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Technology Use Rationale and Assimilation in the Implementation of Electronic Data Interchange

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ABSTRACT

This study explores how rationales for information technology use relate to the extent of its assimilation in organizations and considers whether and how rationales associated with the technology-in-practice are transformed as the organization makes use of the technology. A multiple-case study of electronic data interchange (EDI) adoption and assimilation was analyzed, looking at both institutional and strategic rationales for EDI use. The degree of assimilation was greatest among those organizations that cited a strategically-oriented rationale for using EDI. The study also found evidence of a shift from institutional to strategic rationales in several organizations as they decided to extend their use of EDI beyond their initial implementation. Shifts in rationale emerged as organizational members gained greater exposure to the organizing vision of the larger EDI community and, to a lesser extent, as they experienced improvements in organizational performance through the use of EDI.

KEYWORDS

Diffusion, assimilation, organizing vision, technology frame, rationale

INTRODUCTION

In the context of information technology (IT) diffusion, assimilation is the process by which an organization routinizes and infuses the technology into its operations (Chatterjee, Grewal and Sambamurthy, 2002; Fichman and Kemerer, 1999; Cooper and Zmud, 1990). Studies of technology assimilation indicate that widespread acquisition isn't necessarily followed by widespread deployment and use. Explanations for the lag between acquisition and deployment have included the possibility that there are knowledge barriers that impede deployment, the possibility that acquisition is a means of preserving the option of later deployment, and the existence of discrepancies between the motivations and knowledge of those responsible for acquisition and those who would have to deploy the technology (Fichman and Kemerer, 1999). Although it seems reasonable that adoption decisions would be made as part of a well-conceived plan to improve organizational performance, there may also be other, less rationalistic reasons for adoption – as, for example, "to appear as though they were intended to rationalize work or to improve decision-making without having any real impact on organizational procedures or outcomes" (Markus, 1983:6).

Intention or rationale for the use of IT has been suggested as an important influence on adoption and assimilation (Orlikowski, 2000; Chatterjee, Grewal and Sambamurthy, 2002; Fichman and Kemerer, 1999; Markus, 1983). Weill (1992), too, has suggested that understanding how IT affects firm performance may depend on categorizing IT investments by the management purposes for which the investments are made. The purpose of this study is (1) to explore how rationales for IT use relate to the extent of the technology's assimilation in organizations and (2) to consider whether and how rationales associated with the technology-in-practice are transformed as the organization makes use of the technology.

To explore how institutional forces and an organizing vision help shape the technology-in-practice, the study looks at the adoption of electronic data interchange (EDI), a technology whose diffusion depends on interorganizational connections and cooperation among members of an organizational field. From the early 1970s to the present, EDI has been looked to as a means to improve efficiency by speeding the flow of information through the supply chain. Over that period of time, EDI has evolved, moving from proprietary networks to the Internet (e.g., EDIINT AS2), from record-based data formats to self-descriptive messaging (e.g., ebXML), and from manual to automated tracking of goods in the supply chain (e.g., RFID) (Bednarz, 2004; Whiting, 2003; Hayes, 2002). Although the technology has evolved, the diffusion pattern has been

essentially the same – one or more dominant organizations has adopted the technology and required its suppliers to adopt as well. As seen in suppliers' "slap and ship" approach to RFID implementation and continued use of fax for data transmission, assimilation of the technology is often fairly shallow (Wailgum, 2004; Whiting 2003). Obstacles to assimilation cited by suppliers include high costs (especially for small suppliers), lack of standards, and uncertainty about the future of the specific technologies (Wailgum, 2004; Bednarz, 2004; Dignan, 2004; Whiting, 2003; Benjamin et al., 1990).

THEORETICAL FOUNDATIONS

Recent research in IT has applied the ideas of technology frames and structuration theory to gain new insights into technology implementation and assimilation in organizational settings (Lewis, Agarwal and Sambamurthy, 2003; Davidson, 2002; Chatterjee, Grewal and Sambamurthy, 2002; Orlikowski, 2000; Swanson and Ramiller, 1997; Orlikowski and Gash, 1994). Technology frames are subsets of organizational frames of reference that members use to understand technology in the organizations in which they work. These frames consist of assumptions, expectations, and knowledge that address the nature and role of the technology in the organization, including conditions, applications, and consequences associated with its use and assumptions about management motivation for implementing the technology (Orlikowski and Gash, 1994).

The nature of technology frames is further explored in the technology-in-practice extension of structuration theory (Orlikowski, 2000). From this perspective, the rules and resources enacted in the use of technology (i.e., in practice) are seen to emerge through the agency of material facilities associated with the technology, norms of conduct associated with its use, and interpretive schemes that include assumptions about the usefulness or purposes to which the technology may be employed. The technology-in-practice is enacted through organization members' recurrent interaction with the technology at hand. In the course of its use, the structure represented by the technology-in-practice is reconstituted, either by reinforcing the existing rules and resources or by transforming them. As the structure is transformed, the technology frames of reference are also likely to change, reflecting new assumptions and expectations, including new assumptions about the technology's usefulness and purpose (Chatterjee, Grewal and Sambamurthy, 2002; Davidson, 2002; Orlikowski, 2000).

Assumptions about the technology's usefulness and purpose are also influenced by organizing visions developed by the larger community interested in shaping the technology's course and development (Swanson and Ramiller, 1997). The organizing vision is a focal idea shaped by institutional forces through ongoing discourse among such parties as technology vendors, consultants, industry pundits, industry associations, prospective adopters, and IS practitioners (Damsgaard and Lyytinen, 2001; Swanson and Ramiller, 1997). The organizing vision is an important element in IT diffusion, providing a compelling story of how the technology can benefit adopting organizations (Swanson and Ramiller, 1997). Not only may such institutional structures influence diffusion across an organizational field, they may also influence the technology's assimilation within organizations as it is routinized and infused into everyday activities (Chatterjee, Grewal and Sambamurthy, 2002).

Rationales for technology use are varied. Perspectives on why organizations adopt information technologies fall into two broad categories – a rationalistic perspective oriented toward improving organizational performance and an institutional perspective which expects technology decisions to be governed by exercises of power and efforts to maintain organizational legitimacy (Markus, 1983; Kling, 1980). Strategic choice and institutional isomorphism represent the two primary schools of thought in organizational decision-making research (Goodstein, 1994) and are specifically applicable to innovation adoption and utilization decisions (e.g., Teo et al., 2003; Tingling and Parent, 2002; Orlikowski and Barley, 2001; Barrett and Walsham, 1999; King et al. 1994; Kling and Iacono, 1989; Child, 1987). Strategic choice suggests that technology adoption decisions are made to optimize the achievement of organizational goals, including improving efficiency and achieving a competitive advantage (Hitt and Tyler, 1991; Whittington, 1988; Child, 1972, 1987; Chandler, 1962). Institutional isomorphism theory suggests that organizations may adopt technologies more for their symbolic value than for their technical efficiency, signaling other organizations of their commitment to rationality and good business practice (Perrow, 1979; Pfeffer, 1981; Fennell and Alexander, 1987). The mechanisms of institutional conformity include coercion, normative influence through the effects of professionalization, and mimetic activity that imitates the practices of other organizations that are considered to be successful (Staw and Epstein, 2000; Greve and Taylor, 2000; Mizruchi and Fein, 1999; Dacin, 1997; DiMaggio and Powell, 1983, 1991).

Given the importance of interpretive schemes in enacting the technology-in-practice and its associated assimilation in the organization, it seems worthwhile to consider how the rationale for IT use is related to the extent of its assimilation – to explore, for example, whether certain types of rationale are associated with greater degrees of assimilation. It may also be useful to explore whether and how IT use rationales are transformed as the technology-in-use is enacted through organizational experience.

RESEARCH STUDY

Design

A multiple case study of ten organizations that adopted EDI was analyzed. Organizations were selected according to EDI connection patterns: two organizations that were among the first to adopt EDI and whose positive experiences with EDI were reported in their industry group, four less publicized adopters in the same industry sector, and four smaller trading partners that had implemented an EDI exchange with the first two organizations. The data used in the study were gathered in 1992 and 1993.

Respondents in each of the organizations were executives and managers who had been involved in the EDI adoption and extension decisions (see Appendix A). Interviews of 1 – 1½ hours were conducted with two respondents in each large organization and with one respondent for each small organization. The interviews were tape-recorded and transcribed for later analysis. The responses of organizations were correlated to gain an informal triangulation of their accounts (Lacity and Janson, 1994). Historical and contextual records were also consulted to gain additional insight into the reasons for adoption, as well as to serve as a check on the validity of the exegetical analysis. Annual company revenues ranged from $35 million to $40 billion. Staff sizes ranged from 80 to 40,000 employees. Time since adoption ranged from 3 to 9 years.

Analysis

Analysis of interview responses was pursued with a recognition that institutional and strategic choice rationales for adoption are not mutually exclusive. This is consistent with Scott's (1987) contention that institutional arguments are better seen as complementing and contextualizing rational and efficiency arguments than as opposing them (Dacin, 1997).

Rationales for adopting and extending the EDI implementation were coded independently by two researchers, using two categories of strategic choice rationale (efficiency improvement and competitive advantage) and three categories of institutional rationale (coercive influence, normative influence, and mimetic influence). Initial coder agreement about whether there was evidence of strategic choice or institutional rationales was 89% for the decision to adopt and 93% for the decision to extend the EDI implementation. After further discussion of each of the rationale categories and additional review of the interviews, the coders reached agreement on the coding of the rationales.

ADOPTION RATIONALES

Focal-A

Adoption. Mimetic influences can be seen in the accounts of early awareness of EDI and the decision to adopt. Focal-A staff members had attended TDCC trade shows and had been aware of the EDI initiatives underway in the automotive industry. At about the same time, one of Focal-A's general managers attended a business roundtable meeting and heard of the commitment to EDI by General Motors and Ford. The general manager "came back with a target – kind of like putting a man on the moon. He wanted to see Focal-A using EDI."

The decision to adopt came when a group of Focal-A's managers agreed to participate in an EDI pilot project with several large companies in the chemical and railroad industries. Focal-A's managers heard what the other companies were doing and decided that EDI "made sense".

Normative influence in the form of a desire for professional legitimation also played a role in the decision. Improving morale in the accounting group was cited as a reason for participating in the EDI project. Morale was low because the group was considered "the graveyard of accounting." After implementing the EDI application, the group was seen as "the forerunner of accounting."

A strategic choice rationale was also evident. EDI was presented as a means of reducing the cost of processing. Cost/benefit analysis was performed before the project and the project produced cost reductions.

Extension. The decision to implement subsequent EDI transactions was made on the basis of achieving cost reductions.

Focal-B

Adoption. Normative and mimetic influences are seen in the awareness of EDI that led up to its adoption. Mr. Graves became aware of EDI when COPAS began to take an active role in standardizing EDI. The petroleum industry group Ms. Barnes was involved in had concluded, "Well, if [General Electric] can do it or if General Motors is going to be doing it, that's going to be the future. So we better start promoting it." Consultants and technology vendors published the positive accounts essential to Focal-B's imitation of others' EDI actions, describing General Motors' determination to establish a paperless operation.

Evidence of strategic choice rationales for adoption are also found in the respondents' accounts. Asked if he felt any pressure for Focal-B to get into EDI, Mr. Graves answered:

> Well, sure. All the presentations you heard – that number one, if you don't do it, others will and they'll be the lower-cost producer, and number two, if you don't get involved in it early and get your system set up, other people will tell you how to set your system up and it will cost you more than it would if you started early.

In his presentations to management, Mr. Graves emphasized "cost savings and value added", based on the advantages reported by the automotive and manufacturing industries.

Competitor-A

Adoption. Coercive influence is evident in Competitor-A's decision to adopt EDI. The decision was made in response to General Motors' demand that its suppliers adopt the new technology. Ms. Butler described the initial contact:

> My first introduction to EDI was when … an industrial customer of lubricants called and said, "You will do EDI with us", and we said, "Sure we will. What is it?" And it was General Motors.

Normative influence on adoption also played a role in the decision. Mr. Lowe observed, "There was never any question in my mind or anybody else in the company's that that's what we wanted to do." His professional affiliation predisposed him to favor the technology:

> This was obvious to many of us as we moved into the computing field – that this whole way of doing business, you know, this whole concept ... I guess the paperless office was always something you heard about, dreamed about – never thought it would come into fruition, but you wanted to try to make as much of that come true as possible ... It was just so right.

Extension. Strategic rationales are found in Competitor-A's decision to extend the use of EDI. EDI was adopted as one of the key strategic initiatives to be pursued by Comp A as it entered the decade of the 1990s. New EDI implementations were subject to formal cost/benefit analysis, usually citing cost savings and reduced manpower.

Mimetic influence was also evident in the pressure the chemical division personnel began to feel as they learned that many of the chemical companies had already endorsed EDI and were actively pursuing implementation. Coercion also continued. When other customers began to demand EDI relationships, Competitor-A agreed without hesitation.

Competitor-B

Adoption. Awareness of EDI and the decision to adopt came as the result of coercion on the part of a large, important customer in the railroad industry. Ms. Ford described the event:

One of our major companies came to us and the bottom line was, "If you want to remain a preferred supplier, you will do EDI with us."

The decision to comply was based on Competitor-B's strategy, which included preferred supplier status as a key ingredient.

Extension. Expansion of customer oriented EDI was presented as a "strategic project" that would benefit the customer and provide Competitor-B with a competitive advantage. Ms. Ford described the internal sales effort undertaken to get project funding:

> For this project we did not sell on benefits ... We told them it was all cost and no tangible benefits. But then we went into pages of intangibles at the end, explaining how that was going to benefit the customer. And that's how we sold it as a strategic project.

Customer oriented EDI was viewed as a competitive advantage that would very likely become a competitive necessity.

Competitor-C

Adoption. Evidence of mimetic influence can be seen in the accounts of early awareness and adoption of EDI. The first encounters with EDI were at a TDCC meeting attended by an MIS analyst and a member of the marketing staff. They also attended a trading partner seminar hosted by Montgomery Ward, a customer that wished to initiate an EDI trading relationship.

The decision to adopt EDI was made by the vice-president of MIS. The first discussions about EDI were initiated by IBM, serving as the value-added network provider for Wal-Mart.

Extension. Once Competitor-C got past the initial EDI implementation, discussions about EDI technology turned to efficiency improvement. Cost/benefit analysis was performed for new EDI projects. Reduced cost, improved productivity, and reduction of headcount were cited as prime reasons for developing a corporate EDI strategy.

Evidence of mimetic influence is also seen in Ms. Hughes' account of EDI extension efforts:

> And there's a senior level manager that says, "Hey, I talked to other companies and they say this is the thing to do and this is what I want to do."

Normative influence is seen Ms. York's account of influence from the MIS professional staff. Initiated and funded by MIS, the accountants who were directly affected by one of the proposed EDI transactions were not involved in the decision to implement. The accountants didn't believe the exchange was beneficial:

> And so our senior level management were saying "we don't want to do this because we don't get any benefit and it's going to cost us."

Competitor-D

Adoption. Mimetic influence can be seen in Competitor-D's decision to implement its only EDI application. Competitor-D agreed to participate "basically to cooperate with other producers" with which the company had joint venture applications. Competitor-D's management decided that "the economics were fairly inexpensive", so the cost of cooperation would be quite low.

Supplier-A

Adoption. Supplier-A's adoption of EDI resulted from the coercive influence of one of its most important customers, with the customer saying, "We're **going** to do EDI with you". Supplier-A's management agreed without hesitation.

Extension. Strategic rationales can be seen in Supplier-A's decisions to extend their use of EDI. As Supplier-A became more involved in supporting its customers' EDI needs and participating in industry based EDI associations, senior management began to believe that EDI would be beneficial to the company in improving operating efficiencies.

Coercion continued as Supplier-A extended its use of EDI. Mimetic influence is also seen in Supplier-A's new attitude toward EDI after its initial compliance with a customer's demand. When extensions to the original EDI implementation were demanded by other customers, the decision to comply with the first EDI demand came to be viewed as a matter of good fortune because it permitted Supplier-A to get in on the ground floor of EDI usage and become one of its customers' favored suppliers.

Supplier-B

Adoption. Mimetic influence is seen in Supplier-B's decision to adopt EDI. Supplier-B's first awareness of EDI came when Focal-A contacted them and asked if they would like to establish an electronic trading relationship, describing EDI as "the thing to do". Mr. Arnold was glad to accept the offer, even "not knowing what we were really going into".

Extension. Strategic rationales and evidences of coercion are found in Mr. Arnold's account of his decisions to extend his company's use of EDI. After the initial adoption, the company found that many customers required EDI support as a prerequisite to contract bidding:

> You have to have EDI, otherwise they say don't [bid on the contract]… And there is a trend – has been going on for several years – whereby they want to shrink their base of suppliers.

Mr. Arnold noted that implementing EDI had helped his company:

> The people that are participating [in EDI] are looked at as "Hey, these guys want to go along" … And by having EDI, you have a little bit of stroke. … So it helps us, not only at least to facilitate that end, but also to regain or even get at the business.

Supplier-C

Adoption. Supplier-C's first awareness of EDI came as the result of coercion by three of its largest customers. Supplier-C's managers believed that "We didn't have a choice".

Extension. Further extensions of EDI came as the result of continued demands from Supplier-C's customers.

Supplier-D

Adoption. Supplier-D agreed to adopt EDI because its management believed that refusal would eventually result in losing an important customer account.

Summary

As shown in Table 1, evidence of strategic choice rationales were found in the adoption accounts of three companies and in six extension decision accounts. Evidence of institutional isomorphism rationales were found in the adoption accounts of all ten of the companies and in five of the companies' extension decision accounts.

EXTENT OF ASSIMILATION

The possibilities for EDI use range from implementing only one transaction with a single trading partner to conducting all of a company's external business transactions via EDI. The implementation actions which emerged from the cases are summarized in Table 1. The extent of assimilation was assessed using the implementation stage model developed by Cooper and Zmud (1989, 1990). Table 1 summarizes the actions taken by each of the companies in implementing EDI and the stage of implementation achieved by each company.

	Focal		Competitors				Suppliers			
	A	B	A	B	C	D	A	B	C	D
RATIONALE										
Strategic Choice Rationale for Adoption?	Yes	Yes		Yes						
Strategic Choice Rationale for Extension?	Yes		Yes	Yes	Yes		Yes	Yes		
Strategic Choice Rationale for Either?	Yes	Yes	Yes	Yes	Yes		Yes	Yes		
STAGE REACHED										
Acceptance						Yes				Yes
Routinization		Yes		Yes			Yes	Yes	Yes	
Integrate with system	x		x	x	x	x	x	x*	x	
Extend transaction set	x		x		x		x	x	x	
Recruit for first transaction	x	x	x					x		x
Standards participation	x	x	x	x	x	x	x			
EDI coordinator	x		x	x	x		x		x	
Infusion	Yes		Yes		Yes					
New transaction sets	x	x	x		x					
Recruit new groups of trading partners	x		x							
EDI strategic plan	x		x		x					
EDI progress reports to executives	x		x							

**Integration with system was in progress at the time of the interview*

Table 1. Rationales and Implementation Stages Reached

The first five of the implementation actions are consistent with routinization. Companies that had taken fewer than three implementation actions were classified as having reached only the acceptance stage of implementation; the remainder were considered to have reached the routinization stage. The last four implementation actions are more consistent with efforts to infuse the technology throughout the organization. Companies that had taken at least half of these latter actions were considered to have begun the process of infusion. Table 2 shows the relationship between rationale (for adoption, extension, and both) and the stage of implementation achieved by the company.

	Acceptance	Routinization	Infusion
ADOPTION DECISION			
Strategic Choice	0	2	1
Institutional Only	2	3	2
EXTENSION DECISION			
Strategic Choice	0	3	3
Institutional Only	2	2	0
ADOPTION OR EXTENSION DECISION			
Strategic Choice	0	4	3
Institutional Only	2	1	0

Table 2. Rationale versus Stage of Implementation

CONCLUSION

The purpose of this study was (1) to explore how rationales for IT use relate to the extent of the technology's assimilation in organizations and (2) to consider whether and how rationales associated with the technology-in-practice are transformed as the organization makes use of the technology. With respect to the first question, the picture that emerged suggests that there is a relationship between rationales for IT use and the extent of the technology's assimilation in organizations. No clear pattern was found when attention was focused on the relationship between implementation stage and adoption rationale. Some of the organizations that cited only institutional rationales for adoption had remained at the acceptance stage, but more than half had progressed to routinization or infusion. When the focus of attention was expanded to include the rationales associated with decisions to extend the use of EDI beyond the first implementation, a clearer pattern emerged. Organizations with the most extensive implementations had developed a strategically oriented rationale for implementing EDI. The most superficial implementations were associated with those organizations whose utilization reasons were solely institutional.

Transformation of rationale was also observed. Although adoption rationales consistent with institutional isomorphism were more prevalent than strategic choice rationales, four of the organizations that had exhibited only institutional reasons for adoption later developed strategic choice rationales for extending their use of EDI. For three of the organizations, the shift in rationale for EDI use was not based upon actual benefits achieved within the organization, but emerged instead through contact with the organizing vision that they encountered as they began to participate in industry associations, professional associations, and standards development bodies working to promote EDI. Formal analysis of how the technology might specifically affect the organization was not performed in these organizations. The fourth organization achieved a measurable cost reduction through the use of EDI and decided to extend its use to other applications where cost savings and efficiencies could be achieved.

Taken together, the transformation of technology rationale enacted by the members of these organizations and the relationship observed between extent of assimilation and rationale for technology use suggest that technology use rationale may be an important factor in understanding the extent of assimilation achieved in organizations. The pattern observed in this study also suggests that analysis of the relationship between rationale for use and assimilation must consider not only the initial rationale associated with the technology's adoption, but also the emergent rationales that are enacted afterward as the organization members interact with the technology on a recurring basis. Additional exploration of the role of usage rationale may also be valuable in gaining additional understanding of technology frames and the enactment of technologies-in-practice.

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