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Justin Cochran
University of Georgia

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Organization Strategy and Products Based on Technical Standards

Justin Cochran
University of Georgia
justinc@uga.edu

ABSTRACT
Organizations producing products based on technical standards are interested in the factors that influence a customers’ intention to adopt that product, and accordingly that standard. In general, standards-based products are expected to be affected by factors similar to those that affect ordinary innovations, as described in Rogers’ Diffusion of Innovations with the addition of a few factors including existence of complementary products, perception of an installed base, perception of the importance of the standard, and the risk of failure of the standard. Additionally, this research examines how these newly identified factors affect organizational strategies. Depending on the perceptions of the customer, the organizations can choose a number of strategies along the Strategy Continuum to meet the needs of the customer while maximizing the gains of the organization.

Keywords
Technical standards, Diffusion of Innovations, network externalities, strategy continuum, adoption

INTRODUCTION
Organizations producing products based on technical standards are interested in the factors that influence a customers’ intention to adopt that product, and accordingly that standard. This is important to organizations that are producing technical standards-based products because purchasing decisions of these product types (i.e. digital cameras, computer hardware) are influenced by different factors than non-technical standards based products (i.e. clothing). Among the distinctive factors of these products are network externalities, perceived risk of adopting a particular standard, and awareness of the importance of the standard.

Organizations that understand the influences in the customers’ decision processes are better equipped to choose strategies that effectively sell to those customers. In the realm of products based on technical standards, and the associated factors in the customers’ minds, organizations have different motivations for choosing competitive and cooperative strategies as compared to ordinary products.

This research attempts to extend Rogers’ Diffusion of Innovations in cases where technical standards are involved. Secondly, given the additional factors that influence adoption of technical standards-based products, this research attempts to determine how organization strategies might differ for companies producing these standards-based products as compared to ordinary products.

Suspecting that technical standards-based products introduce a different dynamic in the marketplace, two primary research questions are prompted.

1. What are the factors the influence a customer’s intention to adopt a technical standards-based product?
2. What are the strategies that a company might employ to address the different customer considerations, when the customer is purchasing technical standards-based products?

CUSTOMERS AND TECHNICAL STANDARDS-BASED PRODUCTS
Researchers attempting to explain the adoption of technologies by individuals and organizations have frequently cited Rogers’ Diffusion of Innovations (Rogers, 1983). Rogers’ theory that five Perceived Attributes of Innovations (PAI), relative
advantage, compatibility, complexity, trialability, and observability help explain the rate of adoption of innovations has been supported by various research articles (Moore, and Benbasat, 1991; Plouffe, Hulland, and Vandenbosch, 2001).

For products or innovations that are built on technology standards, adoption decisions are influenced in a number of different ways. Adoption decisions in the case of technical standards-based are expected to be influenced by PAI as well as some additional factors. First, we can examine the definitions of the various PAI (Table 1).

<table>
<thead>
<tr>
<th>Perceived Attribute of Innovation</th>
<th>Definition</th>
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</thead>
<tbody>
<tr>
<td>Relative Advantage</td>
<td>The degree to which an innovation is perceived as being better than the idea it supersedes (p.213)</td>
</tr>
<tr>
<td>Compatibility</td>
<td>The degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters (p.223)</td>
</tr>
<tr>
<td>Complexity</td>
<td>The degree to which an innovation is perceived as relatively difficult to understand and use (p.230)</td>
</tr>
<tr>
<td>Trialability</td>
<td>The degree to which an innovation may be experimented with on a limited basis (p.231)</td>
</tr>
<tr>
<td>Observability</td>
<td>The degree to which the results of an innovation are visible to others (p.232)</td>
</tr>
</tbody>
</table>

Table 1: Rogers' Perceived Attributes of Innovation

Rogers’ definition of Relative Advantage has its roots in his work concerned with agricultural equipment. The definition in a more competitive environment should refer to the relative advantage of innovations that are currently competing and those in the near horizon.

Additionally, it should be noted that Compatibility should be extended to include technical compatibility. This extension applies under conditions where compatibilities are relative to current values, current needs, past experiences, and current technical compatibility concerns. For example, an organization purchasing a new software package would be concerned with the compatibility of the software to its current operating systems.

Beyond the scope of the Perceived Attributes of Innovations are political and emotive factors. Rogers’ model assumes a rather rational approach to adopting innovations, but quite often there are a number of non-rational influences leading to the adoption of an innovation. One example of this is the strength of allegiance to Apple Computers, in essence a brand community (or a Microsoft / Intel anti-brand community), where product evaluation is not rational, but emotive. Other examples are purchases based on the advice of an “expert” or a friend.

Additional Attributes Affecting the Adoption of Standards-based Products

While it is expected that the aforementioned factors are important in explaining the rate of adoption of general innovations, those products that are characterized with technical standards are expected to add factors to the decision making process for the individual. This assumes that the adopter is aware of the standards that could impact the purchase of complementary goods or the sustainability of the standard. For adopters that do not consider this, the purchase of products based on standards should not be unlike the purchase of any other innovation. However, if the adopter is aware of the involved standards, there are a number of factors that could affect their decision (Figure 1).
Additionally, the existence of factors such as network externalities and infrastructure considerations can skew decisions for adoption from those based strictly on Rogers’ model. In fact, inferior standards can rise to dominance under conditions where there is rapid proliferation of an installed base or many complementary products. (This assumes that the term
“inferior” refers to the technical capabilities of a product, though it may be argued that a dominant “inferior” standard is superior through its likely longevity.)

Schilling proposes that there are a number of factors that can lead to “technological lockout” for a company developing products based on technical standards (Schilling, 1998). These factors can serve as a starting point for understanding the factors that a customer might keep in mind when making a purchasing decision.

**Network Externalities**

Technical standards are often associated with network externalities. Network externalities are existent when the customer perceives increased benefit from similar purchases by other customers of the same technology (Jordan, 1994; Katz, and Shapiro, 1986; Schilling, 2002). Traditional examples of network externalities, such as the telephone system, were defined by a physical network. It pays for a customer to adopt a particular telephone standard if many other people adopt that same standard. It is not beneficial for a single user to adopt the standard if he is alone in this purchase. In fact, to adopt the wrong standard on a physical network could severely limit the usefulness of the product to the customer.

While network externalities are traditionally associated with physical networks, networks of consumers using a particular standard can benefit as well. As the consumer base grows, the survival of the standard and the products that use that standard becomes more likely. Two primary sources of network externalities are complementary goods and installed base.

Schilling proposes that a company can become “locked out” by a lack of complementary goods. In other words, customers will gravitate to products that have an assortment of complementary goods that are compatible with the technical standard. In this way, the existence of complementary goods is a forward looking perspective. Essentially, the customer evaluates the opportunities to leverage the compatibility allowed by the technical standard at some future date. Compatibility of products around a technical standard is not described in Rogers’ Perceived Attributes of Innovation, though it is proposed to extend Rogers’ definition of Compatibility to include compatibility with current technical standards. Popular examples of the importance of complementary products are the VCR and video game systems. Video game systems that have few games to choose from are typically disadvantaged when compared to systems with many games. Likewise, the abundance of VHS-based movies over Beta led to the eventual extinction of the Beta standard for consumers. In essence, the existence of complementary goods is expected to increase the intention to adopt that product.

Closely tied to complementary goods is the concept of an installed base. Schilling suggests that companies that have an insufficient installed base for their supported standard can become “locked out”. From the customer perspective, an installed base indicates strength in the technical standard, which translates to longevity of the standard. The concept of installed base is “self-reinforcing” with complementary goods (Schilling, 1998). In essence, an installed base makes production of complementary goods lucrative for manufacturers, while greater numbers of complementary goods entice customers to purchase, resulting in a larger installed base. Recently, the purchase of DVD players has accelerated partially due to increased confidence in the format due to the growing installed base of DVD players. Therefore, for customers evaluating the purchase of standard-based products, the existence of an installed base or the perception of an eventual installed base will increase the likelihood of adoption of that product.

Products based on technical standards are different from ordinary products in that the compatibility between products is related to the value and usefulness of the products. In fact, technical standards can have far reaching effects for many products. For example, one customer might purchase a CompactFlash card for their digital camera. If the customer only uses the CompactFlash card for the camera, then the importance of the standard is small for that customer. In fact, the customer may not even consider complementary goods or the installed base for that standard. However, another customer might have a variety of other electronic purchases to make that could utilize that same CompactFlash card, indicating a level of importance for complementary goods to the customer. To the customer considering a number of products around a common standard, the customer will have increasing interest in the survival of that standard and its installed base, affecting their intention to adopt the standard. The amount of importance that the customer places on the standard is expected to affect both the importance of complementary goods and the importance of the installed base when considering adopting standards-based products.

Customers might also perceive some level of risk associated with choosing a wrong standard. By choosing a standard that fails, a customer is left without support for the standard and the value of the investment is limited to its current uses. This is especially hazardous for large purchases. Choosing a large, expensive software package should increase the assessment of the risk associated with choosing one standard over another. For example, a customer of supply chain management software will likely perceive a lower risk for a package utilizing XML as a standard when compared to a proprietary or inflexible
standard. A high perceived risk of the failure of a standard should discourage adoption of a standards-based product. However, this perception of risk can be alleviated to an extent by the size (or expected size) of an installed base.

Given that there are additional factors in the mind of the customer selecting standards-based products, and by default standards, it is expected that this should affect the strategies that an organization chooses when producing standards-based products for potential customers. By understanding the factors introduced, an organization can better target the needs of the customer.

**ORGANIZATION STRATEGY AND STANDARDS-BASED PRODUCTS**

Products based on technical standards\(^1\) are not entirely unlike most products bought and sold in the open market. These products are controlled by supply and demand principles. They are produced in the presence of competitors. Customers make the final decision of which products to purchase. In these ways, organizations need to continue to consider the factors laid out in PAI.

Furthermore, organizations need to understand the additional customer concerns when choosing standards-based products. Customers respond to the existence of complementary products and installed bases around the standard, and perceive risks associated with the failure of standards. Organizations, however, may not always be in the best position to meet these customer needs and consequently, may need to consider alternate strategies to meet these needs.

**The Emergence of Standards**

Voluntary standards are those created by company or industry specification. They can also arise from success of a product. For example, Ashton describes a voluntary standard as “an agreement of various parties on a set of definitions regarding certain attributes of a product or process (Ashton, 1987).” Other research proposes the idea that a dominant design can become a standard if it is characterized by network externalities (Hill, 1997; Schilling, 1998; Schilling, 2002; Suarez, and Utterback, 1995). Regardless of the path that results in the voluntary standard, the customer’s decision to purchase a standards-based product is still influenced by the same factors. The standards created through these two paths are proposed to be derived from different strategic mentalities.

**Standard by Definition**

Standard by definition describes technical standards that are defined by an industry board (in which membership is voluntary), industry alliances, or company specification. Examples of standards defined by an industry board are those of the Institute of Electrical and Electronics Engineers (IEEE), such as IEEE 1284, the parallel port connection for computer printers, or IEEE 1394, also known as FireWire\(^2\). An example of a standard defined by industry alliances are DVD+R and DVD-R. These competing standards each have strong industry supporters, and have yet to resolve their differences.

In the traditional conception of a standard, or standard by definition, Link (Link, 1983) indicates that a standard serves four purposes:

1. to improve information communication regarding the rules and characteristics
2. to ensure compatibility of complementary products
3. to establish quality levels
4. to reduce the number of competing technologies, resulting in benefits from economies of scale.

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\(^1\) In this research, “technical standards” refers to voluntary standards only. Non-voluntary standards, such as those dictated by government regulation, do not allow much choice if the standard applies to the product type.
Standard through Adoption

Standards through adoption, or de facto standards, are different than standards by definition in that standards through adoption are a result of mass adoption of the standard by users. An example of a standard through adoption is the Microsoft Windows platform. Most companies seeking to compete in the personal computer software market choose to write software that operates on the Windows platform. While there are those companies that choose not to build complementary products for this installed base, doing so eliminates a majority of their potential customers within this market.

In the presence of “standards through adoption”, the standard emerges, usually from a group of competing products, and seems to serve purposes similar to those depicted by Link, though in a different manner.

1. Standards through adoption allow communication of information to be controlled by the controlling party. Since this type of standard is typically controlled as intellectual property, this does not often result in a standard that is “open”. If the controlling company chooses to let others use the standard, certain necessary information may be transferred outside the company as deemed necessary by the controlling company.

2. These standards ensure compatibility of complementary products by forcing those who want to produce goods in that industry to follow, or at the least, recognize, the dominating standard.

3. Standards through adoption do not necessarily communicate quality levels, but do result in similar effects for consumers. A dominating standard increases confidence in the standard and its longevity in the majority of customers.

4. These standards also reduce competing technologies by making it unfruitful in most cases to attack the standard.

Strategy Continuum

In general, standards by definition seem to arise from a cooperative strategy. The nature of industry boards and alliances implies cooperation of multiple organizations to define the standard. Standards through adoption often result from a dominant product in the marketplace. Many times, this form of standard is based on proprietary or protected technology, which gives the controlling party discretion in whether other companies can build on that standard. Of course, a standard through adoption can originate as a standard by definition.

An organization creating a standard or leveraging an existing standard within a product must be aware of the factors determining whether the customer adopts the product or not. Again, it is assumed that the attributes of the product are influenced by Rogers’ PAI. For example, the product needs to have relative advantage over other products and be compatible with existing needs. Of course, the organization is operating in a competitive environment, and therefore, the products offered must appear to have complementary products, an installed base (or expected installed base), and low perceived risk of failure of the standard. Companies can promote their standard as a way to increase the perceived importance of the particular standard.

There are a range of strategies that organizations can take to lead to acceptance of a standard under a variety of situations. For most ordinary products, organizations generally take a competitive stance. In this case, customers generally do not reap benefits from an installed base or network externalities. However, for standards-based products, the organization should ensure that complementary products exist, that there is an installed base (or expected installed base), and low perceived risk of failure. For standards that are perceived to be weak, a company may choose to partner with another organization or an industry group to increase confidence in the standard. If the organization is strong, or perhaps the product is revolutionary, the company may choose a more competitive strategy to maximize their gains. While these are not yet supposed to be prescriptions for choosing strategies in various situations the organization finds itself in, it illustrates how the organization needs to understand how their product will be perceived by the customer in the market along the aforementioned factors. This range of strategy options indicates that there is a Strategy Continuum (Figure 2).
Along the Strategy Continuum, there are various tradeoffs. On the one hand, a purely competitive strategy may maximize the potential profits for the organization, but this assumes that the customers expect an installed base and low risk of failure of the standard. If there is some doubt in achieving this through purely competitive strategy, then perhaps an industry alliance will increase the customers’ confidence. This was the approach taken with the DVD +R / DVD –R alliances. The tradeoff is control of the standard and a share of the potential profits, but the resulting success may exceed that of a purely competitive strategy.

The points along the Strategy Continuum have not been verified, but have been included for clarity. Other strategies that may fit in the continuum are standards that supersede other standards, such as Sun’s Java platform, or utilizing entirely open standards. The exact tradeoffs of the different strategies are as yet unclear as are the relative positions of the strategies, but it is expected that the choice of strategy along the continuum should attempt maximize the satisfaction of the factors that drive the customer’s intention to adopt standards-based products.

DISCUSSION

Implications for Research

Products based on standards compose a significant portion of the products that customers purchase. They are not perceived exactly the same as ordinary products in that there are network externalities and risks associated with standards-based products. Rogers’ Perceived Attributes of Innovation have been successful in explaining the adoption of innovations, but the additional factors described in this research are expected to further explain adoption of innovations when the products are standards-based.

Secondly, given the additional factors that play a role in customers’ adoption of products based on technical standards, organizations need to be aware of how to cater to these factors. Given the dependence on complementary products, installed base, and risk of standards failure, the strategies that an organization might choose differ from those that may be chosen when producing ordinary products.

Implications for Practice

Organizations are constantly trying to understand the customer and the factors they can recognize and cater do in purchasing decisions. Given that there are additional factors for standards based-products, organizations have new insights into the needs of the customer, and subsequently, new strategy choices that satisfy those needs. This research provides a model and a framework to assist organizations in conceptualizing strategies depending on their position in meeting the customers’ needs.

Limitations and Future Research

There are a number of assumptions included in this research. First, it is assumed that most customers consider, at least minimally, that technical standards are important. If they do not think about this, then adoption decisions should be similar when purchasing innovations, whether they are standards-based or not. Secondly, all voluntary standards are grouped together in their influence. However, there are possibly levels of standards that carry more or less importance or prominence. More consideration of this possibility is necessary.
Third, it is assumed that the organizations producing the standards based-products are concerned with and able to identify the factors that drive adoption of these products. Finding out whether the customer desires certain complementary products or perceives the possibility of an installed base may be difficult to do. Fourth, both the model describing the factors affecting the adoption of standards-based products (Figure 1) needs testing empirically. Fifth, the Strategy Continuum needs to be grounded. The model could benefit from establishing the relative positions of the various strategies, though it is unclear if this is crucial. The concept that an organization can make choices and tradeoffs up and down the continuum, whatever that might be for the particular organization, may be sufficient. Some organizations may never consider licensing strategies, for example. Future research will concentrate on testing the described factors and grounding the Strategy Continuum. Additional research could examine staged strategies, where competitive strategies are taken initially and more cooperative strategies are used as necessary become successful. Finally, this research operates removed a couple of degrees from the competition. Competition is filtered through the perceptions of the customers, but this means of conducting business may be too defensive for the organization. Perhaps organizations need a model that combines the customers’ perceptions and competitor actions before they reach the customer.

CONCLUSIONS

The first contribution of this research is to extend Rogers’ PAI concepts to products based on technical standards. Arguments have been made for the inclusion of additional factors affecting the adoption of these types of products. If empirical testing supports these concepts, research will have additional insight into the effects of standards and network externalities on customer buying decisions.

The second contribution of this research is the conceptualization that organizations need to respond to these additional factors, and may choose to do so using a variety of strategies along the Strategy Continuum. In general, standards are expected to drive companies to be more cooperative due to the effects of network externalities, though not in all cases. Based on the organization’s evaluation of themselves (and their product) in the eyes of the customer, there are a number of strategies that can be chosen to maximize the gains of both the customers and the organization.

REFERENCES