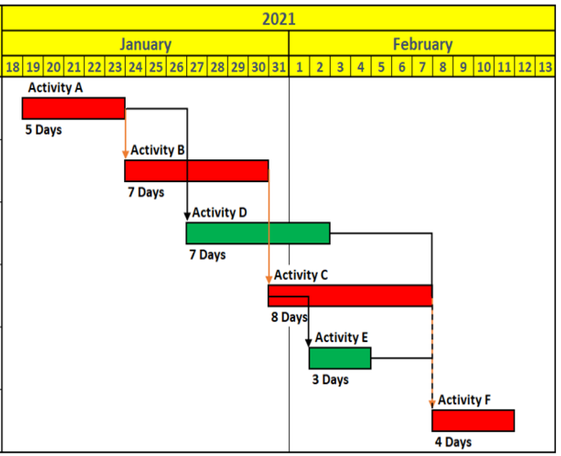
Scheduling Basics

Project schedules range from simple bar charts with few activities to complex Critical Path Method (CPM) schedules with thousands of activities. A simple bar chart showing the start and finish dates of project activities, is known as a Gantt chart. The basic difference between a Gantt chart and a CPM schedule is that the CPM schedule contains relationships between activities and allows date constraints to be placed on individual activities.

An example of a CPM schedule is shown below:

Sample CPM Schedule

Relationship	# Days	Activity Description	Duration	Early Start	Early Finish	Float
Start	0	Activity A	5	01/19/21	01/23/21	0
Finish (A) to Start (B)	0	Activity B	7	01/24/21	01/30/21	0
Finish (A) to Start (D) Lag	3	Activity D	7	01/27/21	02/02/21	5
Finish (B) to Start (C)	0	Activity C	8	01/31/21	02/07/21	0
Start (C) to Start (E) Lag	2	Activity E	3	02/02/21	02/04/21	3
Finish (C) to Start (F)	0	Activity F	4	02/08/21	02/11/21	0



A schedule is a ***tool*** for managing the progress of a project. The schedule is a "*living*" document that is periodically updated to provide current information and an up-to-date status of the project. A schedule must reflect *reality* so that potential slippage in the schedule can be identified early and the situation corrected before it becomes a serious issue. The "living" nature of the CPM schedule is one of its big advantages as the impact of an update or a potential change is readily apparent. The critical path often changes to reflect the dynamic nature of projects.

The level of detail required in a schedule depends on the complexity of the project. The level of detail also depends on who is using the schedule. The schedule used by a FDOT project manager overseeing a consultant project is often very different than one used by the consultant to manage the execution of the project. Schedules used by FDOT project managers overseeing consultant projects will typically include many internal Department activities as well as the key milestone deliverables to be received from the consultant. The consultant project manager may typically use a schedule that excludes all the Department activities but will provide the detailed sub activities that are required to complete and submit the deliverables to the Department. When reviewing a consultant's schedule, the FDOT project manager should check the following items:

- Delivery dates for submittals to the Department or agencies (e.g., submittal of permit applications) are scheduled on or before the dates shown in the Departments schedule
- Key milestones are met
- The logic between activities is appropriate
- Activity durations seem accurate

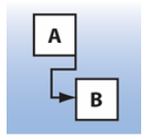
Basic Elements of a CPM Schedule:

A CPM schedule consists of seven basic elements:

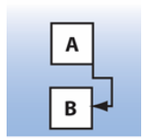
1. **Activities:** Activities are a component of work performed or a deliverable. The number of activities or tasks, in the schedule will vary depending on the phase, type and complexity of the project.

2. **Dependencies:** There are three kinds of dependencies between activities:
   - **Logical:** It is impossible or illogical to begin one activity until another is completed.
   - **Resource constraints:** The availability of resources dictates how long it will take to complete an activity.
   - **Discretionary (preferential):** The order the activities are completed is based on the preference of the project manager.

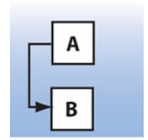
3. **Relationships:** Relationships are the link between related activities within a schedule. There are four **Definitions of Schedule Relationships**, with respect to the *sequencing* of activities and they are:
   - **Finish-to-Start:** Activity B cannot start until Activity A is competed.



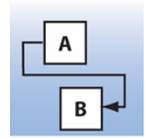
   - **Finish-to-Finish:** Activity B cannot finish until Activity A is complete. In this case, Activity A has to be finished on or before the date Activity B finishes.



   - **Start-to-Start:** Activity B cannot start until Activity A has started.



   - **Start-to-Finish:** Activity B cannot finish until Activity A has started. This relationship is rarely used, however, can be useful in certain situations.



   Relationships Definitions:

   - Predecessor - an activity that must be completed before the next activity in the sequence can begin.
   - Successor - an activity that follows a particular activity.

4. **Durations:** The anticipated time required to complete a schedule activity.

5. **Milestone:** A significant point or event in a project. A milestone has a duration of zero.

6. **Constraints:** Activities are constrained when they are limited to certain dates, rather than flowing with the natural logic of a network. Constraints are manually applied to the start or finish of an activity rather than having the date calculated solely on the logic of the network. We use constraints to maintain compliance with the Work Program.

7. **Critical Path:** The longest path through a project network. Any delay on this path will result in a corresponding delay of the end date of the project. The critical path often changes during the life of a project.

Additional Elements a CPM Schedule:

- **Early Start:** The earliest date an activity can start according to the network logic and/or constraints.
- **Early Finish:** This is the Early Start date plus the duration of the activity.
- **Late Finish:** The latest date an activity can finish without delaying the completion of the project.
- **Late Start:** The Late Finish minus the duration of the activity.
- **Float:** The amount of time that an activity can be delayed without causing delay to other tasks or the project. Although there are several different types of float, total float is typically used.
    - **Total Float** is the amount of time an activity can be delayed without impacting the overall project completion. Total float is calculated by subtracting the early finish date from the late finish date of an activity (early start and late start dates could also be used). Total float can be represented as Positive or Negative Float:
        - **Positive Float** indicates how many days an activity can slip before the activity will cause a slip in the end date of the project.
        - **Negative Float** indicates how late the end date will be delayed if an activity continues to have the same negative float and no change is made to subsequent activities.
    - **Free Float** is the amount of time that an activity can be delayed without impacting its successor activity. Free float is calculated by subtracting the early finish date of the activity from the early start of the successor activity.

    It is important to keep in mind, that Float is shared among activities. This means using up the positive float on an activity, may affect succeeding activities by making them more critical.

    The critical path will always have a float of zero.
- **Lag** is the delay of a successor activity and represents time that must pass before the next activity can begin. Lag may be found in all activity relationship types. An example of lag is illustrated in the **Sample CPM Schedule** between Activities A & D and Activities C & E.
- **Lead** is the acceleration of a successor activity. In other words, the second activity can begin (and be conducted in parallel) as the first activity. Lead is only found in activities with finish/start relationships: Activity A must finish before Activity B can start.