Abstract

Radically innovative information technology projects are considered one of the most challenging and difficult types of software projects to oversee and manage. The unique nature of such projects relegates them into a unique class of projects that we characterize as “Black Swans.” Highly innovative/radical IT projects reflect a “black swan” situation, where knowledge from previous projects do not provide significant insight into how they can be managed. While such “Black Swans” are a unique sub-set within the area of project management, understanding the techniques employed in the development and management of such efforts should enlighten and improve traditional project-management processes employed for most software development efforts. This paper presents and discusses key results of an exploratory field-study that examines eight unique “black swan” projects.

1. Introduction

Information Technology (IT) projects are a high risk proposition which has been known since the early 80’s. The Standish Group study in 1994 reported a 70% project failure rate while a more recent Gartner study indicated a 40% project failure [1, 2]. Over the last three decades, a large number of studies have examined root causes for project failures. As a result, several frameworks have been constructed to raise project management awareness of the typical collection of risks associated with projects [3]. However, these studies have primarily focused on a set of typical, well known problems. Likewise, methodologies promoted and codified by PMI, CMM, and ISO 9001 do not recognize atypical problems and how to handle them. While atypical problems are overlooked due to their infrequent nature, research into such outlier projects offer three distinct advantages. First, by understanding projects that deviate from the norm, we can identify atypical techniques that may be applicable to typical projects. Second, there are known periods of disruptive innovation [4, 5] where successfully managing high-profile and high-risk projects is necessary for firm survival. Third, very large-scale IT failures, (i.e. Sobeys’s failed SAP, or FedEx’s B2B supply-chain integration) [1] continue to be reported. These projects are high-profile, high-risk, and contain risks that are not easily captured by standard risk methods which can potentially bankrupt a firm. Often these risks are borne out from the inherently evolving and unknown facets of technology [4] involved in project scope. A major challenge therefore for conducting these large projects is the need to manage unbounded and non-linear risks reflecting the high level of uncertainty and complexity that arise over the course of a large and innovative project [6]. They bring new challenges to managing software projects that arise from introducing and integrating innovative technologies into project solutions. These innovation risks are caused by the radical nature of the underlying innovation and related unprecedented technical complexity. Such unusual projects are the focus of this study and it is motivated by the fact that they cause constant methodological problems for project managers and very little is known regarding the management of such efforts [for exceptions seen Bergman et al 2004, Drummond 1996, Iscoe et al 1987]. We refer to these projects as “black swans” (coined by Taleb [7]) to recognize situations and events not captured by stringent Gaussian risk models. But, they still do exist and need to be taken into consideration.

The few studies to date that have discussed issues around black swan projects seem to concur that highly-innovative IT projects differ so much that the standard ways of managing projects and developing systems cannot succeed. Yet, one challenge with the earlier studies is that they focus on a specific aspect such as requirements [3], on one dimension of project dynamics like politics [8], or on risk-related project escalation [9]. In
response, new strategies need to be developed that better integrate the management of large projects with the nature of their technological innovation.

We therefore believe that a careful examination of unusual, large and innovative projects allows us to understand: 1) what the differences are between typical IT development efforts and radically innovative development efforts; and 2) how the processes utilized for managing a radical IT development effort have important implications for project management in general. Accordingly, in this study we seek to identify common challenges and response patterns associated with black swan development efforts based on a field study of large and innovative software projects.

2. The management of IT projects

2.1. The project management process

Though a number of project management techniques and methodologies have been applied towards the management of IT projects [10], the management of such projects encompasses the steps outlined in a basic structured process approach (Figure 1). Within this structured project management process, a project is typically initiated by some need or opportunity, planned and scoped from beginning to end, executed by the project team, with appropriate changes and modifications applied. This cycle of execution, change, and scope modification continues until the project reaches a final resolution of either completion or abandonment [11]. Whether a project manager utilizes waterfall, JAD, or some form of agile development methodology, the standard project-management-process steps serve as a basic framework within which these techniques operate [11].

There is an array of literature on different project management techniques, styles and methodologies [3, 10, and 11]. As new techniques evolve, a key focus of this evolution has been to improve upon different aspects of basic project management processes. These refinements include finding ways to better control scope, maintain quality, reduce costs, deliver projects on a timely basis, improve integration and communications, efficiently procure and manage resources, and control risks. These aspects or knowledge areas, as defined by the project management institute (PMI), are the key concerns for a project manager in running their designated projects [12].

2.2. Black swans: innovative, radical and complex projects

While professional organizations such as PMI maintain a codification of best practices regarding project management standards and techniques [12], they do not explicitly account for the existence of highly complex or innovative projects. The methods utilized in handling large and complex IT projects are therefore left to be managed with scaled-up versions of the same basic project management processes [8]. This approach appears to be highly ineffective for IT projects that delve into areas of radical innovation [9]. Prior work that has examined how managers can recognize and measure a project’s level of complexity [9, 10], argue for a need to modify the project management process to fit the unique nature of managing highly innovative information technology projects [10, 11, and 12]. This need to consider changes to the basic IT project management framework can be crucial for the success of highly innovative or radical IT projects.

IT projects considered to be highly innovative or “radical” in nature are defined to be “ground breaking and dissimilar enough from prior IT projects that existing methodologies simply do not adequately work” [13]. These black swans are considered to be unique situations that carry a potential for extreme impact [7]. There exists thus a sub-set of projects that can be identified as “Project Black Swans.” These projects are outliers that fall outside the realm of similarity to previous IT projects such that pre-existing experience provides little transferable guidance. Additionally, these projects carry a high potential for a major impact within their respective marketplaces [7].

2.3. Managing risks on IT projects

A major factor impacting the successful outcome of an IT project is risk. Project managers need to manage the risks that can arise over the course of a project’s life [3]. Studies that have examined the root causes for IT project failures [13, 14] have focused on potential risk factors that need to be mitigated for IT project success [13]. With the identification of these potential risk factors, other studies have attempted to construct a framework to help project managers identify these varying risks within their own IT projects [3].

IT projects can encounter risks arising from factors that are internal (i.e. time and personnel limitations) and external (i.e. new technologies) to a project [3]. By nature, the inherently continual
evolution of technology raises a unique and challenging facet of risk [15]. As technologies constantly evolve, understanding how to manage the application of them continues as well. As the innovation sets become more radical in nature, the application of the technologies become more ambiguous and risky [16]. The advent of these innovation risks can cause process and methodological problems for IT project managers. This can be especially true within the *black swan* subset of IT projects [7] where traditional project management is inadequate. This leads us to the following set of research conjectures:

**Research Conjecture A:** Black swan IT projects significantly impact the effectiveness of existing project management processes of an organization initiating such efforts.

**Research Conjecture B:** Management of black swan IT projects requires development and utilization of non-standard project management techniques and methodologies.

3. Multisite case study of innovative black swan projects

3.1. Research methodology

To examine and validate our research conjectures, a study modeled after a Delphi survey approach developed by Schmidt [17] was conducted. The method provides statistical measures of consensus within the panel, while allowing for comparisons to be made across multiple panels. The experiences and opinions of a panel of IT project management professionals were solicited through a series of iterative, controlled feedback interviews. A total of thirty-five project management professionals were recruited from twenty-nine firms to form an initial panel of experts. Each IT project management professional had multiple years of experience and expertise with managing several large, complex IT projects. Each expert had to have extensively and repeatedly used a set of standard project management methods for these IT projects. The first panel was conducted with 35 information technology project management professionals, representing 29 different firms. Within the first panel, twenty-nine separate sessions were held, with each session corresponding to a particular firm. Each participant only took part in one of the twenty-nine sessions. This helped control the potential for collaborative (“group think”) responses [17] and created a more rigorous approach to the data collection process. Overall, 35 professionals participated in the sessions and had an average of 11.5 years of project management experience.

Within these sessions, additional questioning was conducted to identify those who had managed at least one radically innovative and large project. Utilizing Peter’s definition of radical innovation as the basis for defining highly innovative IT projects [26], the IT project management experts in the first panel were asked during the initial panel phase to describe an IT project they felt was highly innovative in nature. Likewise, they were asked if they found their traditional project management methods were deemed significantly inadequate. Inadequacy was where a significant percentage of previously unknown methods needed to be invented and implemented. Each of the 35 experts was asked to rate the project they just described on a scale of 1 to 5 (*1=no innovation involved in the project, 2=some minor innovative issues, 3=project was equally balanced between innovative and known IT project issues, 4=project was predominantly innovative in nature with over half of the issues on the project being innovative or radical in nature, 5=project was completely innovative in nature, never attempted before*). Respondents who gave ratings of 4 or 5 were asked to participate as experts in a second panel phase.

A second panel of experts was constituted from members of the first panel who had indicated experience in managing a highly innovative project. A total of nine participants were selected (see Table 1), and nine separate sessions were held to discuss project management issues. Eight of the nine selected participants completed the panel sessions. The second panel, of IT project management experts, was asked to discuss their experiences on the highly innovative or radical IT projects they had identified during the initial panel-phase. They were led via a series of questions to describe, explain, and contrast their experiences managing a standard IT project (projects that would rate a 1 or 2 on the aforementioned scale) with the highly innovative/radial projects they had described in the initial panel. Detailed project descriptions regarding the management of forty-nine different IT projects were gathered from the two panels.
3.2. Research findings

The first panel sessions lasted from 45 to 70 minutes in length while the second panel sessions lasted from 120 to 180 minutes in length. Over 800 pages of transcript data was generated from these interviews, which were conducted between April and July of 2008.

Our findings from the panels indicated that a majority of the IT projects described were managed in a “structured IT project management process” approach. Noticeable differences to this approach were found in the approaches taken by project managers who discussed managing IT projects that were rated as highly innovative/radical.

3.2.1. A structured IT project management approach. At its highest, most abstract level, the approach for managing the 40 non-radical IT projects can be described with the simple model shown in Figure 1 which lays out a typical project management life cycle [11]. Each project manager accomplished this cycle using their own extensive collection of standardized methods and tools. The nine projects identified as radical were recognized early on to be profoundly unlike anything the project manager(s) or organization(s) had worked on in the past and required a departure from the norm.

3.2.2. Managing highly complex IT projects. The nine “highly-innovative or radical” information technology projects are listed in Table 2. The nine projects identified carried a high potential for a major impact on their respective marketplaces. These IT projects were “radical” and “frame breaking” [7, 18] and were associated with massive learning barriers to be overcome [18] and were dissimilar enough from prior projects that existing methods simply did not work (similar in nature to Taleb’s definition of black swan occurrences).

Due to scheduling issues, one of the nine identified project managers was not able to complete their second panel session, bringing the total participants in the second panel to eight. Interestingly, none of the project managers in the second panel had managed more than a single black swan project during their career.

The eight black swan projects from the second panel session occurred across a wide span of time ranging from the late 1980’s to the late 1990’s, and included: the development of an online textbook delivery system; the development of a video-on-demand delivery system; and the development of credit card processing systems at individual gas pumps.

The project managers associated with these projects realized early on their existing methodologies would not work. As one project manager stated:

“We knew we couldn’t do what was typically done...so we spent a lot of up-front time to understand everything, or as much of everything, we could.”-F1

While another project manager voiced:

...thinking-outside of the box was needed. We couldn’t take things on head-on, given the large number of technical issues presented by the project.-F3

As noted, the eight projects occurred in eight entirely different firms with eight different IT project managers. Detailed analysis of these eight projects indicates that none of the key characteristics such as specifications, technologies, or solutions shared anything in common except for their level of radicalness. Interestingly, however, the methodological solutions arrived at independently by these eight different project managers overlapped considerably. In each case, the new methodologies included two shared methods not seen in the standard IT project process: (1) a dedicated pre-planning phase for identifying radical innovation points in the project; and (2) an exploration approach for finding potential solutions for each of the identified radical innovation points. While the details differed, at a high-level of abstraction we observed convergent evolution where 8 unassociated project managers in 8 separate firms who had never worked together identified essentially the same set of new meta-methods to manage black swan projects.

3.2.3. A pre-planning phase. Each of the eight complex project management methodologies developed included a dedicated period of up-front time set aside specifically to identify potential problem-points in the project. As one project manager described:

1 Quotes are taken directly from interview data. They are referenced to Table 1, with the designations indicating which firm and project manager is being referenced (i.e., F1 indicates the project manager interviewed from firm 1).
We identified a number of challenges that we had no blueprints for tackling...no one had seen these problems before...we were treading new ground.-F5

The highly innovative projects studied were selected because the project managers recognized each contained many radical deviations from traditional projects. It was apparent to the project managers from the second panel that there was a need to examine and discuss potential issues prior to laying out a project plan.

You need to at least have some idea as to how to approach this type of project, so good upfront work is crucial. Especially when it comes to timing and planning out such a project.-F8

By using a pre-planning phase, all eight project managers in the second panel felt it saved them considerable amounts of time during the execution of their projects. One project manager illustrated the importance of identifying and planning for problem points by describing a key unanticipated project issue that had to be dealt with during execution.

A major issue occurred during the execution of my project. It was something that we or I did not foresee and it held us up for almost 3 months. Once I saw this and knew a similar issue would come again at other points in the project, I was able to plan for them and overcome these issues rather quickly. Granted we had some prior experience now but I'm sure if we had anticipated and planned ahead I could have done things faster...probably 5 times faster.-F4

The second panel project managers felt that a significant number of problem points were identified the pre-planning sessions. The time devoted to this exercise could be fairly lengthy. The average time spent on the eight projects was 3.1 months, with ranges from 3 to 15 weeks in length.

We spent a lot of time to just brainstorm out potential problems. In our case it was about 3 months of looking at what issues and technical problems would...or could be encountered.-F1

Overall, this approach allowed the project manager, prior to starting the project, a chance to identify and segment the problem points into manageable sub-projects where appropriate solutions could be explored.

Even though it sounds like a lot of time, when I look back now, it helped us plan for and anticipate a number of these problems. We could then breakdown a project based on the identified issues and have different groups start working on them...sometimes in tandem.-F3

3.2.4. Exploring innovation points. The identification of the innovation points established key problem areas within projects that required novel solutions. The eight project managers treated their innovation points as unique sub-projects within the greater project.

With the technical issues we had never dealt with before, we chunked things down into more manageable pieces. I looked upon them as unique problems that we had to find solutions for.-F7

The only thing that made sense was to go after the problem one piece at a time. It just made things more manageable...not so daunting a task.-F6

All of the black swan projects approached their innovation-point sub-projects by isolating them and assigning dedicated project personnel to explore for potential solutions. While an IT project is typically planned and executed in sequence, the black swan projects began execution of their innovation-point sub-projects as soon as possible (or as resources permitted). The primary reason given for this was the uncertainty surrounding the time needed to resolve a particular innovation point.

Since we couldn’t accurately come up with time estimates with the more difficult portions of the project, such as figuring out how to increase download speeds for people with dial-up modems, we needed to start tackling this problem from the get go... -F5

This second differentiating point from the standard IT project process, focused on a need to explore multiple solutions for radical innovation point problems. Each radical innovation point
required a diversified problem solving approach of exploring and evaluating multiple potential solutions. A continuous cycle of execution and exploration ruled out potential dead-ends until a viable solution could be utilized.

An interesting part of this process was the approach taken in attempting to find viable solutions for the innovation-points. Instead of a typical problem solving approach, where one has a problem and attempts to solve this problem, two of the project managers described approaches that looked for similar problems or a similar series of problems as a way to find solutions that could be modified to work for their problem(s) in question.

The strategy a number of my sub-team managers utilized was finding similar problems to the problem they were assigned. In some cases they were able to modify solutions from these similar technical issues and apply them to their sub-project. – F3

We tried to keep it simple, since we really didn’t have time to re-invent the wheel. Looking for potential-solutions from similar problems that could be modified for what we were doing was the approach we took whenever possible. – F2

While segmentation in general appears consistent with traditional IT planning (as would be seen in a work-breakdown-schedule [3, 11]), there are three important differences. First, traditional planning does not identify sub-components of a project based on degree of innovation.

We used this time to hash out the problems we knew would appear during the project. I’m talking about issues we hadn’t dealt with before, but that we could anticipate given the unique nature of this project. – F8

Second, traditional methods do not set aside significant time for exploration of multiple solutions to fulfill the requirements for completing sub-components.

Even though we spent what might seem a lot of upfront prep time, in our case five weeks, we needed it to start looking at the true scope of this project. – F7

Finally, traditional projects allow for development of a work-breakdown-schedule at the beginning of a project. This can be accomplished because the sub-components of a project have more recognizable requirements and resource planning can be estimated for each at the beginning of the project. This was simply not the case for the eight black swan projects.

With the black swan projects, a fixed road-map for the entire project could not be planned out due to the numerous radical innovation points that would be encountered. As described by one subject: since a large portion of these radical projects dealt with new or unexplored technologies, the exploration of multiple-paths was needed in order to arrive at a potential solution.

We were constantly looking at different solutions all the time. We weren’t sure what would work so multiple teams always worked towards a solution on a specific issue. – F6

This exploration process went hand-in-hand with the execution of the project. As less promising paths were eliminated and more promising solutions were pursued, the other parts of the project (both related and unrelated) would be re-scoped and re-planned as necessary, which led to a constantly evolving scope-execution-exploration-change cycle.

We needed to communicate constantly and make sure everyone was on the same page. Once a potential solution [was] decided upon, it could impact others on the project...so we made sure everyone was in the loop. And, this was a constant process that never ended, well not until the project was done. – F7

The frequent changes encountered on the black swans required a project manager who could adapt quickly and adjust the project plan appropriately. Once a solution was adopted, the project manager needed to ascertain the impact this adoption would have on other parts (innovation-points) of the project. They had to understand the linkages among the various parts of a radical project in order to be flexible and nimble enough to make the appropriate adjustments to any part of the project.
...as one approach was adopted over others, I had to know how to adjust other related areas in the project, ... sometimes that meant dropping certain approaches and starting down a new set of paths.-F6

At times, the need to adjust could also mean changing an adopted innovation-point solution.

If we chose path C to solve one problem, but it caused problems with some other parts of the project down the line, we may have to go back and say...let’s use path B, even though path C might be the optimal solution on a stand-alone basis, path B was the optimal project solution since it would allow us to move other parts [innovation-points] of the project along.-F6

Whatever the situation, adjusting and adapting to changes appropriately was paramount for the continual progression and advancement of black swan projects. In a particular black swan project, the innovation-points were labeled as discovery pages and were usually examined and ranked for their viability in achieving the desired technical outcome before attempting to integrate them to the core IT project.

...we [created] discovery pages which were rapid durations through technical issues. We tested as much as possible, for potential problems in the project, before integrating them into the actual project.-F8

An iterative cycle of exploration via these mini-technical projects and integration with the core project was utilized until the main project was completed or terminated. As another project manager stated:

A radical or high innovation project is basically a series of discoveries that are required to complete the whole.-F1

Due to the multiple-exploratory paths that these projects required, the ability and willingness to explore along with the ability for rapid adaptability were essential for success.

4. Discussion, follow-up and contributions

4.1. Main findings

While most IT projects by definition are not black swans, we were able to find the development of new project management techniques within these atypical projects. These techniques (careful and elongated up-front planning, exploration of identified innovation-points, and proper integration of innovation point sub-projects), though developed out of necessity, helped facilitate the unique management challenges encountered on these highly-innovative projects.

The highly innovative black swan projects all took an elongated period of time to begin initial preparation and scoping of the overall project. The average of 3.1 months of prep time highlights the importance of the preplanning stage. While some project managers interviewed initially felt this time taken was particularly lengthy and unconventional, by the execution stage of the projects they all felt the time spent upfront had saved them from potentially lengthy setbacks. In particular, the identification of innovation-points (problem areas within the project that were radically different from prior experiences) was a key output of this preplanning stage.

Once the innovation points were identified, the project managers had to devise a method to approach and tackle these unique problems. Multiple potential solutions to the innovation-points were needed. This led to a need to test out the solutions and determine their ramifications on all aspects of the project (including other innovation-points within the project). Once a solution or path was chosen from a series of multiple possibilities, project managers had to understand the ramifications of this decision. Since the choice of a particular solution at an innovation point could limit or even point toward other possibilities in the project, project managers had to be cognizant of this fact and appropriately adjust the execution of other innovation points in a project. As a result, a systemic view had to be taken by the project managers on black swan projects and roadmaps for any and all types of innovation points needed to be fluid and prepared with change in mind. To do otherwise risked implementing solutions that needed to be modified or replaced entirely to the detriment of the overall project. Project managers discussed the need to utilize the appropriate project-level solution as opposed to the most efficient solution for a particular innovation point. While a particular solution might be the most efficient for a particular innovation-point, it did not necessarily work for the project as a whole (possibly disrupting or not
integrating appropriately other phases of the project).

Variations of these techniques we employed by all eight black swan projects we studied. It is interesting to note that these techniques were developed in isolation of each other within separate firms.

4.2. Follow-up to main findings

Up till this point, discussion of managing black swan projects has focused entirely on radical innovation points. By no means were black swan projects comprised exclusively of radical innovation points. Several components in each of the black swan projects were incrementally innovative or non-innovative in nature. For these sub-components, traditional project management techniques could apply and were utilized within all eight “black swan” efforts.

Accordingly, the project managers interviewed described a dual-level process for the planning and execution of a black swan project. Where possible, the project managers retained the standard IT project process [refer to Figure 1] for any incremental innovation points identified. This integrated management style seemed to be adaptable to other IT projects that held some degree of innovation. We did an initial follow-up on this conjecture to see the viability of such an idea.

Follow up interviews with twenty-five of the original project managers from the first panel were conducted. Seventeen of these project managers had indicated no prior experience in managing a black swan type project. Their responses strongly suggested they could see the utility of implementing some of the techniques developed on the black swan efforts on large and complex IT projects. In particular, the idea of identifying potential innovation-points was deemed a viable addition to the current project management processes. All twenty-one project managers recalled managing at least one complex IT project that held multiple highly-innovative points within the makeup of their respective projects. These innovation points had not been identified in advance and ended up being the project bottlenecks on several of these projects, causing significant trouble with quality, cost, and time.

During these follow-up interviews, three of the eight project managers from the second panel recalled developing an early prototyping method for their black swan projects. These prototypes were built for certain innovation points, in particular the points deemed to contain high degrees of complexity and ambiguity. While all three had not worked with a prototyping methodology in their prior experiences, they all felt creating a ‘prototype’ or ‘mockup’ would help with integration of the innovation-point back into the main project. All three indicated that these prototypes were helpful but insufficient for addressing the problems caused by the black swans. It was the development and utilization of the techniques described in the research findings that allowed them to effectively deal with their respective innovation points.

These follow-up interviews appear to give some grounded validity to the use of the black swan management techniques uncovered in this study. Each project manager could see the merit of having a preliminary period of innovation point identification process, especially on large IT efforts. Likewise, seventeen of the project managers saw the value in isolating an innovation point for development and eventual integration into the main project.

The preplanning stage of 3.2 months that we saw in the eight black swan projects would surely be excessive in more traditional projects with fewer radical innovation points. However, our sampled project managers unanimously agreed that some period of classifying radical innovation points would be valuable. Where an innovation point was deemed to be incrementally innovative, a standard IT project process seemed appropriate to the project managers, while innovation points deemed to be radical were seen as areas in a project that required a black swan approach where appropriate resources and planning needed to be applied.

4.3. Contributions

Our examination of projects that focused on the development of new IT product lines or new IT technologies could not be adequately managed by a traditional IT PMI methodology. These findings provide contributions to both practice and research. For practitioners and researchers alike, future models and methods need to be expanded to take deviations from standard methods into consideration. First, because so many projects are known to fail, both need to look outside of what is standard practice or conventional wisdom to identify how we can lower IT implementation failures to a more acceptable level. Second, even in a small sample of 35 project managers, a full 9 (26%) had experienced a black swan project and needed to abandon their traditional ways of work.
So it is not so much that these projects are a rarity to project managers over the course of their careers as they are a rarity to IT projects. As a result, it seems they were occurring among 1/4th of the sampled project managers but none were aware they were having a common experience or coming up with a common set of solutions. This research project eliminates that lack of shared knowledge and begins an important new area for investigation for researchers and practitioners.

The rarity of black swan IT projects does not necessarily mean the techniques employed to manage such highly-innovative efforts need be confined to these unique cases. Instead, the application of black swan techniques seems applicable to a range of large and complex IT projects. We believe that project managers need to begin to see the subset of black swans within all their IT projects. Based on feedback from our project managers, all projects of medium to large scope potentially contain radically innovative sub-project points. By applying the black swan techniques surfaced in this study, these innovation points can be spotted early and these potential bottlenecks will no longer be unpleasant surprises that cause unnecessary delay or require heroics to overcome.

Current project management practices, notably from the best practices espoused by the governing body that oversees the certification of project management professions, PMI (the Project Management Institute), do not address or account for the existence of black swan projects or the existence of black swans within projects. Based on the results of this study, we believe the adoption of black swan project techniques can be effectively integrated. In particular, project managers should be: (1) setting aside a period of time up front to identify where ambiguous choke points (innovation-points) are; and (2) preparing appropriate slack at the choke-points to either increase resources or modify subsequent steps to take into account the new realities of what time, cost, and resources are available. The PMI certified project managers interviewed for this study have confirmed that such practices do not currently exist in a codified form within PMI. The potential adoption of such practices is novel and adds value to both practice and future research. Further explorations can help determine its viability as a process for not only IT project management but it’s feasibility as a practical approach towards managing large-scale, complex projects of all types.

References


Figures & Tables

Figure 1. Standard IT project management process (Derived from the PMI project process model)

![Diagram of IT project management process]

Table 1. Demographics of sites & subjects with innovative IT project experience

<table>
<thead>
<tr>
<th>Firm</th>
<th>Industry</th>
<th>Subject Titles</th>
<th># Years PM Experience</th>
<th>Project Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1</td>
<td>Software</td>
<td>Program Manager</td>
<td>10+</td>
<td>4</td>
</tr>
<tr>
<td>F2</td>
<td>Oil &amp; Gas</td>
<td>Project Manager</td>
<td>17+</td>
<td>4</td>
</tr>
<tr>
<td>F3</td>
<td>Diversified Computer Systems</td>
<td>Program Manager</td>
<td>15+</td>
<td>4</td>
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<tr>
<td>F4</td>
<td>Financial Services</td>
<td>Program Manager</td>
<td>15+</td>
<td>5</td>
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<tr>
<td>F5</td>
<td>Semi-conductor</td>
<td>Program Manager</td>
<td>25+</td>
<td>4</td>
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<td>F6</td>
<td>Consulting</td>
<td>Project Manager</td>
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<td>Communications</td>
<td>Project Manager</td>
<td>15+</td>
<td>5</td>
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<td>Publishing</td>
<td>Project Manager</td>
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<td>5</td>
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<tr>
<td>F9</td>
<td>Internet, Web-Based</td>
<td>Project Manager</td>
<td>10+</td>
<td>4</td>
</tr>
</tbody>
</table>

Table 2. Description of radical / innovative projects

<table>
<thead>
<tr>
<th>Subject</th>
<th>IT Project Innovation Descriptions</th>
<th>Innovation Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1</td>
<td>Develop on-site gas-pump credit card transaction processing IT infrastructure during mid-90's.</td>
<td>4</td>
</tr>
<tr>
<td>F2</td>
<td>Design and implementation of an Intranet interface for all areas of the company during the early 90's</td>
<td>4</td>
</tr>
<tr>
<td>F3</td>
<td>Developed an advanced imaging system for paperless electronic processing of checks in early 90's</td>
<td>5</td>
</tr>
<tr>
<td>F4</td>
<td>&quot;Dobson Project&quot;: dealing with increasing processing speeds and memory swapping capabilities</td>
<td>4</td>
</tr>
<tr>
<td>F5</td>
<td>Developing an integrated paperless check-processing system in late 90's.</td>
<td>4</td>
</tr>
<tr>
<td>F6</td>
<td>Advanced leading edge enterprise level applications (i.e. CORBA) for Banks in early to mid 90's</td>
<td>5</td>
</tr>
<tr>
<td>F7</td>
<td>Develop a multi-media Internet based on demand system for films and videos in mid-90's</td>
<td>5</td>
</tr>
<tr>
<td>F8</td>
<td>Developing an Internet-based Textbook delivery system in mid-80's</td>
<td>5</td>
</tr>
<tr>
<td>F9</td>
<td>Web-based search engine development in mid 90's</td>
<td>4</td>
</tr>
</tbody>
</table>

*Subject assessment of project. Scaled from 1 (no innovation involved) to 5 (completely innovative on all fronts)