

## **Organizational Decisions for I.T. Standards Adoption: Antecedents and Consequences**

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## Organizational Decisions for I.T. Standards Adoption: Antecedents and Consequences

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### **Abstract**

*This paper examines the adoption decisions for I.T. standards made in three types of large U.S. organizations, using a series of depth interviews. The study relates prior research on standards competition and organizational adoption to technological structuration theories. Preliminary findings show how scarcity of human capital and the variance in external coupling drive standards decisions, and also highlight the role of ideology in interpreting and enacting standards decisions.*

This exploratory study examines adoption decisions made by organizations for information technology product compatibility standards. Such strategic decisions constrain the future purchasing and operation decisions of the organization's I.T. staff. These decisions also directly impact the day-to-day work of most office workers, whether by changing their work environment, imposing unanticipated productivity losses or offering new skills that increase job mobility.

Although this study is explicitly theory-creating, it builds on existing research on related topics. The study of standards creation and adoption has been a fertile area of economic research, but prior research has rarely examined adoption decisions directly, treating them as a black box for aggregate-level outcomes. Examining standards in an organizational setting necessarily entails understanding the antecedents to technology adoption and product purchase decisions, which naturally include more general issues of power an authority within the organization. Meanwhile, some research has suggested possible consequences of technology adoption, both in internal outcomes such as the structure of work, and external outcomes such as organizational performance.

The paper first reviews the prior research on standards adoption, as well as organizational studies that relate to the possible antecedents and consequences of such adoption decisions. It then describes an exploratory study of I.T. decision-makers in large U.S. organizations, which examines the adoption process as both an outcome and a mediator.

### I. STANDARDS ADOPTION IN AN ORGANIZATIONAL CONTEXT

One of the largest and fastest-growing areas of organization spending is in the area of information technology products and services. A large

proportion of those I.T. products are based on *de facto* product compatibility standards. Thus, the adoption of standardized products is of managerial interest not only to the thousands of firms worldwide that produce such standards-related products, but also the countless organizations that are current or potential users of such products.

#### *A. Diffusion and Adoption of Product Standards*

A crucial dynamic in I.T. industries is the role played by *de facto* product compatibility standards [11: 224]. Prior research has developed four related theories to explain such standards: asymmetric switching costs, positive network externalities, path dependence of standards adoption, and increasing returns to scale [2, 13, 17, 28].

The combined implication is that the standards selection choices made by individuals or organizations constrain their own future product choices, and the choices made by the overall population constrain the choices of other members.

#### *B. Antecedents of Organizational Decisions to Adopt Technology*

There are two research streams that directly relate to an organization's decision to adopt a new technology standard. One is the general study of organizational purchases, the other organizational adoption of new technology.

*Organizational Buying Decisions.* The decision by organizations to buy specific products is considered distinct from consumer-oriented marketing in four ways: the seller's interfunctional dependence, product complexity, buyer/seller interdependence and the complexity of the organizational buying process [29: 14-17]. The latter three characteristics are relevant to this study.

Significant purchases usually require involvement from multiple individuals within the organizations, representing as many as six different roles: initiator, user, decider, influencer, buyer and gatekeeper [6, 30]. Decisions are reached through a combination of interpersonal (intraorganizational) influence tactics, including problem-solving, persuasion, bargaining and politicking [26]. The organization's decision is often stimulated by a boundary-spanning employee who acts as an internal advocate for an external vendor [19]. The influence of any particular influencer are related

both to formal rank and informal position within intraorganizational communication patterns [25].

Buying decisions for high technology products are constrained by buyer uncertainty, due to rapid technological change and mutually incompatible product offerings. This uncertainty, the level of technical expertise, the organization's potential switching costs and the strategic importance of the decision all drive the breadth of products considered as well as the ultimate purchase decision [16].

*Organizational Adoption of New Technology.* A particular example of an organizational purchase is the adoption of a new technology by an organization, which is theoretically related to research both on the diffusion of innovations and on organizational change.

Most research on innovation adoption focuses on a single innovation and who adopts that innovation (innovation-centric), but another stream (adopter-centric) examines a single adopter (usually an organization) and the innovations it adopts [14]. The innovation-centric diffusion research tends to have a pro-adoption bias, with late adopters labeled "laggards" [1, 23, 24]. This bias is weaker in the study of adopting organizations, which instead demonstrates a bias towards the ability to adopt any innovation rather than any particular innovation.

These adopter-centric studies have shown links between adoption and organizational culture [18, 20]. External pressures can also influence adoption, as when an organization is forced by intense competition to imitate a rival's adoption [22]. Organizations may also gain direct utility from adopting the same technology as other firms in the industry, as found in studying diffusion of fax machines [21]. Studies have shown mixed results on the transferability of the Rogers word-of-mouth influence to organizational adopters, with some studies in support [21] and others showing weak or little support [29: 163].

## II. CURRENT STUDY

This study considers computer and networking standards decisions made in organizations, which are crucial to producers because they comprise the primary or most lucrative market for many categories of I.T. products. These decisions are also important to organizations, since a choice to adopt a particular standard constrains future purchases, while allowing multiple standards constrains future support responsibilities.

### A. Research Questions

The research questions focus on testing the economic theories of standards adoptions in organizations.

- How is technological change within the organization linked to that outside the organization?
- Do prior theories describe the motivations for organizational standards decisions?
- Are there antecedents in the organizations that account for variation in standards decisions?
- Is the process organizationally determined or is there a role for individual strategic choice [8,9]?

The key variable is the standards adoption decision, either as an outcome or as a mediator between organizational factors and other outcomes.

### B. Central Focus: Role of I.T. Administrators

The focus of this study are those who make an organization's spending decisions for information technology adoption and use. Such specialists overlap the technicians studied by Zabusky & Barley [4, 31, 32].

But unlike the stylized horizontal organizations they present, computer technicians in this study also have a vertical hierarchy — i.e., bosses, often former technicians who have ascended into roles managing staff departments responsible for computing. In some organizations, the computing responsibilities may instead be decentralized to group, division or department-level I.T. employees, which coordinate with each other, corporate-level I.T. staff, and their respective line departments. Together these decision-makers are referred to in this study as "I.T. administrators."

### C. Research Design

The study used depth interviews (1-2 hours each) with key informants in organizations. To avoid exaggerating the salience of standards, interviews began with general product purchasing questions before narrowing in on standards-related issues.

Data gathering concentrated on three types of U.S. organizations: public research universities, large high-tech companies and K-12 school districts. The first two are examples of organizations with comparatively rapid diffusion of computing technologies, while the third have similar goals to universities but are comparative laggards in spending, adoption and expertise. The interviews performed thus far are summarized in Table 1.

	Individual Interviews	Organizations Represented
Public research universities	10	4
K-12 school districts	2	2
High-tech companies	2	2
Total	14	8

Table 1: Summary of interviews completed thus far

The study used a purposeful sampling technique, intended to represent a range of patterns that are theoretically useful for inductive research [12]. Where possible, multiple interviews were sought for each organization to identify variation within an organization while providing convergent perspectives in the same organization. This approach is complementary to the existing ethnographies of Zabusky [31], providing a wider range of organizations but in less depth.

### III. PRELIMINARY ANALYSIS

Two findings support prior hypotheses: managers identified a common set of salient standards battles, and their activities showed their role as boundary spanners between their organization and external technological dynamics. Other findings are more novel, showing the role of human capital and the variance in external coupling in driving standards decision and the role of ideology in interpreting ambiguous standards-related information.

#### A. Convergent Assessment of I.T. Standards Battles

The interviews produced a consistent picture of the sorts of standards decisions made by I.T. administrators. When asked about previous, current, or future standards decisions, most identified three or more from a common list of standards battles (Table 2) — which matched a list that might have come from a content analysis of computer-related magazines of the past decade.

Category	<u>Standards</u>		
	<u>Declining</u>	<u>Replacement</u>	<u>Other</u>
Operating systems	Macintosh	Windows	UNIX
Server software	Novell	Windows NT	
Word processors	WordPerfect	MS Word	
Spreadsheets	Lotus 1-2-3	MS Excel	
E-mail	ccMail	MS Exchange	Eudora
Web browsers	Netscape	Internet Explorer	

Table 2: Previous or ongoing standards decisions identified by informants

More remarkably, all informants agreed on the direction of the trend — one standard was clearly identified with the past (and seen as in decline), while another was identified as the standard of the future: between the two most popular standards, switching was always in one direction, although the perceived rate of change differed. In a few cases, some informants rated the standards battle as undecided, or listed a third alternative that was being used or considered by his or her organization.

#### B. Role of IT Administrators as Boundary-Spanners

All organizations studied had computer-specialist technical employees, and in all but one (a K-12 school district), these technicians were supervised either directly or indirectly by an I.T. administrator. Interviews confirmed the hypothesized roles of I.T. administrators linking their organization to external

technological change — technical boundary-spanners for their organization. This is consistent both with the research on industrial marketing [19], and also Barley's [4] typology of technicians as buffers between an external technical community and internal users of that technology.

The interview subjects (as with Zabusky's technicians) display many of the characteristics identified by Damanpour's [10] meta-analysis as being strongly correlated to organization adoption of innovation. These include technical knowledge, role specialization and external communication.

Given selection processes, it is not surprising that senior I.T. managers in this study displayed more intra-organizational focus and loyalty than the junior computer technicians of Zabusky [31]. At the same time, the technicians' career orientation towards occupation rather than organization was not merely a latent issue for these I.T. managers, but of very immediate concern, as experienced computer technicians were becoming difficult to obtain. This pointed up one of the key findings of the study thus far: the central role of human capital in the value of the information technologies.

#### C. Role of Human Capital

Prior research typically conceptualized product standards decisions in terms of technical compatibility — as when the cost of replacing hardware or software is emphasized over the cost of retraining users. However, interviews frequently identified human capital issues as key drivers (or mediators) of standards decisions made by organizations, generally consistent with prior research on the impact of organizational learning upon adoption [3]. Examples of how human capital drove standards decisions included:

##### *Technician Availability Drives Adoption Decisions.*

Often the requisite skills were difficult to obtain, because of technological complexity (e.g. UNIX), declining supply (Macintosh) or where demand outstripped supply (Windows NT). Some also said the amount of support required was a primary concern when making an adoption decision.

##### *Human Capital as the Largest Switching Cost.*

Discussions of switching decisions often focus on how a new standard renders obsolete investments in the previous standard. But for large organizations, the investment in the previous product can be relatively small, as when the purchase of new application software is funded out of operating budgets. The largest cost is replacing the skills of current employees using the existing standard — even though only a fraction of such switching costs were born by the I.T. department.

*Transmission of skills via job mobility.* The standard-specific skills of employees also acted as a source of coupling between the organization and

external influence. For example, if new employees brought into the organization (or transferring within the organization) were experienced on one particular standard, that helped pressure the organization into adopting that standard.

#### *D. Variance in Coupling Predicts Outcome*

The evidence suggested that differences in the actual (or perceived) coupling of the organization to external technology imperatives accounted for at least some of the variance in standards outcomes. In at least some cases, the variance appears to be due to differences in the tightness of coupling.

For example, in a professional school, the computer director described an imperative to use the latest upgrade of a common application suite: because the latest version was not available on a Macintosh, adopting the suite forced the abandonment of the few remaining Macintoshes. At another organization, there was no urgency to upgrade software — so the firm kept a large installed base of Macintosh computers even though new purchases had slowed to a trickle.

Self-reported motivations suggested that cognitive biases were a major factor in the degree of external coupling. The boundary-spanners read the same computer publications and thus had access to the same raw information, but the interpretation varied by individual. There was similar variance of how management or users interpreted such data. In the end, the subjective interpretation of ambiguous information appeared to matter more than the information received by the I.T. administrator.

#### *E. Ideologies of Efficiency and Power*

Such subjective interpretations were naturally guided by the administrators' beliefs. Many beliefs took the form of ideologies — untestable given the ambiguity of managerial situations — consistent with Krapfel's [19] model of buyer advocacy and Swanson & Ramiller's [27] "organizing vision" for I.T. innovation.

An example is the attitude towards multiple operating system (OS) standards. The computing directors for two university departments — hiring faculty from the same schools and competing for the same students — expressed very different views of the importance of having a single standard. One argued that a unified standard was essential for economic efficiency. The other argued that participatory decision-making — allowing users to choose between standards — increased user buy-in and thus reduced support costs.

#### *F. Switching Between Standards*

The study supplements the sparse existing literature on standards switching costs [7, 15, 16]. Most of the I.T. administrators had made at least one decision to discontinue a required (or

recommended) standard in favor of another standard for that same category. For software, the replacement was nearly simultaneous and complete, to facilitate intra-organizational cooperative work using the new standard. But in the case of hardware, few organizations had the wherewithal to replace half the installed base in one fell swoop, so managers typically prevented replacement (reducing numbers by attrition), or imposed the decision when obsolete hardware needed replacement.

The most consistent pattern seen across all switching decisions is that the cost of switching is rarely internalized by the decision-maker. Even if the I.T. retrains users, such training covers a small part of the psychic switching cost, so users continue with reduced productivity for days, or even month. These hidden switching costs do not show up in the I.T. budget but are nonetheless paid by the organization.

## IV. REFERENCES

- [1] Abrahamson, Eric, "Managerial Fads and Fashions: The Diffusion and Rejection of Innovations," *Academy of Management Review* 16, 3 (July 1991): 586-612.
- [2] Arthur, W. Brian, "Increasing Returns and the New World of Business," *Harvard Business Review* 74, 4 (July-August 1996): 100-109.
- [3] Attewell, Paul, "Technology Diffusion and Organizational Learning: The Case of Business Computing," *Organization Science* 3, 1 (Feb. 1992): 1-19.
- [4] Barley, Stephen R., "Technicians in the workplace: Ethnographic evidence for bringing work into organization studies," *Administrative Science Quarterly* 41, 3 (Sept. 1996): 404-441.
- [5] Besen Stanley M. and Joseph Farrell, "Choosing How to Compete - Strategies and Tactics in Standardization," *Journal of Economic Perspectives* 8, 2 (1994 Spring): 117-131.
- [6] Bonoma, Thomas V., "Major Sales: Who Really Does the Buying?" *Harvard Business Review* 60, 3 (May/June 1982): 111-119.
- [7] Breuhan, Andrea Lynn, "Innovation and the Persistence of Technological Lock-in," unpublished Ph.D. dissertation, Stanford, Calif.: Stanford University, Department of Economics, 1997.
- [8] Child, John, "Organizational Structure, Environment and Performance: The Role of

- Strategic Choice," *Sociology* 6, 1 (1972): 1-22.
- [9] Child, John, "Strategic Choice in Organization Studies: Retrospect and Prospect," *Organization Studies* 18, 1 (1997): 43-76.
- [10] Damanpour, Fariborz, "Organizational Innovation: A Meta-Analysis of Effects of Determinants and Moderators," *Academy of Management Journal* 34, 3 (Sept. 1991):555-590.
- [11] David, Paul A. and W. E Steinmueller, "Economics of compatibility standards and competition in telecommunication networks," *Information Economics and Policy* 6 (1994): 217-241.
- [12] Eisenhardt, Kathleen M., "Building Theories from Case Study Research," *Academy of Management Review* 14, 4 (Oct. 1989): 532-550.
- [13] Farrell, Joseph and Garth Saloner, "Standardization, compatibility, and innovation." *Rand Journal of Economics* 16, 1, Spring 1985, 70-83.
- [14] Fiol, C. Marlene, "Squeezing harder doesn't always work: Continuing the search for consistency in innovation research," *Academy of Management Review* 21, 4 (Oct. 1996): 1012-1021.
- [15] Greenstein, Shane M., "Did installed based give an incumbent any, measurable) advantages in federal computer procurement?" *Rand Journal of Economics* 24, 1, Spring 1993, 19-39.
- [16] Heide Jan B. and Allen M. Weiss, "Vendor consideration and switching behavior for buyers in high-technology markets," *Journal of Marketing* 59, 3 (July 1995):30-43.
- [17] Katz, Michael L. and Carl Shapiro, "Network Externalities, Competition, and Compatibility," *American Economic Review* 75, 3 (June 1985) 424-440.
- [18] Klein, Katherine J; Sorra, Joann Speer. The challenge of innovation implementation. *Academy of Management Review* 21, 4 (Oct. 1996):1055-1080.
- [19] Krapfel, Robert E., Jr., "An Advocacy Behavior Model of Organizational Buyers' Vendor Choice," *Journal of Marketing* 49, 4 (Fall 1985):51-59
- [20] Meyer, Alan D. and James B. Goes, "Organizational Assimilation of Innovations: A Multilevel Contextual Analysis," *Academy of Management Journal* 31, 4 (Dec. 1988):897-923.
- [21] Midgley, David F., Pamela D. Morrison and , John H. Roberts, "The Effect of Network Structure in Industrial Diffusion Processes," *Research Policy* 21, 6 (Dec. 1992):533-552.
- [22] Robertson, Thomas S. and Hubert Gatignon, "Competitive Effects on Technology Diffusion," *Journal of Marketing* 50, 3 (July 1986):1-12.
- [23] Rogers, Everett M., *Diffusion of innovations*, 3rd ed. New York: Free Press, 1983.
- [24] Rogers, Everett M., *Diffusion of innovations*, 4th ed., New York: Free Press, 1995.
- [25] Ronchetto, John R., Jr., Michael D. Hutt and Peter H. Reingen, "Embedded Influence Patterns in Organizational Buying Systems," *Journal of Marketing* 53, 4 (Oct. 1989):51-62.
- [26] Sheth, Jagdish N., "A Model of Industrial Buyer Behavior," *Journal of Marketing* 37, 4 (Oct. 1973):50-56.
- [27] Swanson, E Burton and Neil C. Ramiller, "The organizing vision in information systems innovation," *Organization Science* 8, 5 (Sept./Oct. 1997):458-474.
- [28] von Weizsäcker, C. Christian, "The Costs of Substitution," *Econometrica* 52, 5 (Sept. 1984): 1085-1116.
- [29] Webster, Frederick E., Jr., *Industrial Marketing Strategy*. 3rd ed. New York: Wiley, 1991.
- [30] Webster, Frederick E. Jr. and Yora Wind, "A General Model for understanding Organizational Buying Behavior," *Journal of Marketing* 36, 2 (Apr. 1972):12-19.
- [31] Zabusky, Stacia, "Computers, Clients, and Expertise: Negotiating Technical Identities in a Non-Technical World." In Stephen R. Barley & Julian E. Orr, eds. *Between Craft and Science: Technical Workers in US Settings*. Ithaca, NY: ILR Press, 1997, 129-153.
- [32] Zabusky, Stacia E. and Stephen R. Barley, "Redefining Success: Ethnographic Observations on the Careers of Technicians." In Paul Osterman, ed., *Broken Ladders: Managerial Careers in the New Economy*, New York: Oxford University Press, 1996: 185-214.