

FEATURED PAPER

Introducing the Project Complexity Model  
*A New Approach to Diagnosing and Managing Projects*  
Part 1 of 2

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Traditional project management techniques are based on a desire to decompose work into simple and easily managed components. Yet such a building block model just doesn't capture the reality of projects in today's complex and interconnected world. Until now, project management has lagged behind other corporate processes in its quest for simplicity while global entities have embraced complexity, even chaos. For example, enterprises have created complex organizational communities comprised of alliances with strategic suppliers, networks of customers and partnerships with key political groups, regulatory entities and even competitors. It is these alliances that allow them to address the pressures of unprecedented change.

Scientists studying complex systems from ant colonies to galaxies agree: Complexity and chaos are the very nature of the universe. Isn't it time for project management to catch up to what ants have known all along?

### **Diagnosing Project Complexity**

There are many different ways projects can become both multi-faceted and complicated. In some cases, the business problem is difficult to define. In others, the solution is elusive and difficult to determine, describe or grasp. Also, business boundaries might be unclear or business process relationships non-linear with multiple feedback loops. That's why any project management model must be dynamic, adaptive and flexible to account for the ever-changing nature of business systems.

One such model is the *Project Complexity Model*. It is used to evaluate project size, complexity and risk, determine the project's specific dimensions of complexity and then apply complexity management strategies accordingly.

The following table shows seven complexity dimensions that add complexity and risk to projects dependent on three project profiles: (1) small, independent and low risk, (2) medium-sized with moderate complexity and risk, and (3) large, with high complexity and risk.

Complexity Dimensions	Project Profile		
	Small Independent Low Risk	Medium Moderately Complex Some Risk	Large Highly Complex Significant Risk
Time / Cost	< 3 months < \$250K	3 – 6 months \$250K – \$750K	> 6 months > \$750K
Team Size	3 – 4 team members	5 – 10 team members	> 10 team members
Team Composition	Team staffed internally	Team staffed with some internal and some external resources	Complex team structure, <i>e.g.</i> , contractor teams, virtual teams, culturally diverse teams, outsourced teams
Competing Demands	Schedule, budget and scope are flexible	Schedule, budget, scope can undergo minor variations, but deadlines are firm	Deadline is fixed and cannot be changed; schedule, budget, scope, quality have no room for flexibility
Problem / Solution Clarity	Easily understood problem and solution; solution is readily achievable using existing technologies	Either problem is difficult to understand, the solution is unclear or difficult to achieve, or the technology is new to the organization	Both problem and solution are difficult to define or understand, solution is difficult to achieve, and solution likely to be using unproven or complex technologies
Stability of Requirements	Requirements understood, straightforward, and stable	Requirements understood, but are expected to change	Requirements are poorly understood and largely undefined
Strategic Importance Political Implications Multiple Stakeholders	No political implications	Some direct mission impact, minor political implications, 2-3 stakeholder groups	Affects core mission and has major political implications; visible at highest levels of the organization, multiple stakeholder groups with conflicting expectations
Level of Change	Impacts a single business unit	Impacts a number of business units	Large-scale organizational change that impacts enterprise, spans functional groups or agencies, shifts or transforms the organization

**Table 1: Project Complexity Model**

To diagnose the size, complexity and risk of a particular project, apply the following formula:

*A project is large, highly complex and carries significant risk if:*

- Its level of change has large-scale enterprise impact; or
- Both problem and solution are difficult to define or understand, and the solution is difficult to achieve and will likely involve unproven technologies; or
- Four or more categories in the “large” column apply.

*A project is medium-sized, moderately complex with some risk if:*

- Four or more categories in the “medium” column apply; or
- If one category in the “large” column applies together with three or more categories in the “medium” column.

*All remaining combinations are diagnostic of a small, independent, low-risk project.*

### **When to Apply Complexity Thinking to Projects**

To help manage complex projects, complexity thinking should be applied during many phases of the project life cycle. Take your planning team through the analysis recommended in the remaining sections and part 2 of this article to apply complexity thinking to the major decisions to be made about the project. Specifically, adopt the project complexity management approaches outlined here when managing projects that call for:

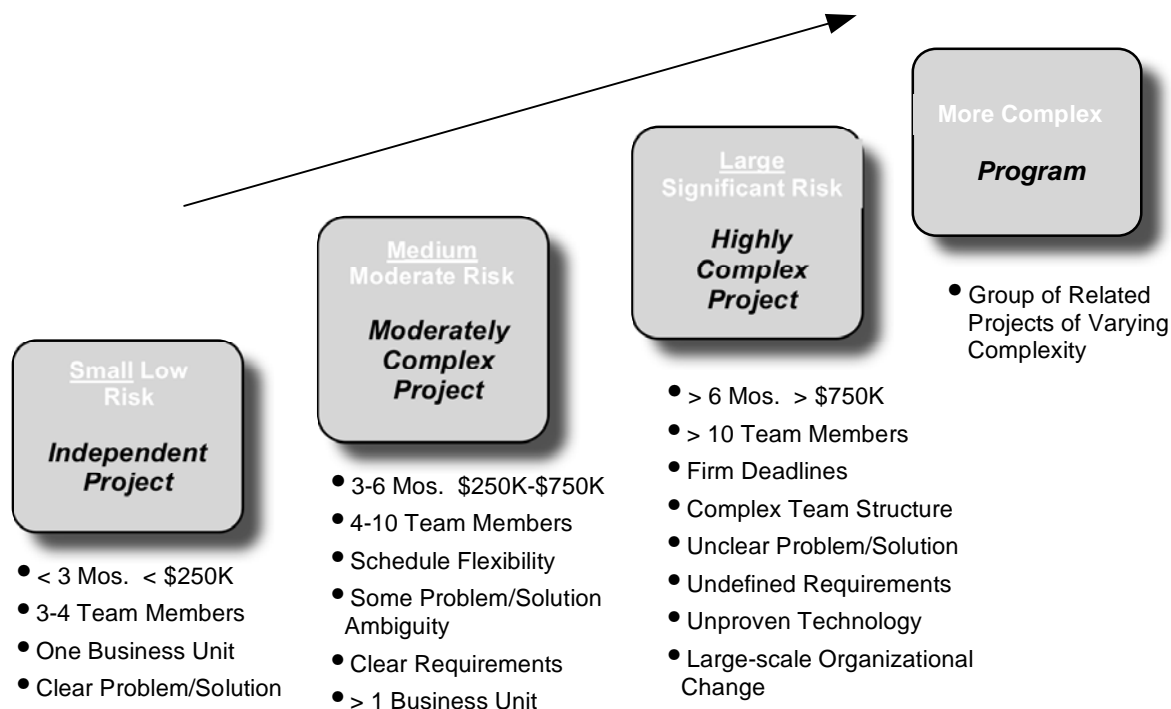
- Conducting pre-project analysis to clarify the problem and solution
- Preparing the business case for a new project proposal
- Initiating and planning a new project
- Initiating and planning a new major phase of a project
- Recovering a troubled project

In addition, the model can be used to manage programs consisting of groups of related projects of varying complexity.

Refer to Figure 1 below for another view of the Project Complexity Model. This view incorporates the concept of program management. In diagnosing the complexity of each project within the program, it is wise to focus on the high-risk, highly complex projects first to ensure

the risks and complexities can be managed, before investing time and resources on the less complex projects.

# Project Complexity Model



**Figure 1: Project Complexity Model**

## Managing Projects with Complexity Thinking

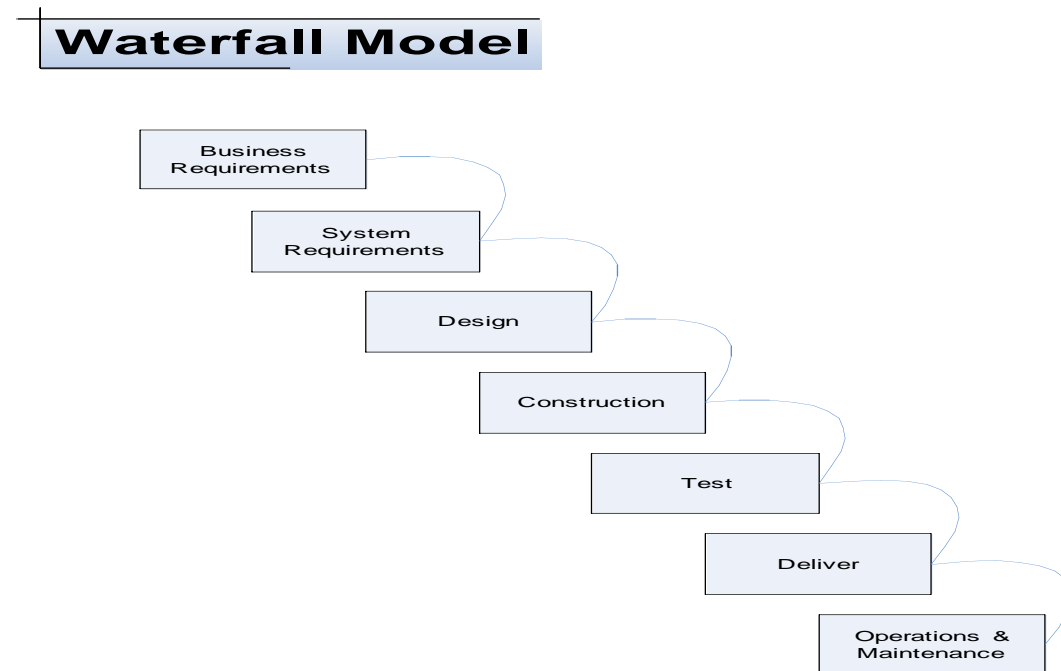
The Project Complexity Model provides project managers and leadership teams with direction on how to set up a project and manage it based on its level of complexity so that risk can be minimized. Once a project has been diagnosed according to profile and complexity dimensions, complexity thinking proceeds with a three-step process. In Step 1, the project team selects the appropriate project cycle to use based on the project profile. In Step 2, the team selects appropriate management techniques based on the complexity dimensions. In Step 3, the

project team assigns project managers and business analysts based on the project profile. Step 1 will be discussed below; steps 2 and 3 will be addressed in Part 2 of this article.

***Step 1: Select the project cycle based on the project profile.***

All projects have a cycle, a sequence of stages through which they pass. Typical cycles have a series of periods and phases, each with a defined output that guides research, development, construction and/or acquisition of goods and services (Mooz, Forsberg and Cotterman, 2003). As projects have become more complex, project cycles have evolved to address the various levels of complexity.

For short-duration, well-understood projects with stable requirements and few or no dependencies, the Waterfall Model is a highly effective project cycle. This is the classic systems development life cycle. It is essentially a linear ordering of activities that presumes requirements are fully developed and approved; that events affecting the project are predictable; that tools and activities are well understood; and that a phase that has been completed will, as a rule, not be revisited. Of course, projects rarely follow the sequential flow, and it is usually difficult to completely state all requirements early in the project. Refer to Figure 2 for a depiction of the Waterfall Model.



**Figure 2: Waterfall Model**

For medium, moderately complex projects, it's advantageous to break down the work into manageable components or sub-projects delivered incrementally. The challenge is to ensure the increments can be integrated into a fully functioning solution that meets project objectives. The "Vee" Model, authored by NASA to manage project complexity, works well for moderate-risk projects because it includes the relationship between decomposition and integration, and the concept of incremental delivery. The Vee Model involves progressively elaborating requirements (the left side of the Vee), while defining the approach to integration, verification and validation (the right side of the Vee) at every decomposition level. It essentially adds the vertical dimension to the Waterfall Model. Refer to Figure 3 for a depiction of the Vee Model.

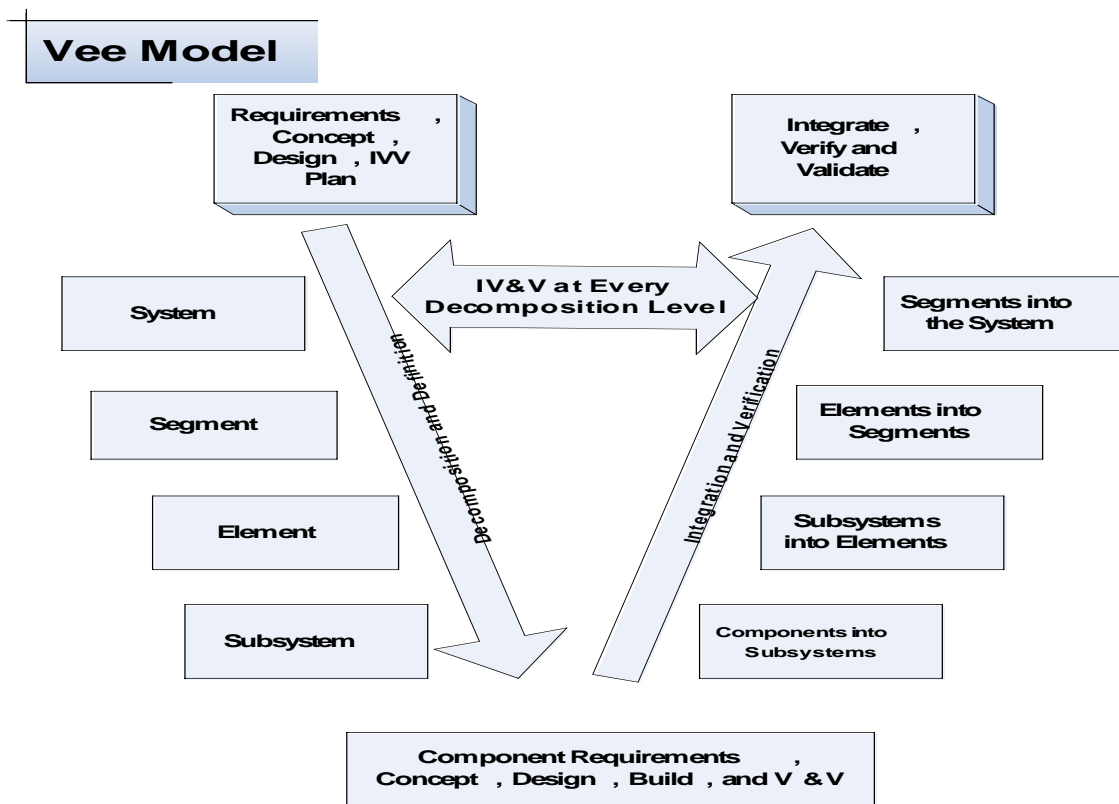
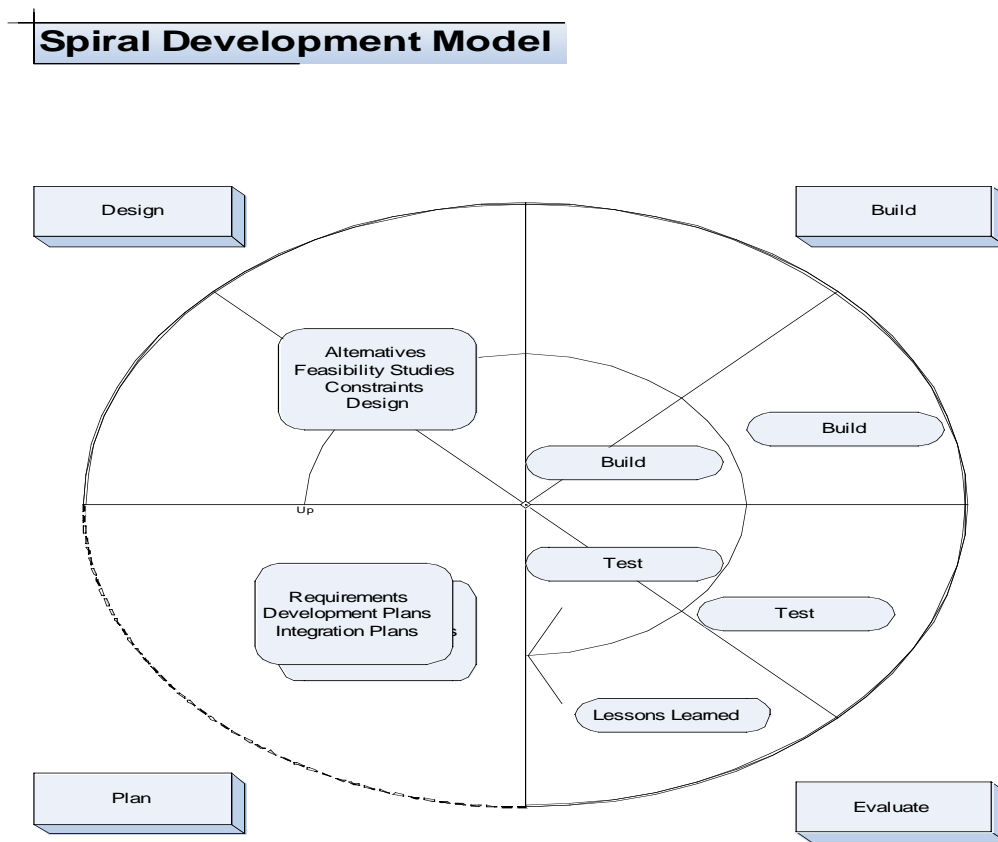


Figure 3: Vee Model

Large, highly complex, high-risk projects require considerable research and study of the business problem or opportunity; competitive, technological and benchmark studies; the definition of dependencies and interrelationships; and the identification of all potential options to meet the business need or solve the business problem. Here the Spiral Model (an iterative waterfall approach) works well. This model allows project teams to keep their options open and even build options into the project approach. Refer to Figure 4 for a depiction of the Spiral Development Model.



**Figure 4: Spiral Model**

Projects sometimes fail because good methods and techniques are misapplied and/or because of an inappropriate match of project leadership to project characteristics. That’s why there are two more steps to the application of complexity thinking to manage projects – the selection of both the appropriate complexity management techniques and the best possible project leadership. These two steps will be discussed in Part 2 of this article.

## Embracing Complexity and Chaos

Complexity thinking enables project managers and business analysts to learn to diagnose the dimensions of complexity present in a project, and then to use the appropriate management techniques. Companies that correctly apply all three steps of the Project Complexity Model will finally obtain the full business benefits expected from new solutions within time and budget constraints – no matter how complex and even chaotic their projects may be. While simple building-block models of project management are insufficient in today's interconnected, interdependent and interrelated business world, the Project Complexity Model succeeds because it embraces complexity and chaos rather than circumventing them.

## Reference

Mooz, Hal, Forsberg, Kevin, Cotterman, Howard (2003) *Communicating Project Management*, Hoboken, NJ: John Wiley & Sons.

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