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IT INNOVATION PERSISTENCE: AN EXPLORATORY ANALYSIS

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Abstract: This study introduces absorptive capacity as a necessary and sufficient condition for systematic IT innovation (ITI). Looking at the characteristics of firms who systematically innovate with IT, we argue that ITI is a cumulative and path-dependent capability that is not easily replicated. Companies that have developed the ITI capability and attained the ITI status among their peers are likely to maintain this status over time, thus demonstrating that ITI is a sustained capability. We tested our proposition with cross-sectional data of large US firms that have attained the ITI status from 1997-2004. The results of our exploratory analysis seem to strongly support our position.

Key words: Information Technology Innovation, Persistence, and Absorptive Capacity
INTRODUCTION

According to the Hype Cycle (Gartner Research – Online 2007), the introduction of new and widely publicized innovations tends to be associated with ‘over-enthusiasm’ or ‘hype.’ The initial adoption of the new technology after the euphoria of its novelty wears off, tends to lead to a ‘trough of disillusionment.’ This pattern seems to capture the history of Innovation with Information Technology (ITI), which at times has been glorified (Porter and Millar 1985) or vilified (Carr 2003).

The main criticism of ITI is that it is not likely to lead to a sustainable competitive advantage because it is easily replicated. The apparent success of innovators motivates the imitating behavior of their competitors. If ITI is replicated with relative ease one might have expected that ITI persistence, a company’s ability to sustain ITI, will be an unlikely phenomenon and an irrational business practice. Companies would have no incentive to systematically devote precious resources in the development of a capability that does not produce significant payoffs. Hence, the main research question of this study: “Is innovation with IT a persistent capability?”

While organizational innovation persistence has been studied (Cefis 2002; Cefis and Orsenigo 2001; Malerba, Orsenigo, and Peretto 1997), our literature review does not detect applications of this research in the ITI domain. Organizational innovation persistence places great emphasis on R&D and tends to measure persistence in terms of the number of patents. While these measures might have been appropriate to evaluate ITI from an IT-producing company's standpoint, they are unlikely to capture the ITI as applied within an organization. Such an ITI is unlikely to be protected through patterns.

Following the suggestion of Swanson and Ramiller (2004) we link ITI to the organizational absorptive capacity (Cohen and Levinthal 1989, 1990, and 2004) and show that absorptive capacity (AC) is a necessary and sufficient condition for the capability to systematically innovate with IT. Looking at the characteristics of firms who systematically innovate with IT, we argue that ITI is a cumulative and path-dependent capability that is not easily replicated. Therefore, companies that have developed the ITI capability and have attained the ITI status among their peers are likely to maintain this status. We tested our position using a cross-sectional data set of large US firms that have attained the ITI status from 1997 to 2004. The results of the exploratory analysis seem to strongly support this position.

In the following section we provide an outline of salient issues in the existing literature to support the development of our main research questions. We then present our methodology including the description of the statistical approach used, the variable specification, and the data set. We conclude the paper with a discussion of our results and implications for future research and practice.

BACKGROUND

In order to establish the link between ITI and AC we start with the definition of ITI. We start with ITI On the academic side; Swanson (1994: 1072) defines ITI as "... the organizational application of ... Information Technology." Approaching the topic from an organizational process standpoint, Swanson and Ramiller (2004: 536) define ITI as “...the pursuit of IT applications new to the organization,” and argue in favor of the merits of mindfulness in IT innovation. From this normative standpoint they propose that a company’s approach to IT innovation “must entail a learning process rich with interpretations of the innovation’s implications for the organization’s own situation.” From a slightly different angle, Fichman (2004: 314) defines the IT innovation field as one “…concerned with the understanding of the factors that facilitate or inhibit adoption and diffusion of emerging IT–based processes and products within a population of potential adopters.”

From the non-Academic side we looked at the way two major IT newspapers, InformationWeek and CIO Magazine, defined ITI. According to the editorial board of InformationWeek “a firm is considered to be IT innovative if it has demonstrated a pattern of technological, procedural and organizational innovation (InformationWeek 500, 2002-2004).” In CIO Magazine, we found that IT-enabled innovation refers to a new product, service, or process that was either created with or supported by IT. IT innovators use IT to advance their company’s strategic goals, and their firm’s value proposition, by differentiating themselves from their peers (Varon 2006a, 2006b, 2006c).
Since the only noticeable difference between the two groups is that, in the professional literature, ITI is linked with the company’s quest for competitive advantage, we propose the following reconciliatory definition: “ITI is the firm’s ability to pursue and adopt emerging IT-based processes and products throughout all levels of the organization. This capability is supported by an iterative learning process rich with interpretations of the IT innovation’s implications for the organization’s own situation and intent to advance its competitive position.”

The concept of Absorptive capacity (AC) was developed by Cohen and Levinthal in a series of three papers (1989, 1990, 1994). AC is defined as a firm-specific capability, one that allows a firm to predict more accurately future technological trends and to be able to take advantage of new technological opportunities before its competitors (Cohen and Levinthal 1994). From a logical and practical standpoint, organizational AC capability seems to be a sufficient condition for innovation with IT. It is sufficient in the sense that if and only if a firm has developed the capability to recognize the value of new internal or external information, assimilate it, and take advantage of it before its competitors, then the firm is likely to be innovative with IT. However, AC does not seem to be a necessary condition for IT innovation because lack of the AC capability does not preclude IT innovation. Simply by chance, a firm with no AC capability could occasionally be able to pursue and adopt IT innovation. The necessity of AC condition becomes apparent if we follow the example of Swanson and Ramiller (2004) and make the distinction between systematic and opportunistic IT innovators (mindful versus mindless in the parlance of Swanson and Ramiller).

Swanson and Ramiller (2004) argue that firms that innovate systematically with IT will resist the temptation to be complacent about a new innovation’s benefits. Conversely, they will view ITI critically, and they will review outputs and outcomes as related to their firm-specific idiosyncrasies of internal processes, products, and markets. These organizations understand that innovating with IT is a risky process and they will resist the temptation to settle for simplified approaches. Opportunistic IT innovators, on the other hand, adopt new IT innovation in a much more spontaneous manner. Given this distinction between systematic and opportunistic IT innovators, it becomes clear that AC is a necessary condition of systematic innovation with IT. If the firm has not developed its AC capability, it is unlikely that will be able to innovate with IT in a systematic manner. Hence, the AC capability is the necessary and sufficient condition for the capability to systematically innovate with IT.

IT Innovation Persistence

According to Cohen and Levinthal (1989, 1990, 1994), absorption capacity capability is the by-product of prior innovation and problem solving. It depends on the individual absorptive capacities of the organization’s members and builds on prior investments made in its members’ individual absorptive capacities. In a similar fashion, Swanson and Ramiller (2004) argue that the capability of a firm to systematically innovate with IT is embedded in the learning of individual members and the creation of ongoing learning ability that organizational members can help to foster in one another. Fichman (2004) observed that prior research in ITI has shown that the development of the ITI capability is more likely to succeed if the senior management perceives IT innovation as an important capability and supports it, and if firms have significant IT experience. Therefore AC, and by extension systematic IT innovation, is a path-dependent capability. Further on, the capability to innovate with IT is cumulative in the sense that it requires several consecutive steps: the firm must continuously scan the external environment for emerging IT-based products and services, it must understand which of them could support the company’s strategy, it must adopt them throughout the organization, and it must do this in a way that increases the company’s efficiency and effectiveness.

Therefore, the development of the absorption capacity capability and the capability of an organization to innovate with IT are cumulative and path-dependent processes and likely to reinforce each other. All else been equal, given their cumulative and path-dependent nature, firms that have developed this capability are more likely to maintain it in the foreseeable future. Conversely, competitors that do not possess such a capability are not likely to be able to replicate it with relative ease. In other words, IT innovation persistence is not a random process. Hence, our first research hypothesis:

RQ1. The probability is higher that ITI firms will be innovative and non-ITI will continue being non-innovative in the following period.
Organizing Vision and IT innovation persistence

In our second research question we turn our focus to the influence of external factors such as the “organizing vision” on the persistence of a firm’s capability to innovate with IT. According to the Hype Cycle, new technologies tend to go through a cycle that starts with a technological breakthrough or the launch of a new product (“technology trigger”) that generates significant press and interest. One can say that the a-la Swanson and Ramiller (1994, 2004) organizing vision is very influential.

In the next phase, this publicity generates over-enthusiasm and unrealistic expectations (“inflated expectations”). Some of the firms that invest with this mindset may be successful in their application of the new technology; however the number of failing firms is likely to be higher. This failure to meet unrealistic expectations leads to the “trough of disillusionment.” The Media and opportunistic adopters of the technology quickly abandon ship. In spite of this, a smaller group of firms continue experimenting with the new technology and gradually understand the benefits and practical application of the technology in the context of their business (“slope of enlightenment”). Eventually, the technology becomes commoditized and adopted by a wide spectrum of firms (“Plateau of Productivity”).

If the IT spending budgets are a barometer reflecting the mood and perception towards ITI then it is clear that we are dealing with a cyclical phenomenon. The attitude and propensity to innovate with IT has changed dramatically in the last ten years. During the period of the dot-com boom (the introduction of Netscape in the mid-nineties to the collapse of NASDAQ in the early 2000) we had the phenomenon of ‘soft IT budgets’. Driven by the organizing logic of the time, companies with or without ITI experience invested heavily in any new IT project that was associated with e-commerce with little or no concern for the IT budget (period of soft IT budgets). According to Swanson and Ramiller (2004) companies that innovate with IT without a thorough understanding of the firm-specific conditions.

During periods when a strong IT related fashion becomes popular (strong organizing vision), the IT budgets become soft and a larger number of companies try to innovate with IT. Given the high elasticity of investment in innovation to IT budgets, this leads to a larger number of innovators. However these innovators are not likely to be able to sustain an IT innovation capability.

The years following the dot-com crash were years of ‘hard IT budgets’ and cutbacks. We had moved into the stage of disillusionment. The article of Carr (2003) reflected the prevailing attitude of the times. During the period of hard IT budgets only the group of firms with the proven capability of sustaining IT innovation continued to be innovative with IT. This means that we will be dealing with the core group of IT innovators. These firms are more likely sustain their capability to innovate with IT.

RQ2: The persistence of IT innovation capability will be weaker during periods of soft IT budgets and higher during periods of hard IT budgets.

Ability to … “sustain IT innovation”

An implicit corollary of the first and second research questions is the fact that we need to make a distinction between different groups of IT innovators. The implicit suggestion of the first research question is that there is a well-defined distinction between companies that innovate with IT and companies that don’t. In the second one, we see that, within the group of IT innovative firms, we can make the distinction between systematic and opportunistic IT innovators. In summary, when it comes to innovation with IT we

1 The discussion on the Hype Cycle is based on publicly available material of the Gartner Research: Gartner Research – Online 2007. J. Fenn introduced the term Hype Cycle in a 1995 Gartner Research report for the introduction of Windows 1995. Since then the process has been adopted by the Gartner Research for the explanation of several other new IT products such as Linux and Open Source (Weiss 2001), the CRM (Nelson 2001), and to predict the bursting of the dot-com bubble (Drobik 1999).

2 The Hungarian economist Janos Kornai introduced the term ‘soft budget’ in order to explain the way the socialist planning system worked. As the name indicates the budget was adjusted to account for the needs of the central plan.
have three types of firms: 1) Firms that take a systematic approach in their IT enabled innovations, 2) firms that take an opportunistic approach, and 3) firms that are non-IT innovative or followers.

Our notion of systematic IT innovators mirrors the description of the companies that innovate with IT mindfully while the opportunistic IT innovators mirror the description of companies that innovate with IT mindlessly (Swanson and Ramiller 2004). The attributes of firms and their approach to IT innovation between the two groups are diametrically opposed. Systematic ITI seem to be taking a long-term and strategic approach. On the other hand, companies that innovate with IT mindlessly are likely to be content with the purchase of IT services and expertise as marketplace commodities (Swanson and Ramiller 2004).

Given the significant differences between these two groups, those identified as having an opportunistic attitude toward innovation with IT are more likely to fall into the category of non-Innovators than advance into the systematic innovators group. In other words, the development of the capability to “sustain IT innovation and respond to changing market condition,” i.e., the IT capability is a systematic process that one cannot replicate by simply acquiring IT resources.

RQ3a: Companies are more likely to maintain their current status (systematic, opportunistic, or non-IT innovator) than change group.

RQ3b: The capability to sustain IT innovation is a not easily replicated; opportunistic IT innovators are more likely to become non-innovators than becoming systematic innovators.

METHODOLOGY

Statistical Approach

Reviewing the literature on persistence of innovation, we came across two statistical methods: The first one looks for the stationary of the process through a first-order autoregressive model (Malerba et al. 1997). The second one uses a Transition Probability Matrix (TPM) to estimate an implicit first-order autoregressive process and, through this, the persistence of innovation (Cefis and Orsenigo 2001; Cefis 2003). Given the fact that the former of these approaches tends to yield biased estimators in small samples, we will follow the example of Cefis and Orsenigo (2001) and Cefis (2003) and use the TPM approach.

The TPM approach leverages the cross-sectional and time series information by describing the evolution of a cross section distribution over time. In the context of our study we will be following the status of a firm as an ITI or non-ITI for a period of eight years.

\[ F_{t+1} = P \cdot F_t \]  

Where \( F_{t+1} \) maps the distribution of IT innovativeness across firms in period \( t+1 \), \( F_t \) maps the distribution of IT innovativeness across firms in period \( t \), and \( P \) maps one distribution into another and tracks where points in \( F_t \) end up in \( F_{t+1} \). The Transition Probability Matrix (\( P \)) captures information regarding the mobility of firms and the persistence of the IT innovation process. The elements of the \( TPM \) are the probabilities \( (p_{ij}) \) that a firm will move from, let’s say, the status of non-IT innovator \( (i) \) in period \( t \) to the status of IT innovator \( (j) \) in time \( t+1 \).

Based on this the typical TPM will look like:

\[
P(X_{t+1} = i \mid X_t = j) = \begin{bmatrix} p & 1-p \\ 1-q & q \end{bmatrix}
\]  

And the implied first order autoregressive AR (1) process will be as follows:

\[
[x_{t+1}=i]=(1-q) + p*[x_t=i]+v_t
\]

3 According to Bahradwaj et al (1999:381) an IT capable company is the one with the “overall ability to sustain IT innovation and respond to changing market conditions through focused IT applications.”
If \( p+q>1 \) the process is persistent. In the context of our discussion this means that firms are likely to maintain their IT innovator status over time. Non-innovative will continue being non-innovative and innovative will continue innovating. Showing that the implicit first order autoregressive process is persistent provides some exploratory evidence supporting our argument that process of developing the IT innovation capability is a cumulative and path dependent process. Choices and investments that companies make in the development of their IT innovation experience are defining their current status making the IT innovation capability one that is not easily replicated.

**Data Set**

The data set will be based on a group of firms that have been identified as being IT innovative by *Information Week* in its annual InformationWeek 500 (IW 500) report, as well as the top three competitors for each one of these IT innovative firms. The top three competitors were selected from the Hoovers and may or may not be in the list of IT innovative firms. Our data set covers the period from 1997 to 2004.

According to various issues (IW500 2002-2004) of the magazine, the IW500 has tracked the IT practices of the nation's largest and most innovative IT organizations. ... To qualify for the list a company must demonstrate a pattern of technological, procedural and organizational innovation. In the September 2002 issue we have that: "*The IW500 report provides a unique opportunity to examine these practices across core areas of operations including their approach to electronic business, customer-knowledge solutions, technology deployment, IT budgets, infrastructure, and IT strategies.*" Similar statements are repeated in the 2003 and 2004 issues.

One of the main criticisms of ITI is that it is not likely to lead to sustainable competitive advantage because it is easily replicated (Carr 2003). The adverse effect of peer recognition on the competitive success of a company has been argued by Porter (1980; 1985) and Scherer and Ross (1990), and empirically documented in the management literature by Chen and Miller (1994) and in the IT literature by Dehning and Stratopoulos (2003). In other words, competitors will try to compete away any advantage that ITI may bestow. If ITI is replicated with relative ease, one might have expected that ITI is not likely to materialize and companies either would not be able to attain this status or, if they did, it would be a sign of irrational behavior. Hence, if ITI is readily replicated it is not likely that we are going to observe firms that can persistently attain the ITI status.

To capture this we have created the data set that looks at the ITI behavior of the company’s top three competitors. We used Hoovers to generate the list of companies that are perceived to be the top competitors for each of the IT innovative firms.

Our combined data set had 2211 firms. Out of them, 1266 had appeared at least once in the *Information Week* list during the 1997 to 2004 period. The remaining were competitors who did not appear at all in the list.

**RESULTS**

For the testing of the first research question, we need to estimate a TPM consisting of all possible one-period transition probabilities. In our case, the possible number of states that a company can hold is two, \( (i=ITI \ \text{or} \ j=\text{non-ITI}) \) therefore the matrix is two-by-two. The calculation of the TPM is a two-stage process. First, we estimated the TPMs for each one of the pairs of consecutive years in the data set (1997-2004).

The second step is estimation of the TPM \( (1) \), for the entire data set. This was calculated as the averages of all one-period transitional probabilities. The results - summarized in table 2 - seem to support our first research question. The upper-left cell of this matrix captures the transition probability that a firm will remain non-innovative and the lower-right cell captures the transition probability that a firm will remain innovative. The former seems to be much stronger than the latter. The estimated transition probability that the firm will be non-IT-innovative if it was non-Innovative the previous year is over ninety percent \( (p=0.911) \). On the other hand the probability that a firm will maintain its ITI capability from one period to

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4 See Appendix A for an example of how we estimated the typical TPM.
the next one is almost seventy percent ($q=0.682$). Seeing the matrix from the standpoint of change in a firm’s status, the probability that a firm will escape from its non-innovative status is small ($1-p=0.089$). However, the risk that an ITI firm will be non-innovative in the following period is relatively high ($1-q=0.318$). The sum of the two diagonal elements is 1.6, hence the process seem to be persistent.

### Table 2

<table>
<thead>
<tr>
<th></th>
<th>$p$</th>
<th>$1-p$</th>
<th>$1-q$</th>
<th>$q$</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>0.911</td>
<td>0.089</td>
<td>0.318</td>
<td>0.682</td>
</tr>
</tbody>
</table>

The results of our empirical analysis seem to indicate that, at least within the group of firms in our data set, there is strong support for our first research question. The development of the absorption capacity capability and the capability of an organization to innovate with IT are cumulative, path-dependent processes that reinforce each other, making the combination less likely to be replicated. Firms that have developed this capability are more likely to maintain it in the foreseeable future whereas competitors that do not possess such a capability are not likely to be able to replicate it with relative ease.

The second research question postulates that the persistence of IT innovation capability will be weaker during periods of ‘soft IT budgets’ and higher during periods of ‘hard IT budgets’. The pre and post Y2K time period offers a unique opportunity to test the above argument. Following a similar two-stage approach, as in the first research question, we estimated two TPMs: one for the period prior and one for the post Y2K.

The results - summarized in table 3 - seem to support our second research question.

Contrasting the transition probabilities shows that, while IT innovativeness is persistent both prior and post Y2K, there seems to be a significant difference. The probability that a firm would maintain its ITI capability increased from around sixty percent ($q=0.601$) in the pre-Y2K period of ‘soft IT budgets’ to more than seventy percent in the post-Y2K period of ‘hard IT budgets’ ($q=0.741$).

One can speculate on these results and argue that during the period of 1997-2000 we have two major organizing visions that define the IT landscape: the issue of fixing the Y2K problem and the dot-com bubble. The first one introduces a sense of incoming doom, which made the concept of the soft IT, budget possible. The second one introduced a sense of euphoria and optimism around everything that had to do with dot-com and e-commerce. The result was a bandwagon type of approach in IT innovation. One would expect, given the increased amount of spending on IT budgets, that it would be more likely to occasionally see firms attaining a status of IT innovator. The collapse of the dot-com bubble coupled with the feeling that the Y2K scare had been exaggerated led to the disillusionment of management with IT. This spirit is reflected in Carr’s (2003) position and it is reflected in the drop of IT spending.

### Table 3

<table>
<thead>
<tr>
<th>TPM(1)_{1997-2000}</th>
<th>TPM(1)_{2001-2004}</th>
</tr>
</thead>
<tbody>
<tr>
<td>$p = .889$</td>
<td>$p = .927$</td>
</tr>
<tr>
<td>$1-p = .111$</td>
<td>$1-p = .073$</td>
</tr>
<tr>
<td>$1-q = .399$</td>
<td>$1-q = .259$</td>
</tr>
<tr>
<td>$q = .601$</td>
<td>$q = .741$</td>
</tr>
</tbody>
</table>

Based on these results we argue that during the period of 1997-2000, more companies tried to be innovative with IT and, as a result, a higher number of firms were vying to attain the status of IT innovator. On the other hand, after 2000, we observed a slashing of IT budgets. This means that only the hard core of companies having a history of successful, and mindful, governance of IT innovation would maintain their IT innovator status. These results further reinforce our prior argument that IT innovation is a path-dependent and systematic capability.
For the testing of the third research question we used three-year rolling windows. Within each one of these three-year windows we classified firms as follows: A firm is non-ITI if the firm did not appear in the IW500 list of firms for any of the three years. The firm was considered to be an opportunistic innovator if it appeared only once and systematic IT innovator if is has appeared two or more times. Therefore, the TPMs will be three-by-three this time.

Using the same, two-stage approach we estimated the TPMs for each one of the pairs of consecutive rolling three-year windows. We repeated the process using four and five-year windows. The estimated transitional probabilities based on the rolling 3, 4 and 5-year windows are relatively consistent.

In all three cases, the estimated transitional probabilities that a firm will maintain its non-IT innovator status from one year to another are very high. They range from 93% for the three-year window to 94% for the five-year window. It seems that it is relatively difficult for a non-IT innovative firm to switch ranks to the opportunistic innovator status from one year to another. The probability of something like this happening is around 6%. In our data set, it is impossible for a firm to switch from non-innovator to systematic innovator status.

Looking at the transitional probabilities of firms that currently are classified as opportunistic IT-innovators, we found that their probabilities of maintaining their current status or falling into the non IT-innovator category are more or less the same. They are between 36-40%. Their probabilities of lifting themselves to the ranks of systematic IT-innovators are relatively lower; they range from 20-27%.

The transitional probabilities for the systematic IT-innovators provide further support to our arguments. The probability that a systematic IT-innovator will maintain its status within consecutive periods is very high, 84-90%; and the chances that they will fall into an opportunistic IT-innovator status are significantly lower, 10-16%. Overall, the results of our empirical analysis seem to indicate that, at least within the group of firms in our data set, there is strong support for our research hypotheses. The development of the capability of an organization to sustain IT innovation is a cumulative and path-dependent processes.

| Table 4 |
|------------------|------------------|------------------|------------------|
| **TPM(l) 3yr**  | **Non – ITI**    | **Opp – ITI**    | **Sys – ITI**    |
| Non – ITI       | .933             | .067             | .000             |
| Opp – ITI       | .367             | .360             | .274             |
| Sys – ITI       | .000             | .165             | .835             |

| **TPM(l) 4yr**  | **Non – ITI**    | **Opp – ITI**    | **Sys – ITI**    |
| Non – ITI       | .938             | .062             | .000             |
| Opp – ITI       | .346             | .412             | .242             |
| Sys – ITI       | .000             | .127             | .873             |

| **TPM(l) 5yr**  | **Non – ITI**    | **Opp – ITI**    | **Sys – ITI**    |
| Non – ITI       | .943             | .057             | .000             |
| Opp – ITI       | .320             | .471             | .209             |
| Sys – ITI       | .000             | .104             | .896             |
CONCLUSION

The tri-partite question of “whether, when, and how to innovate with information technology” (Swanson and Ramiller 2004: 553) rests in the core of the IT innovation literature and managerial quest for success. If the recent past is an indicator of the future then we can safely predict that new technological innovations will continue coming and managers will continue wrestling with these issues. Approaching the IT innovation from a strategic management standpoint, the papers tries to shed light on some of the aspects of the whether to innovate with IT question. The empirical results seem to support our proposition that the development of the capability of an organization to sustain IT innovation is a cumulative and path-dependent processes. Hence, innovating with IT can be a source of competitive advantage.

From a research standpoint, this line of research makes a noteworthy contribution to literatures of AC and business value of IT. Our approach, using AC as necessary and sufficient for systematic ITI, offers a unique opportunity to couple these bodies of literature. Both sides have raised the need for such an approach. From the IT standpoint, Swanson and Ramiller (2004: 554) see their work as an attempt to connect the IT innovation with the larger issues of organizational capabilities, such as the AC. From the strategic management side, Lane et al. (2006) have argued in favor of more research that would extend the AC capability beyond the realm of R&D domain.

Another contribution of this line of research is in the literature on IT capabilities. Recently, we have seen a good amount of theoretical and empirical studies arguing that IT capability is a source of sustainable differential performance (Piccoli and Ives 2005, Melville et al. 2004, Dehning and Stratopoulos 2003, and Bharadwaj 2000). According to Bharadwaj et al. (1999:381) an IT capable company is the one with the “overall ability to sustain IT innovation and respond to changing market conditions through focused IT applications.” Hence, by testing for the persistence of the IT innovation capability, implicitly we were testing for the ‘overall ability to sustain IT innovation,’ which is the IT capability. Extending our finding in the IT capability area we have found that there seems to be stickiness for firms to maintain their IT capability status. The development of the IT capability is cumulative and path-dependent process and one that is not easily replicated.

Linking the IT innovation to the AC and the overall IT capability, can serve as the platform for future research projects: First, what are the antecedents of the persistence of the IT innovation capability and second financial performance implications of IT innovation persistence.

In this study we introduced organizational AC as a necessary and sufficient for the systematic innovation with IT. Building on the AC literature and the ITI literature, we combined the concept of mindfulness in ITI with AC, in order to argue that ITI is a path-dependent capability that is not easily replicated. Companies that have developed the ITI capability and attained the ITI status among their peers are likely to maintain this status over time, thus demonstrating that ITI is a sustained capability.

REFERENCES


APPENDIX A

Let's assume that we have 5 firms (A, ... , E) and two states ($x_t$) of IT innovation in each period, i.e., $x_t=0$ for companies with non-IT innovative status in period t, and $x_t=1$ for IT innovative firms. Table A1, contains hypothetical figures for five years.

<table>
<thead>
<tr>
<th>Firm</th>
<th>$x_t$</th>
<th>$x_{t+1}$</th>
<th>$x_{t+2}$</th>
<th>$x_{t+3}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>B</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>C</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>D</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>E</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

Based on this we can create three TPMs, $x_t$ to $x_{t+1}$, $x_{t+1}$ to $x_{t+2}$, and $x_{t+2}$ to $x_{t+3}$. The first one will look as follows:

<table>
<thead>
<tr>
<th>$x_{t+1}$=0</th>
<th>$x_{t+1}$=1</th>
</tr>
</thead>
<tbody>
<tr>
<td>$x_t=0$</td>
<td>$p$=0.75</td>
</tr>
<tr>
<td>$x_t=1$</td>
<td>$1-q=0$</td>
</tr>
</tbody>
</table>

Hence $P(x_{t+1}=i|x_t=j) = \begin{bmatrix} .75 & .25 \\ .0 & 1.0 \end{bmatrix}$

and based on these we have that: $[x_{t+1}=1] = 0 + 1.75 [x_t=1] + v_t$. 
