A SCALE FOR IDENTIFYING USER INNOVATORS AND ITS VALIDATION PROCESS

ABSTRACT

This paper aims to offer a reliable and valid scale to identify user innovators, who play a noteworthy role in innovation and are a valuable source of ideas. Due to its cross-industrial approach, simplicity and practicality, this cross-market scale constitutes of a valuable measurement instrument that can be applied to regions with a varied level of development in order to identify user innovators. The instrument has surpassed a rigorous validity process and it have been tested in a sample of adult consumers in Bogotá, Colombia. Both an exploratory factor analysis (EFA) and a confirmatory factor analysis (CFA) were performed. The final scale includes twelve variables fit and represented in three constructs: User leadership, curiosity and creativity, and time and skills to develop products. Those constructs are essential to promote user-centered innovation in both large and small companies.

Kew words: instrument validation, user innovation, user innovators, innovation by users, validity

INTRODUCTION

Early research showed that innovation is not only induced by manufacturers, but also by other actors such as users who engage in innovating, exploiting innovations, and play an active role in innovation activities (von Hippel, 1988; von Hippel, 2009; Franke, von Hippel, & Schreier, 2006; Jeppesen & Frederiksen, 2006; Raasch, Herstatt, & Lock, 2008; Schweisfurth, 2013).

Empirical studies have demonstrated that users rather than manufacturers have contributed significantly to the development of new products and services (Urban & Hippel, 1988; Herstatt & von Hippel, 1992; Balwin et al., 2006; Raasch et al., 2008). Involving users into new product/service development processes help managers to adopt a proactive approach and reduce risk of commercial failure by manufacturers (Henkel & von Hippel, 2005; Matthing, Sandén, & Edvardsson, 2004). In order to involve users into innovation processes, it is necessary a correct identification of those users. Evidently, there is a gap and an opportunity to research.

Flowers and Henwood (2010) also observed a gap in the correct identification of innovative users (as cited in Mujika-Alberdi et al., 2015, p.108). Mujika-Alberdi et al., (2015) pointed out the need to apply

cross-industry scales in order to identify user innovators in emerging markets. Mujika-Alberdi et al., (2015) also mentioned the need to conduct psychometric contrasts applying confirmatory analysis to different communities and regions with varied levels of development. In respond to that need, this research offers a validation of a measurement instrument to identify user innovators in an emerging country such as Colombia.

In this study, the reader can examine the validation process of a measurement scale to identify users, following the methodological steps to ensure rigourosity, reliability, and validity. This article describes the validation process of the scale, which includes definition of the instrument to identify user innovators, the application of a pilot test or prototype scale, the application of the final scale, exploratory and confirmatory factor analysis (CFA), correlation matrix per dimension after CFA, and sample and data collection.

METHOD

Prior to the validadtion process, the authors performed a review of the literature, in this case, related to user innovators. Later on, after reviewing preview studies, the authors identified the purpose of the scale and then they decided the most appropriate instrument for the research.

The original instrument illustrated by Flowers, et. al. (2010) has been validated in those countries that have estimated the percentage of user innovators, such as UK, Japan, United States, and Basque country (Gipuzkoa). Mujika-Alberdi, Gibaja-Martíns & García-Arrizabalaga (2015), designed an instrument to identify advanced users at consumer level.

As part of the instrument definition, the authors were particularly interested in applying the scale developed by Mujika-Alberdi et al., (2015) because of its cross-industrial approach, simplicity, and practicability to to be used in regions with a varied level of development. This scale has also been successfully tested and validated in a European region called Gipuzkoa and the authors found out a valuable instrument to validate and test. The following sections describe the validation process.

THE INSTRUMENT DEFINITION

The measurement scale consists of four sections: The first section gathers socio-demographic information (age, education level, income, technical training, and education level) that has proven to be

relevant in identifying user innovators: The second one explores the innovations made by consumer users. The third identifies modifications made by consumer users. The last section looks for user innovator characteristics based on three attributes: User leadership, Curiosity and creativity and Skills to develop products. The last section of the instrument is subject to the entire validation process.

The final scale is composed as follows: User Leadership (UL) construct comprises 5; Curiosity and creativity (CR) construct consists of 4 items; and availability of time and skills to develop products (SK) construct involves 3 items. It is necessary to remember that the purpose of this scale is to look for user innovators. Consequently, a user innovator creates or modifies a product for their own benefit; therefore, in this research, the user innovator will be the individual who makes at least one of these actions.

In this research, the author followed the work presented by Mujika-Alberdi et al., (2015) and the scale "Customers at the cutting edge" to identify advanced users. This research involves the following constructs:

1. User leadership: It refers to certain activities performed by those users who are aware of a need and can develop a completely new solution to address it (Mujika-Alberdi et al., 2015). Those users usually enjoy creating new things, provide suggestions to improve processes or products, develop new solutions and consider themselves as innovators. The characteristic ''User leadership'' is measured by a five-item scale. All the five items are derived from previous studies to identify advanced users and correspond to the scale proposed by Mujika-Alberdi et al. (2015). All items were measured on a one-to-five Likert-type scale, ranging from ''I totally agree'' to ''I totally disagree''.
2. Creativity: The creative potential that users display when they develop new and useful solutions for a problem reveal the strong connection between creativity and lead users. Previous studies have established that lead users are creative individuals (Mujika-Alberdi et al., 2013; Faullant, et al., 2012). Valuing the work by Mujika-Alberdi et al. (2015) and Faullant, et al (2012), the author measure the degree of creativity a four-item scale was utilized. All the four statements are derived and correspond to the scale proposed by Mujika-Alberdi et al. (2015) to identify advanced users. All items were measured on a one-to-five Likert-type scale, ranging from ''I totally agree'' to ''I totally disagree''.

3. Skills for product development: The aim of integrating advanced users into the NPD process is the creation of new and promising products or solutions to appeal to customers. Lead users constitute of a tremendous source of novel ideas and solutions that later on can be prototype and commercialized (Lilien, Morrison, Searls, Sonnack, & von Hippel, 2002). To measure the degree of skills for product development a three-item scale was used. All the three items are derived and correspond to the scale

proposed by Mujika-Alberdi et al. (2015) to identify advanced users. All items were measured on a one-to-five Likert-type scale, ranging from ‘‘I totally agree’’ to ‘‘I totally disagree’’.

SAMPLE AND DATA COLLECTION

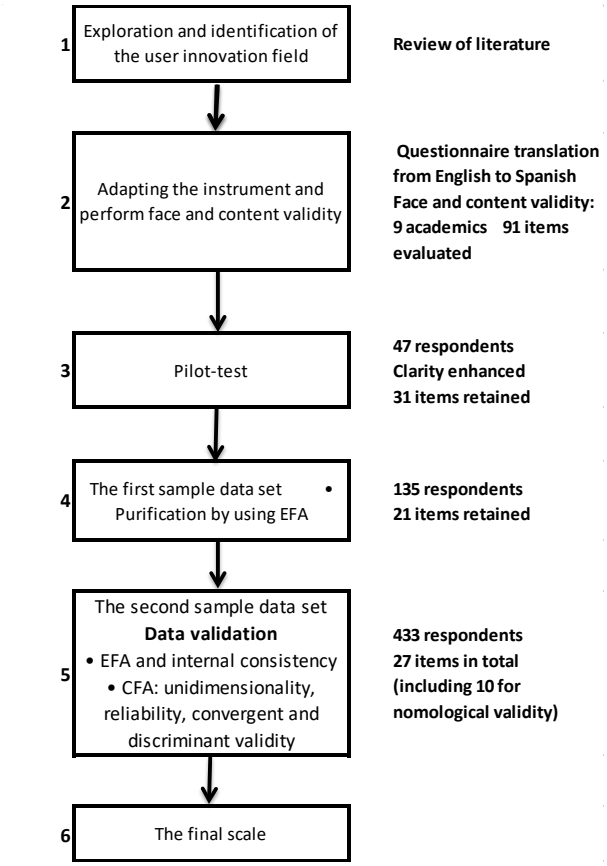
This study has a cross-sectional quantitative design with a descriptive scope. The sampling method used was not probabilistic for convenience. A measurement scale was administered to identify user innovators using a non-representative sample of older adults older than 18 years. The questionnaire was designed to be self-administered. They were asked to answer one of the questionnaires themselves, give a questionnaire to an adult age from their parents and another questionnaire to an adult over 55 years. The purpose of that was to cover three generations: grandparents, parents and children. Fieldwork for data collection took place in 2014. 518 questionnaires, of which 433 were valid, with a response rate of 83.5% were received.

In order to avoid false positives answers, a cleaning process was applied. First, the author checked for originality: If the respondent knew of others who had developed an equivalent “home-made” product, or if he or she knew of an equivalent product available on the market, the case was excluded from the sample. Second, the author checked for innovations that consumers developed during their leisure time, to avoid those on the job innovations or those innovations developed at work, as those are already recorded in official innovation statistics. Finally, a database that systematizes all the information was created and the data was analyzed through SPSS 23.

VALIDATION PROCESS

To ensure the validity of this study, the author followed suggestions from Churchill (1979), Gerbing and Anderson (1988), and Moscoso, Gil, & Rodríguez (2000). Mujika-Alberdi, et al (2015) named advanced users, in their research. They referred to those users who identify specific needs before other users see them and, who are capable to create or modify a new product to meet those needs. For the context of this study, those users comply with the definition of user innovators, proposed by Baldwin & von Hippel (2011), who defined a user innovator as a single firm or individual that creates an innovation in order to use it. Figure 1 illustrates the methodological steps involved in the validation process of the instrument.

Figure 1 Validation Process



Source: Adapted from Moscoso, Gil, & Rodríguez, (2000)

The validation process started with adapting the instrument to a Colombian context. Subsequently, a prototype of the scale was achieved. A pilot test was necessary to test the instrument, ensure an understanding of the question and enhanced clarity. Afterwards, the first sample data set was obtained; a purification process was utilized by applying an Exploratory Factor Analysis. Consequently, the instrument was applied to a second sample data set. In this step, the authors performed a data validation process, applied an EFA, ensured internal consistency of the scale, and applied a Confirmatory Factor Analysis (CFA) to confirm unidimensionality, reliability, convergent and discriminant validity.

ADAPTING THE INSTRUMENT AND FACE AND CONTENT VALIDITY

In order to do so, the first step in the validation process has been adapting the instrument to a new cultural context. The international test commission (2010) provides detailed guidelines for adapting a test, understanding this process as the adjustment of the instrument to a new cultural context, seeking to keep linguistic, conceptual and measurement equivalence (ITC, 2010; Muñiz, Elosu & Hambleton, 2013).

The instrument utilized in this research to identify user innovators in Colombia has been translating and adapting to Colombian context. The Spanish translation of the instrument is part of the process to adapt the instrument to the Colombian context. As recommended by Carvajal, Centeno, Watson, Martínez, & Sanz Rubiales, (2011), in this research different methods of translation and adaptation were used. Maneesriwongul, W., & Dixon, J. K. (2004) suggested a forward-translation followed by testing of the target language version has the advantage of being applicable when only one translator is available. In this case, we utilized forward-translation with testing of bilingual subjects and the pilot study.

Translating and adapting process of the instrument was performed, recalling once again that a pilot study took place in order to ensure validity of the instrument to diminish cross cultural bias. A translation from English to Spanish was made and the operationalization and psychometric properties such as reliability and validity were examined. The translation of the instrument was carried out with the help of a bilingual expert in the subject; the result of this process was reviewed by two experts who conducted content, writing, clarity and grammar corrections. In addition to tests of clarity and appropriateness of the target language version, psychometric characteristics including internal consistency, reliability and indicators of validity were calculated.

In order to assess content and face validity, 91 items from the instrument were evaluated by nine academics and experts in business related areas. The evaluation criteria consisted of: coherence, relevance, and syntax. The judge's agreement through Fleiss´ Kappa was 0.89, and none of the items required modifications.

RESULTS AND DISCUSSION

PILOT-TEST

After initial items were defined, a pilot-test was conducted to ensure whether the measurement scale was reliable and valid. Conducting a pilot-test is an important step in the validation of an instrument because it allows identifying those invalid items that need to be removed from the questionnaire (Gerbing and Anderson, 1988). A pilot test was a random sample of 47 adults, older than 18 years old studying undergraduate programs at the University. Those respondents ranged from 18 to 45 years old, 55% of them were female. They were asked to complete the questionnaire, to indicate any ambiguity and report any difficulty experienced when responding to the items. At this stage, some item wordings and punctuation were refined to give a better understanding to the respondents (e.g., "how much time have you spent" was replaced by "how many days have you spent").

THE FIRST SAMPLE SET AND PILOT QUESTIONNAIRE

Following Churchill (1979), two sample sets were collected in order to purify the measure and to obtained preliminary estimates of reliability and validity. The first questionnaire survey was applied to sample of adults ranged from 21 to 34 years old; 51% of them were female and all of them were students of business administration undergraduate program. In order to purify the first sample, an exploratory factor analysis (EFA) was performed, in which three dimensions were found: 1. User leadership; 2. Curiosity and creativity, and 3. Time and skills to develop products.

PURIFYING THE PILOT QUESTIONNAIRE - FIRST EFA

The first step to purify the pilot questionnaire was to run the EFA. The results are: Kaiser-Meyer-Olkin (KMO) was 0,852 and a significant result ($p < 0.00$) for the Barlett test. Analyzing the KMO, values from 0,8 to 1 are considered meritorious (Martinez and Sepulveda, 2012). Following the consideration of Mujika-Alberdi, et al (2015), the number of factors chose to run the EFA was three. As a result, the three factors were extracted accounting for 44,926%, of the variance, with the first factor explaining 28,307%, the second factor 9,847%, and the third factor 6,152%.

To run the EFA, the extraction method utilized was principal component analysis with varimax rotation. The results show the lowest communalities corresponded to items 3, 16, 23 and 31. Finally, the rotated component matrix was obtained. According to the literature, Martínez, and Sepúlveda (2012) mentioned an approach to look at factorial loadings: values less than 0.3 are considered not significant; between 0.3 and 0.5, minimum acceptable; between 0.5 and 0.7, significant, and values greater than 0.7 are considered relevant. Following their consideration, to run this EFA, items below 0.5 were eliminated. Consequently, the result shows that item 1, 2, 3, 5, 10, 16, 23, 24, and 31 were not represented. According to Mujika-Alberdi, et al (2015), item 3 and 10 did not correlated as expected, and they were eliminated from their scale. Following the consideration of Mujika-Alberdi, et al (2015) and Martínez, and Sepúlveda (2012), and given the results, in this research, items 1, 2, 3, 5, 10, 16, 23, 24, and 31were eliminated.

PURIFYING THE PILOT QUESTIONNAIRE - SECOND EFA

To continue the process of purifying the scale, after eliminated items 1, 2, 3, 5, 10, 16, 23, 24, and 31, a second EFA was run. The results are: The KMO improved, it was 0,879 a significant result ($p < 0.00$) for the Barlett test was kept. Table 17 shows the KMO and Bartlett test results. Moreover, the three factors were extracted accounting for 54,146%, of the variance, with the first factor explaining 33,561%, the second factor 12,967%, and the third factor 7,618%.

To run the EFA, the extraction method utilized was principal component analysis with varimax rotation. The results show the lowest communalities corresponded to items 4 and 18. Additionally, it shows that item 18 is not properly represented. Rotated component matrix displays the distribution of the items among the three factors. According to the literature, Martínez, and Sepúlveda (2012) mentioned the factorial loadings between 0.5 and 0.7 are significant; each item in the rotated component matrix is above 0.5.

PURIFYING THE PILOT QUESTIONNAIRE - THIRD EFA

Finally, after eliminating item 18, a third EFA was run and internal consistency of the scale was improved in terms of the variance. Although the KMO was 0,881, it is still meritorious. A significant result ($p < 0.00$) for the Barlett test was kept. Table 21 shows the KMO test results for the third EFA. The three factors were extracted accounting for 56,208%, of the variance, with the first factor explaining 35,132%, the second factor 13,464%, and the third factor 7, 126%.

To run the EFA, the extraction method utilized was principal component analysis with varimax rotation. The results show the lowest communalities corresponded to item 18. To run the EFA, varimax rotation was utilized and items below 0.5 were eliminated. Table 24 displays the rotated component matrix.

ASSESSING RELIABILITY

Following the literature, in this sample some of the items do not grouped in the same factors reported by Mujika-Alberdi, et al (2015). For instance, in this EFA, items from the User Leadership dimension mentioned in Mujika-Alberdi, et al (2015), UL14, UL15, UL20, and UL25, are grouped within the dimension SK -availability of time and skills to develop products. Moreover, items SK6 is grouped within CR dimension. In this research, items are grouped according to theoretical perspective, it means, original items are grouped in the proper and original dimension. Therefore, constructs are composed as follows: User Leadership (UL) construct consists of seven items (UL17, UL21, UL22, UL26, UL28, UL29, UL30); Curiosity and creativity construct is composed by five items (CR4, CR7, CR9, CR11, CR19); and availability of time and skills to develop products construct comprises three items (SK12, SK13, and SK27). Afterwards, reliability and internal consistency of the sale is calculated.

In assessing reliability and measuring internal consistency, Cronbach´s Alpha was used. The rule of thumb level suggested by Nunnally and Bernstein (1994) is a Cronbach´s Alpha higher than 0.70. The results for each of the constructs are: User Leadership (UL) construct = 0,864 with 7 items; Curiosity and Creativity (CR) construct = 0,793 with 5 items and availability of time and skills (SK) construct = 0,661 with 3 items. Table 1 shows the cronbach´s alpha for the pilot study.

Table 1 Cronbach´s Alpha Pilot Study

Factor	Alfa de Cronbach	No. of elements
UL	0,864	7
SK	0,793	3
CR	0,761	5

Source: Author´s elaboration

Additionally, Martínez, and Sepúlveda (2012) suggested a look at to the correlation matrix between items. For the purpose of this EFA applied to the pilot study, tables 2, 3, and 4 show the correlation matrix between items. Martínez, and Sepúlveda (2012) recommended a moderate to high correlation values within each variable, it means, values greater than 0.30.

Table 1 UL Pilot Study Correlation Matrix between Items

	UL28	UL29	UL30	UL26	UL22	UL17	UL21
UL28	1						
UL29	0,64	1					
UL30	0,528	0,647	1				
UL26	0,574	0,559	0,464	1			
UL22	0,527	0,535	0,533	0,496	1		
UL17	0,384	0,433	0,406	0,424	0,315	1	
UL21	0,426	0,393	0,41	0,409	0,535	0,269	1

Source: Author´s elaboration

Table 3 SK Pilot study correlation matrix between items

	SK27	SK12	SK13	UL14	UL15	UL25	UL20
SK27	1	0,533	0,53	0,437	0,371	0,397	0,417
SK12	0,533	1	0,626	0,425	0,42	0,315	0,293
SK13	0,53	0,626	1	0,447	0,43	0,393	0,389

Source: Author´s elaboration

Table 4 CR Pilot study correlation matrix between ítems

	CR7	CR8	CR9	CR11	CR19
CR7	1	0,537	0,469	0,413	0,415
CR8	0,537	1	0,658	0,36	0,478

CR9	0,469	0,658	1	0,44	0,498
CR11	0,413	0,36	0,44	1	0,406
CR19	0,415	0,478	0,498	0,406	1

Source: Author´s elaboration

THE SECOND AND FINAL QUESTIONNAIRE

Internal consistency of the scale was also measure for the final questionnaire. KMO was 0,926 and the result ($p < 0.00$) for the Barlett test was significant. Total variance explained first EFA for final questionnaire shows that three factors were extracted accounting for 53.695%, with the first factor explaining 38,899%, the second factor 8,790%, and the third factor 6,006%.

To run the EFA, the extraction method utilized was principal component analysis with varimax rotation. The results show communalities above 0.4. Afterwards, to run the EFA, varimax rotation was utilized and items below 0.45 were eliminated.

Mujika-Alberdi, et al (2015) reported three factors: User leadership (UL), curiosity and creativity (CR), and availability of time and skills to develop products. However, in this EFA, items UL14, UL15, UL20, UL21, UL25, which originally belonged to User Leadership construct, are grouped within availability of time and skills to develop products. Additionally, item SK6 is grouped within CR dimension. Following the literature, original items grouped in the proper dimension reported by Mujika-Alberdi, et al (2015), are considered for the Confirmatory Factor Analysis. On other words, User Leadership (UL) construct consists of five items (UL17, UL22, UL26, UL28, UL29, UL30); curiosity and creativity construct is composed by five items (CR4, CR7, CR9, CR11, CR19); and availability of time and skills to develop products construct comprises three items (SK12, SK13, and SK27). Afterwards, reliability and internal consistency of the sale is achieved. Nunnally and Bernstein (1994) suggested a Cronbach´s Alpha greater than 0.70. Table 5 illustrates Cronbach´s Alpha for each dimension; demonstrating reliability and internal consistency, because they are higher than 0.7.

Table 2 Cronbach´s Alpha for each dimension for final questionnaire

Variables	Alfa de Cronbach	No. of elements
CR4 CR7 CR8 CR9 CR11 CR19	0,804	6

SK12 SK13 SK27	0,772	3
UL17 UL22 UL28 UL29 UL30 UL26	0,835	6

Source: Author´s elaboration

CONSTRUCT VALIDITY

Construct validity exists when a measure reliably and truthfully represents a unique concept (Zikmund, Babin, Carr, & Griffin, 2010 p.650). Construct validity is tested in this research by analyzing both convergent and discriminant validity. For the purpose of this study, Confirmatory Factor Analysis (CFA) has been chosen as the appropriate tool for assessing construct validity. As Zikmund, et al. (2010) mentioned, statistical procedures such as factor analysis are helpful in providing evidence of construct validity. A confirmatory factor analysis (CFA) was performed using EQS 6.1, applying the maximum likelihood procedure based on the covariance matrix.

ASSESSING GOODNESS OF FIT

Many alternative indices to measure goodness of fit model have been developed. Hair et al. (2010), Pallant (2010) and Barret (2007) specified that the Chi-square statistic is a traditional measure for assessing overall model fit in covariance structure models. An acceptable measure is fit is the ratio between Chi-square and the degrees of freedom X2 / df (Koufteros, 1999). The X2 / df ratio suggested is between one and five (Marsh and Hocevar, 1988). Other measures of model fit used in this research are root mean square error of approximation (RMSEA) (Garver and Mentzer, 1999), the goodness of fit index (GFI) and the adjusted goodness of fit index (AGFI) (Moscoso, Gil, & Rodríguez, 2000), the Bentler comparative fit index (CFI) (Bentler, 1986), and the non-normed fit index (NNFI) (Garver and Mentzer,1999), and the normed fit index (NFI) (Bentler and Bonnet 1980; Hooper, Coughlan, & Mullen, 2008).

The 15 items of the scale were examined using CFA on the basis of EFA results. To achieve a goodness of fit model, an iteration process was required. During the iteration, three items were eliminated: CR4, CR11, and UL17. Table 34 shows the results indicating an acceptable model fit for M3 (x2/df = 2.9; GFI = 0.931; CFI = 0.935; NNFI = 0.915; RMSEA= 0.079) (Bentler and Bonett, 1980; Gerbing and Anderson, 1988), therefore, they confirm the unidimensionality of the constructs as all indices demonstrate acceptable fit of data to the model.

Table 6 CFA indices

Test / Indices	Marker	X2	Degrees of freedom (df)	X2 / df ratio	RMSEA	CFI	NNFI	NFI	AGFI	GFI
Acceptance				1–5	<0.08.	>.90	0.80<0.95		>.80	>.90
M		340	87	3,9	0.082	0.900	0.879	0.871	0.853	0.894
M1	CR4	287	74	3,9	0.082	0.911	0.891	0.884	0.868	0.907
M2	CR11	204	62	3,3	0.073	0.936	0.920	0.912	0.898	0.930
M3	UL17	149	51	2,9	0.079	0.935	0.915	0.913	0.895	0.931

Source: Author´s elaboration

The list of those items removed from the analysis of the goodness of fit model through the iteration process is shown in Table 7. The iteration process changed the number of factors under the CR and UL constructs.

Table 7 Iterations for goodness of fit model

Code	Construct	Item(s) statements	Removed at
CR4	Curiosity and Creativity	I like being different	Iteration 1 (CR4)
CR11	Curiosity and Creativity	I like challenges	Iteration 2 (CR11)
UL17	User Leadership	I have the ability to transform new	Iteration 3 (UL17)

Source: Author´s elaboration

THE FINAL SCALE

After a rigorous validity process, twelve items compose the final scale. Thus, three factors with 12 items were resulted from CFA of first order factor model of fit. Table 8 shows the results.

Table 8 Final scale for last questionnaire

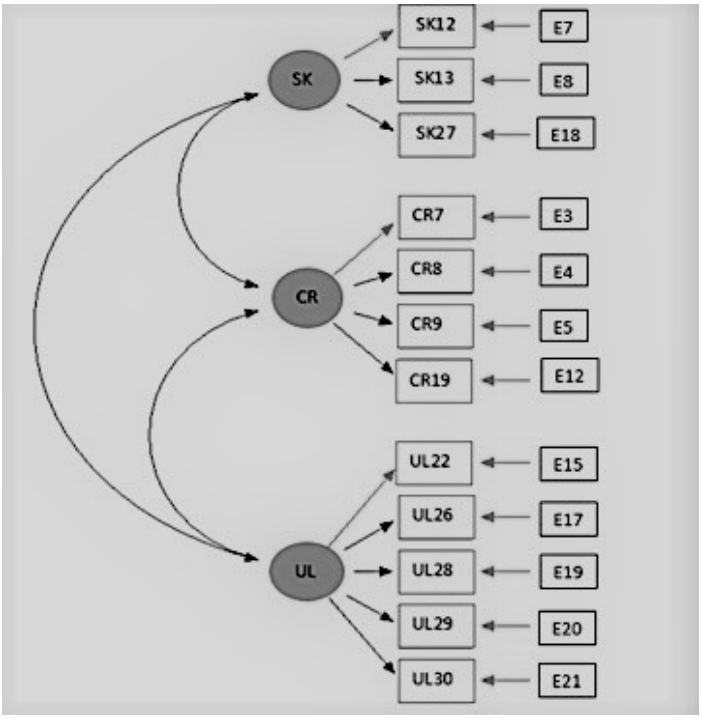
Code	Construct	Item(s) statements
CR7	Curiosity and Creativity	I am a very curious person about new things
CR8	Curiosity and Creativity	I am a person with a great imagination
CR9	Curiosity and Creativity	I consider myself a creative person
CR19	Curiosity and Creativity	I enjoy imagining new things
SK12	Skills to develop new products	I prefer to repair a product for myself rather than ask someone
SK13	Skills to develop new products	I am a very curious person about the inner workings of the products
SK27	Skills to develop new products	If a product breaks, I try to repair it before buying a new one
UL22	User Leadership	Others consider me an innovator

UL26	User Leadership	I love creating new things
UL28	User Leadership	I can easily think of new things that I could create
UL29	User Leadership	I have suggested to others how they could improve processes or products
UL30	User Leadership	When other people around me have a problem, they come to me to see if I can create something

Source: Adapted from Mujika-Alberdi, et al (2015)

Additionally, the model was subjected to first order CFA using EQS 6.1. Figure 2 presents the results of the measurement model fit of the three factors. Factor 1 corresponds to SK factor, which includes the following variables: SK12; SK13; SK27. Factor 3 corresponds to CR which includes the following variables: CR7; CR8; CR9; CR19. Factor 3 represents UL construct, which includes the following items: UL22; UL26; UL28; UL29; UL30.

Figure 21 First order Model CFA



Note: EQS 6 modelo 4 feb 8. Eds Chi Sq = 188.99 P=0.93 RMSEA=0.08. Source: Computed based on data set

The CFA was carried out to achieve a valid model fit for the data obtained as well as theoretical supports behind the developed model proposed by Mujika-Alberdi, et al (2015). The test of the first order implies 12 variables were fit and represented in three constructs: User leadership (UL), curiosity and creativity (CR), and time and skills to develop products (SK).

CONVERGENT AND DISCRIMINANT VALIDITY

Convergent validity examines whether or not the items measuring the same construct are highly correlated (Hair et al., 2006). The value of average variance extracted (AVE) is used as an indicator for supporting convergent validity; the accepted value of AVE for each construct should be at least 0.50 (Fornell and Larcker, 1981).

Discriminant validity represents how unique or distinct are the measures of a construct (Zikmund, et al., 2010). To determine discriminant validity, it is necessary to take into account an AVE greater than the squared correlation between constructs (Gerbing and Anderson, 1988). In this research, the value of AVE was calculated utilizing the inter-correlation matrix and the square root of the AVE in the principal diagonal for each type of dimension (UL, CR, SK).

As it is shown in the Table 37, the value of AVE in the principal diagonal in all cases is above 0.5 and it is greater than the correlation coefficients shown in the inter-correlations matrix, proven the discriminant validity. As it is reported by Zikmund, et al. (2010), a scale should not correlate too highly with a measure of a different construct. The rule of thumb indicates; when two scales are correlated above 0.75, discriminant validity may be questioned. Consequently, it is expected and observed in Table 9, the different dimensions display a significant correlation (convergent validity), and demonstrate they independent concepts (discriminant validity).

Table 93 Correlation matrix for final scale

	CR	SK	UL
CR	0,71		
SK	0,402	0,73	
UL	0,612	0,557	0,71

Note: $p < .01$. The values of the main diagonal corresponding to the square root of AVE. Source: Author´s elaboration

ASSESSING RELIABILITY FINAL QUESTIONNAIRE AFTER CFA

Cronbach Alpha scores for the three factors from CFA of first order factor model (the iterated model) were measured, and the dimensions demonstrate acceptable reliabilities as suggested by Nunnally (1978) with scores that exceed the required > = 0.70. As it is observed in Table 38, the results for each Cronbach-Alpha of the dimensions' level of the CFA of first order model iterated are aceptable. Table 10 also shows the reliability indexes per dimension and per variables if an item is deleted from the scale. In all cases, the possible elimination of an item diminishes the reliability of the scale.

Table 104 Statistics total-item for each dimension

Item	Mean if item deleted	Variance if item deleted	Corrected correlation item-total	Multiple correlation squared	Cronbach´s alpha if item deleted
''UL-User leadership'': Cronbach's alpha: 0,830					
UL22	10,2309	11,816	0,627	0,411	0,797
UL26	10,5277	11,771	0,622	0,407	0,798
UL28	10,418	11,432	0,644	0,423	0,792
UL29	10,6293	11,879	0,598	0,392	0,805
UL30	10,4896	11,465	0,647	0,446	0,791
''CR -Creativity/Curiosity'': Cronbach's alpha: 0 ,777					
CR7	6,4491	6,008	0,503	0,27	0,761
CR8	6,1921	4,961	0,725	0,617	0,644
CR9	6,1019	5,042	0,642	0,569	0,69
CR19	6,2674	5,914	0,468	0,224	0,78
''SK -Availability of time and skills'': Cronbach's alpha: 0,766					
SK12	5,1386	4,799	0,633	0,414	0,646
SK13	5,254	4,953	0,628	0,409	0,653
SK27	5,4919	5,297	0,537	0,289	0,753

Source: Computed based on data set

CORRELATION MATRIX PER DIMENSION AFTER CFA

Another valuable assessment in performing a factor analysis is to look at the correlation matrix between items. According to Martínez, and Sepúlveda (2012), if there are some items with low correlations between variables, it is necessary to question the existence of those items in the scale. In this research, Tables 11, 12, and 13 show the correlation matrix between items. As a result, all variables have moderate to high correlation values with each other, because they are greater than 0.30 (Martínez, and Sepúlveda, 2012).

Table 115 Correlation matrix after CFA for UL

	UL22	UL26	UL28	UL29	UL30

UL22	1				
UL26	0,528	1			
UL28	0,514	0,549	1		
UL29	0,414	0,436	0,473	1	
UL30	0,521	0,45	0,487	0,572	1

Source: Computed based on data set

Table 126 Correlation matrix after CFA for CR

	CR7	CR8	CR9	CR19
CR7	1			
CR8	0,479	1		
CR9	0,382	0,752	1	
CR19	0,382	0,418	0,371	1

Source: Computed based on data set

Table 73 Correlation matrix after CFA for SK

	SK12	SK13	SK27
SK12	1		
SK13	0,603	1	
SK27	0,485	0,477	1

Source: Computed based on data set

CONCLUDING REMARKS

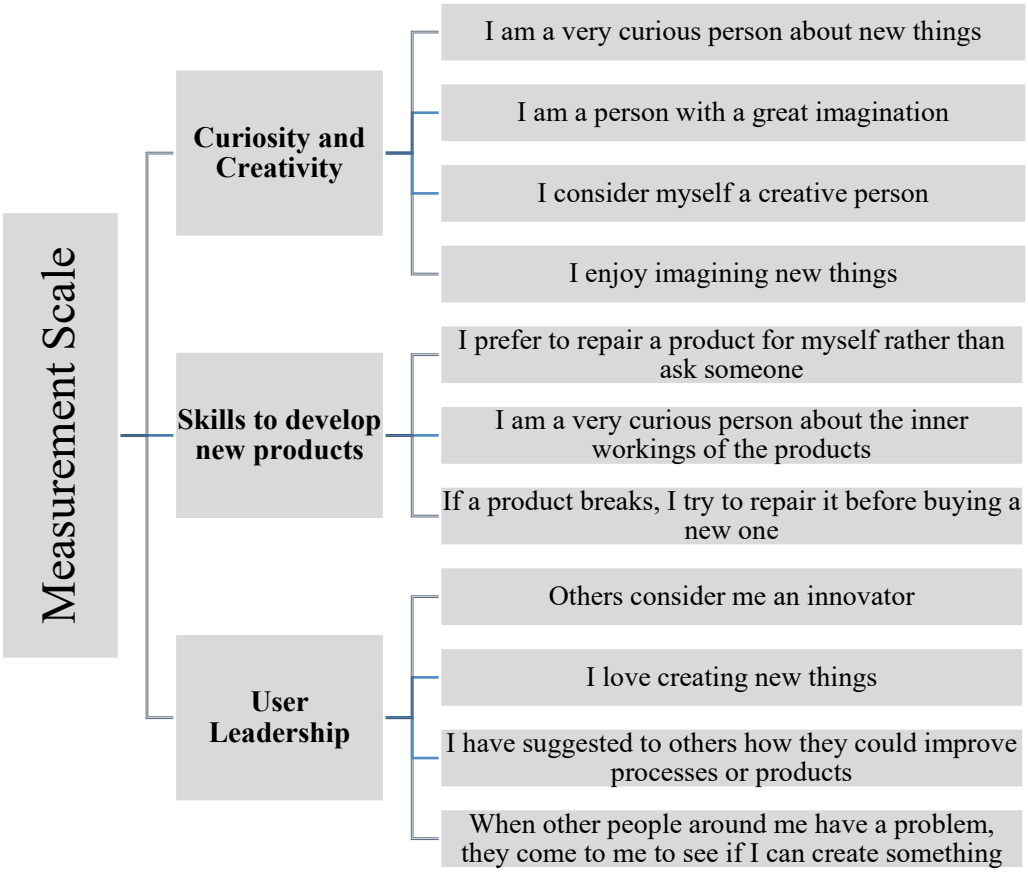
This research performed a rigorous validation process of a measurement instrument and found existence of user innovators in Colombia. This scale has also been successfully tested and validated in a European region called Gipuzkoa and now in Bogotá, Colombia. Given the scarse literarature about user innovator in emerging countries, particularly, in Colombia, this study provided a measurement scale to identify user innovators.

The measurement scale represents a significant input for managers in the identification of user innovators who can assist in co-creacion, new product development or new service development processes. It provides a scale to identify user innovators who can be involved in new prodcuct or service

development process. It also can serve as a tool to promote user-centered innovation in both large and small companies.

The scale surpasses a rigorous validity process and facilitates the correct identification of those type of users. Therefore, we encourage managers, academic and research community to consider this scale in further research. The test of the first order implies twelve variables were fit and represented in three constructs: User leadership, curiosity and creativity, and time and skills to develop products.

Figura 8 Measurement scale to identify user innovators



Source: Author´s elaboration

The instrument is in accordance with previous studies and counts with theoretical support. Quantitative analysis exhibits high correlations among those three dimensions. Both an exploratory factor analysis and a confirmatory factor analysis were performed. Internal consistency of the scale, unidimensionality, reliability, convergent and discriminant validity were confirmed. A confirmatory factor analysis was carried out to achieve a valid model of good fit for the data obtained.

This study examined user innovators from three different dimensions; user leadership, curiosity and creativity and skills for development. Due to its cross-industrial approach, simplicity and practicality, this cross-market scale constitutes of a valuable measurement instrument that can be applied to regions with a varied level of development in order to identify user innovators. Consequently, this research can serve as a guidance for further research.

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