ABSTRACT

Multiple studies in the information systems (IS) literature recognize that information technology (IT) investments may not yield immediate returns. Nevertheless, there has been a lack of theoretical and empirical research to understand and explain this value latency phenomenon. We propose a new theoretical perspective on the latency of IT value and argue that IT value flows occur in three phases: the value dormancy phase, the value trigger phase and the value transformation phase. We substantiate the proposed model by establishing theoretical congruity with the theory of punctuated equilibrium and chaos theory. We validate our theory by mapping prior IT value literature onto its theoretical dimensions. We suggest key strategies that senior executives can use to manage the value lags that their firms experience. To validate the theory, we use it to explain differences in the IT investment value lags experienced by two organizations.

KEYWORDS: Business value, economic analysis, IT investments, IT value, lagged effects, latent value, organizational performance, theory-building research
1. INTRODUCTION

The existing literature on the business value of IT recognizes that returns from IT investments are not instantaneous (Alpar and Kim 1990; Bharadwaj et al. 1999; Brynjolfsson and Hitt 1999; Francalanci and Galal 1998; Grover et al. 1998; Kelley 1999). Bharadwaj et al. (1999) used firm market value to measure returns on IT investments and reveal their contribution to long-term performance. “Investments in IT systems may take years to add value to a firm and are therefore more likely to be reflected in future profit streams” (p. 1011). Similarly, Brynjolfsson and Hitt’s (1998) econometric analysis of firm-level IT returns reveals that long-term returns are two to eight times greater than short-term returns. Devaraj and Kohli (2000) note how the magnitude of lagged effects of IT investments is contingent upon the business context. Brynjolfsson and Hitt (1996) examined the productivity paradox of IT, noting that returns to IT investments are inconsistent over time, with a lag between initial investment and final payoff. Hitt et al. (2002) affirm this for enterprise systems, and conclude that value accrual is subject to significant lags.

The observed lags in returns on IT investments—the IT value latency problem—is an area that clearly calls for more research (Devaraj and Kohli 2003.) IT value latency is the inherent lag in business value returns after the implementation of a new IT investment. We must understand the factors and circumstances that influence and control IT value latency, and result in differential lag lengths. When managers understand how IT investments reach their full potential value, they will be prepared to anticipate and respond to changes that impact projects. Having a theory-based or empirical analysis-based understanding of the value trajectory over time for different kinds of IT investments will lead to appropriate managerial expectations for the benefits the firm can obtain. This will also enable senior managers to track the progress of IT returns, and
help overcome myopic views about IT project investment opportunities. Also, recognizing that there will be peaks and troughs in the value flows over time will provide a basis for bench-marks for IT project performance. This will have the collateral benefit of helping managers to “right size” their IT payoff expectations and focus attention on ways to unlock more value sooner from their investments.

We seek to answer several research questions:

- What are the relevant bases for a *theory of IT value latency* that explains and predicts IT value flows over time in specific kinds of business environments? What will be its explanatory theoretical components? To provide answers, we will specify a *variance theory* that appropriately captures the antecedents and the situational controls which lead to the observation of different lag patterns for IT value flows.

- What evidence can we provide to show the robustness of the theory’s interpretive capabilities? What are its advantages and shortcomings? Can it be leveraged to make strategies for enhancing the managerial control and predictability of lagged IT value flows?

Our theory should be useful to understand more about why the lags in their IT investments occur. Though it is hard to manage aspects of a business that are poorly defined and measured, we hope to initiate a dialogue that will lead to greater awareness of the issues, and new opportunities to formulate managerial policies that will speed the value flows and returns on IT investments.

We review the IT value literature to determine the theoretical premises of which the ideas of value latency will be built on. We next propose a new theory of IT value latency with an analogy to punctuated equilibrium and chaos theory in mind. We use this to establish a basis for preliminary theoretical validity. We further validate the theory by mapping past IT value
literature onto the various dimensions of our proposed theory. We also identify and analyze the antecedents of IT value latency with the proposed theory, and provide managerial control strategies that help reduce the lag time until value returns materialize. Finally, we display the applicability of this theory and managerial control strategies by utilizing it to explain the value lags experienced in two case studies.

2. LITERATURE REVIEW

Our value latency theory is based on the IT value literature. It enables us to understand the overall value creation process of IT investments. Though it doesn’t provide all the answers for the formulation of our theory, it lends structure for the theory-building process. We will highlight only the key conclusions that facilitate the reader’s understanding of the proposed theory.

The impact of firm structure and practices on IT value has been widely researched. Studies have indicated that business practices such as workforce composition, management commitment, decision making policies, and employee empowerment establish the initial set of conditions that make or break the value creation process (Dedrick et al. 2003; Fralcalanci and Galal 1998; Weill 1992). Extending these ideas, firms with the desirable set of initial practices will observe shorter value flow lags. The literature suggests that IT investment performance and business processes are linked. To maximize value, firms have to align their business processes with IT investments alongside their implementation (Hitt et al. 2002). Alignment requires substantial effort from stakeholders of the system. Numerous studies have looked at IT investments in conjunction with business process reengineering efforts (Barua et al. 1996; Bashein et al. 1994; Broadbent et al. 1999; Hitt et al. 2002). They suggest that intra-firm coordination after system implementation is key for value flows. IT investments accompanied by complementary changes to business
processes facilitate coordination, yielding earlier returns.

Based on these works, we posit that value flows for IT investments are impacted by the initial set of firm conditions present prior to the investment, and efforts to enhance the conditions for value creation: the processes leading to value flows. We will build on this premise to develop a theory of IT value latency.

3. A THEORY OF IT VALUE LATENCY

Returns on IT investment occur in three key phases for value: dormancy, triggering and transformation. Phase 1, value dormancy, occurs after an IT investment is made, when a firm experiences inertia in value creation. This may come from existing firm structures and routines, or external factors. For value flows to occur within the firm, a primary set of Phase 2 value triggers needs to be in place. After the current impediments are overcome, the value creation process will undergo a period of extensive change: Phase 3 value transformation.

3.1. Phase 1: Value Dormancy

After an IT investment has been made by the firm, the associated value flows take time to appear. Their timing will be influenced by the underlying structures and routines (set of firm activities) of the organization, as well as other external market factors. We call this value dormancy. Barua et al. (1996) echo these views: that the existing installed base of systems within the organization will create inertia in value creation for the new IT investment. They single out the Connecticut-based health insurance firm, Aetna, to illustrate why existing structures within the firm inhibit value flows from a new IT investment. Aetna’s prior investment in a PC-based software and hardware was influenced by the firm’s original investment in fifteen mainframe computers. The costly existing investment is an obstacle in gaining support from
management to switch to the new platform.

Friction in IT value creation also originates from non-IT related business processes. For example, U.S. healthcare providers’ computerization of medical records has been thwarted by day-to-day medical processes and the practices of medical professionals, which appear to be resistant to effective computerization. External factors play a similar role. IT value is dependent on customer adoption, emerging technology standards, available capital for complementary investments, and a stable economic environment.

Our view of how these considerations impact IT value creation is echoed by Dedrick et al. (2003, p.10), who survey empirical research on IT value. They state that value flows are significantly impacted by “structure and business practices of the firms.” Weill (1992) and Francalanci and Galal (1998) and others conclude that different organizational routines seem to be crucial in the creation of limits to value for IT investments, while others note the external considerations (Reed et al., 1996; Powell and Dent-Micallef, 1997).

3.2. Phase 2: Value Trigger

The second phase of the value creation process involves the triggering of value flows that result in changes in organizational routines and structures that permit the flow of IT value. We call these value triggers. (Note that the external factors tend to be less managerially controllable, and so we do not treat them here.) For effective value creation with constraining organizational structures and routines, strong catalysts are necessary to support the changes. Opportunities for success and threats, and concerns about the ineffective use of invested funds often serve as triggers that prompt managers to focus their efforts on the implementation of new IT projects so that significant organizational changes occur that make IT value flow to the firm.

Barua and Lee (1997) model the value of an electronic data interchange (EDI)
implementation, and conclude that positive motivation and threats result in more efficient utilization of IT. Misapplied threats, however, bring about losses of surplus by the parties that are involved in implementing EDI. The use of threats as a catalyst for change has not been explored in prior IS research. Studies that we surveyed suggest using motivational mechanisms to initiate value creation. The mechanisms include managerial involvement, senior management support, employee empowerment and voluntary use of the resulting system. Martinez (1995) concludes that IS managers who are less involved in business process reengineering will be unmotivated to ensure that new IT investments generate the appropriate value flows. They will set less demanding goals for their operations, maintaining the status quo. Without other countervailing efforts, this will result in lower payoffs. Senior managers can champion change efforts that lead to new IT value flows by providing effective stimuli for organizational changes (Weill 1992).

Another source of motivation originates with end-users of the systems resulting from new IS investments. Bashein et al. (1994) and Brynjolfsson et al. (2000) concluded that empowerment of end-users diminishes the inertia within an organization and promotes acceptance of change. Empowerment is promoted by decision making rights and user involvement during investment decision making and implementation.

3.3. Phase 3: Value Transformation

Identifying the right set of value triggers during implementation is essential to jump-starting Phase 3, value transformation, when value flows begin to occur. During value transformation, changes in existing structures in a firm go beyond existing routines to provide a better fit with the new IT investment, and support value creation (Clemons and Row 1991). Similarly, Barua et al. (1996) propose that radical change in multiple aspects of an organization’s routines is key
to extracting value from IT investments. This view parallels value transformation in our proposed theory of IT value latency. Although the transformation phase has the potential to deliver significant value for the firm, it nevertheless may be plagued with high coordination costs, and the resulting lack of coordination, which is inevitable in the process of implementation.

Higher coordination costs may be a result of various factors, including differences in technological standards (Barua et al. 1997), differences in workflow practices, users’ lack of familiarity with an application’s interface (Grover et al. 1998), and system learning complexities (Kelley 1994). They lengthen value transformation and have confounding impacts on IT value. One means to reduce the lag will be to manage the coordination costs.

4. THEORETICAL CONGRUENCE

Our theory parallels some of the key ideas associated with the theory of punctuated equilibrium (TPT) (Eldredge and Gould 1972) and chaos theory (Levy 1994; Scott 1998; Thietart and Forgues 1995). Earlier, we defined value latency in terms of the temporal variations of the value flows following an IT investment. TPT offers a theoretical analogy for understanding why value flows vary of time. Systems in place for long periods of time create equilibrium-like stability (Gerick 1991). Systems, meanwhile, are characterized by deep structures (e.g., firm routines, processes and workflows, which are a source of inertia). But senior managers are motivated by intra-firm and environmental forces to make changes that will lead to instability.

Chaos theory explains changes in non-linear dynamic open systems, similar to firms. They interact with numerous agents (e.g. competitors, customers, capital providers). Changes in firms occur due to interactions between stabilizing and destabilizing forces. The latter leads firms into
dramatic change. Interactions between them cause fundamental changes within firms, leading to organizational progress or regress. Table 1 shows this analogy among the theories. (See next page.)

5. VALIDATING THE THEORY

To validate our theory, we surveyed the literature on IT value to map the dimensions of our proposed theory onto some of the leading explanations for lagged value. We covered articles published in academic and practitioner journals from 1990 to 2003, including MIS Quarterly, Information Systems Research, Journal of Management Information Systems, Management Science, Strategic Management Journal, Communications of the ACM, various IEEE Transactions and others. This mapping is accomplished in Table 2 by matching the primary and secondary findings of the papers against the value dormancy, triggers and transformation phases associated with our theory. (See Table 2 on next page.)

Based on the contents of Table 2, we see evidence of a rich body of knowledge pertaining to this issue. But it has not been synthesized and presented in a manner that researchers can see its overall outlines. Our mapping of prior works on IT value to our proposed theory of IT value latency suggests that the conceptual dimensions of the theory are already present in prior work.

6. MANAGING VALUE LATENCY

What are the managerial strategies that enable firms to minimize the lags? The solution lies in the facilitation of value creation from one phase to the other, and understanding the sources of the value lags.
Table 1. Congruence among the Three Theories

<table>
<thead>
<tr>
<th>IT VALUE LATENCY THEORY PHASES</th>
<th>PUNCTUATED EQUILIBRIUM THEORY CONCEPTS</th>
<th>CHAOS THEORY CONCEPTS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Phase 1—Value Dormancy:</strong> Existing firm structures and routines set stage for value creation process of IT investments. New IT investments threaten existing structures, creating significant implementation impediments. Friction in the value creation flows stems from existing structures in the firm (Barua et al. 1996; Dedrick et al. 2003; Francalanci and Galal 1998; Weill 1992).</td>
<td>Equilibrium: Deep structures in systems and firm result in inertia for status quo (Eldridge and Gould 1972; Gersick 1991; Kuhn 1970; Tushman/Romanelli 1985).</td>
<td>Stabilizing Forces: Occur in systems and suppress all forms of changes; tendency towards the initial set of conditions. (Levy 1994; Scott 1998; Thietart and Forgues 1995)</td>
</tr>
<tr>
<td><strong>Phase 2—Value Triggers:</strong> Past literature suggests a mixture of motivation and threats trigger value creation process. Motivation can originate from other stakeholders within the firm (e.g., goals set by top management, IS managers’ involvement), or motivation from the individual user (e.g., user empowerment) (Bashein et al. 1994; Brynjolfsson et al. 2000; Martinez 1995; Weill 1992).</td>
<td>Motivation: Intra-system and external forces break down deep structures (Eldredge and Gould 1972; Gersick 1991; Kuhn 1970; Tushman/Romanelli 1985).</td>
<td>Destabilizing Forces: Managers’ initiatives create destabilizing forces, drives systems to dramatic change (Levy 1994; Scott 1998; Thietart and Forgues 1995)</td>
</tr>
<tr>
<td><strong>Phase 3—Value Transformation:</strong> IT implementation results in changing routines and reduced stability in firm. Shifting routines are necessary for value growth, complementary firm structures and new routines to develop. Higher levels of firm discordance lead to higher coordination costs. Management of coordination costs leads to more rapid value returns (Barua et al. 1997; Grover et al. 1998; Kelley 1994).</td>
<td>Revolution: System in chaos with reorganization of deep structures. Tension in coordination between members of the system (Eldredge/ Gould 1972; Gersick 1991; Tushman/Romanelli 1985).</td>
<td>Interaction: Net between stabilizing/destabilizing forces determines upper/lower bounds of change. (Levy 1994; Scott 1998; Thietart and Forgues 1995)</td>
</tr>
</tbody>
</table>
Table 2. Validation: Mapping IT Value Latency Theory to Prior IT Value Literature

<table>
<thead>
<tr>
<th>PHASES</th>
<th>FINDINGS FROM PRIOR LITERATURE</th>
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<tbody>
<tr>
<td>Phase 1: Value Dormancy</td>
<td>• Higher incongruence among existing structural arrangements reduces IT value (Pinsonneault and Kraemer 1997).</td>
</tr>
<tr>
<td></td>
<td>• Four theories describe how IT reacts with org structures, impacts institutional inertia (Robey and Boudreau 1999).</td>
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<tr>
<td></td>
<td>• Installed base of IT may generate inertia for new investments (Barua et al. 1996).</td>
</tr>
<tr>
<td></td>
<td>• Existing firm structures, business practices crucial in initial stages of IT impl. (Dedrick et al. 2003).</td>
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<tr>
<td></td>
<td>• Existing practices, employee skills impact IT productivity (Francalanci and Galal 1998).</td>
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<tr>
<td></td>
<td>• Benchmarking drives stakeholders, ensures creation of sustainable advantage (Powell and Dent-Micallef 1997).</td>
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<td></td>
<td>• Weak CEO-CIO relationship limits IT performance; less monitoring and management of value (Li and Ye 1999).</td>
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<tr>
<td></td>
<td>• Stakeholders set investment goals; users partner on investments, ensure success (Peffers and Gengler 2003).</td>
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<tr>
<td></td>
<td>• Managers less motivated in IT implementation set less demanding goals: result: lower payoffs (Martinez 1995).</td>
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<tr>
<td></td>
<td>• Management commitment and motivation on IT investment impact payoff (Weill 1992).</td>
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<tr>
<td></td>
<td>• User empowerment reduces resistance; speeds value flows (Bashein et al. 1994; Brynjolfsson et al. 2000).</td>
</tr>
<tr>
<td>Phase 3: Value Transformation</td>
<td>General Findings</td>
</tr>
<tr>
<td></td>
<td>• IT-business-mgmt process alignment enhance IT returns and business performance (Rai and Patnayakuni 1997).</td>
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<tr>
<td></td>
<td>• Mgrl. inefficiencies diminish value; corrective mechanisms ensure stable value creation (Lee and Barua 1999).</td>
</tr>
<tr>
<td></td>
<td>• Changing firm processes/structure in implementation aligns incentives for better returns (Mooney et al. 1996).</td>
</tr>
<tr>
<td></td>
<td>• Radical organizational change: positive association with IT investment success (Pinsonneault and Rivard 1998).</td>
</tr>
<tr>
<td></td>
<td>• Reordering routines: complementary resource to IT investments for high value (Powell and DentMicallef 1997).</td>
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<tr>
<td></td>
<td>Coordination Cost-Related Findings</td>
</tr>
<tr>
<td></td>
<td>• Employee training improves org performance with IT by lowering coordination costs (Mahmood and Mann 1993).</td>
</tr>
<tr>
<td></td>
<td>• Tech standards for IT and infrastructure result in lower coordination costs and higher payoffs (Barua, et al. 1997).</td>
</tr>
<tr>
<td></td>
<td>• Workflow standards after IT implementation facilitates coordination and leads to higher payoffs (Kellet 1994).</td>
</tr>
</tbody>
</table>

6.1 Preliminary Considerations

Based on our theory, there are two sources for lags in IT value. The first is organizational inertia that occurs during the value dormancy phase. With the existing structures and fixed routines of the organization, value flows from IT investments are likely to encounter friction and
resistance. The greater the inertia, the longer will be the time lags before value flows begin to appear. A second source will occur even when an IT investment is managed appropriately with respect to the appropriate value triggers that enable movement to the value transformation phase. The major obstacle will be high coordination costs. They slow down value transformation, resulting in longer lag periods for returns to materialize.

Facilitating the transition from phase to phase in value creation is critical in reducing latency in IT value returns. We propose different strategies for each phase: (1) analyze the initial structures within the organization before IT investment; (2) provide the necessary motivational triggers to accelerate the progress of IT implementation into the value transformation stage; and (3) provide coordination and learning structures for the organization to reduce the coordination costs.

6.2. Phase 1 Strategy: Analyzing the Initial Structures

Analyzing the initial structures and routines in the firm prior to the IT implementation enables managers to predict the possible areas of resistance. Although inertia is inevitable, managers can reduce its impact by better managing the initial implementation process. For example, in situations where inertia is likely to be high, managers can break down the implementation into phases to mitigate the impact, resulting in an earlier value triggering process. Similarly, a manager could delay the IT implementation, and instead lay the necessary friction-reducing groundwork. In the earlier example, North American hospitals, in anticipation of the lack of computerized records, could proceed with digitizing medical records months before implementation. Acknowledging the lack of digitized records as a huge initial impediment eases the value creation process.
Scanning the initial structures and routines helps firms to detect potential red flags and provides them with the option of varying the project investments. Prior to implementing changes to the IT processes of British Petroleum (BP), some senior executives informally recognized that these changes would lead to firm-wide resistance (REF). BP nevertheless proceeded with the implementation, but was hit with immense resistance. Institutionalizing pre-implementation resistance analysis can mitigate this problem as it provides firms with a formalized investigation of the underlying dynamics of IT investments. Firms faced with situations where changing surrounding dynamics is costly (as in the case of BP), could consider scaling down the investments to maximize per dollar returns.

6.3. Phase 2 Strategy: Introducing the Value Triggers

Appropriate value triggers are necessary to initiate value transformation. After the implementation of an IT investment, firms have to ensure that the appropriate motivational factors are in place to overcome resistance to the changes that come along with the IT investment. When they do this well, they will be able to compel the various stakeholders to take the first steps towards changing the existing structure. The idea is to avoid letting the stakeholders opt out of the necessary changes that accompany implementation, resulting in longer lead times for value returns. As Barua, et al. (1996) suggest, sometimes radical changes are necessary.

The nature and timing of the value triggers also need to be properly addressed. Having the appropriate motivating factors during the initial stage of IT investment will complement other efforts to achieve an early IT payoff. Delaying the introduction of the value triggers will only lead to longer lags. To decide upon the appropriate value triggers, managers should utilize a mix of positive motivation and threats (Barua and Lee 1997). To be effective, managers need to
ensure they are widely communicated and enforced within the organization.

6.4. Phase 3 Strategy: Reducing Coordination Costs

Establishing the necessary value triggers is only half the battle to control the lags in financial returns to IT investments. The other is guiding implementation through value transformation. During this phase, the firm should expect to experience significant coordination costs among IT investment stakeholders. When the coordination costs are high, there is a potentially negative impact: the time before value flows materialize may be longer, reducing the effectiveness of the investment. To reduce IT value latency during this stage, effective mechanisms have to be put in place to prevent the coordination costs from blocking IT value flows.

We have identified coordination cost-reducing mechanisms that will be beneficial for controlling the latency of IT value. These mechanisms facilitate the flow of information between stakeholders and assist with the synchronization of learning mechanisms during the value transformation phase. They include data and technology standardization, communication within and across workgroups, familiarity with user interfaces to key systems, the appropriate segmentation of workflows, and personnel specialization. We do not provide an exhaustive list of these mechanisms, but instead showcase their necessity for reducing coordination costs.

During the value transformation process, having proper data definitions, compatible data formats and well-accepted technological standards will reduce coordination problems within the firm and among its business partners. Introducing standards and definitions that match existing systems will facilitate work processes for both system builders and end-users alike—to a point. In particular, having compatible technical standards will ensure that system users will be able to integrate their existing work processes with new processes in light of changes in the firm that are caused by the IT investment (Barua, et al. 1997). For example, the introduction of Microsoft-
compatible accounting software from well-known vendors (e.g., Great Plains Software) reduces the coordination cost that accountants face when they need to modify accounting systems outputs and report using Excel spreadsheets. A simultaneous concern exists across organizations which places somewhat greater importance on the use of market standards for various technologies to achieve effective compatibility.

Coordination costs exist when different systems are used, and will be present in the interaction of different workgroups (Barua, et al. 1997). This is especially true for IT investments that span various parts of the value-chain in the organization. An example is enterprise systems investment. Initial implementation of enterprise systems typically causes disruption to various business processes in the firm (Hitt, et al. 2002). When close communications between workgroups across different business processes or strategic business units are needed, new policies to establish the necessary cross-functional or inter-group communication are likely to reduce the costs of the system investment. Communication policies that can be used include regularly-scheduled meetings between business process unit staff members throughout the system implementation process. Another approach is to appoint communication liaisons for each workgroup to facilitate the flow of information.

Furthermore, the introduction of new technology leads to learning disruption in the organization (Tyre and Hauptman 1992). The learning complexities which stem from IT investments often result in high coordination costs among key stakeholders to an IT investment. For example, users who are unfamiliar with new systems and applications will have trouble communicating the learning problems they face. This learning adversity is a result of high coordination costs, and it will lead to longer lags before business value begins to accrue.
One possible way of managing the costs that occur in the learning process is to compartmentalize the complexities of coordination. Workflow segmentation is one mechanism that can help to decompose the larger problem of coordination into divisible parts. Beyond the implementation of a new IT system, firms can also reorganize workflow processes into smaller standardized routines so that users experience more workflows, only with a narrower scope (Kelley 1994). The increase in volume and decrease in scope of work processes may help to reduce the necessary coordination between stakeholders, as well as diminish the learning complexities within the organization.

In addition to workflow segmentation, labor and personnel specialization can help to reduce coordination costs. The specialization of labor involves designating individuals to work in a particular area of the business process that is affected by the IT investment for some time when the early efforts are made to implement system. Changes in the staffing and the duties of these individuals (e.g., due to job rotation or turnover) should be minimized, even after the implementation, for a period of time. The early involvement and specialization of individuals in the new IT investments ensure familiarity with system use, and serve to control the coordination costs that arise from learning difficulties. Figure 1 summarizes the key tenets of this theory.

**Figure 1. Key Tenets of IT Value Latency Theory**

<table>
<thead>
<tr>
<th>CHALLENGES:</th>
<th>Value Dormancy</th>
<th>Value Trigger</th>
<th>Value Transformation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resistance from organization routines</td>
<td>Appropriate triggers required to overcome value inertia</td>
<td>Increased in coordination cost.</td>
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</tbody>
</table>

| STRATEGIES: |  |
|-------------|  |
| • Analyze Initial Structures |  |
| • Lay friction-reducing groundwork |  |
| • Pre-implementation resistance analysis |  |
| • Selecting triggers |  |
| • Proper timing of triggers |  |
| • Synchronize communication mechanisms |  |
| • Synchronize learning mechanisms |  |
7. APPLYING THE THEORY AND STRATEGIES

We next examine two cases of IT investments and their associated lags in value. The first case refers to the implementation of electronic medical records (EMR) at the University of Illinois Medical Center (UIMC) in Chicago, IL (EMRGuide.com 2003). The second refers to a problem-ridden enterprise system at Hershey Foods Corp., Hershey, PA (Carr, 2002). For both cases, we will apply our theory of IT latency to understand the dynamics of value flows, and attempt to provide explanations of the different degrees of latency they experienced.

7.1. University of Illinois Medical Center

The top management of UIMC recognized the long-run benefits of an EMR system, and decided to implement it hospital-wide in 1997 (Koch 2003). EMR technology was relatively new then, present in only about 10% of U.S. hospitals. Implementing the system revolutionized the way data are recorded, stored and utilized, and required UIMC to digitize patients’ records.

Phase 1: Analyzing the Initial Structures. Existing routines within UIMC posed a great challenge to the implementation of the EMR system. The duration of an average medical consultation is twenty minutes, and doctors have to assess, interpret and update medical records within minutes. The culture of medical practitioners is highly results-oriented and doctors will not tolerate delays as a result of digitizing medical records. For instance, an incident of hardware failure in UIMC brought about numerous angry calls by physicians to the IS department, demanding the problem to be solved immediately (Koch 2003).

Prior to implementation, the IS department singled out three key conditions within the hospital that were likely to affect the value dormancy phase: the time constraints physicians face during medical consultation; physicians’ results-orientation and unwillingness to tolerate delays; and the relative integration of hospital departments, making it difficult to isolate just one to run a
pilot test for an EMR system. The IS department chose the “big-bang approach,” implementing hospital-wide all at once. Implementing the system in stages would have required concurrent maintenance of both digital and physical medical records, which causes confusion in records retrieval across multiple data sources. Delays were inevitable in updating the data, as users had to update both physical and electronic records. Dr. Patrick Tranmer, head of the Department of Family Medicine, commented, “Doctors would have said, ‘Now this is twice as hard. Forget it’” (Koch 2003). The IS department foresaw that the project would be abandoned if it were implemented in stages due to resistance. A “cold turkey” cutover compelled employees to use the EMR system without an option to use physical records.

**Phase 2: Introducing the Value Triggers.** EMR implementations revolutionize hospital processes. Impediments in the dormancy phase have to be overcome by the appropriate value triggers to release IT value. In UIMC’s context, a key value trigger was support from the hospital’s top management. The IS department attributed the EMR project’s success to the support of the newly-appointed vice-chancellor for health affairs, Dr. Charles Rice, who successfully prevented the termination of the project at an early stage. In addition, the project, with an initial investment of $11.2 million and a maintenance cost of $1 million annually, had total support from the Chief Medical Officer, CIO and other top management (Koch 2003).

Another value trigger here is user empowerment. To manage inertia in IT value flows, project leaders focused on empowering users. They asked nurses and doctors to manage the system. By empowering the nurses early in implementation, they ensured that the entire organization would be motivated to overcome the barriers to value formation. To facilitate the value triggering process, the hospital appointed some nurses as “power users” to motivate coworkers and influence doctors. The latter were important; doctors had no time for training.
The direct cutover approach to implementation constitutes a direct threat. It removes the fallback options with respect to the physical records. As the project leader, Joy Keeler, pointed out, “We have burned the bridge. No paper” (Koch 2003). This appropriate use of a threat coerced users to embrace the changes that EMR brought.

**Phase 3: Reducing Coordination Costs.** The UIMC EMR system consists of numerous applications. This is confusing to a user if they are not properly integrated. Initial designs of the applications interface were rejected by the project manager for this reason. The IS department eventually decided to organize all the applications to mimic the flow of an email/scheduling program to enhance familiarity and learning, hence reducing coordination costs (Koch 2003). In the value transformation phase, UIMC introduced various means that aided learning and information among stakeholders. These mechanisms were key in managing the increased coordination costs.

To facilitate coordination among medical groups, data and technology in system were standardized to ensure compatibility across all medical departments. This enhanced communication between users within and across medical groups. The EMR system allows physicians to type or dictate medical information into the system. It doesn’t restrict records updates with fixed forms. This made it easier for physicians to learn and minimized coordination costs in medical consultation.

**Outcomes.** UIMC’s EMR investment reduced the average length of patient stays, increased patient capacity per day and reduced prescription errors. The IS leaders understood the lagged value of such systems in general, and were pleased with the exceptionally rapid returns. UIMC has also won the “Enterprise Value Award” conferred by *CIO Magazine* (2003). The value creation process and the strategies that were undertaken by UIMC can be understood in terms of...
three phases associated with our theory of IT value latency. This case shows how our theory helps identify strategies to minimize the IT value lags that IS managers can employ. As Joy Keeler, the EMR System conversion leader, pointed out: "This isn't a project; this is a culture change. Transformation has to be the goal of the organization—not just of the chief medical officer or the CIO” (Koch 2003). And so it is with managing the lags in the accrual of IT value for the organization.

7.2. The Hershey Foods Corporation

Hershey Foods Corp. is a low-end IT user with an annual IT budget of only 1% of total revenue (Hayes 2001). In early 1996, Hershey began an “Enterprise 21 Initiative,” a $112 million enterprise systems investment, to improve inventory management and ensure Y2K compliance (Laudon and Laudon 2001). The investment initially created a large drag on firm profitability. Only one year later did the firm begin to see signs of a payoff.

Phase 1: Failure to Analyze the Initial Structures. Prior to Enterprise 21, Hershey’s last major IT project was a barcode scanning system in the 1980s. As a result, upon initiation of the new project, its technological infrastructure was below industry standards. Its IT infrastructure consisted of mainly mainframe-based hardware. The existing inventory management system lacked the business functionality to support a seamless supply chain process. But, in spite of its low IT capabilities, Hershey still made ambitious plans to implement major IT systems concurrently: an enterprise system from SAP, a customer relationship management system from Siebel Systems, and an inventory management system with the help of Manugistics (Songini, 2000). In addition, Hershey opted for a direct cutover strategy, so that all of its systems would go live enterprise-wide simultaneously to speed up the implementation process (Laudon and Laudon, 2001).
The preconditions in Hershey (low IT capability, low-tech business processes, and mainframe-based systems) suggest problems right from the start. The successful implementation of the three advanced IT systems was likely to be held up by existing firm routines and structures. Hershey failed to analyze the preconditions prior to rolling out the investments, and chose a risky IT investment plan. The selected strategy of building and deploying multiple new and complex systems over a short period of time resulted in extensive resistance within the firm, resulting in inertial value creation. Containing the negative effects of the resistance would require major changes to the firm’s business processes. (Carr, 2002) The failure to manage these problems was acknowledged by Kenneth Wolfe, Hershey’s CEO, who admitted that the project was a failed implementation of new business processes (Laudon and Laudon, 2001).

Phase 2: Lack of Appropriate Value Triggers. Resistance to the IT implementation at Hershey Foods led to an extended period of value dormancy. Compounding this problem, there was a shortage of appropriate value triggers to initiate the IT value flows. Throughout the investment, Hershey did not have a CIO among the senior managers in its organizational structure to provide the necessary support and decisions required for the project (DiSabatino 2000). The lack of a champion for the project made it difficult to effectively move the initiative forward against all the obstacles blocking its way.

Hershey’s ambitious plan to implement a four-year ERP project within thirty months omitted taking time to educate potential users about the merits the various systems associated with Enterprise 21 that were being deployed. Unfortunately, educating users is essential for motivating organization-wide acceptance of the major changes in the firm’s business process that will occur as a result of IT investments, and as a means to nip any resistance in the bud.

Although the entire system went online in July 1999, the lack of appropriate triggers made
the value transformation process less effective. The IT systems experienced numerous obstacles that prevented them from being integrated into the daily operations of the firm. It was only months later that was Hershey able to begin modifying its business processes to effectively leverage and obtain value from the new systems.

**Phase 3: Escalating Coordination Costs.** In the value transformation phase, the business processes and routines at Hershey were reengineered to better align the Enterprise 21 systems with the other IT systems that were still in place. The high coordination costs as a result of the complexity of changes caused many users to be unable to use the software in the new business environment. One consultant from vendor IBM Global Services pointed out that “the business process transformation underway at Hershey is an enormously complex undertaking. [The consultants] are making sure they [Hershey’s employees] are using the business process/software correctly” (Laudon and Laudon, 2001)

Hershey employed various strategies that upset the value transformation process. The training users received for the new system apparently was insufficient and inappropriate. Without proper user training, the complexity of the IT system hindered coordination among processes within the organization. In addition, its primary integration vendor, IBM Global Services, has not previously done systems integration involving the SAP platform and the Manugistics inventory system.

Moreover, the rollout of Enterprise 21 systems was poorly timed. Its value transformation phase coincided with the busiest period of the year, when 40% of the firm’s demand occurs: the Halloween to Christmas seasons (Osterland, 2000). The high transaction volume during this period made it difficult for Hershey to iron out some of the problems that occurred during this phase, leading to delivery backlogs of nearly two weeks, though the firm had about eight days of
inventory on hand. The poor timing also created excessive strain on the users, who were required to handle an unfamiliar and increased workload.

Implementing three major IT systems at once created inappropriate complexity in the value transformation phase. This made the implementation of Enterprise 21 more challenging and prone to failure than it should have been for Hershey. The coordination difficulties between the systems and the processes related to them retarded the value flows.

**Outcomes.** The poor choice of strategies in the three phases of value flow caused the lags in IT value. Due to the extended period of value dormancy and value transformation, Hershey’s profits declined by 19%, resulting in lost sales of about $150 million for the year (Carr, 2002). The desired value flows only appeared after one year in 2000, when profits increased by 23% (Laudon and Laudon, 2001). Similar to the case of UIMC, we applied our theory of IT value latency to explain the IT value flows. However, in this instance, we learned how an investment plagued by extensive value lags could be understood through this new theoretical lens.

8. **CONCLUSION**

We proposed a new theory of IT value latency based on an analogy to the theory of punctuated equilibrium and chaos theory, and a synthesis of existing knowledge on IT value. Our view is that value flows occur in three phases: a value dormancy phase, a value trigger phase and a value transformation phase. Lagged flows of IT value occur as a result of drivers of internal organizational inertia and external environmental inertia that management faces after the investment is made. Only the drivers of internal organizational inertia are typically controllable by management to break through the value dormancy phase. To break through the inertia, value triggers are required that will drive the investment into the value transformation phase. In the value transformation phase, stakeholders of the system will experience uncertainty, significant
changes and increases in coordination costs among one another. The sometimes radical changes that occur are a necessary evil that ultimately help to ensure that a valuable IT payoff will occur with an acceptable lag time. To establish theoretical validity and consistency for our theoretical perspective, we mapped prior research on the business value of IT onto the proposed dimensions of our theory.

We also noted the key strategies that managers can employ to reduce lags in IT value. They include analyzing firms’ structure prior to implementation, introducing the right set of value triggers at the right time to overcome initial inertia, and building in the necessary mechanisms to reduce coordination costs between stakeholders of the system and make value transformation more effective. By applying the proposed theory and managerial strategies in the case studies of UIMC and Hershey, we successfully explained the difference in lagged IT value experienced by these two organizations.

Although the idea of the IT value latency is well recognized by the field (Brynjolfsson 1993; Dedrick, et al. 2003; Devaraj and Kohli 2003; Francalani and Galal 1998; Kelley 1994), no dedicated attempts have been taken to fully understand it. We hope that our theory will be the first step towards establishing a more complete understanding of IT value latency.
REFERENCES


