People, Process, and Technology
Bringing Order to Chaos on a Large Scale

Projects in today’s environment are reaching much higher levels of size and complexity, as organizations make large investments in technology development and business transformation. To take on projects at this scale, however, we must not only acknowledge the significance of good project management principles, but also recognize the importance of people, process, and technology within the overall project enterprise. This paper first makes the case that IT projects consist of more than just technology. It analyzes the underlying complexity of multi-organizational and multi-system implementation projects and discusses a framework for planning, executing, and controlling situations where chaos may be “lurking around the corner”. Finally, it shows that if this approach is understood and applied, large-scale IT project teams can be more productive and cost efficient in the long run.
INTRODUCTION

The Standish Group, an IT research and advisory firm, illustrated some interesting statistics on the successes and failures of IT projects in their 2009 CHAOS report. Results of the report showed that 24% of all projects failed, 44% were challenged, and 32% were successful. Despite the increase of successful projects since the study’s inception in 1994 (Table 1), the number of failed projects has increased every year since 2000. These results suggest that significant chaos still resides somewhere within IT projects. Furthermore, there exists a level of complexity that is not recognized before problems occur. But before these problems happen, is there a way we can recognize them and ultimately avoid them?

<table>
<thead>
<tr>
<th>Year</th>
<th>Successful</th>
<th>Failed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1994</td>
<td>16%</td>
<td>31%</td>
</tr>
<tr>
<td>1996</td>
<td>27%</td>
<td>40%</td>
</tr>
<tr>
<td>1998</td>
<td>26%</td>
<td>28%</td>
</tr>
<tr>
<td>2000</td>
<td>28%</td>
<td>23%</td>
</tr>
<tr>
<td>2002</td>
<td>34%</td>
<td>15%</td>
</tr>
<tr>
<td>2004</td>
<td>29%</td>
<td>18%</td>
</tr>
<tr>
<td>2006</td>
<td>35%</td>
<td>19%</td>
</tr>
<tr>
<td>2009</td>
<td>32%</td>
<td>24%</td>
</tr>
</tbody>
</table>

BUSINESS PROBLEM

When projects fail, it is often very difficult to pinpoint the root cause. The most obvious factors point to problems within the project management “golden triangle” – scope, time, and resources. We learn how these concepts can affect projects through general project management experience and from frameworks such as the Project Management Body of Knowledge (PMBOK) and Projects in Controlled Environments (PRINCE2). Despite the success stories from these resources, these practices only offer deterministic, one-size-fits-all project management approaches and are insufficient for recognizing and dealing with complexity. These practices are highly prescriptive and frequently ignore the different variables that typically exist in complex project environments. Could the frameworks that we typically use on projects be improved?

The project management strategy that we currently use may also be flawed. On many large-scale IT projects, high emphasis is placed on the technical architecture and end product, but the business architecture is often less emphasized. Rarely do project organizations deliberately align their people, processes, structure, and technology to the needs of the overall enterprise. Considering that most organizations invest in multi-million dollar IT projects, it may not be sufficient to utilize these investments on only focused areas within a project. With most of the emphasis tied up on technical architecture and the end product, project organizations typically forego the collective impact of the entire enterprise, which actually enables longer-term success.

1 Source: Adapted from The Standish Group, CHAOS Report 2001, 2009
**SOLUTION**

To unlock productivity and success, IT project organizations must establish a solid project strategy within an enterprise. Prior to tackling this problem, however, IT project organizations must understand how value is created within an overall enterprise and then understand the how complexity affects an IT project. Beyond just technology, project managers must recognize that there are many additional factors that affect the success of large-scale IT projects.

**Assessment**

The Enterprise Value Chain

IT project organizations can run like any other strategic business unit within an enterprise. Typical mid to large-sized organizations have multiple business units, each delivering specific business value from their suppliers to their customers. Like business units, project organizations and IT organizations can be seen in the same way by taking the value of their suppliers and creating additional value for the enterprise. Additional value is created through the delivery of services and products that their customers demand within the organization. Any and all project organizations should consider their place within an enterprise’s value chain by determining the value they create for their customers and assessing how they execute and create that value. The Enterprise Architecture Framework (EAF) in Figure 1 emphasizes how an IT organization fits within the context of an organization’s value chain. Similar to an IT organization supporting a business, project organizations can be seen as subsystems within this overall enterprise, linking supply and demand through various elements. Value is created through the alignment of supply and demand and by the effective delivery of products and services that support the customer.

Figure 1 - Enterprise Architecture Framework

2 Source: Pariveda Solutions, Inc.
Each of the constituent elements within the EAF plays a major role in the creation of value for an enterprise:

- **Suppliers** – The organization’s suppliers include inputs of products and services to the project organization. Many project organizations have relationships with software vendors, hardware vendors, or technical service providers. Based on the value that the project organization creates for its customers, the vendors and service providers may vary.

- **Customers** – The project organization’s customers are the business units or customers they support. For internal IT projects, the employees of a specific business unit may be the beneficiaries of the value that the organization creates. For E-Commerce projects, the end consumers may be the beneficiaries of a public-facing system.

- **Products & Services** – Products and services are the interface points that deliver value to the customer or client. Suppliers may provide hardware and software licenses to a project organization that can then be leveraged to provide value to their own customers. For IT project organizations, the product could be an ERP system that would be beneficial to several other beneficiaries. The project organization could also provide services such as help desk support or training.

- **Business Architecture** – The business architecture establishes the linkage between supply and demand across the enterprise value chain, built primarily by people, processes, and structure.
  - **People** – The right people with certain skill sets, talent, and leadership are needed to support the success of the project. For knowledge work and for productivity, people may have varying levels of creativity, understanding, and imagination.
  - **Process** – The operational execution plans must be sound and reliable for a project organization to be effective. Some organizations may require more agile methods to provide a quick ROI to their customers. Other organizations require a very rigorous process that adheres to a specific maturity model such as CMM (Capability Maturity Model) or Six Sigma.
  - **Structure** – Project organizations must be optimized to minimize organizational layers, spans of control (i.e. number direct reports), utilization on multiple project assignments, team size, and meeting time. The project structure can be adjusted to provide flexibility and meet customers’ needs.

- **Technical Architecture** – The business architecture is supported by applications, frameworks, and infrastructure that enable key business processes. Whether the project organization has a preference for packaged systems or custom-developed solutions, the technical architecture must be aligned with the business architecture to support their customers.
  - **Applications** – Several technical applications may be leveraged to increase worker productivity. For example, project members may utilize technical tools for developing, testing, and deploying software.
  - **Frameworks** – Frameworks help guide the successful execution of the products and services provided to customers. Software development teams may desire a service oriented architecture framework that provides flexibility, maintainability, and scalability.
o **Infrastructure** – Project organizations leverage various technical components such as servers, networks, databases, and services. Some project teams may leverage an on-premise technical solution whereas other teams may desire the use of hosted solutions.

The enterprise strategy encompasses all links and layers of the enterprise architecture from suppliers to customers. Note only must organizational units within the chain maintain their own strategy, but they must also extend the enterprise’s strategy. Consider a large organization comprised of numerous business units across an enterprise: should a business unit lack emphasis on any constituent elements within the framework such as people, process, or structure, the linkage between other adjacent units will be weakened. The links become significantly weakened when multiple business units lack emphasis on any of these elements.

**Understanding Complexity**

“Every decade or so, a grandiose theory comes along, bearing similar aspirations and often brandishing an ominous-sounding C-name. In the 1960s it was cybernetics. In the ’70s it was catastrophe theory. Then came chaos theory in the ’80s and complexity theory in the ’90s.”

- S.H. Strogatz

For years, scientists have studied complexity theory within the context of many real-world environments including: governments, families, the human body (physiological), a person (psychosocial), the brain, the ecosystem of the world and sub-world ecosystems such as deserts, rainforests, oceans, forest fires, traffic jams, the spread of infectious disease, and the weather. At a more abstract level, all of these environments share a common pattern of complexity that typically occurs within a system. In 2008, a study conducted by Harvey Maylor, Richard Vidgen, and Stephen Carver showed that within any system, complexity comes not only from individual structural elements and their interaction, but also from the dynamic effects of changes to these elements and resulting interactions from each change. As a result, further change is caused in other parts of the system. Elements can act independently in a finite, structured environment; however, as the number of interactions between those elements increases, the complexity also increases in the system. This dynamism and change can produce outcomes that are very nonlinear and unpredictable.

The same concepts of complexity have implications on risk within IT projects. As complexity increases within a project environment, the level of risk increases as well. Figure 2 shows this relationship. In typical innovative IT organizations, rapid change occurs frequently, and when creating products, various project teams need to collaborate and interact. Small, autonomous development teams that are tasked with specific technical requirements may experience only a basic level of complexity with slight amounts of uncertainty. However, increased levels of complexity will be felt by IT project teams that require cross-functional team collaboration and lack stable system requirements. For example, this level of complexity is often found in the energy and financial industries. Frequent changes to rules and regulations often cause a business to modify processes, which in turn, causes changes to system requirements across an organization. Numerous project teams are required to absorb the change, often
resulting in communication challenges. Several iterations amongst many inter-related teams (typically with the business and other IT project teams) may be required to build consensus on a final set of requirements. However, it must be noted that “final” is often only relative to a specific time and that requirements typically change as the business evolves. To complicate this situation further, unexpected removal and addition of project resources or key stakeholders can make this even more complex.

This relationship between project complexity and risk affects the way the project team learns and executes effectively. Since complex projects are very open, recursive, and sensitive to emergent changes, project teams must learn often and adapt frequently in the environment. Numerous feedback loops become very important and double loop learning is required. With single-loop learning, the techniques that a project team uses are refined after assessing results of project goals, values, and strategies that yielded those results. However, with double-loop learning we deliberately identify and challenge any underlying assumptions that supported the original goals, values, and strategies that existed. Adaptive software is a good example of how feedback loops are leveraged to redefine goals. Like adaptive software, complex projects change the rules of their development as they evolve over time. As elements interact and change over time, we also change in order to reduce any imminent risks.

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3 Source: Adapted from And then came Complex Project Management, Maylor, Harvey, Whitty, S. Jonathan, (2007)
Evaluating Complexity

In an era where rapid development of technology requires solid management of time, scope, and resources, very rarely do project organizations put deliberate effort into understanding people, process, and structure. Technical Architecture (as previously emphasized in Figure 1) is almost always recognized as complex on large IT projects, often resulting in large investments of time and resources. However, it is the lack of understanding of the Business Architecture and its complexities that create losses in productivity and effectiveness. To harness this knowledge and to communicate on a large scale, we must emphasize people, process, and structure. It is the culmination of all of these aspects within the value chain that leads to the creation of technology.

To deliver projects effectively (and bring order to chaos), complexity can be understood by mapping it against the Enterprise Architecture Framework. Table 2 shows the implications of complexity on the technical architecture, the business architecture, and product & services. As indicated in this table, numerous sources of complexity may exist due to the people, processes, and structure within the organization. The risks associated with these aspects of the project organization may not cause any short-term impacts, but in the long-run, they may become very costly and difficult to fix once they surface as issues. During the planning stages of a project, deliberate assessment of all of these dimensions allows us to fully understand the level of complexity within problems, as well as provides clear evidence for any adjustments that need to be made for long-term success.
Table 2 - Project Complexity Analysis

<table>
<thead>
<tr>
<th>Enterprise Architecture Criteria</th>
<th>Interaction</th>
<th>Change/Uncertainty</th>
</tr>
</thead>
</table>
| **People**                       | - Numerous cross-functional or cross-system teams  
                                  - Development and maintenance of systems are outsourced to virtual teams, external vendors, and offshore teams  
                                  - Major political implications across numerous executive stakeholders | - Key technical and business resources are added or removed from the project before completion  
                                  - Proficiency of project manager and development resources do not match the complex skill sets required  
                                  - Project team has not worked together in the past and does not have any proven track record of estimating |
| **Process**                      | - Requirements must be evolved by business and IT teams over time  
                                  - Numerous business and IT teams utilize different variations of waterfall and agile processes  
                                  - Production Support processes must be put in place to facilitate efficient turnaround across various teams | - High level requirements have been identified, but require breakdown into additional, workable units  
                                  - Requirements changes occur frequently, but must be negotiated across several IT and business teams  
                                  - New project management methodologies are introduced |
| **Structure**                    | - Numerous teams are structured differently by project, system, or functionality  
                                  - Product is owned and funded by multiple stakeholders  
                                  - Decision-making requires several organizational layers  
                                  - Numerous managers with multiple spans of control | - Numerous resources are split between other projects, systems, or functions, causing inefficient use of time  
                                  - Organizational structure change affects the alignment between IT and business |
| **Applications**                 | - Various systems require integration  
                                  - Existing technical interfaces are brittle | - Technical interface changes occur frequently due to changing business needs  
                                  - Solution involves unproven or complex technologies |
| **Frameworks**                  | - System models are inconsistent and incompatible across technical environments | - Tight coupling of systems prevent ease of change and maintenance |
| **Infrastructure**              | - Systems share software and hardware resources  
                                  - Numerous systems needed to support scalability requirements | - Increased user base and activity requires many upgrades to hardware and software |
| **Products & Services**         | - Business data input and migration is required beyond the technical delivery  
                                  - High number of end users must be trained to use the completed system | - Business objectives and problems are unclear or ambiguous  
                                  - Rapidly changing business needs impacts the system requirements and product currently being developed |
Understanding Interrelationships

Numerous interrelationships between individual elements should be considered in addition to understanding how the elements fit within an enterprise architecture. Figure 3 shows how each of the elements within the enterprise interrelates with each other. It is important to note that while each individual element plays a critical role in effectiveness, it is the collective relationship of all of these elements (working in tandem) that enables full value within the IT project organization. As seen within many time, scope, and resource-constrained IT organizations, too much emphasis can be placed on the technology aspect of the project. However, the interrelationships across other elements within the broader enterprise will ultimately enable higher long-term success of the project.

In Figure 3, value may be enabled when each relationship is first recognized and well-understood. For example, people influence the effectiveness of process. People are managed through structure and provide knowledge and support to customers. Process facilitates communication through structure, leverages the technical architecture, and enables the development of the product. Customers provide support and gain insight through process and elaborate on the requirements of the product. Technical architecture standardizes the requirements of suppliers and provides a platform for the product. Lastly, suppliers provide services to the overall project organization. By recognizing, understanding, and strengthening each of these relationships, the overall value of the project can be enabled.
Strategy

A solid project strategy establishes a long-term vision for how a project can be successful within an organization. The assessment of enterprise value chain, project complexity, and interrelationships within the organization helps us define what that project vision and roadmap needs to be for success.

Understanding Strategic Focus

In the book *The Discipline of Market Leaders*, Michael Treacy & Fred Wiersema suggest that there are three possible operating models that can be used to establish market leadership:

1. **Operational Excellence**, which delivers a combination of quality, price, and performance no one else can match;
2. **Product Leadership**, which pushes services into the realm of the unknown, the untried, or highly desirable; and
3. **Customer Intimacy**, which builds strong bonds with their customers and a strong grasp on the products and services they need.

Most businesses typically exhibit aspects of all three of these models, but the most effective businesses focus and excel at one model. IT project organizations must also focus on one of these strategies to better support a business. But how does the project organization know which one to focus on? Typically the most natural fit for an IT project organization is to mirror the strategy of the business. However, there are some cases where the best IT strategy needs to be focused on a different model. For example, online retailer Amazon focuses their business on delivering a highly customer intimate user experience; however, their IT infrastructure must be highly available and responsive, leading to a heavier focus on operational excellence. Likewise, Wal-Mart focuses on a low cost, operational excellence model; however, their IT strategy is focused heavily on innovation and product leadership. Regardless of paralleling strategies across business and IT, spreading the focus of an IT project organization across all three of these models typically results in higher costs and internal conflict.

Each IT strategy has specific implications on the way IT projects are executed within the organization. Product leadership IT organizations such as Apple and Google typically promote early adoption, leading edge solutions, and new and innovative ideas. Operationally excellent IT organizations (Ex: FedEx, Costco, 1-800-Flowers) are late adopters, sharing responsibility with executives to keep costs low, and utilize outsourcing and offshore resources. Customer intimate IT organizations (Ex: Home Depot, JetBlue) focus on customized applications, performing in-house development, and implementing process applications.

Based on the strategic focus, we can determine the most optimal mix of people, process, structure, and technology that provides the best alignment and most value to the business. Table 3 shows the implications of the business and technical architecture on each strategic focus. Whether at the beginning or in the middle of executing a large-scale IT project, formal analyses should be performed to assess the current state against the target IT strategy. Finally, the associated gap can be addressed and adjusted to align the overall IT project organizations with the broader enterprise.
Table 3 - IT Project Strategy Alignment

<table>
<thead>
<tr>
<th>Enterprise Architecture Criteria</th>
<th>Operational Excellence</th>
<th>Product Leadership</th>
<th>Customer Intimacy</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>People</strong></td>
<td>Buttoned-down Project Managers</td>
<td>Technologists</td>
<td>Relationship Managers</td>
</tr>
<tr>
<td></td>
<td>Application architects</td>
<td>Risk takers that drive towards differentiation and competitive advantage</td>
<td>Application Architects</td>
</tr>
<tr>
<td></td>
<td>Documentation specialists</td>
<td>Solution selling</td>
<td>Accountable</td>
</tr>
<tr>
<td><strong>Process</strong></td>
<td>High CMMI levels</td>
<td>Technology assessments, implementation, and integration</td>
<td>Agile methodologies</td>
</tr>
<tr>
<td></td>
<td>PMO</td>
<td></td>
<td>Anticipate and execute on change</td>
</tr>
<tr>
<td></td>
<td>Waterfall processes</td>
<td>Emphasis on time to market</td>
<td>Detailed requirements development</td>
</tr>
<tr>
<td><strong>Structure</strong></td>
<td>Inverted pyramid structure</td>
<td>Diamond structure with small to medium teams and consultants</td>
<td>Pyramid structure with small to medium-sized teams</td>
</tr>
<tr>
<td></td>
<td>Few in-house resources</td>
<td>No buffer between Business and IT</td>
<td>Strong communication between small groups</td>
</tr>
<tr>
<td></td>
<td>Control groups for managing service level agreements</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Applications</strong></td>
<td>COTS, with an emphasis on “out of the box” systems integration</td>
<td>Custom applications</td>
<td>Blend of COTS and custom applications</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Applications are the strategic driver</td>
<td>Tailor applications to meet customer needs</td>
</tr>
<tr>
<td><strong>Frameworks</strong></td>
<td>Reusable frameworks, typically provided by the application vendor</td>
<td>Use the most advanced technical functionality to enable application features</td>
<td>Frameworks support usability that speeds time to market and reduces cost</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Frameworks are the key strategic driver</td>
</tr>
<tr>
<td><strong>Infrastructure</strong></td>
<td>Standardization of products and processes is the key strategic driver</td>
<td>User emerging standards</td>
<td>Implement a widely used infrastructure to gain the greatest flexibility at lower cost</td>
</tr>
<tr>
<td><strong>Products &amp; Services</strong></td>
<td>Standardized technical solutions</td>
<td>Solutions that Dis-intermediate middlemen out of the supply chain</td>
<td>Portal solutions</td>
</tr>
<tr>
<td></td>
<td>Packaged systems</td>
<td></td>
<td>Analytical/reporting tools</td>
</tr>
</tbody>
</table>

BENEFITS

Building a competence in the enterprise value chain and in complex project management provides many benefits to the broader enterprise. It ensures that an emphasis is placed on people and that the skill and talent required for handling change and uncertainty across an organization exists. The knowledge that is shared between people within the project organization enables higher efficiency. It ensures that an emphasis is placed on process, which allows a project organization to be more efficient in managing the change and interaction that occurs across many teams of people. On large-scale IT projects, sound processes foster the development of trust across IT and business organizations. Such processes also ensure that emphasis is placed on project structure, enabling the alignment of business and IT functions, which are almost always highly complex and political. A structure that fosters communication frequency enables high efficiency and ease of project decision making. Building competence in all of these aspects allow IT project organizations to be fully productive, reduce IT costs, and complete projects on-time.

CONCLUSION

Managing large-scale IT projects requires far more than simply managing the development of technology. First, managing these projects requires an understanding of an enterprise’s overall value chain. To enable the most value within an enterprise, technology cannot stand alone – it must be supported by other business-related dimensions such as people, process, and structure. Secondly, it requires an understanding and recognition of complexity. Complexity can be interrelated and found in various forms of interaction and change. Lastly, managing these projects requires an understanding of reliable frameworks and execution of a sound strategy that aligns well with the overall enterprise.

Achievement of project goals cannot happen in an instant but it is well within reach. With proper preparation and strategy, it is possible to improve performance without sacrificing quality. If project managers can recognize and understand these concepts of complexity and this approach to managing large-scale IT projects, costs can be reduced and long-term productivity significantly increased.

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REFERENCES