress rate of the corresponding critical path, for expressing the current performance of the project. In the multi-project system, these parameters are frequently checked for all projects and plotted on a flowchart, as shown in Figure.



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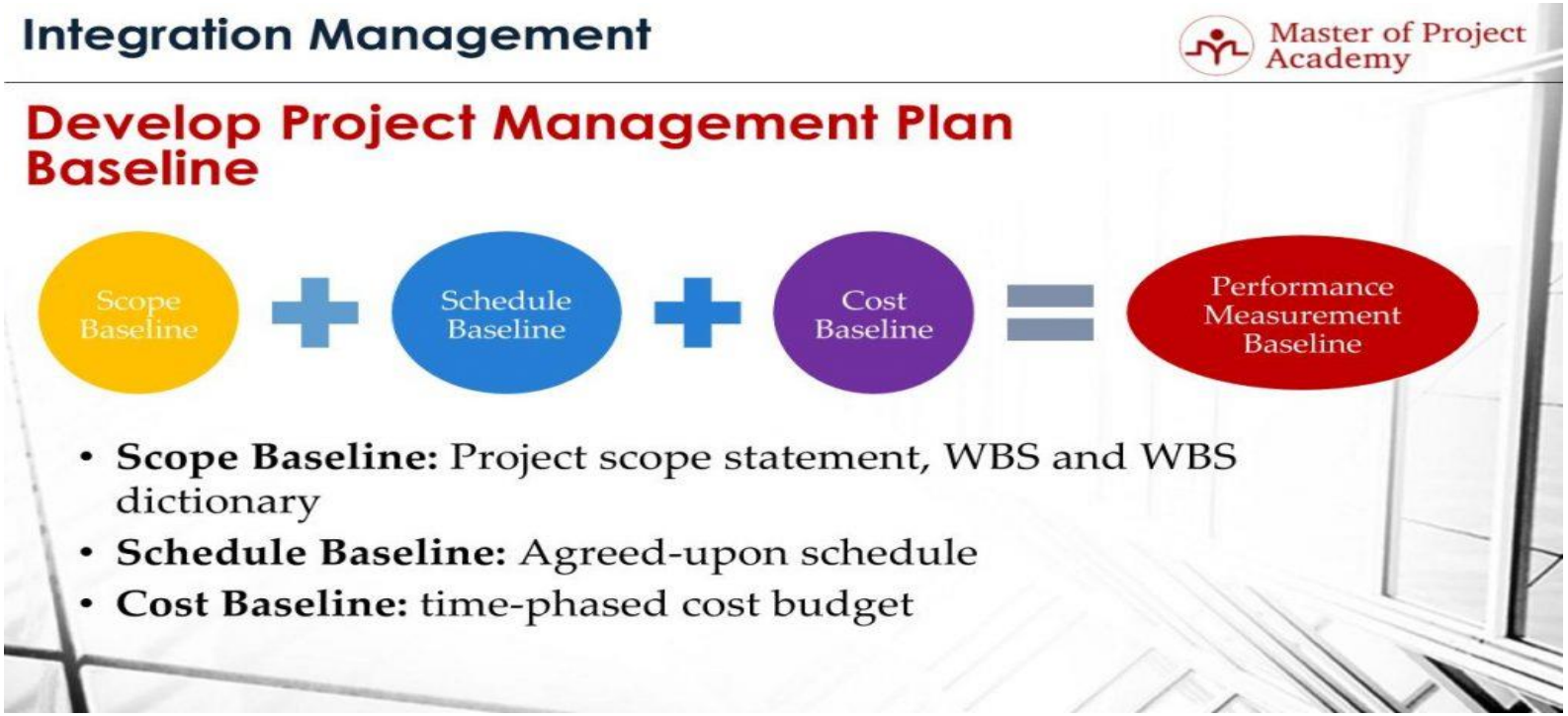
PROJECT METRICS: BASELINE FOR THE PROJECT SCHEDULE

The baseline is the version of the schedule that has been approved. The schedule will change based on the actual work done by the project team. When the deadline of the revised schedule is later than that of the baseline, the project has slipped.



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PROJECT METRICS: VARIANCE FOR THE PROJECT SCHEDULE

Variance is the difference between the estimated effort in the baseline and the actual effort performed by the team. When the deadline of the revised schedule is later than that of the baseline, the project has slipped.

For example, milestone 2 is planned for completion on December 3, but completed one day ahead of schedule on December 2, so the schedule variance is -1, or one day ahead. Milestone 3 is planned for completion on December 5, but not actually accomplished until December 7, leaving a variance of +2 days.

Variance Analysis: Schedule

Scheduled Item	Planned	Actual	Variance
Milestone 1	Dec. 1	Dec.1	0
Milestone 2	Dec .3	Dec. 2	-1
Milestone 3	Dec.5	Dec. 7	2

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https://www.stakeholdermap.com/project-management/variance-analysis-for-new-project-managers.html

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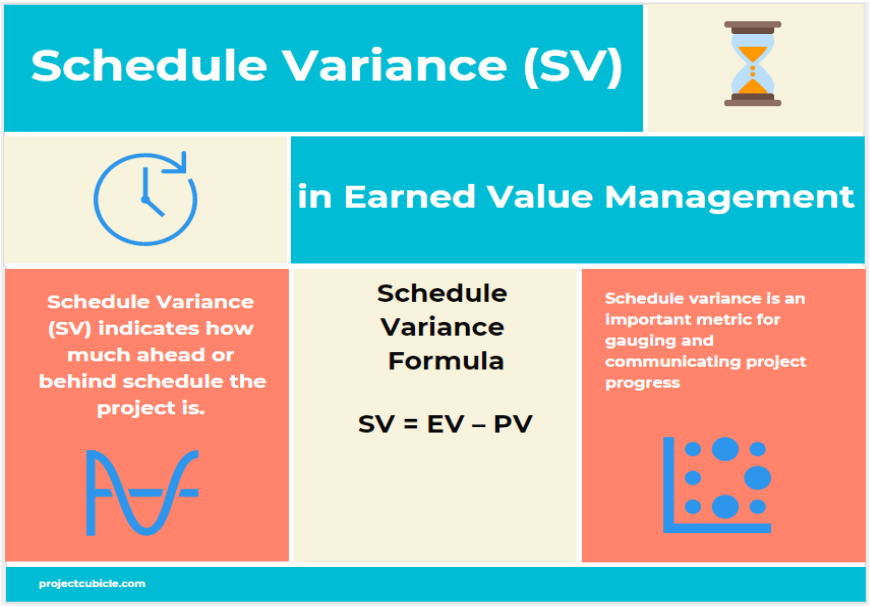
PROJECT METRICS: EARNED VALUE MANAGEMENT FOR THE PROJECT SCHEDULE

Earned value management check the project by considering effort "earned" against a budget only after it has actually been performed.

The earned value (EV) is the estimated effort of the actual tasks that appear on the schedule to date.

The planned value (PV) is the effort spent on the tasks in the schedule that have actually been completed by the development team members.



Schedule Variance (SV)= EV – PV

- If SV is positive, the task is ahead of schedule.
- If SV is negative, the task is behind schedule.
- If SV is zero, the task is on schedule.

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https://www.projectcubicle.com/schedule-variance-sv/

"Applied Software Project Management", Andrew Stellman published by OReily, 2010

SCHEDULE VARIANCE EXAMPLES

We have a project to be completed in 20 months and the budget of the project is 500,000 USD. 10 months have passed and 300,000 USD has been spent, but only 35% of the work has been completed so far.

Now we will calculate our project's Schedule variance (SV) and understand if we are behind or ahead of our work schedule.

Planned Value (PV) = %50 * 500,000 = 250,000 USD

Earned Value (EV) = %35 * 500,000 = 175,000 USD

Actual Cost (AC) = 300,000 USD

Schedule Variance Formula: SV = EV – PV

SV = 175,000 – 250,000 = – 75,000 USD

Our project's Schedule Variance is -75,000 USD and we are behind the schedule. Therefore, corrective action should be taken to reach the targets.

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SCHEDULE VARIANCE EXAMPLES

We have a budgeted cost of a project at $700,000. The project is to be completed in 10 months. After a month, we have completed 10% of the project at a total expense of $150,000. The planned completion should have been 20%.

Planned Value (PV) = %20 * 700,000 = 140,000 USD

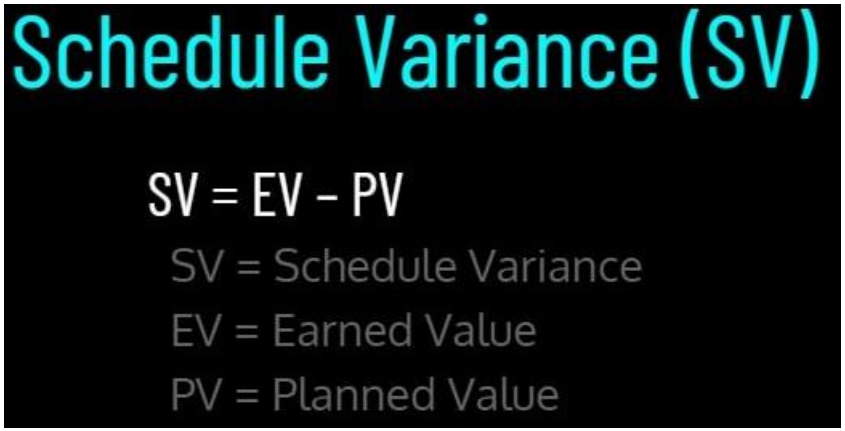
Earned Value (EV) = %10 * 700,000 = 70,000 USD

Actual Cost (AC) = 150,000 USD

SV = EV – PV

SV = 70,000 – 170,000 = – 70,000 USD

SV is negative and the project is behind the schedule.



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SCHEDULE VARIANCE EXAMPLES

Assume that you are a project manager of a software development project. The project consists of 20 phases and all the phases must be completed in 20 weeks. The estimated project budget is 90,000 USD. 10 weeks have passed and 20,000 USD has been spent. Your team completed 14 phases. Is your project behind or above the schedule?

Now we will calculate the project's SV

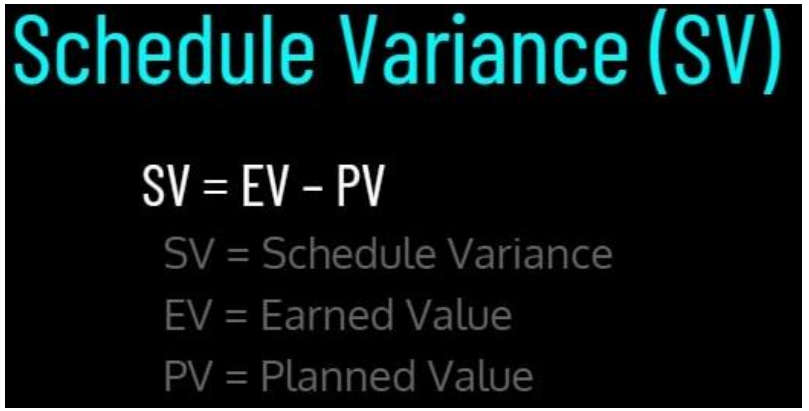
Planned Value (PV) = (10/20) x 90,000 = 45,000 USD

Earned Value (EV) = (14/20) x 90,000 = 63,000 USD

Actual Cost (AC) = 20,000 USD

SV = EV – PV

SV = 63,000 – 45,000 = 18,000 USD



In this example, your project's Schedule variance (SV) is 18,000 USD. This positive value demonstrates that you are above the schedule. Your project's performance is good.

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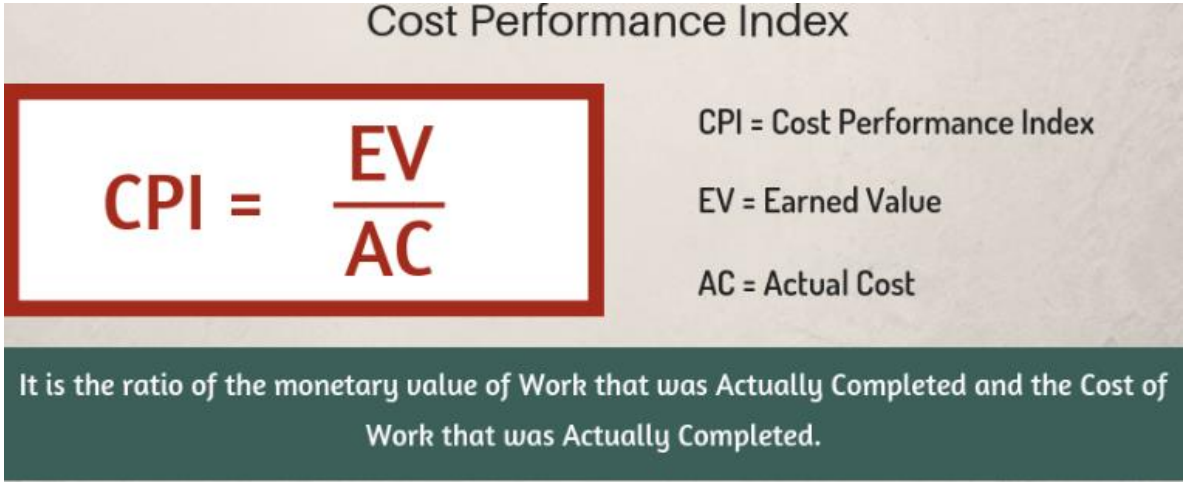
PROJECT METRICS: COST PERFORMANCE INDEX FOR THE PROJECT SCHEDULE

The cost performance index is used to compare projects with each other or to compare phases within a project

CPI is calculated by dividing EV / PV (budgeted cost for work scheduled/actual cost for work performed) and multiplying by 100 to express it as a percentage. A CPI of 100% means that the estimated cost was exactly right and the project came in exactly on budget.

A CPI under 100%, the work cost less effort than planned; a CPI greater than 100% means that the estimate was not adequate for the work involved.



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PROJECT METRICS: CPI & SPI FOR THE PROJECT SCHEDULE

CPI & SPI are used to monitor cost & schedule performance of the project.

• This metrics helps you evaluate the health of the project.

• It gives a reasonable correspondence of the practise included and improves venture perceivability and reliability.

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https://www.slideshare.net/DougBailey8/importance-of-cpi-and-spi-in-project-management-149596134

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Thank you.

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