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Understanding the IT Selection Decision: Interviews with Industry Decision Makers

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ABSTRACT

To study information technology selection decisions, IS researchers typically rely on two main theories: innovation diffusion and network effects theory. According to diffusion theory, selection decisions are based on factors associated with the product such as relative advantage, complexity, compatibility, observability, and trialability. Rather than deciding on product features, network effects theory emphasizes the existence and importance of the network (i.e. how many others buy this technology and the impact that will have) in technology selection decisions. While both these theories have been useful, little research has been done to validate that these factors actually influence decision makers in technology selection decisions. This research uses a set of six interviews with CIOs and IT managers to help evaluate and confirm the accuracy of these theoretical factors. Findings suggest some important questions for future research.

Keywords

Information technology selection decision, innovation diffusion, network effects.

INTRODUCTION

Information technologies derive much of their usefulness from the ability to link products together to improve functionality and communications. Inherent in these links are interdependence, interoperability, and interconnectedness. When IT decision makers are confronted with technology decisions, these technology attributes must be considered. As the numbers and types of information technologies continue to multiply every year, selecting the "right" product is getting more difficult. This decision is particularly difficult for organizations because they rarely begin with a "clean slate". As demands for integration increase, new technologies must interface with old technologies and, for forward looking decision makers, future technologies.

For academics trying to understand the factors motivating particular technology selection decisions, this is a complex issue. Existing theories, such as those developed to explain innovation diffusion, network effects, and switching costs are useful starting points for the complexities involved in these decisions. Practitioners, however, often use a different language to describe their decision making dilemmas. This research brings together the theories used in IS research and matches them with preliminary interview data from industry decision makers to formulate a comprehensive framework that incorporates commonalities from both perspectives. Although innovation diffusion theories have been tested at societal levels and adapted for individual level research, relatively little empirical work has been conducted in network effects theory, either at the market level or individual level.

In the first phase of this research, initial interviews with industry decision makers have been conducted to answer the following research questions:

1) How do organizations evaluate the various assessment areas that must be considered when selecting an information technology?

2) What is the connection between decision makers' evaluations of technologies and the theoretical factors proposed by research?

Using insights gathered in the first phase, the future second phase (not included here) of this research will attempt to understand how to make better technology selection decisions. This is a critical issue theoretically and practically because of the pace of technology change and the tendency of many information technologies to lock consumers into a particular path. To illustrate the path of this research better, a second phase research question is "What are some strategies that companies may use to mitigate the risks associated with technology selection?"

THEORETICAL BACKGROUND

Traditionally, to understand technology selection decisions, many researchers have begun with Innovation Diffusion theory. In perhaps the most famous of diffusion theories, Rogers' surveyed diffusion research in many fields and found five perceived attributes of innovations (PAI) to be most salient in explaining selection decisions of single innovations: relative advantage, [social] compatibility[1], complexity, trialability, and observability of the innovation in question. But diffusion theory fails to consider that information technologies are typically not evaluated as a single product, but as a cluster of products (Rogers, 1995). Additionally, diffusion theory does not consider "community issues" that make a particular technology more or less valuable (Fichman, et al., 1993). These phenomena, which are particularly salient in information technologies, are explained in network effects theory (Church, et al., 1993; Farrell, et al., 1986; Katz, et al., 1986).

Network effects theory describes a number of effects created by the diffusion of products in the marketplace. Among these effects are increasing returns to adoption, in which the total utility of a product for a consumer increases as more consumers adopt a technology (Arthur, 1988). These benefits may be in the form of direct network effects, or benefits derived from direct connections to one another. The classic example of a direct network effect is the telephone network because the "value of that network is based on the total number of users with similar access" (Church et al., 1993). Direct network effects are characteristic of most IT products because of the interconnectivity typically found between them. For example, direct network effects can be found by joining a network of users on a common technology standard, such as HTTP or POP3.

Additionally, benefits can be derived from indirect network effects, where the installed base of users of a technology yields benefits such as increased complementary products, experience and training with the technology, or survivability of the technology (Katz et al., 1986). While indirect network effects are not as closely linked to connectivity between products as direct network effects, the benefits derived are still present in the IT realm. In IT, a common example would be the development of products for the Windows operating system. The large installed base of Windows users creates benefits such as more complementary applications[2], more experienced users for support, and security for new adopters that the technology will survive.

Both innovation diffusion theory and network effects theory claim to have effects on decision making. Diffusion of Innovations theory states that the five Perceived Attributes of Innovation affect the selection decision of a particular technology. Network effects theory states that adopters choose a particular technology based on the benefits they receive from the network, either directly or indirectly. A number of researchers have combined diffusion theory and portions of network effects theory to better explain selection decisions (Fichman et al., 1993; Gallaugher, et al., 2002; Katz et al., 1986). The general assertion is that the total utility of a product is the sum of the standalone product utility and the utility gained from the network, which is a function of the number of users of the technology. In other words, IT selection decisions are not made on any one of these criteria, but a combination of standalone product utility, direct network effects, and indirect network effects. Each of these components exerts an influence on the final selection decision when it is made.

Using this theoretical frame, our goal is to understand decision making in reality and parallel those descriptions with the concepts described by theory as important. Given the lack of research pertaining to the total decision making process of IT selection decisions, as well as a lack of empirical work in network effects theory, this current research could contribute significantly to our understanding of this process. For this research, we interviewed IT decision makers from a number of industries. These interviews were developed using the Straussian approach, which can be used for theory elaboration of

[1] Technical compatibility is distinguished from social compatibility in this research. Technical compatibility refers to the capability of multiple products to work together. For example, "will this software package operate on the computer systems we have?" Social compatibility refers to "the degree which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters."(Rogers, 1995) For example, "will this software alter the way that the organization orders supplies?" or "will this software be compatible with the existing knowledge of the end user?"

[2] Complementary products can create both indirect to direct network benefits when they are added to the subject's network. In other words, development of complementary products may lead to more security in a technology's survival, for example, before adoption. After adoption, the network effects also become direct since the product increases the benefits of the subject's particular network.

existing theory (Strauss, et al., 1994). An aspect of the Straussian approach is to allow theory to drive the formation of questions for interviews (Boudreau, 2002).

INTERVIEW FINDINGS

For phase one of this research, interviews were conducted to verify theoretical concepts in reality. Interviews were conducted with IT decision makers with various job titles in various industries. These decision makers represented companies that employ 30 to 50000, with most being medium to large companies. Each interview ranged from 20 minutes to 2.5 hours. Table 1 summarizes the subjects of these interviews. The interviews were conducted in a semi-structured, open-ended question format, which gradually became more specific based on informant responses[3]. With one exception (informant B), all interviews were flexible in length and interviewees were allowed to elaborate at their discretion in response to both planned and follow-up questions. Typical interview practices of promising anonymity and choice to opt-out at a later date were included. To help minimize missed opportunities for identifying key points and formulating follow-up questions, two researchers were present at each interview.

Informant	Title	Industry	Industry Experience	Formal Decision Making Training	Interview Duration (min)
A	CIO	Banking	18	No	150
B	IT Program Manager	Food	20	No	20
C	CIO	Financial Services	12	No	75
D	Project Manager	Food	29	Yes	40
E	VP/CIO	IT Consulting	25	No	60
F	Program Manager	Public Health	15	Yes	120

Table 1: Informant Profiles

By design, phase one interviews were conducted to get a preliminary confirmation of theoretical forces in action. Of course, practitioners do not talk in terms that could be easily related to theoretical terminology. Practitioners do, however, have their own laundry lists of factors that creep into their decision processes, which we will try to match to theoretical terminology. In general, all of the informants described a number of common themes, which were discovered during an open coding process (Strauss, et al., 1990). Table 2 describes the major themes that decision makers described in their processes. Considering the surface commonalities from the interviews, we looked for a few coarse groupings for the themes from the informants. The themes have been split into three groupings, described as the "standalone" product assessment, the technical compatibility assessment, and the technology viability assessment. Each of these categories is described below with corresponding example quotes from the interviews.

"Standalone" Product Assessment	Technical Compatibility Assessment	Technology Viability Assessment
Product Cost	Compatibility with legacy systems	Vendor Support
Product Functionality	Compatibility with partners	Self-support
Complexity	Compatibility with architecture	Ability to hire trained staff
Performance in demonstration	Risks of Incompatibility	Vendor Product Plan
Performance in testing		Vendor Financials / Financial Stability
		Number of other users
		Vendor experience
		Vendor reputation

Table 2: Categorizations of Informant Themes

[3] Sample questions are available upon request from the lead author.

Standalone Product Assessment

Interviewees selecting IT products for their organizations tended to describe expected factors such as cost and functionality as key drivers. Additionally, when possible, these organizations pilot test the products that they are considering. For many of these decisions, comparisons are made between competing products along these factors. Following is a table of quotations[4] illustrating the standalone product concerns for these decision makers.

Theme	Illustrative Quote
Product Cost	A: "It's not the most important, but the first thing that comes to mind is cost"
Product Functionality	D: Describing the process for evaluating the 8 to 10 vendor-product combinations they've narrowed to…"[we] quantify their responses…whether the functionality is currently available right out of the box, if it is functionality which is planned for future release…or if it can be added with additional development work.
Complexity	C: "Complexity is the number one thing…" D: "We will actually go through and do an evaluation of each one and enter factors such as complexity of actually doing it"
Performance in demonstration	D: "When we've gone through and scored them…we would invite 3 to 5 vendors in for a more detailed presentation…and perhaps do a proof of concept"
Performance in testing	C: "I'm a big believer in piloting on site or doing incremental proofs of concepts of an architecture before you try to do it on any larger scale" F: "[we] weigh the merits, the trade-offs of the choices, and sometimes pilot test."

Table 3 : Standalone Product Assessment Quotes

Based on the descriptions from the interviews, the informants described a need to evaluate the product for its own merits. These merits may be its cost, functionality, or complexity. Additionally, when possible, these informants like to test the products before they purchase. This type of product evaluation makes sense since many IT products are designed to perform some task or provide some functionality to the organization. If the product is not providing that desired functionality for an acceptable cost, then it is likely discarded as an option. Additionally, it is noteworthy to understand that the standalone product assessment is mostly independent of the network benefits of IT[5].

These factors resemble the factors described by PAI. In other words, these decision makers are assessing the relative advantage of one product over another, evaluating the complexity of the product, and requiring opportunities to observe and test the product in their environment before purchase. Interestingly, there was little mention of [social] compatibility in these interviews. One possible explanation is that decision makers at this level are detached from "use" of the products they are selecting, which leads them to place less emphasis on how new technologies fit in with "the way we do things".

Technical Compatibility Assessment

As previously mentioned, organizations are becoming increasingly integrated, which creates a critical concern about technical compatibility in various ways. For example, informants described a need to be compatible with existing systems and architectures, between hardware and software, and with partner's systems. In fact, this factor can become quite powerful in two ways. In one way, decision making can be simplified by limiting the pool of potential choices due to an infrastructure strategy. In another way, a "superior" option can be discarded because of incompatibility. Following is a table of quotations illustrating the technical compatibility concerns for these decision makers.

[4] Prior to each quotation, the letter corresponds to the particular informant.

[5] There are likely some exceptions to this statement for products whose primary functionality is network related, such as routers, for example.

Theme	Illustrative Quote
Compatibility with legacy systems	C: "The legacy system issues…it's a big compatibility problem for most people because you've got to live with what you currently have and it's important that whatever you wind up doing can coexist with the systems that are already in place."
Compatibility with partners	E: After receiving back the request for proposals (RFP), "[we] waded through the responses and came to the decision that Peoplesoft was the best solution for them…but they got bogged down in the final process of signing a contract. Come to find out, the CFO was considering launching a joint venture with another company using Lawson, which was [the partner's] ERP package…the CFO kept saying that if this [joint venture] goes, then we would need Lawson instead, so maybe we should just wait."
Compatibility with architecture	B: "So there are a number of architecture requirements for [a product] to fit into our environment so that we don't end up having to support hundreds of platforms, which at one time we did. Over time we have brought it down to some very defined platform specific requirements and we go out and select software."
Risks of Incompatibility	A: "There are 6500 desktops and notebooks scattered around our enterprise. They all run the same operating system software. There's a single software image used on all of them. We deliver applications in a consistent way. To be able to so that efficiently and effectively, you have to be sure that when you roll out application 601, it doesn't break one of the 600 that already existed. So that whole issue of compatibility and interoperability just gets bigger and bigger with time." D: "We need to recognize if there are any major incompatibilities with our environment to the extent that they would actually have a detrimental effect on other systems within the environment. If that's the case, then it really comes down to looking to other alternatives and perhaps going with someone who might be a lesser alternative."

Table 4: Technical Compatibility Assessment Quotes

Within the context of interconnected IT, it is certainly expected that technical compatibility issues would be present. The extent of compatibility concerns as well as the power of these concerns to limit or alter selection decisions is notable. To understand these concerns in a theoretical context, decision makers are describing the importance of their "connected" network of products. For example, informant A described the problems that could be created by introducing a new application into the existing system of interoperable products. In other words, this informant is feeling the pressures created by direct network effects, or the need for benefits derived from the network that the product is directly interacting with. Interestingly, as one informant described, the pressures for technical compatibility can extend outside the organization boundaries, illustrating the importance of being part of a particular network.

In other terms, network effects theory describes the phenomenon of direct network effects as the benefit derived from the network to which you are directly connected. Paraphrasing the informants, it is critical for the product selected to be compatible with their existing network for the organization to reap the benefits of the interconnections of the network.

Technology Viability Assessment

Informants also indicated an emphasis on the market survival of the product (or associated vendor) that they choose. Again, for IT investments, which are often complex and can cost millions of dollars, organizations are concerned with the ability to get support for those products. In many cases, an organization simply does not have the knowledge or the capacity to support its most complex systems, so the failure of a company providing support for those products can be devastating. This is only enhanced by the history of the IT market, which has been characterized by defunct businesses, mergers and acquisitions, and changing product strategies. Decision makers realize they will need support for many products, but have difficulty predicting the future. To reduce the uncertainty around the future of a particular product or technology, decision makers describe various steps they take to better understand the market and the vendor. Following is a table of quotations illustrating the technology viability concerns and uncertainty-reducing measures for these decision makers.

Theme	Illustrative Quote
Vendor Product Plan Vendor reputation	A: "What is [the vendor's] product plan? What does the roadmap look like for enhancements for both hardware and software, new functionality, leadership in the industry?" D: "I want to have the opportunity to check references and talk with other clients who have used that specific product and hear what types of experiences they've had with it...I want to hear what [the vendor's] future direction is…I want to look back at what their record has been and I want to talk to previous customers."
Ability to hire trained staff Self-support	B: "…the client group has a budget for the ongoing support and sometimes a consultant comes with it." C: "I had to make a choice of whether or not to go the open source direction cause it's free and it's still very powerful…or going the easy direction where I thought that I was going to have more support, cheaper developers, and it would be easier for me to deal with it without having to become a guru in it." E: "I'm going to look to see that if the whole thing goes south, can I still survive."
Vendor Financials / Financial Stability	E: "One of the real big clues is the financial liability of the company manufacturing the product. So I do a very extensive financial background on the vendors…I want to know where the profit is coming from."
Vendor Support Vendor experience	C: "…a tiny little company wrote a goofy little integration model for Quickbooks. That one scares me because those guys could go out of business or decide they don't like this product and not be there in a year. But they have a product that saves us a ton of time."
Number of other users Product Viability	C: "What is the market? What's the user base for [the product]? It's pretty important because it speaks for the viability of the product itself. If nobody's using [the product], it's not going to get support and it's not going to continue to be improved upon, and it's not going to have legs."

Table 5: Technology Viability Assessment Quotes

In the interviews, the informants described the difficulty in evaluating some vendors and the future of some products. As one informant described, this concern is sometimes alleviated by choosing a product from the top two in the product category. There are concerns with this type of strategy. For some products, the top two vendors are not necessarily strong. In one case, an organization can choose between Microsoft's .NET products or Sun's Java products and feel pretty secure in their choice. Choosing an ERP system seems to be a similar situation with a few companies dominating the market. However, as an example of how a relatively well understood landscape can change, Oracle purchased Peoplesoft and had to reassure both their own customers and Peoplesoft's that both systems would receive continued support for years into the future.

In a theoretical context, network effects theory posits that the equilibrium state between two competing network products is complete market control for one product and complete failure for the other. This success and failure is determined by the installed base of the product and the complementary products developed (Farrell et al., 1986). While this extreme does not happen in most cases, there are plenty of cases where a dominant product emerges, and competitors concede the market, leaving their adopters stranded without support.

In essence, decision makers are seeking information and responding to forces created by indirect network effects. Again, indirect network effects are benefits derived from belonging to a network of products, without the need to directly connect with those other products. In other words, adopters of a product with a large installed base reap benefits in terms of continued support, additional complementary product offerings, and experienced users, for example. Since support is so critical for many IT products, decision makers want to know what the installed base for a product is, what the vendor's product strategy is, and what the financial strength of the vendor is.

DISCUSSION

Through the process of interview analysis and theoretical elaboration, this research has illustrated a bridge between actual IT selection decision considerations and suggested theoretical considerations. On one side of the coin, academics have developed language and theories about the factors that drive particular selection decisions in information technologies. These factors, such as relative advantage, direct and indirect network effects, might loosely be called "forces" that influence decisions. Depending on the strength of these forces, a particular technology is chosen.

On the other side of the coin, IT decision makers are trying to make the best decisions they can when faced with many alternatives, many organizational demands, a wide range of possible evaluation criteria of varying importance, and an ever-changing information marketplace. From our coding of interview data, we have created three main assessment areas that seem to influence the decision makers' selection of technology: the standalone product assessment, the technical compatibility assessment, and the technology viability assessment.

To bridge the gap between theoretical description and practical evidence, we have tried to understand the relationship between the decision makers' perceptions and the influences on product selection from the product characteristics and the marketplace. This bridge has led us to the following model termed the Technology Evaluation Axis (Figure 1).

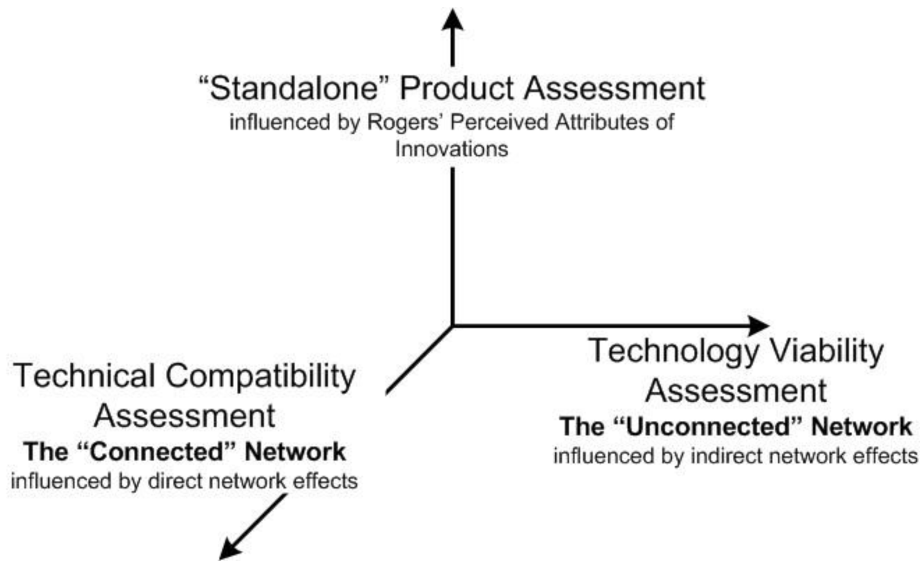

Figure 1: Technology Evaluation Axis

Expanding previous arguments, a decision maker's standalone product assessment seems to parallel with Rogers' Perceived Attibutes of Innovations. This is consistent if the technology is viewed as providing a set of functionalities outside of the benefits derived from belonging to a network of products. For example, a desktop application is chosen based on its relative advantage over a competing product, whether that is cost or functionality, its complexity, and the ability to try it out ahead of time.

Of course, that desktop application probably needs to be compatible with an existing operating system, be able to exchange files with coworkers, and not disrupt any existing applications. This is the technical compatibility assessment. Paraphrasing one informant, the selection of the superior product based on a functionality assessment may not be chosen because of its incompatibility with existing architecture. This parallels with the concept of direct network effects, or benefits derived from being connected to a particular network of products. Stated differently, since information technologies derive much of their benefits from interconnectivity, it is critical that the network interoperate together, whether that is between operating systems, hardware, and applications, or between applications in different organizations. Incompatible systems lose the benefits of direct network effects.

Finally, given the cost, complexity, and effort associated with many information technologies, decision makers are concerned with finding support and not being stranded with a product. This is perhaps the most difficult assessment area in cases where there are not clearly dominant vendors. This requires prediction of the future which can change based on the choices of other users, the entry and departure of competitors, mergers and acquisitions, and commitment to a particular product by the vendor. Decision makers are grasping for information that will reduce the uncertainty of the product's future. This information results from indirect network effects, or belonging to the larger "unconnected" network. For example, for a organization choosing an ERP vendor, they may never have intentions to connect to another organization's ERP system, but they still derive benefits from choosing the same system. This effect increases as the installed base of a product increases.

Among the benefits of indirect network effects is vendor stability, ability to find trained employees, and increased complementary products.

Most technologies have strengths and weaknesses along each of these axes. For some systems, there may be additional information that factors into technology selection. For example, a company that has a highly skilled IT staff may determine that they can support a technology even if the vendor quits supporting it. In another example, an organization may realize that a product will not interconnect with the entire enterprise, so technical compatibility is not as important. Finally, in a commodity market, standalone product features may not distinguish one product from another, shifting the emphasis onto other assessment areas.

LIMITATIONS

As with any research, this is not without limitations. First, while the Straussian approach to elaborating on existing theory is quite useful in this particular research, this approach has its critics. With this approach, there is a risk that a theoretical frame carried into the research can potentially bias findings (Glaser, 1992). While proponents of this research would argue that having a theoretical frame is preferable, especially in a theory elaboration exercise, it is worth noting that the possibility exists. Second, this research has a limited sample. While it is not uncommon to select a sample where theory can be extended (Eisenhardt, 1989), only six interviews have been conducted so far, which may limit the number of themes that have been discovered.

FUTURE RESEARCH

Phase one of this research was designed to get an understanding of the factors that influence technology selection decisions in practitioner minds and map their jargon to concepts in relevant theory. This process has led us to a conceptual model that can help guide our future research. Future research will begin with a more formal coding and categorization process using a software tool. This will help determine inter-rater reliability. Additionally, by using a software tool for coding, we may find additional insights that were overlooked in the preliminary coding process.

Subsequently, the three categorizations can be broken down into smaller concepts which will assist us in creation of an instrument for measuring these factors in a statistical fashion. From a better understanding of the parallels between theoretical concepts and decision making influences in reality, we have a foundation to build research about more interesting and beneficial questions. For example, what are the factors that ultimately determine a successful technology choice? What tools can be created to help organizations make better technology selection decisions? What are the factors that technology vendors need to understand to develop product strategy and retain customers making these decisions? How do open source products change the dynamics of decision making? Future research will begin to address these types of questions using the concepts confirmed and developed here.

CONCLUSION

This research set out to determine how IT decision makers make IT selection decisions and if that relates back to theoretical arguments of the factors that drive those decisions. To determine this, a set of six high level IT decision makers were interviewed using theory-driven, semi-structured, open-ended questions. These interviews were open-coded to find themes and from this process, three primary categorizations of the decision makers' assessment areas were extracted: standalone product assessment, technical compatibility assessment, and technology viability assessment. From these categorizations, we built connections to innovation diffusion theory and network effects theory. These connections allowed the construction of the Technology Evaluation Axis, which will serve as a frame for future research.

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