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Identification of Lead User Characteristics: The Case of Surgeons in Turkey

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Abstract
Lead users are the users of a product or service the experience needs of which are still unknown to the public; lead users also benefit greatly if they are able to obtain a solution to these needs. Lead users have some characteristics that differentiate them from non-lead users. In our study, the characteristics of lead users, such as being ahead of trends, the high level of expected benefits, dissatisfaction, speed of adaption, the frequent use of information, experience of use, possessing resources for research, intrinsic and extrinsic motivation have been analyzed in the medical industry and in surgery. The results of the study indicate that the high level of expected benefits, the frequent use of information and intrinsic motivation is significantly different between lead users and non-lead users.
Keywords: Lead User, Lead User Characteristics, Surgeons, Medical Industry

1.Introduction

Innovativeness is the introduction of new products, services and ideas in the organization (Hult et al., 2004:429). Innovativeness is a key factor in a competitive environment. The effects on sales growth, capacity utilization (Sandvik and Sandvik, 2003:365) and business performance (Calantone et al., 2002:522) have all been demonstrated in empirical studies. But studies have revealed that not all users are innovative. A small section of users tend towards innovation; in management literature these users are accepted as “lead users”. Lower cost and higher efficiency in new product development can be feasible with lead user involvement, and as a result it is very important to identify lead users for this process (He and Yu, 2010:1308). Collaborating systematically with lead users will increase the success of new product development processes in innovative firms (Lilien et al 2002; 2005).

2.Background

2.1.Lead Users

The concept of lead user has been extensively researched in order to bring to light the relationship between manufacturer and customer on new product development. Research into user innovation, particularly lead-user innovation, was pioneered by von Hippel (1976; 1978; 1986) von Hippel observed and concluded that many industrial products originated from customers, who were customers different from the normal customer (Spann et al., 2009:324). To understand what type of users can develop new product ideas in order to attract other users, von Hippel (1986) has developed a guide called the lead-user idea generation process. The four step process of lead-user idea generation (von Hippel, 1986:797) includes:

(1) Identifying an important market or technical trend.
(2) Identifying lead users
(3) Analyzing lead user need data
(4) Projecting lead user data to the general interest market.

The effectiveness and applicability of this process has been tested in many studies in which von Hippel acted as a consultant (Urban and von Hippel, 1988, p.570; Herstatt and von Hippel, 1991; von Hippel and Riggs, 1996; von Hippel et al., 1999, p.49; Lilien et al., 2002, p.1044).
Eric von Hippel (1986:796) firstly defines lead users as having two main characteristics; (1) they encounter needs that will be general in the market months or years before the majority of the relevant market is aware of these needs, (2) they expect to benefit from a solution to these needs. Thus, lead users can considered as need-forecasting laboratories; in addition they also provide new product concepts designs (He and Yu, 2010:1305). Morrison et al. (2004:354) refers to the two components of this definition as leading edge status.
A large number of researchers have tried to explore the benefits of lead users in new product development process, in particular von Hippel (1986). Such research emphasizes that some industries are more suitable for deriving benefit from lead users. Medical equipment (Biemans, 1991; Lettl et al, . 2006; Lettl et al., 2008), computer programming and software (Urban and von Hippel, 1988; Franke and von Hippel**,** 2003), construction equipment (Herstatt and von Hippel, 1992), electronic banking system (von Hippel and Riggs, 1996; von Hippel and Oliveira, 2009), library information systems (Morrison et al, 2000; Morrison et al., 2004), outdoor sport equipments (Lüthje ve Herstatt, 2004; Lüthje et al, 2005; Franke et al., 2006; Hienerth, 2006) are the main

industries that lead users have contributed to either in idea generation or following stages in new product development processes. Moreover, lead user methodology can be a part of technology transfer to less-developed countries (Scheraga et al., 2000:424). This type of activity starts with transferring solution information to users. Then users develop a new service, method or product for their own needs.

2.2.Characteristics of Lead Users

Lead-user literature generally focuses on two main topics. The first interest in research focuses on lead-user methodology (Urban and von Hippel, 1988; Herstatt and von Hippel, 1992; Lilien et al, 2002), while the second is characteristics of lead users (Franke and von Hippel, 2003; Franke et al., 2006). In various study the second set of researchers have been interested in some lead-user characteristics such as being ahead of trends, a high level of expected benefits, dissatisfaction, speed of adaption, product-related knowledge, experience of use, opinion leadership, openness to new technologies, possessing resources for research, intrinsic and extrinsic motivation. (Morrison et al.,2000; Morrison et al.,2004; Belz and Baumbach, 2010; Schuhmacher and Kuester, 2012; Lettl et al. 2006; Lettl et al., 2008; Schreier and Prügl, 2008; Span et al., 2009). In our study, we focused on the differences between lead users and non-lead users, interpreting these as distinctive characteristics.

Being ahead of the trends is an important characteristic that differentiates a lead user from a non-lead user (Belz and Baumbach, 2010:310); this characteristic also facilitates creating valuable innovative ideas by thinking in unconventional ways (Schuhmacher and Kuester, 2012: 430). An important finding in a study carried out by Franke et al. (2006: 304) on lead users is that these types of users are ahead of the trends. This characteristic makes them develop new products that are commercially attractive.

$1H_1$: Being ahead of the trend is different between lead users and non-lead users.

In lead-user theory the high expected benefit that lead users possess has been established in various empirical studies (Morrison et al., 2004; Spann et al., 2009; Oosterloo, 2010). The person who expects benefit from the solution to a problem makes a greater contribution to the solution than others do (Urban and von Hippel, 1988: 570). For example, Franke et al. (2006: 304) investigated the role that kite surfers had as lead users in developing commercially attractive products; they discovered that higher expected benefit causes higher demands for the creation of new ideas and innovation. Three indicators should be evaluated to determine the level of expected benefit characteristic for lead users; user's investment in the product, dissatisfaction of the user and speed of adoption.

Any needs of lead users that are not met trigger necessary motivation to develop products or services to satisfy their needs (Schuhmacher and Kuester, 2012: 430). In the absence of a suitable solution from manufacturers, lead users try to design a new product or modify an existing product in order to meet their needs. In these cases, lead users can invest in new products or modify existing ones. For example, 26% of OPAC (Library Information System) users who were investigated by Morrison et al. (2000:1425) spent time and money on modifying the system to convert it to function as they wanted.

The gap between expected and perceived performance of a product by lead users leads to dissatisfaction; in turn, this dissatisfaction leads to an attempt to invest in a new product idea (Bilgram et al., 2008: 432). This type of dissatisfaction has been observed in a number of studies. For example, Hienerth (2006: 286) discovered that in the Rodeo Kayaking area, lead users started to make innovations due to a technological gap. These users found a solution to create technically more usable materials. In a study carried out by Lettl et al. (2006:259) the standard neurosurgical instruments used by surgeons in their operations did not meet their needs. So these users found solutions that would satisfy their needs. And a study by Belz and Baumbach (2010:310) demonstrated that dissatisfaction is a distinctive feature between lead users and non-lead users.

Everett (2012) states that the lead user makes up the upper segment of innovation diffusion. This segment includes early adopters. Lead users of a new or modified product exist before it is developed by any firm (Herstatt and von Hippel, 1992). Innovative ideas that this sector develops makes them into innovators – the top segment of Rogers diffusion of innovation theory. Indeed, lead users are always open to new technologies (Lettl et al., 2006:259) and their adoption of new technologies is much more rapid than other users. Schreier and Prügl (2008: 343) conducted a research on 193 tech divers, 129 sailplaners and 139 kite surfers; the findings of this research demonstrate that lead users adopt new products faster and more intensely than ordinary users. Moreover, lead users can be an effective support to other users while adopting new products (Morrison et al., 2004:361). As a result of all these empirical studies, lead users who expect high levels of benefit from new products prefer to be at least involved in the idea generation process.

$2H_1$: High level of expected benefits from a new product is different between lead users and non-lead users.

$3H_1$: Dissatisfaction from existing product is different between lead users and non-lead users.

$4H_1$: Speed of adoption is different between lead users and non-lead users.

Lead users tend to possess greater consumer knowledge (Schreier and Prügl, 2008:343) than non-lead users. Lettl et al. (2006; 2008) demonstrated that all innovative surgeons have in-depth knowledge and are acknowledged professionals in their field of expertise. Research activity is vital in order to gain important knowledge, and research resources must be to hand. Information about the main needs is one of the leading

characteristics to improving innovative ideas or products. Both explicit and implicit knowledge directs lead users to contribute to the innovation process of a firm. Marchi et al. (2011: 357) found that product related information of users is positively related to their level of innovativeness. Lüthje et al. (2005: 951) conducted their lead-user research on mountain bikers and found that bikers use their own knowledge while innovating. The knowledge about a suitable solution arises from their professional background and hobbies.

$5H_1$: Frequency of use of information sources is different between lead users and non-lead users.
$6H_1$: Being able to attain resources for research is different between lead users and non-lead users.
$7H_1$: Use experience (Professional background) is different between lead users and non-lead users

Some innovative users do not possess these supportive factors. However, these users are interested in developing products they use as a hobby, spending their spare time to generate new ideas or even new product design (Lettl et al., 2008). Motivation is a key part of creative ideas (Amabile, 1998:78). Lead users have high motivation to develop new solutions in their professional field (Lettl, 2007: 68). In the contribution to innovation, two main aspects of motivation can be considered; intrinsic and extrinsic motivation. Intrinsic motivation appears when an individual engages in behavior, such as a hobby, like dancing, gardening, playing or basketball. External rewards are not obvious when a person has intrinsic motivation. External motivation is activated by external incentives, such as direct or indirect monetary compensation or recognition by others (Leimeister, 2009:203). Intrinsic motivation can be seen as the main incentive for lead users to participate in idea generation or design process of new products (Blohm et al. 2011:118; Füller, 2006:642). Intrinsic motivation allows users to make use of their full potential for creating; intrinsic motivation arises with enjoyable and creative activities (Bilgram et al., 2008: 441). In addition to intrinsic motivation, the other type of motivation, extrinsic motivation, is an important factor in creativity and innovation. Extrinsic motivators, such as rewards for creative ideas, feedback on work and clearly defined project goals support creativity (Schuhmacher and Kuester, 2012:432). For example, contests for new ideas and the prizes awarded can motivate users to take part in innovative activities (Ebner et al., 2009:353; Leimeister et al, 2009:210). The results attained in the research carried out by Burroughs et al. (2011:56) reveal that extrinsic motivation methods, such as public recognition, prizes, financial bonuses based on firm or team performance, and financial bonuses for individual performance are all incentive tools to increase creativity in firms. Füller (2010:101) considers monetary rewards to be an important motive for consumer creativity.

$8H_1$: Intrinsic motivation is different between lead users and non-lead users.
$9H_1$: Extrinsic reward is different between lead users and non-lead users.

3. Methodology

3.1.The Aim of the Study

The aim of the study is to investigate which characteristics are leading factors in developing a new idea/concept by lead users. In the context of lead-user characteristics, the high level of expected benefits, dissatisfaction, speed of adoption, frequency of use of information, resources for research, intrinsic motivation and extrinsic reward are all examined.

3.2.Participants and Procedure

Lead-user research has focused on a few different sectors, such as sport equipments, computer programming and medical equipment (Hienerth and Lettl, 2011; Kaiser and, Müller-Seitz, 2008; Franke and von Hippel, 2003; Lütjhe et al., 2005; Franke et al, 2006). The result of research in medical equipments (Biemans , 1991; Lettl vd., 2006; Lettl vd., 2008; Hienerth and Lettl, 2011) demonstrates that this sector is highly suitable for evaluating the new equipment ideas of lead users. Çetin Gürkan (2012) conducted an explorative study to evaluate the contribution of surgeons to the medical equipment sector in Turkey, and found that medical firms take advantage of the new equipment ideas or methods presented by surgeons. In addition, other surgeons stated that they preferred an instrument that had been produced from the idea of a professional colleague. These results led this study to investigate lead-user characteristics of surgeons in Turkey. Thus, surgeons who were working in a hospital or a clinic and whose e-mail information could be attained were used as samples in this study. 221 questionnaires were returned; after the elimination of unfinished questionnaires, 209 were analyzed. 83.7% of participants were male and 60% of participants were above 40 years in age. The number of years that the participants had been involved in their career for 11 to 20 years was 29.7%, 28.2% for 6 to 10 years, 16.7 for 0 to 5 years and 24.9% for 21 or more years. Their titles were surgeon (MD) (57.9%), professor (21.1%), associate professor (15.3%) and assistant professor (5.7%). In terms of participants' work places, 36.8% of the participants worked in university hospitals, 31.1% in private hospitals, 15.3% in education and research hospital, 14.4% in state hospitals and 2.4% in clinics.

3.3.Measure

The research instrument used in this study was a structured questionnaire. The questionnaire consisted of 2 sections. Section one contains professional information such as title, type of organization, average number of operations in a week, years working, as well as personal information such as gender and age. Section two consists of 22 items and is designed to ascertain information about the lead-user characteristics of the surgeon.

Multi-item measures of lead-user characteristics were developed based on previous lead-user literature and scales for lead user characteristics were applied (Morrison et al., 2004:356; Lettl et al., 2006; Spann et al., 2009: 330; Oosterloo et al., 2010:22; Schuhmacher and Kuester, 2012:442).

4. Results

Twenty-two questions relating to lead-user characteristics were factor-analyzed using principal component analysis with Varimax (orthogonal) rotation. The analysis yielded seven factors that explained a total of 67.002% variance for the entire set of variables (Table 1). Two items were eliminated due to lower factor loadings. These items were designed to predetermine trend characteristics of lead users. Due to the elimination of these items, $1H_1$ of the study was unable to be tested. The KMO and Bartlett's Test of Sphericity both indicate that the set of variables are, at the very least, adequately related to factor analysis. After factor analysis, the Cronbach Alpha was used to determine the reliability of the questionnaire. The Cronbach Alpha value of the scale was 0.810.

Table 1. Factor Analysis Result

Item No	1	2	3	4	5	6	7
HLEB2	,866						
HLEB1	,842						
D1		,848					
D3		,626					
D2		,550					
SA2			,868				
SA1			,840				
FUI3				,747			
FUI4				,664			
FUI2				,658			
FUI1				,590			
FUI5				,521			
RR2					,799		
RR3					,731		
RR1					,646		
IM2						,705	
IM3						,693	
IM1						,612	
ER2							,843
ER1							,837
Explained Variance	8,00	5,03	5,86	23,30	11,96	7,31	5,52
Total Explained Variance	**67,002**						
	Kaiser Meyer Olkin: ,752 **Barlett's Test of Sphericity (p): ,000**						

*1-**HLEB**:High level of expected benefits; 2-**D**:Dissatisfaction; 3-**SA**:Speed of Adoption;*
*4-**FUI**:Frequency of use of information; 5- **RR**:Resources for Research; 6-**IM**:Intrinsic Motivation; 7-**ER**:Extrinsic reward*

Normality tests are used to determine if parametric or non-parametric tests are suitable. The assumption of normality was tested using Kolmogorov-Smirnov. Review of the Kolmogorov-Smirnov (p = 0.000) suggested that normality was not a reasonable assumption. So non-parametric tests (Mann-Whitney U and Kruskal Wallis) were used to reveal the differences between lead user and non-lead user characteristics.

In order to determine lead users in our sample, two discriminative questions were put into the study. "Did you develop an instrument/a method that can be used in your surgical field?" and "Did you have a new instrument/method idea that a medical firm was interested in producing?". The surgeons whose answer is "yes" to any of these questions can be accepted as lead user. 32 surgeons of the total sample (15.3%) were lead users in our study sample.

The results of the comparison analysis between lead users and non-lead users reveal that in support of Hypothesis 2, 5 and 8, the high level of expected benefits [U(207)= 2218,000, Z= -2,063, p=,039<,005], the frequent use of information [U(207)= 2122,000, Z= -2,264, p=,024<,005], and intrinsic motivation [U(207)= 1,477E3, Z= -4,332, p= ,000<,005] differ significantly between these two groups (Table 2). These average characteristics of lead users are higher than the averages of non-lead users. In other words, lead users expect

greater benefits from new products, and use information more frequently than non-lead users. Furthermore, lead users have more intrinsic motivation than non-lead users.

Table 2. Mann-Whitney U Test Results

	HLEB	***D***	***SA***	***FUI***
df	40,1	43,3	38,3	42,1
Mann-Whitney U	2218,000	2568,000	2605,000	2122,000
Z	-2,063	-,847	-,733	-2,264
Asymp. Sig. (2-tailed)	***,039***	,397	,464	***,024***
	RR	***WYE***	***IM***	***ER***
df	40,9	41,8	38,6	41,5
Mann-Whitney U	2,483E3	2639,000	1,477E3	2,543E3
Z	-1,119	-,586	-4,332	-,934
Asymp. Sig. (2-tailed)	,263	,558	***,000***	,350

*1-**HLEB**:High level of expected benefits; 2-**D**:Dissatisfaction; 3-**SA**:Speed of Adoption; 4-**FUI**:Frequency of use of information; 5- **RR**:Resources for Research; 6- **WYE**: Working Years Experience; 7- **IM**:Intrinsic Motivation; 8- **ER**:Extrinsic reward*

The results demonstrated that $3H_1$, $4H_1$, $7H_1$ and $9H_1$ were not confirmed (Table 2). Lead users and non-lead users do not acquire different characteristics in dissatisfaction, [U(207)= 2568,000, Z= -,847, p= ,397>,005], speed of adoption [U(207)= 2605,000, Z= -,733, p= ,464>,005], having resources for research [U(207)= 2,483E3, Z= -1,119, p= ,263>,005], extrinsic motivation [U(207)= 2,543E3, Z= -,934, p= ,350>,005]. To test differences in professional background, the number of years that the individual worked was used. No difference was found between lead users and non-lead users according to professional background [U(206)= 2639,000, Z= -,586, p= ,558>,005]. So $6H_1$ was not confirmed.

5.Discussion

The aim of this study is to reveal lead user characteristics that can contribute to new product development processes in companies. In order to compare the characteristics of lead users and non-lead users, an empirical study was conducted on surgeons in Turkey.

The results of the study demonstrate that lead users expect high benefit from a new product or method. This result is compatible with the study results of Urban and von Hippel (1988), Morrison et al. (2004), Spann et al. (2009) and Oosterloo (2010) about lead user characteristics. Expecting high benefits from a new product or method leads individuals to try developing the product themselves. Furthermore, the study results revealed that lead users make use of information in the area of expertise more frequently than non-lead users. This part of our results support the results of Lettl et al. (2006; 2008) and Marchi et al. (2011) on the frequency of information use. This frequency of use includes more expert knowledge; lead users benefit from this knowledge while developing new ideas of new products or methods. In the results of the study, intrinsic motivation is found to be the final characteristic of lead users that is higher than non-lead users. This characteristic is acknowledged to be one of the main characteristics which stimulate creativity in lead users. Consequently, intrinsic motivation in lead users is higher than in non-lead users. In order to increase new product development tendency in users, this type of motivation should be encouraged. These three characteristics in lead users could be discriminative elements for determining who the actual lead user is. The third level of the lead-user idea-generation process is identifying the lead user (von Hippel, 1986). Many methods can be used to identify lead users, such as market research or the pyramiding search method. Those lead users who have been identified can be encouraged to contribute to the innovation process of a firm. If distinct characteristics of leads users are determined, firms could benefit from using the lead-user idea-generation method more efficiently. The identified lead users could be invited to the firm in order to test the concepts of new versions of medical instruments.

The present study also has some limitations. Identifying lead users is very difficult, as they are outnumbered in the population. The screening method can at times be inefficient, but in-depth research methods are sometimes not applicable. Moreover, the results rely on the self-evaluation of users. This might be insufficient for evaluating the characteristics of lead users. A third section could be included to the evaluation process in order to eliminate this limitation.

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