A model of brand switching by lead users of high-tech capital equipment

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Abstract:

This study investigates the antecedents of brand switching by lead users of high-tech capital equipment. In markets for capital equipment, the incumbent is usually assumed to have an advantage because of high switching costs. However, much of the research on brand switching focuses on mass-market consumers of competitive products, where switching barriers are manageable. A model of the factors behind brand switching for capital equipment is developed and tested with data gathered by a survey of research centers around the world that use magnetic resonance imaging (MRI) equipment. The results confirm the expectation that lead users are willing to overcome high switching barriers to obtain a new technology when it is essential to renew organizational capabilities that are important to sustaining their competitive advantage. The decision to replace high-tech capital equipment is primarily influenced by the features and capabilities associated with the new product.

Key words: Brand Switching, Lead Users, Capital Equipment Technology, Product Features, Internal Capabilities.

1 Introduction

The long-term success of a firm depends in part on retaining customers because satisfied users are likely to repurchase, thus reducing customer recruitment and servicing costs (Mittal, et al., 2005; Rust, Moorman, and Dickson, 2002). However, ensuring user satisfaction requires continuous improvement in product features and capabilities to meet changing preferences, especially for high-tech products in business markets where access to the latest features can help purchasers to secure a competitive position (Pae and Hyun, 2006). Lead users demand cutting-edge technological features that help them to achieve their objectives and maintain their competitive position (Teplensky et al., 1993; Von Hippel, 1986). Suppliers that are slow to develop new technologies can lose existing users to more innovative competitors (Henard and Szymanski, 2001). Brand switching (defined as purchasing a new technology from a new supplier) is important because it can shrink the market share of an incumbent and make it costly to win back customers (Zins, 2001). Thus, an understanding of the factors behind brand switching is important for strategy-making by producers of high-tech capital equipment.

The marketing literature reports considerable research that investigates brand switching. However, most of it focuses on mass-market consumer goods where switching costs are generally low (e.g., Low and Johnston, 2006; Wathne, Biong, and Heide, 2001; Heide and Weiss, 1995). In contrast, there is a paucity of knowledge about what influences lead users of high-tech capital equipment to switch between suppliers. We define high-tech capital equipment as a technology-based product that is acquired infrequently, significantly exceeds the cost of an average purchase in a customer's organization, and has an extended and complex purchasing process. Magnetic resonance imaging (MRI) equipment is the example studied in our research. In addition to costs that range into the multiple millions of dollars, MRI equipment is characterized by rapid technological change, technology heterogeneity, absence of a standard design (Anderson and Tushman, 1990), and significant differentiation between brands (Kreig, 2004).

We use the concepts of organizational resources and dynamic capabilities to explain why an organization might switch technologies even in the presence of high search and switching costs. Eisenhardt and Martin (2000) argue that organizations, particularly those operating in a rapidly changing environment, need to possess

"dynamic capabilities" to achieve competitive advantages. These capabilities include the ability to build, integrate, or reconfigure organizational resources (Teece, Pisano, and Shuen, 1997). An incumbent technology might fail to support an organization's strategy to secure competitive advantage because of slow technological improvement. In this situation it is difficult for an organization to meet its objective using the old technology, so it searches for new equipment that will help it to renew its resources and enhance organizational performance (Wang and Ahmed, 2007).

The dominant logic is that because of high search and switching costs incumbents have a strong advantage when customers consider upgrading or replacing high-tech equipment (Heide and Weiss, 1995). However, the literature also suggests that cutting-edge users are willing to meet the costs of acquiring new technology because they have the capabilities needed to lever significant advantages (Morrison, Roberts, and Midgley, 2004). We reviewed the literature to identify additional influences on the decision to switch between brands of high-tech capital equipment. The result is a model of the decision to switch that we test using data gathered from MRI research centers around the world. The empirical test identifies the most important influences on the decision to switch. We conclude by discussing implications for further theory development and management practice.

2 Model and hypotheses

In this section, we develop a model and related hypotheses about the antecedents of brand switching in the context of high-tech capital equipment. We argue that the primary motive for switching, especially by lead users, is the need for state-of-the-art product features and capabilities that help to sustain a competitive advantage. Thus, our overarching expectation is that aspects of product design, especially product features, are the most important among a set of criteria purchasers may consider. To test this, we searched the literature for variables associated with brand switching, and organized these into four categories: product design, switching costs, marketing strategies and institutional factors. In the sections that follow, we explain how each set of variables may influence the likelihood of switching and summarize this with a testable hypothesis. By including additional variables we are able to demonstrate the relative importance of product features in the switching decision.

2.1 Product design

2.1.1 Product features

Product features are expected to be the most important factor in the product design category and the major stimulus behind switching. In rapidly changing markets where product features quickly become dated, users continuously evaluate existing features and their role in creating a competitive position. This assessment determines whether more features can be added, or if the product is reaching its utmost capacity, and switching to a new brand is the only solution to sustaining a competitive advantage (Hogan and Armstrong, 2001). Determining the attractive features to include in capital equipment is a challenging task for suppliers (Krieg, 2004; John, Weiss, and Dutta, 1999) because technology is changing rapidly and users' preferences are difficult to predict (Bhattacharya, Krishnan, and Mahajan, 1998). Thus, product designs that incorporate the widest range of features associated with high performance are expected to provide more incentive to switch.

> H_1: The likelihood of switching to a brand is positively associated with the range of product features offered by that brand.

2.1.2 Product variety

Meeting the requirements of several market segments using a single product increases design sophistication and product cost (Meyer and Lehnerd, 1997). Thus a common strategy is to produce a variety of products under the same brand to meet the preferences of different customer segments (Ramdas, 2003). From a customer's perspective, a brand that has a wide range of products with distinctive functionality increases the incentive to switch as these may provide additional competitive advantages (Athanassopoulos, 2000). Functionalities that provide exceptional capabilities help users to distinguish themselves from others in the market (Meyer and Lehnerd, 1997). Since the high technology market is changing rapidly, users evaluate existing technology and its ability to create value for the organization in order to decide whether they should move to a new brand to increase their competitiveness. Increasing product variety is therefore an effective strategy for meeting wider preferences while increasing users' incentives to switch.

H_2: The likelihood of switching to a brand is positively associated with the product variety offered by that brand.

2.2 Switching costs

2.2.1 Technology incompatibility

Previous studies show that users frequently repurchase technological products and add features from existing suppliers. The main reason behind this repeated purchasing is technology compatibility (Low and Johnston, 2006; Heide and Weiss, 1995). A user's prior investment influences their commitment to obtain related upgrades from the same vendor, particularly for products that lack a standard design (Anderson and Tushman, 1990). In such cases, it is not possible to purchase attractive features or applications from other suppliers unless the entire product is ordered. In the case of MRI equipment, the costs associated with overcoming technology incompatibility are exceptionally high, and this cost could inhibit users from renewing internal resources and capabilities with more attractive ones from another supplier.

H_3: Technology incompatibility with the incumbent brand is negatively associated with the likelihood of switching.

2.2.2 Relationship incompatibility

Over time the supplier-user relationship may become close leading to profitable outcomes for both (Gadde, Huemer, and Hakansson, 2003). If the relationship changes users have to develop new practices and procedures (Heide and John, 1990), and occasionally the entire set of working and personal interorganizational relationships need to be rebuilt with a new supplier. This might include rearrangement of technical support personnel and application specialists (Weiss and Heide, 1993). Previous research shows that a long relationship creates pressure to stay with the same supplier to maintain the accumulative value of the relationship (Wathne, Biong, and Heide, 2001). In the context of research hospitals, switching to a new MRI supplier would create a major disruption of regular operations. Therefore, established relationships are expected to create a strong barrier to switching.

H_4: Relationship incompatibility with a new brand is negatively associated with the likelihood of switching.

2.2.3 Cost of verifying technology

The decision-making process used to purchase a new MRI product is complex (Kreig, 2004). It begins by establishing a special committee that includes different members of the medical imaging department. The committee gathers extensive information about the current status and potential development of existing and emerging MRI products. MRI products are information intensive and it is sometimes difficult to evaluate the performance of product features (Glazer, 1991). This may force users to engage in extensive search efforts and to act on information quickly before it becomes outdated (Glazer and Weiss, 1993). This condition makes switching complicated and costly from the verifying stage to the final decision.

H_5: The likelihood of switching to a brand is negatively associated with the cost of verifying its technology.

2.2.4 Cost of learning technology

While users find it difficult to verify the functionality of different products, they also have a problem in learning how to use the new technology after switching (Jones, Mothersbaugh, and Beatty, 2002). Each MRI product has a different platform and the way to operate it is different. MRI equipment has multiple features to diagnose various diseases, and many features are complex and require considerable time to learn how to use them effectively (Pae and Hyun, 2006). For high-tech capital equipment products in general, difficulties associated with learning and training may favor the incumbent.

H_6: The likelihood of switching is negatively associated the cost of learning how to use the technology provided by a brand.

2.3 Marketing strategies

2.3.1 Price

Price is an important variable in the switching equation because it represents a large proportion of the total switching costs (Jones, Mothersbaugh, and Beatty, 2002). Suppliers have control over this variable: by lowering the price suppliers can influence the economic value of switching. In rapidly changing technology markets, lower prices are an effective strategy to encourage users to switch. Wathne, Biong, and Heide (2001) found that price dominated all other factors that influence switching behavior because it directly impacts the total switching costs.

H_7: A lower price increases the probability of switching to a new brand.

2.3.2 Product bundling/breadth

Product bundling is an effective marketing strategy to attract more users because it offers users more options and services than those provided by the core product. Bundling may refer to extra services or components to be used with the same product, or to the inclusion of separate supporting devices that enhance overall product capabilities (Ranganathan, Seo, and Babad, 2006). Wathne, Biong, and Heide (2001) found that product breadth has a significant effect on the decision to switch. In the MRI case, bundling could include adding more software packages or providing external units for image storage or processing. Each feature enables additional capabilities; therefore, bundling makes the product more attractive and increases the incentive to switch brands.

H_8: The product breadth offered by a brand is positively associated with switching to that brand.

2.3.3 Research collaboration

Conducting research is an important activity in research hospitals. Thus, research collaboration with MRI suppliers is central to overcoming research-related challenges and utilizing the technology to test new innovative applications (Lee, 2000). This is especially the case when the technology contains many complicated capabilities that are difficult for users to modify (Athaide, Meyers, and Wilemon, 1996). For MRI research centers, this is an important issue for implementing various research projects and generating reputable research. Therefore, the extent to which an MRI supplier is willing to collaborate in research has a positive influence on switching.

H_9: The extent to which research collaboration is offered by a brand increases the likelihood of switching to that brand.

2.3.4. Product service

Since MRI technology contains multiple advanced features, it is a very sensitive technology, requiring a specialized engineer to fix and calibrate the system after each service. Product service is vital to ensuring that MRI equipment runs without interruption. Users of such technology are always concern about the delay in getting an engineer from the supplier's main office and the time needed to fix a sudden problem. Thus, most users prefer to use a nearby service center that can provide quick on-site service support (Athaide, Meyers, and Wilemon, 1996). Without appropriate product service, a technology cannot function competitively, which could limit the value of the internal capabilities gained by switching (Mathieu, 2001). Therefore, providing reliable service will increase incentives to switch to a new supplier.

H_{10}: The likelihood of switching to a brand is positively associated with the reliability of its product service.

2.4 Institutional factors

The decision-making process at the organizational level is more complicated than that at the individual level because of the organizational structure and involvement of different individuals in the process (Bunn, 1993). Heide and Weiss (1995) found that formalization of the purchasing process sometimes limits the ability to switch because bonding and routines make the process of acquiring and analyzing information tedious. In the context of research hospitals, the support of top management may play an important role in overcoming this inertia. If an MRI research center is able to attract financial support from external funding agencies to finance equipment, the decision may be less formal. However, when the funding is allocated from the hospital budget, the support of top management is crucial to facilitate the switching process.

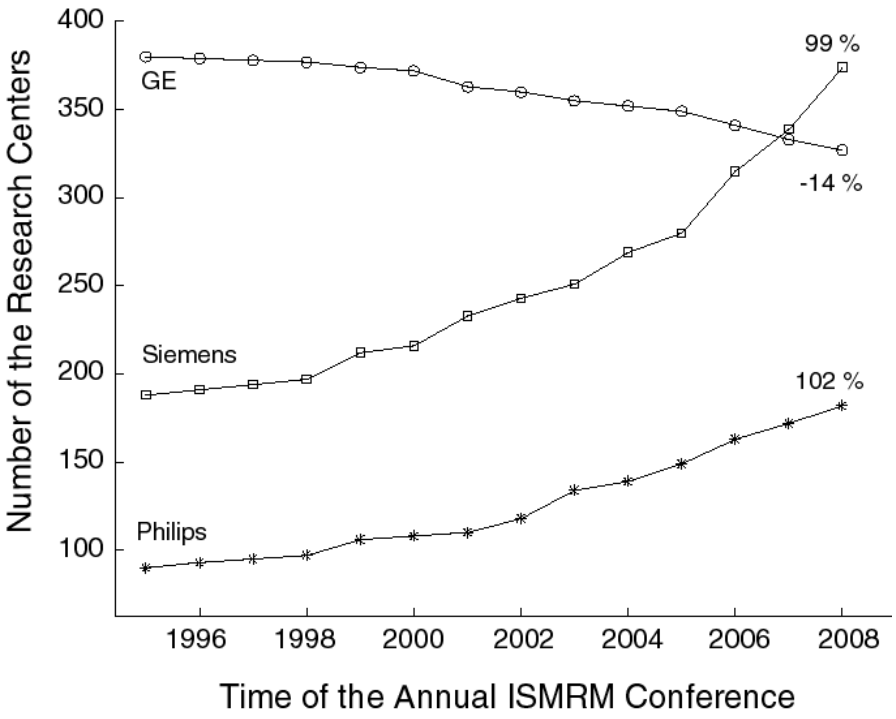
H_{11}: Support of top management is positively associated with the probability of switching brands.

3 Method

As an example of high-tech capital equipment we studied the choice of MRI suppliers by university hospitals (or MRI research centers). This is an appropriate context because MRI research centers represent lead users that

perform regular clinical operations in addition to conducting advanced medical research to modify products and explore new solutions, and their associated switching costs are high. In university hospitals brand switching takes place at the organizational level (i.e., medical imaging departments), where MRI equipment is specialized and must respond to complex organizational requirements. Users at this level are more likely to focus on long-term relationships and engage in cooperative activities that result in greater benefits for both users and suppliers further complicating the switching process (Dabholkar, Johnston, and Cathey, 1994). In addition to the high costs of replacing old MRI equipment, MRI research centers face various challenges during the replacement process. These include: (1) training MRI technologists to operate the new equipment efficiently, (2) learning how to control different components (hardware and software) to implement new research projects, (3) building new practices and procedures with the supplier to ensure the equipment is productive, and (4) transferring research projects to the new platform, which may be difficult because of incompatibilities. In the MRI market, three suppliers - GE, Siemens, and Philips - share around 75% of the world market. To confirm that brand switching is taking place in the MRI market, we collected conference proceedings from the International Society of Magnetic Resonance in Medicine (ISMRM) annual meetings from 1995 to 2008. Lead users attend this conference to present their research findings to MRI community. The abstract of each paper was scanned to identify the research center and type of MRI equipment used in the research. This process identified 658 research centers around the world, and the brand of MRI equipment used by those centers in each year. For some centers, it was not possible to identify the MRI brand because its name was not mentioned explicitly in the conference abstract. In addition, only the three major suppliers were included because of the small number of occurrences of the other brands.

Figure 1 uses the ISMRM conference proceedings data to illustrate the changes in market share between MRI equipment manufacturers between 1995 and 2008. In 1995, 380 research centers operated GE-MRI equipment compared with 188 for Siemens, and 90 centers for Phillips. Over time research centers expanded their operations by upgrading or by buying new MRI technology. Centers that use Siemens-MRI technology increased steadily, reaching 374 centers in 2008 (a 99% increase over 1995). The number of centers using Philips' technology increased to 182 centers (a 102% increase over 1995). However, the number of centers operating equipment from GE declined over time, ending at 327 centers (a decrease of 14%).



** The percentage at the end of each curve represents the change in value reported at 1995.*

Figure 1: MRI brand switching 1995-2008

3.1 Data and sample

Our model is tested using data gathered by an online survey administrated in 2008. Potential respondents were identified using the International Society of Magnetic Resonance in Medicine membership database (ISMRM, 2007). Members of the ISMRM community (MRI research centers) represent lead users, because they are active in modifying MRI products and protocols to explore new solutions to diagnostic problems. Research findings from this community are presented in different conferences and journals. These findings are also vital to improving the MRI products produced by different suppliers.

As the response rate is typically low in studies such as this, we included multiple participants from each MRI research center to increase the likelihood of receiving at least one response from each center. However, only one response was included in the analysis. The potential participants were Department Chair, Medical Doctor, Scientist, Physicist, and Chief Technologist. In the case of multiple respondents from the same center, the response was retained for the highest ranking individual who also indicated they were involved in or very familiar with the purchasing process of MRI technology.

From the ISMRM membership database we identified 1217 MRI research centers worldwide. The online survey was sent out to 5831 participants. As a result, 967 respondents completed the online survey for a 17% response rate. To account for multiple informants from the same MRI research center, 231 responses were removed. However, before removing them, the inter-rater reliability was calculated to check whether different participants (from the same MRI research center) were consistent in their responses. Results showed significant correlation ($p < .05$) between participants from the same center for all variables. Finally, an additional 77 cases were removed because the respondent was not sufficiently familiar with the purchasing process, and another 24 responses were removed because of missing data. The final sample consisted of 635 responses, representing 52% of the MRI research centers worldwide. In this sample 360 participants reported switching brands, and 275 remained with the same supplier.

3.2 Measures

3.2.1 Dependent variable

The dependent variable, brand switching, has two values: "switched," defined as purchasing new MRI equipment from the supplier of a different brand, and "not switched," defined as repurchasing new MRI equipment from the supplier of the incumbent brand. Participants were also asked to identify the impact of buying a new technology (from the same supplier or a new one) on their organizational capabilities.

3.2.2 Independent variables

Measurement items for the independent variables were adapted from the extant literature. Appendix I contains a list of these measurement items and the results of reliability tests. To enhance scale validity and reliability, the initial survey was administered to three marketing managers and two consultants in the MRI industry. In response to their comments some items were added and others adjusted or deleted. This process took a few iterations to ensure that all measurement items reflect the study context. A second test of the measurement items was performed by considering the opinion of three academic researchers as to the appropriateness of measurement items. In the final stage of development, the modified survey was administered to 28 individuals from different MRI research centers to review items for clarity and face validity. As a result, the final online survey was created containing 34 measurement items representing the 11 independent variables identified in our model. Items were

randomly presented, and responses recorded on a seven-point Likert scale ranging from “strongly disagree” to “strongly agree".

3.3 Preliminary data analysis

3.3.1 Non-response bias

Possible non-response biases were examined by wave analysis (i.e., comparing characteristics of the first and last quartile of respondents as suggested by Armstrong and Overton (1977)). No statistically significant ($p < .05$) differences were found between early and late participants for any of the variables included in the model.

3.3.2. Convergent and discriminant validity

A factor analysis of the 34 measurement items was conducted to check for convergent and discriminant validity, and to construct linear combinations of the individual items to represent the independent variables. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was 0.80, indicating that the data includes distinct and reliable factors. Likewise, Barlett’s Test of Sphericity ($\chi2 = 9983.54$; $DF = 561$; $p = .000$) is significant ($p < .001$), so factor analysis is warranted. Eleven factors having Eigenvalues greater than 1.0 were extracted, and all items had a loading of at least 0.6 with their respective factors. The high loadings within each factor indicates convergent validity. These eleven factors explain 74.9% of the variance in the data. The convergent validity was also tested by calculating Cronbach Alpha, as reported in Appendix I. Values greater than 0.7 for each factor provides evidence of internal consistency. Finally, discriminant validity was tested by running the factor analysis with oblique rotation, and calculating correlations between all pairs of factors. There are no values greater than 0.5 in the correlation matrix, indicating that no two factors significantly overlap conceptually.

4 Findings

Table 1 provides a correlation matrix and descriptive statistics for the variables. The correlation coefficients are low (< 0.4) suggesting that collinearity is not a problem.

Table 1: Correlation matrix and descriptive statistics of measures.

Variables	1	2	3	4	5	6	7	8	9	10	11
(1) Product variety	1.000										
(2) Product features	.318*	1.000									
(3) Price	-.227*	-.339*	1.000								
(4) Product breadth	-.038	-.055	.012	1.000							
(5) Research collaboration	.177*	.163*	-.141*	-.021	1.000						
(6) Product service	.161*	.235*	-.223*	-.012	.112*	1.000					
(7) Technology incompatibility	-.237*	-.270*	.254*	-.004	-.133*	-.181*	1.000				
(8) Relationship incompatibility	-.136*	-.224*	.175*	.011	-.110*	-.156*	.169*	1.000			
(9) Learning technology	-.200*	-.295*	.238*	.005	-.093*	-.206*	.200*	.088*	1.000		
(10) Verifying technology	-.106*	-.156*	.104*	-.006	-.038	-.112*	.084*	.090*	.087*	1.000	
(11) Support of top management	-.065**	-.053	.069**	.012	-.036	-.073**	.087*	.073**	.071**	.041	1.000
Mean	4.343	4.241	3.714	3.520	4.206	4.159	3.346	3.601	3.456	4.404	3.942
Standard Deviation	1.124	1.443	1.140	.857	1.115	1.030	.954	1.131	.938	.775	.916

* $P < .05$.
** $P < .01$.

Table 2 shows the number of centers using each of the major brands of MRI equipment before and after switching as reported by respondents to the online survey. Switching improved the market share of both Siemens and Philips (104% and 89% respectively). In contrast, GE lost close to 10% of its share, despite being the dominant incumbent supplier. The share of other brands combined shrunk 20% as the result of switching. This pattern is generally consistent with the changes in market share observed from ISMRM conference abstracts.

Table 2: Market share changes as a result of MRI brand switching.

MRI Technology Suppliers	Users before Switching	Users after Switching	Market Change (%)
GE	294	263	-10%
Siemens	131	268	105%
Philips	75	142	89%
Other+	135	108	-20%

+ Includes other MRI firms.

We used logistic regression to test the hypotheses developed in Section 2. Table 3 reports the results of the logistic regression analysis. A statistically significant χ^2 value for the model ($p < .000$), and non-significant H-L test ($\chi^2 = 2.56$, $p = .959$) indicate a strong fit between the model and the data. The Nagelkerke R^2 of 0.90 suggests that the model explains 90% of variability in switching. Further, the classification table shows a high rate of prediction (94.3%). The Wald statistics associated with the parameter estimates for the individual independent variables show that eight of the eleven variables are statistically significant ($p < .05$). The variables that do not significantly influence the likelihood of switching are product breadth, cost of verifying technology, and support of top management.

The odds ratio indicates the relative importance of each independent variable. For example, after controlling for the effect of all other variables, the odds of switching increases 3.52 times for a one unit increase in the measure of new product features, and the corresponding probability of switching is 3.521/(1+3.521) = 0.78. Odds ratios above 1.0 increase the probability of switching, whereas values below 1.0 decrease this probability.

Table 4 demonstrates the perceived influence of brand switching on organizational capabilities. The results suggest that centers were able to enhance their organizational capability by switching brands to improve capabilities that help them to explore new clinical treatments, produce more reputable research, and attract more research funds.

Table 3: Results of maximum-likelihood logistic regression analysis

Independent Variables	b	S.E.	Wald	Odds Ratio
Product variety	1.125**	.273	16.920	3.080
Product features	1.259**	.220	32.708	3.521
Price	-1.547**	.284	29.567	.213
Product breadth	.190	.325	.340	1.209
Research collaboration	.956**	.251	14.505	2.603
Product service	.571*	.240	5.683	1.771
Technology incompatibility	-1.465**	.287	25.974	.231
Relationship incompatibility	-1.156**	.251	21.166	.315
Learning technology	-1.087**	.307	12.546	.337
Verifying technology	-.457	.352	1.683	.633

Support of top management	.241	.309	.609	1.272

* $P < .05$.
** $P < .01$.

Table 4: The impact of new technology on organizational capabilities

Organizational Capabilities	Switched brand Mean (SD)	Did not switch brand Mean (SD)
The new MRI improved our capability to investigate new clinical applications, which was not possible using the old scanner.	5.577 (.934)*	5.123 (.768)
The new MRI increased our capability to produce reputable research, which was not possible using the old scanner.	5.250 (1.184)	4.690 (.960)
The new MRI enabled us to increase the number of publications.	5.355 (1.045)	4.741 (.979)
The capabilities of the new MRI scanner helped us to attract more grants and funding.	5.427 (.976)	4.905 (.911)

*Responses recorded on a seven-point Likert scale ranging from “strongly disagree” to “strongly agree".

5 Discussion

In this study we explored the factors behind brand switching by lead users of high-tech capital equipment. The results show that product features and product variety are the most influential factors behind switching in this context. We argue that these characteristics reflect technological capabilities that motivate lead users to switch to renew organizational capabilities and develop or maintain a competitive advantage. The pattern of switching suggests that Siemens has more attractive features (and to a lesser extent Philips), than does the incumbent

provider GE. These findings are consistent with previous research about the importance of product design in achieving market performance (e.g., Chang and Hsu 2005).

Our research also shows that switching to a new supplier imposes significant challenges, including technology incompatibility, relationship incompatibility, and the cost of learning the technology. All are barriers to switching; as is high price. If not addressed properly by suppliers, and if appropriate measures are not taken to reduce their impact, such barriers can outweigh the incentives to switch provided by new product features. Our findings are consistent with those of previous studies that identify these barriers as important obstacles to switching (e.g., Low and Johnston, 2006; Heide and Weiss, 1995).

A supplier's marketing strategies may be important to lower switching costs. For example, promising assistance during the transition process may lower some of the barriers to switching, or offering research collaboration can help overcome technology incompatibility and learning issues (Athaide, Meyers, and Wilemon, 1996). Even lead users may find it difficult to use new equipment properly without help from the supplier. Research collaboration can include networking opportunities with other users to share experiences and best practices. Another effective marketing strategy is the provision of product service and reliable technical support to mitigate concerns about building new and effective relationships (Athaide, Meyers, and Wilemon, 1996; Mathieu, 2001). This strategy is essential to ensure the equipment runs without interruption, as disruptions in research or clinical operations have significant financial and other consequences.

Interestingly the cost of verifying technology is not statistically significant. An explanation may be that MRI lead users spend considerable time and effort to verify different technologies regardless of the final decision: stay or switch. Also lead users may feel that the cost of verifying different technologies is manageable and/or rely heavily on their own experience. Lead users appear to be more worried about the post-switching costs related to building a new relationship, technology incompatibility and learning to use the equipment effectively.

Product breadth had no statistically significant effect, suggesting this is a weak approach to encouraging switching. It appears that lead users are primarily focused on having a specialized technology that provides specific features (capabilities) to achieve certain objectives. Additional components (i.e., product bundles) that are not related directly to the core capabilities of the product have a minor influence on the switching decision.

In contrast, some prior literature shows that bundling has a significant influence on the decision to switch. An example is Wathne, Biong, and Heide's (2001) study of switching between banks. However, banking is a very different context. It is a highly competitive industry in which users are often indifferent to choice and are usually motivated by service costs or promises of financial return. Top management support for the decision to switch is also not significant. A likely explanation is the extent to which departments influence the purchasing decision; especially if funding comes from an external agency that supports research activities.

Overall, the results provide evidence that substantial switching occurs, despite high switching costs, and that in aggregate switching is significantly altering the market shares of the leading manufacturers of MRI equipment. This will be magnified when lead users also influence the purchase decisions of clinical users. In addition, the results provide evidence that the switching behavior of lead users is strongly influenced by product features, which contrasts with the findings of several studies conducted in the context of highly competitive products for mass-market consumer goods (e.g., Low and Johnston, 2006; Wathne, Biong, and Heide, 2001).

6 Contributions

This research contributes to the technology marketing literature by identifying the influence of product design on the brand switching decisions of lead users of high-tech capital equipment. Previous studies have rarely mentioned the influence of product design on user switching, putting emphasis on factors such as marketplace characteristics (Heide and Weiss, 1995), switching costs (Low and Johnston, 2006), and marketing strategies (Wathne, Biong, and Heide, 2001). The selection of these factors to explain users' decisions can be due to product characteristics and competitive market conditions. However, this research shows that lead users of capital equipment focus mainly on enhancing their internal capabilities by obtaining a product that contains the best features to provide these capabilities.

There is no universal model in the literature that describes or predicts brand switching behavior. Each study adopts different independent variables to explain this behavior based on the industry or product under investigation. Our research contributes a model that explains the switching behavior of lead users of high-tech capital equipment. This model clarifies our understanding of brand switching in a context where successful

product design plays a significant role. This contrasts with the dominant assumption that the incumbent has a distinct advantage because of switching costs.

Managers should find a reliable model to assess antecedents underpinning brand switching for their industry. They should not rely on their expectation to predict these antecedents, because previous research shows that users and suppliers often have different perceptions of the determinants of switching (Wathne, Biong, and Heide, 2001). Determining the main factors behind switching is a critical matter when defining the appropriate strategy to keep their market share from eroding. In capital equipment markets, these factors are related to product features and technological capabilities, which enhance the internal capabilities of the buying organization and maintain its competitiveness.

In general managers should continuously identify and work with lead users as a trusted source of new product ideas, reliable source of market research, and influence on others to adopt the same technology (Hassan, Mourad and Tolba, 2010). Targeting lead users as part of a supplier strategy to launch a new technology is an effective tactic for capturing the main market, because those early switchers will provide other users with solid motivation to pursue the same behavior later after they discover the value of the new product.

References

Anderson, P. and Tushman M.L. (1990) 'Technological discontinuities and dominant designs: A cyclical model of technological change', *Administrative Science Quarterly*, Vol. 35, No. 4, pp.604–633.

Armstrong, J.S. and Overton, T.S. (1977) 'Estimating nonresponse bias in mail Surveys'. *Journal of Marketing Research*, Vol. 14, No. 3, pp.396–402.

Athaide, G.A. Meyers, P.W. and Wilemon, D.L. (1996) 'Seller-buyer interaction during the commercialization of technological process innovations', *Journal of Product Innovation Management*, Vol. 13, No. 5, pp.406–421.

Athanassopoulos, A.D. (2000) 'Customer satisfaction cues to support market segmentation and explain switching behavior', *Journal of Business Research*, Vol. 47, No. 3, pp.191–207.

Bhattacharya, S. Krishnan, V. and Mahajan, V. (1998) 'Managing new product definition in highly dynamic environments', *Management Science*, Vol. 44, No. 11, pp.50–64.

Bonner, M.J. and Calantone, R.J. (2005) 'Buyer attentiveness in buyer-supplier relationships', *Industrial Marketing Management*, Vol. 34, No. 1, pp. 53–61.

Burnham, A.T. Frels J.K. and Mahajan V. (2003) 'Consumer switching costs: A typology, antecedents, and consequences', *Academy of Marketing Science*, Vol. 31, No. 2, pp. 109–126.

Bunn, M. (1993) 'Taxonomy of Buying Decision Approaches', *Journal of Marketing*, Vol. 57, No. 1, pp.38–56.

Chang, W. and Hsu, Y. (2005) 'Strategic groups, performance, and issues related to product design strategy', *International Journal of Innovation Management*, Vol. 9, No. 2, pp.133–154.

Dabholkar, P.A. Johnston, W. and Cathey, A. (1994) 'The dynamics of long term business-to-business exchange relationships', *Journal of the Academy of Marketing Science*, Vol. 22, No. 2, pp.130–145.

Eisenhardt, M.K. and Martin, J.A. (2000) 'Dynamic capabilities: What are they?', *Strategic Management Journal*, Vol. 21, No. 10, pp.1105–1121.

Gadde, L.E. Huemer, L. and Hakansson, H. (2003) 'Strategising in industrial networks', *Industrial Marketing Management*, Vol. 32, No. 5, pp.357– 364.

Glazer, R. (1991) 'Marketing in an information-intensive environment: Strategic implications of knowledge as an asset', *Journal of Marketing*, Vol. 55, No. 4, pp.1–19.
Glazer, R. and Weiss, A.M. (1993) 'Marketing in turbulent environments: Decisions processes and the time-value of information', *Journal of Marketing Research*, Vol. 30, No. 4, pp.509–521.
Heide, J.B. and John, G. (1990) 'Alliances in industrial purchasing: The determinants of joint action in buyer-supplier relationship', Journal of Marketing Research, Vol. 27, No. 1, pp.24–36.
Heide, J.B. and Weiss, A.M. (1995) 'Vendor consideration and switching behavior for buyers in high-technology markets', *Journal of Marketing*, Vol. 59, No. 6, pp.30–43.
Henard, D.H. and Szymanski, D.M. (2001) 'Why some new products are more successful than others', *Journal of Marketing Research*, Vol. 38, No. 3, pp.362–375.
Hogan, E.J. and Armstrong, G. (2001) 'Toward a resource based theory of business exchange relationships: The role of relational asset value', *Journal of Business to Business Marketing*, Vol. 8, No. 4, pp.3–28.
ISMRM (2007), International Society for Magnetic Resonance in Medicine (accessed May 2007), [available at http://www.ismrm.org].
John, G. Weiss, A.M. and Dutta, S. (1999) 'Marketing in technology-intensive markets: Toward a conceptual framework', *Journal of Marketing*, Vol. 63, No. SI, pp.78–91.
Jones, A.M. Mothersbaugh, D.L. and Beatty, S.E. (2002) 'Why customers stay: Measuring the underlying dimensions of services switching costs and managing their differential strategic outcomes', *Journal of Business Research*, Vol. 55, No. 6, pp.441–450.
Krieg, R. (2004) 'Impact of structured product definition on market success', International *Journal of Quality and Reliability Management*, Vol. 21, No 9, pp.991–1002.
Lee, Y.S. (2000) 'The sustainability of university-industry research collaboration: An empirical assessment', *Journal of Technology Transfer*, Vol. 25, No. 2, pp.111–133.
Liu, A.H. Leach, M.P. and Bernhardt, K.L. (2005) 'Examining customer value perceptions of organizational buyers when sourcing from multiple vendors', *Journal of Business Research*, Vol. 58, No. 5, pp. 559–568.
Low, B. and Johnston, W.J. (2006) 'Relationship equity and switching behavior in the adoption of new telecommunication services', *Industrial Marketing Management*, Vol. 35, No. 6, pp.676–689.
Mathieu, V. (2001) 'Product services: From a service supporting the product to a service supporting the client', *Journal of Business and Industrial Marketing*, Vol. 16, No. 1, pp.39–61.
Meyer, H.M. and Lehnerd, A.P. (1997) 'The power of product platform: Building Value and Cost Leadership', New York: The Free Press.
Mittal, V. Anderson, E.W. Sayrak, A. and Tadikamalla, P. (2005) 'Dual emphasis and the long-term financial impact of customer satisfaction', *Marketing Science*, Vol. 24, No. 4, pp.544–555.
Morrison, D.P. Roberts, J.H. and Midgley, D.F. (2004) 'The nature of lead users and measurement of leading edge status', *Research Policy*, Vol. 33, No. 2, pp.351–362.
Pae, H.J. and Hyun, J.S. (2006) 'Technology advancement strategy on patronage decisions: The role of switching costs in high-technology markets', *The International Journal of Management Sciences*, Vol. 34, No. 1, pp.19–27.
Ramdas, K. (2003) 'Managing product variety: An integrative review and research directions', *Production and Operations Management*, Vol. 12, No. 1, pp.79–101.
Ranganathan, C. Seo, D. and Babad, Y. (2006) 'Switching behavior of mobile users: Do user's relational investments and demographics matter?', *European Journal of Information Systems*, Vol. 15, No. 3, pp.269–276.
Rust, R.T. Moorman, C. and Dickson, P.R. (2002) 'Getting return on quality: Revenue expansion, cost reduction, or both', *Journal of Marketing*, Vol. 66, No. 4, pp.7–24.
Teece, D. Pisano, G. and Shuen, A. (1997) 'Dynamic capabilities and strategic management', *Strategic Management Journal*, Vol. 18, No. 7, pp.509–533.
Teplensky, D.J. Kimberly, J.R. Hillman, A.L. and Schwartz, S. (1993) 'Scope, timing and strategic adjustment in emerging markets: Manufacturer strategies and the case of MRI', *Strategic Management Journal*, Vol. 14, No. 7, pp.505–527.
Von Hippel, E. (1986) 'Lead users: A source of novel product concepts', *Management Science*, Vol. 32, No. 7, pp.791–805.
Wang, C. and Ahmed, P. (2007) 'Dynamic capabilities: A review and research agenda', *International Journal of Management Reviews*, Vol. 9, No. 1, pp.31–51.
Wathne, H.K. Biong, H. and Heide, J.B. (2001) 'Choice of supplier embedded markets relationship and marketing program effects', *Journal of Marketing*, Vol. 65, No. 2, pp.54–66.
Weiss, A.M. and Heide, J.B. (1993) 'The nature of organizational search in high technology markets', *Journal of Marketing Research*, Vol. 30, No. 2, pp.220–233.
Zins, A.H. (2001) 'Relative attitudes and commitment in customer loyalty models: Some experiences in the commercial airline industry', *International Journal of Service Industry Management*, Vol. 12, No. 3, pp.269–294.

Appendix I: Measurement items, factor loadings and reliability tests

Measurement items / scale origin / reliability test	Factor loading
Product features (Calantone, Chan, and Cui 2006) (α = .844)	
	.628

• Since our department is working on different clinical applications, we selected a scanner that provides a wide range of software applications with the highest hardware performance in market.	.807
• We selected a scanner that has new pulse sequences that are not available on other scanners.	.638
• Overall, the new scanner provided unique features and capabilities that are not offered by other scanners, which are important to generate reputable research (or clinical findings) compared to other MRI users.	.601
• The new scanner provided better work flow, post processing, post analysis and reporting tools compared to other MRI scanners.	
Product variety (Stump, Athaide and Joshi 2002) (α = .781)	
• We selected the scanner because it is more dedicated (or specialized) to serve specific applications (for example cardiac or neuro-imaging), which is not offered by other suppliers.	.673
• We selected the scanner because of its wider range of RF coils for different applications, which are not offered by other suppliers.	.784
• Since our department is working on different clinical applications, it is essential to have a variety of advanced RF coils for different areas of research.	.615
Technology incompatibility (Heide and Weiss 1995) (α = .869)	
• Incompatibility of the new MRI scanner with existing MRI scanner(s) is a critical issue in our department.	.864
• Existing research projects (including pulse sequences) could be incompatible with the new MRI scanner.	
• Incompatibility could restrict our collaboration with other departments or hospitals.	.862
	.851
Relationship incompatibility (Bonner and Calantone 2005) (α = .870)	
• Because we have a close working relationship with the old supplier, it would be difficult to build a similar relationship with a new supplier.	.869
• Developing new procedures to deal effectively with a new supplier would take a lot of time and effort, which could negatively impact our regular operations.	.861
• We are concerned that the new relationship will not be as effective as that with the old supplier.	.876
Cost of verifying technology (Burnham, Frels, and Mahajan 2003) (α = .826)	
• It takes significant time to complete the installation and calibration process of a new scanner.	.860
• We independently verify MRI features and performance for different MRI scanners by visiting different sites, in addition to relying on the technical reports given by suppliers.	.881
• It takes significant time and effort to evaluate and compare different MRI scanners, and then determine which one matches our department objectives.	.841
Cost of learning technology (Burnham, Frels, and Mahajan 2003) (α = .853)	
• It takes significant time for technologists to learn how to operate the new scanner effectively.	.860
• After switching, continuing effective research operations on the new scanner requires learning the new pulse sequence language and hardware communications.	.843
• Transferring existing research projects (including previous pulse sequences) onto a new scanner would require significant time and effort.	.853
Price (Wathne, Biong, and Heide 2001) (α = .830)	
• To achieve our department objectives, we focus on having the optimal MRI scanner regardless of price.	.712
• Having the best MRI scanner is important, but the price is a critical issue due to limited financial resources.	
• Since we focus on general (or less advanced) clinical applications, we are in less need of the most expensive MRI scanner.	.658
	.836
Bundling (Wathne, Biong, and Heide 2001) (α = .824)	
• Offering additional medical equipment (as bundling) or free scanner upgrades will increase the probability of buying the new MRI scanner.	.832
• We are not interested in any additional bundling offers, our main goal is to buy the optimal scanner that achieves our objectives.	.847
Research collaboration (Athaide, Meyers, and Wilemon 1996) (α = .865)	
• Offering good research collaboration will significantly increase the probability of buying the new MRI scanner.	.777
• Since our department is heavily focused on research, we need to have a strong research collaboration in order to solve technical problems.	
• The old supplier offers limited research collaboration when we face any research related difficulties.	.820
• Facilitating collaboration with other MRI users (through community of users support) will increase the probability of buying the new MRI scanner.	.803
	.699
Product service (Liu, Leach, and Bernhardt 2005) (α = .836)	
• Offering a good service contract will significantly increase the probability of buying the new MRI scanner.	.841
• Having immediate response service is important to reduce scanner downtime, which negatively impacts our regular operations.	
• The scanner service provided by the old supplier was not satisfactory and causes significant interruption to our regular operations.	.827
	.858
Support of top management (Heide and Weiss 1995) (α = .769)	
• Final decision to buy a new scanner was determined only by higher-level management.	.789
• Higher-level management was supportive of the medical team in finding the best scanner, regardless of price.	.822
• To a large extent, the medical team was in full control of the process to buy a new scanner.	.847