LUMEN PMC
PROJECT MANAGEMENT CONSULTANTS

Leading Indicators - What are they for Scheduling?

There is much written about leading and lagging indicators related to the state of the economy and economic performance, such as corporate profits and stock prices. To make indicators meaningful for project management, performance measures need to be provided by project controls, understood by the project team, and used during project execution. Leading indicators are trends in manhours, deliverables, productivity or other project parameters that may be symptoms that a project has problems. The purpose of these leading indicators is to forewarn project management of potential issues and allow corrections to be made before the project gets out of hand.

Making them effective

To be effective, the project team must recognize when a leading indicator shows a potential issue and determine what action to take to reverse the trend. By definition, leading indicators are predictive – if a trend continues, variances from the approved plan *might* occur, and the cost of corrective action must be evaluated against the likelihood of materializing. The results of leading indicators may merit subsequent extensive reviews, such as trending milestone delays, but calculating them should be kept simple and easy to understand. Since typical trailing or lagging indicators are normally part of formal monthly reporting, which is time consuming to prepare, consideration should be given to using leading indicators in flash reports or made part of the weekly status meetings. Flash reports are typically one-page reports focused on project highlights for the period, with very little narrative, and primarily statistical in nature and issued quickly.

Differing measures

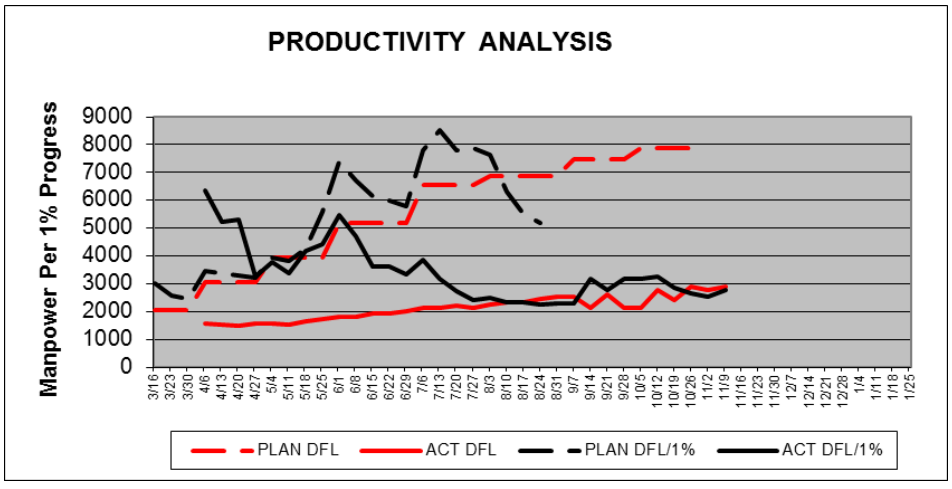
When it comes to improving project performance, all indicators need to be equally monitored since they address differing measures and can validate each other. They may be grouped into the following categories:

- Leading
  - A collection of measures that can be predictive of future performance or outcomes
  - Measures against strategies
- Current
  - Predicted value of leading indicators, current project status, current resource allocations
- Trailing, or lagging
  - An indication of what has already happened
  - Measured percentages: schedule variance (SV), schedule performance index (SPI) metrics, Earned Value Management (EVM)
  - Can be weeks out of date and allows problems to become worse before corrected

Examples

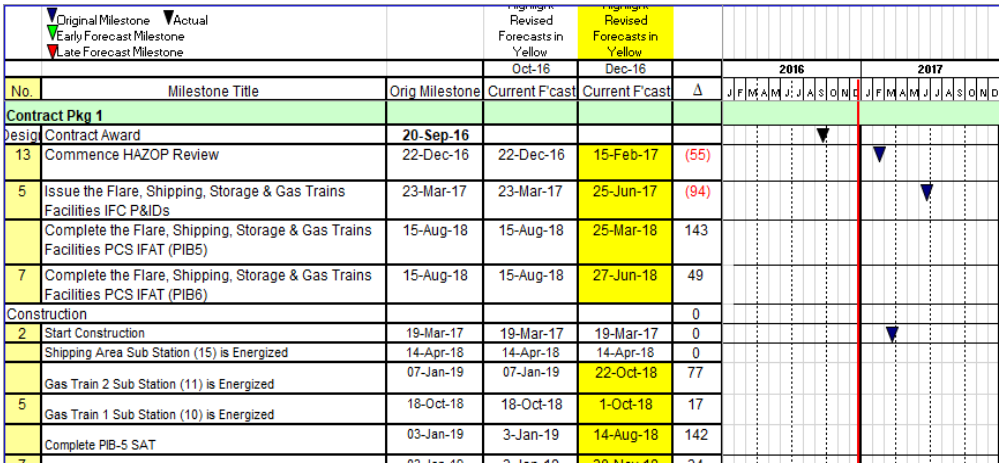
Schedule related leading indicators may change over the life of a project, depending upon the emphasis of the phase, but may include:

- Growth in estimated quantities – the original budget compared to installed/forecast quantities. This can be the result of bid packages released prior to Approved for or Issued for Construction status, or with substantial Holds, wrongly factored bulk quantities if estimated early, or project changes not being fully accounted for.
- Engineering deliverables milestone achievement –a simple count of milestones completed, extracted weekly from the document control system database and compared to the approved baseline.
- Changes in fabrication or manufacturing durations – the baseline schedule compared to a current update. The original baseline schedule can be prepared based primarily on procurement inquiries, with final placements differing substantially from the initial assumptions. This is a significant issue if suppliers are new to the contractor or lack experience with new technologies where vendor inspections may uncover trends in non-compliance issues.
- CPM activities duration growth – engineering or construction activity baseline durations compared to a current update for completed activities. Applied correctly, growth in activity durations should be applied consistently across remaining activities to produce a revised forecast. Logic should be reviewed carefully to confirm that the baseline plan is still valid. Updates need to be reviewed carefully to confirm that logic relationships have not been modified simply to maintain targeted milestone dates, which is a common manipulation practice of weak contractors.
- Labor Productivity – actual manhours expended / 1% complete compared to budget (also used for establishing measured mile). This is a simple calculation that should be standard practice on projects, both in engineering and construction, and can be used at any summary or detail level. This incremental and cumulative indicator is used to challenge Indicated Total Manhours and productivity calculations. For example, tracing direct field labor manhours can be provided as shown in this chart:



- Total/Free Float consumption – average TF/FF for remaining activities. Based on an export from the scheduling system for remaining activities (remaining durations greater than 0), compares average floats per activity to the original baseline schedule and previous updates.

- Percentage (%) milestones forecasting delay – approved baseline schedule milestone dates compared to current update, converted to frequency of target dates missed between updates as shown below:



No.	Milestone Title	Orig Milestone	Current F'cast	Current F'cast	Δ
Contract Pkg 1					
Desig	Contract Award	**20-Sep-16**			
13	Commence HAZOP Review	22-Dec-16	22-Dec-16	15-Feb-17	(55)
5	Issue the Flare, Shipping, Storage & Gas Trains Facilities IFC P&IDs	23-Mar-17	23-Mar-17	25-Jun-17	(94)
	Complete the Flare, Shipping, Storage & Gas Trains Facilities PCS IFAT (PIB5)	15-Aug-18	15-Aug-18	25-Mar-18	143
7	Complete the Flare, Shipping, Storage & Gas Trains Facilities PCS IFAT (PIB6)	15-Aug-18	15-Aug-18	27-Jun-18	49
Construction					0
2	Start Construction	19-Mar-17	19-Mar-17	19-Mar-17	0
	Shipping Area Sub Station (15) is Energized	14-Apr-18	14-Apr-18	14-Apr-18	0
	Gas Train 2 Sub Station (11) is Energized	07-Jan-19	07-Jan-19	22-Oct-18	77
5	Gas Train 1 Sub Station (10) is Energized	18-Oct-18	18-Oct-18	1-Oct-18	17
	Complete PIB-5 SAT	03-Jan-19	3-Jan-19	14-Aug-18	142

- Changes in staffing plans – This is both a Cost and Schedule Indicator. Negative changes in assigned grade codes compared to the budget will impact the supervisory levels hours spent managing lesser experienced personnel, either in engineering, procurement or construction. Although actual salary rates from using lower grade codes are often attractive, the impact on supervision is often detrimental to the execution of work.
- Contract/Subcontract awards at lowball rates – This is both a Cost and Schedule Indicator. Awards to lesser qualified contractors or subcontractors will normally require more project oversight by the contracting party (client or prime contractor). Awards of this nature should be included in updated risk registers with appropriate mitigation plans, and tracked routinely as issues.

Existing Construction Industry Institute (CII) tools

Formal tools have been developed by the CII and have been in use to provide indications of the completeness or thoroughness of a project's execution. The existing CII Indicator tools include:

CII Implementation Resource 112-2 – The Project Definition Rating Index (PDRI) is a formal, but easy method to measure project scope definition completeness that allows a project team to quickly predict factors impacting project risk during front end planning. The PDRI is intended to be used at least once during each of the feasibility, concept and detailed scoping phases of a project.

CII Implementation Resource 220-2 – The Project Health Indicator Tool for assessing project health during project execution. The PHI tool will not actually measure and quantify a specific amount of risk for a project, but will forecast the potential risk if certain project outcomes will not be met. The tool consists of 43 leading indicators that provide early warning signs of an unhealthy project in outcome measures of Cost, Schedule, Quality/Operability, Safety and Stakeholder Satisfaction. Indicators specifically for schedule include:

#4 – validity of the schedule
#5 – meeting project milestones
#6 – construction awarded before design readiness
#21 – lack of sufficient skilled craft and turnover
#22 – project lacks sufficient resources
#31 – difficulties in integrating schedules
#36 – high float consumption
#37 – actual schedule lagging behind planned
#38 – forecasts to complete are projecting overruns.

Conclusion

Utilizing leading indicators adds additional oversight and predictive tools for the project controls reporting function but calculating them should be kept simple and easy to understand. To provide more effective forecasting capabilities, leading and lagging indicators need to be equally monitored to confirm each other's validity. And it is perfectly normal that useful leading indicators change over the life of a project as new phases start with differing quantities to report on and control.

For questions or additional information on this topic email Ronald Smith, Director, Lumen PMC at rsmith@lumenpmc.com.