Lead and Lag in Project Management: Definition and How To Use

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In project management, there are many strategies you can use to define objectives, coordinate projects and exceed goals. Project schedule managers sometimes use leads and lags as a technique to help schedule their activities within a project's timeline. Leads and lags can be useful tools for efficient scheduling, timeline optimization and as inputs to determine a project's critical path. In this article, we introduce the terms lead and lag, explain what they're used for and provide a practical use example for leads and lags.

What is a lag?

In project management, lag refers to the delay before the next activity in a project's timeline can begin. There are many reasons to schedule a lag, including:

- **Resource constraints:** A lag may occur if supplies are unavailable for a project. For example, in a construction project, waiting for a delivery of wood would cause a lag.
- **Physical constraints:** Access issues, drying or setting time and needing accessory projects to conclude before beginning the next phase of a project all represent physical constraints.
- **Waiting for a date or event:** Sometimes projects work around specific dates or events. A project schedule manager may have to schedule a lag to accommodate an event or wait for an approved phase start date.

In network diagrams, plus signs are used to represent lags because they show the addition of time. Lag time may refer to hours, days or weeks. A lag is any amount of time that must elapse between a successor activity and a predecessor activity.

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What is a lead?

Leads and lead time refer to the overlap of scheduled activities. Leads occur when one phase of a project begins before the conclusion of the previous phase. In these scenarios, leads exist when the predecessor activity requires no physical constraint considerations before the successor activity can begin. In network diagrams, subtraction symbols represent leads. This is because leads shorten project lengths by overlapping activities.

Leads are important for project schedule managers because leads allow them to identify areas where activity overlap is possible and they can save time. For example, a project with two activities where the first takes four days, and the second takes six days, would take 10 days to finish. However, if you can start the second activity two days before the first concludes, the project now takes only eight days to complete. A project where each activity must finish before another can begin would have no lead time and would likely conclude behind schedule.

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What are lead and lag used for?

Project managers use leads and lags to identify necessary delays and plan for timesaving opportunities. When scheduling projects, understanding lead and lag time can help managers accurately predict the project's end date. These tools also allow them to optimize project phases and reduce unnecessary lag time.

Leads and lags can help managers sequence events logically within a larger project timeline, create schedules and monitor efficiency. Construction managers, IT professionals and project schedulers all might use leads and lags to organize, plan and optimize their projects. To do this, project managers sometimes use network diagrams where plus symbols represent lags to signify the addition of time needed to complete the project, and subtraction symbols represent leads to show the subtraction of time from the total.

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Using lead and lag in network diagrams

Schedulers, coordinators and managers use network diagrams to illustrate the relationships between the different phases of their projects. Diagrams can be a useful way to model activities and identify lead and lag times to optimize your scheduling process. Sometimes called the precedence diagramming method, network diagrams allow schedulers to analyze potential leads and lags to identify logical relationships.

In a precedence diagram, there are four types of logical relationships:

- **Finish to start relationships (FS):** A finish to start relationship means that one activity must be completed before the next can begin. An example of this might be waiting for plaster to dry for two days before painting.
- **Finish to finish relationships (FF):** In this relationship, the second activity depends on the first to be completed before it can conclude. For example, fracking completion may be put on hold until the pressure test is finished.
- **Start to start relationships (SS):** In a start to start relationship, the predecessor activity must start before the successor activity can begin. For instance, professionals may have to wait to start mixing chemicals until after they've begun an air quality test.
- **Start to finish relationships (SF):** The last type of logical relationship is the start to finish relationship. In this somewhat rare scenario, the predecessor activity can't begin until the completion of the successor activity. For example, maybe a site would need to wait for a client review to start before they're able to finish an inspection.

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Example of lead and lag

Some real-world examples of lead and lag might be sequencing a software development project, planning a residential or commercial construction job or beginning an excavation. Using the construction application, here is an example to show how lead and lag can impact a project:

A contractor's first step when beginning a project with lots of moving parts might be to create a list of dependent predecessor activities. They might start by outlining the major phases of their project, such as design, building, installing utilities and finishing. Within those phases there are tasks like drafting blue prints, excavation, framing, plumbing, electrical, dry walling, painting, installing windows and landscaping listed. Some of these tasks depend on others' completion before they can begin, and some may not.

For example, dry walling the house can't begin until the team installs electrical wiring. However, landscaping and window installation are not dependent on one another, so those two tasks could happen simultaneously. In this example, a contractor may denote relationships using tags like FS and SS to identify dependencies. By understanding logical relationships, project managers can optimize task start dates and avoid redundancy or unnecessary delays.

They can then use plus and subtraction signs to represent the leads and lags. If painting can begin two days after installing the drywall, that could be represented as FS + 2. The lag time is two days and the successor activity can't begin until the predecessor activity ends. For this example project, wiring can begin three days after framing starts. Framing doesn't have to be finished to start the electrical, it just has to be started. A contractor may represent this as SS - 3.