Welcome and Introductions

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Agenda

- Objectives
- Time Management Knowledge Area
  - Inputs
  - Tools & Techniques
  - Outputs
  - Practical Application
- Q & A
Objectives

- Familiarity With Project Schedule Development & Management
  - What are the steps to developing a schedule
  - What Tools and Techniques to use
  - How to Monitor Schedule
- Get PMP Study Tips
- Find Sources for Additional Knowledge
Ice Breaker

Finish one sentence below:

- The best project – Why?
- The worst project – Why?
- The riskiest thing I ever did was – What did you learn?
Opening Thoughts

- Doubt and skepticism
  - It will never work
  - Schedule always slips and no point in developing one
  - Why waste time planning?

*Giving up on a goal because of a setback is like slashing your other three tires because you got a flat...*
Opening Thoughts

What Is Not Measured Cannot Be Managed

- To measure changes, you have to establish baselines
- Schedule management is all about monitoring changes
Opening Thoughts

Lost and Confused Alice approaches the Cheshire cat and asks, "Would you tell me, please, which way I ought to go from here?"
"That depends a good deal on where you want to get to," said the Cat.
"I don’t much care where," said Alice.
"Then it doesn’t matter which way you go," said that Cat.

- Managing projects successfully is hard work & can be complicated.
- Be aware of the end game & goals ("Big Picture")
- Plan and follow past successful practices or risk ending up like Alice playing the Red Queen.
Knowledge Area: Time Management

- Define Activities
- Sequence Activities
- Estimate Resources
- Estimate Duration
- Develop Schedule
- Control Schedule

Plan Schedule Management
Project Time Management: Overview

- **Plan Schedule Management**
  - PMBOK: Process of establishing the policies, procedures, and documentation for planning, developing, managing, executing, and controlling the project schedule

- **Define Activities**
  - PMBOK: Identify & document specific activities to produce deliverables
  - PMBOK: Break down work packages for estimating, scheduling, executing, monitoring, and controlling
Project Time Management: Overview

- **Sequence Activities**
  - PMBOK: Identify & document relationships between activities
  - PMBOK: Logical sequence to obtain greatest efficiency with constraints

- **Estimate Resources**
  - PMBOK: Estimate type and quantity of material, human resources, equipment, or supplies
Project Time Management: Overview

- **Estimate Durations**
  - **PMBOK**: Estimate number of work periods needed to complete each activity with estimated resources.

- **Develop Schedule**
  - **PMBOK**: Analyze activity sequence, duration, resources, and constraints to create the project schedule model.

- **Control Schedule**
  - **PMBOK**: Monitor status of activities to update progress and manage changes by taking corrective or preventive actions to minimize risk.
Knowledge Area: Time Management

- Define Activities
- Sequence Activities
- Estimate Resources
- Develop Schedule
- Control Schedule
- Plan Schedule Management
- Estimate Duration
Plan Schedule Management: Overview

- In this step we develop
  - Schedule Management Plan
    - This guides the rest of the schedule Mgmt. activities
    - Forms the basis for all future schedule/time management activities
Plan Schedule Management: Inputs

- **Project Management Plan**
  - Scope, WBS, Cost, Risk, Communications Decisions

- **Project Charter**
  - Milestones and Approval Requirements

- **Enterprise Environmental Factors**
  - Culture, Structure, Resource Availability and Skills, PM Software, External Standards, Best Practices, Governance

- **Organizational Process Assets**
  - Monitoring & Reporting Tools, Historical Data, Schedule Control Tools, Templates, Governance Procedures
Plan Schedule Management: Tools & Techniques

- **Expert Judgment**
  - Historical data and gurus provide insight from prior projects and suggest opportunities or pitfalls

- **Analytical Techniques**
  - Scheduling methods, estimating tools or techniques, PM software, top down, bottom up, rolling wave, Agile Product Grooming, alternative analysis, issue papers, leads and lags

- **Meetings (Yes, MORE meetings)**
  - Assemble the brain trust to develop the schedule management plan for buy-in, ensuring stakeholders needs are met, reality checks, collaboration, and communication

- **Templates, Process maps, instructions**
Plan Schedule Management: Outputs

- **Schedule Model Development**
  - Methodology and tools

- **Level of Accuracy**
  - Range used for realistic accuracy duration estimates and possible contingency times

- **Units of Measure**
  - Staff hours, days, materials tons, cubic yards, metric defined for each resource

- **Organizational Procedures Links**
  - WBS developed in Scope Management

- **Project Schedule Model Maintenance**
  - Process used to update status and record progress during project execution

- **Control Thresholds**
  - Variance rules to indicate when action needs to be taken

- **Rules of Performance Measurement**
  - % complete, Earned Value, Schedule Variance, Schedule Performance Index, Baselines

- **Reporting Formats**
  - Format and frequency

- **Reporting Venues**

- **Process Descriptions**
  - Describe all the above

- **Escalation process**
Plan Schedule Management: Summary

**Inputs:**
- Project Management Plan, Project Charter
- Enterprise Environmental Factors
- Organizational Process Assets

**Tools & Techniques:**
- Expert Judgment
- Analytical Techniques
- Meetings

**Output Schedule Management Plan:**
- Schedule Management Plan
Knowledge Area: Time Management

- Define Activities
- Sequence Activities
- Estimate Resources
- Estimate Duration
- Develop Schedule
- Control Schedule
Define Activity: Overview

Key Points

- Flows from Work Breakdown Structure
  - PMBOK: **Hierarchical** decomposition of the total scope of work...to accomplish the project objectives and create the required **deliverables**
  - Lowest level of WBS is the work package – products and deliverables
- Work packages broken down or decomposed to schedule activities
- Activities should be small enough to estimate for resources, time, and cost and can be assigned to a single person or group
Define Activity: Inputs

- **Schedule Management Plan**
  - Level of detail needed to describe the work
  - How the process of define activities will be done

- **Scope Baseline**
  - Provides explicit guidance to define activities
  - WBS, WBS dictionary

- **Enterprise Environmental Factors**
  - Culture, Structure, Resource Availability and Skills, PM Software, External Standards, Best Practices, Governance

- **Organizational Process Assets**
  - Monitoring & Reporting Tools, Historical Data, Schedule Control Tools, Templates, Governance Procedures
Define Activity: Tools & Techniques

- **Decomposition**
  - Breaking down, or dividing and subdividing the WBS work packages into smaller, more manageable activities...verbs instead of nouns

- **Rolling Wave Planning**
  - Iterative planning technique
  - Imminent (current month/quarter) activities are identified in great detail
  - Activities further in the future are planned in less detail or higher level
  - Progressive elaboration

- **Expert Judgment**
  - Experienced and skilled team members or experts will create activities...the organization may have templates from previous similar projects
Define Activity: Outputs

- **Activity List**
  - Complete and total list of all activities, at the appropriate level of detail
  - Should include an activity identifier and sufficient description so team members understand what they are to do
  - Unique title for each activity
  - Should point to one and only one WBS work package

- **Activity Attributes**
  - Have durations, usually have resources, may have costs
  - Additional attributes are described in resources, duration, and order are defined
  - Used for schedule model development and for sorting or displaying activities in different reports

- **Milestones**
  - Significant point or event in a project
  - Have zero duration, no resources, no cost
  - Should be identified in Schedule Management Plan
  - May be contractually related or a requirement from the organization’s standards
  - Mandatory requirements
Define Activity: Summary

**Inputs:**
- Schedule Management Plan, Scope Baseline
- Enterprise Environmental Factors
- Organizational Process Assets

**Tools & Techniques:**
- Decomposition
- Rolling Wave or Other Activity Processes
- Expert Judgment

**Output:**
- Activity List
- Activity Attributes
- Milestone List
Knowledge Area: Time Management

Plan Schedule Management

- Define Activities
- Sequence Activities
- Estimate Resources
- Estimate Duration
- Develop Schedule
- Control Schedule
Sequence Activities: Overview

- Planning Process that Creates a sequenced representation of schedule activities called the;
  - Project Schedule Network Diagrams
  - Contains activity/task dependencies or links (Implied or explicitly stated)
  - Network Diagram shows the “rules” that govern the order in which the activities must be performed
Sequence Activities: Inputs

- **Schedule Management Plan**
  - IDs scheduling methods and tools

- **Activity List**
  - Includes Activity Attributes
  - Describes mandatory sequence

- **Milestone List**
  - Specific dates for certain milestones

- **Project Scope Statement**
  - Details that impact sequence
  - Ensure that activity list and sequence is complete and meets objectives of the project
Sequence Activities: Inputs

- Enterprise Environmental Factors
  - Culture, Structure, Resource Availability and Skills, PM Software, External Standards, Best Practices, Governance
  - Government / Industry standards,
  - Framework, Tools and technology (CA-PMM, MS-Project)

- Organizational Process Assets
  - Project knowledgebase
  - Polices, procedures and guidelines
  - Templates
  - Scheduling methodology
Sequence Activities: Tools & Techniques

- **Precedence Diagramming Method (PDM)**
  - Activity-on-node is a type of PDM and is used by most PM scheduling software products
  - Finish to start, finish to finish, start to start, start to finish

- **Dependency Determination**
  - Determines which activities must precede which ones
    - Mandatory, discretionary, external, and internal
    - e.g., Legal and contractual required steps

- **Leads and Lags**
  - A lead lets you start a successor activity sooner
  - A lag is the time needed to delay a successor activity
Rectangular nodes - Activity Node (Represents Activity)
Arrows - Represents Dependency.
(Activity J cannot start till both H and E are finished).
Numbers - Represent Units of Duration.
Task Dependencies

- **Finish to Start**
  - A FS B = B cannot start till A is finished

- **Finish to Finish**
  - A FF B = B cannot finish before A finishes

- **Start to Start**
  - A SS B = B cannot start till A has started

- **Start to Finish**
  - A SF B = B Cannot finish until A Starts
Critical Path Method (CPM)

- Schedule analysis method focusing on the critical path
- Will be covered later in schedule development section
Sequence Activities: Outputs

- Project Schedule Network Diagram
  - Any unusual activity sequences should be fully described

- Project Document Updates
  - Activity list
  - Activity Attributes
  - Milestone list
  - Risk Register
Sequence Activities: Summary

**Inputs:**
- Schedule Management Plan, Project Scope Document
- Activity List, Activity Attributes
- Milestone List, Enterprise Environmental Factors
- Organizational Process Assets

**Tools & Techniques:**
- Precedence Diagramming Method
- Dependency Determination
- Leads and Lags

**Output:**
- Project Schedule Network Diagrams
- Project Document Updates
Knowledge Area: Time Management

Plan Schedule Management

- Define Activities
- Sequence Activities
- Estimate Resources
- Develop Schedule
- Control Schedule
- Estimate Duration
Estimate Resources: Overview

- **PMBOK**: Type, quantity, and characteristics...to complete an activity...allows more accurate cost and duration estimates

- Resources are personnel, material, equipment, infrastructure, etc.
  - Number, type, skill set may change duration or level of quality

- Resources should be estimated and assigned to each activity

- Resource pool may exist
Estimate Resources: Inputs

- Schedule Management Plan
  - Describes level of accuracy and units of measure
- Activity List
- Activity Attributes
- Resource Calendar
  - Who is available, when, how long, what days or times, geographical location, KSAs
- Risk Register
  - Risk events may impact selection and availability
- Activity Cost Estimates
  - Senior vs. junior
- Enterprise Environmental Factors
- Organizational Process
  - Staffing rules such as no overtime
  - Ability to gain resources (BCP)
  - Rent or buy equipment or software
Estimate Resources: Tools & Techniques

■ Expert Judgment
  ■ Requires specialized knowledge in resource planning & estimating

■ Alternative Analysis
  ■ Should we use a senior or junior C#/.net programmer?
  ■ Build, rent, buy?

■ Published Estimating Data
  ■ Organization standards (e.g., Small Project – 1 PM, 1 Architect etc.
  ■ Data published by different industries which provide recognized standards for estimating resources
Estimate Resources: Tools & Techniques

- **Bottom-up Estimating**
  - Aggregate the estimates of smaller work packages
  - *MOST EFFECTIVE SCHEDULING METHOD*
  - Document dependencies and assumptions

- **Project Management Software**
  - Resource breakdown structures, rates, and calendars
  - Example is MS Project Enterprise can hold this data
Estimate Resources: Outputs

- **Activity Resource Requirements**
  - Types and quantity needed for each activity
  - Will be used to estimate resources for each work package or work period
  - Can include basis for estimation and assumptions made

- **Resource Breakdown Structure**
  - Graphical or hierarchical chart similar to the WBS which groups resources needed by category & type

- **Project Documents Updates**
  - Includes: activity list, activity schedules, calendars
Estimate Resources: Summary

**Inputs:**
- Schedule Management Plan, Activity List, Activity Attributes
- Resource Calendars, Risk Register, Activity Cost Estimates
- Enterprise Environmental Factors, Organizational Process Assets

**Tools & Techniques:**
- Expert Judgment, Alternatives Analysis
- Published Estimating Data, Bottom-Up Estimating
- Project Management Software

**Output:**
- Activity Resource Requirements
- Resource Breakdown Structure
- Project Document Updates
SHORT BREAK

Please be back in 10 minutes
Knowledge Area: Time Management

- Define Activities
- Sequence Activities
- Estimate Resources
- Estimate Duration
- Develop Schedule
- Control Schedule
Estimate Activity Duration: Overview

- Planning process that determines how long each of the scheduled activities take
  - Closely associated with Activity Resource Estimation
  - Generally done together
- Results in Activity Duration Estimates
Estimate Activity Duration: Inputs

- **Inputs**
  - **Schedule Management Plan**
    - Describes method & level of accuracy
  - **Activity List & Attributes**
    - Activities that we need to resource estimates for
    - Attributes drive the resource requirements
  - **Activity Resource Requirements, Calendars, Breakdown Structure**
    - Resource requirements drive the duration
      - E.g., Skill/Capacity of resources drives the duration (Jr. engr. vs Sr. engr.)
  - **Project Scope Statement, Risk Register**
    - May include contract requirements, risks may point out that key resources may be unavailable
  - **Enterprise Environmental Factors & Organizational Process Assets**
    - Estimating software, productivity metrics, historical information, lessons learned, organizational maturity level
Estimate Activity Duration: Tools & Techniques

- **Expert Judgment**
  - May help with reality checks or reconciling differences in differing estimation results

- **Analogous Estimating**
  - Estimate based on actual duration data from similar activities performed previously or on other projects.

- **Three Point Estimation (PERT Estimate)**
  - Uses weighted average of most likely ($t_M$), Optimistic ($t_0$), and Pessimistic ($t_P$)
  - Triangular $t_E = (t_M + t_0 + t_M)/3$
  - Beta Distribution $t_E = (4t_M + t_0 + t_P)/6$
  - SD of PERT = $(t_P - t_0) ÷ 6$
Estimate Activity Duration: Tools & Techniques

- **Parametric Estimating**
  - Uses an algorithm such as story point or function point analysis and actual duration data from previous or similar activities
  - E.g., Cocomo Model (Effort = a * (KLOC)^b * c... etc.)

- **Group Decision Making (Bottom-Up)**
  - Engages team members, improves commitment by team
  - Task members participate in the estimating process

- **Reserve Analysis**
  - Set aside for unforeseen or risk contingency

- **Fiat (Top Down)**
  - Boss says to do it by a certain date
  - Legislative mandate (e.g., cover California Portal)
Estimate Activity Duration: Outputs

**Activity Duration Estimates**
- The length of time (in days, weeks, etc.) each activity is expected to last
- May be expressed as a range (Accuracy of estimate)

**Project Document Updates**
- New or changed activity or resource attributes
Estimate Activity Duration: Summary

**Inputs:**
- Schedule Management Plan, Activity List, Attributes
- Activity Resource Requirements, Calendar
- Project Scope Statement, Risk Register
- Resource Breakdown Structure, Enterprise & Organizational Assets

**Tools & Techniques:**
- Expert Judgment
- Analogues Estimation, Parametric Estimating
- 3 Point Estimating, Group Decision Making
- Reserve Analysis

**Output:**
- Activity Duration
- Project Documents Updates
Knowledge Area: Time Management

Plan Schedule Management

- Define Activities
- Sequence Activities
- Estimate Resources
- Estimate Duration
- Develop Schedule
- Control Schedule
Develop Schedule: Overview

- Planning process that creates a Project schedule
  - Integrates
    - Activities
  - Sequencing
  - Resources
  - Duration
- Creates a schedule baseline
Develop Schedule: Overview

- When you are done, it will answer
  - What/Which Activities Must be performed?
    - Activity List
  - In what order
    - Network Diagram / Dependencies
  - When can it be performed
    - Resource Availability
  - How long will it take
    - Activity Duration
- May be iterative
  - Remember rolling wave planning
- See the PMI Practice Standard for Scheduling
Develop Schedule: Inputs

- **Schedule Management Plan**
  - Identifies method, tools, & calculations

- **Activity List, Attributes,**
  - Logical ordering

- **Project Schedule Network Diagrams**
  - Logical ordering

- **Resource Requirements, Calendars, Activity Duration Estimates**
  - Availability, quantitative durations

- **Scope Statement, Risk Register, Project Staff Assignments, Resource Breakdown Structure**
  - Assumptions & constraints
  - Risks that impact schedule
  - Details of resources

- **Enterprise & Organizational Assets**
  - Standards, templates, communication channels
  - Methodology, calendars
Develop Schedule: Tools & Techniques

Schedule Network Analysis

- Uses the following techniques
  - Identifies early and late start & finish dates
  - Used for Critical Path Analysis
  - Can be used for compressing, crashing, or fast tracking a schedule
Project Network Diagram (AKA Precedence Diagram)

Rectangular nodes - Activity Node (Represents Activity)
Arrows - Represents Dependency.
(Activity J cannot start till both F and I are finished).
Numbers - Represent Units of Duration
Paths

St – A – B – C – D – Fi
St – E – F – Fi
St – E – F – J – Fi
St – G – H – I – J – Fi
Critical Path

A (2) → B (4) → C (3) → D (2)

St - A - B - C - D - Fi = 2 + 4 + 3 + 2 = 11
St - E - F - Fi = 7 + 5 = 12
St - E - F - J - Fi = 7 + 5 + 1 = 13
St - G - H - I - J - Fi = 3 + 2 + 1 + 1 = 7
Early Start / Finish

- Calculate Early Start and Finish To Optimize the Schedule
- Early Start & Finish Reduces Risk & May Free Up Resources

- Early Start
  - Earliest possible start date for an activity to begin

- Early Finish
  - Earliest date a task could finish

- These are calculated by forward pass
  - Left to Right
Early Start / Finish

Start

A (2) → B (4) → C (3) → D (2)

E (7) → F (5)

G (3) → H (2) → I (2) → J (1)

Finish
Late Start / Finish

- Late Start & Finish Help Manage Delay Risk
- Helps to optimize your resources

- Late Start
  - Latest possible time a task can start without delaying subsequent tasks

- Late Finish
  - Latest possible date an activity could finish without delaying subsequent tasks

- These are calculated by Backward Passes
  - Right to Left
Late Start / Finish

```
A (2) → B (4) → C (3) → D (2)

Start → E (7) → F (5) → Finish

G (3) → H (2) → I (2) → J (1)
```
Float

**Float or Total Float**

- Total float is the amount of time that an activity can be delayed without delaying the project completion date.
- On a critical path, the total float is zero.
- \[ TF = \text{Duration} \text{ Critical Path} - \text{Duration} \text{ Non-Critical Path} \]
- \[ TF_{\text{Activity}} = (\text{Late Finish} - \text{Early Finish}). \]

**Free Float**

- Free float is the amount of time that an activity can be delayed without delaying the Early Start of its successor activity.
- \[ FF_{\text{Activity}} = \text{ES}_{\text{Next Activity}} - \text{EF}_{\text{Activity}} - 1 \]
Float Example

Start → A (5) → B (10) → C (2) → D (5) → Finish

St – A – B – C – D – Fi = 22 Days (Longest & Hence Critical Path)
St – A – E – F – D – Fi = 15 Days
Total float on Path_{AEFD} = 22 – 15 = 7 Days

Homework – Figure out Free Float for activities in the next section
Critical Path Method

- A technique for determining the longest path in your schedule
- Critical to manage the tasks on the critical path closely to deliver project on schedule
- By shortening the critical path, project duration can be improved
Critical Path

- Called critical because if one activity slips, the project finish will be delayed
- Tasks on these paths pose the greatest risks to the overall schedule and hence need special attention
- There can be more than one critical path
- As the project progresses, critical path could change
Issues with Critical Path

- Assumes unlimited resources
  - All resources are available all the time
  - Managing resources may be difficult due to other activities
  - Very optimistic way of managing scheduling

- Misuse of float and slack
  - Parkinson’s law – Work expands to fill the available time!
  - Team members misuse slack and float

- Delays accumulate, but Gains do not
Critical Chain Method (CCM)

Buffers - Duration ("Non-Activity") buffers are added to manage uncertainty

- Project buffer is at the end of the critical path
  - Usually you take 50% of time for contingency built into each task and build the buffer
  - Saves overall Schedule time

- Feeder buffers added to non-critical to critical path chain of activities (non-critical path activity feeds into critical path)
  - Feeding Buffers protect critical chain from slippage along the feeding chains

- Resource buffers – Dummy activities with resources allocated

- Manage time remaining in buffers
- Improves probability of On-Time delivery
CCM: Buffers (Before)
CCM: Buffers (After)

Assumes a contingency of 20%
Resource Optimization Techniques

Resource Levelling – Adjust the schedule dates to balance demand for shared or critical resources
- May lengthen critical path
- Reduces risk

Resource Smoothing – Adjust the schedule model for each activity to stay below predefined resource limits
- Maintains critical path
- Completion date is not changes
- Activities are delayed only within their Float.
Develop Schedule: Resource Levelling

Day 1
- Task A
  - Adi: 8 Hrs
  - Cyndi: 8 Hrs
- Task B
  - Adi: 8 Hrs
Adi: 16 Hrs
Cyndi: 8 Hrs

Day 2
- Task C
  - Adi: 8 Hrs
Adi: 8 Hrs

Day 3
- Adi: 8 Hrs

Day 1
- Task A
  - Adi: 8 Hrs
  - Cyndi: 8 Hrs
- Task B
  - Adi: 8 Hrs
Adi: 8 Hrs
Cyndi: 8 Hrs

Day 2
- Task B
  - Adi: 8 Hrs
Adi: 8 Hrs

Day 3
- Task C
  - Adi: 8 Hrs
Adi: 8 Hrs

Start

Start
Develop Schedule: Tools & Techniques

- **Modeling “What If” Analysis**
  - Process of evaluating scenarios in order to predict their effect.
  - Network analysis is performed to compute different scenarios
    - Differing resource loading or constraints
    - Differing equipment delivery times

- **Modeling “Simulation” Analysis**
  - Calculate multiple project durations with different assumptions and probability distributions (e.g. different 3 point estimates)
  - Monte Carlo simulation – Common technique
Develop Schedule: Tools & Techniques

- Leads & Lags
  - Refinements during network analysis to adjust start times of successor tasks
  - Leads advance a successor activity
  - Lags are used when a set time elapses that does not impact resources or work
Develop Schedule: Tools & Techniques

- **Crashing**
  - Schedule compression technique by increasing resources
    - Use 3 painters instead of 1 to finish the job early
  - **Issues of Crashing**
    - Some tasks cannot be compressed
      - Give an e.g.
    - Usually increases costs as returns are not linear
    - Increases communication and other overhead
    - Sometimes may increase the schedule
      - Mythical man month
      - Give an e.g.
Develop Schedule: Tools & Techniques

- **Fast Tracking**
  - Compressing of schedule by performing activates in parallel that otherwise would have been done in sequence
    - Instead of painting 1 wall at a time, paint 2 walls at a time
      - May be constrained by resources (why the e.g., above will not work)
    - Code in parallel while design is in progress using draft design document
    - Develop User Manuals while user interface design is in progress using draft design document
  - Increases risk
  - May increases cost if there is rework
  - May impact schedule due to rework
  - Takes a lot more co-ordination and configuration control
Develop Schedule: Outputs

- Project Schedule
  - Gantt Chats, Network Diagram, Milestone Charts

- Schedule Baseline
  - Schedule placed under change control
  - Compare to actual results to respond to variances
  - Component of project management plan

- Schedule Data
  - Used to describe and control the schedule
  - Resource requirements by time
  - Scheduling of contingency reserves
  - Alternate views: best case, worst case
Develop Schedule: Outputs

- Project Calendars
  - Working days and shifts
  - Shows available times vs. unavailable times
  - May be useful to have more than one calendar

- Project Management Plan and Project Documents Updates
  - Schedule baseline or management plan
  - Risk register, activity attributes, resource requirements
Schedule Development: Summary

Inputs:
- Schedule Management Plan, Activity List, Activity Attributes
- Activity Resource Requirements, Resource Calendars
- Activity Duration Estimates, Resource Breakdown Structure
- Project Network Diagram, Scope Statement, Risk Register
- Project Staff Assignments, Enterprise, Organizational

Tools & Techniques:
- Schedule Network Analysis,
- Critical Path Method, Critical Chain Method
- Resource Optimization Techniques, Modeling Techniques,
- Leads and Lags, Schedule Compression, Scheduling Tool

Output:
- Project Schedule, Baseline
- Schedule Data, Project Calendars,
- Project Management Plan Updates
- Project Document Updates
Knowledge Area: Time Management

- Define Activities
- Sequence Activities
- Estimate Resources
- Estimate Duration
- Develop Schedule
- Control Schedule

Plan Schedule Management
Control Schedule: Overview

- Monitoring and controlling process

  - Proactive
    - Monitor for variance
    - Recognize that change is occurring
    - Influencing the factors that create change
    - A good project manager knows how to do this!

  - Reactive
    - A mediocre project manager is always in this mode
    - Take corrective actions
    - Manage changes and change requests
    - To manage changes, follow schedule management plan
      - Closely related to change management
Control Schedule: Inputs

- **Project Management Plan**
  - Contains baseline, how schedule will be managed

- **Project Schedule**
  - Most recent version, percent complete, updates, in progress or not started activities

- **Work Performance Data**
  - Actual start, elapsed or remaining duration

- **Project Calendars**
  - Use to calculate forecasts based on past results

- **Schedule Data**

- **Organizational Process Assets**
  - Schedule policies & procedures, schedule tools, reporting templates
Control Schedule: Tools & Techniques

- **Performance Reviews**
  - Showing how the project is performing against the plan/schedule
  - Trends, Comparing actual progress against the critical path
  - Critical chain compares remaining buffer against needed buffer

- **Root cause for deviations from plan**
  - Cause and Effect diagram – Fishbone/Ishikawa
  - Pareto charts
  - Flowcharts
  - Scatter diagrams
  - Checklists
  - Control charts
Control Schedule: Earned Value

- Schedule Performance Index (SPI)

- SPI = EV \div PV \text{ (usually expressed in \$\$)}

  - EV = Earned Value = Actual \% Complete \times \text{BAC}
  
  - PV = Planned Value = Planned \% Complete \times \text{BAC}
  
  - BAC = Budget At completion

  - E.g., Task A takes 10 days by one programmer Costing \$100/day.

    - BAC = \$1000 \text{ (or 10 Days)}
    
    - Day 4 Planned Value is \$400 \text{ (or 4 Days)}
    
    - At day 4 if the \% complete is 30\% \text{ EV = \$300 (Or 3 Days)}
    
    - SPI on day 4 = 300/400 (or 3/4) = 0.75
    
    - We are performing at 75\% efficiency

- SPI less than 1 is bad

- SPI 1 or above are good
Control Schedule: Earned Value

- **Schedule Variance (SV)**
  - \( SV = EV - PV \) (Also expressed as $$)
  - 300 – 400 = -100 \) (or \( 3 - 4 = -1 \))
  - Negative SVs are bad
  - Zero or Positive SVs are good

- **There are other EV calculations**
  - Out of scope for this session
Control Schedule: Tools & Techniques

- Project Management Software
  - Tracks planned vs. actual
  - Reports variances with helpful graphics
  - Forecast the effects of changes

- Resource Optimization
  - Scheduling resources to take advantage of their availability and project time

- Modeling
  - Review various scenarios
  - Risk Mitigation
  - Bring the schedule model in line with baseline and project management plan

- Lead and Lags
  - Adjustments
  - Starting tasks early

- Schedule Compression
  - Bring activities back into alignment
  - Use buffers
  - Add resources
  - Reduce scope

- Scheduling Tool
  - Updates to schedule model
  - Visual or graphic warnings of variances
Control Schedule: Outputs

- Work performed (% Complete)
  - Schedule Performance Index
  - Schedule Variance (SV)
  - Communication to stakeholders

- Schedule forecasts
  - Based on the current status (Work efficiency), when will the project milestones be accomplished?
  - At what efficiency do we need to run to bring the schedule back on track?

- Corrective actions
  - Change approach
  - Change personnel
  - Others (Participants to list!)

- Change Requests
  - Change happens!
  - Approved through governance
  - May react to beneficial or harmful change
  - May course correct to avoid or mitigate risk

- Project Management Plan & Documents Updates
  - Approved changes may change baseline
  - Schedule management plan
  - New Baseline(s) (Schedule, Cost)

- Organizational Process Updates
  - Lessons learned
Control Schedule: Summary

**Inputs:**
- Project Management Plan, Project Schedule
- Work Performance Data, Schedule Data
- Project Calendars, Organizational Process Assets

**Tools & Techniques:**
- Performance Reviews
- Project Management Software, Scheduling Tool, Schedule Compression
- Resource Optimization & Modeling Techniques
- Leads & Lags

**Output:**
- Work Performance Information
- Schedule Forecasts
- Change Requests
- Organizational Process Assets Updates
- Project Management Plan and Project Documents Updates
Extra Learning

- PMI
  - http://www.pmi.org/passport/mar09/passport_mar09_seven-tips-on-how-to-build-a-solid-schedule.html
- https://www.youtube.com/watch?v=LYusPqtEYJc
- Your friends & co-workers
Closing Thoughts

- Project Management is a Science
  - Science of PM as described in PMBOK

- Actually Managing a Project is an Art
  - Few things that might make for a successful PM are:
    - Domain Knowledge
    - Instinct to spot the risks and take preemptive actions
    - Keen sense to spot the critical tasks/items to address in a project
    - Good communications
    - Foster good teamwork.
    - Keep the stakeholders engaged and motivated
    - Be the “Leader” or the “Strategic one”
    - Planning alone will not get you there, but it is great Start!
Questions
One Last Thought...

The best time to plant a tree is twenty years ago. The second best time is now.

- Chinese Proverb