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# Informational Cascades and New Technology Acquisition in IT

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## **Abstract**

This is a study based on observational learning or the idea that an organization as a potential acquirer of a new technology in IT can be influenced by the acquisition of the technology by other organizations. The paper takes the framework of informational cascades and herding behavior from economics and applies it to acquisition of new technology decisions by organizations in the early majority phase of adoption of a new technology. The concept of an organizing vision for a new technology is used to locate the organization's view of a new technology in a larger community view of the technology. A conceptual model is presented that encompasses the initiation of cascades, the characteristics of cascades, and possible deleterious outcomes of cascades.

## **Introduction**

The premise of this research is that some aspects of new technology acquisition can be better understood when technology acquisition is viewed through the lens of informational cascades and herding behavior. Technology acquisition decisions are sometimes made with an eye to what other organizations are doing. When another organization acquires a new technology, this sends a positive signal to all other organizations considering the new technology causing some of them to acquire. The new acquirers, in turn, send their signals causing still more organizations to acquire. The resulting herding behavior can be understood as an instance of what is known as an informational cascade in economics.

The idea that potential adopters of a new technology are influenced by the adoption activities of others is not new. However, the informational cascade models of economists include the premise that public accumulation of information on a new technology slows appreciably or even stops while cascades are in progress; this is a relatively new aspect with significant implications. If organizations focus on the adoption behavior of other organizations and largely stop or ignore other methods of information accumulation as many of them follow the actions of adoption leaders, then a greater potential exists for misguided or wrong adoption decisions.

To place the focus of this research firmly at the organizational level, the argument put forward in this paper takes advantage of the notion of an "organizing vision" in new technology acquisition, as well as the informational cascades literature.

The paper first describes the ideas of an organizing vision and informational cascades, then sets out a conceptual model of informational cascades for new technologies in IT.

### **The Organizing Vision of a New Technology**

Swanson and Ramiller's (1998) notion of an organizing vision for new technology adoption is a useful place to start for the inter-organizational context it provides for new technology decisions in IT. For Swanson and Ramiller every new technology has an organizing vision which is a community's idea of why and how a new technology can be applied in organizations. An organizing vision is a community's attempt to make sense of a new technology and what its potential is for organizations that might acquire and implement it.

An organizing vision has an **inter**-organizational form and an **intra**-organizational form. In its **inter-organizational** form, the community that creates a vision is an amalgam of heterogeneous individuals and organizations with an interest in a new technology. It includes

vendors, consultants, the trade press, other potential acquiring organizations, even academics. The community converses about the potential of the new technology through advertisements, press articles, sales calls, conferences, exhibitions, training sessions, workshops, and consultants' reports. The experiences of organizations that first acquire a new technology are also communicated to the larger community and become an input to the organizing vision. The organizing vision in the general community is what Swanson and Ramiller call a "portal" through which information on a new technology flows into an individual organization.

In its **intra-organizational** form, the group that creates an intra-organizational vision of a new technology includes persons in the IT department, the business units that would use the new technology, the business units that would be affected by it, and senior managers who have influence over the acquisition of the new technology. An individual organization need not have an organizing vision that corresponds with the community's organizing vision. For example, often it is the true that some organizations are much more sanguine about the case for adoption of a new technology than the general community view and others are more doubtful. Thus some organizations adopt earlier and others adopt much later, or never.

An organizing vision has three functions, according to Swanson and Ramiller: (1) Interpretation: It is a story of the new technology -- what it is, how it works, and what it is good for. (2) Legitimation: It provides authenticity and viability to a new technology through its acceptance by a wider community and its acquisition by other organizations. And (3), mobilization: It provides a rationale for action, for acquiring the new technology. The idea of an organizing vision for new technology is not the same as Abrahamson's (1996) concept of "management fashion" where management fashions come and go with regularity. If a technology is widely adopted and used, it becomes a permanent part of the technological

infrastructure of organizations and the vision gradually fades away; no further legitimation or motivation is necessary. If the organizing vision never provides sufficient legitimation and motivation for widespread adoption, the technology will languish and fade in the marketplace as will the organizing vision (Swanson and Ramiller, 1998).

Uncertainty surrounds all new technologies at the outset. Therefore, the organizing vision in the early history of a technology is quite "fuzzy," to use Swanson's (2000) term. Clarity is gradually provided by both the development of capabilities in the community that increase knowledge about the technology (like service bureaus, consultants and vendors that simplify the technology (Attewell, 1992)) and by further adoption and use of a new technology by community members. As Rogers says (1995, p. 216), "...diffusion of innovations is an uncertainty-reduction process." However, some organizations acquire a new technology much earlier than others, long before mechanisms for reducing uncertainty have had much impact.

### **Informational Cascades and Herding Behavior**

Herding occurs in decisions where payoffs from behavior are similar but information available to various actors is not and the gathering and analyzing of additional information is slow or costly or both. In these situations an actor may decide what to do based on (a) direct communication with other actors and the sharing of information and/or (b) observing what others do, or what is sometimes called observational or social learning. When behavior is based on observing what others do, the potential for herding exists. The process of herding is known as an informational cascade, where the information communicated is through observation of the actions of others (Bikhchandani et al, 1992 and 1998).

We all engage in herding behavior; for example, when searching for a restaurant in an unfamiliar neighborhood, our decision of a restaurant to patronize can be influenced by other

persons patronizing the establishments available. When we see many patrons in one restaurant, but few in other nearby restaurants, the patrons of the more popular restaurant send us a signal that may influence our choice and trigger our decision to join the crowd in the more popular restaurant. We join the herd, and our decision may influence the next person who comes after us looking for a place to eat, who then further increases the size of the herd.

The work of economists has revealed the following aspects of informational cascades and herding behavior:

- When information is costly or hard to get, actors are more likely to rely on the actions of others.
- Imitative action doesn't depend on the number of positive or negative signals received from other actors but on the order in which they are received. A stream of positive signals tends to start a cascade.
- Not all signals are equal. When early action is by actors who are known to be important and respected (e.g., seen as having special knowledge or experience), or feared (e.g., competitors), their actions are more likely to be followed than are actions by actors seen as newcomers, misfits, or particularly entrepreneurial.
- Even when delaying an action is a possibility for all actors, when a well-respected actor makes a choice and acts others may follow very rapidly.
- Cascades can start under conditions of uncertainty -- even when the actors who follow in the cascade know the probability of the outcome they are pursuing by the action they take is less than one. For example followers may know that the actors they are following are not like them in various ways -- the initial actors may have greater risk tolerance, for example. Thus the signals of the initial actors are "noisy", but if enough

initial actors move in a certain direction, other actors overcome or ignore parts of their private information and a cascade can start.

- Cascades can start based on actor type. When the type or kind of actor can be observed along with his/her action, cascades can start based on actors of a similar type. This leads to the possibility of multiple cascades that converge on different outcomes.
- Once a cascade starts, information accumulation by other means stops (or slows down appreciably) as actors defer to the actions of predecessors and ignore other information, and actors may also ignore some of their own private information. This finding requires more explanation. In the choice of restaurant example above, when we follow the herd into a restaurant we often do not collect other information, even information that is readily available but would take a bit more time to collect, like perusal of the publicly displayed menus of other nearby restaurants. If we join the crowd in a Chinese restaurant, we may ignore our own private information that we generally prefer Italian food (offered by another restaurant down the street) to the Chinese cuisine we are about to eat.
- Relying on the actions of others may add distortions. The act of another is a crude filter and doesn't convey the subtlety of the reasoning behind their action. Because a cascade blocks some learning, in the worst case herding can converge on the "wrong" outcome.

### **A Conceptual Model of Informational Cascades in Acquisition of New Technology in IT**

The model that follows is for new technology acquisition in the beginnings of the early majority phase of new technology acquisition and implementation. Technology **adoption** can be separated into two parts -- new technology **acquisition** followed by new technology

deployment or **assimilation** (Fichman and Kemerer, 1999). In this research I am concerned with new technology acquisition only.

The distribution of new technology acquisition over time is often seen as being somewhat bell-shaped (Rogers, 1995). A few organizations, sometimes called pioneers, initially acquire. Pioneers are followed by a large group in the early majority, then another large group in the late majority, and finally a small group of lagers. This research concerns the early majority, not pioneers or later adopters. Pioneers are outliers and might be motivated by atypical risk taking or special circumstances that give the new technology extraordinary appeal, such as knowledge or expertise that is uncommon. It is the early majority where theories of informational cascades and herding behavior have potential relevance.

My preliminary conceptual model is presented in Figure 1. The model encompasses the formation of cascades, some characteristics of cascades, and outcomes or effects of cascades. Cascades may be started by the signal sent when a respected organization or organizations acquires a new technology. Signals can be strengthened or weakened by aspects of the community's organizing vision of the technology. Multiple parallel cascades on the same technology can form when followers identify with differences in some characteristic of the initial acquirers. Cascade behavior can lead to less favorable outcomes than would otherwise be the case because of the information blocking nature of cascade activity. The details of the model are presented in the following propositions.

#### Formation of Cascades

I assume that cascades are not a universal phenomenon in new information technology, and that they will occur only under certain circumstances. In addition to the signals sent by initial respected acquiring organizations, I propose that various conditions in the organizing

vision of a new technology can act to strengthen the signals of initial acquirers. Since most of these variables are not categorical and represent aspects of an organizing vision usually present to some degree whether cascades ensue or not, it is the level of these variables that is important for the development of cascades. Perhaps the correct specification of the model would include thresholds for some variables, but these are issues for consideration after empirical work yields some clues.

Proposition 1. Initial acquirer: The acquisition of a new technology by a respected initial acquirer sends a positive signal to potential acquirers which, if strong enough, starts a cascade. Respected initial acquiring organizations are analogous to Roger's (1995) opinion leaders in adoption of innovations by individuals.

Proposition 2, Reputation: The greater the reputation of the initial acquirer the stronger the signal will be.

Proposition 3, Clustering of initial acquirers: If multiple respected organizations acquire in a short time, their combined positive signals are greater than the sum of the signals that each would send in the absence of acquiring action by the others. The larger the number of reputable initial acquirers taking action to acquire a new technology in a short period of time, the stronger their combined signal will be.

The next five propositions (4 through 8) concern aspects of the community's organizing vision of the new technology that may be present and act to modify signal strength.

Proposition 4, Alignment: A new technology seen by the organizing vision to have an impact on business-IT alignment, particularly alignment with competitive implications, increases the strength of acquisition signal(s) sent by initial respected acquirer(s) to potential acquiring organizations. If strategic realignment is a result of the new technology, the cost of

waiting to accumulate more information is the potential surrender of competitive advantage to a rival, and for this reason signal strength is greater. The alignment literature stresses the importance of aligning IT strategy and structure with overall business strategy and structure and the importance of adjusting alignment as the business environment and technology change (Henderson and Vankatraman, 1992; Luftman and Brier, 1999), notwithstanding the difficulties that may stand in the way of achieving and holding alignment (Hirschheim and Sabherwal, 2001).

Proposition 5, Trialability: Trialability is the ability to experiment with a new technology on a limited basis. Rogers (1995) points out that trialability is more important for early acquirers of a new technology than for those who come later. When the organizing vision holds that it is not feasible to give the new technology a trial as less than a full implementation, the signal of respected initial acquirers is strengthened -- their acceptance can signal that a trial, with its associated time and expense, is not necessary.

Proposition 6, Complexity: If the organizing vision sees the new technology as complex and difficult to implement, the signals of the respected initial acquirers will be strengthened. Action by respected initial acquirer(s) sends the signal that payoffs from the technology justify the costs and/or that the difficulties can be overcome. For individuals as adopters, complexity refers to difficulty in understanding and using an innovation (Rogers, 1995). For organizations and IT, the possible difficulties can have multiple dimensions. Complexity may arise from technical, organizational and/or financial factors.

Proposition 7, New, upstart vendor(s): If the organizing vision sees the vendor(s) of a new technology as unproven, the signal of a respected few acquirers is strengthened.

Acquisition by a respected few sends signals of confidence in the viability of upstart vendor(s). Waiting to see how the new vendor performs over time is necessarily a lengthy process.

Proposition 8, Network effects: If the full value of a new technology is dependent on its acquisition and implementation by many organizations, as seen by the organizing vision, then the acquisition signals of a respected few are stronger. Acquisition by a respected few signals that important organizations will use the technology and help assure its viability. This confirmation is particularly important if a change in technology standards is at issue. The acquisition by a respected few initial acquirers of the technology signals that the new standard is likely to prevail.

Proposition 9, State of the economy. If the economy is strong and slack resources are available for IT spending, the signals of the initial acquirer(s) of a new technology are stronger. With a strong economy, more potential acquirers have the ability to invest in the new technology (Rogers, 1995).

### Characteristics of Cascades

Proposition 10, Differentiated cascade: Cascades may be limited to organizations sharing some characteristic of the initial acquirer. For example, a cascade may be limited to an industry or a region of the world based on the characteristics of the initial respected acquirer(s). This is more likely if the organizing vision of the new technology sees particular advantage in the technology for organizations sharing a characteristic of the initial respected acquirer and/or abilities to implement the technology represented by characteristics of the initial acquirer.

Proposition 11, Multiple cascades on the same technology: Identification with the characteristics of a particular respected, initial acquirer may be important to the formation of a

cascade, and when initial respected acquirers differ in some characteristic, separate cascades may form based on organizations that share the same variant of the characteristic.

Proposition 12, Multiple cascades differentiated by a vendor's version of the new technology: A new information technology is often offered by competing vendors in somewhat incompatible forms. In a case where separate cascades ensue based on differences in characteristics of initial acquirers and initial acquirers choose different vendors of the new technology, then the separate cascades may be differentiated by vendors versions of the new technology. Organizations cascading after a particular initial acquirer interpret the acquirer's choice of vendor as important for success in the implementation of the new technology for organizations of their type and follow this lead.

#### Outcomes of Cascades

A cascade may proceed with no significant effect on outcomes, other than speeding the overall rate of acquisition of a new technology. But cascades also have the potential for increasing the difficulties associated with adoption. Cascades temporarily slow the acquisition of information about a new technology which increases the possibility of "wrong" or "misguided" acquisition decisions by organizations in the cascade. Two propositions on the deleterious effects of cascades follow; others may be possible.

Proposition 12, Wrong vendor: Unexpected and disappointing outcomes from new technology adoption may result from choosing a vendor of a new technology whose implementation is ultimately found to be inferior to that of other vendors. If a standards battle is represented by differences in the technology between vendors, choosing the wrong vendor is particularly costly. Multiple cascades differentiated by vendor may, therefore, arrive at very different outcomes. And because a cascade blocks some of the information gathering that

would otherwise warn organizations away from a vendor's inferior technology, more problems and disappointment ensue than would otherwise would be the case in the absence of a cascade.

Proposition 13, The respected initial acquirer is, in fact, quite different: As noted above, economists' models show that cascades can form even when followers know that they differ from initial actors and know that they may not experience exactly the same outcomes. But followers can error in the degree to which they differ from initial actors, and for adoption of new information technology the degree of these differences can be crucial. Followers may not have the same ability to implement, they may not have the same resources to address problems, the technologies complementary to the new technology may be different in their organizations, their managers' or customers' expectations may be different, etc. Any of the many factors necessary to successfully acquire and implement a new technology may differ between initial respected acquirers and follower organizations. Because the followers herd and slow down gathering of information that would help alert them to differences and the problems that can flow from differences, they can encounter unforeseen problems.

The two preceding propositions both depend on the information blocking nature of cascades. But is this a reasonable assumption for organizations acquiring new technology in an information age? Clearly additional information is gathered and rapidly disseminated as multiple organizations acquire a new technology, including information from the few well-respected organizations that lead the way in the early majority. This is the essence of the organizing vision process. Organizations often publicly announce their acquisition decisions and include a rationale in their announcement; key people in the acquiring organization are interviewed by the trade press; they speak at conferences and conventions; the vendor of the new technology makes special efforts to broadcast the decisions of acquirers. In addition,

experts and consultants interpret the actions of initial acquirers and publicize their analyses. Organizations that follow in the early majority also explain their actions. So unlike the economists' models, much more is communicated than the simple signal that an acquisition has occurred.

Nonetheless, information transfer can be reduced allowing a cascade to form because organizations acquiring new technology do not reveal all. Information transfer is impeded and further information gathering is reduced for several reasons:

- First, although organizations give rational explanations for new technology acquisition to the outside world, the actual decision making process leading to an acquisition need not be rational. A very extensive literature on organizational decision making shows (a) that politics and power often play a large role in organizational decision making (Cyert and March, 1963; Butler and Gibbons, 1998), (b) that the decision making process is, in part, a function of the type of organization in which it occurs, and that in complex organizations the exact method and basis on which decisions are made may not be clearly understood, even by those involved in the process (Cohen et al, 1972; Weick, 1979), and (c) that rationality is bounded or limited, particularly for decisions that involve something new (Simon, 1960), so that even honest attempts to make a decision in a rational way and to communicate the reasons for the decision can be frustrated (Miller, Hickson and Wilson, 1996).
- Second, the internal organizing vision for a new technology necessarily has some fuzziness (Swanson, 2000). The decision to acquire means the fuzziness has been sufficiently resolved to proceed, at least in the minds of those with the power to make the acquisition decision. The fact that there is fuzziness and the extent of the fuzziness

is not communicated in the press releases, trade press articles, and speeches at conferences and conventions. It may not be communicated in full to a personal confidant in another organization. And it is possible that the nature of the fuzziness differs between members of the decision making group -- a detail that is not communicated to the outside world.

- Third, organizations may purposely convey less than they know about a new technology and less than their full reasons for acquiring it. They may do this to mask competitive motives and hoped for outcomes of their actions. Again, even close confidants in another organization may not learn the details.

For these reasons, substantially less than full information may be communicated when an organization acquires new technology, even if the organization wants to be forthcoming. Therefore, when a well-respected organization acquires a new technology and explains why, other organizations understand that the explanation lacks detail and subtlety. The act of acquiring still sends a signal that can have meaning beyond explanations -- a signal that is positive. It follows that acquisition signals by a few well-respected organizations can start an informational cascade and create a herd, and further private information gathering can be slowed as follower organizations hop on the bandwagon while slowing further attempts to obtain information and, perhaps, ignoring private information as well.

It is also true, as Fichman and Kemerer (1999) point out, that the knowledge needed to acquire a technology differs from the knowledge needed to implement it. Important portions of the latter knowledge may be obtained through learning-by-doing on the part of the early acquirers of the technology. Implementation knowledge costs may be higher than the organizing vision forecasts, and this can permit a cascade to form and lead to disappointing

outcomes before good knowledge is available. In the absence of a cascade, acquisition and implementation rates would be slower, and knowledge accumulation might benefit more organizations as they undertake acquisition and implementation decisions and actions. Further, organizations may acquire a technology to preserve the option of fully implementing it and using it at a later date (Attewell, 1992; Fichman and Kemerer, 1999). This may be a motive of initial respected acquiring organizations that is not communicated to followers who cascade after it.

### **Concluding Comments**

The conceptual model is static in the sense that there is no feedback to the organizing vision from the actions of the initial respected acquirers, from the formation of a cascade, or from the outcomes of cascades. Clearly an organizing vision would be modified by these events, and a dynamic model would incorporate feedback effects. A static model assumes that cascades form and proceed quickly so that feedback effects are too small to be relevant. Whether this characterization produces the most useful results is, of course, an issue to be determined by testing of this model against alternative models.

Is there any evidence for cascades in new information technology acquisition? And an even more fundamental question: how would one identify a cascade? Since respected organizations can acquire a new technology without triggering a cascade, my provisional approach is, first, to look for sharp discontinuities in the rate of acquisition of a new technology showing that many organizations suddenly acquired it in a short period of time, then to evidence of immediately preceding acquisition(s) by respected organization(s). To help rule out pure coincidence in the timing of events, I would also look for a burst in the "buzz" about the technology and its respected acquirer(s) in the trade press prior to and parallel with

the sharp increase in the acquisition rate. Mention of the initial, respected acquirers by followers would, of course, be useful evidence as well.

Several previous studies present data that may identify instances of informational cascades in new technology for IT. Fichman and Kemerer (1999) present annual data on firms acquiring relational database management technology, CASE technology, and fourth generation language technology. Discontinuities in the distribution of acquisitions over time may mark informational cascades for relational database and 4GLs, but not for CASE. Loh and Vankatraman (1992) studied the incidence of organizations signing large IT outsourcing deals before and after the announcement of Kodak's mega-deal with IBM in 1989 and show that there was a "Kodak effect" in which the incidence of large outsourcing deals increased markedly after 1989.

This work is at an early stage and much remains to be done. Ultimately insights that might be developed through use of the informational cascades framework may be helpful for development of normative guidelines that reduce new technology implementation disappointments and failures.

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**Figure 1. Conceptual Model: Informational Cascades (early majority phase)**

