Project Schedule Management

Schedule Management

- **PMBOK -** Schedule Management includes the processes required to manage the timely completion of the project.

Process	Process group	Outputs
Plan Schedule Management	Planning	Schedule Management Plan
Define Activities	Planning	Activity List, Activity Attributes, Milestone List
Sequence Activities	Planning	Project Schedule Network diagrams
Estimate Activity Durations	Planning	Duration estimates
Develop Schedule	Planning	Project schedule, schedule baseline, Project Calendars
Control Schedule	Monitoring and Controlling	Work Performance information, Change Requests

Plan Schedule Management

- Establishing the policies, procedures, and documentation for planning, developing, managing, executing, and controlling the project schedule.

- Provides guidance and direction on how the project schedule will be managed throughout the project.

Plan Schedule Management

INPUTS
1. Project Charter
2. Project Management Plan
   a. Scope Management Plan
   b. Development Approach
3. Enterprise Environmental Factors
4. Organizational Process Assets

TOOLS AND TECHNIQUES
1. Expert Judgment
2. Data Analysis
3. Meetings

OUTPUTS
1. Schedule Management Plan

Plan Schedule Management - Inputs

- Project Management Plan
- Project Charter
- Enterprise Environmental Factors
- Organizational Process Assets

Plan Schedule Management - Tools

- Expert Judgment
- Data Analysis
- Meetings

Plan Schedule Management - Outputs

- **Schedule Management Plan**
  - how the project schedule will be planned, developed, managed, executed, and controlled throughout the phase or project
  - It may establish the following:
    - Levels of Accuracy
    - Rules of Performance Measurement
    - Reporting formats
    - Release and Iteration Length
    - Project Schedule Model Development

Define Activities

- Process of identifying and documenting the specific actions to be performed to produce the project deliverables.

- Decomposes work packages into schedule activities that provide a basis for estimating, scheduling, executing, monitoring, and controlling the project work.
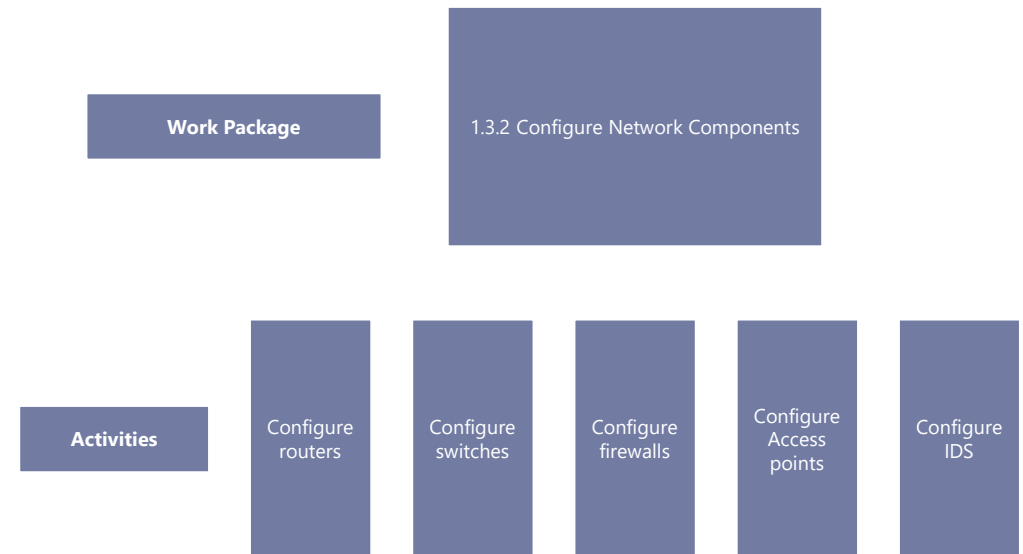
Define Activities - ITTO

INPUTS

1. Project Management Plan
   a. Schedule Management Plan
   b. Scope Baseline
2. Enterprise Environmental Factors
3. Organizational Process Assets

TOOLS AND TECHNIQUES

1. Expert Judgment
Decomposition
Rolling Wave Planning
Meetings

OUTPUTS

1. Activity List
2. Activity Attributes
3. Milestone List
4. Change Requests
5. Project Management Plan Updates

Define Activities - Inputs

- The Project Management plan
  - ▸ Schedule Management Plan
  - ▸ Scope Baseline
- Enterprise Environmental Factors
- Organizational Process Assets

Define Activities - Tools

- Expert Judgment
- Meetings
- Decomposition
- Rolling Wave Planning
  - ▸ A form of Progressive Elaboration. Near term work packages are able to be defined in a much great detail. Long term work packages may not be able to be defined in any detail, a place holder maybe created for later date.
  - ▸ As the project moves along to completion, long term place holders will be removed and then allowed to be decomposed into work packages as more details become available.
  - ▸ This planning must always be revisited throughout the life cycle of the project when long term work pages can not be clearly define

Work Package	1.3.2 Configure Network Components

Activities	Configure routers	Configure switches	Configure firewalls	Configure Access points	Configure IDS

Define Activities - Outputs

- Activity List
  - A complete list of all scheduled activities that is required to be perform on the project.
  - It should include a sufficient work description as well as an activity identifier. This is recommended so all stakeholders have better understanding of all work that is needed to be perform on the project
  - Work packages are Scope determined deliverable based,
  - Activity are focused in the work that needs to be executed the work packages
  - Schedule focused, not WBS focused
  - Each activity should map back to one and only one work package(work package could have many activities

Define Activities - Outputs

- Activity Attributes
  - Any additional information required to execute the Activity list
    - Point of contact, location of work being performed
    - Used for scheduling development
- Milestone List
  - Key dates of the projects
  - Mandatory, optional, contractual, % complete
- Change Requests
- Project Management plan updates
  - Schedule Baseline
  - Cost Baseline

Sequence Activities

- Is the process of identifying and documenting relationships among the project activities.

- It defines the logical sequence of work to obtain the greatest efficiency given all project constraints.

- Taking the activity list defined earlier and arranging the activities in the order they must be performed

- Sequencing can be performed by using project management software or by using manual or automated techniques.

Sequence Activities

INPUTS

1. Project Management Plan
   Schedule Management Plan
   Scope Baseline
   Project Documents
   Activity Attributes
   Activity List
   Assumption Log
   Milestone List
   Enterprise Environmental Factors
   Organizational Process Assets

TOOLS AND TECHNIQUES

1. Precedence Diagramming Method
2. Dependency Determination and Integration
3. Leads and Lags
4. Project Management Information System

OUTPUTS

1. Project Schedule Network Diagrams
2. Project Documents Updates
   a. Activity Attributes
   b. Activity List
   c. Assumption Log
   d. Milestone List

Sequence Activities - Inputs

- Project Management Plan
  - ▸ Schedule Management Plan
  - ▸ Scope Baseline
- Project Documents
  - ▸ Activity Attributes
  - ▸ Activity List
  - ▸ Assumption Log
  - ▸ Milestone List
- Enterprise Environmental Factors
- Organizational Process Assets

Sequence Activities - Tools

- Precedence Diagramming Method, (PDM)
  - ▸ Graphical representation of all work that is needed to be perform on the project. This represents the flow of the project. What work packages tie into another work packages, in order as well as durations. Simply stated it is work packages relationships to each other.

Sequence Activities - Tools

- Relationships
  - ▸ Finish to Start (The most commonly used)
    - ☐ The start of the successor's work package depends upon the completion of its predecessor work package
  - ▸ Finish to Finish
    - ☐ The completion of the successor work package depends on the completion of the predecessor work package
  - ▸ Start to Start
    - ☐ The start of the successor's work package depends upon the start of its predecessor work package
  - ▸ Start to Finish
    - ☐ The completion of the successor work package depends upon the start of its predecessor work package

Sequence Activities - Tools

- **Dependency Determination**
  - Mandatory Dependencies (Hard Logic)
    - ‣ They are tangible limitations of work packages that are tie together. One work package MUST be completed prior to the subsequent work package beginning.
      - □ Foundation of the house erected prior to the house being built
      - □ Turning on the computer prior to writing code
      - □ Purchasing the paint prior to painting the walls
  - Discretionary Dependencies (Soft Logic)
    - ‣ Work packages that are tied together, but do not have physical limitations. Work packages may work in unison or tandem.
      - □ Painting the walls of a room, &laying carpet at the same time
      - □ Cooking both Dinner & Dessert at the same time in the oven
      - □ Designing the packing of a computer game, while it is in a finial testing stage

Sequence Activities - Tools

- External Dependencies
  - Work package relationship between project and non-project activities. Non-project Activities are usually outside the control of the project team.
    - The gas station receiving Gas prior to you filling up the Bulldozer gas tank
    - The Home Improvement store down stocking the paint prior to you buying it
- Internal Dependencies
  - Project Activities are within control of the team
    - How to test computer software after you installed it
    - Who does what tasks on a project

Sequence Activities - Tools

- Leads and Lags
  - ▸ The management team during the planning of activates will determine the order of work packages upon completion. During this phase of this process, work packages leads and lags must be processed.
    - ☐ A lead is the amount of time a successor activity can be advanced with respect to a predecessor activity
      - ☐ i.e. The windows maybe scheduled to be installed in the house up to 3 weeks prior to the siding being installed.
    - ☐ A lag directs the delay in the successor work package or activity
      - ☐ i.e. The windows can not be scheduled to be installed in the house until the external walls have been installed
- Project Management Information Systems

Sequence Activities - Outputs

- **Project Schedule Network Diagrams**
  - ‣ These are system wide drawings which shows the entire project work packages/activities from start to finish. It shows logical relationships as well.
- **Project Document Updates**
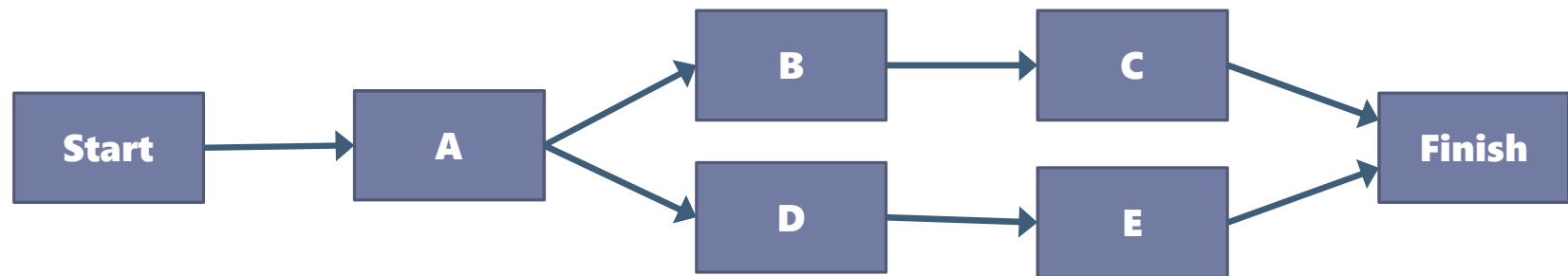
Estimate Activity Durations

- Estimating the number of work periods needed to complete individual activities with estimated resources.

- It provides the amount of time each activity will take to complete.

- It should be calculated by the individual most familiar with the nature of work in the specific activity.

- Uses information from the scope of work, required resource types or skill levels, estimated resource quantities, and resource calendars.

Estimate Activity Durations - ITTO

Inputs

1. Project Management Plan
   - a. Schedule Management Plan
   - b. Scope Baseline
2. Project Documents
   - a. Activity Attributes
   - b. Activity List
   - c. Assumption Log
   - d. Lessons Learned Register
   - e. Milestone List
   - f. Project Team Assignments
   - g. Resource Breakdown Structure
   - h. Resource Calendars
   - i. Resource Requirements
   - j. Risk Register
3. Enterprise Environmental Factors
4. Organizational Process Assets

Tools and Techniques

1. Expert Judgment
2. Analogous Estimating
3. Parametric Estimating
4. Three-Point Estimates
5. Bottom-Up Estimating
6. Data Analysis
   - a. Alternatives Analysis
   - b. Reserve Analysis
7. Decision Making
8. Meeting

Outputs

1. Duration Estimates
2. Basis of Estimates
3. Project Documents Updates
   - a. Activity Attributes
   - b. Assumption Log
   - c. Lessons Learned Register

Estimate Activity Durations - Inputs

- The Project Management plan
  - Schedule Management Plan
  - Scope Baseline
- Project Documents
  - Activity List/Attributes
  - Assumption log
  - Milestone List
  - Resources calendars
- Enterprise Environmental factors
- Organizational Process Assets

Estimate Activity Durations - Tools

- Expert Judgment
- Meetings
- Analogous Estimating(top-down estimating)
  - This relies on historical information to predict estimates, (i.e. Time, Budget, Difficulty), for current projects. Often used when there is limited amount of information available. Cost less in Time and Money to uses, but it gives the least accuracy when it comes to estimating.

Estimate Activity Durations - Tools

- Parametric
  - A technique that uses a statistical relationship between historical data and other variables (for example, square footage in construction, lines of code in software development) to calculate an estimate for activity parameters, such as scope, cost, budget, and duration.
- Three Point Estimate
  - Calculates an expected duration using a weighted average of 3 estimated, Optimistic, Pessimistic, Most Likely. (O+P+4M)/6.
    - If the Optimistic is 8 days, Pessimistic is 14 days, and Most likely is 10 days, Pert is 10.333.
      - ((8+14+4*10)/6)
      - (22+40)/6
      - 62/6
      - 10.33

Estimate Activity Durations -Tools

- Bottom-Up Estimating
  - The work has to be very detailed for this type of estimation to take place.
  - Takes a very long time to complete, but highly accurate.
  - You break down the work to the lowest levels and then aggregating the work back up to find an overall duration.
- Data Analysis
  - Reserve Analysis
    - Often call Slack Time, or Contingency Reserve, Time Reserves. Buffer
    - Maybe a percentage or a set determined time allowance
    - Usually added because of Risk Factors
- Decision Making

Estimate Activity Durations Output

- Duration Estimates
  - The likely number of work periods required to completed an activity or a work package. It does not have any leads or lags assigned to it. It is just a number. i.e. Painting room 6 with take at least 36 man hours, to a maximum of 42 man hours
  - May include some indication of the range of possible results
- Basis of Estimates
  - How the estimates were developed and their ranges.
  - It can also include all assumptions and constraints made to create the estimate
- Project Document Updates

Develop Schedule

- Analyzing activity sequences, durations, resource requirements, and schedule constraints to create a schedule model for project execution and monitoring and controlling.

- It generates a schedule model with planned dates for completing project activities.

- Entering the activities, durations and resources into the scheduling tool will generates a schedule with planned dates for completing the project activities.

Develop Schedule - ITTO

Inputs

1. Project Management Plan
   a. Schedule Management Plan
   b. Scope Baseline
2. Project Documents
   a. Activity Attributes
   b. Activity Log
   c. Assumption Log
   d. Basis of Estimates
   e. Duration Estimates
   f. Lessons Learned Register
   g. Milestone List
   h. Project Schedule Network Diagram
   i. Project Team Assignments
   j. Resource Calendars
   k. Resource Requirements
   l. Risk Register
3. Agreements
4. Enterprise Environmental Factors
5. Organizational Process Assets

Tools and Techniques

1. Schedule Network Analysis
2. Critical Path Method
3. Resource Optimization
4. Data Analysis
   a. What-if Scenarios
   b. Simulation
5. Leads and Lags
6. Schedule Compression
7. Project Management Information System
8. Agile Release Planning

Outputs

1. Schedule Baseline
2. Project Schedule
3. Schedule Data
4. Project Calendars
5. Change Requests
6. Project Management Plan Updates
   a. Schedule Management Plan
   b. Cost Baseline
7. Project Documents Updates
   a. Activity Attributes
   b. Assumption Log
   c. Duration Estimates
   d. Lessons Learned Register
   e. Resource Requirements
   f. Risk Register

Develop Schedule - Inputs

- **The Project Management Plan**
  - Schedule Management Plan
  - Scope Baseline

- **Project Documents**
  - Activity List/Attributes
  - Assumption Log
  - Basis of Estimates
  - Milestone list
  - Project Team Assignments
  - Resources calendars
  - Lesson learned Register
  - Project Schedule Network Diagrams
  - Risk Register
  - Duration of Estimates

- **Agreements**

- **Enterprise Environment Factors**

- **Organizational Process assets**

Develop Schedule - Tools

- Schedule Network Analysis
  - It employs several different techniques, (Critical path, Critical Chain, What-if analysis, and resource optimization techniques) to determine the length of the schedule. It is used to calculate the early start and early finish dates, late start and late finish dates.
- Resource Optimization Techniques
  - A method to flatten the schedule when resources are over-allocated or allocated unevenly. Resource leveling can be applied in different methods to accomplish different goals. One of the most common methods is to ensure that workers are not overextended on activities.

Develop Schedule - Tools

- Critical Path Method
  - ▸ Calculate the early start (ES), early finish (EF), late start (LS) and late finish (LF) dates, without require for any resource limitations. It is used to help determined Lags, Leads, activity relationships, schedule constraints
- Critical Chain Method
  - ▸ A technique the adjusts the project schedule, accounting for limited project resources. Once resources are allocated a possible altered critical path maybe determined
  - ▸ A method of planning and managing projects that puts more emphasis on the resources required to execute project tasks developed

Develop Schedule - Tools

- Data Analysis
  - ▸ What If Scenarios (Monte Carlo)
  - ▸ Simulations
- Leads and Lags
- Schedule Compression
  - ▸ Crashing(Adding resources to a project activity)
    - ☐ Always adds cost
    - ☐ May add additional Risk
  - ▸ Fast Tracking(Activates performed in parallel)
    - ☐ May not always add cost
    - ☐ May increase risk due to project rework

Develop Schedule - Tools

- PMIS
- Agile Release Planning
  - The schedule will be broken up into smaller iterations, verses to a traditional project where the schedule is for the entire product release. Smaller increments allows the customers an opportunity to give feedback on the product with a quicker turnaround
  - Iteration plan is a plan that will be used to create a single iteration for part of the product.
  - Release plan is a set of iterations that will help to create a product that would be given to the customers for feedback

Develop Schedule - Outputs

- Project Schedule
  - ▸ Project start and end date. Each activity start & end date. The project schedule maybe a high level document, or as detail as having each activities resourced assign to it. Most often showed as a graphically presentation.
    - ☐ Project Network Diagrams
    - ☐ Bar charts
      - ☐ Activities represented by horizontal bars on a horizontal axis that represents the calendar.
    - ☐ Milestone Chart
      - ☐ A list of only key dates in the project. A very high level detail of the status of the project.
- Schedule Baseline
  - ▸ Original Schedule baseline with any approved changes to the schedule

Develop Schedule - Outputs

- Schedule data
  - Schedule templates that the team used to calculate durations, assumptions, constraints or resource requirements
- Project Calendars
  - Identifies Project shifts and work days
- Change requests
- Project Management plan updates
  - Schedule Management plan
  - Cost Baseline
- Project Document Updates
  - Activity Attributes
  - Assumptions log
  - Lessons Learned
  - Risk Register

Control Schedule

- Monitoring the status of the project to update the project schedule and managing changes to the schedule baseline.

- The schedule baseline is maintained throughout the project.

- Compare the work results to the plan to see if they line up

- What is the status of the project, how did it reach this point?

Control Schedule - ITTO

INPUTS

1. Project Management Plan
   a. Schedule Management Plan
   b. Schedule Baseline
   c. Scope Baseline
   d. Performance Measurement Baseline
2. Project Documents
   a. Lessons Learned Register
   b. Project Calendars
   c. Project Schedule
   d. Resource Calendars
   e. Schedule Data
3. Work Performance Data
4. Organizational Process Assets

TOOLS AND TECHNIQUES

1. Data Analysis
   a. Earned Value Analysis
   b. Iteration Burndown Chart
   c. Performance Reviews
   d. Trend Analysis
   e. Variance Analysis
   f. What-If Scenario Analysis
2. Critical Path Method
3. Project Management Information System
4. Resource Optimization
5. Leads and Lags
6. Schedule Compression

OUTPUTS

Work Performance Information
Schedule Forecasts
Change Requests
Project Management Plan Update
Project Documents Updates

Control Schedule - Input

- Project Management plan
    - Schedule Management Plan
    - Schedule Baseline
    - Scope Baseline
    - Performance Measurement Baseline
- Project Documents
    - Lessoned Learned register
    - Project Calendars
    - Project Schedule
    - Schedule Date
- Work Performance Data
- Organizational Process Assets

Control Schedule - Tools

- Data Analysis
  - Performance Reviews
    - Measuring actual start/finish dates vs. planned start/finish dates
    - If negative variance is in place, is the project in jeopardy
  - Earned Value Analysis
  - Performance Reviews
  - What-If Scenarios
- PMIS
- Critical Path Method
- Resource Optimization Techniques
- Leads and Lags
- Schedule Compression, (Fast Track or Crash)

Control Schedule - Output

- Work Performance information
- Schedule Forecast
  - ‣ Based on Past performance and expected future performance
- Change Requests
- Project Management Plan Updates
  - ‣ Schedule/Cost/Performance Measurement Baselines
  - ‣ Schedule Management Plan
- Project Document Updates
  - ‣ Lessons Learned Register
  - ‣ Risk Register
  - ‣ Project Schedule

3-Point Estimate (PERT)

- **PERT(Program (or Project) Evaluation and Review Technique)**
  - Three-Point Estimate
  - A scheduling tool that uses a weighted average formula to predict the length of activities and the project.

- **Beta Distribution**
  - Specifically, the PERT formula is (O+R(4)+P)/6

$$\frac{(\text{Optimistic Estimate} + (4 \times \text{Realistic}) + \text{Pessimistic Estimate})}{6}$$

- **Standard Deviation**

$$\frac{(P-O)/6}{}$$

- **Triangle Distribution**
  - The Triangle Distribution formula is (O+R+P)/3

$$\frac{(\text{Optimistic Estimate} + \text{Realistic} + \text{Pessimistic Estimate})}{3}$$