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Project complexity is the degree of interrelatedness between project attributes and interfaces and their consequential impact on predictability and functionality.

When large complex projects come off the rails, they tend to go through a chaotic phase.

Complexity can arise in engineering and construction programs from a broad range of factors.

Management of project complexity is greatly aided by objective, tracking metrics and other actions.

Complex projects are often described as being large and most large projects face increasing levels of complexity. Scale, however, is not the only determinant of complexity as there are many scientific and research projects much smaller in scale that are equally complex.

This Executive Insight focuses on:

- defining project complexity, providing an easy-to-understand visual analog.
- identifying potential sources of complexity in engineering and construction projects.
- providing a reference to one potential measure of project complexity.

The reader is also guided to the Executive Insight, [Coupling in Large Complex Projects](#).¹

Complex projects can be defined as:

a large number of interacting tasks.

unanticipated emergent properties (see description of emergence).

extensive coupling¹ (networked nature), which drives nonlinear behaviors.

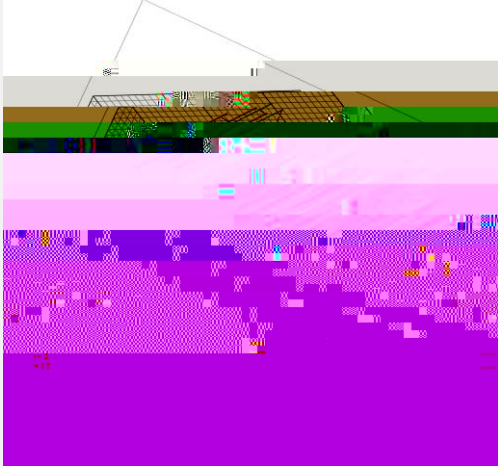

the ability to absorb most random disruptions.

¹ Executive Insight, [Coupling in Large Complex Projects](#)

vulnerable to catastrophic behavior under stress.

We are now in the "Century of Complexity," according to the late theoretical physicist, cosmologist, and author Ste

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| <p>On the top sheet we draw a line along one of the horizontal graph lines with each vertical line representing the ending of one activity and the beginning of the next.</p> | |
| <p>This would represent a simple project and the project would remain simple even if we add a couple of horizontal lines with just a few vertical connecting lines.</p> | |
| <p>Now let's think about a project with many horizontal and vertical lines essentially encompassing all the boxes on that top sheet of graph paper. We would describe such a project as complicated.</p> | |
| <p>Finally, let's take that complicated project with many horizontal and vertical connections and add two new elements. The first, diagonal lines between seemingly random nodes on this top sheet representing precedence and constraint coupling.</p> | |

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|---|--|
| <p>Each of these other sheets of graph paper is not static. Rather they are being tugged and rotated by various externalities and stakeholders. We call this very dynamic project, complex.</p> |  |
| <p>To continue with this analogy: when large complex projects come off the rails, they tend to go through a chaotic phase. The stack of graph paper is thrown up in the air and stability does not return until the project manager gathers up and reorganizes that stack of graph paper.</p> |  |

Complexity can arise in engineering and construction programs from a broad range of factors. These include:

- Strategic Business Objectives (SBOs)
- Organizational
- Stakeholders
- Political
- Project portfolio
- Program execution
- Technological
- Environmental

Each of these source categories is further developed in Table 1.

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| | Ambiguity; Visibility; Alignment |
| | SBO Migration Over Time |
| | Conflicting SBOs |
| | Competitive Landscape Changes |
| | |

The measurement of project complexity remains an industry challenge. Methods related to assessment of the presence and strength of the various factors associated with complexity, similar to many of those in Table 1, have been suggested. Reference 1 (see References below) suggests one method based on precedences that consider coupling, and is in some ways analogous to the cyclomatic coupling used in the programming industry. It provides the benefit of addressing the impacts from modularization as well as assessing how complexity changes as new couplings emerge and precedences are retired through performance of work.

- 13.15 Location Factors in Large Complex Projects
- 14.4 Human Factors in Large Complex Projects
- 14.8 Considerations in Cross-Cultural Negotiations
- 14.11 Cross Cultural Factors

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