

**“Towards a Finer Understanding of Lead Users.”**

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# **TOWARDS A FINER UNDERSTANDING OF LEAD USERS**

**Pamela D. Morrison\*, John H. Roberts\*\* and David F. Midgley\*\*\***

## **Abstract**

Leading edge users present a reasonably new concept in the innovation literature. von Hippel (1986) suggests that they can be used as a source of new product ideas and to predict market acceptance of new products, yet to date little work has been done to establish the validity and reliability of this construct and how it relates to more traditional measures in diffusion theory such as innate innovativeness and time of adoption. In this paper we develop multiple measures of how leading edge an organization is and establish the reliability of the construct. That enables us to examine its relation to other variables in the adoption literature. We propose a continuous analog to the construct, leading edge status, and examine the characteristics of users who have high levels of this variable.

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## **Introduction**

von Hippel (1986) proposed that an important group to understand when studying the development and diffusion of new products early in their product life cycle is the set of leading edge users or lead users.<sup>1</sup> He argued that they are capable of generating solutions to fuel the new product development process and they are in a better position to evaluate the market appeal of new technologies. von Hippel (1986, p796) defined lead users as those displaying two characteristics with respect to the novel product or service:

"Lead users face needs that will be general in a marketplace--but face them months or years before the bulk of that marketplace encounters them, and

Lead users are positioned to benefit significantly by obtaining a solution to those needs."

The idea of segmenting members of the population on the basis of the applications to which they put the innovation and the value of those applications to them is appealing. It has the potential to move beyond the most frequently studied measure of innovativeness, time of adoption (Rogers 1995), which examines solely behavior and to incorporate the underlying characteristics of the adopting unit. However, it also includes some of the contextual richness missing in constructs such as Midgley and Dowling's innate innovativeness (1978). Applications segmentation has a strong tradition in the marketing literature (e.g., Haley 1968 and Srivastava et al 1984) and operationalizing it by identifying leading edge users seems a logical way to discriminate as to which members of a population will adopt and when they will adopt.

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<sup>1</sup> The terms lead user and leading edge user appear interchangeably in the literature. In this paper we refer primarily to leading edge user because it provides a better correspondence to our continuous analog, leading edge status.

The idea of leading edge users has potential to assist our understanding of the development and diffusion of new technologies. The contribution of this paper is to validate and extend the construct and contrast it to other variables studied in the related disciplines of diffusion of innovations and behavioral adoption theory. It proceeds by examining work done in studying the nature of leading edge users. From there it critiques the construct and identifies the need for a validation study, a framework to relate it to other variables in the adoption process, and the distribution and characteristics of leading edge users in the population.

## **Literature Review**

Most research to date involving leading edge users has focused on their role in the development of new products (e.g., Urban and von Hippel 1988; Herstatt and von Hippel 1992; Wagner and Hayashi 1994). But this is not their only role. As an extension of their new product development potential, Urban and von Hippel (1988) have suggested that leading edge users can fulfil an important function in both the pre-launch stage as test sites, and post-launch as opinion leaders, thus fueling the diffusion process. For technological innovations Gatignon & Robertson (1985, p863) have stated:

"The key to diffusion of technological innovation may be in building the consumer knowledge and experience base for this type of technology".

Therefore, the hypothesized role of leading edge users in playing to the communication receptivity of others may also be an important part of the diffusion process. For example, Foxall (1989) has argued that for discontinuous innovations, leading edge users are crucial in providing detailed implementation experience to later adopters, playing a valuable function in supporting the communication network. Morrison, Midgley and Roberts (1994) report a correlation of 0.786

between their measures of leading edge users and opinion leadership. The role of leading edge users in supporting the communication network is predicated on them being early adopters and, although there is little empirical evidence of this, most authors suggest that leading edge users will be at the vanguard of the diffusion curve. Trondsen (1996) claims that this early adoption makes leading edge users particularly valuable in increasing the effectiveness of database marketing and magnifying the innovating supplier's pioneering advantage.

In addition to their product development, early adopter, and communication roles, leading edge users may provide valuable market research information to the manufacturer about the acceptability of dramatically new products and trends in preferences and perceptions in the marketplace. von Hippel (1989) points out that "lead users' familiarity with future conditions puts them in a position to provide accurate data on needs related to those conditions". Day (1993) suggests, that while it is important for innovative companies to stay close to their customers, it is particularly important that they stay close to their leading edge users.

The above benefits of leading edge users relate to their role in the calibration and development of manufacturer-developed innovations. Urban and von Hippel (1988) also show that leading edge users will have the ability to manipulate the technology to meet the needs of their organizations, generating solution content that may be of commercial value to suppliers. This is consistent with von Hippel's (1986) argument that users able to gain the most benefit from a new product (ie leading edge users), will also be those who have devoted the most resources to understanding it. The combination of greater understanding of the innovation and the greater derived benefit leads to the ability and motivation of leading edge users to adapt technology to suit their requirements, seek out the most advanced technology and harness its capabilities early, and exchange knowledge with others about new products.

In summary, von Hippel (1978, 1986) and later authors propose that leading edge users have an ability to develop and understand new knowledge and new patterns of experience. When this is combined with their early need for new technology, it makes them important players in the diffusion process; as innovators in their own right, for pre-launch market calibration, as early adopters, as providers of the experience base necessary to start the diffusion process, and in their role of communicating the knowledge.

## **Critiquing the Leading Edge User Construct**

While it appears to be a useful idea, the leading edge user construct is subject to a number of potential problems. These include the fact that there is ambiguity in its definition, it has not been related to existing, traditional constructs currently used in the study of adoption, and the assumption that the population is dichotomously divided into leading edge users and others. We examine the nature of each of these threats to the validity and usefulness of the construct before proposing a methodology to test their importance in practice.

### ***Validity of the Leading Edge User Construct***

The leading edge user construct proposed by von Hippel (1986) and further developed by Urban and von Hippel (1988) is predicated on two assumptions:

1. Some people will experience a need before others. This is supported by the diffusion of innovation literature (e.g., Rogers 1995), and
2. Users differ on the level of benefit they can expect. The amount of effort they will exert to understand and resolve the need will vary with the expected benefit. This is supported by research focused on the economics of innovation adoption (e.g., Mansfield 1968).

Note that there are two elements to the leading edge user construct: the novel application of technological innovations and the earlier perception of the product's benefits. To the extent that these elements are perfectly correlated throughout the population we have a single-faceted construct. To the extent that they are not, we can have some organizations, which are primarily classified as leading edge because of their early novel applications of technology and others that derive it from early need recognition. That is, there is no guarantee that these two elements of the leading edge user definition are indeed correlated and that we have a single construct.

### ***Contrast of Leading Edge Users and Related Constructs***

When von Hippel introduced the concept of leading edge users as a group of advanced users in 1986 there was already a well-established literature on the characteristics of early adoptors or innovators. The two most important constructs in differentiating between the adoption patterns of users are Rogers' (1995) time of adoption and Midgley and Dowling's (1978) innate innovativeness.

Rogers (1995, and in earlier editions of his book going back to 1962) defines *innovators* as those individuals or units of adoption possessing a high level of innovativeness, where innovativeness is the "degree to which an individual or other unit of adoption is relatively earlier in adopting new ideas than other members of the social system". While Rogers' innovativeness (time of adoption) measures a behavior, Midgley and Dowling's innate innovativeness measures an inherent characteristic or trait of a population member. Innate innovativeness is defined in terms of an inherent desire to experiment with the novel rather than a situational response. Midgley and Dowling (1978) define it as the extent to which consumers make the adoption decision independently of the communicated experience of others.

We argue that while leading edge users, those with high innate innovativeness, and Rogers' innovators all tend to adopt early, they represent different aspects of the potential adopter. Rogers' (1995) innovativeness represents purely a behavior while Midgley and Dowling's 1978 innate innovativeness represents purely a trait, stripped of any contextual influences. Leading edge users fall somewhere in between these two extremes. We aim to demonstrate that by combining aspects of both the adoption behavior and the psychological trait, and showing leading edge users fill a useful role in the general framework of organizational adoption of technological innovations and provide some insights that are not available from simply looking at Rogers' innovators.

Currently the lead user and innovator streams of research are independent, with no cross-referencing either way between them. They need to be related. Where the constructs are different it is useful for the nature of these differences to be better understood. We cannot use leading edge users in conjunction with, or in contrast to, time of adoption and innate innovativeness until we have established the relationship between the three constructs.

### ***Distribution of Leading Edge Users in the population***

In the study of leading edge users, nowhere is there any rationale as to why the population should be dichotomous, divided into leading edge users and others. Nor indeed is there any empirical evidence that it is. Leading edge users may be compared to innovators, but for that construct Rogers (1995) proposes a unimodal distribution of the population rather than the polarization into two discrete groups that von Hippel's classification would suggest. There is also strong empirical evidence that the distribution of adoption times is bell-shaped rather than bimodal (see Mahajan, Muller and Bass 1993 for a review of models and fits).

To enable a finer and more flexible definition of leading edge users, we introduce the construct of Leading Edge Status (LES), a continuous variable. We define LES to be “the *degree* to which organizations use and apply technology innovations in new and different ways to solve problems faced by the organization, and the *degree* to which they perceive the benefits of new products earlier than the rest of the marketplace”. We define leading edge users to be those organizations exhibiting high levels of LES. If the distribution of LES proves to be bipolar then the assumption of a dichotomous classification of the population will be a good one. If it is unimodal then any classification into two discrete groups will tend to be somewhat arbitrary and throw away useful information.

Once we have determined the distribution of leading edge status throughout the population we will be in a position to study the characteristics associated with high levels and to contrast them to those of innovators and early adopters.

## **Methodology**

These research questions are pursued in three stages. Firstly we assess the validity of the leading edge user construct. Then we look at its relationship to similar constructs from a traditional adoption framework. Finally, we examine the distribution of the continuous form of leading edge user, leading edge status (LES), and the characteristics of adopters with high levels of LES.

### ***The LES Construct Defined***

von Hippel’s definition of lead user, the discrete precursor to our leading edge status, is defined on the basis of two elements; the recognition of benefits from an innovation early in the process and the potential for accruing large benefits (von Hippel 1978 p796). In addition, von Hippel

(1978 p798) stresses that leading edge users are “at the leading edge of each identified trend in terms of related new product and process needs” and he advocates this as a method of identifying leading edge users. Thus, leading edge users are defined to have two distinguishing features and hypothesized to possess a third, the generation of new applications and solutions. To date there has been no empirical study to test the validity of this construct. Clearly, it is an empirical question as to whether these three elements move together and form part of the same construct. Confirmatory factor analysis (CFA) provides an excellent technique with which to test this assertion. CFA tests whether hypothesized variables all load on the same factor, leading to an internally consistent construct. See Hair et al (1998) for a detailed description of the approach.

To operationalize leading edge status four types of measure may be used; the two elements of von Hippel’s definition (“benefits recognized early” and “high benefits expected”), his method of identifying lead users (applications generation), and direct elicitation of the construct from respondents (both self reports and from third parties). These four groups allow us to examine the internal consistency of the two components of von Hippel’s definition and the method that he proposes to use to identify it. If leading edge status does represent a single, valid construct we can contrast it to related constructs and test the hypothesis that leading edge users form a discrete group identifiable by their score on the resultant LES scale.

### ***Hypothesized Relationships between LES and Related Constructs***

After validating the construct of leading edge status the next challenge is to determine how it is affected by, and affects, traditionally used constructs such as innate innovativeness and time of adoption, as well as mediating variables such as communications receptivity, perceived benefits, perceived risk, and organization fit. The framework we use to incorporate leading edge users

into the traditional diffusion/adoption literature is the Organization Adoption Model developed in Morrison and Midgley (1996). That framework is illustrated in Figure 1 with hypothesized relationships to and from leading edge status included. An examination of Figure 1 shows that Morrison and Midgley (1996) calibrate the mediating variables between Midgley and Dowling's (1978) trait, innate or dispositional innovativeness, and Rogers' (1995) behavior, time of adoption. The logic of the placement of LES in the Morrison and Midgley framework is given below.

The construct of leading edge status (LES) is expected to be closely related to the construct of Organization Dispositional Innovativeness (ODI), the analog of Midgley and Dowling's (1978) innate innovativeness in organizations. Both LES and ODI refer to a cross-category predisposition to innovate. Therefore, the first step in incorporating LES into the Morrison and Midgley (1996) framework is to form a link between ODI and LES. Because LES is more contextually dependent than ODI we expect ODI to be a determinant of LES. Next we examine Morrison and Midgley's links into ODI and determine whether they should affect LES directly or continue to be mediated by ODI. Similarly, links out of ODI must be examined to decide whether they should still go directly to the construct to which they are joined or if they should be mediated by LES.

Morrison and Midgley's structural equation model hypothesizes two links going into organization dispositional innovativeness, and three coming out of it. Of the two constructs that influence ODI, organizational culture and organization structure, we expect the former still to directly influence ODI (and thus influence LES indirectly) while the latter is more logically linked to LES.

Organizational culture is hypothesized to be still directly related to ODI because innate innovativeness or organizational dispositional innovativeness springs at least in part from the ethos of a culture that is generated within the organization. While organizational culture will influence the degree of benefits that the organization can gain and how early it recognizes that benefit (LES), we hypothesize that it will do so via the level of dispositional innovativeness that the culture generates. In contrast, because LES is more contextually dependent than is ODI, it is intuitive that the structure of the organization (as opposed to its culture) directly effects the benefits the organization expects and how quickly it expects to get them. Therefore the Organizational Structure - ODI link is replaced by an Organizational Structure - LES one.

In terms of the three constructs in Morrison and Midgley's model that are influenced by organization dispositional innovativeness (communications receptivity, perceived benefits and time of adoption), we expect all three to be mediated by a link through LES.

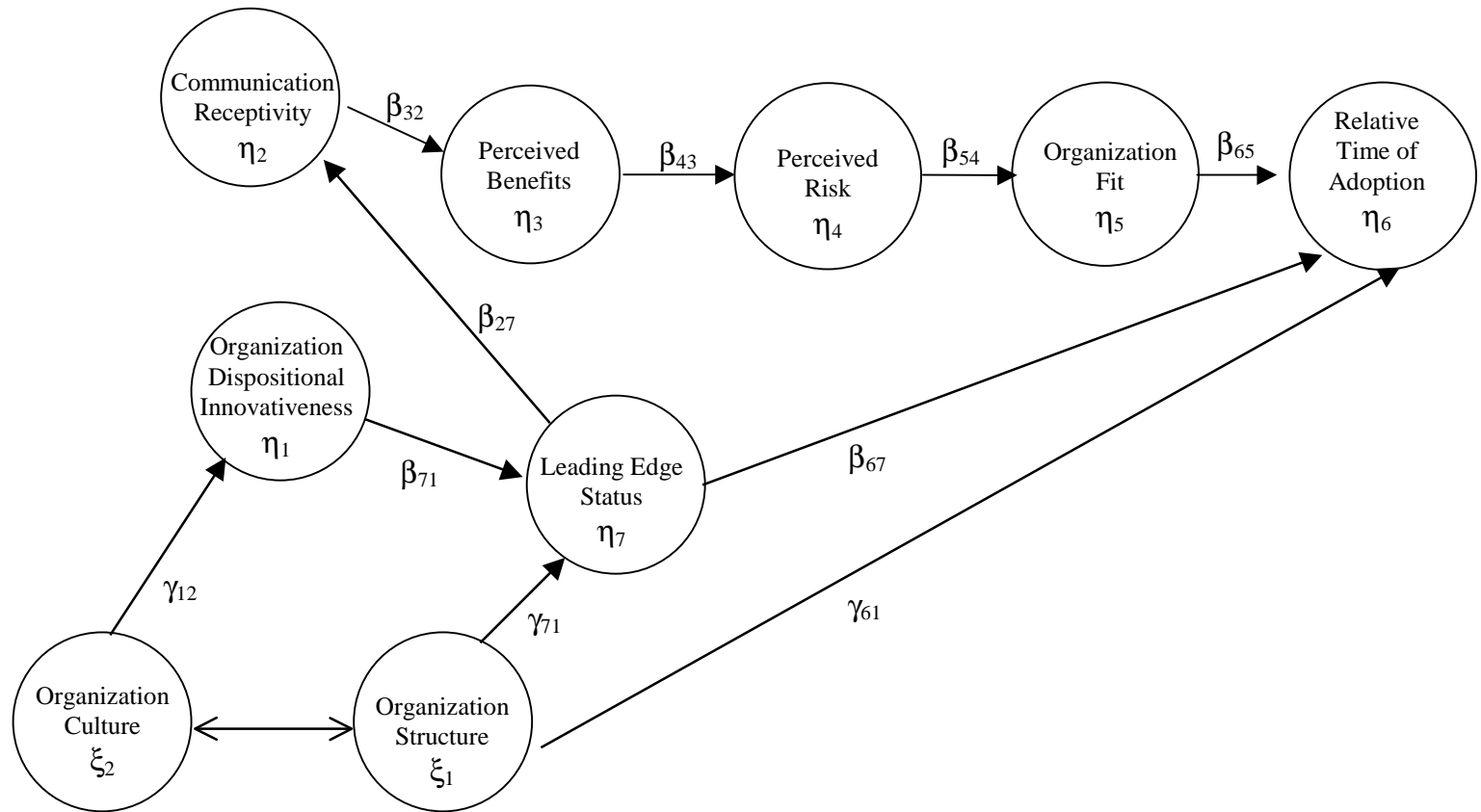
Organizational dispositional innovativeness is the trait of desire to experiment with novel approaches, but before potential adopters can be receptive to communications about such innovations they must perceive a benefit. Hence LES mediates the link between ODI and communications receptivity. A similar argument holds for the link between ODI and perceived benefits. This link in the chain to time of adoption will also be mediated by how early the potential adopter recognizes the need and the degree of benefit the innovation will offer (LES). Finally, the direct link from ODI to time of adoption will also be mediated by how early the adopter perceives the benefit from the innovation, one of the two key aspects to LES.

### *The Nature of LES*

Once we have tested the validity of the construct and established its relation to the literature we can study its distribution and the background characteristics of members with high LES. By understanding the nature of high LES adopters we can target them more readily, focus our marketing program to them more finely, and harness their ideas and potential to fuel the adoption process more fully.

### **Empirical Testing of the LES Construct and Model**

The empirical testing of the model illustrated in Figure 1 proceeded in two stages as suggested by Bagozzi and Baumgartner (1994). Firstly the measurement model was calibrated. Secondly the position of LES in the Morrison and Midgley (1996) adoption framework was examined; that is, relationships between the constructs were calibrated. Calibration of the measurement model, which establishes the validity of each of the constructs, enables us to address the first research question: the validity of von Hippel's proposed construct, leading edge user. The second step investigates the second research question: how the LEU concept fits with previous adopter classifications, particularly organizational dispositional innovativeness and time of adoption. After this two step procedure the distribution of the LES construct was examined, including leading edge user background characteristics, the third issue that the paper addresses.



**Figure 1: Incorporating LES into the Morrison and Midgley (1996) Structural Model of Organization Adoption**

### *Experimental Setting*

To test the model we needed an industry which exhibited homogeneity of product interest among respondents; heterogeneity with respect to size, adoption rate, market sector and adoption timing; and the capability and motivation for good recall. Based on these requirements, libraries were selected as the organizations to be studied. Technologies in libraries tend to be reasonably homogeneous although the rate of adoption of these technologies is not. There is considerable heterogeneity in the size and type of information used in each library. Finally, because librarians are in the profession of storing, accessing and retrieving information we expect them to have good capability and motivation for recall. Within each library the primary respondent was the principal librarian or the librarian responsible for information processing technology.

The population consisted of 13,000 libraries employing almost 20,000 people. Of these approximately 10,000 were school libraries, the majority staffed only part-time. The survey questionnaire was sent to 747 libraries, comprising all identified libraries with five or more professional staff (i.e. a census of large libraries), and to a stratified sample of the remaining small and medium libraries (stratified by library type: Business, Public, Government, Academic, and Tertiary). Within each type of library, the final sample was selected by systematic sampling from available lists. The response rate of 62% showed no obvious bias, with all types and sizes of libraries being well represented in relation to their sampling proportion. The libraries in the final sample account for 56.5% of people employed by libraries in the population and 50% of the total library spend.

The empirical testing of the model involved a cross-sectional survey of organizations within an industry. Restricting the study to one industry may restrict the generalizability of the results,

but as the goal of this research is not primarily external validity, but rather to understand the internal validity of the organization adoption process and the concept of leading edge users, it is necessary to trade off generalizability for a more in-depth study of construct elements (Calder, Phillips & Tybout 1981).

Multi-item scales were used where appropriate, and relevant validated existing scales where they were available. Sufficient redundancy was also built into the measurement to provide estimates of convergent validity. Innovation specific variables were measured for four innovations: Online Public Access Catalogues, Online Database Systems, Searchable Compact Disk Databases, and Electronic Data Interchange.

### ***Methodology***

The relationships between the constructs were studied using a two-stage process of structural modeling. This approach first estimates the measurement model, and in the second stage simultaneously estimates the measurement and structural models. The reason for adopting this strategy is that it provides a more accurate representation of the reliability of the indicators (Anderson 1987) by avoiding the interaction of measurement and structural models.

### ***Measures Used to Calibrate LES and Related Variables***

*Operationalization of LES:* Multi-item measures of LES were developed based on the measurement model proposed in the previous section. Table 1 contains details of the measures used.

**TABLE 1: Measures of Leading Edge Status Construct,  $\eta_7$ : : Cronbach Alpha = 0.83**

Scale Item	Item Wording	Scale	Alpha if Item Deleted
<i>Benefits Recognized Early</i>	1. We are usually ahead of other libraries in recognizing and planning new solutions to problems.	5 point scale: 1 = definitely false 5 = definitely true	0.81
<i>High Level of Benefits Expected</i>	2. This library can benefit significantly by the early adoption and use of technological innovations.	5 point scale: 1 = definitely false 5 = definitely true	0.85
<i>Perceived LES</i>			
<i>(a) By Self</i>	3. How <i>leading edge</i> is the library you work in? (Definition of leading edge user given)	7 point scale: 1 = not at all leading edge user 7 = highly leading edge user	0.80
<i>(b) By Others</i>	4. A count of how often library is mentioned by others as being a <i>leading edge user</i> .	integer variable	0.84
<i>Applications Innovativeness</i>			
	5. We often find that we are suggesting new applications to equipment developers.	5 point scale: 1 = strongly agree 5 = strongly disagree	0.80
	6. We have been used as a test site for prototype versions of new equipment.	5 point scale: 1 = strongly agree 5 = strongly disagree	0.81
	7. We have close relationships with technology suppliers.	5 point scale: 1 = strongly agree 5 = strongly disagree	0.81
	8. We are regarded as having pioneered some applications of technology.	5 point scale: 1 = strongly agree 5 = strongly disagree	0.79

**TABLE 2: List of Items Used to Calibrate Constructs Related to Leading Edge Status**

**Organization Structure,  $\xi_1$**

*(Cronbach alpha = 0.95)*

Log (total employees)

Log (total library budget)

**Organization Culture,  $\xi_2$**

*(Cronbach alpha = 0.83)*

Quick to take advantage of opportunities

Willing to experiment

Risk-taking

**Organization Dispositional**

**Innovativeness,  $\eta_1$**

*(Cronbach alpha = 0.63)*

Advisable to wait before adopting

Reliance on others' opinions

Number of innovations adopted

Library is innovative

**Communications Receptivity,  $\eta_2$**

*(Cronbach alpha = 0.66)*

Frequency of receiving information from:

suppliers

journals

conferences

consultants

associations

**Benefits of Innovation,  $\eta_3$**

*(Cronbach alpha = 0.80)*

Perceived Reliability

Ease of use

Value for money

Ease of maintenance

Ease of integration

Expected benefits

**Organization Fit,  $\eta_5$**

*(Cronbach alpha = 0.83)*

Financial resources

Library performance

Extent of services

Quality of services

**Perceived Risk,  $\eta_4$**

Risk of adoption

**Relative Time of Adoption,  $\eta_6$**

Rogers adoption categories

### ***Constructs in the Morrison and Midgley (1996) Adoption Model***

The eight measures of the elements of LES in Table 1 enable us to examine the construct validity of the concept. To relate it to the traditional construct of adoption traits and behavior in Figure 1 we also need measures of these and other mediating variables such as perceived benefits, organizational fit and communications receptivity. We used the same measures as used by Morrison and Midgley (1996). A list of these variables is included in Table 2.

## **Analysis and Results**

The analysis has three objectives. These are to:

- (1) ***Test and refine the construct.*** To clarify what LES is and whether its elements hold together, leading to an increased understanding of the appropriateness of the construct and its definition.
- (2) ***Integrate LES into the Adoption Decision Framework and contrast LES to other measures of innovativeness.*** To learn how LES fits in with previously developed constructs, clarifying the role leading edge users might play in the adoption of new technology.
- (3) ***Study the distribution of LES and the nature of lead users.*** To be able to identify *characteristics* of LES adopters.

We address each of these objectives in turn.

### ***Testing the Construct of Leading Edge Status.***

We constructed measures of LES (see Table 1) in accordance with current leading edge user literature and our definition of the continuous analog. Initially we need to see how reliable these

measures are in representing the LES construct. We do this by estimating the LES measurement model using confirmatory factor analysis.

The reliability of the construct as measured by Coefficient Alpha is  $\alpha = 0.83$  with 430 observations (where the unit of analysis is the organization). Given this high level of reliability we use confirmatory factor analysis to test the unidimensionality of the LES construct. There are no offending estimates and all the parameter estimates are significant (see Table 3).

**TABLE 3: Confirmatory Factor Analysis Results for the Leading Edge Status Construct**

Item	Std ML Estimates	Standard Error
Benefits Recognized Early	0.683	0.035
High Benefits Expected	0.272	0.035
Perceived LES (self)	1.377	0.056
Perceived LES (by others)	0.386	0.035
Applications innovativeness:		
- New applications suggested	0.926	0.041
- Test site for prototypes	0.952	0.048
- Close supplier relations	0.758	0.041
- New applications pioneered	1.153	0.000
GFI = 0.94      RMSR = 0.08		
Coeff of Determination = 0.88		
Composite Reliability = 0.86		

The composite reliability measure is 0.86, providing support for the reliability of the Leading Edge Status measurement model. Given these results the measurement model for the Leading Edge Status construct was regarded as highly reliable. The fact that von Hippel's two definitions

of lead user and the third he advances to identify them do form part of the same construct, at least in this application, is an important finding.

## ***(2) Testing the fit of LES in the Adoption Framework***

We examine the fit of LES in the adoption framework by testing the hypothesized relationships between the various constructs in Figure 1. This model incorporates numerous variables that vary by innovation and thus the unit of analysis is the innovation rather than the organization. The proposed structural equation model including LES, labeled  $M_{LES}$ , is estimated using the ML method in LISREL VII. The structural equation proposed in Figure 1 resulted in a good fit and all relationships significant except that although the indirect link between leading edge status and perceived benefits was statistically significant, the direct link,  $\beta_{37}$ , was not. The structural equation model was rerun with this link deleted, but with the link from ODI to perceived benefits (present in Morrison and Midgley's model) reinserted. This provided a slightly improved fit and all the links were significant.

This direct link between ODI and perceived benefits and indirect link between LES and perceived benefits is also highly plausible. ODI predisposes the potential adopter to be open to new products and this will be relevant if the adopter is of the habit of recognizing substantial benefits early, that is, has high leading edge status. The perceived benefits may not eventuate, however, unless the adopter is receptive to communication about the innovation. In other words, the tendency to recognize benefits early and for the benefits to be large is totally mediated by communication receptivity with respect to the specific innovation before its individual perceived benefits are realized. However, there is a further effect: organizations with high dispositional

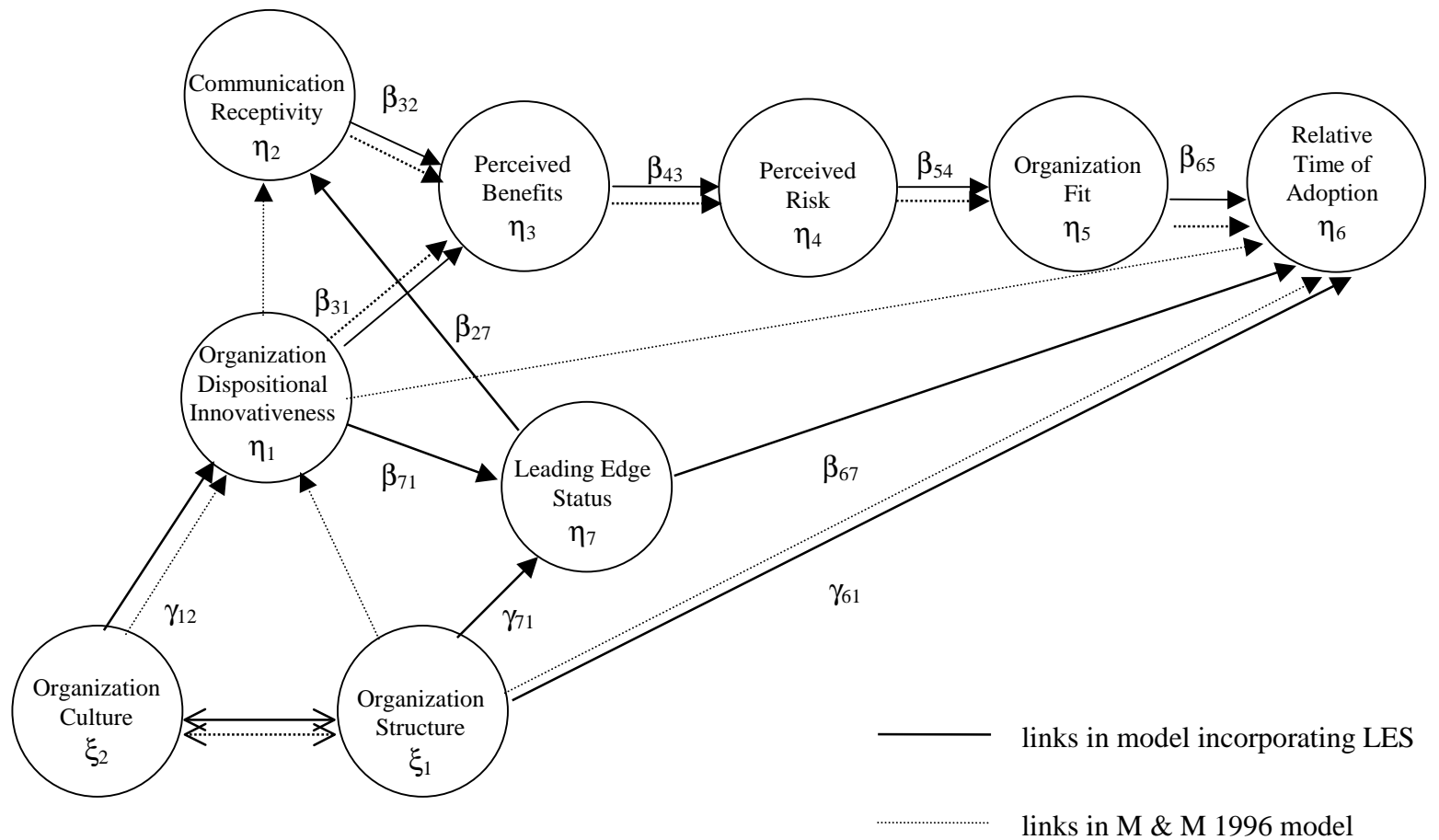
innovativeness will tend to be more optimistic in the evaluation of those benefits (hence, there is also a direct link between ODI and perceived benefits).

The results of the modified model are presented in Table 4 and compared with the benchmark Midgley and Morrison model diagrammatically in Figure 2. Figure 2 highlights the role of LES in the model of organization adoption. As can be seen by the strong links between ODI and LES ( $\beta_{71} = 0.930, t = 11.975$ ) and LES and Relative Time of Adoption ( $\beta_{67} = -0.224, t = -3.861$ ), LES plays a strong mediating role between ODI and Relative Time of Adoption. In contrast to Morrison and Midgley who have a link from Organization Structure to ODI ( $\lambda_{11}$ ) we argue Organization Structure directly affects LES ( $\lambda_{71} = 0.227, t = 11.840$ ). This link is very intuitive as we would expect Organization Structure to be more closely aligned with LES (because both are more context specific) than with the trait ODI. The other link that is different between this model and that of Morrison and Midgley is that  $\beta_{21}$  (ODI to Communication Receptivity) has been replaced by the direct link from LES to Communication Receptivity ( $\beta_{27} = 0.119, t = 3.290$ ).

The results for the model incorporating LES ( $M_{LES}$ ) show that the relationships are all in the hypothesized direction and significant. The overall fit measures suggest that this is an appropriate model. The Goodness of Fit index (GFI) of 0.832 and the Root Mean Square Residual (RMSR) of 0.081 indicate a good fit. Furthermore, the squared multiple correlation (SMC) for the structural equation for Time of Adoption was high with over half of the variance (SMC=0.521) in Time of Adoption being explained by the constructs in the model.

**TABLE 4: Structural Model Incorporating LES ( $M_{LES}$ )**

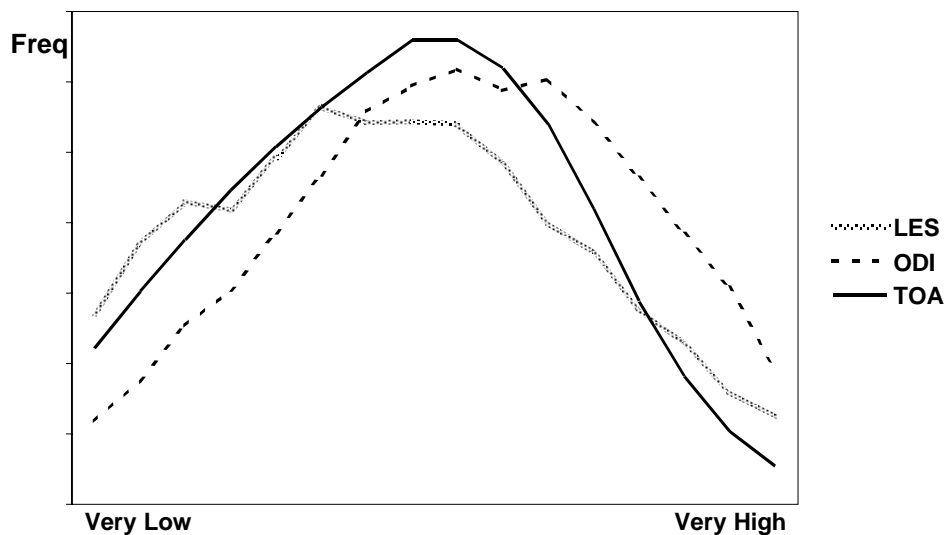
<b>Proposed Model Incorporating LES (<math>M_{LES}</math>)</b>		
<b>Path</b>	<b>Estimate</b>	<b>t-value</b>
<b>Direct Effects</b>		
$\gamma_{71}$ Organization Structure $\rightarrow$ LES	0.227	11.840
$\gamma_{12}$ Organization Culture $\rightarrow$ ODI	0.606	12.525
$\beta_{71}$ ODI $\rightarrow$ LES	0.930	11.975
$\beta_{67}$ LES $\rightarrow$ Time of Adoption (TOA)	-0.224	-3.861
$\beta_{27}$ LES $\rightarrow$ Communication Receptivity	0.119	3.290
$\beta_{31}$ ODI $\rightarrow$ Perceived Benefits	0.181	3.603
$\gamma_{61}$ Organization Structure $\rightarrow$ Time of Adoption (TOA)	-0.189	-5.893
$\beta_{32}$ Communication Receptivity $\rightarrow$ Perceived Benefits	0.127	2.381
$\beta_{43}$ Perceived Benefits $\rightarrow$ Perceived Risk	-0.341	-4.781
$\beta_{54}$ Perceived Risk $\rightarrow$ Organization Fit	-0.096	-2.183
$\beta_{65}$ Organization Fit $\rightarrow$ Time of Adoption (TOA)	-1.193	-3.149
<b>Indirect Effects</b>		
Organization Structure $\rightarrow$ Time of Adoption (TOA)	-0.051	-3.642
Organization Culture $\rightarrow$ Time of Adoption (TOA)	-0.131	-3.970
ODI $\rightarrow$ Time of Adoption (TOA)	-0.216	-3.857
LES $\rightarrow$ Time of Adoption (TOA)	-0.001	-2.500
Communication Receptivity $\rightarrow$ Time of Adoption (TOA)	-0.005	-1.667
Perceived Benefits $\rightarrow$ Time of Adoption (TOA)	-0.039	-2.052
Perceived Risk $\rightarrow$ Time of Adoption (TOA)	0.114	2.235
<b>GFI = 0.832    RMSR = 0.081    SMC (TOA) = 0.521</b>		
Coefficient of Determination for x-variables = .998		
Coefficient of Determination for y-variables = .999		
Total Coeff of Determination for Structural Equations = 0.816		



**FIGURE 2: Comparison of Morrison and Midgley's Model with LES and without LES**

### *(3) Distribution of Leading Edge Status*

As discussed earlier, there is no rationale in the literature as to why the distribution of leading edge users in the population should be dichotomous. By examining the distribution of the continuous analog, Leading Edge Status from the measurement model in Table 3 we can examine that assumption. Figure 3 provides the distribution of LES which demonstrates that it is a unimodal variable, leading to the recommendation that a leading edge user dichotomy should not be used as it is not a good representation of the population mix and its use throws away useful information.



**FIGURE 3: Distribution of Leading Edge Status Construct, Organization Dispositional Innovativeness and Time of Adoption.**

This distribution of LES is consistent with Rogers' (1995) assertion of the bell-shaped distribution of the related construct, Time of Adoption (TOA) and the diffusion of innovation

literature on the time trajectory of the population adopting an innovation. Because we know of no research which has studied the empirical distribution of Midgley and Dowling's (1978) innate innovativeness construct in the adopting population, in Figure 3 we also show the distributions of ODI and TOA. All are bell-shaped, leading to an interesting conclusion. The diffusion of innovation literature suggests that S-shaped diffusion patterns occur (leading to bell-shaped distributions of time of adoption) as a result of an increasing contagion effect followed by the limiting influence of saturation. These results suggest that it is not just the nature of communications that is causing a bell-shaped curve but also the distribution of population heterogeneity with respect to propensity to adopt innovations (ODI and LES). This is consistent with the view of the diffusion process advanced by Russell (1980) and Horsky (1990).

### ***The relation of LES to other measures of innovativeness***

In the previous section, we examined how LES fit into the adoption framework developed by Morrison and Midgley (1996). It is also useful to make a direct comparison of LES to the traditional definitions of innovativeness, innate innovativeness (ODI) and time of adoption (TOA).

Pairwise correlations between the three constructs, illustrated in Table 5, are all highly significant ( $p=0.000$ ). It is not surprising given we are estimating across respondents where there are many extraneous sources of variation (e.g. people use scales differently) that  $\rho$  is much smaller than one. We can see from the correlations ( $\rho_{(LES, ODI)}$  and  $\rho_{(LES, TOA)}$ ) that LES is more closely related to the trait (ODI) than to the behavior (TOA).

**Table 5: Leading Edge Status and Innovativeness Pairwise Correlations**

Pairwise correlations	LES (need level)	ODI (trait)	TOA (behavior)
LES	1.0000	0.5123	-0.3078
ODI		1.0000	-0.3013

Note: All coefficients significant at  $p = .0001$

Both ODI and LES are comparably strong in explaining TOA, though they explain different but overlapping aspects. We demonstrated this by using structural equation modeling in Table 4. We may illustrate the same point more simply by showing the results of a multiple regression of both variables on Time of Adoption. Where:

$$\text{Time of Adoption} = 4.6 - 0.09 \text{ ODI} - 0.04 \text{ LES}$$

$(t=-4.44) \quad (t=-5.04) \quad R^2 = 0.35 \quad \text{Signif F} = 0.00$

Even after allowing for the organization's innate innovativeness trait measured by ODI, LES still captures a significant amount of the variation in adoption times.

Having examined the interrelation of these three constructs we proceed to investigate how each is related to other characteristics of the organization. These results are presented in Table 6. All pairwise correlations except  $\rho_{(\text{TOA}, \text{Financial resource})}$  are significant. While Table 5 illustrated that there is substantial overlap between the three constructs, Table 6 shows that there are also considerable differences between them. High LES organizations are generally larger in size than organizations with high ODI or those which adopt early. This is consistent with the opportunity to reap greater benefits. The level of respondent knowledge about specific innovations is more highly correlated with LES and Time of Adoption than with ODI (and this is particularly so for very recent innovations such as Electronic Mail and Electronic Data Interchange). High LES

organizations are more likely to exhibit an innovative work environment, perform better than libraries of a similar type and size, and enjoy a higher level of autonomy in new technology decisions than organizations with just high ODI. But, as reflected by earlier discussion of  $\rho_{(LES, ODI)}$  and  $\rho_{(LES, TOA)}$ , high LES organizations are more similar to the trait ODI in these characteristics than are early adopters.

**Table 6: Characteristics of Leading Edge Users and Innovators**

Pairwise correlations	LES	ODI	TOA
Number of Employees (size)	.4512 <sup>a</sup>	.2691 <sup>a</sup>	-.2967 <sup>a</sup>
Budget Expenditure (size)	.4872 <sup>a</sup>	.2832 <sup>a</sup>	-.3269 <sup>a</sup>
Level of respondent knowledge	.2316 <sup>a</sup>	.1096 <sup>b</sup>	-.2286 <sup>a</sup>
Innovative culture	.5562 <sup>a</sup>	.4702 <sup>a</sup>	-.2260 <sup>a</sup>
Comparative performance of organization	.4141 <sup>a</sup>	.2704 <sup>a</sup>	-.1973 <sup>a</sup>
Level of autonomy in new technological decisions	.2516 <sup>a</sup>	.1930 <sup>a</sup>	-.1124 <sup>b</sup>
Comparative level of financial resources	.1435 <sup>a</sup>	.1131 <sup>b</sup>	n.s.

NOTE: <sup>a</sup> Coefficients significant at  $p = .001$       <sup>b</sup> Coefficients significant at  $p < .005$

## Discussion and Implications

von Hippel (1986) proposed the concept of lead user or leading edge user to understand how those who were in some sense “advanced” in an adopting population could be harnessed for forecasting purposes and to generate new products based on their advanced application status. It

is a motivation predicated on the usefulness of these population members to the innovating manager and thus is an appealing concept to the researcher who is interested in the application of innovation theory to the design of the new product's marketing mix. To von Hippel's motivation for understanding the concept we might also add an interest in discovering how leading edge users are susceptible to the innovation relative to the rest of the population and, related to this, how early in the diffusion process they adopt. It is also useful to discover the role they play in the contagion process (assisting others in the adoption process) which is a function of the earliness of their adoption combined with their importance as communication sources. Finally, von Hippel (1986) suggests that LEUs are also useful in providing informed and reliable behavioral intentions with respect to radical innovations.

While von Hippel's concept of leading edge users is intuitively appealing and appears to be managerially useful, it has not been without its problems. These include lack of validation of the construct, lack of any relationship between LEUs and other measures of innovativeness, and a lack of understanding of the characteristics of LEUs, both their distribution in the adopting population and correlates in terms of organizational characteristics. We have attempted to take a first step in addressing these problems.

The first problem was addressed in this paper in the measurement model. The correlation between early benefits expected and large benefits was 0.295 (highly significant with  $p = 0.000$  and reasonably large considering the other sources of variation between respondents). All four measures of applications innovativeness were consistent with the leading edge user construct, suggesting high construct validity between the construct and the measures von Hippel proposes for its identification.

The second issue with respect to LEUs is their relation to other constructs in the adoption of innovations literature. We were able to use structural equation modeling to investigate how leading edge status fit into Morrison and Midgley's (1996) adoption framework. The continuous analog of LEU, LES, is an intermediate construct mediating a number of links between the trait of organization innovativeness and the behavior measured by time of adoption. Dispositional innovativeness (ODI) drives the ability to see large benefits early. Communication receptivity will determine how quickly those large benefits are perceived in any specific situation based on the level of leading edge status.

The third problem with leading edge users, that of an implied dichotomy, was addressed by examining the empirical distribution of Leading Edge Status (LES), the continuous analog of Leading Edge User. LES was found to have a unimodal distribution making any dissection of it arbitrary and meaning that talking of leading edge users/others throws away valuable information. Thus, for this population at least, the continuous variable LES appears to be a more useful and more informative measure than leading edge user, particularly when trying to understand the continuous behavioral variable, time of adoption (TOA) in terms of the continuous trait, innate innovativeness or ODI.

The results of this paper are optimistic. Leading edge users do seem to be an internally valid group of adopters, particularly if measured in their continuous analog form, LES. We can see how they fit with other constructs of the adoption framework using structural equation modeling. LES adds significantly in explaining organizations' times of adoption, even after accounting for their dispositional innovativeness. Finally, it is more highly correlated with all respondents background characteristics than either ODI or TOA suggesting that it may be more easily identified by these surrogates than other measures of innovativeness.

However, there is still further research required. It would be useful to replicate the results in a number of different industries. Although there seems little reason why these results would not carry over to other adopting populations, their external validity needs to be established. We have looked solely at the role of leading edge status in the adoption decisions of individual's own organizations. It would be valuable to now relate this to their role in the adoption decisions of others, as well as relate it to the level of innovation that they undertake internally.

In conclusion, the study of leading edge users is attracting increasing attention because of their value as early adopters, source of new product ideas, market research potential, and role in fueling the diffusion process. We have attempted to consolidate the measurement basis on which the concept is founded and relate it to other approaches studying differences between adoption behavior in the population.

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