MIT develops measures to predict performance of complex systems

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Taking a cue from the financial world, MIT researchers along with experts in industry and government have developed a list of 13 measures that engineers can use to predict how well a system--or project--will perform before it is even finished.

Known as leading indicators, analogous measures are regularly used by economists, investors and businesses to help predict the economy's performance.

The idea behind the new set of leading indicators is to improve the management and performance of complex programs before they are delivered, in a more predictive way than simple business metrics.

"Leading indicators can provide important insights for managers of complex programs, such as those in the aerospace industry, and can allow them to make real-time adjustments to project activities, staffing and schedules to ensure a project stays on track," said Donna Rhodes, a principal researcher for MIT's Lean Aerospace Initiative (LAI).

The MIT leading indicators project, co-led by Rhodes and industry colleague Garry Roedler of Lockheed Martin, began in 2004 following an LAI/U.S. Air Force workshop on systems engineering that established the groundwork for the project. Systems engineering is an interdisciplinary approach to creating successful systems by focusing on variables including customer needs, system requirements, design synthesis and system validation, all while considering the complete

problem.

A leading indicator may be an individual measure, or collection of measures, that are predictive of future system performance before the performance is realized.

Thirteen ways of looking at a system

The 13 leading indicators defined by the MIT team include risk handling trends. This indicator would be used by management to determine whether a project team is proactively handling potential problems (or risks) at the appropriate times with the goal of minimizing or eliminating their occurrence. If the actions to address a given project risk are not taken, then there is a higher probability that the risk will be realized, resulting in negative impact to project cost, schedule, performance or customer satisfaction. The insight gained through the use of this indicator can help identify where additional effort may be needed to avoid preventable problems or reduce impacts.

Several major aerospace companies worked to validate the 13 indicators in pilot programs during 2006, which helped refine them. Then, working in collaboration with the International Council on Systems Engineering (INCOSE), the leading professional society for systems engineering practitioners, the MIT team published a guidance document about the work. That document has been made available to the larger systems engineering community.

According to Rhodes, "The leading indicators project is an excellent example of how academic, government and industry experts can work together to perform collaborative research that has real impact on engineering practice."

The other leading indicators identified by the team are: system definition

change; backlog trends; interface trends; requirements validation trends; requirements verification trends; work product approval trends; review action closure trends; risk exposure trends; technology maturity trends; technical measurement trends; systems engineering staffing & skills trends; and process compliance trends.

Source: MIT