Do or Die:
How Exceptional IT Professionals Innovate

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Abstract

The shift to a more innovation-driven economy is clear, and one of the single largest differentiators for our economy today is the link between technology applications and business opportunity. Paradoxically, a group within many organizations, who has substantial expertise in technology applications of all types but has not been an active part of the innovation discussion, is the Information Technology (IT) professional. This research study looks at the relationship among IT knowledge worker innovative traits, such as risk taking, IT transformational leadership, IT innovative culture, including methods and values embracing experimentation and openness, and IT performance. Based on survey research with 105 IT professionals across several industries, we find that IT innovative culture mediates the relationships between both IT professional innovative traits and performance, and IT transformational leadership and performance. Implications for both the IT researcher and practitioner are also discussed.

Introduction

The shift to a more innovation-driven economy is clear, and one of the single largest differentiators for our economy today is the link between technology applications and business opportunity. Global organizations as diverse as Apple, Nike, GE, MasterCard, and the American Cancer Society remind us that technology is radically transforming the business and operating models of the future. The turbulence, complexity and competitive nature of most organizational environments have made technological-enabled innovations a core capability for increased profitability and growth (von UrffKaufeld&Freem, 2009).

Paradoxically, a group within many organizations, who has substantial expertise in technology applications of all types but has not been an active part of the innovation discussion, is the Information Technology (IT) professional. There are several reasons for this. Recently, many IT capabilities have been outsourced and offshored to reduce costs, improve flexibility, and focus on core projects. Also, traditionally, many organizations have viewed the IT function as providing the communications and data processing infrastructure capability for business (i.e., “keeping the lights on”), and the biggest IT focus has been on maintaining, training, and supporting users on existing legacy systems, rather than building new and innovative systems and business solutions. Finally, the perception of the IT group among employee end-users has been that it is a slow-moving, bureaucratic organization that is more concerned about maintaining data security and control than it is about experimenting with the latest technology solutions.

More recent trends, however, is forcing executives to re-think the IT function. The emergence of Big Data and business analytics to improve decision-making requires the ability to acquire, analyze, and apply data in its many different forms, including transactional, social, and mobile data. IT professionals appear to be the ideal candidate to act as the partner among the decision-makers across the business functions and the technology systems and data that reside everywhere.

As a result, executives are looking to their current IT leadership and professionals to play a different role in the organization, from back-end service provider to the role of an active problem solver and innovator (Roberts & Watson, 2014). The demands of IT have shifted from the "fix-it" mode to innovation, and with this comes the need for IT leaders to be agile and innovative solution providers as opposed to back-end customer service personnel (Brandel, 2013). Nash's work (2012) reminds us that the CIO and IT leaders of the future "will be an entrepreneur who can inspire a global staff and persuade IT suppliers to collaborate." Nash goes on further to say that "The CIO will be an in-house futurist, measured by the same financial metrics as any other C-level executive, plus one better: innovation." If this turns out to be true, previous researcher and practitioner views suggest that there is a serious disconnect between what the IT leader/professional's capabilities and processes are now as opposed to what they will need to be in the future (Lundquist 2012).

This proposed study will be one of the first empirical studies to better understand the skills and work processes today's IT leaders need when the focus is on innovation. Although many organizations are demanding these new capabilities, IT researchers have not examined what it takes to be an innovator in the IT role. *Therefore, the purpose of this study is to take a deeper dive into the personal traits and leadership styles of IT workers, as well as the IT team-based culture (behaviors, values and work processes), which predict IT innovation and performance.*

Discussion and Hypotheses

We define IT innovation as the use of new technologies, people, and processes in creative ways to create positive business impact.While the link between innovation and performance has been studied extensively (e.g., Geroski, 1994), much of this research has been conducted in R&D settings within the established company or entrepreneurial activities of the startup organization. We propose to investigate constructs that have been used to study innovation in these other settings to the IT context. In particular, we will focus on IT professional innovative traits, IT transformational leadership, and IT culture.

IT professional innovative traits

Most of the previous IT research on performance has focused on specific technical skills, and not the personality characteristics and traits of IT workers.Technical skills are important in the traditional context of IT professionals as implementers, but are not sufficient when describing them as innovators. From both the entrepreneurship and leadership literature, personality characteristics often linked to innovators include: the ability to take moderate risk, high need for achievement, personal responsibility for decisions, dislike of routine work, as well as resilience in the face of setbacks (Kets de Vries, 1977; McClelland, 1967). Schmidt and Rosenberg (2014) use the term "smart creatives" to describe today's digital-age knowledge workers. These creatives are often risk-takers who are easily bored and change jobs frequently. They are also

intellectually flexible, “combining technical depth with business savvy and creative flair”. The ability to take calculated risks, take ownership of ideas, and be receptive to new solutions has become increasingly important to IT professionals as employee expectations have been raised from the level of technology service they personally are receiving outside of the workspace. Employees are expecting easy to use mobile and social applications to help them with their job tasks and decision-making.

Other critical traits associated with open innovation are the ability to discover ideas outside the R&D and organizational boundaries and find opportunities to leverage these ideas inside the organization. Whelan et al. (2011) used the terms “idea scouts” to define individuals who bring in useful ideas from scanning the external environment. These workers tend to have strong analytical skills and high IT literacy. “Idea connectors” have a strong social network inside the organization and can identify the appropriate stakeholders who could validate and benefit from these ideas. These connectors tend to have long company tenure, which allows them to target business opportunities. The idea scout and connector rolesare critical to IT professionals today (Rohrbeck, 2010). With technology changing rapidly, IT professionals have to constantly keep up-to-date with the latest trends. At the same time, understanding the needs of different business groups to leverage innovative technology applications, and then having the fortitude to see these solutions through to implementation are just as critical.

IT transformational leadership

Among the many factors that influence employees’ innovative thinking and performance, leadership is still identified by researchers as being one of the most significant (Amabile, 1998; Dvir et al., 2002; Jung et al., 2003). The type of leader being examined in this research is based on a set of transformational behaviors that have been studied for the past two decades. Often times referred to as “transformational”, “charismatic” and “visionary” leadership, researchers agree that transformational leaders exhibit charismatic behaviors, inspire and motivate their team, and provide intellectual guidance and stimulation. Transformational leaders emphasize longer-term and vision-driven motivation (Bass &Avolio, 1997).In one of the first empirical studies to examine the capabilities that are most closely linked to the enablement of innovation, Howell and Higgins (1990), in their study of champions of technological innovation, found that the leaders of these projects used transformational leadership behaviors, exhibited higher risk-taking, initiated more influence attempts, and used a greater number of influence tactics than the non-champions.

In an IT context, little has been studied about the notion of the transformational leader. This concept is particularly salient in today’s environment because the work of the software developer/engineer has changed so drastically. With software-as-a-service (SaaS) becoming increasingly popular, instead of creating code, many ITleadersare motivating their team to create innovative solutions with technology that already exists but needs to be modified, recombined, or integrated in particular ways that add value to the end-users. Internal motivation and inspiration are often times the only motivators that keep IT professionals from leaving the organization because their work hours are so long and their jobs so complex.

The use of influence by technical leaders to promote their ideas has been well documented in case studies of innovation (Mumford, 2000; Schon, 1963).Influence is particularly relevant in an IT context since IT leaders often do not have direct control over IT resource allocation or IT project outcomes, but must work through their business partners, often within a matrix structure, to make things happen. This becomes particularly relevant with regards

to experimenting with new technologies, where the outcomes and metrics of success are much less certain.

IT team innovativeculture

While IT individual traits and leadership styles certainly can have an impact on innovation and performance, often it is the IT team-based culture, including the team's values, methods, and work routines, which have a direct impact on IT performance. Innovation processes, often times referred to as design thinking, reflects the complex processes of inquiry and learning that designers perform in a systems context, making decisions as they proceed, focusing on human-centered design aspects, and often working collaboratively on teams in a social process. Design thinking includes identifying the problem or opportunity, idea generation, experimentation and piloting, as well as sharing and implementation (Kaspar for the W.K. Kellogg Foundation, 2008).

In the IT context, defining the problem or opportunity is akin to identifying the user requirements. The classic systems development life cycle (SDLC) is a waterfall methodology that IT professionals have followed for years. Although the method includes feedback loops back to the user, it has been heavily criticized for an inflexible approach to design and development. It is not a good example of human-centered design because the user is often not a continuous part of the process. The user defines the initial requirements and then often goes away for months before seeing a mock-up of the system.

Newer IT development methods stress spending time with the user through observation and conversation throughout the development and delivery process. The newer methods are becoming increasingly popular because the IT professional may be able to see things and deliver value to end-users as part of a team that is looking for a new and innovative solution. In particular, the following are specific methods and values embraced by IT teams focusing on creativity.

a). Agile software development. Agile approaches are based on an iterative and incremental development process. Continuous user or stakeholder involvement is a critical piece of the process. Theoretically, by creating and deploying software on an incremental basis with increased user involvement, agile development processes deliver increased business value and adaptability much earlier in the life cycle of the project, reducing project risk and increasing innovative solutions (Dingsyr et al., 2010).

b). Prototyping. Prototyping and piloting solutions enable individuals to reduce complexity and make sense of their surroundings (Harkema, 2003). In the IT context, prototyping solutions are a way to engage the user for feedback regarding user interfaces and functionality to decrease the risk of delivering a solution that does not meet the needs of the user. Utilizing a computer simulation, the designer provides a more realistic mock-up of the system under development. End-users can interact with the system to see problems or suggest new alternatives.

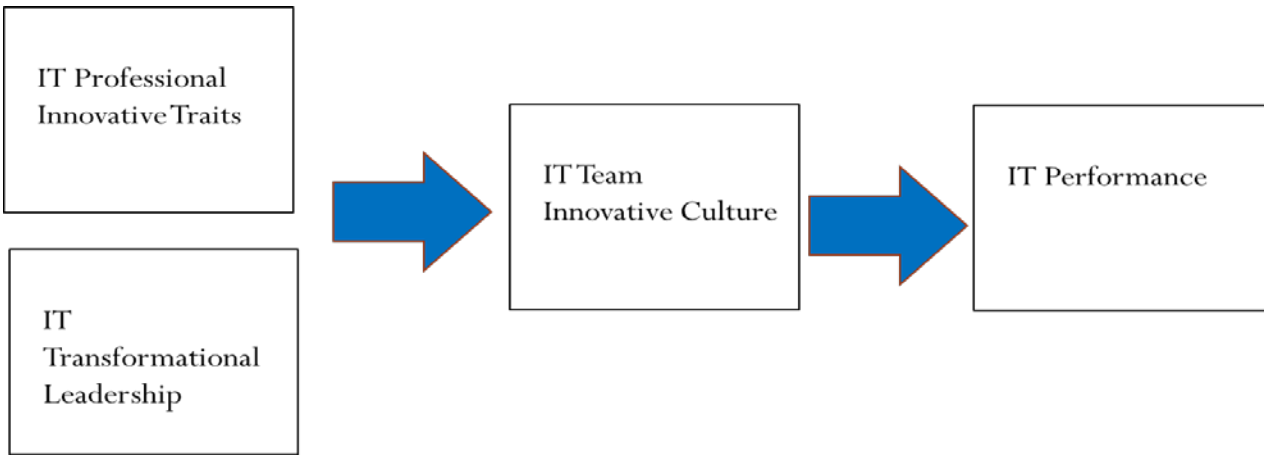
c). Experimentation. Experimentation is critical in the innovation process. Making mistakes and learning from these mistakes through iterative approaches enables innovation (Kelley, 2001). Learning how to fail in IT systems development is an important skill. What IT professionals have not done successfully is to learn from their mistakes to optimize their next project (Lyytinen& Robey, 1999).

IT performance has been measured in several ways, including impacts of IT on the business, impacts of IT on user satisfaction and productivity, and IT project productivity (e.g.,

Gray et al., 2011; Guinan, 1988).We argue that IT professional innovative traits, IT transformational leadership, and IT team innovativeculture will have a positive effect on IT performance. In particular, we argue that IT team innovativeculture will have a positive *direct impact* to IT performance, since this construct involves the innovative methods, work processes, and values to design and deliver IT solutions with end-user involvement. The effect of individual cognitive traits on performance, especially company performance, is typically mediated by work processes, behaviors, and capabilities (Epstein & O'Brien, 1985). Therefore, we hypothesize that there will be a positive *indirect effect* of both IT professional innovative traits and IT transformational leadership on IT performance, mediated by IT team innovative culture. To summarize, our hypotheses are below and our conceptual model to be tested is shown in Figure 1.

> *Hypothesis 1: IT professional innovative traits have a positive indirect effect on IT performance via IT team innovative culture.*
>
> *Hypothesis 2: IT transformational leadership has a positive indirect effect on IT performance via IT team innovative culture.*

Figure 1: IT innovation conceptual framework



Research Methodology

Research setting and data collection

A web-based, cross-sectional quantitative survey was developed and distributed to IT professionals through an electronic link. The survey link was posted on popular IS practitioner forums and communities (e.g., Society for Information Management (SIM)). Survey directions pointed out the purpose of the research as well as the anonymity of the survey responses. A total of 105 completed surveys were received from IT professionals. The average survey completion time was roughly 20 minutes. Respondents came from several industries.

Variable measures

As much as possible, previously published scales/items were used to measure variables in our model. However, due to the exploratory nature of this study, in several cases, items had to be either created or modified to properly describe the construct in an IT context. Reliability testing

was done using Cronbach's alpha, while factor analysis was conducted using principle components extraction (Eigenvalues > 1) with varimax rotation.

IT Professional Innovative Traits. This variable consists of items describing all three of the following dimensions. An average across all three dimensions was used in the analysis.
1). Domain Expertise. This was measured by asking a question on IT career experience. The average IT job experience of respondents in our sample is 22.7 years. This item was transformed into a 1 to 7 scale to be consistent with the other item scales.
2). Innovative Traits. The following question was asked, "Please answer the following questions about your personal expertise areas, passions, and work styles with regards to your IT work.". A 1 (strongly disagree) to 7 (strongly agree) Likert scale was used. Factor analysis yielded a 7-item scale tapping into embracing risk, uncertainty, and self-direction. The Cronbach alpha score is .95.
3). Scout. Factor analysis yielded a 3-item scale describing idea scouting behaviors. The Cronbach alpha score is .87.

IT Transformational Leadership. The following question was asked, "Please answer the following questions with respect to senior IT leadership that oversees multiple IT projects in your area.". A 1 (strongly disagree) to 7 (strongly agree) Likert scale was used. Factor analysis yielded a single 11-item scale describing critical aspects of transformational leadership. The Cronbach alpha score is .97. Items were modified from Bass and Avolio (1995) and Pearce and Sims (2002). The average across the 11-item scale was used in the analysis.

IT Team Innovative Culture. The following question was asked, "Please answer the following questions with respect to the most recent IT project team in which you have been an active member and on which you have spent a significant portion of your time.". A 1 (strongly disagree) to 7 (strongly agree) Likert scale was used. Factor analysis yielded two distinct variables: a 5-item scale describing an open culture (Cronbach alpha score is .94) and a 6-item scale describing experimentation (Cronbach alpha score is .91). Items were modified from Anderson and West (1998). Item averages were used for both the openness and experimentation culture variables.

IT Performance. The following question was asked, "Please answer the following questions regarding the impact of taking on more innovative projects on your IT area." The 5-item scale indicates important measures of performance including recent (past 12 to 18 months) IT impact to the business and end-users. A 1 (strongly disagree) to 7 (strongly agree) Likert scale was used. The Cronbach alpha score is .95. The average across the 5-item performance scale was used in the analysis.

Control Variables. We also controlled for both company size and IT group size. Respondents selected among employee range options. The mean score for company size is in the 1,001 to 5,000 employee range. The mean score for IT size is in the 101-500 employee range.

Results

Correlations and descriptive statistics for each variable in the model are provided in Table 1. In terms of the control variables, there is slight negative correlation between company size and IT performance. This may reveal how challenging it is to design and implement more innovative solutions in larger, bureaucratic organizations. It may also indicate it is harder to

“see” the business impacts of an innovative IT culture in a larger company, since there may be more factors that also come into play in terms of project performance. Splitting the sample into two groups (small and large company size) did not impact the mediation results in either group.

Table 1: Descriptive statistics and correlations

Variables	**Mean**	**S.D.**	**1**	**2**	**3**	**4**	**5**	**6**
1. Company size	4.2	1.5						
2. IT size	3.9	1.9	.11					
3. IT Professional Innovative Traits	5.1	1.0	-.12	.11				
4. IT Transformational Leadership	4.8	1.8	-.15	-.03	.24*			
5. IT Team Innovative Culture (Openness)	5.2	1.2	-.03	-.06	.42***	.67***		
6. IT Team Innovative Culture (Experimentation)	4.2	1.4	-.04	.05	.26**	.63***	.52***	
7. IT Performance	5.1	1.4	-.18†	-.10	.22*	.51***	.63***	.70***

Notes: n = 105. † p< .1. * p< .05. ** p< .01. *** p< .001

We tested our hypotheses using mediation analysis (Baron and Kenny, 1986). Table 2 provides the Sobel test results for mediation. Hypothesis 1 (a and b) and Hypothesis 2 (a and b) indicate full mediation and therefore both hypotheses are supported. IT professional traits and IT transformation leadershiphave a significant positive *indirect effect* on IT performance through the mediator IT team innovative culture (both openness and experimentation).

Table 2: Sobel Test for Mediation

Predictor	**Mediator**	**Indirect Effect (Mediation)**	**Z-score**	**p-value**	**Hypothesis**
IT Professional Innovator Traits	Openness	.3704	3.968	.0001	Hypothesis 1(a) Supported
IT Professional Innovator Traits	Experimentation	.2405	2.568	.0102	Hypothesis 1(b) Supported
IT Transformational Leadership	Openness	.2658	4.404	.0000	Hypothesis 2(a) Supported
IT Transformational Leadership	Experimentation	.3014	5.307	.0000	Hypothesis 2(b) Supported

Implications

The results of this empirical study provide initial support for a strong positive relationship among innovative IT professionals'traits and leadership capabilities, and IT culture of experimentation and openness, and IT performance. The results also indicate that the "path" among these variables matter. A team innovative culture, which measures both team values and methods, has the most significant direct impact on performance. Two distinct dimensions of IT culture were revealed from the factor analysis: openness and experimentation. The openness variable indicates the importance of sharing ideas, listening to and supporting ideas from co-workers who might not be as vocal or who might not have a high-level title, and being open to change. The experimentation variable taps into the importance of trying new technologies as well as testing new ways of developing and delivering IT solutions, such as rapid prototyping. This variable also measures the importance of incentives to innovate and having a culture that it is fine to "fail often and fast".

As we hypothesized, the IT professional innovative traits variable has an indirect effect on IT performance and is mediated by IT culture. In other words, individual innovative traits directly predict the IT culture. Not only is domain expertise important, but the ability to take risks, take ownership of one's ideas, and scout for ideas and practices outside the organization is critical to shaping the team culture. Similarly, IT transformational leadership also predicts team culture and has an indirect effect on IT performance. Items that measured empowering employees, motivating them, and providing learning opportunities loaded strongly on this construct.

There are several implications to global IT business leaders from this research. The first is the type of IT professionals that should be hired into the organization. Traditionally, many IT hires were based solely on domain expertise. These research findings imply that IT leaders should also be thinking about innovative traits as part of the hiring process. For example, are new hires willing to experiment, take risks, and look outside for ideas and not just rely on their own expertise?

Another implication has to do with the onboarding of new IT employees, with the emphasis on instilling innovative values and work processes. For example, providing IT newcomers opportunities to work on exciting innovative projects might go a long way in engaging and retaining them. Leaders also have to think about those senior IT managers and employees who do not want to learn new and innovative methodologies such as Agile and Scrum. Therefore, change management becomes an important skill for IT leaders. Changes to incentives or providing creative ways to learn new technologies, such as innovation labs and job rotations, are some ideas that IT groups are currently implementing.

IT leaders need to think about integrating traditional "keeping the lights on" infrastructure projects, which will not go away, with leading edge, end-user centric IT projects. The organization also needs to decide what IT projects an organization wants to keep "in-house" versus outsourcing to potentially a global IT service provider. Therefore, how the IT business is structured and governed will also have a large impact on the success of making IT more innovative. Finally, when thinking about IT innovation, leaders might have to go outside their own industry to learn what it takes to be customer-centric. Best practices and lessons learned from business-to-consumer organizations can be incorporated into the IT culture way of working.

There are also implications to IT researchers. While this is an exploratory project, innovation constructs from other empirical work were adopted and seemed to show reliability in our model. Future research should refine these constructs and test more specific aspects of culture, leadership, and innovation in the IT context. Also, with more tested constructs and a larger sample size, more advanced statistical testing such as structural equation modeling (SEM) could also be leveraged (e.g., the relationship among IT leadership and IT professional innovation variables).

One limitation of this research was that a cross-sectional survey was used to test a "flow" model. Therefore, another direction for this research is to take a more process-oriented view and measure the different stages of IT innovation maturity over time using a longitudinal methodology. This empirical work should also be complemented by qualitative interview data from IT professional and leaders in terms of *how* to build an innovative culture and workforce. We have started this process and have interviewed over 100 IT leaders to date. It is interesting to see the connection between some of the IT innovative practices we have heard to date (e.g., innovation labs and agile projects) and some of the findings from this empirical research.

Conclusions

This research contributes to the academic literature involving innovative behaviors of IT professionals – a research stream that is currently sparse - both from a theoretical and empirical perspective. Important innovation constructs, such as risk-taking traits, transformational leadership, and an experimental culture and work processes, seem to matter in the IT world. In addition, there is strong practitioner relevance associated with this research area as IT practitioners are currently struggling with supporting a global workplace that is demanding business analytics, bring-your-own-devices, mobile support, app development, and cloud computing. This research benefits IT practitioners by defining some of the traits and behaviors to support innovative behaviors that lead to higher performance.

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