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Gender roles in social network sites from generation Y

Francisco Javier Rondán-Cataluña^{1*}, Borja Sanz-Altamira¹, Begoña Peral-Peral¹

Abstract: One of the fundamental and most commonly used communication tools by the generation Y or Millennials are online social networks. The first objective of this study is to model the effects that exercise social participation, community integration and trust in community satisfaction, as an antecedent of routinization. Besides, we propose as a second objective checking if gender roles proposed to underlie the different behaviors that develop social network users. An empirical study was carried out on a sample of 1,448 undergraduate students that are SNS users from Generation Y. First, we applied a structural equation modeling approach to test the proposed model. Second, we followed a methodology using a scale of masculinity and femininity to categorize the sample obtaining three groups: feminine, masculine, and androgynous.

Keywords: sex roles; masculinity; femininity; androgyny; social networking sites (SNS); Generation Y.

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Introduction

Internet users may use social networking sites (SNS) with various degrees of intensity. An SNS user can merely visit websites but can also contribute, disseminate, share and collaborate. Specifically, communication is a crucial part of keeping contact with our social ties. Social connections are an essential part of everyone's life. In this media-dominated world, all the people tend to go back to the very purest form of getting trusted information by asking friends for recommendations and advice. Recently, some authors presented a review of academic works on SNS indicating that gender role and age are still being exciting topics about SNS (Tsay-Vogel, 2015).

Among the users of social networks sites (SNS) highlight individuals belonging to Generation Y or Millennial Generation, born during the 1980s and early 2000s. Millennials are the first generation to grow up with the new technologies, having constant access to technology in their youth, and using it at higher rates than people from other crops, especially in comparison to the older age cohorts. There is no agreement on the archetypes that give Generation Y a specific character. In the other hand, other works questioned these predictions and attributed this generation with the traits of confidence and tolerance, but also with a sense of entitlement and narcissisms (Twenge, Campbell, & Freeman, 2012).

Many studies have tried to find sex differences in Information and Communication Technology (ICT) and sex associations with SNS use in the case of Millennials. For instance, the influences of diverse issues on the continued use of information technology diverge due to biological gender differences (K. Y. Lin & Lu, 2011) or the different behavior in online purchasing, being significantly higher for men the level of purchases than for women. Other studies found significant differences between traditional genders in Facebook use or gender impact. Concretely men are more persuasive than women and women influence men more than they affect other women (Aral & Walker, 2012).

Furthermore, some authors (Baruh, Chisik, Bisson, & Šenova, 2014) have revealed a predisposition for male profile viewers to reply more positively to information published by profiles from other males. For female viewers, this result was less important.

According to Valerio, there are slight sex differences focused on the management of photographs and variety of contents in the use of SNS among college students, maybe because it is a reproduction of the traditional stereotype that for women, their image is more important than for men (Valerio, 2014). Colas et al. (2013) showed that women are more implicated with SNS than males. Besides, young men use SNS to cover emotive features and strengthen their self-esteem, while for women of the same age, the interpersonal purpose predominates (Colás, González, & de Pablos, 2013).

However, the current generation of students in higher educational settings is seeking a more radical change in gender roles beyond the binary of male/female, in particular when using networking sites. In this sense, Bem some decades ago proposed that masculinity and femininity occur on two distinct continuums rather than the typical male-female question. Later, Hofstede suggests there are nations with "masculine cultures" or "feminine cultures" people, and Yoo et al. adapt Hofstede's cultural dimensions scale to assess masculinity/femininity at the individual level. As Srite and Karahanna noted, masculinity and femininity are not synonymous with gender defined by biological sex. They measure a psychological aspect of sex; therefore, men and women can possess masculine and feminine values to different extents (Srite & Karahanna, 2006).

Consequently, it seems interesting to wonder if gender roles have changed over time with regards to new technologies, such as social network sites (SNS) in Generation Y. For this, the objective of this paper is to develop a model to demonstrate the factors that lead to satisfaction and routinization of SNS in Generation Y and to analyze the influence of gender roles in this model. Therefore, this study

(1) Dpt. Administración de Empresas y marketing, University of Seville, Spain.

*Corresponding author: rondon@us.es



examines whether the evolution of gender roles shows differences in their behavior concerning the model. Hence, an empirical research was carried out on a sample of 1,448 undergraduate students from a Spanish University that are SNS users from Generation Y. First, we reviewed the literature concerning the concepts SNS and the masculinity and femininity. After presenting the model and the hypothesis, we applied a structural equation modeling approach, using Partial Least Square methodology, to test the model that proposes that community integration, social participation, and trust shown by individuals when using SNS, are positively related to their satisfaction. And the latter will influence the routinization, defined as assimilating the technology into daily habits in Generation Y. Secondly, we followed Bem's methodology using Hofstede's scale of femininity and masculinity to categorize the sample and test if there are differences between these groups in the model.

Proposed model

Researchers have observed SNS by a diversity of procedures and theoretical foundations from various disciplines. In this paper, community satisfaction refers to the emotional reply to the usage of the applications and facilities delivered by the SNS. Some studies have shown satisfaction as an antecedent of loyalty and subjective well-being (Chiu, Cheng, Huang, & Chen, 2013). Based on expectancy confirmation theory (EDT) (OLIVER, 1980) 1980 and the information systems (IS) success model (Delone & McLean, 2003), satisfaction has been considered a significant element of continuance intention in research about new technologies. Besides, the constant use of SNS is likely to become progressively automatic. Therefore, SNS users may repeat a sequence of well-learned activities without being aware of it (Kang, Min, Kim, & Lee, 2013). Routinization is connected to "habitual usage – that is, to integrate the technology into daily routines" (Schwarz & Chin, 2007), p. 240). As followers practice an SNS habitually, they turn into more habituated to it, decreasing ambiguity in future decisions. Routinization does not necessarily denote that someone uses the maximum degree of possibility accessible from the SNS, but its usage turns into individual's daily routine (Sanchez-Franco & Roldan, 2010). According to these ideas hypothesis 1 is formulated:

H_1 : Community satisfaction is positively related to routinization.

Other studies have demonstrated the relationship between satisfaction and sense of belonging or community integration (H. Lin et al., 2014). Community integration can be specified as "members' feelings of membership, identity, belongingness, and attachment to a group that interacts primarily through electronic communication" (Blanchard, 2007), p. 827). Followers generate their identities within the SNS. Therefore, community integration will be a sense of recognizing with the SNS that affiliates also share with one another (Sanchez-Franco & Roldan, 2010).

In this paper, we conceptualize social participation as community involvement, social interaction, or active involvement in community activities. This concept highlights the social community's interactivity

level, raising the chances for support interchange. Social participation is consequently related to the position to which people are dynamic followers of the SNS and implicated in social activities in the SNS, emphasizing the utility of such contacts to the requirements of the community organization. Consequently, social participation pursues to apprehend the degree to which people actively offer support and get involved in community actions. Social participation will, therefore, be essential for lasting sustainability and, thus, a crucial driver of prosperous SNS (Sanchez-Franco & Roldan, 2010). According to the thoughts mentioned above hypothesis 2 and hypothesis 3 are verbalized:

H_2 : Social participation is positively related to community satisfaction.

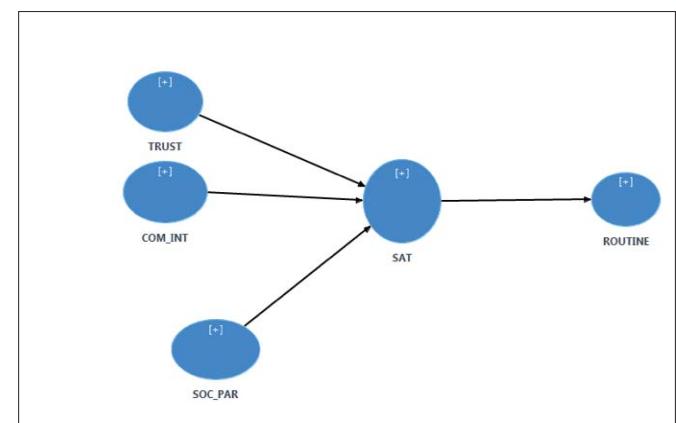
H_3 : Community integration is positively related to community satisfaction.

Satisfaction connects to the positive emotional reactions of followers who discover mutual interactions rewarding. Adherents who trust on an SNS will be loyal to it, and consequently, they will be satisfied with it. Above all, trust is described by the feelings of safety and perceived the power of the association and is entirely more narrowed to individual experiences with the principal partner (Johnson & Grayson, 2005). Therefore, we assume trust as the integration of two concepts: exchange partner's integrity and benevolence. Following the previous thinking, we formulate hypothesis 4:

H_4 : Trust is positively related to community satisfaction.

Figure 1. presents the proposed model summarizing all the hypotheses.

Figure 1. Proposed model



Masculinity/Femininity

Hofstede proposes analyzing the Nations around the world in function of a series of features, one of them difference masculinity and femininity (G. H. Hofstede, 2001) 2001. Higher scores indicate high masculine societies. In this type of communities or "masculine cultures" people (men and women) tend to value assertiveness, ambition, competitiveness, and the accumulation of wealth and material possessions. However, people (again men and women) tend to value other variables such as relationships and quality of life in "feminine cultures." Besides, usually, the differences between gender roles are

more dramatic and less fluid in masculine cultures than in feminine cultures (Cumming, Fleming, Johan, & Takeuchi, 2010). The Masculinity scale is the most controversial of Hofstede's dimensions. As time went on, Hofstede has changed the definition of Masculinity/Femininity to emphasize women's equality in the workplace. Nowadays, Hofstede defines the masculinity versus femininity dimension as: "The masculinity side of this dimension represents a preference in society for achievement, heroism, assertiveness and material reward for success. Society at large is the most competitive. Its opposite, femininity, stands for a preference for cooperation, modesty, caring for the weak and quality of life. Society at large is more consensus-oriented" (G. Hofstede).

Nevertheless, for firms and organizations, the reflection of the culture at the individual level is more important and relevant. Managers know that treating as equivalent the stereotypical culture of a country with all people of the country is a grave mistake, especially in those countries having the heterogeneous population with different cultural backgrounds (Yoo, Donthu, & Lenartowicz, 2011).

Many research contexts have widely used Hofstede's metric at both country and individual levels in cross-cultural studies. Some authors have used it at the personal level, such as in consumer ideologies (Swaidan, Rawwas, & Vitell, 2008), and in consumer ethnocentrism (Cleveland, Laroche, & Papadopoulos, 2009). Yoo et al. developed a scale to assess Hofstede's cultural dimensions at the individual level named CVSCALE (Individual Cultural Values Scale) (Yoo et al., 2011). Their study divides the measurement of this aspect into two separate parts: masculinity and femininity.

At the individual level, Bem (1974) suggested that gender is a construct: men might show certain stages of behaviors that might have been conventionally observed as being feminine, and women might also reveal specific actions that would have conventionally been considered as masculine. Besides, she proposed the term "androgynous" for those who have both male and female attributes. The aim of her work was different from Hofstede's intention, but the psychological backgrounds of their measures were similar.

Some studies analyses the use of ICTs and sex roles identified by Bem (1974). Bozionelos found that individuals who score higher on expressiveness (femininity in Bem's terminology) are more likely to report interest in learning about and utilizing computers (Bozionelos, 2002). Other authors (Venkatesh, Morris, Sykes, & Ackerman, 2004) pointed out that attitude influences masculine individuals, while subjective norms and perceived behavioral control were significant in the case of female ones. Regarding androgynous, the three variables were significant. And Tufekci agrees that, regarding masculinity vs. femininity, information technology (IT) adoption and usage can differ (Tufekci, 2008).

Other studies analyzed cultural issues of website documents and their relation to masculinity-femininity dimension, suggesting the use of the concept of androgyny to develop more effective communications on the Web (Zahedi, Van Pelt, & Srite, 2006). In fact, females try to

report an androgynous profile in SNS, because for their psychological comfort, they evaluate positively to have both feminine and masculine characters (Renau Ruiz, Carbonell, & Oberst, 2012).

Meanwhile, Hupfer and Detlor consider gender-related self-concept traits known as self- and other-orientation (Hupfer & Detlor, 2007). Other-orientation presents common characteristics- nurturing, understanding, compassionate, sympathetic and sensitive- and was a positive predictor of using the Internet to find friends or relationships and of how often respondents reported using internet applications. Furthermore, other-orientation is related to a more effortful search strategy and higher search frequency. These studies conclude that 50 percent of women and 25 percent of men show other-oriented behavior (Hupfer & Detlor, 2007).

Androgynous individuals might display sex role adaptability across situations, acting without worrying about the most appropriate stereotype for one sex or the other (Bem & Lewis, 1975). In this respect, the Internet and its applications can affect the behavior of individuals since conceptualizations of masculinity might be different in online and offline environments. Computers create an impersonal social situation in which individuals feel more anonymous and can behave freely regardless of what others might think.

Only a few studies have attempted to differentiate among SNS users according to their personality characteristics. Concerning SNSs, one of the primary motivations to use them is seeking social support, and this motivation can be closer socially to the sensitive nature of feminine cultures rather than to more masculine ones because feminine role endorses more common and socio-emotional traits. However, other authors found that masculinity was positively correlated with time spent on Facebook but not on LinkedIn (Shneor & Efrat, 2014). The engagement may serve as a platform for exhibiting social power and prestige if the number of friends in an SNS is an indicator of social status. Lewis and George tested theoretical explanations about the role of culture (including the masculinity dimension) in deception in SNS (Lewis & George, 2008). It is likely that this cultural magnitude measured at the individual level can be discriminant in the segmentation of SNS users.

According to the ideas mentioned above the next proposition is formulated.

Proposition. People from Generation Y have different behavior about the proposed model according to gender roles in the context of SNS.

Methodology

The literature suggests that the more someone is involved and familiar with Web 2.0 interactive tools and applications, as SNS, the more he or she will trust and will be satisfied with the virtual medium. Therefore, an empirical study was carried out on a sample of 1,448 undergraduate students, included in Generation Y. The statistical analysis involved two stages.

Firstly, we applied a structural equation modeling (SEM) approach to test the proposed model, using SmartPLS 3.0. First, the model

was validated and tested. Then, based on masculinity and femininity Hofstede's scale, we use Bem's methodology. This methodology is the best to characterize the nature of the person's gender role: calculating the difference between an individual's masculinity and femininity normalized concerning the standard deviations of his or her masculinity and femininity scores (Bem, 1974), p. 158). This procedure allows us to propose three groups: masculine, feminine and androgynous. Finally, the Henseler's Multigroup Analysis was carried out using as groups the three gender roles obtained.

Sample

Empirical research using a non-probabilistic sampling method validated the theoretical model and the hypotheses discussed above. We collected surveys from February to March 2012. The sample size is 1,460 undergraduate students that are SNS users from Generation Y, from a public university located in the south of Spain. All of them were studying in different courses of business, marketing, economics or tourism management degrees.

Once we collected the questionnaires, those answered by students over 30 were eliminated from the sample, because the object of study was students belonging to Generation Y, resulting in 1,448 valid surveys. Demographic information of this selection of students is as follows. The average age of the sample is 20 years old, 57.6 % are females, 95.1% singles, the average size of their households is 3.63 individuals, and 92.4% had three years of experience as Internet users. As for the SNS, 85% were users for two years. Home is the principal place chosen for connecting to the network (94.5% of cases), followed by the study center (26.3%). The laptop is the device most commonly used to connect to the network (87%), followed by mobile phone (47.5%). Regarding the frequency and time of access, 84.3% accessed at least once a day and half of the respondents spent more than an hour of their time to connect to the network. The average number of contacts was 300. It is noticeable that 74.2% of respondents use mainly Tuenti as SNS, a Spanish SNS created in 2006, and it has more than 14 millions of users. Facebook is the second SNS more preferred by the respondents.

All these demographic and uses of SNS features were analyzed to determine if there were differences due to the sex of the respondent. In all cases, there were no statistically significant differences between men and women.

Measures

Confirmed items adapted from preceding revisions were used to measure routinized behavior, social satisfaction, trust, community integration, social participation and masculinity/femininity. Also, selected scales were adapted to make them applicable to the SNS-based environment. We measured routinized behavior using the three items from Sanchez-Franco and Roldan (Sanchez-Franco & Roldan, 2010). The social satisfaction measure was adapted from Flavian et al. (Flavian, Guinaliu, & Gurrea, 2006). The trust scale was adjusted from McKnight et al. (McKnight, Choudhury, & Kacmar, 2002). Sca-

les taken from Casaló et al. (Casaló, Flavián, & Guinaliu, 2007) and Sanchez-Franco and Roldan (Sanchez-Franco & Roldan, 2010) were adapted to measure community integration and social participation. Finally, the masculinity/ femininity scale has been measured through two constructs adjusting the scales of some previous studies (G. H. Hofstede, 2001) (Srite & Karahanna, 2006); (Yoo et al., 2011). All items are seven-point Likert-type, ranging from «strongly disagree», 1, to «strongly agree», 7.

A trial test of the questionnaire was conducted to assess the content validity and to clarify ambiguous and non-discriminating items, without additional suggestions.

Statistical tool

The first part of the methodology was to use SmartPLS 3.0 software to validate and estimate the proposed model. The use of PLS rather than other kinds of SEM technics is also applicable at this point because (Diamantopoulos & Winklhofer, 2001): this work is exploratory; and SmartPLS is a nonparametric technique, so scholars do not need to guarantee the normality of the data. Further, this method is becoming more significant, ought to the number of articles using it in the leading journals (Henseler, Ringle, & Sinkovics, 2009).

Then we applied Bem's procedure to calculate the Androgyny Score (AS). This process consists of deducting individual's masculinity and femininity normalized concerning the standard deviations of his or her masculinity and femininity scores. The Androgyny Score reveals the relative quantities of masculinity and femininity that somebody embraces in his or her self-description, and, as such, it best typifies the type of the person's total sex role. The higher the value of AS, the higher the predisposition of the person to femininity (high positive scores) or masculinity (high negative scores). On the contrary, the closer the AS is to zero, the more the individual is androgynous (Bem, 1974). After this, we performed a multigroup analysis between people tending to masculinity, to femininity, and to androgyny. Multigroup variable has a moderating effect whereby a categorical moderator variable states each subject's group membership (Henseler et al., 2009).

Results

Routine construct achieves an R square of 0.264 and R square of the Satisfaction construct is 0.508. Table 1 presents composite reliability, Cronbach's Alpha, and AVE.

Table 1. AVE, composite reliability, and Cronbach's Alpha.

	AVE	Composite Reliability	Cronbach's Alpha
TRUST	0.623	0.929	0.912
COM_INT	0.551	0.895	0.865
SOC_PAR	0.606	0.859	0.782
SAT	0.801	0.924	0.876
ROUTINE	0.831	0.936	0.898

Table 2. Discriminant validity (Fornell-Larcker criterion)

	TRUST	COM_INT	SOC_PAR	SAT	ROUTINE
TRUST	0.789				
COM_INT	0.522	0.742			
SOC_PAR	0.397	0.641	0.778		
SAT	0.442	0.695	0.549	0.895	
ROUTINE	0.248	0.547	0.569	0.514	0.911

As can be seen from Table 1, each average variance extracted (AVE) value is above 0.50, which points out the good convergent validity of the scale. Every amount of composite reliability and AVEs are considered satisfactory. The diagonal elements (square root of AVEs) are higher than the correlation of that construct with all the other constructs in the model (see Table 2), which indicates satisfactory discriminant validity (Fornell & Larcker, 1981). We further tested for potential multicollinearity, all inner and outer scores of VIF collinearity statistics are below 5, this indicates that there are not multicollinearity problems in the data (O'brien, 2007). Standardized root mean square residual (SRMR) was 0.046, as it was less than 0.08, the model shows an appropriate goodness-of-fit.

Next, we present the structural model of SmartPLS results. Path coefficients were calculated using a bootstrapping with 5,000 samples. All path coefficients are statistically significant (all p values are 0) and positive (Table 3). The most robust relationships are between community integration and satisfaction, and between satisfaction and routine (supporting hypotheses H3 and H1, respectively). The other connections are also positive and significant, social participation and trust are positively related to community satisfaction (supporting hypotheses H2 and H4, respectively). As a consequence, the study confirms all the hypotheses.

Table 3. Path coefficients.

	Path coefficient	T Statistics	P Values
TRUST -> SAT	0.094	4.062	0.000
COM_INT-> SAT	0.540	19.935	0.000
SOC_PAR -> SAT	0.165	6.511	0.000
SAT -> ROUTINE	0.510	23.603	0.000

Figure 2 represents the path coefficients for the whole sample.

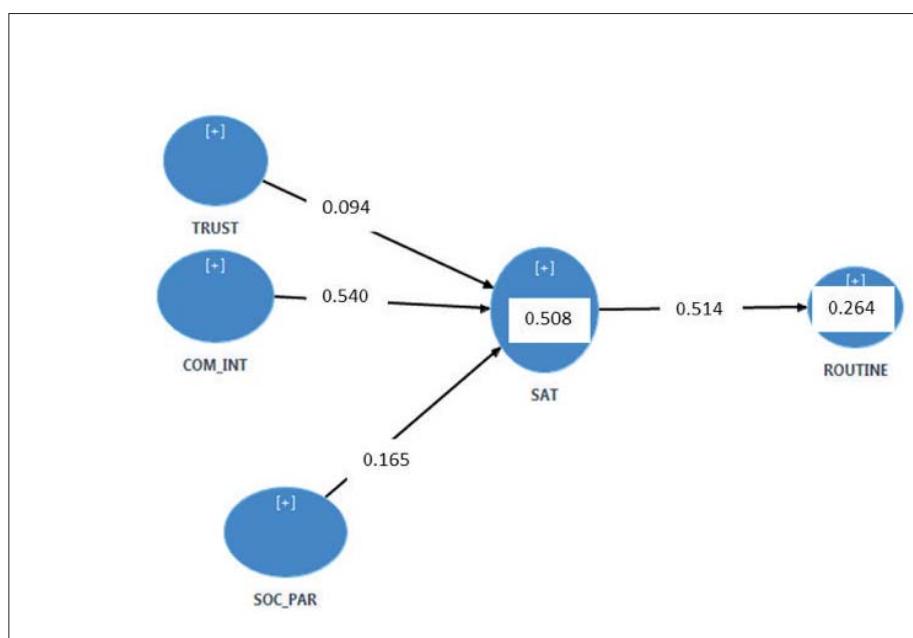
Figure 2. Path coefficients of the model

Table 4 presents the groups obtained regarding the gender roles.

Table 4. Classification of subjects according to gender roles.

	Males (n=608)	Females (n=840)	Total (n=1448)
% feminine	3.2% (n= 46)	9.4% (n=136)	12.6% (1<AS<1.83)*
% androgynous	26.6% (n= 385)	33.1% (n=480)	59.7% (-1 ≤ AS ≤1)*
% masculine	12.2% (n=177)	15.5% (n=224)	27.7% (-1.87<AS <- 1)*

* Androgyny scores obtained in this research

The highest percentage of individuals in the sample corresponds to the androgynous, made up 63.3% of men and 57% of women, reflecting that the current generation of young behaves according to more flexible gender roles. These are individuals who are both male and female, both assertive and yielding depending on the situational appropriateness of behaviors. There are also students who appreciate behaviors inconsistent with those traditionally expected of his/her sex: 7.5% of men value the feminine aspects, and 26.2% of women (more than triple) appreciate the masculine characteristics. However, in the sample, we also found individuals who behave as sex-typed standards: 29.1% of men and 16.2% of women.

Afterward, we present the results of the multi-group analysis. The previously tested model is applied to each group to search for differences in the relationships between students classified as androgynous.

Table 5. Path coefficients for groups androgynous vs. feminine and Henseler's MGA.

	Path Coefficients Original (androgynous)	Path Coefficients Original (feminine)	Path Coefficients-diff (androgynous - feminine |)	p-Value (androgynous vs. feminine)
TRUST -> SAT	0.095	0.038	0.058	0.197
COM_INT -> SAT	0.491	0.582	0.091	0.887
SOC_PAR -> SAT	0.193	0.229	0.037	0.684
SAT -> ROUTINE	0.528	0.601	0.073	0.898

We can observe that path coefficients for feminine and androgynous groups are quite similar and p-values of Henseler's Multigroup Analysis are over 0.05 (Table 5). As a consequence, both teams of students have

nous and students classified oriented to masculinity and those geared to femininity and between the last two, performing three multi-group analyses.

Table 6. Path coefficients for groups androgynous vs. masculine and Henseler's MGA.

	Path Coefficients Original (androgynous)	Path Coefficients Original (masculine)	Path Coefficients-diff (androgynous - masculine |)	p-Value (androgynous vs. masculine)
TRUST -> SAT	0.095	0.123	0.028	0.717
COM_INT -> SAT	0.491	0.608	0.117	0.979
SOC_PAR -> SAT	0.193	0.090	0.103	0.032
SAT -> ROUTINE	0.528	0.455	0.072	0.080

In table 6 we can observe that two of the relationships are statistically different between androgynous and masculine. The positive connection between satisfaction and routine is stronger for androgynous than for people categorized as masculine (90% of confi-

dence level). The same fact occurs on the relationship between social participation and satisfaction (95% of confidence level). The other two connections of the model do not change significantly in both groups.

Table 7. Path coefficients for groups feminine vs. masculine and Henseler's MGA.

	Path Coefficients Original (feminine)	Path Coefficients Original (masculine)	Path Coefficients-diff ( | feminine - masculine |)	p-Value (feminine vs. masculine)
TRUST -> SAT	0.038	0.123	0.085	0.888
COM_INT -> SAT	0.582	0.608	0.026	0.631
SOC_PAR -> SAT	0.229	0.090	0.139	0.042
SAT -> ROUTINE	0.601	0.455	0.145	0.016

In this case (table 7), people categorized as feminine show stronger relationship between social participation on satisfaction and the latter on routine than the group masculine (95% confidence level). This outcome indicates that, concerning SNS and Generation Y, people tending to masculinity values give less importance to social

participation as an antecedent of satisfaction, and to the latter as an antecedent of routinization. Therefore, we can accept the initial proposition: People from Generation Y have different behavior concerning the proposed model according to sex roles in the context of SNS.

Discussion and Conclusions

This paper explores the antecedents of satisfaction and routinization of SNS in the context of Generation Y through a model. All the proposed hypotheses are confirmed, showing that this model allows us to improve the knowledge about satisfaction and routinization of SNS in Generation Y. Furthermore, the proposition of different behaviors about this model is partially confirmed.

Social connections are critical to human biology, and the impact of SNSs on these relationships has been significant. Generation Y is the digital generation, the vanguard that represents the future, and the first generation to grow up with SNS; therefore, authors should incorporate a complete understanding of SNSs usage: patterns of use and online communication.

The authors focused on Generation Y because this is the group that is entering a phase of the lifecycle as they form families and households and will likely lead our society in a few years. The use of these social networks will influence the forms of communication for these young people. Therefore it is essential to know and understand the effects that SNS have in their lives. As this generation is likely to come under the attention from the researchers and practitioners, they would benefit from greater understanding of the issues that concern this group.

While many authors have written on SNS usage patterns, little research has focused on specific gender roles of Generation Y, particularly online. This paper addresses this gap by focusing on this cohort and offering insights into Millennials use of SNS depending upon the gender roles: femininity, masculinity, and androgyny. An essential result of this study is the number of people classified as androgynous; almost 60% of the sample, reflecting that the current generation of young behaves according to more flexible gender roles. Twenge (1997) found similar results. She studied subjects of the same age (college students) at different moments. Her outcomes point out that women have increasingly informed masculine-stereotyped personality characters as features of themselves, and men have also endorsed more masculine personality traits. This author suggests that personality can be affected by cultural changes. Therefore, the values and expectations formed during childhood are influenced by cultural and economic environments, so it is likely that the daughters of working mothers valued masculine aspects. Another theory suggests that female university students who intend to pursue a career, begin to acquire in college personality traits they consider necessary for success in the professional field, which is a traditionally masculine trait (Eagly, 2013). Furthermore, our sample is composed of students enrolled in degrees where cultural concepts such as making money, success in life, ambition, improve your professional career are cornerstones for them, opposite to other students enrolled in more humanistic studies. We believe that the business-economic scope of the students of our sample could influence the fact of obtaining a high percentage of women presenting masculine personality traits and women with high androgyny scores.

This model reveals there are differences in some of the relationships of the model when considering the gender-roles. Specifically, androgynous have a similar behavior than the female group. The masculine segment has behavior more away from the rest. Thus, feminine and androgynous show a stronger relationship between social participation on satisfaction and the latter on routine than the masculine group. This consequence points out that, concerning SNS and Generation Y, people tending to masculinity values give less significance to social participation as an antecedent of satisfaction, and to the latter as an antecedent of routinization.

One might think that the difference in the relationship between the variables of the model between androgynous, feminine and masculine are due to their characteristics as users. However, there are no significant differences in time as an Internet or SNS user, or concerning the frequency of access to the SNS, or the number of contacts, whether one is androgynous, feminine or masculine. We believe, therefore, that this depiction of gender is highly influential in explaining by itself the SNS behavior of young people in the proposed model. In this regard some authors (Venkatesh et al., 2004) suggest that the psychological conceptualization of gender is a more accurate predictor of ICT adoption and user behavior than sex, because it has a lasting impact throughout the technology adoption lifecycle, influencing the decisions of long-term use.

This study extracted the results from a significant sample, with more than 1,400 people; one limitation is the lack of diversity in the sample, which was composed only of millennial university students. The research should be extended to other groups of people with different cultural levels and to other countries to extrapolate our findings to them.

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Leveraging firm innovation performance through alliance portfolios in emerging economies: the role of absorptive capacity

T. Diana L. van Aduard de Macedo-Soares^{*1}, Fábio de Oliveira Paula¹, Hudson Lima Mendonça¹

Abstract: Firms are increasingly engaging in alliance portfolios/networks – AP/Nets - to leverage their innovation performance –IP - and thus boost their competitiveness. Most studies, with a few exceptions especially from emerging countries, found a positive relationship between AP/Net and IP, depending on portfolio characteristics and firm absorptive capacity – AC. This article undertakes an empirical investigation of the AP/Net – IP relationship and AC's potentially moderating role in this relationship in an emerging country: Brazil. Statistical testing of hypotheses regarding these relationships, and AC's role, corroborated the exceptions. However, it confirmed how important it is that firms in an emerging country ensure a high level of AC to mitigate the negative effects of AP/Net diversity on IP. Some managerial and policy implications were also formulated.

Keywords: innovation; alliance portfolios/networks; absorptive capacity; emerging countries; Brazil.

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Introduction

Open innovation (Chesbrough, 2003), defined as a concept according to which firms make use not only of internal but also external knowledge to generate innovation, has become a necessity (Chesbrough, 2003; Dahlander & Gann, 2010; Laursen & Salter, 2006; Randhava, Wilden & Hohberger, 2016) to contend with increasingly complex technologies. In addition to dyadic partnerships, firms in various industries have established alliance portfolios in the scope of their innovation-oriented strategies. Consistent with our network theory approach, alliance portfolio is defined here as an ego-centric network (Knoke, 2001), or ego-net for short, i.e. the network formed by the focal firm, its direct linkages and the linkages between its partners (Ahuja, 2000; Ozcan & Eisenhardt, 2009); hence our abbreviation of alliance portfolio as AP/Net. AP/Nets are thus made up of multilateral alliances that nowadays constitute around 27% to 50% of all alliances, particularly in technology intensive firms (Xu, Fenik, & Shaner, 2014).

Participation in AP/Nets is considered important for firms that seek to increase their innovation performance - IP (Faems, Van Looy & Debackere, 2005; Duysters & Lokshin, 2011). However, AP/Net's role in enhancing IP depends upon its characteristics. Gulati, Nohria and Zaheer (2000) argued that the alliance network could "serve as a source of both opportunity and constraint" (p. 207); depending on the network's structure and access to resources it provides, it could be a "source of competitive advantage" (p.207). Based on his literature review, Wassmer (2008, p. 150) stated that "the configuration of a focal firm's AP ...determines the quality, quantity, and diversity of information and resources to which the focal company has access".

Zaheer, Gözübüyük and Milanov (2010) identified network characteristics for boosting firm performance that are pertinent to IP. They consider that networks constitute an "important source of resources..."

(p.65) the most cited one of which was information. High centrality of the focal firm, i.e. involved in many ties in the network, make it a "major channel of information". Network closure - generally measured as "ego network density" (p.66) - increases knowledge sharing and trust, and thus lowers transaction costs. However, excessive density, leading to overembeddedness, limits the diversity of information to which firms in the network can access. Referring to Burt (1992), the authors state that "certain network structures (i.e. rich in structural holes) provide more diverse and timelier information than other structures" (p.65).

Zaheer et al. (2010) do not explicitly mention innovation. However, they do so implicitly. Strong ties improve firm performance when exploitation behavior is required, weak ties do so when exploration behavior is necessary. March (1991) distinguished between exploitation and exploration, defining the latter as innovation. Recently, several authors have associated exploration with radical innovation and exploitation with incremental innovation (e.g. Leeuw, Lokshin & Duysters, 2014; Hooge, Béjean & Arnoux, 2016).

In addition, diversity of alliances (ties/linkages) and of partners in an AP/Net that obviously contribute to the diversity of information and other resources, were considered important for IP in several studies (see Macedo-Soares, Barbosa & Paula, 2016a).

Although the characteristics of the AP/Net and the relative position of the firm in the AP/Net may influence its IP, other factors are also important.

What is critical is that the firm can derive benefits from the information provided by the AP/Net. This depends on the firm's level of absorptive capacity – AC, i.e. the "ability of a firm to recognize the value of new, external information, assimilate it, and apply it to commercial ends" (Cohen & Levinthal, 1990, p. 128).

(1) Business School, Pontifical Catholic University of Rio de Janeiro, Rio de Janeiro, Brazil.

*Corresponding author: diana@iag.puc-rio.br



According to Kim (1997), AC involves two important variables: i) "existing knowledge base ... mostly tacit knowledge" which influences learning processes and is fundamental for the creation of new increased tacit knowledge, ii) ... the intensity of effort..." "or commitment" (p. 97) to integrate this knowledge.

Most empirical studies on the AP/Net – IP relationship and AC's role in this relationship focus on companies from developed countries (e.g. Beers & Zand, 2014; Srivastava, Gnyawali & Hatfield, 2015; Hurmelinna-Laukkonen et al., 2012). Only a few investigate developing/emerging economies, mainly in Asia (e.g. Tsai, 2009; Lião & Yu, 2013; Yu, 2013), with hardly any concentrating on Latin America (exceptions are García Fernández, Sánchez Limón, & Sevilla Morales, 2012; Gomez, Daim & Robledo, 2014).

This article shares research that explored the relationship at issue in developing/emerging countries, specifically in Latin America's largest country and only BRIC member: Brazil. Its objective was to answer the question:

How do AP/Net characteristics of firms in developing/emerging countries in Latin America - in this specific case Brazil - impact their IP and how is this relationship influenced by firms' AC?

For this purpose, we used a model developed in our research's previous stage for analyzing the moderating role of AC in the AP/Net – IP relationship in firms in developing/emerging countries that seek to boost their competitiveness by leveraging IP through their AP/Nets.

The remainder of this paper is divided into four sections: i) theoretical references; ii) research methodology; iii) results; iv) discussion; v) concluding remarks.

Theoretical References

We first summarize the theoretical references that formed the basis for the conceptual model and hypotheses, whose subsequent testing helped answer our research question.

Literature review

A lot of research has been conducted on the engagement of firms in AP/Nets as a source of knowledge for improving their IP. Macedo-Soares et al. (2016a) found that cutting-edge research conditions the success of a focal firm's AP/Net in terms of leveraging IP to the characteristics of the AP/Net and to its AC.

Caner, Sun and Prescott (2014) and Gilsing, Nooteboom, Venhaverbeke, Duysters and van den Oord (2008), both found that firms which have high network centrality generally have higher exploratory IP. According to Caner et al. (2014) this was because high centrality increased "the positive moderating effect of the acquisition component of AC in the alliance ego-net – IP relationship" (in Macedo-Soares et al., 2016a, p.28). Gilsing et al. (2008) stressed the importance of considering both network density and technological distance when analyzing network centrality.

Lin, Wu, Chang, Wang and Lee (2012) found that there is an inverted U-shaped relationship between AP/Net partner technological distance and IP, and that this relationship is positively moderated by AC, especially when this distance is significant and the portfolio includes a high percentage of R & D alliances. An inverted U-shaped relationship was also found between the number of existing technological alliances in an AP/Net and IP (Vanhaverbeke, Belderbos, Duysters and Beerkens (2015), and between AP/Net diversity of the AP/Net and IP (Wuyts & Dutta, 2014; Yu, 2013).

In the literature reviews conducted, respectively, by Macedo-Soares, Turano, Esteves and Porto (2016) and Macedo-Soares et al. (2016a), diversity was found to be the most significant AP/Net characteristic for boosting IP. AC affected the AP/Net – IP relationship differently, depending on the type of AP/Net diversity, as Tsai (2009), for example, made evident, AC's role also varies depending on the type of IP – explorative/radical or exploitative/incremental. Beer and Zand (2014) found positive relationships, respectively, between functional AP/Net diversity and radical IP, and between geographic AP/Net diversity and incremental IP. AC helps derive benefits from the firm's prior experience with multiple alliances, which is another fundamental factor for ensuring that AP/Net characteristics boost firm IP.

As regards geographic diversity, Lião and Yu (2013) suggested that AC has a lesser moderating role in the linkage diversity – IP relationship in the case of international linkages with firms from emerging countries. Differences between developed/emerging countries' AC levels are related to a technology gap in the latter and influenced by institutional diversity.

Conceptual model

The model adopted in our study features the relationship between a firm's AP/Net characteristics and its IP, as well as AC's influence in this relationship (Figure 1). As explained in Macedo-Soares et al. (2016a), it was based on extensive literature reviews and drew upon Macedo-Soares's (2011) Global SNA Framework and its variation - the SNA-IF (Strategic Network Analysis Innovation Framework) (Macedo-Soares, 2015).

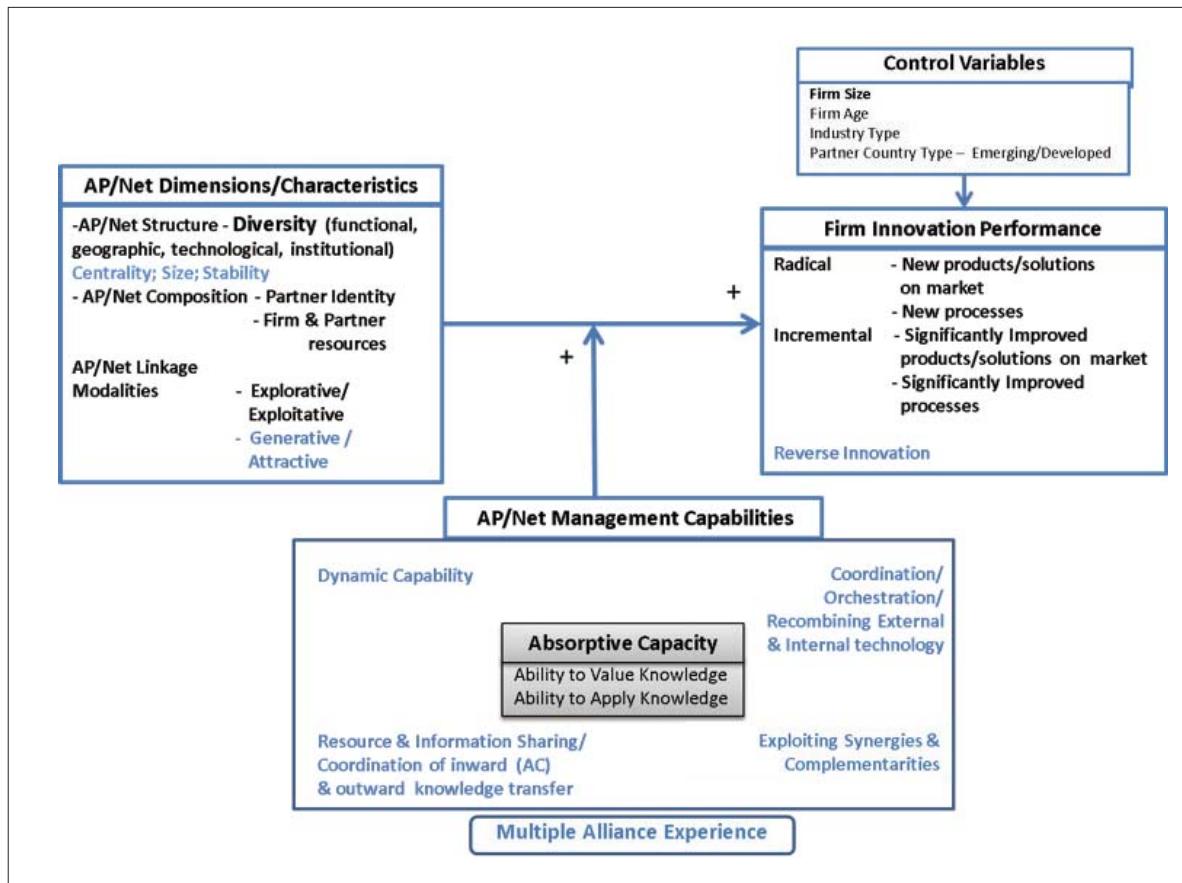
In this framework AP/Net characteristics for leveraging IP were classified according to the following dimensions: AP/Net Structure (diversity, centrality, size and stability); AP/Net Composition (partner identity, firm and partner resources); AP/Net linkage modalities (explorative/exploitative, generative/attractive), to help assess the characteristics' positive or negative strategic implications at both industry and firm levels.

In the model diversity is highlighted in bold characters among the AP/Net structure characteristics because of its significance in the AP/Net – IP relationship. This is also the case of the explorative and exploitative alliance types in the AP/Net linkage modalities dimension. AC is featured in the AP/Net Management Dimension and is highlighted among other relevant AP/Net management capabilities in the center of this dimension, due to the focus on its role. Multiple alliance experience is also

shown as supporting AC and the other AP/Net management capabilities, in keeping with literature review findings. The two types of IP – radical and incremental – appear in bold type in the Firm Innovation Performance box, together with the constructs used to qualify them. Reverse innovation is not highlighted because it was not investigated. This is also

the case of control variables that were identified in the literature, with the exception of firm size. The arrows indicate the direction of the AP/Net - IP relationship, with the plus sign showing that this relationship is positive. Similarly, in the case of AC, the arrow and plus sign indicate its positive moderating influence on the AP/Net – IP relationship.

Figure 1: Conceptual model (Macedo-Soares et al., 2016a)



The hypotheses, formulated at this stage in keeping with the relationships shown in the model, are listed below.

Hypotheses

H1: The innovation performance (radical and incremental) of firms in Brazil engaged in AP/Nets is positively associated with the firm's AP/Net Diversity (functional, geographical, technological and institutional)

H2: The IP (radical and incremental) of firms in Brazil engaged in AP/Nets is positively associated with the strength of the identity of the partners in the firm's AP/Net.

H3: The IP (radical and incremental) of firms in Brazil engaged in AP/Nets is positively associated with the level of the resources of the firm's AP/Net and of its partners.

H4: The AC level of firms in Brazil positively and linearly moderates the relationship between the above-mentioned firm's AP/Net characteristics (diversity, partners' identity and resources of the focal firm and of its partners in the AP/Net) and the focal firm's IP (radical and incremental).

These hypotheses may be challenged, especially in developing/emerging countries where firms' accumulation of technological capabilities is still not as developed in the most innovative countries (Choung, Hwang, & Song, 2014; Kim, 1997). In developing/emerging countries, the firms' level of AC may not be high enough to enable them to take advantage of external knowledge sources to improve their IP (Paula & Silva, *forthcoming*) and attaining the appropriate level depends not only on the firm itself but on the existence of an institutional infrastructure (i.e. policy support, public research institutes) to support the acquisition of such capabilities (Choung et al., 2014). This could prevent finding the expected positive relationships between

AP/Net and IP. Some studies identified non-positive direct relationships between certain AP/Net characteristics and IP. Notably, Cui and O'Connor (2012) found that high partner diversity may have a negative relationship with IP due to high transaction and AP management coordination costs. Leeuw, Lokshin and Duysters (2014) came to a similar conclusion, attesting that excessive AP/Net diversity accounts for a negative influence on innovation. (See also Caner et al. 2014 and Tsai, 2009). These conflicting findings increase the importance of testing these relationships, using different methods, in an emerging economy - in the case of this article, Brazil.

Research Methodology

Note that the research presented here is part of a wider investigation conducted in several stages. The previous stages were dedicated to bibliographic studies - both quantitative and qualitative - and the development of the theoretical bases, including the model, for achieving the research's objective. The stage at issue here is the first one in which an empirical study was carried out involving the application of this model.

Data source and sample

To conduct this research we collected data from two sources: i) a survey to capture data for the proxies of the constructs AP/Net Dimensions/Characteristics, AP/Net Management Capabilities and for some proxies of Firm IP; ii) secondary data from a survey of Finep's beneficiaries' to complement the proxies used for the Firm IP construct with others, as well as some descriptive information regarding the firms, such as their industrial sector and labor force quality.

Finep, founded in 1967, is Brazil's Innovation Agency, and is linked to the Ministry of Science, Technology and Innovation. Its mission is to promote the country's economic and social development by fostering science, technology and innovation in firms, universities, technological institutes and other private and public institutions (Finep, 2016). To achieve these goals, Finep uses grants for companies and universities, cheap credit, equity and quasi-equity investments and non-financial innovation support.

The questionnaire, developed by the authors for carrying out the survey, was pre-tested according to Churchill (1979), using a sample of 70 respondents involved in innovation alliances entered into by CEN-PES, the research center of Petrobras, the largest Brazilian Oil & Gas and renewable energy company. Several changes were made to the questionnaire following this test before applying it with the support of the Qualtrics platform (Snow & Mann, 2013).

The survey aimed at capturing important data from all the firms that had subscribed to "FINEP 30 Dias", the agency's core program to boost innovation in Brazil. Launched in September 2013, this program aims at supporting both Brazilian firms' specific innovation projects and their innovation strategies (Finep, 2016). It is based on the assumption that in Brazil there is a specific group of companies called "technological core of the industry", that could propel the

country to a new level of innovation (De Negri & Lemos, 2011). To bring about the necessary changes, this program needs to understand these companies' innovation strategies, including their dyadic and multilateral alliances.

The number of firms in FINEP's database amounted to 497, of which 70 answered our questionnaire adequately, or a response rate of 15.3%, only slightly below that of other innovation studies in Brazil (Ribeiro et al., 2014; Borba, Neto & Figueiredo, 2016). We excluded one case from the sample because it appeared as an outlier in many variables ($z\text{-score} \geq 3$). A special variable in which the case behaved as an outlier was turnover with a $z\text{-score}$ of 7.94, indicating that the firm is much bigger than those of the sample.

Of the remaining 69 respondents, 26 (37.68%) were engaged in multilateral alliances. Their data could therefore be used to test our model. It was complemented with data about general characteristics and IP previously collected by FINEP when these companies filled out their application for financial innovation incentives from this agency.

Description of the variables

As explained earlier, the model involves three interacting constructs: AP/Net, AC and IP. The AP/Net Alliance Portfolio construct was operationalized using the following variables:

- i) AP/Net's geographical diversity – number of AP/Net partners' different nationalities, considering nine different locations: Brazil; Mercosur countries; Other Latin American countries; USA and Canada; Western Europe; Japan; Eastern Europe and other Asian countries; Africa and Oceania (AP1);
- ii) AP/Net's functional diversity - number of different types of AP/Net partners, considering seven different options: clients, suppliers, substitutes, competitors, new entrants, universities/research institutes and government (AP2);
- iii) AP/Net technological diversity – degree of technological diversity between the AP/Net partners and the focal firm on a 5 point Likert scale, from '0 = very low' to '4 = very high' (AP3);
- iv) Focal firm's value - degree of value of the focal firm as a partner of the AP/Net partners on a 5 point Likert scale, from 0 to 4 (AP4);
- v) AP/Net Partners' value - average value for the focal firm of the partner by partner type, from 0 to 4 (AP5);
- vi) AP/Net Partner resources' richness - average richness of the partner's resources by partner type, from 0 to 4 (AP6);
- vii) AP/Net Partner resources' volume - average volume of the partner's resources by partner type, from 0 to 4 (AP7);
- viii) AP/Net Partner resources' complementarity - average complementarity of the partner's resources with those of the focal firm by partner type, from 0 to 4 (AP8);

- ix) AP/Net Partner resources' access - average easiness of access to the partner's resources on the part of the focal firm by partner type, from 0 to 4 (AP9);
- x) AP/Net strength - average strength of the tie with each partner type from 1 to 7 (AP10);
- xi) Exploration / exploitation - averaged by the level of exploration / exploitation for each AP/Net partner type, considering '0 – exploitation' and '1 – exploration' (AP11).
- xii) AP/Net size - the average number of partners in the firm's AP/Net (AP12) up to six (the last option is six or more partners);
- xiii) Percentage (%) of alliances in an AP/Net – percentage of alliances of the firm's total number of alliances that are multilateral.

The construct AC was operationalized through a 5-point scale composed of 12 questions (AC1 to AC12) to measure the focal firm's capacity to identify, acquire, assimilate and use the external information to leverage its innovation outcome. This scale was based on Ritala and Hurmelinna-Laukkonen's (2013) potential AC scale. The endogenous construct, Innovation Performance, was operationalized using the following variables;

i) Product Innovation

- a. Percentage (%) of total turnover from products new to the market (did not innovate / more than 0 to 10% / more than 10 to 40% / more than 40%) (%PROD);
- b. Product innovation complexity – 0 if no product innovation was introduced by the focal firm in the last five years. If at least one product innovation was introduced during the period, the sum of the level of radicalness of product innovation (1 point if the innovation was incremental and 2 if it was radical) and the degree of innovativeness of product innovation (0 point if it was new to the firm, 1 point if it was new to the country and, 2 points if it was new to the world) (IPROD)

ii) Process Innovation

- a. Process innovation complexity – 0 if no process innovation was introduced by the focal firm in the last five years. If at least one process innovation was introduced during the period, the sum of the level of radicalness of process innovation (1 point if the innovation was incremental and 2 points if it was radical) and the degree of innovativeness of process innovation (0 point if it was new to the firm, 1 point if it was new to the country and, 2 points if it was new to the world) (IPROC).

As control variable we used 'firm size', measured by the total number of employees. Other control variables were not used due to a lack of necessary data.

Statistical method

After calculating the variables' z-score, we conducted an exploratory factor analysis to reduce the dimensions of AP/Net and AC (Hair, Black, Babin, Anderson, & Tatham, 2006). The variables with individual measure sampling adequacy (MSA) below 0.5 in the anti-image matrices were removed from the analysis. Next, we analyzed the global MSA and whether Bartlett's test of sphericity was significant at $P < 0.05$. The number of factors was chosen by a composition of the eigenvalue > 1 criteria and the scree plot analysis. The resulting factors were subjected to a varimax rotation and the final dimensions of the constructs were established by a summated scale of the variables with a weight of more than 0.7 in the case of AC. To test the hypotheses we conducted a multiple regression analysis (Hair et al., 2006) to find relationships between the constructs. One regression was run for each dimension of Innovation Performance (Product and Process Innovation) as a dependent variable. The independent variables were the factors for AP/Net and AC that had resulted from the summated scales derived from the factor analysis. The moderation relationship was tested by using the multiplication of the factors that represented AP/Net Characteristics and AC as independent variables in the regressions.

Results

According to Brazil's official 2012-2014 Innovation Survey, there was a slight increase in the innovation rate of Brazilian firms: 36% versus 35.7% in 2011-2013 (IBGE, 2016). Product innovation improved from 17.3% to 18.3% and process innovation from 31.7% to 32.7%. The R&D investment rate (% of turnover invested in R&D) improved very slightly: 0.61% versus 0.58% in the previous period. An analysis of the type of investments in innovative activities, reveals a substantial increase (69.4%) in the external sources of innovation (acquisition of external R&D and external knowledge): 12.2% in 2012-2014 versus 7.2% in 2009-2011.

Although the reports evidence an overall increase in innovation activities and innovation outputs in Brazilian firms, and even though Brazil is the 9th economy in the world in terms of GDP (Worldbank, 2017), the country was recently ranked 69th in the Global Innovation Index (Dutta, Lanvin & Wunsch-Vincent, 2016), which was worse than in 2014 when it occupied the 61th place (Dutta, Lanvin & Wunsch-Vincent, 2014). These numbers reinforce the urgency of understanding the characteristics of innovation alliances in Brazil, in order to suggest ways to improve firms' IP, considering its importance for sustained growth (Christensen & Raynor, 2003) and potential to drive the country's economic development as a whole (Kim, 1997).

Table 1 presents some characteristics of the full sample of 69 firms, classified in three groups: Group 1 (7 firms) – firms with no alliances for innovation; Group 2 (36 firms) - firms engaged only in dyadic alliances for innovation; Group 3 (26 firms) – firms operating in AP/Nets for innovation. As Table 1 shows, most firms in the survey had introduced at least one product or process innovation (65 firms, or 94.9%), whereas 6.80% (4 firms) had not, had failed to introduce at least one innovation during the period, or had not even tried.

A certain positive balance was found between product and process innovation: 57 of the 69 firms had introduced product innovations (82.6%), and 59 of the 69 firms had introduced process innovations (85.5%). This was observed in all three groups. Another characteristic highlighted in Table 1 is the firms' turnover for the last year (2015). There are important differences between the three groups. Group 3 has a higher average (R\$1,318 MM) followed by far by Group 2 (R\$475MM) and Group 1 (R\$141MM). These data suggest that innovation-oriented firms in Brazil engaged in AP/Nets are much bigger in terms of turnover than those without alliances or with dyadic alliances for innovation. The difference between Groups 2 and 1 also suggests that firms with dyadic alliance are bigger in terms of turnover than those without innovation alliances.

Because our literature review revealed a positive relationship between exports and innovation capabilities in firms of developing/emerging countries (Gashi, Hashi and Pugh, 2014), thus highlighting their contribution to firm growth (Golovko & Valentini, 2011), we also conducted an analysis of the relationship between alliance types and exports of the sampled firms. In absolute terms, Group 3 had a much higher export average (110.4 MM) than Group 2 (19.9 MM) or Group 1 (2.3 MM). This difference was also perceived in relative terms -export/turnover ratio, - and similar patterns were found when comparing Groups 3 (14.01%), 2 (5.71%) and 1 (4.72%). These figures suggest that there is a positive relationship between firm's participation in AP/Nets and its export volume. Moreover, when considering the number of employees, although the average was close to two thousand (1,990), with 2.34% dedicated to R&D, firms that operated in AP/Nets were much bigger, having on average 3,407 employees, with around 56 dedicated to internal R&D (1.65%).

Firms engaged only in dyadic alliances were much smaller; although the percentage of people dedicated to internal R&D was higher (1,257

employees on average, with 3.74% dedicated to R&D). Firms that had no alliances for innovation were even smaller, with merely a fraction of their employees dedicated to internal R&D (494 employees and 1.62% engaged in R&D). The percentage of employees involved in internal R&D in each group was consistent with the firm's internal R&D intensity (the ratio between a firm's spending on internal R&D and its total turnover). Firms of Group 2 had a higher internal R&D intensity compared to firms from Group 3 (5.62% vs. 3.54%), as they had a greater percentage of employees in R&D, suggesting that firms of this group were more dedicated to internal R&D, in general, than those of the other two groups. External R&D acquisition intensity (the ratio between the sum of total spending from external R&D and the firm's total turnover), was also higher in the case of Group 2, with 0.88% versus 0.57% for Group 3. As expected, firms of Group 1 that had no alliances for innovation, invested very little in external R&D (0.38%). Since internal R&D intensity was also low in this group (0.93%), we inferred that it was not dedicated to innovative activities and the innovations its firms developed were merely circumstantial.

The percentage of a firm's turnover from new products was somewhat higher for firms that had engaged in dyadic alliances (37.8% in Group 2 had more than 40% of their turnover from new products, versus 14.3% in Group 1 and 11.5% in Group 3). Group 1 evidently innovated less. Firms of Group 3, however, innovated at a similar level to those in Group 2 (Group 3 - 96.2% and Group 2 - 94.4%). A possible reason for the difference in the participation of new products in the firm's turnover is that Group 2 may have introduced a higher number of product innovations in the period, which would be consistent with a higher investment in internal R&D. As we did not have information on the number of products introduced by these firms, no definitive conclusion could be made regarding this point.

Table 1: Characteristics of the sample

Characteristics	Group 1 -No Alliances (n = 7)	Group 2 -Dyadic Alliances (n = 36)	Group 3 -Alliance Portfolio (n = 26)	Total (n = 69)
No innovation introduced	2	2	1	5
Innovation introduced	5	34	25	65
Product Innovation	5	30	22	57
Process Innovation	5	30	24	59
Avg. Turnover last year(million R\$)	142	475	1,318	759
Avg. Number of Employees	494	1,257	3,407	1,990
<i>% Turnover from new products</i>				
0%	2	3	1	6
0-10%	2	9	11	22
10-40%	2	10	11	24
40-100%	1	14	3	18
Avg. Export Intensity	4.72%	5.41%	14.01%	8.58%
Avg. % Employees R&D ₁	1.62%	3.74%	1.65%	2.34%
Avg. Internal R&D Intensity	0.93%	5.77%	3.54%	4.44%
Avg. External R&D Acquisition Intensity	0.38%	0.88%	0.57%	0.70%

Since our hypotheses concerned AP/Nets, our analysis henceforth focused on the 26 firms in Group 3. The statistics for the variables representing the model's constructs were calculated for this sample. Table

2 presents the means, standard deviations, minimum and maximum values pertinent to the latter.

Table 2: Statistics for the constructs' variables (n = 26)

Construct	Variable	Mean	S.D.	Min.	Max.
AP / Net Characteristics	Geographical diversity (AP1)	2.58	1.24	1	6
	Functional diversity (AP2)	2.46	1.21	1	6
	Technological diversity (AP3)	4.18	0.60	3	5
	Focal firm's value (AP4)	4.10	0.66	3	5
	Partners' value (AP5)	4.06	0.81	2	5
	Partner resources' richness (AP6)	4.01	0.65	3	5
	Partner resources' volume (AP7)	3.38	0.70	2	5
	Partner resources' complementarity (AP8)	1.44	0.37	1	2
	Partner resources' access (AP9)	1.96	0.66	1	4
	Strength (AP10)	3.81	0.80	2	5
	Exploration / exploitation (AP11)	4.12	0.71	3	5
	Size (AP12)	3.23	1.50	1	5
	% of alliances in an AP (AP13)	67%	36%	4%	100%
Absorptive Capacity	AC1	4.00	0.75	3	5
	AC2	4.23	0.76	2	5
	AC3	3.65	1.02	1	5
	AC4	3.69	1.01	2	5
	AC5	3.88	0.86	2	5
	AC6	3.73	1.22	1	5
	AC7	4.12	0.82	3	5
	AC8	3.88	0.82	2	5
	AC9	4.23	0.82	2	5
	AC10	3.92	1.02	2	5
	AC11	3.92	0.89	2	5
	AC12	4.38	0.64	3	5
Innovation Performance	% Turnover new products (%PROD)	1.62	0.75	0	3
	Product Innovation Intensity (IPROD)	2.96	1.08	0	4
	Process Innovation Intensity (IPROC)	3.04	1.00	1	4

The first step in this phase was to conduct an exploratory factor analysis to reduce the number of independent variables representing the AC and AP/Net constructs. Two strategies were used. For AC we verified whether we could represent this concept using merely one factor. For this purpose we ran a factor analysis fixing one dimension without any rotation. No variable below 0.5 was excluded according to MSA criteria. We thus obtained a global MSA of 0.720 and the Bartlett's sphericity test had a χ^2 of 160.363 with df of 66 and a significance of 0.000. The total variance explained by the unique factor was 46.906%. Although it was below 50%, for reasons of parsimony, we considered that AC could be represented by this single factor. The final factor was calculated using summated scales of the variables with a weight of 0.7 or more. These were AC4, AC5, AC6 and AC7.

In the case of the AP/Net construct we conducted an exploratory factor analysis choosing the number of dimensions according to eigenvalue > 1 criteria. AP7 and AP9 were dropped from the analysis because their individual MSAs were lower than 0.5. The global MSA of 0.714 and the Bartlett's sphericity test had a χ^2 of 111.111 with df of 55 and a significance of 0.000. The model resulted in four factors with a total variance of 75.093%. Factor 1 had weights of more than 0.7 for the variables AP3 – value of partners (0.814), AP5 – volume of partners' resources (0.908), AP6 – complementarity of partners' resources (0.779) and AP11 – value of focal firm (0.777). We called this factor *AP Resources*. Factor 2 had weights of more than 0.7 for the variables AP1 – geographical diversity (0.818), and AP2 – functional diversity (0.839), and were named *AP Diversity*. Factors 3 and 4 had

only one variable, AP10 – technological diversity (0.748) and AP8 – exploration/exploitation (0.881) respectively, weighing more than 0.7. We called Factor 3 *AP technological breadth* and Factor 4 *AP level of knowledge exploration / exploitation*.

Next, we ran two separate multiple regressions with both variables representing product innovation (% of total turnover from products new to the market - %PROD, and product innovation complexity - IPROD) and process innovation complexity (IPROC), as dependent variables to test the hypotheses, totaling six regressions. For each dependent variable, one regression was run only with the AP/Net and AC factors followed by another introducing the interacting variables. As the dependent variables were not normal they were transformed using reciprocal transformation (Box & Cox, 1964), after adding 1 to the original variable to avoid zero values in the denominator, having respectively $1/(1+\%PROD)$, $1/(1+IPROD)$ and $1/(1+IPROC)$. Although the transformed variables were still not normal, they improved the regression results and we continued our analysis with them.

The results of the regressions were not significant for the transformed %PROD (F-statistics = 0.610, with a significance of 0.783 for the complete model) and IPROC (F-statistics = 0.678, with a significance of 0.729 for the complete model). Therefore, we proceeded using only

the regression of IPROD (see Table 3). The analysis strongly suggested that the model improved significantly if the moderation of AC on the AP/Net characteristics was added to the model. Model 1 that used only the isolated factors of AP and AC as independent variables was not significant ($p<0.1$). When we added the moderation variables (Model 2) we found a significant improvement in the F-statistic of 3.048 and the model was significant with $p<0.1$. AC by itself improved the product innovation complexity level, with a $\beta=-0.403$ ($p<0.1$). The negative load represented a positive influence on the level of product innovation complexity as the variable in the regression received a reciprocal transformation beforehand. The only AP factor that was also significant was *AP diversity* ($\beta=0.425$ with $p<0.1$) and it had a negative influence on product innovation complexity. These results were consistent with previously mentioned studies which found that AP/Net diversity may have a negative impact on IP by increasing AP management complexity and costs (Cui & O'Connor, 2012; Leeuw et al., 2014).

Our findings led us to reject Hypotheses 1, 2 and 3, as the effect of diversity was found to be negative instead of positive, and the other firms' characteristics had no significant direct effect on the level of radical and incremental product innovation (represented by product innovation complexity).

Table 3: Results of the multiple linear regression with independent variable Product Innovation Complexity (with reciprocal transformation)

		Model 1 ($R^2=0.269$; Adj $R^2=0.038$)		Model 2 ($R^2=0.590$; Adj $R^2=0.317$)	
Dependent Variable: Product Innovation Complexity (transformed)		β	Std. Error	B	Std. Error
Factors					
Firm size		-0.020	0.044	-0.148	
Absorptive capacity		-0.326	0.054	-0.403*	0.05
AP resources		-0.291	0.059	-0.127	0.05
AP diversity		0.304	0.048	0.427*	0.05
AP technological breadth		0.047	0.046	-0.074	0.04
AP level of knowledge exploration/ exploitation in the AP		-0.069	0.043	0.068	0.04
Moderation effects					
Absorptive capacity x AP resources				0.255	0.05
Absorptive capacity x AP diversity				-0.529**	0.06
Absorptive capacity x AP technological breadth				-0.091	0.05
Absorptive capacity x AP level of knowledge exploration/ex- ploitation				-0.139	0.06
Model F		1.163		2.162*	
Change in F				3.048*	

* $p<0.1$; ** $p<0.05$

However, when we tested the interaction of AP/Net diversity with AC, the latter had a significant positive influence on product innovation complexity ($\beta=-0.529$ with $p<0.05$). The other interacting fac-

tors were not significant. We thus partially accepted Hypothesis 4. The regression did not find any significant effect of firm size on product innovation complexity.

Discussion and Concluding Remarks

In order to discuss our study's results it is important to recall its central question: *How do AP/Net characteristics of firms in developing/emerging countries in Latin America - in this specific case Brazil - impact their IP and how is this relationship influenced by firms' AC?*

Our study identified three groups of innovation-oriented firms in Brazil: i) firms with no innovation alliances, that invested very little in innovation development; ii) firms engaged only in dyadic alliances and that invested more in internal and external R&D; iii) firms involved in AP/Nets. Firms in the third group were the most successful ones, as they were bigger, both in terms of revenues and number of employees. They also exported more - an indicator that they were more competitive in the international market (Azar & Ciabuschi, 2016; Rodil, Vence, & Sánchez, 2014) it is also based on the complementary assumption that internationalization pushes firms to increase innovation performance (learning-by-exporting hypothesis).

Such positive performance results for firms engaged in AP/Nets, with lower R&D expenditures (both internal and external R&D), reinforced the importance of understanding the impact of AP/Net characteristics on IP and the role of AC in the AP/Net – IP relationship.

However, as mentioned earlier, our study revealed that several AP/Net characteristics did not have a positive impact on IP in the case of innovation-oriented firms in Brazil. It suggested that the firms' AP/Net partner resources and their identity were not significantly related to product innovation, and that AP/Net diversity had a negative relationship with IP. As already noted, these results were consistent with previously cited studies (Cui & O'Connor, 2012; Leeuw et al., 2014; Paula & Silva, *forthcoming*), which found that diversity influenced innovation outcomes negatively because it increased coordination and transaction costs.

What is most important, however, is that our research made evident that the negative impact of AP/Net diversity could be mitigated by improving the firm's level of AC. It indeed strongly suggested that AC moderates the relationship between AP/Net diversity and product innovation positively, indicating that "the ability of a firm to recognize the value of new, external information, assimilate it, and apply it to commercial ends" (Cohen & Levinthal, 1990) is a dynamic capability that is vital for enabling firms to succeed in their endeavors to leverage IP through their AP/Nets.

As observed earlier, in developing/emerging economies firms' level of AC is on average lower than in developed ones. Thus, the ability of firms in these economies to attain a reasonably high level of AC is fundamental for boosting their IP. However, it is not easy for them to achieve this on their own. Including international partners from developed countries in their AP/Nets and engaging in global production networks could enhance the development of their technological capabilities. This would contribute to narrowing the technology gap in these countries and thus boost their firms' level of AC so that

the latter could exert its positive moderating role in the AP/Net – IP relationship, thus also making these firms more competitive in the international market (Choung, Hwang and Song, 2014; Paula & Silva, *forthcoming*).

Our study enabled us also to draw some public policy implications for innovation-oriented firms in Brazil and possibly other emerging countries with a similar innovation profile. In Brazil more than 63% of innovations in the last years were process innovations (IBGE, 2016). However, in the last four years most public funding, notably by Finep, was for product innovations (61% of the total) (IBGE, 2016) aimed at developing products that add new value and do not merely enhance existing processes, so as to increase the country's exports and competitiveness. To improve the results of public funding, in terms of bringing about the desired level of product innovations through firms' AP/Nets, our study's results show that public policies should consider financing programs designed to increase these firms' AC levels. It should prioritize financing programs for firms in AP/Nets that include partners such as universities and research centers, as well as foreign partners from countries with the necessary technological capabilities, thus encouraging firms to operate in the above-mentioned global production networks.

Regarding the study's limitations, we should mention the limited number of cases, which did not permit the consideration of industry effects on the relationships. In addition, we lacked access to data on the firms' age, an important control variable. Moreover, our study was restricted to firms in Brazil. Although Brazil is representative of an emerging country and several conclusions may be extended to other emerging economies, part of the results may be country specific. According to Choung et al. (2014), the country's institutional infrastructure also has a critical role in enhancing firms' AC level. Our literature review highlighted the importance of institutional factors, particularly AP/Net institutional diversity, in developing/emerging countries in terms of their ability to influence the level of AC. We could not investigate AP/Net institutional diversity as we lacked access to international partners in the AP/Net.

We thus recommend that future studies consider institutional factors that are specific to the country at issue and to the AP/Net's partners. Studies comparing developing/emerging countries, such as Brazil, with developed ones could investigate differences in firms' AC levels and AC's role in improving the AP/Net – IP relationship in both types of countries.

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Effects of informal competition on innovation performance: the case of Pacific Alliance

Jorge Heredia^{1*}, Alejandro Flores¹, Cristian Geldes² y Walter Heredia¹

Abstract: This study evaluates the impact of informal competition on the innovation performance of formal firms in emerging economies. A theoretical model under the strategy tripod framework is proposed. It analyzes the effects of Institutional factors as the quality of governance and market labor rigidities on innovation performance, and the mediating effect of informal competition. It is used the Causal Mediation Analysis with data from 3,268 companies from the World Bank Enterprise Survey from countries of the Pacific Alliance (Chile, Colombia, Mexico, and Peru). The results state that informal competition has a negative effect on the innovation performance of formal companies. Based on these findings, it is suggested some promising avenues for future research and managerial implications.

Keywords: Informal competition; innovation performance; emerging economies; Pacific Alliance.

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1. Introduction

The informal economy is defined as economic activities related to the production and trade of goods and services that are not registered or are conducted by unregistered entities; such activities operate outside of government regulation and tax systems (Webb *et al.*, 2013). According to Schneider (2002), more than 50% of the gross domestic product of emerging economies is connected to the informal economy. Becoming an important area of study. Indeed, researchers who study informality in Latin American countries and Eastern Europe and Central Asia agree that companies must now address two types of competitors, both formal and informal (McCann & Bahl, 2016, Mendi & Costamagna, 2017). Because they avoid the costs associated with regulatory compliance and tax payments, informal competitors enjoy relative cost advantages that allow them to undervalue their products. As a result, they may remain in the market despite their low productivity (Farrell, 2004; Perry *et al.*, 2007).

However, the influence of the informal economy on strategic management within the formal economy remains unexplored (Webb, Ireland, & Ketchen, 2014). Different studies consider informal competition as a relevant factor in the competitive dynamics of industries in emerging economies and on formal enterprises. In this sense, Iriyama, Kisshore & Talukdar (2016) found in IT industry in India, that informal competition increases the non-market competitive corruption activities of formal enterprises, which aim to reduce the benefits that informal enterprises derive from their lower costs in terms of money and time. Additionally, Mendi & Costamagna (2017) found that informal competition has a negative effect on innovation types (process and product). These relationships were tested with data from the World Bank taken from a sample of African and Latin American countries. These results are relevant because the study of informal activity can yield important insights in areas such as the boundaries of the firm, diversification, dynamic capabilities, the resource-based view, property rights, disruptive technology, and innovation (McGahan, 2012).

Given the importance of informal competition, it is essential to explore the effects of this phenomenon on the innovation capacity of Latin American companies and analyze how informal competition's interaction with institutional factors affects innovation, and which strategies companies can use to mitigate the effects of informal competition on innovation performance (Grazzi & Pitrobelli, 2016; Webb *et al.*, 2014). For both the theory and the practice of strategic processes, it is important to analyze how Latin America's particular conditions interrelate and influence the enterprises' innovation performance (Mendi & Costamagna, 2017). In the same vein, other arguments highlighting the need to analyze the relationship between informal competition and innovative performance are that no theory has attempted to explain the effect of quality of governance on the informal competition among, and the innovation performance of companies in emerging economies. In particular, the effect of quality of governance on strategic processes such as innovation has been ignored (Becheikh, Landry & Amara, 2006). Moreover, the factors behind innovation performance in emerging economies are underexplored, as most studies have been conducted in developed countries, where conditions are different from those of emerging economies (Grazzi & Pitrobelli, 2016).

The purpose of this study is to analyze the effects of informal competition on innovation performance, taking the case of the countries belonging to the Pacific Alliance (Chile, Colombia, Mexico, and Peru) as representative of Latin American and emerging economies. These relationships are evaluated with Casual Mediation Analysis (Hicks & Tingley, 2011), and previous evaluations of the proposed theoretical model with Structural Equation Modelling (SEM) (Hair *et al.*, 2010; Hoyle, 2012). The data are from 3,268 manufacturing firms from the "World Bank Enterprise Survey" (2010). To build the theoretical model between informal competition and innovation performance, we draw from the strategy tripod which argues that the management of innovation might be based not only on the firm's ability to enhance

(1) Business School, Universidad del Pacífico. Lima, Perú.

(2) Assistant Professor, Faculty of Economy and Business, Universidad Alberto Hurtado, Santiago, Chile

Corresponding author: ja.herediap@up.edu.pe



its internal resources and capabilities, as in the resource-based view, but also on industry (informal competition) and institutional effect (Peng et al., 2008). Thus, the impact of informal competition on key issues such as innovation is an unexplored field, the study of which may lead to promising new conceptual frameworks, thus furthering our understanding of how Latin America's specific environment influences the sustainability of its companies' competitive advantages. Against this backdrop, we propose the following research questions: a) Does informal competition affect the innovativeness of companies in the Pacific Alliance? If so, how does it affect them? And b) How do the quality of governance, market labor rigidities and informal competition interact? In sum, this study presents a theoretical model for empirical validation that explains how the quality of governance, market labor rigidities and informal competition simultaneously, and directly or indirectly, influence the innovation performance of companies in emerging economies, generating theoretical and managerial implications.

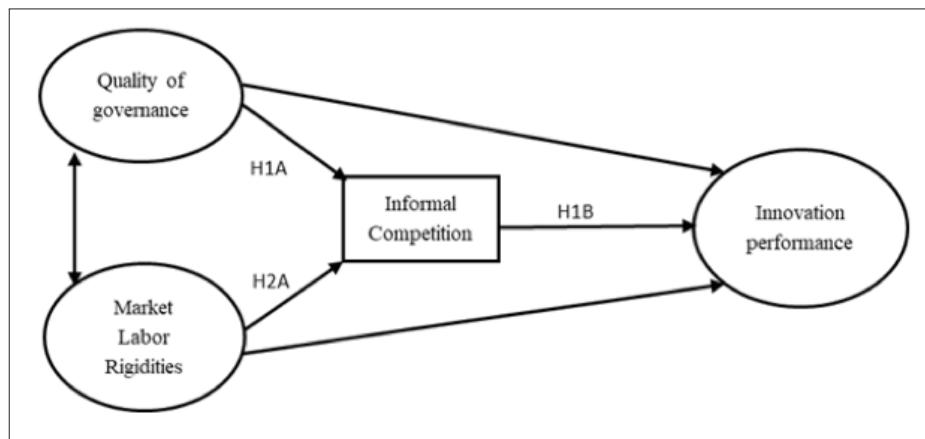
In the next sections, we discuss the literature including the strategy tripod approach as the theoretical approach, the effects of quality of governance and market labor rigidities on innovation performance through informal competition and the influence of informal competition on innovation performance. Next, the method is explained and

data. Then, the results are discussed in the context of emerging economies. We conclude with our findings, implications for managers and policymakers.

2. Conceptual background, theoretical model and hypothesis

In emerging economies, the strategy tripod proposed by Peng *et al.*, (2008) refers to institutional, industry and firm factors (resources and strategic capabilities) that are complementary and relevant to explaining strategic behavior and business performance. In this study, the strategy tripod approach is applied to the study of factors affecting the innovation performance of firms in emerging economies. Specifically, the strategy tripod approach gives the theoretical framework to identify and analyze external factors (institutional) affecting innovation performance of the firm. In this case, it is selected two categories following the Borrman, Busse & Neuhaus (2006) division of institutional factors: the quality of governance and labor rigidities. In the following sections, it is argued and stated the effect of the selected external factors in innovation performance and their hypothesis. These assumptions are shown in the theoretical proposed model (Figure 1). Basically, the model explains how external factors affect the innovation performance and the mediating role of informal competition.

Figure 1. Theoretical model.



2.1. The influence of informal competition on innovation performance

Most studies of innovation performance have been conducted in developed economies, where the external and internal factors that influence innovation performance have been previously identified (Becheikh *et al.*, 2006; Geldes & Felzensztein, 2013; Geldes *et al.*, 2017). In particular, Latin America and many developing countries are characterized by a unique environment that experiences sudden changes in economic volatility and significant increases in informal competition (unregistered firms) (Vassolo *et al.*, 2011) but it also faces serious challenges that severely underscore these opportunities. We apply a simple framework of analysis to describe the Latin American business environment and detect research opportunities. For that, we focus on four aspects of the region: (1. However, no study has inves-

tigated the impact of informal competition (unregistered firms) on innovative performance in Latin America (Webb *et al.*, 2014). Our aim in this article is to better understand the conditions under which informal competition (unregistered firms) affect innovation performance through the indirect effect of quality of governance. Current measures of innovation performance can be roughly divided into two categories: input measures and output measures. Input measures evaluate how innovation activities have been arranged and how resources are allocated to them. Output measures evaluate the effects of successful innovations (Becheikh *et al.*, 2006). We define the innovative performance construct according to Becheikh *et al.*, (2006) and consider the following as inputs: research and development, and purchases of licenses to use intellectual property. As outputs, we consider sales of new/significantly improved products.

2.2. The indirect effect of the quality of governance on innovation performance mediated by informal competition

In relation to the quality of governance, formal innovative industries find their performance negatively impacted by regulation, i.e., taxes or bribery, when interacting with the government (Grazzi & Pietrobelli, 2016). Moreover, excessive regulations are the main reason for the existence of a large informal sector, which chooses to operate informally to avoid the costs, time demands, and procedures imposed by the formal regulatory environment (De Soto, 2000). In addition, studies have shown that when government regulations were effectively enforced, the percentage of firms affected by informal competition increased (Tokman, 1978).

To measure the quality of governance, Kaufmann, Kraay & Mastruzzi (2009) propose six dimensions: political instability, voice and accountability, corruption control, the rule of law, government effectiveness and regulatory quality. Low institutional quality, represented by increases in corruption and insecurity and by excessive regulation informal competition in emerging economies (Tokman, 2001). The interconnection between institutions and the informal sector may be partially explained by the country's institutional setting, and, conversely, the presence of an informal sector may affect institutional efficiency (Mendi & Costamagna, 2017). This informal competition negatively influences formal companies' ability to innovate in sluggish emerging economies, which have low barriers to entry and plentiful opportunities for imitation due to the lack of protection of intellectual property, as well as the lower competitive advantage (Allred & Park, 2007; Godfrey, 2011). Additionally, if the Intellectual Property Right (IPR) are weak and ineffective (Allred & Park, 2007) discourages manufacturing firms from filing for new patents related to their innovations (Allred & Park, 2007). Given the weakness of Latin America's IPR system, this factor is especially relevant in our Latin American context (Barros, 2015; Grazzi & Pietrobelli, 2016). With these backgrounds, it is proposed the following hypothesis:

H1: The quality of governance indirectly influences companies' abilities to innovate when there is informal competition in emerging economies.

H1A: The quality of governance is positively related to informal competition in emerging economies.

H1B: The informal competition is negatively related to innovation performance in emerging economies.

2.2. The indirect effect of market labor rigidities on innovation performance mediated by informal competition

The second category of institutional factors that are considered in this study is that of labor rigidities (regulations). Labor rigidities, according to Borrmann *et al.*, (2006), including paying taxes, obtaining credits and managing licenses. In addition, Thai & Turkina, (2014) enrich the category of labor rigidities by including supply factors (resources and abilities) as a category that contains both labor regulations and human development. Excessive use of the regulations (e.g.,

labor market rigidities) and procedures for business development provided by institutions influence the increase in the number of informal businesses (Webb *et al.*, 2014) in emerging economies. A poor support system, represented by a high level of labor rigidity and lack of qualified personnel, increases informal competition in companies in emerging economies (Ketchen, Ireland & Webb, 2014). Furthermore, formal and informal firms compete for the same customers and resources (McGahan, 2012). The resulting informal competition reduces firms' innovation performance by means of imitation.

H2: Market labor rigidities indirectly influence the innovation performance of formal enterprises through informal competition.

H2A: Market labor rigidities increases informal competition in emerging economies.

3. Data and Method

In the following section, it is described the data, the case of study and the method.

3.1. Data and case of study

To test the hypotheses, it is employed the 2010 "World Bank Enterprise Survey". The surveys provide information on the companies' characteristics, strategies, and economic performance, as well as their perceptions of the institutional, policy, and economic environment and the degree of competition in which they operate. The Enterprise Survey data have been featured in a number of previously published studies in the field of informal competition (Iriyama *et al.*, 2016; McCann & Bahl, 2016; Mendi & Costamagna, 2017).

The case of study are the countries of the Pacific Alliance a trade initiative, namely Chile, Colombia, Mexico, and Peru. This selection is a response to a diverse range of issues. The group of countries hosts 38% of the population of Latin America and 34% of its GDP. Moreover, the group already accounts for half of intraregional trade, 50% of regional trade with Asia and 42% of foreign direct investment in Latin America. Chile and México have shown strong economic growth over the past ten years, with growth rates between 6% and 8% (Illescas & Jaramillo, 2011), high export volumes and the implementation of trade liberalization policies that foster international trade. Although Peru has not been considered in the previous studies we examined, it was included in our sample because, in recent years, Peru has also experienced a rapid increase in its exports of goods and services as a percentage of GDP. During the period 2005–2010, Peru had a median growth rate of 5.5% of its GDP (Illescas & Jaramillo, 2011; Peña-Vinces *et al.*, 2017). According to with World Bank Enterprise Survey (2010), the economy percent of firms competing against unregistered or informal firms for each country are Chile (55.8), Colombia (70.9), Mexico (70.3), and Peru (68.6).

The data, corrected for outliers and missing values, included interviews at 3,268 manufacturing firms in the year 2010. The Enterprise Surveys collect data from key manufacturing and service sectors and employ a standardized format and uniform sampling methodology to

minimize measurement error and make the data comparable across countries. We focus on manufacturing industries because they have the imperative to continually invest in innovation and are more consistent in their reporting procedures for innovation investment compared with other industrial categories such as services or non-profits (Allred & Park, 2007). Moreover, innovation is relatively more important in manufacturing and services industries, where value added originates and knowledge and skills are more valued (Crespi & Zuniga, 2012) Chile, Colombia, Costa Rica, Panama, and Uruguay. Additionally, the determinants of innovations and the effects of the different types of innovation are specific to each economic sector (Geldes *et al.*, 2017).

3.2 Method

The method follows the guidelines of Structural Equation Modelling (SEM). The latent variables and the theoretical model are built with Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA), with SEM the hypotheses are tested (Hoyle, 2012). Table 1 provides a detailed summary of indicators for each latent variable: (i) Labor Support, (ii) Quality of governance and (iii) Innovation performance. The remaining variable, the mediator Informal Competition, is considered observable (continuous).

Table 1: Summary of variables and constructs.

	Construct	Scale variable	Description/measure	References
Explanatory variable	Market labor rigidities	Ordinal (0-4)	How much of an obstacle: tax administrations	Borrman, Busse, & Neuhaus (2006); Kaufman, Kraay, & Mastruzzi (2009); Thai & Turkina (2014); Zhu, Wittmann, & Peng, (2012).
		Ordinal (0-4)	How much of an obstacle: tax rates	
		Ordinal (0-4)	How much of an obstacle: corruption	
	Quality of governance	Ordinal (0-4)	How much of an obstacle: political instability	
Dependent variable	Innovation performance	Continuous	In the fiscal year 2009: how much was spent on purchases of licenses to use intellectual property?	(Becheikh <i>et al.</i> , 2006)
		Continuous	In the fiscal year 2009: how much was spent on R&D activities performed within this establishment?	
		Continuous	In the fiscal year 2009: how much was earned through sales of new/significantly improved products (introduced in the past 3 years)?	
Mediator variable	Informal Competition	Ordinal (1-5)	How big the obstacle is: business practices of competitors in the informal sector?	Mendi & Costamagna (2017) Iriyama <i>et al.</i> , (2016) (McCann & Bahl, 2016)

Additionally, in Table 2 are the tests of latent variables for i) reliability (Cronbach's alpha > 0.7; Construct reliability - CR > 0.7), ii) Convergent validity (Standardized factor loading - FL > 0.5; Average variance extracted - AVE > 0.5) and iii) Discriminant validity (AVE > MSV - Maximum shared variance squared; AVE > ASV - Average variance shared square) (Hair *et al.*, 2010).

Table 2: Test of latent variables.

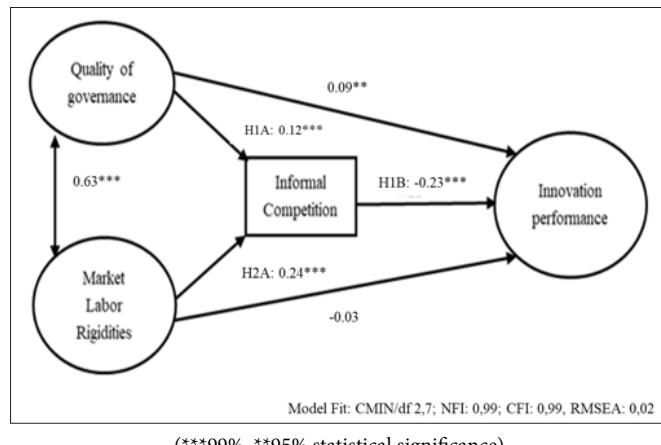
Constructs and items	FL	Reliability		Convergent validity		Discriminant validity	
		Cronbach's alpha	CR	AVE	ASV	MSV	
Quality of governance		0.84	0.80	0.67	0.12	0.64	
How much of an obstacle: crime, theft, and disorder?	0.82						
How much of an obstacle: political instability?	0.88						
Market Labor rigidity and regulations		0.81	0.70	0.54	0.11	0.64	
How much of an obstacle: tax administrations?	0.85						
How much of an obstacle: tax rates	0.80						
Informal competition							
Innovation capabilities		0.83	0.54	0.28	0.01	0.01	
In 2009 fiscal year: how much was spent on purchases of licenses to use intellectual property?	0.78						
In 2009 fiscal year: how much was spent on R&D activities performed within this establishment?	0.81						
performed within this establishment?							
In 2009 fiscal year: sales new/significantly improved products (introduced last 3 years)?	0.78						

To evaluate the theoretical model and SEM are used indicators for "minimum" and "good" fit of the model accordingly to CMIN/df ($2 < \chi^2 < 3$; $\chi^2 < 2$); NFI ($\chi^2 > 0.90$; $\chi^2 > 0.95$); CFI ($\chi^2 > 0.95$; $\chi^2 > 0.99$); RMSEA ($2 < \chi^2 < 3$; $\chi^2 < 2$) (Hair *et al.*, 2010). Moreover, with the purpose of analysis, the possible mediation of informal competition in the relationship between a dynamic environment and Innovation performance, it is estimated the total effects and its decomposition indirect effect and indirect effect. It involves two steps. First, two regression models are fitted, one in which the mediator is regressed on the exposure variable, adjusted for covariates, and a second in which the outcome is regressed on the exposure and mediator variable, adjusted for covariates. Predictions from these models are then used within a Monte-Carlo framework to calculate estimates for total, indirect and direct effects (Hicks & Tingley, 2011; Cheong & MacKinnon, 2012).

4. Results and Discussion

The Figure 2 shows that all the correlation between the variables in SEM model is statistically significative, with the exception on the relation between market labor rigidities and innovative performance. Moreover, the SEM has a good level of fit and the latent variables accomplish with all requirements, with the exception of market labor rigidities with low levels of convergent validity. This last point can be explained due to nature of secondary data. Additionally, in relation to the hypotheses, it is stated the H1A is no rejected meaning that the quality of governance is positively related to informal competition in emerging economies with a correlation of 0.12. In the second term, the H1B is no rejected too. It is mean that the informal competition is negatively related to innovation performance in emerging economies (-0.24). In the case of H2A, it is no rejected, then market labor rigidities are related to informal competition (0.24). Moreover, there is a significative and positive relationship between the quality of governance and the market labor rigidities (0.63).

Figure 2. SEM.



In relation to H1 “The quality of governance indirectly influences companies’ abilities to innovate when there is informal competition in emerging economies” and H2 “Market labor rigidities indirectly influence the innovation performance of formal enterprises through informal competition”, both hypotheses are not rejected, demonstrating the mediation role of informal competition. Table 3 shows the indirect effect in both cases and they represent 45% and 67% of effect mediated. These results are relevant for the competitive strategy of firms in emerging economies. The governments of emerging countries, such as those of the Pacific Alliance, have initiated national programs to support innovation and increase spending on innovation, with the goal of helping companies improve their competitive advantage in the global environment (Ketelhöhn & Ogliastri, 2013). However, the innovative performance of Latin American countries is still low (Olavarrieta & Villena, 2014). Our empirical analyses first demonstrated that informal competition has a negative effect on the innovation performance of formal firms. Formal firms change their behavior due to informal competition (unregistered firms), which capture returns from the formal firms’ innovative efforts by copying. Therefore, formal firms invest less in innovation. Our findings reinforce a quantitative study by Mendi & Costamagna, (2017) which

used data from the World Bank of African and Latin American countries and found that informal competition has a negative effect on innovation types (process and product). In addition, similar evidence is found in the Chinese market, in which informal competition affects firm investment in R&D (Su, Xie, & Peng, 2010).

Table 3: Mediation analysis. Total Effect and Indirect Effect.

Variables	Total effect	Direct effect	Indirect effect	% effect mediated
Quality of governance	0,07	0,10	-0,03	45%
Market labor rigidities	-0,09	-0,03	-0,06	67%

5. Conclusions, implications and limitations

The governments of emerging countries intend to support innovation with the goal of helping firms to improve their competitive advantage in the global environment. However, our empirical analyses demonstrated that informal competition has a negative effect on the innovation performance of formal firms. These firms change their behavior due to informal competition (unregistered firms), which capture returns from the formal firms’ innovative efforts by copying. Therefore, formal firms invest less in innovation and governments’ goals are not achieved. It is clear that firms do not progress on their foundations of competitive behavior. However, the negative effect of informal competition is not uniform across companies in different industries, for example, high barriers to entry and high fixed costs act as natural barriers to informal competition. More research on competitive actions to reduce the impact of informal competition is necessary to identify the right approach to help formal firms to thrive in unfriendly competitive landscapes.

5.1. Implications

These results have theoretical and practical implications. From a theoretical point of view, informal competition is a new variable that should be included in the study of innovative performance and strategic behavior in emerging economies, along with quality of governance and labor market rigidities.

From a practical point of view, managers in charge should not overlook the influence of informal competition. Our work confirms that informal competition negatively affects the innovative performance of formal firms. Such competition requires companies to implement activities that allow the configuration of their innovation capabilities. These activities may include investing in technology to differentiate themselves and to maintain competitive advantage in environments of informal competition.

5.2.- Limitations

There are some limitations of our study. First, the secondary sources of information we have used shed light on only one construct of innovation performance. Therefore, future research should consider the development and validation of new quantitative scales to assess model robustness (Becheikh *et al.*, 2006).

Second, this study is context-specific, as it focuses solely on Pacific Alliance (i.e., Chile, Colombia, Mexico, and Peru) firms. Owing to the great differences between the Pacific Alliance and other emerging economies, the generalizability of our conclusions may be limited. Therefore, applicability to other emerging economies must be validated. However, this limitation leads to a series of new research opportunities to investigate our model in other countries and contexts, such as China or other Latin American countries.

Finally, the cross-sectional nature of research into a dynamic concept enables analysis of the organizations' situations at only one specific point in time rather than their overall conduct over a period of time. Future research should consider performing evaluations using panel data analysis.

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Understanding lean & safety projects: analysis of case studies

Maria Crema¹ and Chiara Verbano^{1*}

Abstract: Facing the current socio-economic contingency while guaranteeing a high level of care quality is particularly challenging in the field of healthcare. Through an integrated adoption of emerging managerial solutions, projects that allow organizations to achieve both efficiency and patient safety improvements could be implemented, thereby transposing policy directives towards a safer and more sustainable healthcare system. Therefore, the purpose of this paper is to investigate the features of Lean & Safety (L&S) projects. Three Health Lean Management (HLM) projects that had unexpected patient safety results were selected from the same region. Differences and similarities among the cases have been highlighted and interesting points of evidence have been noted. Despite the fact that the projects were pursuing similar objectives and benefiting from comparable support, the obtained changes had direct impact on patient safety enhancement in the cases that involved the front-office processes, and an indirect impact on patient safety for the L&S project that focused on back-office activities. The implementation processes and the Information and Communication Technologies (ICT) adoption of the cases are also different.

Keywords: healthcare management; Health Lean Management; Clinical Risk Management; Lean & Safety projects; case studies.

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Introduction

In the current macroeconomic situation, healthcare spending is difficult to afford, especially in countries where healthcare is funded partially or completely by government. All expenditures for public services, including healthcare, have been questioned and reduced. At the same time, risks in healthcare have been increasing, and insurance companies are not prepared to provide the right solutions for solving the problems. Nonetheless, quality levels have to be guaranteed not only for obtaining accreditations, but also for complying with challenging ethical issues. In this challenging context, new solutions for service operations and management are required in order to manage healthcare in a more efficient and effective way, thereby reducing healthcare wastes and, at the same time, improving quality of care and patient safety. In several cases, the main obstacles for providing timely and accurate treatments and therapies relate to managerial issues, rather than clinical ones (Bensa et al., 2010). This leads to a lack of synchronization among the actors of the hospital, which causes overcrowding in the emergency department, bed shortage, delays, lack of proper materials and equipment, high costs, waste, errors (both administrative and clinical), excessive workload, and inappropriate care settings, which all negatively affect medical care. Advanced Operations Management models, such as Health Lean Management (HLM) (Womack & Jones, 2003) could be developed in health care settings in order to control process variability and to ensure a strategic alignment in the organization, thereby achieving the competitive advantages defined in the company's strategy (Slack & Lewis, 2002; Hines et al., 2004). Other managerial approaches towards quality improvement, such as Clinical Risk Management (CRM), could also support the increasing of care quality. A methodology that combines HLM and CRM is missing in the literature (Crema & Verbano, 2013), even though it could be a potential solution for obtaining simultaneous

efficiency, effectiveness, and safety enhancements. For this reason, the first studies in the literature have analysed "Lean & Safety" (L&S) projects, which are defined as HLM projects that report patient safety improvements (Crema & Verbano, 2015); however, their features deserve to be deeply investigated. For this reason, the purpose of this paper is to investigate the key managerial and organizational aspects of L&S projects that were developed in the same regional context. In the following section, the theoretical background will be synthesized. Then, the research objective will be explicated and the methodology will be described. Afterward, the results of the analyses will be reported and they will be compared with the literature, and then the conclusions of the paper will be outlined, along with their implications for future research.

Theoretical background

Quality of care can be defined, evaluated, and improved differently, according to the diverse perspectives of the interested stakeholders. One study defined it as "consistently delighting the patient by providing efficacious, effective and efficient healthcare services according to the latest clinical guidelines and standards, which meet patient needs and satisfies providers" (Mosadeghrad, 2013, p.215). The adoption of a single managerial approach does not seem to be enough to simultaneously improve the efficacy, efficiency, and effectiveness of care quality. A poor level of care is often due, not to the laziness and incompetence of the healthcare staff, but rather to systems that are not adequately projected and managed (Reason, 2000). Over time, approaches to quality management have become more proactive in healthcare, as in many other sectors, with a focus on designing and adopting quality systems that aim to reduce the possibility of errors. From the perspective of quality control and assurance, many organizations have implemented Total Quality Management (TQM), where

(1) Department of Management and Engineering, University of Padova, Stradella San Nicola 3, 36100 Vicenza – Italy.

*Corresponding author: chiara.verbano@unipd.it



everybody, at any level of the firm, has to be involved and provide a contribution to quality management, thereby pursuing excellence. However, according to Bohmer and Ferlins (2006), TQM was problematic due to its emphasis on a hierarchical control on the processes that occurred at the top levels of management, and by the extreme rationalization required for every decision. Other approaches were not suitable for a healthcare organization. In particular, Six Sigma was a purely statistical methodology that allowed for a small percentage of errors, but was still unacceptable for healthcare. Traditional quality management initiatives, such as quality control, quality assurance, and Six Sigma, assume a retrospective approach and are not applicable to the entire system, and it seems that they do not lead to a proper reduction and prevention of errors (Herring, 2009; Schwappach, 2011; Berte, 2004). Currently, process management provides the basis for advanced quality management, and the methodologies that have been considered thus far are Business Process Reengineering, Business Process Improvement, Lean Management, and Lean Six Sigma. In particular, Health Lean Management aims to develop a hospital culture that is characterized by increased satisfaction through continuous improvements, in which all employees actively participate in identifying and reducing non-value-adding activities (i.e. waste) (Dahlgaard et al., 2011). The definition of value in healthcare should be linked to the attributes identified for quality of care (Arah et al., 2006; Mosadeghrad, 2013); among these, the most recognized are accessibility, safety, efficiency, equity, and effectiveness. Clinical Risk Management should also be performed starting from the stage of process analysis, according to its system approach. Only in this way it is possible to develop defensive systems and processes to detect, prevent, and avoid errors.

Risk Management in a health care context can be defined as "an organized effort to identify, assess, and reduce, where appropriate, risks to patients, visitors, staff, and organizational assets" (Kavaler & Spiegel, 2003, p.3). CRM is a particular kind of risk management that focuses on clinical processes that directly or indirectly involve patients. It includes the organizational structures, processes, instruments, and activities that enable hospital employees to identify, analyse, contain, and manage risks while providing clinical treatment and patient care (Walshe, 2001; Briner et al., 2010). CRM is often deemed to be the opposite of HLM, because it is focused on identifying and managing risks, rather than eliminating waste and aiming to improve efficiency. The latter is a typical objective of HLM, which aims to eliminate all the waste and all the obstacles that hinder the flow of the analysed process. The focus of the two managerial approaches seems conflicting. However, in a healthcare organization, risks should be managed and prevented and, at the same time, efficiency enhancement is required by diverse external pressures, as aforementioned. To this extent, a methodology that combines HLM and CRM could permit the development of new solutions that would reach multiple objectives. In the literature, L&S projects that focused on patient safety improvement objectives have recently been studied (Crema & Verbano, 2015). However, there are no studies that investigate whether and how L&S projects can lead to patient safety improvements, deliberately pursuing only increases

in efficiency. Although Waring and Bishop (2010) underlined the perplexities and struggles with the translation of lean management practices into the clinical practice, this approach has demonstrated interesting results, mostly in terms of productivity, cost, and timely care delivery, but also in patient care improvement (Toussaint & Berry, 2013; Kollberg et al., 2006). According to McDermott and Venditti (2015), learning about the effectiveness, tools, and practices of lean management in a knowledge-based work environment needs to be increased. As the settings are different from the manufacturing industry, the key elements required for a successful project implementation could vary. In particular, the peculiar characteristics of the knowledge-based work environment with regards to task uncertainty, process invisibility, and architectural ambiguity, are particularly evident in front-office operations, rather than in back-office ones (McDermott & Venditti, 2015; Staats et al., 2011). As emphasized by McDermott and Venditti (2015), specific contextual variables impact the effectiveness of the HLM. Aiming at developing integrated value streams, HLM destroys the professional boundaries within which employees are used being in; in this way, HLM influences the social organization of healthcare (Waring & Bishop, 2010; Joosten et al., 2009). Several authors denoted the paucity of research on human elements of HLM adoption, such as motivation, team working, training, empowerment, and respect for people, which constitute the key factors for the long-term sustainability of any lean programmes (Yang et al., 2012; Hines et al., 2004). For this reason, in the current study, these dimensions are part of the analysis framework, in which operational improvements, outcomes of quality of care, an overall focus on patient safety, impacts on organizational climate, and employee satisfaction have been included. As Joosten et al. (2009) highlighted, all these aspects are rarely considered together and the sociotechnical effects of HLM are neglected, even if HLM should favour employee well-being. In particular, top managers should support HLM in order to develop an environment where collaboration and teamwork permit the achievement of higher performance levels than those achievable by a single person. Hospital managers, at senior and local department levels, should become leaders and facilitators of HLM and they should be sufficiently trained on Lean Thinking, in order to involve and enrol other clinicians and enact changes (Toussaint & Berry, 2013; Waring & Bishop, 2010). As demonstrated by Waring and Bishop (2010), if people are not involved they will often comply with the new procedures, but only in a superficial way, without demonstrating a profound conversion, and they will often return to the previous situation or procedure as soon as possible. Therefore, in the cases analysed in the current research, the support of top management and employee involvement will also be investigated. Moreover, in each phase of the project implementation process, the adopted tools and practices will be identified in order to understand those that can be adopted in an L&S project. In the literature, phases of HLM implementation are suggested by Poksinska (2010). In other cases, the steps of a Root-cause analysis and quality management system, such as PDCA (Plan-Do-Check-Act) are followed (e.g. Amin, 2012). Nevertheless, the implementation process of L&S projects has been never developed, and thus, it will be rebuilt for the following three investigated cases through analysis

of the collected data, responding to the needs of theory, which will guide the expectations of the possible effects of HLM (Shah & Ward, 2003), in particular those of L&S projects.

Objectives and methodology

The purpose of this paper is to compare the main characteristics of L&S projects in different contexts that are affected by the same regional policy that fosters HLM principles. Considering that there are few studies on L&S projects have patient safety enhancement as an objective, HLM projects that reported unexpected safety improvements were selected. In particular, three cases from two hospitals (Alpha and Beta) have been chosen; two of them concern front-office processes,

while the other is focused on back-office processes. The cases come from similar fields of application, which support literal replication (Yin, 2009). After defining a designed research protocol (Saunders et al., 2009; Yin, 2009; Voss et al., 2002) to assure the analysis reliability, a key informant for each hospital was contacted and informed about the research project. From this contact, snowball sampling took place, and the most appropriate people to interview were identified (Harris et al., 2009). In order to assure the research validity, transcripts of the semi-structured interviews were triangulated with data from web sites, reports, internal documentation, and archival records (provided by hospitals or gathered online) (Eisenhardt & Graebner, 2007; Yin, 2009), as reported in Table 1, where the information about the role of the interviews can also be found.

Table 1. Information about data collection

CASE	FIELD OF APPLICATION	TYPE OF HOSPITAL	DATA COLLECTION	
			Interviewees	Other Sources
NV2SI	Emergency dept.	University hospital	Economist lean specialist and a nurse (staff of HLM unit)	Internal documentation and reports about the projects and the HLM experience, documents from the hospital website
SIMED	Internal medicine	University hospital	Two management engineers (HLM unit staff)	Internal documentation and reports about the projects and the HLM experience, documents from the hospital website
PROJECT BETA	Medicine dept.	Hospital of LHU	Economist and management engineer (staff of HLM unit)	Initial meeting with a brief presentation of the project and interventions of the general director, documents from the hospital website

Following a defined research framework (Crema & Verbano, 2015), several features were analysed, including organizational aspects, triggers and objectives of the project, phases followed, activities adopted, tools and techniques, outcomes, and enabling and hindering factors of the project implementation. After the coding and category creation was completed, a uniform variable matrix was developed in order to report the results of the within-case analysis (Miles & Huberman, 1994). The adoption of the same framework permitted the development of three tables with the same format, allowing for a simple comparison of the three cases according to the most relevant variables.

The context of hospital Alpha

Two L&S projects were selected from a hospital (Alpha) that began to adopt HLM in 2012. Alpha is a highly specialized Italian university hospital, a centre of teaching and research, built many years before 2000. With approximately 800 beds and 3,000 employees it provides basic local and specialized services for about 120,000 and 250,000 citizens respectively. The presence of the Medicine Faculty adds additional national and international value to this hospital, especially in relation to the specialized services, which increase the number of potential patients that can access the hospital.

The mission of the hospital is to assure the highest possible level of health care, reconciling research and teaching, and making the organization comparable with the most prestigious university hospitals.

Another aspect of the mission relates to the integration of its structure with the surrounding community in order to guarantee continuity of assistance, and the creation of a climate of internal collaboration that emphasizes the principles of professionals' valorisation and mutual respect. Listening, information, and support are offered to patients in a service that has to be global, personalized, safe, and evidence-based. One of the hospital objectives is to improve the service level through high professionalism and specialization, providing a service that has value for the patient in a safe and comfortable place, and which integrates a high level of clinical assistance with attention to human and relationship aspects. Therefore, the patients are at the centre and pathways have to be developed according to their needs.

The hospital is organized into eight departments, and three separated units of staff work under the hospital director and are in charge of HLM, CRM, and quality. Since the first adoption of HLM, more than 30 projects have been implemented, also thanks to a yearly competition that awards the best projects developed inside the hospital. Moreover, the HLM unit has been providing HLM training courses at different levels (more than 300 people are already trained) in order to create an efficient and collaborative work environment that has to be continuously improved and in which waste is eliminated through adoption of HLM. So far, the realized projects aim mainly to reduce time, costs, movement, space, and defects not directly linked to patients (e.g. errors occurring from reading bad handwriting), but there are also new projects whose objectives aim to reduce inappropriate

services and/or deal with patient satisfaction. However, the HLM unit seems to not be integrated with CRM, which was not involved in the two projects analysed in this research. In addition, the quality unit was not involved even though, among other things, it had to accredit the procedures required for HLM adoption. In general, the quality department uses audits, checklists, and questionnaires to monitor adherence to defined standards, and it supports the definition of assistance pathways. Beginning from quality evaluations performed by the quality department, improvement actions can be requested and carried out by the interested unit. Moreover, the hospital follows the institutional accreditation, ISO 9001, and the accreditation for providing Continuous Medical Education.

The context of hospital Beta

One of the projects was selected from a hospital of a Local Health Unit (LHU) that was built more than 15 years ago. With more than 2,500 employees and approximately 500 beds, it serves a catchment area of approximately 200,000 inhabitants. The LHU intends to guarantee, among others, the principles of:

- centrality and participation of the citizen;
- universality and equal access and Essential Assistance Levels that are managed by a unique healthcare system and financed by public funds;
- institutional subsidiarity and full involvement of local authorities in the policies of health promotion;
- free choice of the place where one is to be cared for;
- professional evaluation of employees.

In particular, reflecting the objectives of its regional authority, it aims to improve the healthcare and the well-being of the population, satisfaction and participation of citizens, and efficiency and sustainability of the system. It has also started to redefine its assistance settings according to the intensity of a care-based model, which has involved reorganizing the surgery and medical areas, developing a model of assistance continuity through integration of the hospital with the other healthcare organizations distributed in the territory, and defining the roles of medical tutor and referent. This LHU has reported excellent results in terms of quality of the healthcare processes, especially in demonstrating the existence of adequate diagnostic and therapeutic pathways shared between emergency department and inpatient wards. Moreover, due to integration between the hospital and the other healthcare organizations in the territory, the hospitalization rate for this LHU is lower than the regional mean. The management of admissions and discharges is evaluated using measurement indicators such as hospitalization rate, discharge rate, and percentage of hospitalizations of over 30 days.

The above-mentioned results were obtained in an organizational structure that includes three units in staff who work under the general hospital director: the quality and accreditation unit, the CRM unit, and the HLM unit. There is no integration among these units, even though the clinical risk manager has required at least some integration between CRM and the quality and accreditation unit. The latter

unit deals with all the activities concerning institutional accreditation, maintenance of the quality book, and procedures regarding the general management. This LHU is also strongly committed to implementing procedures for reducing clinical risks. The CRM unit executes audits (e.g. for adverse events with the highest impact, frequency, and difficulty in being detected), verifies the adoption of good practices, assures the application of regional and national recommendations, and oversees the encouragement of preventive actions and monitoring of activities. Furthermore, it draws up a plan, a budget, and a final report. In addition to checking the execution of best practices, monitoring compliance with protocols and procedures or guidelines, and application of the ministerial recommendations, the hospital Beta uses reference standards and compares the results with the available literature. Beta analyses claims and incidents, studies errors, adopts incident reporting including the Mortality & Morbidity review, structures the registration of information for the patient, obtains consent, performs auto-evaluation, monitors the medical records, manages litigation, and utilizes check lists for the operating room.

Since 2012, there has been a simply structured team that manages HLM projects in the LHU.

The key strategic aspects of the two hospitals are reported in Table 2

Table 2. Key strategic aspects of the interested hospitals

key strategic aspects	Alpha	Beta
Alignment with customer needs and expectations/ personalization/ value for customer	X	X
Offer of comprehensive, personalized, safe and evidence-based healthcare	X	
Continuity of care	X	
Listening, informing and comforting patients and family / considering relational and human aspects	X	X
Being financially sustainable/ resource cheapness/ efficient		X
Development of a work environment that favour operators (safe and comfortable environment)	X	
Development of a climate of internal collaboration	X	
Reduction of the assistance variability		X

Results from the three case studies

Project Alpha 1

The first project selected in Alpha was implemented in the emergency department.

The emergency service manages about 50,000 patients per year. Thanks to regional funds, this project was implemented in order to improve patient flow and reduce waiting times, thereby enhancing patient service. The regional authority was a financial and technical supporter of this project, and therefore no external consultants were included on the project team, which consisted of people from the HLM unit who were already trained. Another relevant support

came from the hospital director, who believes in HLM and has experience with this new managerial approach. The project team consisted of members of the HLM unit, members of the management audit, a medical referent, an operator, and a member from the data processing centre. As is detailed in Table 2, after a planning phase, a training course of four hours was provided to all the employees of the emergency department. Other hospital staff and patients were informed through an article in a periodical journal and through leaflets distributed inside the hospital.

Afterwards, patient processes were identified and analysed, and, in particular, critical issues, value added, and no-value-added activities were recognized. Thus, HLM tools were adopted, including one-piece flow, visual management, checklist, triangulation, fast track, facilitated paths, 5S, layout change, and organization of workstations for the process optimization. Feedback was gathered from questionnaires that were sent to the operators, and also through economic indicators, indicators related to the organizational system and to the "muda", indicators from MeS (Management and healthcare – "Management e Sanità": an Italian laboratory) that were collected in a managerial dashboard. Feedback from patients was obtained through the MeS questionnaire. Efficiency increase was reported, and, indirectly, the care appropriateness was improved through the reduction of exams executed more than one time. Moreover, since they were spending less time in the emergency department, patients were less exposed to risk of infection. Without using sophisticated ICT or other additional resources, the work climate improved, spreading among the operators a feeling of trust, involvement, and freedom to express their own opinions. Some of the aspects that were recognized as facilitating the implementation of the project were the support of the top management, the continuous presence of the team in the field, and the utmost respect for the operators' experience by the HLM team. These factors permitted the realization of the project despite the low level of HLM training of the operators and the difficulties surrounding information exchange, which occur mostly due mostly to the changing work shifts, the absence of data reporting, the institutional bureaucracy, and the mind-set of physicians that is still linked to their traditional way of working. In order to guarantee the sustainability and continuity of HLM adoption, in addition to time spent in the ward and the organization of meetings with people from other departments, training was considered to be fundamental, since it extends the HLM culture.

Project Alpha 2

Some of the interviewees considered this project as a continuation of the previous one. It was realized in internal medicine due to the input of regional funds. Like in the previous case, external consultancy was not deemed useful due to the existence of internal HLM competences. The team was constituted of nine people who were involved with the staff of the HLM unit, two members of the ward, the head nurse, and a nurse. Part of the team was, at the beginning, engaged with the project on a full-time basis. Training was provided first to the team members and then to all the people of the ward through an initial training course and periodical meetings. The latter were organized at the beginning to inform and train the referents and operators, during

the project to deal with individual issues and to obtain opinions and suggestions from operators, and at the end to monitor and communicate the results. As is noted in Table 3, the objectives of the project included optimization of the process flow in order to reduce the average length of stay and consequently the costs, the improvement of communication between physicians and nurses, and the achievement of an image of high quality. These objectives were pursued through adopting different HLM tools. After a planning phase and the identification and analysis of the process of a typical patient, the two members of the first medicine area that was involved drew the Value Stream Map with the HLM staff, in order to better understand the context in which they worked.

Afterward, the participants from the other two areas that comprise internal medicine were involved in order to define the legend and the panel to be used for planning the patient service. After informing all the ward staff and after simulations, the defined tools were adopted by operators. Visual management, one-piece flow, 5S, check list, fast track and Heijunka were adopted, in addition to a plan for every patient. Through these HLM tools, efficiency improvements were obtained. The achieved results are monitored monthly, measuring the mean of the length of stay and its statistical dispersion, the use of the discharge room, and other indicators for admissions, discharges, and the planned activities, as reported in Table 3. In particular, because of this project, it was possible to reduce the average length of stay, to care for patients in a shorter time frame, and to enhance the management of discharges. One of the most significant results is in relation to the reduction of potentially inappropriate DRGs (Diagnosis-Related Groups) which, according to Fetter et al. (1980), permit the classification and management of hospital cases based on diversifying variables. A better, well-organized environment has led to decreased downtime and fewer useless complications and organizational causes that delay the discharges. Moreover, operators now work more calmly, thereby indirectly reducing the risk of erring. In the operator survey, briefing was considered useful and communication among practitioners seemed improved. Moreover, now operators share the patient process and feel themselves to be an active part of the care pathway.

These outcomes were obtained with no additional resources and with only a few organizational changes, such as the briefings managed by the head nurse. One of the project enabling factors was the continuous presence of HLM team on the field and the team's availability, listening efforts, and ability to collaborate with operators without interfering with their daily work, and their leaving the final decision to the ward. Other key factors for the success of the project were the training course, the sharing with the organization, the support of the top management, and the adoption of a clear concept of planning. Closed mind-sets and resistance to change, lack of support from the head physician, lack of information/data, and of the use of information systems were recognized as hindering factors.

In order to sustain HLM adoption, training is considered fundamental for extending the right culture, in particular including "cascade training" (Jacobs, 2002). Moreover, it is important to transmit the

following concept: lean valorises the operator and the support of the HLM team serves to guarantee the continuity of the project.

Project Beta

Different external experts have provided HLM training courses to the staff of hospital Beta, constituted by people with diverse roles, such as physicians, nurses, directors. Therefore, no external consultants were involved in the examined project. For some years, the LHU has been working on a unique large project, with the intention of integrating different productive platforms. The first single project activated in the medicine department began in a context of economic and financial resource reduction, in which the community requested that the department guarantee at least the same level of service for the patients and adopt new tools for process optimization and for hospital performance evaluation. The project started with the aim of optimizing the patient flow, guaranteeing a continuous flow and reducing process variability due to organizational inefficiencies, and reducing the average length of stay. Favoured also by the opening of the hospital in a new place and the reorganization of services and revision of internal processes, other project objectives were: elimination of local sub-optimizations through process governance with system logics, involvement of all the staff, multidisciplinary and multi professional integration, simplification of processes/activities, and efficient and appropriate use of resources.

The project was entrusted to a new unit (HLM unit) that was dedicated to it on a full-time basis. The hospital director, who believes in HLM, supported the project, provided the strategic direction, and made all the necessary resources available. The first phase of the project realization was the demand analysis. As detailed in Table 4, after the study of the patient process, the critical issues were identified and analysed, including, for instance, the information exchange and the practitioners' agenda. The priority of interventions was defined with the hospital director and a testing phase was executed, simulating the sought screen on paper. People with different roles and diverse backgrounds were involved, first of all through a training lesson at the beginning of the project, followed by ongoing coaching on the field realized through close contact with the HLM team, especially during the first four days. Using the software ADT (Admission, Discharge, Transaction), beds are now managed through computerized visual management. Results are also continuously monitored through a dashboard with indicators, information about bed occupancy, use rates, waiting and response times, residual production capacity, system of process alerts, real-time representation of the work plans, and average length of stay. The latter has moved from -0.17 to -0.52 days in respect to the previous year. The implemented system allows for more transparency. Before the project implementation, there were often no available beds at the time of a patient's admission, and now there are 10-15 vacant beds. Moreover, the problem analysis has been improved and duplications reduced, as the nurse does not have to transcribe the patient data more than one time, thereby decreasing time for this activity and limiting the potential for error. Everything is computerized, thus it is not necessary for a person to physically be in a place, and phone calls are not required. From all of this, in

addition to creating simplification from a bureaucratic and administrative point of view, there is a simplification and a learning process of many activities: the inpatient unit is managed in the emergency department by a unique manager of emergency admissions (a physician), discharges are performed in "3 clicks" and beds are managed in "2 clicks". Furthermore, employees have direct access to the area of labels and bracelets printing. Consequently, the patient flow is also more rapid. With only a few organizational changes, transparency has increased and collaboration between operators and the HLM team has been introduced.

Moreover, even if not all the staff have accepted the changes, those who took part actively in the project are now satisfied with it. The elements that enabled the project include the use of ADT, which was already known in the hospital, the support of the top management, a system view of the interventions, the numerous contacts of the HLM team that included operators with a strong sense of motivation and determination. Nevertheless, there were also hindering factors. The first one was the resistance to change, as "it is difficult to change the organizational behaviour" (according to an interviewee). There are professionals who still struggle to accept the changes, especially those who have lost part of their control. Moreover, HLM procedures are still not properly defined and there are not shared accreditation standards to be followed for assuring the development of a quality system based on HLM. Therefore, defining HLM standards and procedures inside the hospital by the quality unit is not always easy and foregone.

However, the examined project is the first of a series of planned projects that will be realized in this LHU. The integration of all the projects using a unique software package is a way of guaranteeing the continuity and sustainability of HLM. Other tools and practices to be adopted in relation to this are: training courses, contacts with operators, continuous refreshes and recalls of HLM information, the execution of cyclic activities thanks to PDCA, but mostly the motivation of the team in charge of the realization of HLM projects.

Discussion of the results

All the three analysed projects were supported by the regional authority and they pursued efficiency objectives. The emphasis of the interested regional authority on HLM adoption is evident and it emerges from the analysis of its Regional Health Plan, as well as from the analysed projects and from the strategic direction of their hospitals that are working to put into practice the transposed regional directives. Other similar features have to be emphasized. First of all, the projects demonstrate analogous hospital organizational characteristics. In particular, a unit dedicated to HLM exists in both of the hospitals and CRM is not involved in the projects, except for at the end of the project Beta, where the clinical risk manager was consulted after the reporting of the first results. The role of the HLM unit was fundamental for the implementation of these projects. The staff of those units included people without a medical background. Consistent with McDermott and Venditti (2015), the involvement of people who are not involved on a daily basis with the clinical activities can be crucial, in order to design the clinical activities according to a process logic and

then to identify problems. In addition to the commitment and the availability of the HLM team and the employee participation, the support of the top management was crucial. As has been demonstrated by some scholars who study quality management and HLM (Dickson et al., 2009; Lagroesen et al., 2007), leadership and commitment of managers are required to achieve effectiveness and efficiency improvements. In all the analysed cases, the hospital director had previous HLM experience and he strongly believed in it. Thanks to the existing internal competences of HLM and the regional community, which provides also technical support if requested, no external consultants were required for the project's success. In addition to similar efficiency objectives, in the second and the third cases there is a need to improve the communication between people with different roles in the hospital. In these projects, the project team intended also to improve the hospital's image and the focus on patient needs. A challenging change management was ascertained in all the projects. As emphasized by McDermott & Venditti (2015), in a knowledge-based work environment, employees are often afraid of cost-cutting and efficiency increases, an attitude that worsens patient care and safety. For this reason, training courses, staff involvement and all the initiatives to diffuse the culture of quality improvement should be encouraged inside the hospital. However, similar results were obtained in terms of efficiency, internal collaboration, and communication improvements, especially for the second and third cases. In particular, trust in the HLM unit was increased after the realization of the projects.

On the contrary, there are different characteristics regarding the implementation process, the ICT adoption, and the processes to be improved. As concerns the latter, the processes were for the front-office in the first two cases, as they were visible to patients, while in the last project the attention was focused on the flows of material and patient information, and on employees' well-being, which indirectly impacts patient care. In particular, as noted by McDermott & Venditti (2015), by reducing time wastage, hospital staff have more time to be dedicated to patients. However, the projects report dissimilar results concerning patient safety; for instance, only in the first two projects were reduction of infection risks and potentially inappropriate DRGs declared. In the third case, the reduction of errors was mostly in relation to the transcription of patient data and the simplification of the practitioner work, issues that have an indirect impact on patient safety. Considering the factors categorized by Vincent (1998), in the analysed cases, errors can be prevented by removing any issues that relate to: team factors (especially concerning verbal and written communication), task factors (in particular for task design), work environment (mainly for administrative and managerial support), and organizational and management factors (concerning financial resources and constraints, organizational structure, policy standards, and goals). In the investigated cases, adopting HLM permitted the hospitals to improve these factors that affect the clinical practice. At the same time, the latter is influenced also by the economic and regulatory context, which in the examined region fosters HLM adoption.

Considering the implementation process, there are similar phases, even if they are positioned in different sequences. For example, the

planning and the information and training phases were postponed in the third case, but they were also executed in the others. Demand analysis and definition of intervention priorities were recognized only in the project Beta, while the investigated flow was identified and mapped at the beginning of the project implementation in all three cases. In terms of ICT support, while in project Beta an electronic platform was designed, the interviewees of the second case claimed a need for information systems to support the realization of L&S projects. Looking at the interesting results of the first two projects, the ICT adoption seems to be not fundamental for assuring project success. However, the potentialities of the third case are evident, considering the strategic aim, the final involvement of CRM and the ICT support, and they will be concrete when more attention is dedicated to the front-office processes: only through the improvement of them, it is possible to achieve direct patient safety improvements.

Conclusion

Even if some of the strategic aspects of the interested hospitals seem to foster the adoption of HLM, the approach adopted for continuous improvement could not still be defined an organization-wide philosophy; rather, according to the research of Øvretveit (2000), so far it has been implemented only as a set of methods for problem solving and process improving. However, the outcomes obtained in this study are significant and they have provoked a diffusion of HLM in the interested hospitals, in addition to improving the work conditions, and increasing staff communication and collaboration. In these projects, the presence of an HLM unit inside the hospital was considered fundamental for the continuity of L&S projects implementation.

The investigated cases provide a contribution to the academic and managerial literature, reporting the organizational and managerial aspects of three L&S projects. The sociotechnical elements have been analysed, together with the performance achieved in terms of quality improvement. The obtained results should be monitored in the future. Furthermore, in order to raise the generalizability of the reported study, the investigated L&S projects should be compared with other cases developed in diverse hospitals, settings, and regions with a different Regional Health Plan. It could be also interesting to confront the characteristics of the cases with those of unsuccessful projects, looking at the problems that hinder the continuity of the project and the achievement of the defined objectives. The analysed L&S projects constitute first experiences implemented in hospitals not used to HLM. However, they represent the first empirical experimentation of a research stream that aims to understand how, by adopting HLM, safety improvement can be obtained, and how a synergic methodology, which combines elements of HLM and CRM, can be developed to simultaneously enhance different attributes of quality of care.

Biographical notes

Maria Crema is Postdoctoral research fellow at Department of Management and Engineering of the University of Padova. Her main research areas are: innovation management and healthcare management.

Chiara Verbano is Associate Professor of Management and Engineering Economics at the Department of Management and Engineering of the University of Padova. Her major research interests are the fields of risk management and innovation management.

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Appendix: key characteristics of each project examined

Fig. 1 Key characteristics of the “Lean & Safety” project Alpha 1.

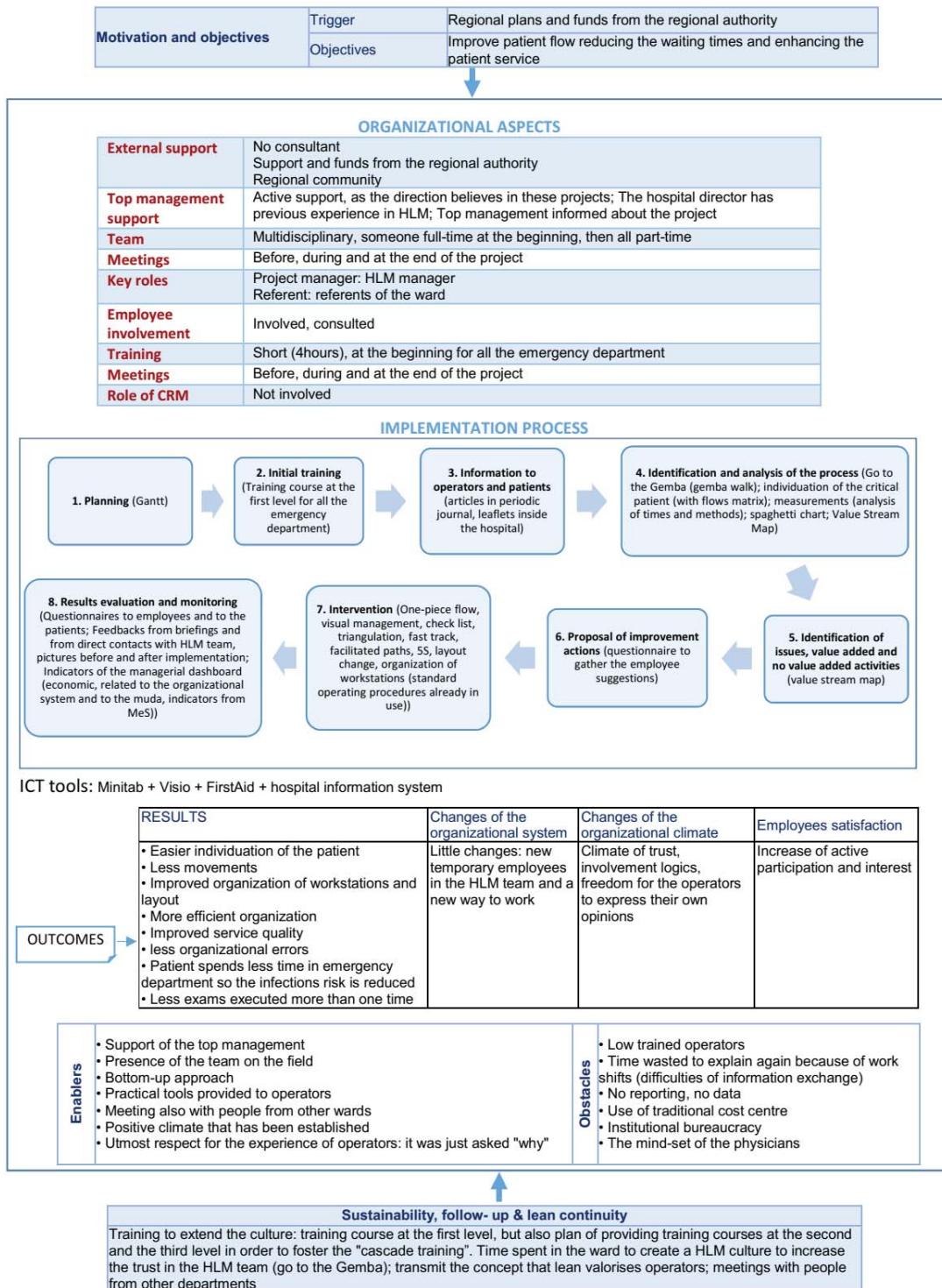


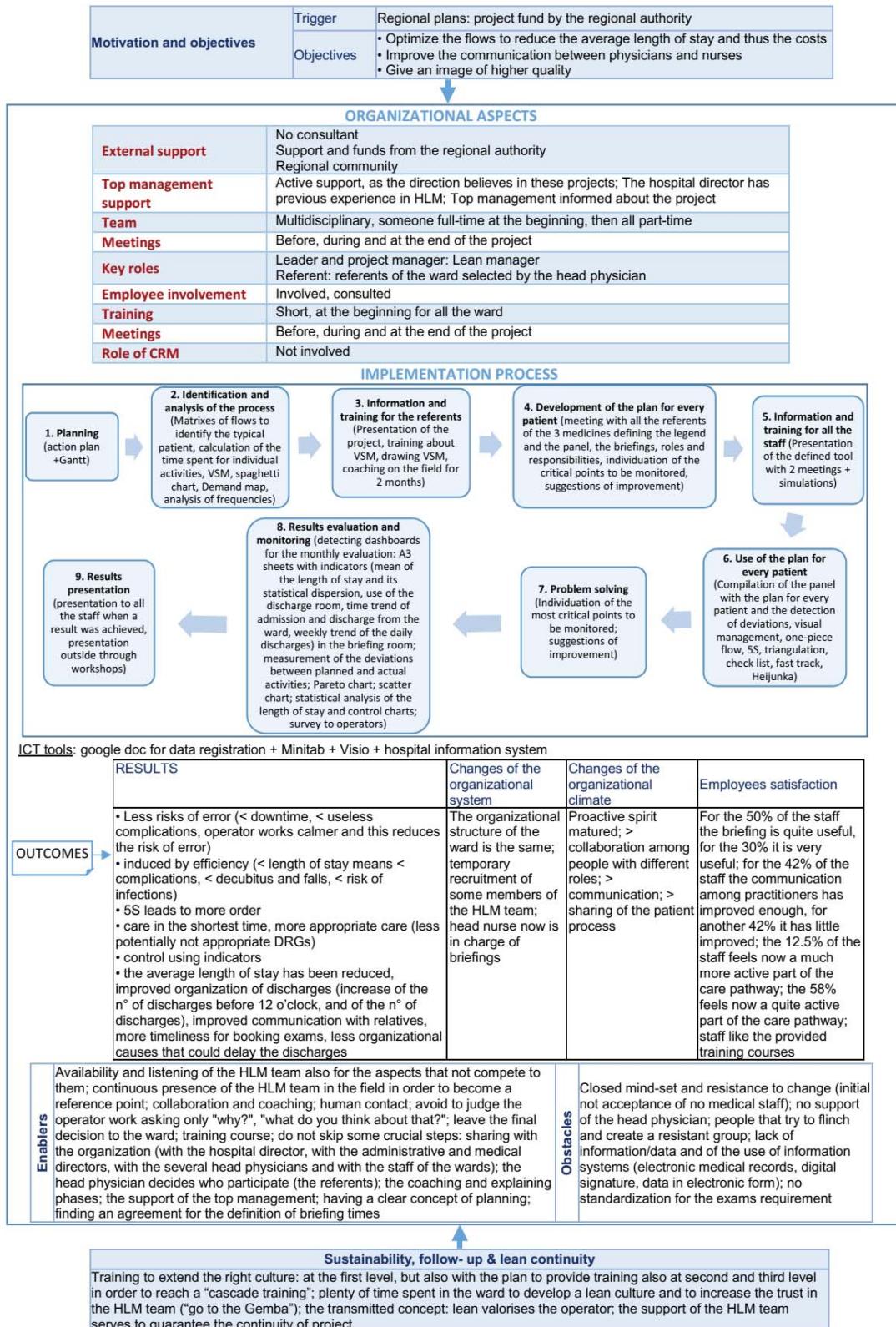
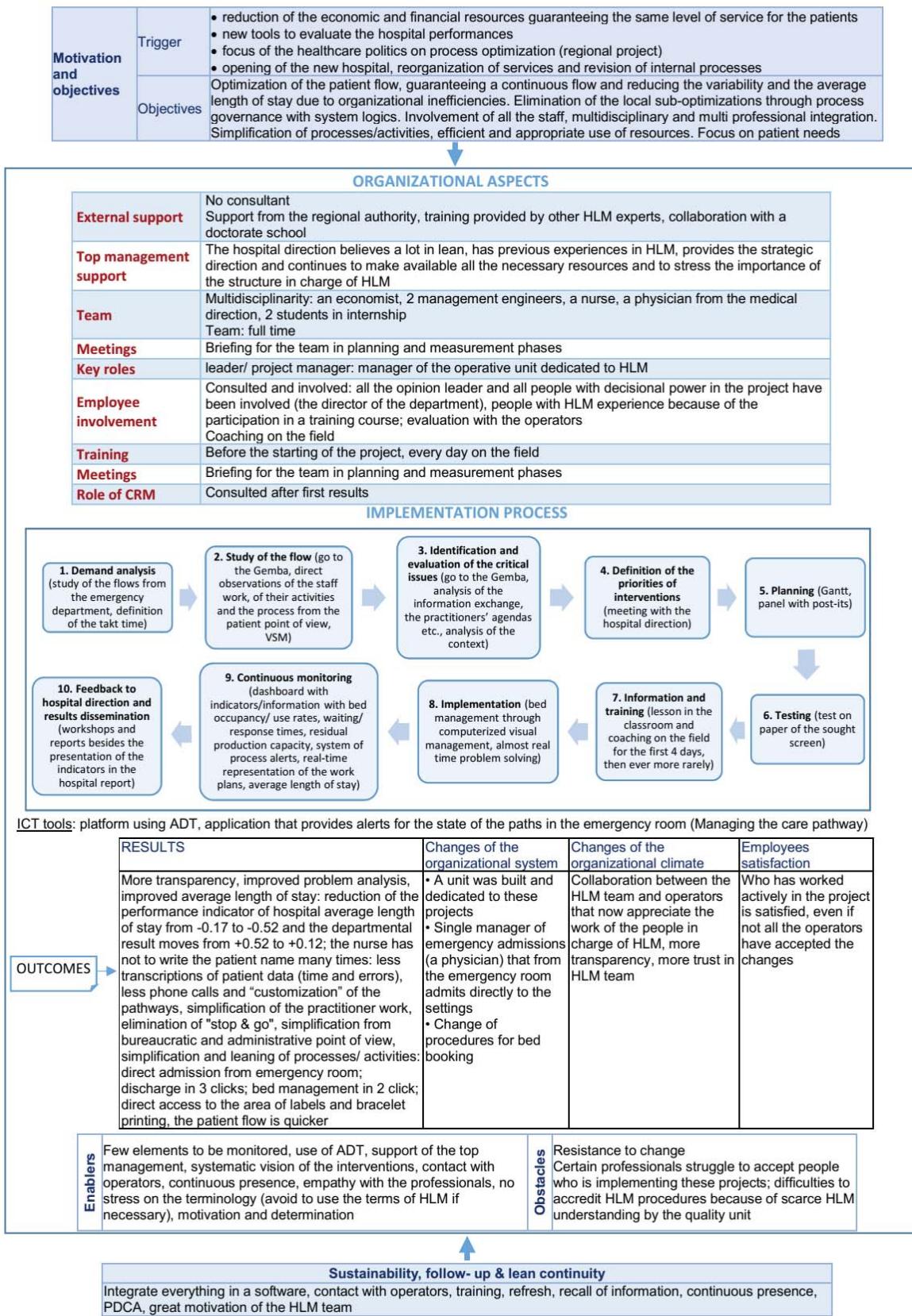
Fig. 2 Key characteristics of the “Lean & Safety” project Alpha 2.

Fig. 3 Key characteristics of the “Lean & Safety” project Beta.



Developing technology pushed breakthroughs: an empirical study

Jari Sarja^{1*}, Samuli Saukkonen¹, Kari Liukkunen¹, Elina Annanperä¹

Abstract: Developing a technology push product that brings real novelty to the market is difficult, risky and costly. This case study analyzes success factors defined by the literature. True industrial cases, representing Finnish ICT firms in their early phase after a successful market entry, were researched for the success factor analysis. The whole set of the previously introduced success factors were variably supported, and three new factors arose. Because the technology pushed development processes are risky with high failure rates, the validated success factors are valuable knowledge for the developments intensive firm's management.

Keywords: New Product Development; Technology Push; ICT; Start-up.

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Introduction

Developing new and successful products is necessary for all development-intensive firms (e.g., Balachandra & Friar, 1997; Cooper, 1994; Ernst, 2002). Because new product projects are risky and failure rates are high, it is obvious that the management of firms must be interested in those factors that lead to breakthrough innovations. In practice, success factors are defined to mean a limited number of elements or areas where "things must go right" for the business to flourish. These areas must be constantly and carefully monitored by the management, and they are necessary for an organization or project to achieve its goals (Rockart, 1979).

Previous literature on the New Product Development (NPD) discipline has presented conflicting findings regarding two key approaches, namely technology push (TP) and market pull (MP) (e.g., Herstatt & Lettl, 2004; Samli & Weber, 2000). The TP school swears that innovation is driven by internal or external research, while the MP school says that innovation is driven by the users' needs (Chau & Tam, 2000). In past, most literature stresses that emphasis should be on MP (e.g., by Myers & Marquis, 1969; Langrish et al., 1972; Rothwell et al., 1974; Utterback, 1974). Both concepts have their benefits and weaknesses. The market researched MP concept ensures, theoretically speaking, commercial success, but the products are incremental ones, ensured versions of current products, aka line extensions (Samli & Weber, 2000). The TP concept does not guarantee a market demand, but the products have a high level of novelty. Currently, the literature encourages combining both approaches in NPD projects (e.g., Ulrich & Eppinger, 2008).

Sarja (2014, 2015) has studied why some technology pushed ICT projects have succeeded. As an example, he mentions Apple's and Basecamp's products and Facebook. After a broad literature review (2015) including a few meta-analyses with almost 100 peer-reviewed papers and cases, he conducted a handful of success factors for closer examination. Because many of them were nebulous in nature, the explanatory definitions were given, and the survey instrument framework was defined. The framework compiled four different categories:

market, product, management and organization [related] success factors. The theories behind the factors (e.g. Ansoff model, generic development process, alternative study), and the success factors are introduced in concept level in Sarja's research paper (2015b).

The aim of this study is to validate empirically the success factors of technology push products in the ICT industry. The goal of the validation is to find out the relevance of the introduced success factors and possibly define new ones. The validation is executed by an empirical study with semi-structured company interviews.

This paper proceeds as follows. At first, the research method and process are described. The following section provides the results of the empirical study. Here the authors address the validity of success factors in all four categories. We conclude by discussing the impact of success factors on future research and industrial NPD projects.

Research approach

We examined whether the TP success factors discussed above are relevant ones, whether any new factors have arisen during the exploration, and whether some of the factors are aimless. We also wanted to examine if some factors could be focused differently. We mapped our study as an exploratory and inductive case study. With this in mind, we chose the qualitative case study method. As a research method, the case study has been a common research method in many science disciplines. Yin (2009, p. 4) states that the case study method allows investigators to retain holistic and meaningful characteristics of real-life events, including organizational and managerial processes, such as in our study. In the case study method, the theory and data will be compared and iterated toward a theory that closely fits the data (Eisenhardt, 1989).

For evaluating discussed TP success factors we have followed Eisenhardt's (1989) widely cited theory building process (from case study research) where appropriate. In this way, we have sought to maximize the novelty, testability and empirical validity of the study.

(1) Department of Information Processing Science, University of Oulu, Pentti Kaiteran katu 1, FI-90570, Oulu, Finland.

*Corresponding author: jari.sarja@oulu.fi



Also, the four tests of trustworthiness by Yin (2009, pp. 40) have been taken into consideration.

The data collection was conducted using semi-structured interviews (e.g. Myers & Newman, 2007). The case selection was done intentionally (Runeson & Höst, 2009) from theory building point of view instead of random sampling (Eisenhardt, 1989). The informants represent different sizes of Finnish ICT start-up firms with breakthrough products. Another common factor of interviewees is a long new product development (NPD) background either in their own business or as an employee. The number of cases was not planned at the starting phase, but the theoretical saturation (Glaser and Strauss, 1967) as well as minimization of the incremental improvement (Eisenhardt, 1989) of the study was reached. It was observable after the first few cases that the results of the interview were repeating themselves. In the end, the study was conducted with nine cases. Nine firms in the study were viable. It was supported well by the principle of Eisenhardt (1989): a number of cases between 4 and 10 usually works well.

The interviewees were typically founders of their own businesses, and the firms were typically established around a technology pushed product idea. Two interviewees were selected to leading positions due their experience, and they were also granted with a partnership. Half of the interviewees used a CEO title, and the rest of them were chosen for an expert task and given their title accordingly. The position of informant G is named as a “Founder” instead of his personal original title in order to protect his identity and linking to specific answers. The age distribution of interviewees was 28 to 56 years (mean = 42 years, median = 46 years). As mentioned before, most of them had long years of experience in NPD activities before starting to work on their own innovations. The entrepreneurship experience is mainly a suggestive variable because informants had different kinds of backgrounds: serial entrepreneurs, NPD experience as a worker, and entrepreneurial experience without NPD activities such as trading. Tables 1 and 2 describe the nine cases used in the study. The tables can be read in such a way that interviewee A represents company A, and so forth.

Table 1. Descriptions of the Informants.

Interviewee	Position	Founder	Partner	NPD experience (years)	Entrepreneurship experience (years)
A	CEO	X		16	3
B	R&D manager		X	33	6
C	CEO	X		1	10
D	CEO	X		17	3
E	CEO		X	14	0
F	Service director	X		10	8
G	Founder	X		16	12
H	CTO	X		28	3
I	CEO	X		6	3

Five TP cases were hardware products, and four cases were software products. The business model in three cases was to sell to distributors and/or company users as well as straight to final users (A, C, I). It is noteworthy that regardless of the business model, in eight cases the final user could also be a private person. In other words, the product could be purchased by a distributor (A, C, I) or by a service provider (D, E, F, G, H). In one case, the product was only for business use and was sold straight to the business customer (B).

The 1.5 – 2 hour interviews were taped for transcription, and the content analysis method was used for analyzing the results. The interview questions were based on the study of Sarja (2014) who had a similar approach. We further defined the question list by adding more detailed background questions, and we also added one open question to the end of the list. The definitive question list is presented in Appendix 1.

Results

In this chapter, the TP success factors are discussed taking into account the case study results. Sarja (2014, 2015, 2015b) introduced 13 TP success factors in four separate categories. These relatively theoretical success factors are based on extensive literature review and form the basis for the study. The success factors are introduced in Table 3 and in concept level in Sarja's research paper (2015b).

Table 2. Descriptions of the TP Products in Cases.

Company	HW/SW	B2C	B2B
A	HW	X	X
B	HW		X
C	HW	X	X
D	SW		X
E	SW		X
F	SW		X
G	SW		X
H	HW		X
I	HW	X	X

Table 3. TP Key Factors.

Market related	Product related	Management related	Organization related
MP methods used	TP for difficult adopted	Management support	Project team skills
Focus on customer needs	Life cycle	Degree of funding	Networking
Market development	Fill an unrecognized need		
Alternative study	Technological advantages		
Adoption time and technophobia			

Market-related success factors

MP methods used can be seen as an umbrella term for all market related success factors (Sarja, 2015b). In this study, the author defined two aspects of this factor: the development process and customer involvement. More precisely, customer involvement should be an early part of the development process (e.g. Ulrich & Eppinger, 2008) regardless of the type of innovative new product (MP or TP).

Seven informants (out of nine, not mentioned in further text) stated they did not have any kind of defined and/or documented development process in the beginning. Two other informants said they used lean and agile methods (they did not specify the methods) at the beginning. Six informants stated that the defined development process had been put into operation or that process development was ongoing simultaneously with product development. Three informants did not see the formal development process as an important issue.

"We didn't have any defined development process. But we hired a guy who knew how the [developing] process should be implemented."

"No, we didn't have We just went ahead like a train and tackled issues as they existed."

"No we hadn't. A few years later we started to think processes when the number of employees was increased."

However, from a customer involvement point of view, the relations were contrary; six informants said they tried to find customers and introduced the product plan to the potential customers before or in the beginning of the development process. One informant had identified afterwards that this should have been done, and two of them stated that the customers found their product without any activities from their side. All nine informants stated they had made customers aware during the development process, in one way or another. The depth of cooperation varied from information sharing to gathering customer feedback and development ideas. One informant told about their learning process; they were serving the wrong customer, a retailer instead of the end user. All informants explained that the marketing aspect had been involved in the development process from the beginning.

"We started by trying to find customers. In fact, we established our business just because we found the lead customer."

"Yes. We started to sell our product in the beginning of xxxx (year) even though the product was not ready until the end of xxxx."

"Well, okay. The whole thing started by finding the customer need, and because I already knew some customers with that problem."

"We introduced our idea and then we refined that with the customer."
"Yes. We have had a pilot customer for every product we have developed. My opinion is that you don't discover everything in the lab. There must be weight to different features. It looks different from the user's perspective."

"It was a one-man company at that time. I did everything by myself but marketing aspects were involved. I did not sell only products but rather benefits."

The factor *focus on customer needs* included two interests; customer segmentation and defining customer needs. Five informants said they had segmented customers clearly in the beginning of the development process. Three informants stated they did that partly, meaning that they noticed afterwards that the rigor of the study was not at the required level. Perhaps because of the general nature of the consumer product, one informant said they had not done any kind of customer segmentation.

"Yes, in the beginning we thought about what our target segment is. Later on it turned topsy-turvy...it wasn't where we go now. Money talks, the market is where it comes."

Seven informants explained that they tried to clarify the exact customer needs in the beginning. Also, three of those were personally operating in a customer segment before establishing their own business. Two respondents explained they did that in a later phase or asked only about the desired features. All nine informants stated that the customer needs were documented in various forms and formalities: e-mails, sketch papers, back logs, use case documents, CRM (Customer Relationship Management) systems and reports. Five informants told that the customer needs documentation were also updated during the development process.

"Yes, we have written them as they come along. But it was not a process type operation. We were such a small team at that time, so the information was conveyed anyway. The tool has been case specific; email, CRM, or some other one."

All nine informants mentioned they had analyzed and interpreted the customer need documentation. One result of the analyses had been typically a different kind of wish or feature which were mainly weighted and organized in order of importance. One informant said they did not reorganize based on the analysis because they had started to collect feedback too late and the product was already ready. In one case, the whole customer segment was omitted after the analysis due to the lack of resources. In some cases, the requested features were implemented without any further analysis, but in other cases, the customer required a solution that was too customer-specific. The weighting of customer needs occurred between asked-for features and the proposal of improvements, and in some cases, it was calculated according to the number of customer requirements.

"We have a very long wish list. We have to examine it very carefully and prioritize them and draw up a road map how to continue."

"We selected the most important use cases and they have to be in the next release. Any things outside use case list don't proceed."

"There was not any extraordinary systematics, but clearly according to how many customers felt it was relevant. Does it bring any new market or is it just incremental development."

"All our customers hoped for a xxxx-function, so we prioritized that initiative higher."

"All implemented things are not coming as requests, but also as customer problems."

Market development, in the sense of a success factor, describes recognized firm growth strategy opportunities (Ansoff, 1957), and it must be developed, instructed or prepared concurrently with the product design (Bishop & Magleby, 2004). However, according to current understanding, based on practical industrial experience and the interviews of this study, the focus of market development should be stressed in the beginning of the development process or even before that (instead of as a concurrent activity). In many cases, the interviewees said that the idea was sold to the customer in advance. As an outcome of this, the entrepreneurs received letters of intent, pre-orders and even money payments.

"We even got the letter of intent before we started the development work."

"We did some pre-sales. The first batch we will produce has already paid itself. During that 30 days period I told the world that this kind of device is coming to the market, 600 people ordered and paid it in advance."

"The whole beta series was sold via web store, and we realized that there is a demand."

Comparing the answers of the interviews to the traditional Ansoff model¹, all informants had recognized the type of market they tried to reach. Six of them defined that the target market was new for them and three of them aimed at an existing market. It seems that the informants were carefully familiarized with the target market, and most of them were even divided segments to the smaller pieces. Markets were also divided geographically. In six cases, the target market had changed during the development process and updates had been made accordingly.

"We build a kind of internal 'segmenting automat'. It happened via our price setting. 5% of our customers are too big for us, and 25% are too small and they are not able to pay our monthly charge."

At the beginning of the product development process, *alternative study* is a sub-process similar to customer need identification (Sarja, 2015b). The focus of the alternative study is to not only recognize product types created by competitors but also to create an alternative solution for addressing customer needs (Lewitt, 1960; Peteraf & Bergen, 2003). In this study, the competitor field was deeply examined. All informants explained they had studied alternative solutions in terms of products in the market and in terms of customer needs to be served. In other words, they had mapped direct competitors and their products as well as indirect competitors serving the same customer field and at least partly solving the same problems.

"Yes, we studied all competitors' solutions. We even became acquainted with our customers' old devices."

"Because of our previous experiences our vision of alternative solutions was clear, we knew them precisely and we knew what was still missing in the market."

"Naturally we have studied these alternative solutions...and did they destroy our product idea? But we concluded that never in this life."

Five informants said the alternative study was updated during the product development process, and the rest states there had not been a need for that because the existing solutions had not changed. The document forms of the study varied in the same way as customer needs identification.

Adoption time means a time period when the customer adopts new products or ideas. The more novel a new product is, the longer the adoption time (e.g. Samli & Weber, 2000). The concept of technophobia is a combination of technology-based new product anxiety and negative attitude. Research communities emphasize a commercial motivation for continued user-friendliness in hardware and software solutions for reducing adoption time and technophobia (Brosnan, 1998; Davis, 1989). Different technology acceptance models are developed for supporting that. The simplified message of acceptance models is that the user must feel that an application is useful (perceived usefulness) and easy to use (perceived ease of use) (Sarja, 2015b).

(1) Ansoff model is a commonly used product-market growth strategy. It is thoroughly presented e.g. by Ansoff (1957) and Pleshko & Heiens (2008), and the applicable part summarized by Sarja (2015b).

In our study, we examined whether the case firms considered the adoption time during the development process. Two informants told they did not consider the adoption time at all. Interestingly, both of those case firms were one-man companies at the time their products came to market. Another similarity was that in both cases, the market entry was smooth and did not require much special effort. The rest of the seven informants were able to explain their actions for reducing adoption time. Two of those informants stated that they did not think about adoption time in advance or during development time, but instead they learned about adoption time after market entry. Typical functions that informants listed for reducing customers' adoption time were advertising, sample distributions, trade fair introductions, customer involvement in the development process, communication, development of delivery and sales processes, ease of use, customer training, pre-sales and helping customer to simplify their processes. The data also included a few comments about failed actions.

"It didn't cause any changes to the final user. The storekeepers got a new model of the application. From that point of view the storekeepers knew what they got from us, regardless of the new package. That's why their adoption time was very short."

"We have learned this a bit hard way. The big part of our product should be the launch and implementation. Actually, this is the most center stage of our job just now."

"We have sent samples to wholesalers and distributors. But unfortunately it doesn't increase the end-users' awareness."

The ease of use was an important premise in all cases. All nine informants confirmed that they were aware of the ease of use, and it was perceived during the development process. A typical target for the case firms was that the final user be able to use the product without a manual. The ease of use was measured in different ways in the cases: with customer feedback, automated integrations and minimalist designs. In one case, the product was relatively complicated, and in that case, the firm established an Internet-based learning environment with video instructions. The perceived usefulness was also an important premise for most of the cases. Eight informants gave examples of how usefulness was taken into consideration during the development phase. Typically, the information was collected straight from the customers and/or end users.

"We have invested lots to ease of use. We have hired a user interface designer to our development team."

"That [the ease of use] was a starting point. The user focus to his (or her) core action to the full, and the technology is only helping him (or her). As a result we designed a one button user interface, and all technology is hidden behind that."

"This doesn't differ from a normal device in any way. All its features are built-in. All users can use this spontaneously."

Product-related success factors

We discussed above adoption time and shortening it from the customer behavior point of view. The success factor *TP for difficult to adopt* considered the developers' perspective: how to commit and survive during the adoption time when the new product does not bring a cash flow to the firm (Sarja, 2015b). This is an essential question for start-up firms, which are established around one innovation and without a cash flow generated from other products.

Six informants explained the different actions they executed for surviving during adoption time, one informant said they realized the adoption time in practice and learned what they should have done, and two informants explained that their business customers were involved with the project so deeply that the adoption time was funded by the customer. Typical ways for funding adoption time were economic planning, use savings, applying external funding and also expanding the ownership base. Furthermore, many activities of customer involvement discussed in the last chapter (2.1) were brought up again, for example pre-sales.

"In the very early phase we planned how to survive from the Death Valley. The main way was to connect the customer deeply to the development process."

"Design, marketing and sales have been involved in the developing process from the beginning."

All nine informants emphasized their management's commitment to the development project. The answers were similar because in all cases the management consisted of entrepreneurs. The commitment was inclusive because all projects had been established around the management's own product idea, and the start-ups were funded with the management's own money. In addition, two of the case firms were one-man companies in the beginning. The tricks for committing to the projects were working long days, working without salaries, or receiving salary income from other work. The adequacy of resources was ensured by financial arrangements and resource allocation. Two informants explained personnel transition inside the firm when they were transferred from the development process to customer deliveries. One informant described the resource allocation between two firms owned by the same owners. The main themes, from developing firm point of view, for surviving the adoption time period seemed to be the appropriate proportion of resources and bootstrapping funding.

"Because the management is the same as owners, and their own property is pledged...that guarantees the commitment"

"Our resources have been limited, so the schedules have been flexible. We have funded our work in different ways. Mostly we have gotten our salary elsewhere."

"This is a big challenge for us. Same resources work with product development and product deliveries. When we concentrate on the other one, the other one gets less attention."

"That's why we have those priority lists. They tell the order of the development processes. From the staff's point of view we started development weighted, and now the weight is moving to sales activities."

A firm's target for developing new products is to get long-term profits (e.g. Griffin & Hauser, 1996). When asked about the *life cycle*, all nine informants were able to tell at least something about the life cycle of their products. The most cursory comments were about expected life time estimations, and the most advanced ones were about the real life cycle planning already in the development phase. The expected life cycles were from one year to endless (SW products with continuous releases), and the depth of the life cycle planning was performed accordingly.

"It's a managements' task to make sure, that when the new version is released, the customers can upgrade. In other words, the product development keeps an upgrade, or in a sense life cycle in a delivery process."

"We see that this product is endless. New versions will be released monthly."

"This is a device which must be maintained and repaired. And its working environment is very challenging. We couldn't take this into account beforehand. But we learned that by trial and error."

"We thought about upgradability. The device can be upgraded almost similar to the latest version just by changing some 'bricks'. This was a part of our life cycle planning."

"One thing was that we designed the architecture of the device to be modular. We are not dependent on any technology, and the subparts are changeable."

Six informants stated that they had made economic plans for the product's life cycle period. Two informants explained that they were doing regular economic plans but not necessarily from the life cycle viewpoint. Instead, they mentioned economic planning as part of their firm's common activity and funding applications. One informant explained they do not do economic planning as a process but still try to optimize the costs.

In five cases, human resources planning for the life cycle period was carried out, and in three cases that was irrelevant because of the small size of the firm or the fact that the development work was outsourced. In one case, the planning was done only in the management's mind and not as a formal process.

"Yes, we did economic planning. We are a SaaS company and the biggest item of expenditure is product development and maintaining."

"No we haven't planned. But still we have tried to optimize the costs. Not necessarily by minimizing, but if something cost more and was an easier solution, we preferred that one. We always chose the easiest option."

"Yes, we do [human resources planning] as a part of head count and task allocation."

The success factor fill an unrecognized needs is ignored in this study, and we propose to remove it from the TP success factor set. Samli & Weber (2000) state that the market and the customer needs must be studied by the developers. This is discussed deeply in the 'Market related success factors' chapter.

The factor technological advantages was sorted out by asking about the technological ability and availability of the development project and by asking how the developed products differed from competing solutions technology-wise. The most common sub-factor was the technical know-how and ability of the development team. In some cases, it was due to the long experience of the developers, but in some cases a shorter amount of experience with enthusiasm led to the same ability level. Apart from that, the ability to combine existing technologies in new ways was mentioned in a few cases. The other repeated issues were successful technology choices and particular ability in some sub-process (e.g. manufacturing cost reduction). Technological advantages in developed products offered many benefits to the customers (e.g. smaller size, simplicity, safety, connectivity [with other platforms and devices], reliability, possibility to use in new environment, feature extensions). From the developers' perspective, technological advantages enabled cheaper and more robust product development and production.

"We have combined existing technologies in a way that no one had done before. In the customers' eyes it's totally new technology."

"The core competence of this kind of firm is technology know-how. It is a prerequisite for the whole operation."

"Our audio and mechanical abilities are on the top of the world. We also have some simulation methods which others don't have, yet."

"We have benchmarked the best solutions from competitors, but we have benchmarked also from other industries using the same technologies."

"We are able to use technology which enables fast and cheap product development, and thereby the competitive price to the customer."

Management-related success factors

In this study, management support, as a success factor, is limited only for resource organizing (like Samli & Weber, 2000; Ernst, 2002). This success factor does not sit very well with the start-up firms wherein the management are also the principal owners and the business is built around one product innovation. However, the informants were able to tell about a few issues related to management support. Surprisingly,—maybe because of the Finnish economic situation—they saw the most important support from management was ensuring the continuity of the project, in other words, employment. In start-up cases with always limited resources, most of informants also saw time as a resource and as a solution for limitations of the other resources. Interestingly, when asked about the adequacy of resources in the development phase, all informants declared they would prefer to have more resources, but in the end, they found that they had enough

because they were able to complete the product. Also, the know-how, information sharing, strategic guiding and activity focusing were mentioned as management support tasks.

"Know-how, resource organizing and the fact that it's possible to tell at least somewhat that there is a future in this business. For sure we have had exciting times but the management can't show it outwards."

"In our case, it has allowed to work in peace. I think the workers have appreciated it. The whole story has been the continuity."

"The whole start-up bustle is about scarcities."

"In start-up firms this all is always a challenge. With more resources we would be able to develop more and faster."

"With more resources the workload would be tolerable. But it seems that performing sensibly it's possible to go forward with a smaller head count."

Samli & Weber (2000) and Ulrich & Eppinger (2008) outlined that adequate funding must be available and maintained during the development process for carrying it out. This degree of funding must be ensured by aggregate planning and prioritizing for the projects that are realizable within the budgeted resources. Also, this success factor did not sit well with start-up firms with only one product. However, similar prioritizing with mentioned one arose, but the target of prioritizing was product features. All nine informants stated they either had an R&D budget, or they just used the biggest part or all available money for development work. All informants agreed the importance of prioritization. In five cases, prioritization was about the product features, and in one case, prioritization was done between the development of the application and the development of the supplementary services. In the rest of the cases, it was explained that prioritization was around the one and only existing product. In all cases, project funding was monitored at different levels and by different measures. The most common measures were monitoring budget realization and cash flow.

"In this case we used 100% for this project because we didn't have any other projects."

"Yes, it [the budgeted money] is pretty much gone from hand to mouth."

"We have only one product. We have prioritized its' features."

"Yes, we thought business first. We organized features according to how we got more business."

"The budget monitoring has been very easy. We have had planned money for molds, marketing and salaries. And it has all gone. In the beginning the budget was very precise and then we used that money."

"In principal, we have been doing financial calculations all the time, and also monitored the cash flow."

Organisation-related success factors

Following the idea of Sarja (2015b), we did not consider project team skills at the individual level, instead we focused on the versatility of cross-functional teams. All interviewees described their project teams as very experienced time-wise. One younger informant described his experience in a relatively modest way, but after reasoning, we concluded that he was very experienced with the new technology used in his project, also on a global scale. In three cases, the entire project team was described as very experienced, and in five cases, the founders were highly experienced but later they also hired younger avid employees.

"We have very experienced system designers and then we have hired younger to learn, and they can come straight from school. I see that we have a large scale of experience."

"In firm's starting phase we had a very experienced gang, everyone understood what was going on. Later we have hired also younger workers. We have a good mix of older experienced guys and younger dudes with fresh thoughts. In recruiting-wise we are always looking for the type."

When discussing the versatility of the development teams, two interviewees stated their teams were purely engineer-driven, and two other cases, which had started as a one-man project (in a starting phase), were also engineer-driven. One of these one-man cases extended its know-how by hiring and the other one by outsourcing the whole development work. The rest of the cases had been cross-functionalized since the beginning. The typical cross-functional team in these small case firms consisted of engineering and commercial backgrounds. Both of these fields of know-how are divided for more exact expertise (e.g. user interface expertise, coding, testing, database expertise, marketing, sales, customer service etc.). In many cases, the know-how outside these mentioned fields was outsourced.

"Yeah, we have room for improvement in this engineer-economist driver [of the organization] now when we have grown bigger. So far we have utilized subcontracting in this."

"Our team members have different backgrounds. Commercial, technical, financial, marketing. We have people of different types even inside the unrelated teams. The common factor is passion."

"Versatility is a mental issue! All you need is the desire to learn and do!"

"It has been very important from the beginning that the wholeness was well planned. So that we would be able to start to sell as early as possible. Marketing, image, design, media expertise, all this was planned since the beginning. R&D is only part of it! We have gotten positive feedback because of this [from the investors and consultants]."

The case firms arranged various different kinds of team training. Three interviewees stated that training was not arranged at all or had been internal or self-study. Four interviewees said they had conduc-

ted unplanned training sessions when needed (e.g. when some new tools were introduced). In two cases, team training had been planned as part of the operation, and it was arranged regularly.

In conclusion, it was clear that the entrepreneurs saw employees as a vital resource, and they invested in recruiting. All nine informants said that they had a fully committed and capable development team. In most of the cases, the development team had also been very professional. In two cases, the possible lack of expertise was replaced by enthusiasm with good attitudes and self-study.

Networking is a traditional and widely studied success factor in the NPD discipline, and in the process of time, new interest groups are connected to the network (see Sarja, 2015b). The main purpose of networking is to consolidate in-house know-how and resourcing beyond the development teams. It is particularly important for TP development intensive firms (Ledwith & Coughlan, 2005) and small resourced start-ups. Ledwith & Coughlan (2005) have defined a framework² for managing firms' networking which we followed in this study.

All nine informants explained that they had done networking, but the level of these activities varied. In all cases, informants mentioned different Finnish public sector players as a network partner because of funding and other public support activities. In two cases, the collaboration was mostly with the manufacturing partner (EMS³), but both cases were active and open regarding new collaboration. In one case, the whole operations model was based on networking; public and privately funded firms was operated by one person, and the development and design work was outsourced. The rest of the six cases were operating somewhere in the middle ground.

In addition to the previously mentioned activities, collaboration with software platform distribution firms, marketing firms and joint marketing, open source communities, and research institutes and academies was mentioned. The noteworthy networking activities were product development in collaboration with the customers and complementary development work with competitors.

A needed and available know-how was the most important driver for the firms' networking, and such know-how was mentioned in every case. In the cases of EMS, academia and research collaboration the geographical closeness saw to play some role but otherwise the networking happened at national and international levels. In three cases, the key persons in the firms had ready contacts and networks from previous positions, and in two cases, the national research programs were mentioned as a tool for networking.

*"We needed knowledge, skills and competence to make things happen.
We didn't want to invent the wheel again."*

"It was relatively need driven [action]. We needed something that was what these particular players were able to supply. The networking happened in the national level."

"That [national research program] was our proper networking action during the development process. From that way we got also contacts with the research institutes."

"Then, we have discussed with the other players of the industry and thought how to combine our businesses."

"I would allege that we have made a big difference in it. Before everyone who did somewhat similar things was a competitor and no one didn't discuss or do anything with them. Now we [can cooperate] and avoid overlapping and inventing the wheel again."

Proposed success factors by an empirical study

The last question of the interview (see Appendix 1) was open, and its purpose was to clarify how well the 12 (the factor fill an unrecognized need was excluded during the study) defined success factors covered the operations of the case firms in real life, and if the informants were able to define some additional success factors based on their experience of developing TP product for the market.

The coverage of the introduced success factors was supported in two ways. First, all informants were able to respond to all questions and discuss all factors. Secondly, all responses to the open question started by repeating already discussed factors instead of defining new ones. After the interviewers redirected conversation, the discussion turned to new proposed factors.

Most of the proposed success factors were just a case-specific ideas suggested by one informant only. However, three generalized thoughts arose from more informants, namely scalability, visibility and timing.

Half of the interviewees brought up the characteristic of scalability. Two of them explained that the scalability of the product is necessary in the consumer product group. The scalability must be noted already in the product planning phase.

"We planned the architecture so that the final product is scalable."

"If you do what the customer wants you can create a consulting business, not a scalable product like this."

"If you do exactly what the customer wants you likely to end up doing customer projects. You need to have a scalable solution which can solve the problem of many customers."

(2) The authors have found conflicting findings in studies between networking on a NPD and increased success. The framework represents the best understanding about the firms' successful network management, and further research is needed (see Ledwith & Coughlan, 2005 and Sarja 2015b). A simplified description about the framework is questions with who, why, and what skills the collaborating organizations have.

(3) Electronic Manufacturing Services

Three informants saw visibility as an important success factor in their cases. In all of these cases, the entrepreneurs started to publicize their product already during the development phase (as soon as IPR issues were ensured) and pre-sell successfully. Two interviewees were able to create a kind of phenomenon by way of good visibility. It was also noted that visibility was a great advantage in funding negotiations.

"The visibility has to be good! Must be in the press. The whole pipeline from the product development to the media service must be planned."

"It is always positive if you can create a phenomenon. It boosts the grapevine [and awareness of the product]."

"The visibility in web and media has greatly helped this exercise. The visibility in the media and getting into viral phenomenon. Personification, and building a community around the phenomenon or person."

In five cases, successful timing for market entry was seen as a success factor. In this context, timing was seen from a technology and product maturity point of view. The technology in use should be ready enough for commercial solutions, but the rough version of the product is enough for market entry. Three informants explained that the first version of their product on the market was a rough one, and the next versions were upgraded. One informant explained that he

started to sell a product that did not even exist. The optimized timing for market entry seemed to increase the visibility of the product and funding of the development work.

"The used technology must be mature enough. It influences also the length of the adoption time."

"We were in the right place at the right time! We got our product to market fast. We started to sell it when it was still rough, and then fixed it."

"We think that the market entry should be done early enough. No need to do things too ready, in every case it will never be ready. We must recognize that the product isn't too rough but it's workable. You can do certain things with that but it's not perfect."

Summary of the empirical study

As mentioned, all 12 success factors were supported by the informants, and three more factors arose during the study. The factors *fill an unrecognized needs* were removed. We positioned the new success factor *scalability* in the product-related success factor group because it was clearly a planned characteristic of a developed product. Visibility and timing were strategic management decisions and naturally management-related factors. The whole set of empirically validated TP success factors are presented in Table 4.

Table 4. TP Key Factors after the Study.

Market- related	Product- related	Management- related	Organization- related
MP methods used	TP for difficult adopted	Management support	Project team skills
Focus on customer needs	Life cycle	Degree of funding	Networking
Market development	Technological advantages	Visibility	
Alternative study	Scalability	Timing	
Adoption time and technophobia			

Conclusion

In general, we can conclude that this empirical study supports that the discussed 12 TP success factors are relevant. It also raised three new factors. We saw that the age of the informants or the years of the entrepreneurial or NPD experience did not play any role because of the small sampling and the nature of the case study method, but it was rather interesting background information. However, the amount of experience came up from time to time, and of course it can have a positive effect on a firm's performance.

It is not possible to put success factors in order of importance with this level of information, but it can be concluded that the weight is in marketing-related success factors. A large number of factors belong to that group, and perhaps it is the most researched discipline.

It is notable that the achieved results are generally level. We studied the whole set of success factors empirically knowing that every single case or every single success factor would be an adequate target for its own study. That way it would be possible to receive more detailed knowledge about each factor's function, efficiency and application of the factor as a part of firms' development processes.

During the research process, we also noticed three variables that should be taken into account in more elaborated studies: the product type (HW/SW), the business model (B2C, B2B) and the size of the studied case firm. In many (but not all) cases, the responses were similar between hardware firms and also between software firms. The same occurrence recurred between firms with the same business model and firms representing the same size. We propose that in future research at least these three characteristics should be distinguished. As discussed, the common factor of our case firms was that they are

all start-ups that had already placed their product on the market. Still they represent different sizes in human resources (e.g. head count, turnover). Some success factors do not sit very well with the small firms that have only one product and where the management are also owners. For example, the questions regarding management-related success factors would apply better to bigger and older players in market with thousands of employees and several products rather than to start-ups.

As discussed, future research should go deeper by studying a limited number of success factors (even only one) within several cases. Another fruitful approach could be to focus only on cases of one product type, similar business models or firms of the same sizes. In addition, it might be beneficial to compare the implemented success factors and the success of the company's prosperity.

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Appendix 1. Interview question list

0. Background questions (name, organization, position etc.)

[Questions about the Market related success factors]

A. MP methods used

1. Did you have any described and/or documented product development process in use?
2. In the beginning of the development process, did you try to find appropriate customers for your technology?
3. In the beginning of the development process, did you contact the customer in some way? For example, did you introduce the product to him/her?
4. Did you keep the customer in the loop during the development process?
5. Did the marketing sector (person or organization) belong to the development team?

B. Focus on customer needs

6. In the beginning of the development process, did you segment your appropriate customers?
7. In the beginning of the development process, did you try to define the exact need(s) of the customer/customer segments?
8. How did you document customer related findings?
9. Did you interpret findings somehow?
10. Did you order/weight the needs somehow (e.g., importance)?
11. Did you update customer need (list) during the development process?

C. Market development

12. In the beginning of the development process, did you define the target market (existing/new)?
13. In the beginning of the development process, did you define the target market by some other more specific way?
14. Did you update/redefine the target market during the development process?

D. Alternative study

15. In the beginning of the development process, did you make an alternative study?
16. Did you notice the other solutions for customer needs than direct competitors (e.g., other indirect/potential technologies etc.)?
17. Did you update the alternative study during the development process?

E. Adoption time/technophobia

18. During the development process, how did you prepare yourself for customer adoption time in advance?
19. How did you take into consideration customer adoption time? How did you try to shorten it?
20. During the development process, did you take into consideration the customer's feeling about the usefulness of the product? How?
21. During the development process, did you take the ease of use into consideration? How?

[Questions about the Product related success factors]

F. TP for difficult adopted

22. How did the management prepare the project for the adoption time?
23. How was the commitment of management shown?
24. How was resource ensuring organized?

G. Lifecycle

25. How was the product's life cycle taken into consideration during the development process?
26. Was there any kind of economic planning for the life cycle period in the development phase?
27. Was there human resource planning for the life cycle period in development phase?

H. Technological advantages

28. How do you see the technological ability of your project to develop as a breakthrough product?
29. How would you describe the technological advantage of your development team?
30. What technological advantages does your product have as compared to competitors or other available solutions?

[Questions about the Management related success factors]

I. Management support

31. What was the most important support from the firm's management for your project?
32. Did you have the needed financial and human resources for your project?

J. Degree of funding

33. Was the degree of funding (e.g., the agreed percentage of the total budget) included in the firm's strategy? How much was that share?
34. Was the development project prioritized from an economic point of view?
35. How was the project funding monitored during the development process?

[Questions about the Organization related success factors]

K. Project team skills

36. How would you describe the experience of the development team members?
37. Was any kind of team training arranged during the development process?
38. How would you describe the development team members' expertise and ability?
39. How would you describe the versatility of development team? Was the team cross-functional?

L. Networking

40. Did your project network with the other organizations (firms or public sector e.g., research institutes)?
41. If this was the case, why did you do that? What benefits were achieved?
42. How did your project find or justify the network partners?

General question

43. Can you mention any other than discussed success factors which has influenced your [current or previous] firms' products commercial success?

Assessing adverse effects of inferior innovations with brand innovability: perspectives of consumer innovativeness

Joseph W. Chang*

Abstract: This research examines the adverse effects of inferior innovative extensions on the brand innovability and quality of own parent brands from the perspective of consumer innovativeness. The results reveal that inferior radical innovations weaken the perceptions of brand innovability and quality of high-innovativeness consumers less than the perceptions of brand innovability and quality of low-innovativeness consumers. Conversely, inferior incremental innovations weaken the perceptions of brand innovability and quality of low-innovativeness consumers less than the perceptions of brand innovability and quality of high-innovativeness consumers. In comparison, brand innovability is less susceptible than brand quality to inferior innovation information. The threats of inferior innovations are less detrimental than expectation if the adverse effects are assessed with brand innovability, instead of brand quality. The findings suggest that brand innovability is a more justifiable indicator than brand quality in evaluating the adverse effects of inferior innovations.

Keywords: brand innovability; consumer innovativeness; adverse effect; inferior innovation.

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Introduction

Wearable smart devices represent a major trend in high-tech markets, among which smart glasses were generating significant interest. Google Glass, the pioneer of smart glasses, was recognized as one of the “Best Invention of the Year 2012” (Time, 2012) and hailed as the “next big thing” in high-tech (Woollaston, 2014). To test the market and stimulate application developers’ interests, Google Glass strategically launched its Explorer version for developers in Feb. 2013 and publicly unveiled the conceptual Explorer version for consumers in May 2014. However, given the price of US\$1,500, test users were disappointed with the product design, specifically battery life, data access, heat generation, voice recognition, and nerdy image. As a result, only thousands, rather than the estimated millions, of Google Glass were shipped a year after its launch. Moreover, roughly about 80 percent of Glass application developers either abandoned or suspended application development for Glass. Industry experts were generally pessimistic about the future of Google Glass given the concerns of problematic product design, emerging substitutes (e.g., action cameras, smart watches), privacy intrusion (e.g., video recording), and augmented reality incapability (e.g., widespread adoption for the mainstream). The same industry experts predicted the death of and recommended Google abandon the Glass before its commercial launch. In response to the overwhelming criticism, Google reconfirmed its commitment to develop the Glass and announced indefinite postponement for the release of the consumer version originally scheduled for 2014 (Haydin, 2014; Metz, 2014; Rowinski, 2016; Sun, 2014).

Is the failure of Google Glass damaging to Google? Why did Google insist on sustaining the problematic Glass? The Google Glass case raises several questions about the adverse impacts of innovation failures on brands (e.g., Google). For example, will the failures of high-tech

innovations (e.g., Google Glass) be more detrimental to brands? Will innovative brands (e.g., Google) be more vulnerable to innovation failures? Are fans of high-tech innovations (or innovators) more susceptible to innovation failures?

In innovation research, innovability is utilized to describe the capability to innovate (e.g., Dahlgaard-Park & Dahlgaard, 2010). Profiting firms (e.g., Google) are typically innovative companies with high innovability in inventing high-tech innovations (Jonash & Sommerlatte, 1999; Nedergaard & Gyrd-Jones, 2013), which are relevant to the increases of long-term performance, including the bottom line of firm income, the top-line of firm revenue, and the firm value in stock markets (Pauwels, Silva-Risso, Srinivasan, & Hanssens, 2004). Thus, in addition to brand quality, brand innovability has become an important indicator evaluating brand health. Moreover, extant research in brand evaluations has widely investigated the adverse effects of brand extensions (e.g., Google Glass) on their family brand names (e.g., Google), which are moderated by the characteristics of brands (e.g., Gurhan-Canli, 2003), brand extensions (e.g., Arslan & Altuna, 2010; Dimitriu, Warlop, & Samuelsen, 2017; Liao, Chou, & Lin, 2015), and perceivers (e.g., Salinas & Pérez, 2009). However, these studies mainly discuss the adverse impacts of regular extensions on regular brands specifically in the perspective of brand quality. Less is known about the adverse impact of inferior innovations (as brand extensions) specifically on brand innovability.

Moreover, extant research in innovation documents that consumer innovativeness is relevant to the evaluations of brand extensions (Salinas & Pérez, 2009). High-innovativeness consumers prefer, and have higher adoption rates for, high-tech extensions than low-innovativeness consumers (e.g., Bartels & Reinders, 2011; Tellis, Yin, & Bell, 2009). However, the previous research mainly discusses the relevance

*Charlton College of Business, University of Massachusetts, Dartmouth, E-mail: joseph.chang@umassd.edu



between consumer innovativeness and the evaluation and adoption of extensions. Less is known about the moderation of consumer innovativeness on the adverse effects of inferior innovations from both the perspectives of brand innovability and quality. Therefore, this research advances innovation research by examining the adverse effects of inferior innovations on brand innovability and quality from the perspective of consumer innovativeness.

Theoretical Background

Brand innovability

In innovation research, the capability of innovation is discussed with various, but interchangeable, terminologies including innovability, capability to innovate (Dahlgard-Park & Dahlgard, 2010), innovation ability (Schreier, Fuchs, & Dahl, 2012), innovativeness capability (Luo & Bhattacharya, 2006), and perceived innovativeness (Kunz, Schmitt, & Meyer, 2011). Specifically, Dahlgard-Park and Dahlgard (2010) create the terminology of innovability to represent the ability to innovate for the development of a system for assessing and improving technology development and innovations. The research scope is mainly from the perspectives of firms. Luo and Bhattacharya (2006) delineate that firms with low innovativeness capability are highly correlated with low customer satisfaction and market value. Kunz and colleagues (2011) uncover that perceived innovativeness affects consumer loyalty via the two processing routes of functional-cognitive and affective-experiential routes. Moreover, Schreier and colleagues (2012) depict that common design by users enhances consumers' perceptions of innovation ability. While similar concepts about innovability were utilized to examine innovation research questions, none of them investigates the adverse effects of inferior innovations on brand innovability.

To be consistent, this study adopts the shortest terminology of innovability for its novelty and uniqueness and to differentiate it from the innovativeness of innovative brands and extensions. Moreover, based on the extant research, innovability can be more comprehensively defined as the ability to generate new and useful products/services innovatively (Brown & Dacin, 1997; Dahlgard-Park & Dahlgard, 2010; Luo & Bhattacharya, 2006; Rust, Moorman, & Dickson, 2002; Schreier et al., 2012; Zeithaml, 2000).

Brand innovability and quality

In innovation research, brand (or corporate) abilities consist of brand quality and innovability, which refer to a brand's (or firm's) ability to improve existing brand quality and generate new innovations (Luo & Bhattacharya, 2006; Rust et al., 2002; Zeithaml, 2000). The definition suggests that innovative brand's quality is associated with, and affected by, its innovative extensions' quality, whereas innovative brand's innovability is associated, and affected by, its innovative extensions' innovativeness.

However, innovability is not just about the creation of creative and novel innovations (Kunz et al., 2011). The created innovations have to be (of good quality to be) useful in order to survive and exert market

impacts, which is the third key point of an innovative brand (Kunz et al., 2011; Schreier et al., 2012). A brand with the characteristics of novelty and creativity is insufficient to be a high-innovability brand if its innovations are of low quality and, thus, useless. Moreover, operationally, the first three measures of the brand innovability scale (Schreier et al., 2012; see the Appendix) capture the relevance between brand innovability and extension quality (i.e., "In my opinion, the innovation ability of this company is high/low," "In my opinion, the innovation ability of this company is weak/strong," and "In my opinion, the innovation ability of this company is poor/excellent"). As a result, brand innovability is relevant to, and affected by, innovation quality, in addition to extension innovativeness. Consumers' judgment about brand innovability is jointly affected by both the innovativeness and quality of innovative extensions. In contrast, consumers' judgment about brand quality is affected by the quality of innovative extensions alone. Thus, the influence of inferior innovative extensions on the innovability and quality of own parent brands are supposed to be different.

Moreover, brands are characterized as pioneers, opportunists, and followers on the basis of innovability, whereas new innovations are classified as incremental, substantial (or breakthrough), and radical (or transformational) offerings on the basis of product innovativeness (e.g., newness, value-add) (Crawford, 2014). Specifically, pioneers are high in innovability and commit to radical innovations, which create new industries and transform the way people live and work. In contrast, followers are low in innovability and engage in incremental innovations, which are continuously improved products or technological processes. The discussion about the adverse effects of new innovations on own parent brands consists of four conditions: the adverse impacts of (a) radical innovations on pioneer brands; (b) radical innovations on follower brands; (c) incremental innovations on pioneer brands; and (d) incremental innovations on follower brands.

Consumer innovativeness

Consumer innovativeness is a personal trait defined as consumers' inclination to embrace new products (Tellis et al., 2009). High- and low-innovativeness consumers prefer radical and incremental innovations, respectively. The construct of consumer innovativeness consists of ten elements across the three dimensions of openness to new things, enthusiasm for new products, and reluctance to adopt new products. The consumer innovativeness concept is captured by averaging the ten innovativeness measures (Tellis et al., 2009; see the Appendix).

The impacts on brand quality

Among the ten traits of consumer innovativeness (Tellis et al., 2009), risk aversion is one primary characteristic to differentiate the reception of new innovations of high- and low-innovativeness consumers (Raju, 1980; Rogers, 1995). In evaluating innovations, consumers with higher tolerance for risk (i.e., high-innovativeness consumers) are more receptive to radical (or low-fit) innovations. In contrast,

consumers with lower tolerance for risk (i.e., low-innovativeness consumers) are less receptive to the relatively higher risk associated with the radical extensions (Klink & Smith, 2001). As a result, high-innovativeness consumers more tolerate the failures of radical innovations than low-innovativeness consumers (Klink & Smith, 2001). The toleration ameliorates the negative impacts of inferior radical innovations on brand quality. Specifically, inferior radical innovations less saliently weaken high-innovativeness consumers' perception of brand quality. In contrast, low-innovativeness consumers more tolerate the failures of incremental innovations (Klink & Smith, 2001). The toleration ameliorates the negative impacts of inferior incremental innovations on brand quality. As a result, inferior incremental innovations less saliently weaken low-innovativeness consumers' perception of brand quality. Thus,

H1a: Inferior radical innovations weaken the perception of brand quality of high-innovativeness consumers less than the perception of brand quality of low-innovativeness consumers.

H1b: Inferior incremental innovations weaken the perception of brand quality of low-innovativeness consumers less than the perception of brand quality of high-innovativeness consumers.

The impacts on brand innovability

Brand innovability consists of the two dimensions of brand quality and brand innovativeness (Kunz et al., 2011; Schreier et al., 2012), which correspond to extension quality and innovativeness, respectively. Thus, the evaluations of brand innovability are affected by extension quality and innovativeness. Contrary to the negative impact of inferior extension quality, extension innovativeness is positive force enhancing brand innovativeness. The enhancement equally counterbalances the negative impacts of inferior innovations on both high- and low-innovativeness consumers' perception of brand quality. Moreover, hypothesis 4a states that inferior radical innovations instigate less negative impacts on high-innovativeness consumers' perception of brand quality. By combining the impacts of extension quality and innovativeness, it is expected that inferior radical innovations also instigate less negative impacts on high-innovativeness consumers' perception of brand innovability. In contrast, hypothesis 4b states that inferior incremental innovations instigate less negative impacts on low-innovativeness consumers' perception of brand quality. By combining the impacts of extension quality and innovativeness, it is expected that inferior incremental innovations also instigate less negative impacts on low-innovativeness consumers' perception of brand innovability. Therefore,

H2a: Inferior radical innovations weaken the perception of brand innovability of high-innovativeness consumers less than the perception of brand innovability of low-innovativeness consumers.

H2b: Inferior incremental innovations weaken the perception of brand innovability of low-innovativeness consumers less than the perception of brand innovability of high-innovativeness consumers.

In comparison, the impacts of inferior innovations on brand innovability are affected by both the innovativeness and quality of innovations (Kunz et al., 2011; Schreier et al., 2012), whereas the impacts on brand quality are mainly determined by innovation quality (Luo & Bhattacharya, 2006; Rust et al., 2002; Zeithaml, 2000). Given that, the negative impacts of inferior innovations on brand innovability get the chance to be counterbalanced by the positive impacts of extension innovativeness. As a result, brand innovability appears less saliently weakened than brand quality by inferior innovations. However, the counterbalance effect of extension innovativeness diminishes when the level of extension innovativeness is lower than the level of brand innovativeness (e.g., pioneer brands with inferior incremental innovations). Under the situation, the negative impacts of inferior innovations on brand quality and innovability turn to be indifferent. Thus,

H3: Inferior innovation information weakens brand quality more than brand innovability, except the condition when the brand is a pioneer brand and the inferior extension is an incremental innovation.

Methodology

Materials

In line with previous research and for the ease of manipulation (e.g., Loken & Roedder-John, 1993), the fictitious names of Appsung and Appsung V6 were created to represent the innovative brand and new innovative extension. The Appsung brand name was based on the two major smartphone makers of Apple and Samsung for the ease of high quality associations. The experimental treatments of the Appsung brand and Appsung V6 extension were cultivated with PC Home assessments.

As the launches of radical innovations were unlikely for low-innovability brands in reality, this study examined the adverse effects of radical and incremental innovations specifically on pioneer brands. The pioneer Appsung brand was portrayed as a smartphone pioneer (i.e., "pioneering a few patented breakthrough innovations;" see the Appendix). The high- and low-innovativeness Appsung V6 were delineated as a radical (i.e., "with wireless charging and hyper processor;" see the Appendix) and incremental (i.e., "with higher display resolution;" see the Appendix) innovations, respectively. There are internal and external reasons causing the failure of an innovation. This research specifies the internal reason of inferior innovation with low-quality.

Subjects and procedures

The data were collected online via the Amazon Mechanical Turk (www.mturk.com) with Qualtrics questionnaires (www.qualtrics.com). One hundred and fifty-two smartphone users residing in the USA ($M_{age} = 33.68$, 75 females, 77 males) were randomly assigned to the 2 (consumer innovativeness: high vs. low) x 2 (extension innovativeness: high vs. low) between-subjects factorial design. Consumer innovativeness was captured with the 10-item consumer innovativeness scale developed by Tellis et al. (2009) (see the Appendix).

The participants were informed that the purpose of study was to investigate consumer opinions about smartphones. The participants started with reading the PC Home assessment about the Appsung brand and rating the prior quality and innovability of the Appsung brand, followed by a series of rating tasks including the quality and innovativeness of the newly launched Appsung V6 and the posterior quality and innovability of the Appsung brand. Prior and posterior brand quality was captured with the three-item brand attitude measure of quality, favorability, and desirability (e.g., Kempf & Smith, 1998). The brand innovability was captured with the seven-item innovation ability measures (Luo & Bhattacharya, 2006; Rindfleisch & Moorman, 2001; Schreier et al., 2012; see the Appendix). The extension innovativeness was identified with the 9-item product innovativeness measure (Lee & O'Connor, 2003; see the Appendix).

Results

Manipulation checks

Scale reliability analyses on the multiple-item measures of brand quality, brand innovability, and extension innovativeness yielded high levels of reliability ($\alpha_s \geq .89$). Thus, the indices were formulated by averaging the scores of multiple items, respectively.

T-tests and one-way ANOVAs revealed that (a) the innovability levels of Appsung in the conditions of inferior radical and incremental Appsung V6 are equal ($M_{\text{radical}} = 5.77$, $M_{\text{incremental}} = 5.82$, $F(1, 150) = .10$, $p > .10$) and moderately high ($M_{\text{radical}} = 5.77$, $M_{\text{neutral}} = 4.00$, $t(69) = 19.44$, $p < .001$, $M_{\text{pos-xtrm}} = 7.00$, $t(69) = -12.56$, $p < .001$; $M_{\text{incremental}} = 5.82$, $M_{\text{neutral}} = 4.00$, $t(81) = 21.19$, $p < .001$, $M_{\text{pos-xtrm}} = 7.00$, $t(81) = -13.83$, $p < .001$); (b) the quality levels of Appsung in the conditions of inferior radical and incremental Appsung V6 are equal ($M_{\text{radical}} = 5.95$, $M_{\text{incremental}} = 6.12$, $F(1, 150) = 1.26$, $p > .10$) and moderately high ($M_{\text{radical}} = 5.95$, $M_{\text{neutral}} = 4.00$, $t(69) = 16.42$, $p < .001$, $M_{\text{pos-xtrm}} = 7$, $t(69) = -8.72$,

$p < .001$; $M_{\text{incremental}} = 6.12$, $M_{\text{neutral}} = 4.00$, $t(81) = 23.80$, $p < .001$, $M_{\text{pos-xtrm}} = 7$, $t(81) = -9.85$, $p < .001$); (c) the innovativeness levels of inferior radical and incremental Appsung V6 are high ($M_{\text{radical}} = 4.82$, $M_{\text{neutral}} = 4.00$, $t(69) = 9.76$, $p < .001$) and low ($M_{\text{incremental}} = 3.45$, $M_{\text{neutral}} = 4.00$, $t(81) = -4.32$, $p < .001$), respectively; and (d) both the inferior radical and incremental innovations were moderately low quality ($M_{\text{radical}} = 1.87$, $M_{\text{neutral}} = 4.00$, $t(69) = -26.08$, $p < .001$, $M_{\text{neg-xtrm}} = 1.00$, $t(69) = 10.72$, $p < .001$; $M_{\text{incremental}} = 2.88$, $M_{\text{neutral}} = 4.00$, $t(81) = -8.05$, $p < .001$, $M_{\text{neg-xtrm}} = 1.00$, $t(81) = 13.55$, $p < .001$).

Thus, the independent variables of Appsung's innovability and Appsung V6's quality and innovativeness were properly manipulated. Specifically, the levels of brand innovability and quality and extension quality and innovativeness were carefully crafted to be moderately high to prevent the bias of ceiling effect.

Test of hypotheses

The impacts on brand quality

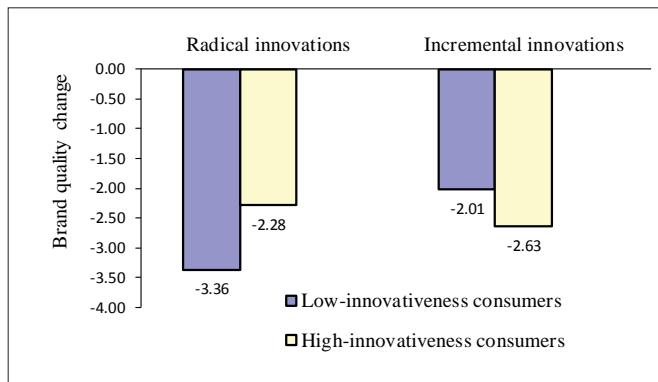
A median split was used to classify participants as being low innovativeness (those whose scores were 4.59 or less, $n= 75$, $M_{\text{low}} = 3.96$) or high innovativeness (those whose scores were greater than 4.59, $n= 77$, $M_{\text{high}} = 5.21$). Two-way ANOVA on the quality change index yielded the main effect of extension innovativeness ($F(1, 148) = 9.51$, $p < .05$) and the interaction of consumer innovativeness and extension innovativeness ($F(1, 148) = 14.54$, $p < .001$). Specifically, simple-effects tests revealed that the inferior radical Appsung V6 instigated less negative impacts on high-innovativeness respondents' perception of Appsung quality ($M_{\text{low}} = -3.36$, $M_{\text{high}} = -2.28$, $F(1, 148) = 10.87$, $p < .001$). As a result, hypothesis 1a was supported (see Table 1 & Figure 1). Moreover, inferior incremental Appsung V6 instigated less negative impacts on low-innovativeness respondents' perception of Appsung quality ($M_{\text{low}} = -2.01$, $M_{\text{high}} = -2.63$, $F(1, 148) = 4.21$, $p < .05$). As a result, hypothesis 1b was supported.

Table 1. Summary of the Main Study: Means and Standard Deviations.

Innovation	Consumer Innovativeness		Comparison (F value)	Hypo.	Results
	High-innovativeness	Low-innovativeness			
Radical	-2.28 (1.48)	-3.36 (1.17)	10.87***	H1a	Supported
Incremental	-2.63 (1.48)	-2.01 (1.30)	4.21*	H1b	Supported
Innovability change index					
Radical	-1.41 (1.37)	-2.32 (1.13)	8.45**	H2a	Supported
Incremental	-2.56 (1.49)	-1.84 (1.18)	6.25*	H2b	Supported
Change of Index					
Consumer Innovativeness		Quality change	Innovability change	Comparison (t value)	Hypo.
High-innovativeness					Results
Radical	-2.28 (1.48)	-1.41 (1.37)	-2.86**	H3	Supported
Incremental	-2.63 (1.48)	-2.56 (1.49)	-.44	H3	Supported
Low-innovativeness					
Radical	-3.36 (1.17)	-2.32 (1.13)	-5.63***	H3	Supported
Incremental	-2.01 (1.30)	-1.84 (1.18)	-1.19	H3	Supported

*: $p < .05$; **: $p < .01$; ***: $p < .001$.

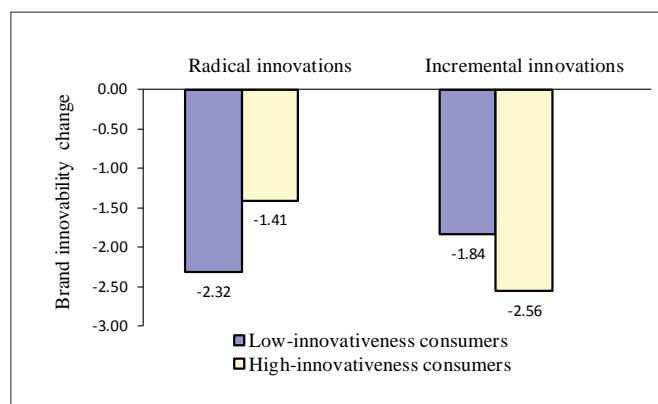
Figure 1. The adverse effects of inferior extensions on the perceptions of high- and low-innovativeness consumers on brand quality.



The impacts on brand innovability

Two-way ANOVA on the innovability change index yielded the interaction of consumer innovativeness and extension innovativeness ($F(1, 148) = 14.68, p < .001$). Specifically, simple-effects tests revealed that the inferior radical Appsung V6 instigated less impacts on high-innovativeness respondents' perception of the innovability Appsung ($M_{low} = -2.32, M_{high} = -1.41, F(1, 148) = 8.45, p < .01$) (see Figure 2). Thus, hypothesis 2a was confirmed. Moreover, the inferior incremental Appsung V6 instigated less negative impacts on low-innovativeness respondents' perception of the innovability of Appsung ($M_{low} = -1.84, M_{high} = -2.56, F(1, 148) = 6.25, p < .05$). Thus, hypothesis 2b was confirmed.

Figure 2. The adverse effects of inferior extensions on the perceptions of high- and low-innovativeness consumers on brand innovability.



The susceptibility of brand innovability and quality

Pair-samples t-tests revealed that the innovability (vs. quality) of pioneer Appsung was less significantly weakened by the inferior radical Appsung V6, regardless of consumer innovativeness ($M_{innovability} = -2.32, M_{quality} = -3.36, t(36) = -5.63, p < .001; M_{innovability} = -1.41, M_{quality} = -2.28, t(32) = -2.86, p < .01$) (see Figures 3 & 4). However, both the innovability and quality of pioneer Appsung were identically weakened by the inferior incremental Appsung V6, regardless of consumer innovativeness ($M_{innovability} = -1.84, M_{quality} = -2.01, t(37) = -1.19, p > .05; M_{innovability} = -2.56, M_{quality} = -2.63, t(43) = -.44, p > .05$). Therefore, hypothesis 3 was confirmed.

Figure 3. The vulnerability of brand quality and innovability toward inferior innovation information for high-innovativeness consumers.

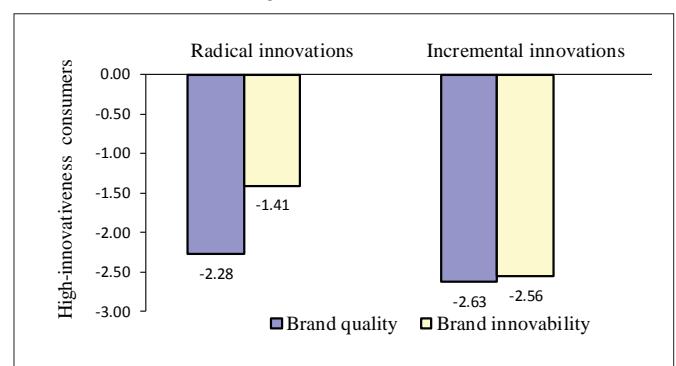
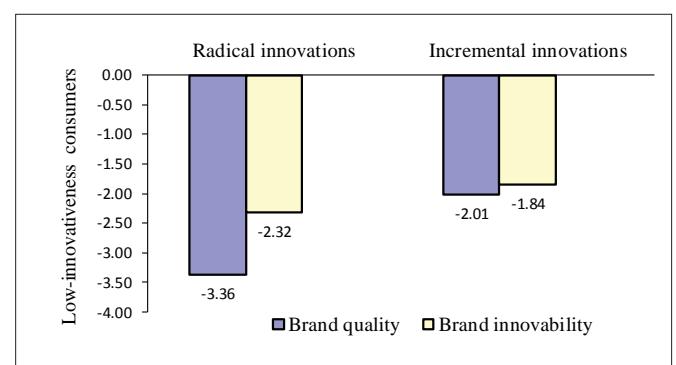


Figure 4. The vulnerability of brand quality and innovability toward inferior innovation information for low-innovativeness consumers.



In conclusion, the impacts of inferior radical and incremental innovations exert asymmetric impact patterns on consumers' perception of brand quality. Specifically, inferior radical innovations instigate less negative impacts on high-innovativeness consumers' perception of brand quality. Adversely, inferior incremental innovations instigate less negative impacts on low-innovativeness consumers' perception of brand quality.

As with the impact patterns on brand quality, inferior radical and incremental innovations also exert asymmetric impact patterns on consumers' perception of brand innovability. Inferior radical innovations instigate less negative impacts on high-innovativeness consumers' perception of brand innovability. In contrast, inferior incremental innovations instigate less negative impacts on low-innovativeness consumers' perception of brand innovability. Moreover, in comparison, the quality of pioneer brands is more susceptible than the innovability of pioneer brands to the quality of inferior radical innovations, regardless of consumer innovativeness. In contrast, the quality and innovability of pioneer brands are equally susceptible to inferior incremental innovations, regardless of consumer innovativeness.

Discussion and Conclusions

This article advances innovation research by examining the adverse effects of inferior innovations on brand quality and innovability from the perspectives of consumer innovativeness. The adverse effects of inferior innovations on the perceptions of brand innovability and

quality of high- and low-innovativeness consumers are asymmetric. The research contributes innovation research by proposing the more justifiable and relevant indicator of brand innovability in evaluating innovative brands. Based on the research findings, the theoretical and managerial implications and the limitations and future research are discussed as follows.

Theoretical implications

The study uncovers that inferior radical innovations weaken the perception of brand quality of high-innovativeness consumers than the perception of brand quality of low-innovativeness consumers. In contrast, inferior incremental innovations weaken the perception of brand quality of low-innovativeness consumers less than the perception of brand quality of high-innovativeness consumers. Moreover, inferior radical innovations weaken the perception of brand innovability of high-innovativeness consumers less than the perception of brand innovability of low-innovativeness consumers. Conversely, inferior incremental innovations weaken the perception of brand innovability of low-innovativeness consumers less than the perception of brand innovability of high-innovativeness consumers. In comparison, brand quality is more susceptible than brand innovability to inferior innovation information.

The findings reveal that consumer innovativeness theories (Klink & Smith, 2001; Luo & Bhattacharya, 2006; Tellis et al., 2009) perfectly interpret the research questions. Consumers with higher tolerance for risk (i.e., high-innovativeness consumers) are more receptive to radical innovations. In contrast, consumers with lower tolerance for risk (i.e., low-innovativeness consumers) are less receptive to the relatively higher risk associated with the radical extensions. As a result, high-innovativeness consumer more tolerate the failures of radical innovations than low-innovativeness consumers. The toleration ameliorates the negative impacts of inferior radical innovations on both brand innovability and quality.

The finding suggest that the impacts of inferior innovations on brand innovability are affected by both the innovativeness and quality of innovations, whereas the impacts on brand quality are mainly determined by innovation quality. Brand innovability appears less saliently weakened than brand quality by inferior innovations as the positive impacts of extension innovativeness counterbalance the negative impacts of inferior innovations on brand innovability. However, the counterbalance effect of extension innovativeness turns to be less effective for low-innovativeness extensions.

Managerial implications

The research findings suggest that radical and incremental innovations should target their markets on high- and low-innovativeness consumers, respectively, to maximize the efficiency of innovation adoption and diffusion and minimize possible negative results caused by innovation failures. Given that, it was wise for Google to initially avail the Glass to application developers and, then, the consumer launch to innovators (Haydin, 2014; Metz, 2014; Sun, 2014). Both

of developers and innovators were high-innovativeness consumers, who more preferred and tolerated the inferior Google Glass, a radical innovation. Moreover, the findings also suggest that the assessments about consumers' attitudes toward radical and incremental innovations should differentiate high- and low-innovativeness consumers to accurately reflect the truth of target markets.

In conclusion, the findings suggest that it is more justifiable to evaluate innovative brands with brand innovability, instead of brand quality, for two reasons. Firstly, brand innovability is more realistic than brand quality because brand innovability is more relevant than brand quality to profits. Secondly, brand innovability is inclusive of brand innovativeness, which ameliorates adverse effects when innovative extensions are inferior. The threat of inferior innovative extensions is less detrimental than expectation if the adverse effects on the innovative brands are assessed with brand innovability, instead of brand quality.

Limitations and future research

The three-level consumer innovativeness theory depicts that consumer innovativeness consists of the three levels of innate innovativeness, domain-specific innovativeness, and actualized innovativeness (Bartels & Reinders, 2011; Hoffmann & Soyez, 2010). Innate innovativeness is a trait-like construct with the highest level of abstraction in the three-level model. Innate innovativeness consists of cognitive, hedonic, functional, and social innovativeness. Domain-specific innovativeness describes the tendency to adopt innovations in a specific domain, whereas actualized innovativeness is the least abstract level indicating the actual adoption of new products. The discussion about consumer innovativeness of this research is based on Tellis et al. (2009) consumer innovativeness model specifying the innate innovativeness, the first level of the three-level model. Future research should investigate the moderations of brand innovability, consumer innovativeness, and extension innovativeness on the second and third levels.

Moreover, this research specifically compares the perceiver characteristic of consumer innovativeness on the adverse effects of inferior innovations. Extant research in brand research has identified several personality characteristics of perceivers on brand evaluations (e.g., consumer involvement, subjective knowledge, self-construal, self-regulatory, need of cognition). For example, Reinhardt and Gurtner (2015) report that early adopters of disruptive and sustaining innovations are more knowledgeable and involved consumers, respectively. Research should further examine the moderations of consumer involvement (Mittal & Lee, 1989) and subjective knowledge (Flynn & Goldsmith, 1999), as well as other personality traits, on the adverse effects of inferior innovations. Furthermore, Kunz and colleagues (2011) verify perceived firm innovativeness affects consumer satisfaction and loyalty from two route, the functional-cognitive and affective-experiential routes. This research examines the adverse effects of inferior innovations on brand innovability and quality mainly from the functional-cognitive route. Future research should compare the adverse effects from both routes.

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Appendix

A. Experimental treatments

Pioneer brand:

“Appsun is a leading high-tech brand in the smartphone market. The brand has pioneered a few patented breakthrough innovations of smartphone operating system and physical feature, including larger and better displays, faster video processors, slimmer and durable batteries, and faster and more sensitive cameras. The patented Appsung operating system, supporting third-party applications, is marvelously stable and user-friendly and has become the dominating platform in the smartphone market.” -- *Smartphone experts of PC Home*

Inferior radical innovation:

“The performance of the featured breakthrough innovations was surprisingly unstable and inefficient, which was disappointing.

Wireless charging. The wireless charging device fell short in capturing and connecting the wireless signals of Wi-Fi and internet for battery charging, which induced an unusual long full recharging of about 10 hours. Moreover, the wireless charging obviously heated up the device and incurred a slower operating system.

Hyper processor. The configuration and operation of the hyper video processor for gaming and movies was very unstable. Games and movies got stuck with the processor easily. In comparison, the processing speed was only 30%, rather than four times, faster than regular processors. Moreover, the unstable hyper processor consumed additional battery power and resulted in a much shorter battery life.

The two featured breakthrough innovations had consequently turned the smartphone experience into a nightmare. Given the inferior offer of product benefits, the Appsung V6 clearly falls short compared to its rivals and is overpriced.” – *Smartphone experts of PC Home*

Inferior incremental innovation:

“The Appsung V6 is supposed to be the higher-end variant of Appsung. However, the featured 1920 x 1080 full HD screen does not make the display look better. If this is the best that Appsung has to offer in terms of innovation, then, it is safe to say that any of rivals’ Android flagships blow the Appsung devices out of the water. In terms of specs, features, and price, it’s hard to find a single aspect of the new Appsung flagship that is either powerful or innovative. The Appsung V6 flagship falls short compared to Android rivals. As a result, the new Appsung V6 is overpriced and overrated.” – *Smartphone experts of PC Home*

B. Measurement items

Product innovativeness: (Lee and O'Connor, 2003)

- (1) The technology this product incorporates was new to me
- (2) The benefits this product offers were new to me.
- (3) The product features are novel/unique to me.
- (4) This product introduced many completely new features to the market
- (5) This product offers dramatic improvements to existing product features
- (6) The knowledge required to use this product was new to me
- (7) I need to learn how to use this new product.
- (8) I tend to resist adopting this new product.
- (9) I needed to change my behavior in order to adopt this product.

Brand innovability: (Schreier et al., 2012)

- (1) In my opinion, the innovation ability of this company is high/low.
- (2) In my opinion, the innovation ability of this company is weak/strong.
- (3) In my opinion, the innovation ability of this company is poor/excellent.
- (4) In my opinion, this company has the ability to develop really innovative new products.
- (5) In my opinion, this company is in the position to derive very original product ideas.
- (6) In my opinion, this company has a large potential to foster creativity.
- (7) In my opinion, this company can create very interesting new products.

Consumer innovativeness: (Tellis et al., 2009)

- (1) I like being exposed to new ideas. (*Openness-Stimulus variation*)
- (2) I hate any change in my routines and habits. (r) (*Openness-Habituation*)
- (3) I constantly find new ways of living to improve over my past ways. (*Openness-Variety seeking*)
- (4) I enjoy the novelty of owning new products. (*Enthusiasm-Novelty seeking*)
- (5) Purchasing new products takes too much time and effort. (r) (*Reluctance-Effort*)
- (6) I relish the gamble involved in buying new products. (*Enthusiasm-Risk taking*)
- (7) New products are getting shoddier and shoddier. (r) (*Reluctance-Nostalgia*)
- (8) Others often ask me for advice about new products. (*Enthusiasm-Opinion leadership*)
- (9) Many new products allow firms or governments to spy on individuals. (r) (*Reluctance-Suspicion*)
- (10) New products have an unacceptably high price. (r) (*Reluctance-Frugality*)

Do social networks and technological capabilities help knowledge management?

Encarnación García Sánchez^{1}, Víctor Jesús García Morales¹, Rodrigo Martín-Rojas¹*

Abstract: Dynamic capabilities are currently becoming an important extension of the theory of resources and capabilities that enables companies to adapt better in the current competitive environment. This paper examines how knowledge management, a dynamic function related to management or administration of a set of knowledge flows, develops thanks to the greater dynamism of social networks. It then shows how this relationship is especially strengthened by different technological capabilities. To achieve these goals, the paper examines the main tools that permit companies to develop an ability to achieve competitive advantage relative to the technological capabilities of managers and workers, social networks and knowledge management.

Keywords: Social networks; Top management support for technology; Technological skills; Distinctive technological skills; Knowledge management.

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1. Introducción

The current environment is characterized by continuous change that is more rapid and less predictable than before. The organization's response to such change will be decisive for its future development. An inappropriate, incomplete or slow response will damage the firm and its ability to adapt and learn (Hanssen-Bauer & Snow, 1996). It is thus of vital importance that the firm be up to date with what is happening beyond its boundaries, and increasingly clear that the firm must stimulate learning and manage the resulting knowledge (Fernandez Perez et al., 2012). We therefore stress that the strategic activity of the 21st-century firm lies not in its products and services, but rather in the continuous learning of its human resources to achieve continuous improvement of workers' competencies, knowledge and abilities, as human resources are the foundation of competitive advantage (Fernandez Perez et al., 2011; Garcia, 1998; Maurer, 2001).

In addition, organizations take strategic decisions in competitive global environments in which the development of technology and technological processes are important for maintaining levels of competitiveness (Jones et al., 2000).

Technology is a strategic mechanism for improving cooperation, communication, and exchange of information and knowledge through the presence and proper use of tools or assets that foster knowledge. With technology, information flows faster and is propagated more easily throughout the organization. This study thus analyses the concept of technology through the different key technological means in the current context (Martin-Rojas et al., 2011):

A) Top management support for technology (TMS) shows the development of a work environment that supports systems of knowledge and information management. TMS can, in turn, provide the appropriate funds and resources, encourage teams and help to overcome problems, fostering multi-functional cooperation, knowledge and communication (Garcia et al., 2008).

B) Technological abilities can be understood as one of the "dimensions that distinguishes and provides the knowledge set needed to enable an essential capability" (Leonard-Barton, 1992, p. 113). This dimension of abilities spans both the specific techniques of the firm and scientific knowledge, providing the foundation for the firm's competencies and for sustainable competitive advantage in a specific firm (Teece et al., 1997).

C) Distinctive technological skills (TDC) represent "the organization's experience in mobilizing diverse scientific and technical resources through a series of routines and procedures that enable the development and design of new products and production processes" (Real et al., 2006, p. 508).

TMS, the development of technological abilities and the fostering of TDCs play an important role in accessing information and seeking internal and external knowledge sources (Jiménez et al., 2011).

In addition to technology, one must take social networks into account. A social network can perform a key role in improving the organization's capabilities, particularly in knowledge management (Dyer & Nobeoka, 2000; Liebeskind et al., 1996.). Social networks constitute a basic element for acquiring information and knowledge from the outside, to be disseminated within the organization (Fernandez Perez et al., 2012).

2. Theoretical Framework

This research focuses on tools within the reach of the organization that permit it to achieve competitive advantage related to technological variables, social networks and knowledge management. It does so by using the theoretical framework of the resource-based view (Barney, 1991) and the theory of dynamic capabilities (Eisenhardt & Martin, 2000; Teece et al., 1997).

With the resource-based view, one must take into account two fundamental issues. First, resources are distributed heterogeneously among

(1) Business Administration Department at Granada University (Spain).

*Corresponding author: encags@ugr.es



different firms; second, resources persist over time. That is, organizations possess a set of resources and capabilities that are more or less valuable, which permit them to obtain a sustainable competitive advantage. The resources and capabilities must therefore be valuable, rare, difficult to imitate and difficult to replace (Barney, 1991).

Despite the valuable contribution of the resource-based view, various studies have criticized its static vision, indicating the need to complement it with the dynamic capabilities perspective.

Organizations are conscious that the conditions that surround them are those of changing and turbulent environments where competition is very strong. Factors change with increasing speed, technological advances cause more rapid innovations, etc. In the face of such circumstances, it is quite difficult for organizations to maintain the competitive advantage achieved in the past unless they adapt to the changes. The theory of dynamic capabilities is grounded in the idea that only firms that can develop dynamic capabilities will be able to generate sustainable competitive advantage (Teece et al., 1997).

According to this theoretical framework, and taking into account the definitions of technological variables studied, a dynamic integrating capability can be assimilated that enables reconfiguration of internal competencies and promotion of the organizational changed needed based on the demands of the environment. Social networks, in turn, can be analysed as "the links that connect a specific set of people or social actors" (Seibert et al., 2001, p. 220). Finally, we find an abundant literature on knowledge management that defines it as a basic pillar for development of dynamic capabilities and a key strategic factor supporting the search for collaborative learning and communication (Jiménez et al., 2011). Organizations thus need knowledge management to adapt to the changes in the environment and to respond properly to existing uncertainty. For this reason, knowledge management is considered as a dynamic capability for the organization (Zahra & George, 2002).

3. Social Networks and Knowledge Management

As indicated above, social networks can be analysed as the links that connect a specific set of people or social actors (Seibert et al., 2001). Research on social networks suggests that the links in these networks enable collaborative work and exchange of ideas, information and knowledge among the members who compose them (Fernandez Perez et al., 2012; Flaster & Spiess, 2008), as well as generation of solutions and identification of problems and opportunities (Kijkuit & Van Den Ende, 2007). As the largest social networks are efficient for accessing a large quantity of new information and knowledge (Burt, 1992), many authors stress the importance of mechanisms for organizational integration that permit assimilation of knowledge from outside the organization so that this knowledge can be transformed and exploited (Cohen & Levinthal, 1990).

Knowledge management, in turn, is defined as identification and exploitation of the collective knowledge of an organization to help the entity to compete (Alavi & Leidner, 2001). In recent years,

organizations' interest in knowledge management has grown, as it represents a means of obtaining greater benefits and a source of sustainable competitive advantage. Knowledge management encompasses a set of activities that enable the organization to create value from the knowledge assets the firm possesses (Alavi & Leidner, 2001).

Knowledge management thus involves the transformation and management of all knowledge flows and is responsible for the administration of all intangible assets that contribute value to the organization in achieving essential and distinctive capabilities and competencies (Fernandez Perez et al., 2011). In conclusion, one could say that knowledge management is a dynamic function related to the management or administration of a set of knowledge flows (Bueno, 1999).

The literature includes various studies that argue the benefits gained from social networks (e.g., Burt, 1992; Fernandez Perez et al., 2012; Kijkuit & Van Den Ende, 2007; Obstfeld, 2005; Powell, 1990; Zucker, 1991). And the presence of these contacts can contribute very significantly. First, one can access extensive sources of information and improve the levels of quality, relevance, and opportunity of this information. Social networks are more efficient in providing valuable information on markets or even internal hierarchical structure, where communication difficulties can occur (Powell, 1990). Second, they provide solidarity and trust, since having strong shared norms and beliefs reduces the need for control of information obtained and provides incentive for the establishment of knowledge flows. Despite these results, social networks can generate risks that in some cases outweigh the benefits they can yield. The first risk comes from the type of information accessible, since obtaining this information requires considerable investment in establishing and maintaining these relationships. Second, as to the risks of solidarity and trust, the presence of strong solidarity among the members of a group can limit flows of new ideas and lead to a closed mentality, even reducing the group's entrepreneurial activity, growth and development (Fernandez Perez et al., 2011).

A social network can thus play a key role in improving the organization's capabilities, especially in knowledge management (Dyer & Nobeoka, 2000; Liebeskind et al., 1996). As social networks constitute a basic element for acquisition of information and knowledge from outside the organization, which can then be disseminated within the organization, we can affirm that knowledge management and social networks are closely related (Fernandez Perez et al., 2012).

4. Technological variables, Social Networks and Knowledge Management

Technological variables play a crucial role in knowledge management, due to their strategic capability to support communication and the search for knowledge, and to stimulate collaborative learning (Hargadon, 1998; Martin-Rojas et al., 2013). Among these technological assets, support for technology management, technological abilities and distinctive technological capabilities fosters creation of an organizational culture that seeks to identify opportunities and generate new ideas, knowledge and concepts (Garcia-Sanchez et al., 2016).

Such creation and acquisition of knowledge can come from exploring the environment, through technological media or interaction with agents, through technology systems or networks. By means of interactions with others, firms can access external knowledge and combine it with existing knowledge. These relationships between organizations include the contacts that a firm may have with external organizations, including customers, suppliers, investors, the government, institutions, etc. (Dyer & Singh, 1998; Larson, 1992). Luo (2001) indicates that network ties between local Chinese managers and foreign managers with different culture and diverse experience and management abilities increases the managers' willingness to develop new knowledge. The knowledge management process thus requires collaboration among network members to carry out a specific task in a specific time period (Powell et al., 1996). Along the same lines, Dyer and Nobeoka (2000) find that learning teams in networks of Toyota suppliers contribute to the articulation of new practices by increasing trust and capabilities to advance together in a new direction.

Further, technological variables provide key support for the exchange and exploitation of knowledge. Intranet, extranet, virtual private networks (VPN) and Ethernets, for example, combine technologies and services, enable construction of a digital environment in which new knowledge is constantly created, and permit rapid dissemination of this knowledge and processes and their exploitation throughout the organization (Garcia-Sanchez et al., 2015). Organizations that invest in technological assets to support knowledge exchange among the members of virtual groups or teams contribute not only to obtaining greater yield from the knowledge but also to developing the organization's knowledge management capability (Young-Choi et al., 2010). Technological variables enable members of work teams to interact with each other, not only to transform and transfer knowledge, but also to solve complex problems and invent new solutions (Boland & Tenkasi, 1995; Martin-Rojas et al., 2013). A positive relationship exists among technological variables, social networks and knowledge management, since firms must assimilate this knowledge in order to learn from external relationships, recognize the new utility of information and knowledge, and thus apply it to commercial ends.

5. Conclusions

In recent years, the business environment has become more competitive, due to globalization, rapid technological changes and greater sophistication in the behaviour of customers and employees (Jiménez et al., 2011). To face these changes, firms innovate through a process of continuous learning through which they generate new competencies and knowledge (Md Zahidul et al., 2009). Today, knowledge management is a necessity rather than an option if firms wish to maintain a competitive advantage (Fernandez Perez & Gutierrez-Gutierrez, 2013).

Networks of social relationships are an important resource for organizations. Since they are what link us to other groups, they can condition the firm's action to a great extent. Through networks, the organization acquires information and knowledge, fundamental resources for competitiveness and survival in today's knowledge society. A greater number of contacts generates a greater number of

perspectives. This diversity of views contributes to knowing more ideas and creating new ones (Burt, 1992; Obstfeld, 2005), although it also requires greater involvement of the organization's administrators in management of these ideas, due to the size and complexity involved.

It is thus important, even crucial, that organizations invest in technological assets. Managers must invest continuously and substantially in developing knowledge management and learning in the organization and create incentives for the creation and development of a social network adequate to the organization's interests or competitive needs. It is crucial to have people who are trained and capable of accessing new and relevant information and knowledge, thereby contributing to improvements in the firm's performance (Collins & Clark, 2003; Martin-Rojas et al., 2013).

As a result, organizations must foster the development of environments characterized by collaborative work and trust, in which each employee can edit content and documents, and interact with other members of the organization at any moment from any place. Organizations must invest in tools and social networks to design, modify and execute work flows with inter-hierarchical lines of communication among the organization's members. Such flows will enable free circulation of ideas from different processes in the firm or in advanced search engines to capture and apply external knowledge and stimulate innovation, thereby increasing the organization's performance.

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Biographical Notes

Encarnacion Garcia-Sanchez is Assistant Professor of Management and Business Economy at Granada University, in the South of Spain. She current research interests include knowledge management, organisational learning, information technologies, technological distinctive competencies, corporate entrepreneurship

and organisational performance. She has published in *Industrial Management & Data System*, *Journal of Engineering and Technology Management*.

Víctor J. García Morales is Professor of Management, Business Economy and Environmental Issues in the Business Administration Department at Granada University (Spain). He received his PhD in Organisational Learning and Knowledge Management at Granada University. His current research interests include organisational learning, innovation, new technologies and corporate entrepreneurship and organisational performance. He has published in some journals such as: *British Journal of Management*, *Technovation*, *Industrial Management & Data Systems*, *Production Planning and Control*, *International Journal of Human Resource Management*, *Teaching and Teacher Education*, *International Journal of Manpower*.

Rodrigo Martín Rojas Assistant Professor of Management and Business Economy at Granada University, in the South of Spain. His current research interests include personal IT innovativeness, high technology based firms, new technology, Information Technologies, technological distinctive competencies, tourism organisations, family business, corporate entrepreneurship and organisational performance. Recently, he has published in journals such as *Industrial Management & Data Systems*, *Engineering Economics*, *Journal of Knowledge Management*, *International Journal of the Academy of Organizational Behavior Management* or in books such as *Handbook of Sustainable Management*.

Innovación como campo de estudio en Latinoamérica 2010-2017: Brasil, Chile y México

Rubén Oliver^{1*} y Federico Stezano¹

Resumen: Es objetivo de este trabajo explorar a la innovación como tema de estudio en Brasil, Chile y México, durante 2010-2017. Se recurre a la búsqueda de *innovation* y algunas variantes como tema de búsqueda en la base de datos Scopus. A partir de esa recopilación se ofrecen cuatro indicadores: se identifican áreas de conocimiento que concentran las publicaciones; algún grado de interdisciplinariedad del tema por país, que da una noción de difusión del tema y clústeres de conceptos asociados a la innovación que son relevantes para cada país. Se encuentran diferencias entre países: el tema es más interdisciplinario en México, pero en Brasil se aborda con mayor profusión y sistematicidad con respecto a Chile y México.

Palabras clave: innovación; campo de estudio; Latinoamérica.

Abstract: The objective of this work is to explore innovation as a subject of study in Brazil, Chile and Mexico during 2010-2017. It is used to search for innovation and some variants as a search topic in the Scopus database. Based on this collection, four indicators are offered: areas of knowledge are identified that concentrate publications; Some degree of interdisciplinarity of the theme per country, which gives a notion of diffusion of the theme and clusters of concepts associated with innovation that are relevant for each country. There are differences between countries: the subject is more interdisciplinary in Mexico, but in Brazil it is dealt with more profuseness and systematicity with respect to Chile and Mexico.

Keywords: innovation; field of study; Latin America.

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Introducción

El estudio de la innovación se remonta a la obra pionera de Schumpeter y, desde entonces, se ha estructurado una comunidad y un ambiente institucionalizado que le da carácter científico y es socialmente organizado. El trabajo de Fagerberg, Fosaas y Sappasert (2012) explora profusamente la base de conocimiento de la innovación y evidencia la sistematización de su estudio desde los años sesenta del siglo pasado, manifiesto en publicaciones, autores, temas, instituciones académicas y espacios de difusión e identificación de una comunidad temática. Podría decirse que la estructuración de la disciplina ha ocurrido relativamente rápido en años recientes, en virtud de que Fagerberg y Verspagen en 2009 reportaban una organización social temática en círculos para los estudios de la innovación, en relación con la estructura imperante mejor consolidada en el campo de la gestión estratégica, para los mismos períodos.

La innovación no escapa a la región latinoamericana como objeto de investigación, en razón de lo cual este trabajo tiene por objetivo explorar el concepto como tema de estudio en Brasil, Chile y México, durante el periodo 2010-2017, para tener un acercamiento a los tópicos asociados a la innovación que son relevantes en cada país. ¿Cuál es la relevancia de abordar a la innovación como tema de estudio? ¿Qué se puede decir al respecto a partir de la revisión de las publicaciones científicas, particularmente a partir de los temas asociados a la innovación? ¿Qué puede evidenciarse para el caso de contextos particulares que comparten el mismo objeto de estudio?

Estas interrogantes rondan el presente trabajo y se fundamentan en la necesidad eminentemente académica de identificar el abordaje analítico de la innovación, en función del contexto socio-económico y cultural de su producción.

Esta investigación, basada en información recabada en la base de datos científica Scopus, posee un carácter exploratorio dado que exhibe diferencias significativas entre países por cuanto hace al registro de publicaciones e investigadores. Esto dificulta la posibilidad de ofrecer resultados robustos (como los que podrían provenir de trabajos basados en metodologías de análisis factorial por ejemplo) que permitan alcanzar una mayor profundidad explicativa sobre la incidencia de determinados factores críticos que determinan los ritmos y tendencias de la producción y publicación científica. No obstante, los datos a los que ha podido acceder este trabajo permiten realizar un análisis complejo de la temática con base en cuatro indicadores: (i) uno de conglomeración del tema, en función de las áreas de conocimiento en que se publica el tema innovación; (ii) y (iii) dos indicadores que buscan un acercamiento a la difusión del tema, vista desde la interdisciplinariedad y (iv) un último que agrupa clústeres de conceptos asociados a la innovación.

Además de la introducción, en el segundo apartado se habla de la innovación abordada como tema de estudio en dos vertientes: una cognitivo-política y la otra en su vertiente metodológica que deriva de los estudios bibliométricos. La tercera parte expone la metodología de la investigación. Luego se exponen resultados y un apartado final presenta la discusión y conclusiones del trabajo.

Subdirección de Investigación y Posgrado, Centro de Investigaciones Económicas, Administrativas y Sociales, Instituto Politécnico Nacional, Ciudad de México, México

*Autor de correspondencia: neburevilo@gmail.com



La innovación como tema de estudio: su contexto cognitivo-político y su abordaje metodológico

Contexto cognitivo-político

La innovación es un tema de estudio surgido en el ámbito económico y de los negocios, dada su definición como eje de la competencia capitalista en los trabajos seminales de Schumpeter. Su consiguiente configuración como campo disciplinar obedece al interés que suscitó como objeto de investigación y cuya manifestación ha sido núcleo de publicaciones y sus autores ampliamente identificados y validados como constructores de las bases de conocimiento (Fagerberg y Verspagen, 2009; Fagerberg, et. al, 2012).

Desde su origen, y con toda claridad actualmente, se puede ubicar a la innovación como tema interdisciplinario, dada su diseminación a diferentes campos de la investigación: la *Science Policy Research Unit* (SPRU), primera unidad académica orientada hacia el estudio de la innovación, se conformó de un cuerpo académico de variado origen disciplinar: ingenierías, ciencias naturales y ciencias sociales (Fagerber et. al., 2012). Rafols, Leydesdorff, O'Hare, Nightingale y Stirling (2012) ubican la naturaleza interdisciplinaria de la innovación y su correlativa inserción en las clasificaciones académicas como tema asociado a temáticas de gestión y negocios. En este trabajo, asimismo, se evidencia que para los tres países latinoamericanos analizados en este estudio la innovación aparece imbricada con áreas temáticas de las ciencias exactas, las naturales, las humanísticas y principalmente, las ciencias sociales.

El proceso por el cual la innovación adquirió su carácter disciplinario se acompañó de un proceso de cimentación de condiciones institucionales respectivas. Tal como reportan Fagerberg, Landsström y Martin (2012), luego de que suscitara interés en corporaciones no académicas (como la corporación RAND y la OCDE), el primer esfuerzo por desarrollar la base científica de la innovación ocurrió con la creación de SPRU en 1966, bajo liderazgo de Chris Freeman.

La base institucional de la innovación como tema de estudio es explicable en términos de lo que reportan autores con respecto al surgimiento de otros conceptos que se consolidan como tema de interés científico. Aldrich (2012) para el caso del concepto emprendimiento (*entrepreneurship*); Clausen, Fagerberg y Gulbrandsen (2012) para el caso de surgimiento de nuevas unidades de investigación (laboratorios, departamentos, entre otras formas) en el marco de campos científicos emergentes; Fagerberg et. Al. (2012) para el caso del concepto sociedad del conocimiento, y Nerur, Rasheed y Natarajan (2008) para el caso de la gestión estratégica, evidencian un patrón de institucionalización de conceptos que radica en una movilización de carácter político-intelectual de los investigadores. Esta movilización se deriva de la identificación del valor cognitivo de un concepto y el consecuente posicionamiento como tema digno de transformarse en objeto de estudio. Ante esta situación, los académicos posicionan el concepto en los ámbitos presupuestario, administrativo, científico, técnico, mediante la organización académica a través de conferencias,

seminarios; publicación de libros, revistas; la edificación de laboratorios, departamentos; la institucionalización de consorcios, programas de posgrado, entre otras formas organizativas.

En conjunto, alrededor de un concepto se estructura un complejo organizativo-institucional dinámico, cuya forma y movimiento dependen de cómo los académicos (actores centrales del proceso de creación y desarrollo del campo de conocimiento) conciben el alcance, las vías y la robustez del concepto como objeto de estudio. Y, por tanto, de cómo sus aportes teórico-analíticos y resultados empíricos contribuyen a la producción científica. El establecimiento de un concepto conlleva la estructuración de un discurso y sus medios de difusión, con un trasfondo cognitivo a través del cual ganar adeptos y crear una comunidad. En paralelo, también se detecta una pugna por recursos para producir y difundir conocimiento relacionado a él. Como concepto con una robustez intelectual, se piensa como actividad de largo aliento que, por lo tanto, requiere de formas organizativas manifiestas en escuelas, programas de estudio, departamentos, laboratorios, seminarios.

Por su cuenta, la industria editorial también opera desde su lógica la forma en que la producción científica se organiza para su difusión. En tal medida, contribuye a consolidar conceptos cuyo valor amerita exponerse al mundo científico. Esta situación muestra dos caras de la moneda. La primera es expuesta por Rafols et. al. (2012) quienes señalan que el abordaje de la innovación (dados su carácter interdisciplinario y orientado hacia la solución de problemas desde diferentes unidades de investigación que representan retos institucionales) se distingue por una carencia de paneles de evaluación ajustados a una base disciplinaria. De este modo la innovación, comprendida como parte de la investigación en negocios y gestión, suele enfrentar la desventaja de una evaluación sesgada, propia de la investigación interdisciplinaria con respecto a la investigación disciplinaria.

La segunda cara de la moneda es consecuencia de la retroalimentación del mismo complejo organizativo-institucional. Esta forma de difusión del conocimiento obedece a los matices que adquiere el concepto mismo en el marco de las diversas disciplinas para las que observa significatividad. Así, se encuentran publicaciones que específicamente abordan el tema de la innovación a la vez que también se amplía su estudio hacia temas colaterales que se valen de su valor explicativo. Esto potencia el tema en sí mismo, al expandirlo a campos de estudio fuera del ámbito de los negocios y la gestión.

La tensión que subyace en estas distintas perspectivas es reflejo de la lógica social específica del mundo de la ciencia y sus subcampos especializados. En última instancia así se hacen más evidentes los conflictos entre dos fuerzas: (i) las que intentan consolidar en las agendas de los campos científicos los conceptos ya predominantes y (ii) las nuevas nociones, heterodoxas, que cuestionan los conceptos dominantes en el paradigma y construyen nuevas revoluciones científicas en el campo (Merton, 1964). Estas tensiones permanentes, muestran que la elaboración científica implica una elaboración social de la realidad y que el ámbito o campo científico emerge como un espacio conflictivo a su interior y en sus límites con campos cercanos (Bourdieu, 2000).

En el caso de Latinoamérica, la segunda posguerra generó un ambiente propicio para la institucionalización del estudio de los procesos de desarrollo en ciencia, tecnología e innovación en Argentina, Brasil, México y Chile. En esos años distintos apoyos de política crearon facultades de ciencias sociales y consejos nacionales de ciencia y tecnología (Vessuri, 1987: 520-523).

Desde fines de los 60, se consolida un enfoque crítico cuyo discurso enfatiza el análisis del subdesarrollo tecnológico de la región y lleva las temáticas de la relevancia de la ciencia y la tecnología en la sociedad y la industria. Desde mediados de los años 70 y los 80 el interés se comienza a centrar en nuevas temáticas: las instituciones centrales de la innovación, el rol de las comunidades científicas, las evoluciones y tensiones disciplinarias, los análisis de las políticas científicas, así como el estudio de los vínculos existentes entre la innovación tecnológica y la industrialización de la región (ídem: 524-545).

A partir de los finales de los años 80 y los 90 comienzan a re-pensarse los ejes centrales de los estudios latinoamericanos sobre la innovación. En este marco se consolidan los trabajos de corte constructivista, analíticos de procesos de desarrollo científico y tecnológico desde enfoques de redes de conocimiento o de Triple Hélice. En paralelo se impulsa una fuerte producción de estudios de sociología e historia de la ciencia y la tecnología, apoyados en programas de investigación de base empírica. En términos generales además desde esos años hubo un predominio por el estudio de objetos más específicos desde enfoques metodológicos y epistemológicos basados en estudios de caso.

Los temas más recientes de investigación vinculada a la innovación de este siglo muestran similitudes con ciertos temas relevantes para las comunidades europea y norteamericana: la mercantilización de las universidades y el rol de estudios en ciencia y tecnología en las sociedades (Kreimer et al., 2015).

Abordaje metodológico

Desde una perspectiva metodológica, el estudio del surgimiento y posicionamiento de conceptos como temas de estudio se apoya de la explotación de recursos bibliométricos, cuya base radica en el conteo de ocurrencia y co-ocurrencia de conceptos temáticos y autores, en tres vertientes. La primera vertiente se posiciona en torno a técnicas de análisis factorial, tal como en los trabajos de Di Stefano, Peteraf y Verona (2010) para el estudio del concepto capacidades dinámicas; Nerur, Rasheed y Natarajan (2008) para la identificación de la estructura de la gestión estratégica como campo de estudio y Ponzi (2002) para la identificación de estructura e interdisciplinariedad de la gestión del conocimiento. La segunda vertiente se basa en la representación temática y de autores en mapas a partir de los cuales se identifican temas y autores organizados en clústeres y relaciones entre clústeres, como en los trabajos de Rafols et. al. (2012) para probar la forma en que los *rankings* de revistas suprinen la investigación interdisciplinaria, y van Eck y Waltman (2010 y 2014), quienes desarrollan un algoritmo para la realización de mapas bibliométricos mediante el programa VOSviewer; en esta misma línea se encuentra el trabajo de Merigó, Cancino, Coronado y Urbyano (2016), quienes a partir del

índice H, el conteo de citas, la identificación de nacionalidad de los autores, organizan una clasificación para identificar regiones, países y redes de coautorías por nacionalidad para el tema de la innovación. La tercera vertiente es explotada en el trabajo de Ramos y Ruiz (2004), quienes realizan el conteo de citas para identificar por frecuencia de citas los documentos más relevantes, y el análisis de co-citas para identificar los pares de documentos que son percibidos como similares, mediante el uso del r de Pearson como medida de similitud, para identificar la estructura intelectual de la investigación en gestión estratégica.

Tanto el análisis factorial, como la definición de medidas de similitud mediante estadísticos como r de Pearson presuponen una mayor robustez en la información recopilada, en términos de la cantidad de publicaciones, citas, co-citas y clusterización de información. Por tanto, tal como se señaló previamente, este trabajo observa un carácter exploratorio, esencialmente con respecto a los conceptos que son relevantes en la investigación sobre innovación. En virtud de lo cual se eligió una estrategia basada primeramente en la conglomeración de áreas de conocimiento que agrupan el tema de la innovación para dar una noción general del grado de interdisciplinariedad del tema, así como en la agrupación de conceptos en clústeres, para identificar temas que son relevantes en los estudios de la innovación, como a continuación se explicita.

Metodología

En la base Scopus se buscaron las publicaciones (libros y capítulos; conferencias; artículos de revista) que en el título reportaran las palabras *innovation*, o *innovative*, o *innovating*, o *innovate*, como criterio conceptual a partir del cual contabilizar el número de publicaciones en temas de innovación, para el periodo de 2010-2017.

Como siguiente criterio de búsqueda se delimitó el país de afiliación del investigador a los países en estudio: Brasil, Chile y México. En este caso, aunque una publicación tenga a varios autores, conque uno de ellos manifieste su filiación en una institución de esos países, sin importar el orden en que aparece como autor, se contabiliza como válida para el conteo de publicaciones que abordan el tema de la innovación.

Con esos criterios de búsqueda, al 8 de abril de 2017 se identificaron 815 publicaciones para Brasil, 87 para Chile y 177 para México (cuadro 1).

Cuadro 1. Tipo de documento			
	Brasil	Chile	México
Artículo	597	67	108
Documento en conferencia	134	14	35
Capítulo de libro	76	5	27
Libro	8	1	7
Total	815	87	177

Fuente: Scopus

A partir de esa búsqueda se elaboran cuatro indicadores, que a continuación se discuten.

Primer indicador: Conglomerados de áreas de conocimiento donde se concentran las publicaciones

Haciendo uso de las mismas herramientas analíticas de Scopus se identificaron las áreas de conocimiento en que la misma editorial agrupa las publicaciones. Esta agrupación se presenta en los resultados, organizada por conglomerados (tres), organizados mediante el método de vinculación completo, por medición de distancia euclíadiana, por lo que la distancia entre clústeres está dada en atención al grado de disparidad entre componentes de los clústeres.

Segundo indicador: factor de interdisciplinariedad

Luego, a partir del número de publicaciones, a sabiendas de que una misma es clasificada, de acuerdo con el criterio de Scopus, en más de un área de conocimiento, se calculó lo que denominamos factor de interdisciplinariedad, que es el cociente del total de clasificaciones en áreas de conocimiento en que aparecen registradas las publicaciones, entre el total de las publicaciones:

Si planteamos que a es la suma de las publicaciones x_i ,

$$a = \sum x_i \quad (1)$$

Dado que con respecto a x_i puede ser posible que

$x_i \in A$, y/o $x_i \in B$, y/o , donde A y B representan áreas temáticas que pueden incluir a una misma publicación x_i , entonces:

$\Sigma_{x_i} A \cup B \cup \dots + \Sigma_{x_i} A \cap B \cap \dots$, es igual al número de publicaciones dadas las áreas temáticas A , B ... en que se clasifican las publicaciones x_i , una por una.

De modo que el factor de interdisciplinariedad c es igual a:

$$c = \frac{\Sigma_{x_i} A \cup B + \Sigma_{x_i} A \cap B}{a} \quad (2)$$

Ahora bien, dado (1) y que cuando , (2) se transforma:

$$c = 1 + \frac{\Sigma_{x_i} A \cap B}{\Sigma_{x_i} A \cup B} \quad (3)$$

De modo que el factor de interdisciplinariedad ; y a mayor c , mayor interdisciplinariedad, en este caso, de la innovación.

Tercer indicador: Índice de concentración disciplinaria

Como siguiente indicador, se calcula el índice de concentración disciplinaria d , el cual muestra la proporción que representa el área temática x_i que con mayor frecuencia registra publicaciones, respecto al número de publicaciones a (ecuación 1), dadas las áreas temáticas en que se clasifican las publicaciones, y que se representa como y_i

$$d = \frac{\max_{x_i \in a} x_i}{y_i} \quad (4)$$

Donde $y_i = \Sigma_{x_i} A \cup B \dots + \Sigma_{x_i} A \cap B \dots$

Cuarto indicador: clústeres de conceptos

Para la elaboración de los clústeres de conceptos se recurre al algoritmo del programa VOSviewer. Éste es una herramienta informática para representación gráfica de mapas bibliométricos (citas, co-citas, autores, conceptos), cuya fortaleza y distintivo radica precisamente en que, a diferencia de otros programas, mediante las representaciones robustece la presentación de resultados (van Eck y Waltman, 2010).

Los clústeres de conceptos que se presentan en este trabajo derivan del título de las publicaciones en el tema de la innovación. La organización de conceptos en clústeres se realiza en el programa a través del cálculo de la fuerza de asociación de conceptos, con base en una matriz de co-ocurrencia: dos conceptos co-ocurren si aparecen en un mismo documento y se les otorga un peso relativo con respecto a la ocurrencia total de ambos conceptos en todos los documentos:

$$s_{ij} = \frac{c_{ij}}{w_i w_j} \quad (5)$$

Donde c_{ij} denota número de co-ocurrencias de los conceptos i y j , mientras que w_i y w_j indican el número de ocurrencias de los conceptos i y j . La representación de mapas implica el cálculo de otros algoritmos para definición de cercanía de los conceptos, explicados en van Eck y Waltman (2010).

Resultados

Conglomerados de áreas de conocimiento

Mediante el programa MiniTab se realizó el ejercicio de conglomeración de áreas de conocimiento en que agrupan las publicaciones de los tres países. Como previamente se señaló, se conglomeró por método de vinculación completa, a través de la medición de distancia euclíadiana, lo que gráficamente se muestra en el dendrograma (gráfica 1).

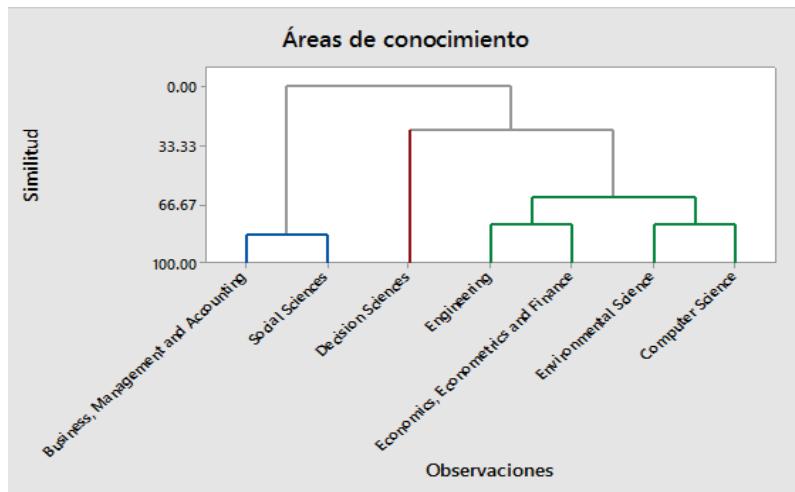
Se decidió organizar la información en tres conglomerados, a partir de las siete áreas de conocimiento en que mayormente se concentran las publicaciones brasileñas, conforme a la información organizada en el cuadro anexo A1. Allí se ve que excepto por lo referente a Ciencia de las Decisiones el resto de las áreas de conocimiento coinciden para los tres países.

Uno de los conglomerados se forma del conjunto de publicaciones que se clasifican en las áreas de Negocios; Gestión y Contabilidad (NGC), y Ciencias sociales (CS), en consecuencia con el origen mismo del concepto en el ámbito de los negocios y sus derivaciones hacia nociones relacionadas con el desarrollo social, la sustentabilidad o la educación, según se verá en los clústeres de conceptos (cuadro 4). Un segundo conglomerado agrupa publicaciones en el área Ciencias de Decisiones (CD), en virtud de que en Brasil es la tercera área de conocimiento que más concentra publicaciones, aunque en Chile esa área de conocimiento es prácticamente marginal (cuadro anexo A1). Ambos conglomerados trazan una perspectiva de la investigación de la innovación en un ámbito empresarial-social.

El tercer conglomerado, el más nutrido por áreas temáticas, aunque no por cantidad de publicaciones, se forma con las áreas Ingeniería (I); Economía, Econometría y Finanzas (EEF); Ciencias Ambientales (CA), y Ciencias del Cómputo (CC). Es relevante to-

mar en consideración de que en este tercer conglomerado el tema de la innovación parece identificarse mayoritariamente con áreas de aplicación técnicas (ingeniería, ciencias ambientales y de cómputo).

Gráfica 1. Conglomerados de las áreas de conocimiento en que se agrupan las publicaciones sobre innovación



Fuente: Elaborado a partir del software MiniTab 17, con datos de publicaciones de la base Scopus

Factor de interdisciplinariedad e índice de concentración disciplinaria

De acuerdo con las definiciones que se establecieron de manera previa, el índice de interdisciplinariedad busca establecer una medida de la diversidad de áreas de conocimiento en que se registran las publicaciones para un tema en particular. Se definió que, a mayor índice, un tema tiende a registrarse como interdisciplinario; a menor índice un tema tiende a registrarse como disciplinario. De la comparación entre países, el cálculo del índice señala que en México el tema innovación muestra una mayor interdisciplinariedad (cuadro 2).

En este caso, México es el país cuyas publicaciones en innovación registran una mayor interdisciplinariedad, aunque su índice de concentración disciplinaria es superior al de las publicaciones chilenas.

Cuadro 2. Factor de interdisciplinariedad e Índice de concentración disciplinaria

País	Factor de interdisciplinariedad	Índice de concentración disciplinaria
Brasil	1.80	0.367
Chile	1.74	0.285
México	1.84	0.291

Fuente: Elaboración propia con base en Scopus

La relevancia de ambos indicadores radica en que pueden manifestar la amplitud de difusión de un tema entre áreas del conocimiento, dado el número de publicaciones. El cuadro A1, por ejemplo, da cuenta de la publicación de trabajos sobre innovación en áreas que aglutinan temas de salud, física y química.

Clústeres de conceptos

De acuerdo con la información del cuadro 1, la cantidad de publicaciones brasileñas en temas de innovación es mayor 9.4 veces que la chilena y 4.6 veces superior que la mexicana. Consecuentemente, dado que los clústeres se forman a partir de las co-ocurrencias, para un mismo número de éstas, la cantidad de clústeres y sus conceptos asociados para Brasil es superior: a mayor cantidad de publicaciones, la co-ocurrencia de conceptos asociados a la innovación es mayor. De manera que, para efectos de comparación de clústeres y conceptos, se optó por realizar el ejercicio de agrupación de clústeres contando, para el caso de Brasil, a partir de 10 co-ocurrencias; para el caso de Chile de dos y para México de tres. Esto es: a través del programa VOSviewer, se identificaron clústeres a partir de parejas de conceptos que co-ocurren un mínimo de 10 veces para el caso de publicaciones brasileñas, dos veces para el caso de las chilenas y tres para las mexicanas. En resumen, el cuadro 3 muestra la cantidad de conceptos y clústeres identificados a través del programa de cómputo.

Cuadro 3. Conceptos y clústeres: resumen

País	Conceptos	Clústeres
Brasil	37	7
Chile	38	7
México	31	6

Fuente: Elaborado a partir de VosViewer, con datos de Scopus

El cuadro 4 presenta los clústeres de conceptos derivados de los títulos de las publicaciones que hablan de innovación. Para el caso de Brasil la organización de conceptos en clústeres denota dos intereses

principales de investigación: (i) en una perspectiva de los negocios y la gestión y las ciencias de decisiones, los conceptos se orientan hacia el estudio de los modelos y estrategias de innovación (clústeres 1, 2 y 3) y (ii) en una perspectiva de las ciencias sociales y la sustentabilidad, se aprecian un conjunto de conceptos asociados a la vertientes sociales de la innovación, como la innovación social, el desarrollo y la sustentabilidad (clústeres 3, 4 y 5).

Para el caso de Chile se destacan dos hallazgos: (i) la agrupación de conceptos en el ámbito de las ciencias sociales y sus vertientes sobre la educación, ciencia, tecnología, así como la innovación y la política

pública (clúster 1), (ii) un segundo grupo de conceptos aglutinados en torno a la publicación en áreas de negocios y gestión (clústeres 2, 3, 4), 3) referencias sectoriales, como los servicios, en particular los financieros, y las TIC (Clústeres 5 y 6).

Por su cuenta, en el caso de México se manifiesta una producción de publicaciones en una perspectiva de las ciencias sociales manifiesta en la reflexión sobre tema del desarrollo, la ciencia, la tecnología y la política de innovación, con algún grado de imbricación con temas sobre gestión de la innovación (Clústeres 1 y 2) y un grupo de publicaciones cuya base es la gestión de la innovación (Clústeres 3 y 4).

Cuadro 4. Clústeres de conceptos de los títulos de publicaciones sobre innovación

Brasil						
Clúster 1	Clúster 2	Clúster 3	Clúster 4	Clúster 5	Clúster 6	Clúster 7
Brazil	Inovao	Innovation	Case	Impact	Knowledge	Science
Analysis	Case study	Knowledge management	Challenge	Practice	Process	Technology
Company	Uma	Relationship	Development	Sustainable development	Research	
Brasil	Caso	Study	Management	Technological innovation		
Innovation system	Estudo	Sustainability	Social innovation	Use		
Role						
Strategy						
Innovation management						
Evidence						
State						
Innovation process						
Contribution						

Chile						
Clúster 1	Clúster 2	Clúster 3	Clúster 4	Clúster 5	Clúster 6	Clúster 7
Construction	Approach	Context	Business sustainability	Effect	Chilean model	Case
Higher education	Determinant	Efficiency	Challenge	Evidence	Development	Chile
Information	Innovative practice	Innovation	Decade	Financial innovation	ICT	
Innovación	Patent	Knowledge	Lesson	Productivity	TIC	
Innovation policy	Practice	Model	Women entrepreneur	Service		
Latin America	Study	Role				
Science	Technological innovation	Sequential innovation				
Technology						

México						
Clúster 1	Clúster 2	Clúster 3	Clúster 4	Clúster 5	Clúster 6	
Mexico	Technology	Innovación	Performance	Innovation	Design	
Development	Science	Innovation system	Role	Entrepreneurship	Research	
case	Innovation policy	Latin America	Knowledge	Sustainability	State	
Process	Challenge	Technology management	Pymes			
Technological innovation	Inclusive development	Empirical study				
Case study	Latin American experience	Process innovation				
Lesson						
Eco innovation						
Educational innovation						

Fuente: Elaboración propia, con base en el programa de cómputo VosViewer

Discusión y conclusiones

Se argumentó que la conformación de un concepto como tema de investigación deriva de una forma político-cognitiva de proceder de la comunidad científica. Esta, a su vez, es corresponsable de que el tema adquiera peso (por la cantidad de publicaciones que genera) y una condición interdisciplinaria (por la diversificación de áreas de conocimiento que reportan publicaciones) como consecuencia del poder explicativo asociado al tema.

Desde esta perspectiva, la conglomeración de las publicaciones en áreas de conocimiento en Brasil, Chile y México, indica una forma de organización del tema por las áreas de conocimiento que implica. Para los tres países, las áreas de conocimiento en que más se aglutan publicaciones son los negocios y la gestión, así como las ciencias sociales. Asimismo, se evidenció el peso de las publicaciones en el área de las ciencias de decisiones -cuyos vínculos son fuertes con las dos áreas previas- en Brasil. En consecuencia, el denominado índice de concentración disciplinaria más elevado corresponde a ese país. Inversamente, el mayor factor de interdisciplinariedad corresponde a México lo que se manifiesta en una configuración de clústeres de conceptos menos concretos (o más difusos) que en Brasil.

Estos datos, en sí mismos, arrojan una aproximación respecto al alcance de la investigación hacia la noción de interdisciplinariedad y difusión del tema: en términos absolutos la cantidad de publicaciones brasileñas es superior al de los otros dos países, pero en términos relativos (en función de la cantidad de publicaciones por país) es un tema tratado menos interdisciplinariamente cuando menos con respecto a México. La misma estructura disciplinaria arroja una identificación más concisa del contenido de los clústeres de conceptos. Si bien éstos se estructuran a partir de un algoritmo, el cálculo no es arbitrario puesto que se forman a partir de enunciaciones significativas (a partir del título de las investigaciones). En el caso de Brasil fue posible identificar tales enunciaciones con mayor claridad.

Dada la forma en que se produce y difunde, el posicionamiento de un concepto como tema de investigación requiere la acumulación de una masa crítica, encarnada en una comunidad de investigación y concretada en condiciones institucionales y organizativas. Estas condiciones son contextuales, de manera que el valor universal de un concepto como tema de estudio enfrente realidades específicas. Estas diferencias son manifiestas en el caso de Brasil, Chile y México con respecto al abordaje de la innovación como tema de estudio: en Brasil la producción científica sobre innovación es más voluminosa que en los otros dos países y allí se observa un mayor índice de concentración disciplinaria y una estructura de conceptos organizados en clústeres más específicos.

En esa perspectiva, los hallazgos de este trabajo ofrecen resultados complementarios al de Kreimer et al (2014) quienes detectan una comunidad científica en torno a un campo científico que crece sistemáticamente, incluyendo a centros de investigación bastante productivos en Argentina, Brasil y México y, en menor medida, a grupos emergentes en años recientes en Colombia, Chile, Venezuela, Uruguay, Perú, Costa Rica y Cuba.

Por su cuenta, la presente investigación observa que para los tres países el tema es relevante en el ámbito de los negocios, pero en Brasil y México es más claro su abordaje en una perspectiva social y de la sustentabilidad. En ambos países, además, se conjugan el interés de investigación tanto en perspectiva macro (sistemas de innovación, por ejemplo) como micro (gestión tecnológica). Otro hallazgo significativo alude a la significación que la producción científica sobre innovación da a la región: para Chile y México Latinoamérica es una referencia, pero no lo es para Brasil.

Los resultados obtenidos en este trabajo ofrecen un diagnóstico sobre la dinámica latinoamericana de producción científica sobre la innovación, con base en la comparación entre países de la región. En términos globales, Latinoamérica observa un relativamente importante crecimiento que la investigación en innovación. No obstante, como señalan Merigó et al (2016) el marcado liderazgo de producción científica de Estados Unidos, seguido de cerca por Reino Unido, pero muy superior a la de los países de Europa occidental y aún más respecto a otras regiones (Europa del Este, Asia, América Latina y África, respectivamente). Los resultados de este trabajo deben ser así interpretados conforme a estas marcadas diferencias inter-regionales de volumen de producción científica sobre innovación, pero especialmente considerando la creciente relevancia que va adquiriendo este tema en América Latina. Dicha importancia se refleja en la cantidad creciente de publicaciones científicas que este trabajo ha identificado en la base de Scopus para Brasil, Chile y México.

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Cuadro anexo A1

Áreas de conocimiento donde aparecen publicaciones sobre innovación (Cantidad de publicaciones por país)

Brasil	Chile	México			
Business, Management and Accounting	538	Business, Management and Accounting	43	Business, Management and Accounting	95
Social Sciences	227	Social Sciences	32	Social Sciences	70
Decision Sciences	189	Economics, Econometrics and Finance	29	Economics, Econometrics and Finance	43
Engineering	117	Engineering	12	Environmental Science	26
Economics, Econometrics and Finance	113	Computer Science	6	Engineering	19
Environmental Science	90	Environmental Science	6	Computer Science	18
Computer Science	50	Psychology	4	Decision Sciences	17
Energy	27	Agricultural and Biological Sciences	3	Arts and Humanities	8
Medicine	24	Arts and Humanities	3	Agricultural and Biological Sciences	6
Agricultural and Biological Sciences	22	Decision Sciences	3	Energy	6
Arts and Humanities	22	Energy	3	Medicine	6
Mathematics	9	Mathematics	3	Chemical Engineering	5
Earth and Planetary Sciences	8	Chemical Engineering	1	Psychology	3
Psychology	8	Earth and Planetary Sciences	1	Chemistry	2
Chemical Engineering	6	Immunology and Microbiology	1	Health Professions	1
Biochemistry, Genetics and Molecular Biology	3	Medicine	1	Immunology and Microbiology	1
Chemistry	3				
Materials Science	3				
Physics and Astronomy	3				
Pharmacology, Toxicology and Pharmaceutics	2				
Health Professions	1				
Immunology and Microbiology	1				
Nursing	1				

Fuente: Elaborado a partir de Scopus

La innovación y sus efectos: la evidencia de los sectores manufactureros ecuatorianos y argentinos

Silvana Astudillo^{1*}, Anahí Briozzo²

Resumen: El objetivo del presente estudio consiste en comparar los efectos de la innovación en el producto y en el proceso en las micro, pequeñas y medianas empresas (MIPYMES) manufactureras argentinas y ecuatorianas. Se utilizó la base de datos de la *Enterprise Survey* del Banco Mundial (Panel 2006-2010) a través de un análisis multivariado y el control de la endogeneidad de la innovación. Los resultados evidencian que la innovación en el producto y en el proceso presentan efectos significativos diferenciales en ambos países.

Palabras Clave: innovación en el producto; innovación en el proceso; efectos; Argentina; Ecuador.

Abstract: The goal of this investigation is to compare the effects of the introduction of product and process innovation activities of micro, small and medium manufacturing enterprises (MSME), in respectively Argentina and Ecuador. For this purpose, World Bank's *Enterprise Survey* (Panel 2006-2010) data are used. A multivariate analysis was applied and included the innovation as an endogenous variable. The results show that the introduction of product and process innovations have significant differential effects in both countries.

Palabras Clave: product innovation; process innovation; effects; Argentina; Ecuador.

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1. Introducción

La introducción de innovaciones en los productos y en los procesos por las empresas manufactureras sugiere varias ventajas en sus resultados, sin embargo estas ventajas podrían ser diferentes entre empresas, industrias y entre países (Metcalfe, 1998). Así, la capacidad innovadora nacional de los países latinoamericanos ha mejorado su posición relativa en los últimos años y poseen diferentes indicadores de Ciencia Tecnología e Innovación (CTI) que hacen que experimenten impactos en su competitividad, aunque la inversión en este rubro es muy limitada.

Crespi y Dutrénit (2013) plantean que en el contexto latinoamericano, la mayoría de países han implementado similares enfoques de las políticas de CTI, pero con diferentes resultados. La comparación de los impactos de la innovación en diferentes economías ilustra la heterogeneidad y la diversidad de la región, así como las tendencias de convergencia y divergencia.

Por lo expuesto, la presente investigación tiene por objetivo realizar un estudio comparativo de los efectos de la innovación del producto y del proceso en las MIPYMES (micro, pequeñas, y medianas empresas) manufactureras argentinas y ecuatorianas. El Ecuador y la Argentina poseen diferente perfil en CTI, sin embargo presentan similares indicadores de desigualdad en la región. Esta investigación aporta con una nueva evidencia empírica a la comparabilidad de los efectos de innovación en economías latinoamericanas con diferente perfil de CTI especialmente en economías como el Ecuador en donde la evidencia empírica es escasa en lo que respecta a los impactos de la innovación. En la Argentina, existen investigaciones de los efectos de

la innovación, sin embargo este trabajo se diferencia de los anteriores por el diseño metodológico y la base de datos.

A fines de analizar los efectos que generan las innovaciones en las empresas manufactureras ecuatorianas y argentinas, se utilizaron los datos a nivel de empresa con base a la *Enterprise Survey* del Banco Mundial en el periodo 2006-2010 a través de un análisis multivariado con un control endógeno de la innovación. La medición de los resultados de la innovación en las empresas manufactureras evidencia impactos por la introducción de las innovaciones en producto y en proceso, lo que sugiere enfocar la innovación como una política pública para la mejora de la competitividad en las empresas de ambos países.

La estructura del artículo describe en la sección I el marco teórico y la literatura empírica, en la sección II se exponen los datos y la metodología, en la sección III se presenta los resultados y la discusión y la sección IV algunas conclusiones sobre los efectos de la innovación en cada país.

2. Marco Teórico

2.1 Teoría de los efectos de la innovación

En referencia a los efectos de la innovación, una aportación importante la realiza Schumpeter (1934), quien menciona los efectos positivos que entraña la generación de nuevos productos y procesos. Schumpeter define a la innovación como el desarrollo de un nuevo producto o proceso por parte de una empresa y su introducción exitosa en el mercado, el desarrollo de nuevas formas de organizar los negocios, nuevas fuentes de aprovisionamiento o la explotación de nuevos mercados.

(1) Universidad de Cuenca, Cuenca - Ecuador. Unidad de Innovación y Transferencia Tecnológica.

(2) Universidad Nacional del Sur, Bahía Blanca - Argentina. Departamento de Ciencias de la Administración IIESS (UNS-CONICET).

*Autor de correspondencia: silvana.astudillo@ucuenca.edu.ec



Posterior al postulado de Schumpeter, la teórica evolucionista señala que el capitalismo está caracterizado por un proceso evolutivo asociado a la innovación. Una innovación significativa puede dar a una empresa una ventaja importante sobre otros (Nelson y Winter, 1982; Kline y Rosenberg, 1986). Malerba & Orsenigo (1996) en un estudio en siete países sobre los patrones de innovación schumpeterianos explican que existen diferencias importantes como consecuencia de los efectos específicos de cada país en relación con los sistemas nacionales de innovación y las historias específicas de las empresas e industrias en cada país.

Posteriormente, la teoría endógena del crecimiento muestra la ventaja del enfoque schumpeteriano y su tratamiento explícito de la innovación como una actividad económica distinta, se introduce el paradigma de innovación endógena en el manejo de las políticas que influyen en el crecimiento (Grossman & Helpman, 1993; Aghion, Howitt, Brant-Collett, & García-Péñalosa, 1998).

Con Lundvall (1992) emerge el enfoque de los sistemas nacionales de innovación que sostiene que la innovación es un proceso sistémico con interacciones entre todos los actores de una nación. Con respecto a las ventajas comparativas de la innovación en los productos y en los procesos, Metcalfe (1998) establece que los resultados son diferentes para cada empresa por su desempeño innovador, no existen dos empresas que innoven de la misma manera ni a la misma velocidad. De hecho, Fagerberg (2004) concluye que los esfuerzos para promover la competitividad mediante la innovación rara vez pueden entenderse al margen de lo que otros están logrando al mismo tiempo. Lo que sugiere que el desempeño innovador es diferente en las firmas, industrias, regiones y entre países.

Lundvall (2009) considera que el motivo fundamental por el cual los gobiernos nacionales implementan políticas de innovación es el supuesto que la innovación es un elemento clave para el crecimiento económico nacional.

2.2 Literatura empírica de los efectos de la innovación

Los estudios empíricos manifiestan que la innovación genera un impacto positivo en las empresas (Crépon, Duguet, & Mairesse, 1998; Lööf, Heshmati, Asplund, & Nåås, 2001; Klomp & Van Leeuwen, 2001; Sandven & Smith, 2000; García Pérez De Lema & Gálvez Albaracín, 2012, Gunday, Ulusoy, Kilic, & Alukan, 2011). Hassan, Shaukat, Nawaz, & Naz (2013) sugieren la necesidad de una investigación comparativa de los efectos de la innovación cruzando las diferencias culturales. En esta línea Dutrénil & Katz (2005) en un estudio de la innovación en Latinoamérica plantea necesario tener más conocimiento sobre la relación de los enlaces entre los esfuerzos de la innovación y resultados de innovación.

Los inputs de la innovación y la performance empresarial

Un aspecto que se presenta en la medición de los efectos de la innovación es la relación entre la innovación y sus determinantes y la relación de sus determinantes en los resultados de la empresa. Un primer aspecto que se analiza en las empresas son los factores que influyen

en la decisión a innovar y luego como estos factores influyen la innovación a través de diferentes efectos. En el estudio comparativo sobre las determinantes de la innovación en el producto y en el proceso en las empresas manufactureras en la Argentina y en el Ecuador realizado por Astudillo y Briozzo (2015) se evidencian a la investigación y desarrollo, la calidad y los recursos humanos calificados.

En este sentido, autores como Griffith, Huergo, Mairesse, & Peters (2006) señalan que existe una relación entre la investigación y desarrollo y la innovación y la productividad. Crépon, Duguet, & Mairesse (1998) manifiestan que la investigación y el desarrollo constituyen una entrada de la innovación y la participación en ventas los resultados de la innovación. Lööf & Heshmati (2002) manifiestan que el crecimiento de la productividad se correlaciona de manera positiva con los resultados de la innovación, incluso cuando se controla por el tamaño, la intensidad del uso de los factores y la destreza de la mano de obra. En este estudio, además del tamaño de la empresa se incluyen otras variables de control en el modelo con el fin de controlar los efectos de la innovación en la *performance empresarial* de las empresas que pudieran afectar el efecto de las variables independientes como la antigüedad, el género del gerente, el financiamiento externo y la competencia.

Los outputs de la innovación y la performance empresarial

El impacto de las innovaciones en las firmas sobre los resultados empresariales resulta ser variable para cada empresa. Por lo que en un esfuerzo de estandarizar definiciones sobre los efectos de la innovación se analizan algunos estudios que definen cuáles son los beneficios para los empresarios. En este sentido, el Manual de Oslo (OCDE, 2005, p.37) argumenta que es muy importante conocer porqué las empresas innovan:

Cuando se trata de innovaciones de proceso consiguen ganancias de productividad, la empresa se beneficia de una ventaja de costes sobre sus competidores. Cuando se trata de una innovación de producto, la empresa puede obtener una ventaja competitiva lanzando este nuevo producto, lo que le permite aumentar la demanda y su margen de beneficio.

Con base a estos indicadores, se presentan las variables que se persiguen en los objetivos del estudio y en la información provista en la *Enterprise Survey* del Banco Mundial. Se considera como un efecto importante el *impacto económico* de la innovación, existen algunas investigaciones que llegan a la conclusión que existen distintos objetivos perseguidos por las empresas como el incremento de las ventas, el aumento de la rentabilidad, el aumento de las exportaciones, la reducción de costos. En esta línea, Dosi *et al.* (1988), manifiestan que la innovación en el producto y en el proceso en las firmas o en las industrias implican diferentes oportunidades como beneficios económicos, aporte que concuerda con los resultados de Božić & Radas, 2006, Evangelista & Vezzani, 2010; Gómez & Calvo, 2011; Reichert & Zawislak, 2014. A este análisis, existe un cuestionamiento de Sandven & Smith (2000) que mencionan una relación entre la rentabilidad y la innovación, pero no necesariamente en términos de ganancia.

Con otro planteamiento, existen investigaciones en las industrias manufactureras, que señalan que la innovación en el producto tiene un enlace débil con las ventas de las empresas (Yeh-Yun & Chen, 2007; Gunday, et al., 2011). En referencia a las *exportaciones*, otros autores señalan que las pymes que tienen un historial de innovación son más propensos a exportar (Caldera, 2010; Martins, Goméz-Araujo, & Vaillant, 2015; Love & Roper, 2015). Por otra parte, las innovaciones permiten a las empresas reducir los costes marginales y obtener una ventaja sobre los competidores (Božić & Radas, 2006; Caldera, 2010). En relación al impacto de la innovación en el *mercado*, la innovación puede ampliar el mercado e impulsar el crecimiento de la industria de manera positiva, en este argumento Drucker (1986) plantea que una innovación produce un cambio en el mercado o en la sociedad, lo que sugiere que las empresas pueden penetrar en nuevos mercados o tener una mayor cuota de mercado, esta afirmación la plantean también Lööf, et al., 2001; Klomp & Van Leeuwen, 2001; Gómez & Calvo, 2011; Brown & Guzmán, 2014.

Con respecto a la relación de la innovación con el *empleo*, Pianta (2003) plantea que la innovación en el producto tiene un impacto positivo en el empleo y la innovación en el proceso con un efecto negativo. El efecto de la innovación de procesos en el empleo es negativo (Peters, 2008). Otro impacto de la innovación se presenta en la mejora de la *calidad* de los bienes y servicios y la obtención de certificaciones de calidad (Prajogo & Sohal, 2003; Thai Hoang, Igel, & Laosirihongthong, 2006). Los autores indican una relación positiva y significativa en particular de la innovación de procesos. Otro argumento de los efectos de la innovación como resultado de la actividad innovadora y analizada por el Banco Mundial es la utilización de menos materiales y energía por unidad producida, analizado por Gómez & Calvo (2011) en la Encuesta sobre Innovación Tecnológica en las empresas del Instituto Nacional de Estadística de España en el año 2006.

En este marco, estudios realizados sobre los impactos en el desempeño de las firmas en el Ecuador son escasos, una primera aproximación sobre los objetivos para realizar las actividades de innovación se analizan en la primera encuesta de innovación 2009-2011 (SENESCYT-INEC, 2014) que permite distinguir efectos como la mejora de la calidad de bienes o servicios, el aumento de la capacidad para producir bienes o servicios, el incremento de la participación de mercado, el aumento de la variedad de bienes o servicios, la mejora de la salud o seguridad ocupacional de sus empleados, el ingreso a nuevos mercados, la reducción de impactos ambientales, la reducción de costos.

En la Argentina, existen algunos estudios empíricos previos sobre los resultados de los esfuerzos de la innovación. Así por ejemplo, un estudio sobre la innovación y productividad en las compañías manufactureras argentinas en los años 90 realizado por Chudnovsky, Lopez, & Pupato (2004) encuentra una relación entre el rendimiento de las empresas a través de una variedad de indicadores, como la mano de obra y la productividad total de los factores, los beneficios, las tasas de crecimiento de las ventas, los activos totales, las exportaciones a través de las determinantes como la investiga-

ción y desarrollo y el tamaño. Planteamientos similares sobre los impactos de la innovación han sido considerados en los trabajos de Lugones, Suárez, & Gregorini, 2007; Lugones, Suárez, & Le Clech, 2007; Anlló & Suárez 2009 que analizaron las encuestas de innovación elaboradas por el Instituto Nacional de Estadísticas y Censos- INDEC- de los períodos 1998, 2003, 2006 con la conclusión que la innovación genera un impacto positivo en las ventas, en las ganancias, en las exportaciones, en los salarios de los trabajadores y en sus características, además permite reducir los costos y aumenta la cuota de mercado.

En este sentido, con base a los argumentos anteriores se definen a continuación las siguientes hipótesis:

H1: La innovación en el producto genera impactos en la performance empresarial en ambos países tras controlar su endogeneidad

H2: La innovación en el proceso genera impactos en la performance empresarial en ambos países tras controlar su endogeneidad

3. Metodología

Para los propósitos de la investigación, una innovación de producto, se corresponde con la introducción de un bien o de un servicio nuevo significativamente mejorado, en cuanto a sus características o en cuanto al uso que se destina. Esta definición introduce la mejora significativa de las características técnicas, de los componentes y los materiales, de la informática integrada de la facilidad de uso u otras características funcionales. Una innovación de proceso es la introducción de un nuevo o significativamente mejorado, proceso de producción o de distribución que implica cambios significativos en las técnicas, los materiales, y/o programas informáticos (OCDE, 1995). En la *Enterprise Survey* del Banco Mundial las variables innovación en el producto y la innovación del proceso son medidas cualitativas resultados de la percepción de los empresarios. La base de datos denominada Panel 2006-2010 para cada país facilita los datos de los *inputs* de la innovación: investigación y desarrollo, calidad, recursos humanos calificados y los *outputs* de la innovación del año 2010, innovación en el producto y la innovación en el proceso. La *performance empresarial* (desempeño empresarial) en el año 2010 es medida como variación porcentual en las siguientes variables: ventas, exportaciones, productividad, empleo, fuerza laboral calificada, nuevos mercados, incremento de bienes ofrecidos, mejora de la calidad, reducción de costos y energía, obtención de certificaciones de calidad o de exportación. La separación temporal de las variables se realiza por la demora en la materialización de los efectos de la innovación y para evitar problemas de endogeneidad.

3.1 Universo y Muestra

El universo bajo estudio son las micro, pequeñas y medianas empresas manufactureras de la Argentina y Ecuador. A fines de este trabajo se consideran como MYPYMES solo aquellas empresas que contratan en forma permanente hasta 200 empleados.

Se utiliza la base de datos de la Enterprise Survey del Banco Mundial del panel 2006-2010¹. El Banco Mundial toma una muestra estratificada siguiendo tres criterios: ubicación geográfica², tamaño de la empresa según el número de empleados, y sector de actividad. La sub-muestra empleada en este estudio está compuesta por 54 MIPYMES manufactureras pertenecientes al Ecuador y 311 MIPYMES manufactureras de la Argentina.

En la Tabla 1, se muestra el número de empresas del sector manufacturero (MIPYMES) de la Argentina y el Ecuador. Se observa que el

mayor número de empresas se concentran en la pequeña empresa de 10 a 49 empleados y la actividad más representativa en ambas naciones es la de Alimentos.

En la Argentina (Buenos Aires, Mendoza, Córdoba, Rosario) existen: 56 microempresas, 166 pequeñas empresas y 89 medianas empresas del sector manufacturero. En el Ecuador (Pichincha, Guayas, Azuay) se encuestaron a 10 microempresas, 28 pequeñas empresas y 16 medianas empresas del sector manufacturero.

Tabla 1. Argentina y Ecuador: Distribución por sector manufacturero de la muestra (Panel 2006-2010). En porcentajes

Sector Industrial (en porcentaje)	Argentina	Ecuador
Alimentos	23,72	27,78
Textiles	12,82	11,11
Confecciones	15,38	9,26
Productos Químicos	10,26	7,41
Plásticos y Cauchos	1,28	7,41
Productos minerales no metálicos	0,32	1,01
Metales Básicos	0,32	.....
Fabricación de productos metálicos	8,01	11,11
Maquinaria y equipos	18,91	.....
Electrónicos	0,45	.....
Otros	8,53	24,91
Número de empresas por tamaño (en porcentaje)		
Microempresas (<10 empleados)	18,01	18,52
Pequeñas (>=10<49 empleados)	53,37	51,85
Medianas (>=49<200 empleados)	28,62	29,63
Total número de empresas	311	54

Fuente: Elaboración propia con base en Enterprise Survey del Banco Mundial (Panel 2006-2010) a empresas del sector manufacturero en el Ecuador y la Argentina.

3.2 Variables y herramientas de análisis

La finalidad del estudio es identificar cómo las empresas manufactureras ecuatorianas y argentinas realizan esfuerzos de innovación y generan resultados dentro de las empresas y su posterior comparabilidad de resultados. Se utilizó a la innovación en el producto y en el proceso como una variable endógena que es considerada en un modelo de regresión con dos ecuaciones. El problema de endogeneidad aparece cuando una variable independiente está correlacionada con el error, que es la parte no observada de la regresión. En este caso, puede esperarse que la innovación sea una variable endógena a la *perfomance* de la empresa, ya que puede estar relacionada con factores no observables que influyen también en la *perfomance*. El problema

de endogeneidad de los regresores se pueden controlar con el uso de variables instrumentales³ y de regresiones en dos etapas.

La investigación utiliza como metodología un análisis multivariado. Para las variables cuantitativas de los efectos de la innovación se utiliza el siguiente modelo de regresión de dos ecuaciones (Cameron y Trivedi, 2009, p. 467):

$$\text{Ec. 1} \quad y_i = y_i\beta_1 + X_{1i}\beta_2 + u_i$$

$$\text{Ec. 2} \quad y_i = X_{1i}\Pi_1 + X_{2i}\Pi_2 + v_i$$

(1) La etiqueta del panel “2006 y 2010” indica empresas entrevistadas en 2006 y 2010 solamente.

(2) Para la Argentina las regiones de muestreo son: Buenos Aires, Rosario, Mendoza, Córdoba; para el Ecuador las provincias de muestreo son Pichincha, Guayas y Azuay.

(3) Las variables endógenas equivalen a las variables dependientes de un modelo de regresión de una sola ecuación, y las exógenas a las variables X, o regresoras en tal modelo, en tanto las variables X no estén correlacionadas con el término de error de esa ecuación. La variable instrumental es una variable representante para la variable regresada rezagada pero con la propiedad que no está correlacionada con el error (Gujarati & Porter, 2009).

Donde

\mathbf{y}_i es la variable dependiente para la observación i -ésima (efecto de la innovación), \mathbf{y}_i representa al regresor endógeno (innovación en producto/proceso), X_{1i} representa los regresores exógenos incluidos, X_{2i} representa los regresores exógenos excluidos. u_i y v_i son los términos de error con media cero, y la correlación entre u_i y los elementos de v_i , son presumibles diferentes a cero.

Para las variables cualitativas de los efectos de la innovación se controla la endogeneidad de la variable innovación en dos ecuaciones probit, bajo la forma de *seemingly unrelated bivariate probit*. La primera ecuación estima la variable efecto de la innovación y la segunda ecuación, la probabilidad la innovación y sus determinantes. El modelo puede escribirse así según Baum (2006, p. 271):

$$\text{Ec. 1} \quad \mathbf{y}_1^* = X_1\beta_1 + u_1$$

$$\text{Ec. 2} \quad \mathbf{y}_2^* = X_2\beta_2 + u_2$$

Donde

$$\begin{pmatrix} u_1 \\ u_2 \end{pmatrix} \sim N \left(\begin{pmatrix} 0 & 0 \\ 0 & 0 \end{pmatrix}, \begin{pmatrix} 1 & \rho \\ \rho & 1 \end{pmatrix} \right)$$

Las variables observables a las dos variables latentes \mathbf{y}_1^* , \mathbf{y}_2^* son \mathbf{y}_1 , \mathbf{y}_2 . Estas variables \mathbf{y}_1 , \mathbf{y}_2 , toman el valor 1 si las correspondientes variables latentes \mathbf{y}_1^* , \mathbf{y}_2^* toman valores positivos, y cero. Una formulación del modelo es el *seemingly unrelated bivariate probit*, donde dos ecuaciones probit son vistas como un sistema y deben estimarse en forma conjunta si $\rho \neq 0$. El no rechazo de la hipótesis nula conduce a la realización de una de un modelo probit simple.

En la Tabla 2 se presenta la descripción de las variables de innovación así como las variables utilizadas para instrumentar las mismas, en la primera etapa del modelo de dos ecuaciones, los determinantes de la innovación se identificaron en un estudio comparativo utilizando la *Enterprise Survey* del Banco Mundial del panel 2006-2010 (Astudillo y Briozzo, 2015) y se muestran en la ecuación 1.

$$\text{Ec. 1 : } \text{Innovación Producto}_{2010} = f(I + D_{2006}, rrhh_{2006}, calidad_{2006}, v_i)$$

$$\text{Ec. 1: } \text{Innovación Proceso}_{2010} = f(I + D_{2006}, rrhh_{2006}, calidad_{2006}, v_i)$$

Tabla 2. Descripción de las variables dependientes, independientes y de control

Variables	Descripción	Tipo de Variables
Variables Dependientes (2010)		
Innovación de producto	MIPYMES que introdujeron un nuevo o significativamente mejorado producto (bienes o servicios), en los tres últimos años	Categórica 1 (Sí) 0 (No)
Innovación de Proceso	MIPYMES que realizaron un nuevo o significativamente mejorado proceso, en los tres últimos años	Categórica 1 (Sí) 0 (No)
Variables Independientes (2006)		
Investigación y desarrollo	MIPYMES que realizaron actividades de investigación y desarrollo en el año fiscal	Categórica 1 (Sí) 0 No
Calidad	MIPYMES que tienen una certificación de calidad reconocida internacionalmente	Categórica 1 (Sí) 0 No
Recursos humanos calificados	MIPYMES que han realizado programas de entrenamiento para los trabajadores	Categórica 1 (Sí) 0 (No)

Fuente: Astudillo y Briozzo, 2015

Posteriormente, la siguiente etapa de la ecuación consiste en estimar la siguiente ecuación, Ec. 2, empleando los resultados de la Ec. 1 para instrumentar la innovación:

$$\text{Ec. 2: } \text{efecto}_{2010} = (\text{estimaciones innovación producto y proceso}(\text{Ec. 1}), \text{variables control}, \mu_i)$$

En donde, los efectos de la innovación (*performance empresarial*) están en función de la innovación del producto y del proceso y necesitan de variables instrumentales que no estén correlacionadas con pero que estén correlacionadas con . Una variable que satisface estas condiciones es una variable instrumental que no esté correlacionada con el efecto de la innovación pero sí con la variable innovación.

Para estimar la Ec. 2, se utilizaron las siguientes variables en la segunda etapa de cada regresión:

Variables Dependientes (2010) Efectos de la innovación en el producto y en el proceso

Variables	Descripción	Tipo de Variables
Variables Cuantitativas		
Ventas Totales	Variación en las ventas totales de 2010 con respecto a 2006	Cuantitativa
Exportaciones	Variación en las exportaciones de 2010 con respecto a 2006	Cuantitativa
Empleo	Variación en los empleados de tiempo completo de 2010 con respecto a 2006	Cuantitativa
Fuerza laboral especializada	Variación de la fuerza laboral calificada de 2010 con respecto a 2006	Cuantitativa
Productividad	Variación en productividad (ventas por empleado) de 2010 con respecto a 2006	Cuantitativa
Variables Cualitativas		
Nuevos bienes y servicios ofertados	Incremento en el número de bienes /servicios ofertados	Categórica 1 (Sí) 0 No
Apertura de nuevos mercados	MIPYMES en nuevos mercados	Categórica 1 (Sí) 0 No
Reducción de Costos	Reducción de los costos de producción	Categórica 1 (Sí) 0 No
Reducción de energía	MIPYMES que reducen el consumo de energía	Categórica 1 (Sí) 0 No
Obtención de certificaciones de calidad o exportación	MIPYMES que obtienen certificado de calidad y/o de exportación	Categórica 1 (Sí) 0 No
Variables de control (2010)		
Antigüedad	Número de años de antigüedad desde la creación de las MIPYMES	Cuantitativa
Tamaño	Número de empleados formales de las MIPYMES	Cuantitativa
Financiamiento externo	Porcentaje del capital financiado por bancos	Cuantitativa
Características del propietario	Género del gerente	Categórica 1 (Femenino) 0 (Masculino)
Competencia	Número de competidores	Ordinal, transformada en Categórica, dummy 1 (Mayor a cinco) 0 (Menor a cinco)

Fuente: Elaboración propia a partir de datos de la Enterprise Survey del Banco Mundial a empresas del sector manufacturero en la Argentina y en el Ecuador, Panel (2006-2010).

Para el análisis de la endogeneidad e la innovación en las variables cualitativas, se utiliza los tests de Durbin- Wu- Hausman (Baum, 2006, p. 211), que consideran a la variable innovación como exógena. En este trabajo, para el análisis de endogeneidad se considera el test de Durbin que usa una estimación de la varianza del error basada en el modelo suponiendo que las variables que se están probando son exógenas. La aceptación de la hipótesis nula de exogeneidad de la innovación, es decir un test Durbin no significativo, conduce a la realización de una regresión en una sola etapa: la estimación de mediante mínimos cuadrados ordinarios. A su vez, la endogeneidad de la innovación para las variables cualitativas se estima con el test de la hipótesis nula de (Baum, 2006, p. 271). La aceptación de la hipótesis nula de exogeneidad, es decir un no significativo, conduce a la realización de una regresión en una etapa: la estimación mediante un modelo probit simple.

4. Resultados

Las Tablas 4 y 5 recogen las estimaciones de las variables desempeño cualitativas y cuantitativas de la innovación en el producto y en el proceso de las empresas manufactureras argentinas y ecuatorianas. Las sub-tablas A y B evidencian las variables desempeño cualitativas y presentan el p-value de la regresiones probit en dos etapas, la hipótesis nula rho=0 en la regresión biprobit y la regresión probit en una etapa en las últimas filas de las tablas. Se muestran los coeficientes de correlación y la significancia de las variables control del MCO de dos ecuaciones cuando rho=0 es significante es decir se acepta la hipótesis de endogeneidad de la innovación. De lo contrario, se presentan los coeficientes de correlación y su significancia de una regresión probit en una etapa cuando tiene significancia estadística.

Las variables desempeño cuantitativas se presentan en las sub-tablas C y D y presentan el p-value del MCO en dos etapas, el test Durbin de endogeneidad y el MCO en una etapa en las últimas filas de las tablas. Se muestran los coeficientes de correlación y la significancia de las variables control del MCO de dos ecuaciones cuando el test Durbin es significante es decir se acepta la hipótesis de endogeneidad de la innovación. De lo contrario, se presentan los coeficientes de

correlación y su significancia de un MCO de una etapa con su significancia estadística.

El Anexo 1 recoge los estadísticos descriptivos de las variables dependientes, independientes y de control y el Anexo 2 las preguntas de los efectos de la innovación y su codificación de la *Enterprise Survey* del Banco Mundial.

4.1. Efectos de la innovación en la Argentina

Tabla 4. Estimaciones para la innovación en el producto y en el proceso para la Argentina– variables de la performance empresarial cualitativas y cuantitativas

Tabla 4A. Argentina: Efectos cualitativos de la innovación en el producto

Efectos/Variables control	Nuevos Mercados	Incremento en el número de bienes ofrecidos	Mejora de la calidad	Reducción de Costos	Reducción energía	Obtención de certificaciones de calidad o exportación
Innovación en el producto	1,4592* (0,000)	2.0368* (0,000)	2,2845* (0,000)	1,8499* (0,000)	0,0229 (0,930)	1,5676* (0,000)
Antigüedad	0,0051 (0,106)	-0,0160** (0,067)	0,0035** (0,083)	0,0042 (0,219)	0,0020 (0,638)	-0,0012 (0,743)
Tamaño	0,0022 (0,143)	0,0016 (0,648)	-0,0000 (0,969)	0,0016 (0,462)	0,0009 (0,687)	0,0027 (0,165)
Financiamiento externo	0,0044 (0,305)	0,0129 (0,507)	0,0093 (0,171)	0,0005 (0,908)	-0,0016 (0,814)	0,0048 (0,229)
Género del gerente	-0,0419 (0,919)	-0,1063 (0,760)	-0,1739 (0,598)	0,0770 (0,812)	-0,4716 (0,374)	-0,2911 (0,158)
Competencia	-0,0372 (0,291)	0,0881 (0,413)	-0,0094 (0,825)	-0,0056 (0,908)	0,0336 (0,550)	-0,0450 (0,161)
Biprobit Prob>F	0,0000*	0,0025*	0,0000*	0,0000*	0,8050	0,0000*
Likelihood-ratio test para rho=0	0,0922*	0,0940**	0,0198*	0,0979*	0,6182	0,0001*
Probit Prob>F	.....	.....	.....	.....	0,9352.....	.....

Fuente: Elaboración propia a partir de datos de la *Enterprise Survey* del Banco Mundial a empresas del sector manufacturero en la Argentina y en el Ecuador, Panel (2006-2010).

*significancia al 0,05, **significancia al 0,10 (p-values entre paréntesis)

Para la Argentina, la Tabla 4A evidencia que los resultados de las regresiones probit (biprobit) en dos etapas son globalmente significativas para las variables de la *performance empresarial* cualitativas: *Nuevos Mercados*, *Incremento de Bienes Ofrecidos*, *Mejora de la Calidad*, *Reducción de Costos* y *Obtención de Certificaciones de Calidad o Exportación*. Se rechaza la hipótesis de exogeneidad de la innovación para estas variables dependientes, por lo que estas variables se analizaron con las regresiones probit en dos etapas. La variable *Reducción de Energía* no es significante en la estimación de dos re-

gresiones y no se rechaza la hipótesis nula de exogeneidad de la innovación, por lo que se analiza con una regresión en una etapa, que resultó no significativa globalmente. Los resultados muestran un efecto positivo de la variable innovación en el producto de manera individual en *Nuevos Mercados*, *Incremento en el Número de Bienes Ofrecidos*, *Mejora de la Calidad* y *Reducción de Costos*. La única variable control significativa es la antigüedad, con un efecto negativo sobre el *Incremento en el Número de Bienes Ofrecidos* y positivo en la *Mejora de Calidad*.

Tabla 4B. Argentina: Efectos cualitativos de la innovación en el proceso

Efectos/Variables Control	Nuevos Mercados	Incremento en el número de bienes ofrecidos	Mejora de la calidad	Reducción de Costos	Reducción energía	Obtención de certificaciones de calidad o exportación
Innovación en el proceso	1,2889* (0,058)	1,0538* (0,069)	0,8691 (0,449)	0,5681* (0,002)	1,6286 (0,858)	1,829* (0,000)
Antigüedad	0,0069 (0,125)	0,0033 (0,415)	0,0023 (0,646)	0,0013 (0,725)	0,0031 (0,541)	-0,0016 (0,660)
Tamaño	0,0018 (0,495)	0,0012 (0,640)	0,0002 (0,946)	0,0232 (0,281)	0,0005 (0,860)	0,0022 (0,214)
Financiamiento externo	0,0082 (0,197)	0,0023 (0,699)	0,0135 (0,149)	0,0023 (0,539)	0,0013 (0,851)	0,0057 (0,145)
Género del Gerente	0,2506 (0,588)	0,1613 (0,686)	0,1361 (0,756)	0,0968 (0,801)	-0,2579 (0,651)	-0,1807** (0,066)
Competencia	0,0628 (0,290)	0,0141 (0,772)	0,0253 (0,669)	-0,0283 (0,539)	-0,0136 (0,828)	-0,0397 (0,129)
Biprobit						
Prob>F	0,0001*	0,0052*	0,0278	0,1153	0,2728	0,0000*
Likelihood-ratio test para rho=0	0,3059	0,2942	0,7123	0,7353	0,9385	0,0000*
Probit	0,6442	0,1946	0,1946	0,0458*	0,5755	.....
Prob>F						

Fuente: Elaboración propia a partir de datos de la Enterprise Survey del Banco Mundial a empresas del sector manufacturero en la Argentina y en el Ecuador, Panel (2006-2010).

*significancia al 0,05, **significancia al 0,10 (p-values entre paréntesis)

La Tabla 4B para la Argentina muestra que se rechaza la hipótesis nula de exogeneidad de la innovación únicamente para la variable *Obtención de Certificaciones de Calidad o Exportación*. En este caso, los resultados de la regresión en dos etapas muestran un efecto positivo de la innovación en proceso, junto con la incidencia negativa de contar con una gerente mujer. Este resultado puede explicarse por diferencias de los sectores productivos en los cuales predomina la contratación de hombres.

El resto de las variables resultados fueron estimadas mediante regresiones probit simples. Los resultados son globalmente significativos para la Reducción en costos, donde la innovación en proceso tiene efecto positivo. Para las restantes variables resultados (*Nuevos Mercados, Incremento en el Número de Bienes Ofrecidos, Mejora de la Calidad y Reducción de Energía*), los resultados son globalmente no significativos.

Tabla 4C. Argentina: Efectos cuantitativos de la innovación en el producto

Efectos/Variables Control	Ventas	Exportaciones	Empleo	Fuerza Laboral Calificada	Productividad
Innovación en producto	-48,2304 (0,135)	-0,9877 (0,429)	0,0403 (0,380)	1,9704 (0,506)	-5,962 (0,454)
Antigüedad	0,0194 (0,843)	-0,0178 (0,457)	-0,0019* (0,023)	-0,0880 (0,454)	-0,0237 (0,325)
Tamaño	0,2249* (0,000)	0,0234* (0,074)	0,0001 (0,755)	0,0080 (0,900)	0,0275* (0,056)
Financiamiento externo	0,1298 (0,305)	-0,0354 (0,327)	0,0017 (0,178)	-0,1813 (0,191)	0,0179 (0,566)
Género del Gerente	-8,7611 (0,245)	2,5017 (0,236)	0,1895* (0,014)	-0,0600 (0,940)	-5,962 (0,454)
Competencia	-3,1835 (0,120)	0,6064* (0,036)	0,0001 (0,985)	0,1507 (0,437)	-0,3658 (0,469)
Constante	43,2240	-1,9337	0,1018	0,4160	8,0957
MCO de 2 ecuaciones Prob>F	0,0007*	0,0067*	0,0525*	0,6560	0,4068
Durbin score Chi2	0,0101*	0,8407	0,8295	0,5158	0,3579
MCO Prob>F	.....	0,0136*	0,0230*	0,4630	0,2089

Fuente: Elaboración propia a partir de datos de la Enterprise Survey del Banco Mundial a empresas del sector manufacturero en la Argentina y en el Ecuador, Panel (2006-2010).

*significancia al 0,05, **significancia al 0,10 (p-values entre paréntesis)

Para la Argentina, la Tabla 4C muestra regresiones globalmente significativas en 2 etapas (ivregress) para las *Ventas*, las *Exportaciones* y el *Empleo*. En cambio, para la *Fuerza Laboral Calificada* y la *Productividad* las regresiones en 2 etapas no son en conjunto significativas. Como se rechaza la hipótesis de exogeneidad de la innovación sólo para las *Ventas*, esta variable dependiente se analizó con la regresión en 2 etapas, y el resto de las variables de la *performance empresarial* se estudian con una regresión en una etapa. Los resultados de las regresiones en una etapa son conjuntamente significativos para *Ex-*

portaciones y *Empleo*, y resultan no significativos para *Fuerza Laboral Calificada* y *Productividad*.

La innovación en producto no presenta efectos significativos para ninguna de las estimaciones. En cuanto a las variables control, el tamaño tiene una incidencia positiva en las *Ventas* y *Exportaciones*, mientras que la antigüedad incide negativamente en el *Empleo*. Contar con una gerente mujer incide positivamente en el *Empleo*, y una elevada competencia tiene un efecto positivo en las *Exportaciones*.

Tabla 4D. Argentina: Efectos cuantitativos de la innovación en el proceso

Efectos/Variables control	Ventas	Exportaciones	Empleo	Fuerza Laboral Calificada	Productividad
Innovación en proceso	0,7788 (0,761)	8,5474** (0,069)	0,1010* (0,011)	-0,9330 (0,498)	-0,7403 (0,812)
Antigüedad	0,0331 (0,564)	0,0303 (0,399)	-0,0019 (0,021)*	-0,1283 (0,158)	-0,0191 (0,380)
Tamaño	0,2262* (0,000)	-0,0461* (0,012)	0,0000 (0,894)	0,0020 (0,702)	0,0229 (0,380)
Financiamiento externo	0,0841 (0,311)	-0,0179 (0,675)	0,0019 (0,143)	-0,1456 (0,245)	0,0120 (0,559)
Género del Gerente	-3,3768 (0,500)	4,1121 (0,120)	0,2019* (0,008)	-0,0364 (0,715)	2,0772 (0,236)
Competencia	0,7783 (0,906)	0,7339* (0,034)	-0,0017 (0,864)	0,0354 (0,715)	-0,0403 (0,862)
Constante	-2,4745	-6,7277	0,0838	1,6665	3,1606
MCO de 2 ecuaciones Prob>F	0,0000*	0,0080*	0,0539*	0,6396	0,3518
Durbin score (chi2)	0,7132	0,0264*	0,3242	0,3110	0,8864
MCO Prob>F	0,0000*	.....	0,0023*	0,4552	0,2483

Fuente: Elaboración propia a partir de datos de la *Enterprise Survey* del Banco Mundial a empresas del sector manufacturero en la Argentina y en el Ecuador, Panel (2006-2010).

*significancia al 0,05, **significancia al 0,10 (p-values entre paréntesis)

En la Tabla 4D, se observan regresiones globalmente significativas en 2 etapas (ivregress) para las *Ventas*, las *Exportaciones* y el *Empleo*. En cambio, para la *Fuerza Laboral Calificada* y la *Productividad* las regresiones en 2 etapas no son conjuntamente significativas. Como se rechaza la hipótesis nula de exogeneidad de la innovación para las *Ventas* y las *Exportaciones*, estas variables dependientes se analizaron con la regresión en 2 etapas, y el resto de las variables de la *performance empresarial* se analizan con una regresión en una etapa. Los resultados de las regresiones en una etapa son conjuntamente signifi-

cativos para las variables *Ventas* y *Empleo*, y resultan no significativos para *Fuerza Laboral Calificada* y *Productividad*.

Los resultados muestran un efecto positivo de la innovación en proceso en las *Exportaciones* y en el *Empleo*. Con respecto a las variables control, sobre las *Ventas* tiene un efecto positivo el tamaño de la empresa. En las *Exportaciones* incide positivamente la competencia, y de manera negativa el tamaño, y en el *Empleo* incide positivamente el género del propietario y de manera negativa la antigüedad de la empresa.

4.2. Efectos de la innovación en el Ecuador

Tabla 5. Estimaciones para la innovación en el producto y la innovación en el proceso para el Ecuador- variables de la performance empresarial cualitativas y cuantitativas

Tabla 5A. Ecuador: Efectos cualitativos de la innovación en el producto

Efectos/Variable control	Nuevos Mercados	Incremento en el número de bienes ofrecidos	Mejora de la calidad	Reducción de Costos	Reducción energía	Obtención de certificaciones de calidad o exportación
Innovación en el producto	-	-	-0,5662 (0,312)	1,2630* (0,002)	1,5714* (0,000)	-
Antigüedad	-0,0098 (0,1688)	0,0255 (0,471)	-0,0000 (0,997)	0,0020 (0,865)	0,0142* (0,058)	0,0057 (0,726)
Tamaño	0,0006 (0,940)	0,0958 (0,426)	-0,0055 (0,352)	-0,0045 (0,387)	0,0040 (0,221)	-0,0016 (0,862)
Financiamiento externo	-0,0286 (0,138)	-0,0145 (0,205)	-0,0099 (0,939)	-0,0048 (0,730)	0,0102 (0,404)	0,0004 (0,970)
Género del Gerente	-0,4287 (0,595)	0,1116 (0,889)	0,6178 (0,315)	0,6147 (0,238)	0,5457 (0,289)	0,1550 (0,852)
Competencia	-0,1017 (0,546)	-0,1135 (0,511)	-0,0099 (0,939)	-0,0590 (0,675)	0,1195 (0,247)	-0,1953 (0,239)
Biprobit Prob>F	0,8822	0,5944	0,0002*	0,0112*	0,0728*	.....
Likelihood-ratio test para rho=0	0,9850	0,1816	0,1835	0,0244*	0,0313*	.....
Probit Prob>F	0,6805	0,9239	0,2988	.....	.....	0,8115

Fuente: Elaboración propia a partir de datos de la Enterprise Survey del Banco Mundial a empresas del sector manufacturero en la Argentina y en el Ecuador, Panel (2006-2010). *significancia al 0,05, **significancia al 0,10 (p-values entre paréntesis). Nota: En la estimación de las variables resultado Nuevos Mercados, Incremento de Bienes Ofrecidos y Obtención de certificaciones de calidad o exportación, la variable Innovación en el Producto se omitió por su variabilidad y por el tamaño de la muestra.

Para el Ecuador, la Tabla 5A muestra regresiones globalmente significativas en 2 etapas (biprobit) para la *Reducción de Energía* (consumo de gas, electricidad, etc.) y para la *Reducción de Costos*. Dado que se rechaza la hipótesis nula de exogeneidad de la innovación, estas variables se analizaron con la regresión en dos etapas. Los resultados muestran

que la innovación en el producto está relacionada positivamente con la *Reducción de Energía* y la *Reducción de Costos*. En las regresiones restantes (*Mejora de la Calidad*), la innovación en el producto no resulta significativa. Con respecto a las variables control, se observa que la antigüedad tiene un efecto positivo en la *Reducción de Energía*.

Tabla 5B. Ecuador: Efectos cualitativos de la innovación en el proceso

Variable	Nuevos Mercados	Incremento en el número de bienes ofrecidos	Mejora de la calidad	Reducción de Costos	Reducción energía	Obtención de certificaciones de calidad o exportación
Innovación en el proceso	0,9682** (0,067)	0,2384 (0,614)	0,7562 (0,424)	-1,7605* (0,001)	1,6424* (0,008)	-0,7017 (0,252)
Antigüedad	-0,1251 (0,417)	0,0027 (0,626)	0,0513 (0,254)	0,0022 (0,879)	-0,0191 (0,296)	0,0097 (0,521)
Tamaño	0,0024 (0,731)	-0,0012 (0,818)	-0,0165 (0,244)	-0,0016 (0,792)	0,0045 (0,524)	-0,0022 (0,781)
Financiamiento externo	-0,0050 (0,666)	0,0140 (0,623)	-0,0018 (0,929)	0,0032 (0,819)	-0,0024 (0,806)	0,0077 (0,552)
Género del Gerente	0,2800 (0,385)	-2,6125 (0,673)	.....	0,5586 (0,448)	0,4438 (0,471)	-0,0124 (0,987)
Competencia	0,1184 (0,536)	0,0405 (0,792)	0,1042 (0,698)	-0,0771 (0,672)	0,1745 (0,247)	-0,2430 (0,122)
Biprobit Prob>F	0,1089	0,3459	0,0054* (0,002)	0,0292* (0,001)	0,0152* (0,001)	0,0779* (0,001)
Likelihood-ratio test para rho=0	0,0129* (0,001)	0,0029* (0,001)	0,4471 (0,001)	0,0398* (0,001)	0,3463 (0,001)	0,1099 (0,001)
Probit Prob>F	.....	.....	0,6241 (0,001)	.....	0,1136 (0,001)	0,6254 (0,001)

Fuente: Elaboración propia a partir de datos de la Enterprise Survey del Banco Mundial a empresas del sector manufacturero en la Argentina y en el Ecuador, Panel (2006-2010). *significancia al 0,05, **significancia al 0,10 (p-values entre paréntesis). Nota: En la estimación de las variables resultado Mejora de la Calidad se omitió la variable género del gerente por su variabilidad y por el tamaño de la muestra.

En relación a los efectos cualitativos de la innovación en el proceso para el Ecuador, la Tabla 5B muestra que se rechaza la hipótesis de exogeneidad para las variables *Nuevos Mercados*, *Incremento de Bienes Ofrecidos* y *Reducción de Costos*, siendo esta última la única regresión globalmente significativa en dos etapas. En este caso, se observa

un efecto negativo de la innovación en proceso sobre la *Reducción de Costos*. Las restantes variables resultado (*Mejora de la Calidad*, *Reducción de Energía* y la *Obtención de Certificaciones de Calidad o Exportación*) se estiman en una etapa y no resultaron globalmente significativas.

Tabla 5C. Ecuador Efectos cuantitativos de la innovación en el producto

Efectos/Variables control	Ventas	Exportaciones	Empleo	Fuerza Laboral Calificada	Productividad
Innovación en el producto	-59,7717 (0,158)	-13,4531 (0,693)	0,4600 (0,522)	2,0198 (0,423)	-1,4287 (0,535)
Antigüedad	0,1112 (0,750)	0,0534 (0,820)	-0,0012 (0,819)	-0,0078 (0,714)	-0,0029 (0,878)
Tamaño	0,2687* (0,048)	-0,0360 (0,688)	-0,0002 (0,839)	-0,0063 (0,522)	0,0146* (0,048)
Financiamiento externo	0,2869 (0,479)	0,1460 (0,632)	-0,0055 (0,393)	0,0008 (0,975)	-0,0035 (0,873)
Características del propietario	10,2124 (0,416)	3,4186 0,441	0,0758 (0,703)	0,8787 (0,306)	0,1471 (0,830)
Competencia	1,4728 (0,604)	-2010 (0,854)	-0,0339 (0,819)	-0,0606 (0,766)	-0,0508 (0,742)
Constante	22,6016	6,3627	-0,0579	1,2237	1,8937
MCO de 2 ecuaciones Prob>F	0,0124*	0,9753	0,8310	0,5929	0,1371
Durbin score Chi2	0,0763**	0,7200	0,3317	0,6097	0,3680
MCO Prob>F	.....	0,8873	0,4543	0,6029	0,6371

Fuente: Elaboración propia a partir de datos de la *Enterprise Survey* del Banco Mundial a empresas del sector manufacturero en la Argentina y en el Ecuador, Panel (2006-2010). *significancia al 0,05, **significancia al 0,10 (p-values entre paréntesis)

En la Tabla 5C, para el Ecuador la innovación en el producto muestra regresiones de 2 etapas (ivregress) con una significancia global únicamente en las *Ventas*, donde se rechaza además la exogeneidad de la variable innovación. Sin embargo, la innovación no resulta individualmente significativa. La variable control con relevancia es el tamaño de la empresa, con una relación positiva con las *Ventas*.

Las variables *Exportaciones*, *Empleo*, *Fuerza Laboral Calificada*, y *Productividad* no resultaron significantes en las regresiones de 2 etapas y no se rechaza la hipótesis de exogeneidad de la innovación, por lo que estas variables se estudiaron en una regresión en una etapa. Las regresiones así estimadas no resultaron conjuntamente significativas.

Tabla 5D. Ecuador Efectos cuantitativos de la innovación en el proceso

Efectos/Variables control	Ventas	Exportaciones	Empleo	Fuerza Laboral Calificada	Productividad
Innovación en proceso	9,6015 (0,128)	-14,5454 (0,322)	0,0424 (0,912)	2,0198 (0,423)	0,6982 (0,700)
Antigüedad	-0,1866 (0,212)	-0,0935 (0,363)	0,0018 (0,539)	0,8787 (0,306)	-0,0083 (0,551)
Tamaño	0,3406* (0,000)	0,0132 (0,762)	-0,0003 (0,591)	-0,0063 (0,522)	0,0157* (0,014)
Financiamiento externo	0,1876 (0,176)	0,1439 (0,319)	-0,0022 (0,531)	0,0080 (0,975)	-0,0192 (0,310)
Características del propietario	12,088 (0,125)	4,8440 (0,278)	-0,0004 (0,997)	0,8787 (0,306)	0,1998 (0,733)
Competencia	2,5704 (0,121)	-0,8391 (0,394)	-0,0349 (0,223)	-0,0606 (0,766)	-0,0015 (0,993)
Constante	-13,9932	8,0228	0,1318	1,2237	0,7671
MCO de 2 ecuaciones Prob>F	0,0000*	0,9055	0,6378	0,5929	0,0499*
Durbin score Chi2 Prob>F	0,6839	0,4563	0,7619	0,6097	0,8264
MCO Prob>F	0,0002*	0,8404	0,3057	0,5103	0,3438

Fuente: Elaboración propia a partir de datos de la *Enterprise Survey* del Banco Mundial a empresas del sector manufacturero en la Argentina y en el Ecuador, Panel (2006-2010). *significancia al 0,05, **significancia al 0,10 (p-values entre paréntesis)

Los resultados de la Tabla 5D indican que en todos los casos analizados, no se rechaza la hipótesis de exogeneidad de la innovación, por lo cual se presentan las estimaciones en una etapa. La única regresión globalmente significativa tiene como variable dependiente a las *Ventas*, encontrándose que la innovación en el proceso no resulta significativa, mientras que el tamaño tiene un efecto positivo.

En la Tabla 6 se resumen los resultados de las estimaciones que muestran un efecto positivo de la innovación tanto en el producto como en el proceso sobre las variables desempeño, así como un efecto negativo de la innovación en el proceso.

Tabla 6. Argentina y Ecuador: Comparación de efectos de la innovación del producto y proceso

	Argentina	Ecuador
Innovación en producto	Con innovación como variable endógena (biprobit/ivregress)	
	Nuevos mercados	
	Incremento en el número de bienes ofrecidos	Reducción energía
	Mejora de la calidad	Reducción de costos
	Obtención de certificaciones de calidad o exportación	
	Con innovación como variable exógena (probit/regress)	
	Reducción de Costos	
Innovación en proceso	Con innovación como variable endógena (biprobit/ivregress)	
	Obtención de certificaciones de calidad o de exportación	Reducción de costos (-)
	Exportaciones	
	Con innovación como variable exógena (probit/regress)	
	Reducción de costos	
	Empleo	

Fuente: Tablas 4 y 5

Discusión

Los resultados del estudio evidencian que la innovación en el proceso genera un impacto positivo en el *Empleo* con un modelo probit simple en la nación Argentina, contrario a lo planteado por Pianta (2003) que señala un impacto negativo de la innovación del proceso en esta variable desempeño en un estudio en las naciones de Europa. De igual manera, en la Argentina existe un impacto de la innovación en el proceso en las *Exportaciones*, lo que corrobora el criterio de que los más innovadores son más propensos a exportar, evidenciadas por Caldera, 2010; Martins, Goméz-Araujo, & Vaillant, 2015; Love & Roper, 2015, autores que encuentran una relación positiva entre las exportaciones y la innovación.

El impacto de la apertura de *Nuevos Mercados* y el *Incremento de Bienes Ofrecidos* en la nación argentina coincide con lo planteado en la literatura empírica revisada en Lööf *et al.*, 2001; Klomp y Van Leeuwen, 2001; Gómez & Calvo, 2011; Gunday *et al.*, 2011; Brown & Guzmán, 2014, en investigaciones en otras naciones y de manera específica en la Argentina coincide con estudios realizados en esta nación por Lugones, Suárez, & Gregorini, 2007; Lugones, Suárez, & Le Clech, 2007; Anlló & Suárez 2009.

El impacto *Mejora de la Calidad* y *Obtención de Certificaciones de Calidad o Exportación* en la Argentina y en el Ecuador coincide con lo manifestado por Prajogo & Sohal, 2003; Thai Hoang, Igel, & Laosirihongthong, 2006 en estudios empíricos en otras naciones.

La *Reducción de Energía* considerado por Gómez & Calvo, 2011 como un objetivo del empresariado se revela en esta investigación como un efecto de la innovación en el producto en el Ecuador. En referencia a la reducción de costos, contrario a Božić & Radas, 2006; Caldera, 2010, el empresariado manufacturero del Ecuador percibe que la innovación en el proceso no influye en la reducción de costos de manera positiva, sin embargo los datos mostrados en la Argentina coinciden con estos autores en la evidencia que la innovación en el producto tiene un efecto la reducción de costos.

Conclusiones

El análisis desarrollado en esta investigación evidencia que la innovación en el producto y la innovación en el proceso generan efectos en la *performance empresarial* de las empresas manufactureras argentinas y ecuatorianas. Se realizó el control de la endogeneidad de la innovación en tres años de gestión empresarial (2006-2010) con la inclusión de variables control como el tamaño, la antigüedad, el financiamiento externo, el género del gerente, la competencia, la investigación y desarrollo, la calidad y los recursos humanos calificados y las estimaciones muestran evidencia de impactos diferentes y similares en ambos países como resultado de su actividad innovadora en el producto o el proceso.

En lo que respecta a impactos diferentes con el control endógeno de la innovación, la innovación en el producto se evidencia en el Ecuador con una significancia positiva en la reducción del consumo de energía (gas, electricidad, etc.) y en la Argentina un efecto positivo en la

apertura de nuevos mercados, la mejora de la calidad, el incremento en el número de bienes ofrecidos y la obtención de certificaciones de calidad o de exportación. El efecto semejante positivo de la innovación del producto que se observa en ambos países es la reducción de costos con un control endógeno de la innovación solamente en el Ecuador. Con referencia a la innovación en el proceso tras controlar su endogeneidad, el Ecuador muestra un efecto positivo en la reducción de energía (gas, electricidad, etc.) y en la Argentina, la innovación en el proceso genera un efecto positivo en la obtención de certificaciones de calidad o exportación y en las exportaciones. En el empleo la innovación en el proceso genera un efecto positivo en el empleo sin controlar su endogeneidad. Con respecto a los impactos similares, en ambos países se observa a la reducción de costos como un efecto, sin embargo en el Ecuador la significancia de la innovación en el proceso es negativa en este impacto y en la Argentina esta variable desempeño es significativa con un modelo probit simple. Las actividades de innovación realizadas por las mipymes manufactureras no presentaron efectos significativos sobre las ventas, la productividad y la fuerza laboral calificada en ambos países. Las variables control que tuvieron relevancia en el estudio fueron el tamaño de la empresa, la antigüedad, el género del gerente y el grado de competencia.

Es necesario valorar los esfuerzos por innovar en las empresas manufactureras en ambos países, sin embargo, en comparación con el Ecuador, la Argentina presenta mayores efectos en la *performance empresarial*, esta evidencia revela que las empresas manufactureras argentinas poseen mayores resultados de su actividad innovadora posiblemente por un esfuerzo mayor en la inversión en ciencia, tecnología e innovación. De esta manera, se sugiere que la nación ecuatoriana promueva y facilite los procesos de ciencia, tecnología e innovación mediante el apoyo al financiamiento, una política fiscal con incentivos, la inversión en I+D+i, entre otros factores para la consecución de mayores impactos de la innovación empresarial.

Una de las limitaciones del estudio es que la *Enterprise Survey* del Banco Mundial ofrece un listado de variables desempeño de la innovación que satisface el estudio y la aplicación de los tests estadísticos, sin embargo los objetivos de los empresarios del sector manufacturero pueden ser más extensos al momento de evaluar los impactos de la innovación. Así también, por el número reducido de observaciones en el Ecuador se omitieron variables control por el grado de convergencia de los datos. Además, es importante aclarar que el tamaño de la muestra en Ecuador pudo ser una limitación para evidenciar un mayor número de efectos de la innovación en este país, sin embargo la información del Banco Mundial permitió generar un aporte a la comparabilidad de Ecuador con otro país de la región como la Argentina.

De hecho, resultaría interesante luego de analizar los inputs, los *outputs* y sus efectos en la *performance empresarial* de las empresas manufactureras entre el Ecuador y la Argentina, identificar los obstáculos que impiden el proceso innovador en estas naciones con diferente perfil de CTI, estudio que puede contribuir a la formulación de políticas públicas para la cooperación en el desarrollo de la innovación en ambos países y al planteamiento de líneas de actuación en torno a la mejora de la competitividad empresarial al interior de cada país.

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Anexo No. 1**Argentina y Ecuador: Estadísticos Descriptivos de los *inputs*, los *outputs* de la innovación y la *performance* empresarial**

	Argentina			Ecuador		
	Número de Empresas	Media	Desviación Estándar	Número de Empresas	Media	Desviación Estándar
Outputs de la Innovación						
Innovación en producto	306	0,72	0,44	51	0,66	0,47
Innovación en proceso	306	0,53	0,49	51	0,47	0,50
Inputs de la Innovación						
Investigación y Desarrollo	270	0,48	0,50	47	0,48	0,50
Recursos humanos calificados	271	0,39	0,49	47	0,57	0,49
Calidad	309	0,22	0,41	50	0,14	0,35
Firm performance						
Variables cualitativas						
Nuevos mercados	239	0,23	0,42	40	0,17	0,38
Incremento en el número de bienes ofrecidos	238	0,56	0,49	41	0,68	0,47
Aumento de la calidad	241	0,78	0,41	41	0,92	0,26
Reducción de costos	237	0,48	0,50	41	0,58	0,49
Reducción energía	232	0,18	0,38	41	0,26	0,44
Obtención de certificaciones de calidad o exportación	241	0,26	0,44	41	0,12	0,33
Variables Cuantitativas						
Ventas Totales	277	10,10	23,97	27	35,29	66,91
Exportaciones	306	-4,66	14,68	52	-1,66	11,93
Empleo	296	0,09	0,31	51	0,03	0,31
Fuerza Laboral Calificada	249	1,88	2,83	40	1,51	1,83
Productividad	276	3,42	5,94	44	1,98	3,04
Variables de Control						
Antigüedad	310	32,66	23,17	54	33,05	23,11
Tamaño	311	43,46	46,31	54	43,01	45,42
Financiamiento externo	311	9,93	16,48	53	14,37	24,39
Género del Gerente	309	0,06	0,25	54	0,16	0,37
Competencia	279	2,46	1,94	48	2,91	1,79

Fuente: Elaboración propia a partir de datos de la *Enterprise Survey* del Banco Mundial a empresas del sector manufacturero en la Argentina y en el Ecuador, Panel (2006-2010).

Anexo No. 2**Codificación de variables cualitativas y cuantitativas de los efectos de la innovación del estudio en el cuestionario de la Enterprise Survey**

Variables Cualitativas	Código de la Variable
Incremento del número de bienes o servicios ofrecidos por el establecimiento	LACp16a
Apertura de nuevos mercados	LACp16b
Mejora de la calidad de bienes o servicios	LACp16d
Reducción de los costos unitarios de producción	LACp16e
Reducción del consumo de energía (electricidad, gas, etc.)	LACp16f
Obtención de certificados de calidad o de exportación	LACp16g
Variables Cualitativas	Código de la Variable
Empleados a tiempo completo permanentes del último año 2010	l1
Empleados a tiempo completo permanentes en el 2007	l2
Ventas anuales del establecimiento en el año fiscal	d2
Exportaciones directas e indirectas	d3b, d3c
Trabajadores a tiempo completo especializados al final del año 2010	l4a
Trabajadores a tiempo completo no especializados en el último año	l4b
Productividad	d2, l1

Elaboración propia con base en *Enterprise Survey* del Banco Mundial (2006-2010).

Percepciones de académicos sobre las dificultades para el fomento de la innovación y el emprendimiento: el caso de la FCFM de la Universidad de Chile

Natalia Zisis¹, Patricio Moya^{2*}, Francisco Molina³

El objetivo de la presente investigación es describir y analizar la percepción de los profesores sobre las dificultades para fomentar la innovación y el emprendimiento en una institución de educación superior tradicional como lo es la Facultad de Ciencias Físicas y Matemáticas de la Universidad de Chile. El estudio, de carácter cualitativo, busca mejorar la toma de decisiones por parte de las instituciones involucradas. Se llevaron a cabo entrevistas semiestructuradas con los profesores de la Facultad. Los resultados señalan que mientras el término *innovación* no genera resistencia entre el profesorado, *emprendimiento* no produce el mismo consenso, ya que para algunos se relaciona con habilidades distintas a las que debieran ser formadas en la Universidad de Chile, dado su sello de alto prestigio y calidad. Esto a su vez implica que la exigencia y carga académica para los estudiantes sea muy alta, lo cual desincentiva la realización de proyectos extracurriculares de innovación y emprendimiento. Por otro lado, se reconoce un carácter extremadamente academicista, enfocado en el desarrollo de investigación no aplicada, altamente específica y desconectada de problemáticas del medio, que responde en gran medida a los incentivos establecidos para el quehacer académico. Esta cultura academicista se permea a los estudiantes, quienes encuentran pocas instancias de conexión con la realidad en su formación, de trabajo en equipo y de relación con otras disciplinas.

Palabras clave: innovación; emprendimiento; ingeniería; percepciones de los profesores.

Abstract: *Title:* Perceptions of academics on the difficulties for the promotion of innovation and entrepreneurship: The case of the FCFM of the University of Chile

The aim of this research is to describe and analyze the teachers' perception of the difficulties to foster innovation and entrepreneurship in a traditional higher education institution such as the Faculty of Physical and Mathematical Sciences of the University of Chile. The qualitative study seeks to provide information on this topic in order to improve decision making by the institutions involved. Semi-structured interviews were conducted with faculty teachers. The results indicate that while the term *innovation* does not generate resistance among teachers, the term *entrepreneurship* does not produce the same consensus, mainly because for some of the academics, it relates to skills that do not fit with Universidad de Chile standards, given its seal of prestige and quality. This also implies that the exigence and academic load for students is very high, which disincentives the development of extracurricular innovation and entrepreneurship projects. Additionally, the interviewees recognize a highly academic character of the institution, with focus on the development of non-applied, highly specific and detached from issues of the milieu research, which responds mainly to the structure of incentives that defines the academic job. This academic culture permeates to students, who find little instances of connection with reality, teamwork and relation with other disciplines within their formation.

Keywords: innovation; entrepreneurship; engineering; teachers' perceptions.

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Antecedentes generales

En la actualidad, Chile se está enfrentando a desafíos que requieren de la participación de una serie de actores comprometidos con el progreso social y productivo. Dichos desafíos se encuentran relacionados, principalmente, con alcanzar los índices de calidad de vida que se encuentran en países desarrollados. Para lograrlo, se ha insistido en que debe existir una reorientación de las políticas públicas hacia la innovación y el emprendimiento, en la medida en que son las formas más efectivas en las que se puede contribuir con el progreso social y económico de los países (World Economic Forum, 2009). Durante los últimos años en Chile se ha incentivado, desde la esfera pública, el desarrollo en innovación y emprendimiento, puesto que se entiende que solo gracias a este tipo de iniciativas se pueden alcanzar niveles económicos y sociales propios de los países desarrollados.

La formación de profesionales en las áreas de ciencia y tecnología, y en particular en ingeniería, se ha transformado en uno de los elementos clave para el progreso de los países (Bjorklund y Colbeck, 2001). En la misma línea, la demanda por diversos servicios de ingeniería se encuentra en aumento y, además, la globalización de los mercados y los avances científico-tecnológicos han impactado la práctica ingenieril, ya que se integran ámbitos de actuación que antes no estaban considerados (Crawley et al., 2007). En este contexto, para adecuarse a estas demandas, la Corporación de Fomento a la Producción (Corfo) del Estado de Chile ha lanzado el programa "Nueva Ingeniería 2030", que tiene como uno de sus objetivos principales apoyar la formación de capacidades en innovación y emprendimiento en los alumnos de las carreras de ingeniería de las universidades que forman parte de este programa (como la Universidad de Chile o la Pontificia Universidad Católica de Chile).

(1) Investigadora Independiente

(2) Laboratorio de Innovación y Emprendimiento - Facultad de Ciencias Físicas y Matemáticas - Universidad de Chile

(3) Facultad de Ciencias Físicas y Matemáticas -Universidad de Chile

*Autor de correspondencia: pmoyam@uchile.cl



La Universidad de Chile es la más antigua y, a la vez, una de las principales instituciones de educación superior en el país. Por su parte, la Facultad de Ciencias Físicas y Matemáticas (FCFM), donde se dictan las carreras de ingeniería civil en la Universidad, cuenta con alrededor de 4.900 estudiantes de grado, 1.200 de posgrado y 330 académicos (220 profesores a jornada completa, de los cuales el 97% posee el grado de doctor). En cuanto a la capacidad científica que se produce en el país, la Universidad produce el 25% del total, mientras que la FCFM produce el 6%. Sin embargo, a pesar de estas características, la Universidad reconoce que tanto la transferencia tecnológica como la innovación y el emprendimiento basado en ciencia y tecnología son las áreas más débiles del desarrollo institucional. Además, como la propia Facultad reconoce, la formación del alumnado en los conceptos de innovación y emprendimiento no ha sido una de las preocupaciones de la institución, y solo por medio de la ejecución del programa “Nueva Ingeniería para el 2030”, se han comenzado a integrar dichas competencias en los planes formativos. La perspectiva adoptada para llevar a cabo este cometido se relaciona con el emprendimiento dirigido por la innovación (*innovation-driven entrepreneurship*) que se caracteriza por perseguir oportunidades orientadas a llevar a los clientes nuevas innovaciones que tienen claras ventajas competitivas y un gran potencial de crecimiento. En este contexto, la innovación es entendida como el poder insertar nuevas ideas en el mercado, la técnica o el modelo de negocios (Aulet y Murray, 2013). Como sea, dados los rasgos de la FCFM, la innovación y el emprendimiento no pueden ser entendidos si no integran un fuerte componente de ciencia y tecnología.

Considerando esta nueva empresa en la que se embarca la institución, es interesante preguntarse por los elementos que podrían facilitar o dificultar su éxito. Según la literatura, uno de los factores más críticos para explicar el éxito de la introducción de la innovación y emprendimiento en las universidades es la percepción de académicos y estudiantes hacia el emprendimiento (Guerrero y Urbano, 2010). Sin embargo, hasta ahora los estudios en el área se han centrado en describir las percepciones de los estudiantes sobre la innovación y emprendimiento en general (Souitaris, Zerbatini y Al-Laham, 2007; Davey, Plewa y Struwig, 2011) y no se ha considerado de igual manera la imagen que los académicos podrían tener al respecto. Por tal razón, el objetivo principal de nuestra investigación es describir y analizar la percepción de los profesores sobre las dificultades para fomentar la innovación y el emprendimiento en una institución de educación superior tradicional como lo es la FCFM de la Universidad de Chile. El estudio, de carácter cualitativo, busca entregar información sobre este tema con el fin de mejorar la toma de decisiones por parte de las instituciones involucradas.

Marco teórico

Los obstáculos para fomentar la innovación y el emprendimiento en las universidades

Son diferentes las dificultades que enfrentan las universidades, sobre todo tradicionales, en pos del fomento de la innovación y el emprendimiento. En primer lugar, destaca la subordinación que presentan

con respecto al Estado, en la medida en que son fuertemente dependientes de este, tanto regulatoria como financieramente (Mora y Villareal, 2001). Esto implica, en términos financieros, una falta de incentivo por mudar hacia un sistema que busque vías alternativas de financiamiento y al mismo tiempo responda a las demandas de la sociedad y del mercado mediante el emprendimiento. Al mismo tiempo, según Mora y Villarreal (2001), esta dependencia se traduce en una lentitud burocrática para llevar a cabo cambios innovadores, así como en poca libertad para tomar decisiones respecto al personal. Se percibe, así, un desbalance cada vez mayor entre lo que se espera y demanda (enseñanza e investigación) de las universidades y su capacidad efectiva de responder, debido a la poca diversificación que tienen respecto al origen de su financiamiento y a la mantención de estructuras internas rígidas que son herencia de un pasado más simple para la educación superior de élite (Clark, 2001). En segundo lugar, los procesos de toma de decisión en las universidades tradicionales tienden a ser lentos e ineffectivos dada la estructura de *colegialidad* que lo determina. El poder de decisión se reparte entre múltiples entidades separadas (facultades, escuelas o departamentos) que tienen privilegios individuales y que apenas se relacionan entre sí. Finalmente, esto se traduce en que los recursos se dirigen a la mantención más que a inducir y apoyar algún cambio (Oleksiyenko, 2002), y a que la responsabilidad directa de las decisiones operacionales no esté bien definida (Mora y Villareal, 2001).

Por último, influye el carácter mismo de las universidades tradicionales y su pertenencia al sector público. La existencia de emprendimientos en el sector público es ya percibida como una paradoja, ya que para muchos el sector público se percibe como sinónimo de *burocratización* y se asocia a comportamientos rutinarios, evitación del riesgo y falta de iniciativa (Bernier y Hafsi, 2007). A esto se suma la dificultad de medir ganancias, el establecimiento de objetivos poco definidos y complejos, los problemas de la acción colectiva y la coerción que se da en instituciones públicas (Klein y Zur 2009). A su vez, Morris, Coombes, Schindehutte y Allen (2007), refiriéndose al mismo tipo de instituciones, agregan que los espacios de trabajo en los cuales los errores son tratados como oportunidades de aprendizaje, se alienta la iniciativa individual, se pone énfasis en la excelencia, los trabajadores se esfuerzan por el bien del equipo y existe una búsqueda continua por nuevas maneras de mejorar las operaciones, tenderán a tener niveles de emprendimiento más altos.

La universidad emprendedora

En la actualidad, se ha asumido que la universidad, junto con la enseñanza y la investigación, se encuentra cumpliendo una tercera misión: contribuir a la sociedad y al desarrollo económico de manera más directa. Las líneas de investigación en el área sugieren que si bien las universidades comparten objetivos y metas, tienen diferentes historias, tradiciones y estructuras organizacionales que moldean las formas en las que se lleva a cabo dicha tercera misión (Martinelli, Meyer y von Tunzelmann, 2008).

La universidad emprendedora (*entrepreneurial university*) juega un rol fundamental tanto como institución productora de información

como diseminadora de la misma. En esta línea, se trata de universidades que han mejorado diferentes mecanismos tanto para contribuir al desarrollo regional como para incrementar sus ingresos (Guerrero y Urbano, 2010). Además, la universidad no se concibe solo como una promotora de una serie de medidas de apoyo al emprendimiento, sino que también es una desarrolladora de una serie de técnicas administrativas y estrategias competitivas. Así, estas universidades están involucradas en alianzas, redes de contacto y otros tipos de relaciones con organizaciones públicas y privadas. Estas relaciones se transforman en un verdadero paraguas para la interacción y colaboración que puede existir entre los diferentes elementos de un sistema nacional de emprendimiento. Los estudios identifican dos tipos de factores que confluyen en el desempeño de una universidad emprendedora: del medio e internos. Por un lado, entre los factores del medio se cuentan los factores formales y los informales. Mientras los primeros se relacionan con, por ejemplo, la organización emprendedora, las medidas de apoyo para el emprendimiento y la educación en emprendimiento; los segundos implican las actitudes de la comunidad hacia el emprendimiento, las metodologías para su enseñanza y, por último, los sistemas de incentivo. Por otro lado, los factores internos se dividen entre recursos (humanos, financieros, físicos y comerciales) y capacidades (estatus, redes de contacto y localización) (Guerrero y Urbano, 2010). El modelo más citado de este tipo de universidad es el que propone Clark (1998, cit. en Brunner, 2006). Más que responder a una propuesta normativa, destinada a incrementar el *managerialismo* de su gestión, Clark caracteriza un tipo de universidad que durante la década de los '90 habría enfrentado exitosamente los procesos de adaptación al nuevo entorno, en el cual la entrada en vigencia del nuevo modelo neoliberal obligó a las economías de casi todo el mundo a abrir sus mercados a la competencia externa y a reducir la intervención del Estado en ellas (Clark, 2001). Esta adaptación por parte de las universidades se realizó mediante la adopción de cambios que les permitieron elevar sus capacidades de respuesta y acelerar su trayectoria adaptativa (Brunner, 2006).

Sin embargo, existe una fuerte resistencia cultural frente a este tema. El factor más crítico para explicar el desarrollo de universidades emprendedoras es la percepción de académicos y estudiantes hacia el emprendimiento (Guerrero y Urbano, 2010). Cada comunidad universitaria es única y sus actitudes hacia el emprendimiento se definen por una combinación de factores, tales como educación en emprendimiento, metodologías de enseñanza, modelos a seguir y sistemas de incentivos (Guerrero y Urbano, 2010). El legado de las universidades tradicionales es que aún hoy muchas universidades no ven el emprendimiento como una oportunidad, sino más bien como una amenaza. Esto porque su sistema de incentivos tiene más que ver con el estatus y el prestigio (lo cual se traduce en financiamiento público), que con emprendimientos que conlleven financiamiento por otras vías (Oleksiyenko, 2002). Además, en las universidades tradicionales aún se busca realizar investigación teórica, que responden a motivaciones intrínsecas de satisfacción de los académicos, para satisfacer su curiosidad en el tema, y pocas veces motivada por incentivos fuera de la investigación misma (McInnis, 2001). La cultura de las universidades tradicionales tiende a ser altamente respetuosa de la autonomía indi-

vidual, poco amenazante y segura para los académicos. En general los académicos tienen que dar poca cuenta de su labor a sus pares y superiores, por lo cual cuando se les exige ser más flexibles, adaptables, rápidos o innovadores para lograr la nueva misión de transformar a la universidad en una emprendedora, perciben el emprendimiento como un término negativo (Oleksiyenko, 2002). El fenómeno de las universidades emprendedoras ha emergido con una estrategia común que se enfoca en ser emprendedor en todo nivel implicado en la universidad. Sin embargo, las universidades son organizaciones complejas que comprenden un gran número de comunidades de práctica sobrepuertas y anidadas y el beneficio económico para el área local es poco visible.

Método

Considerando que nuestro objeto de estudio son las percepciones de profesores de una institución tradicional respecto a un fenómeno complejo y que implica construcciones de significado por parte de una comunidad, fue necesario adoptar un enfoque que permitiera observar el fenómeno de manera holística, sin reducir a los actores involucrados, escenarios, contextos, etc., a variables (Taylor y Bogdan, 2010). Por esto, el tipo de investigación adoptado fue cualitativo, ya que se busca determinar cómo se crea la experiencia social y cómo se construyen significados comunes; a diferencia de la investigación cuantitativa, la cual busca la cuantificación de ciertos fenómenos en cuanto a su frecuencia, cantidad, intensidad, etc. (Denzin y Lincoln, 2000). La metodología escogida es, además, particularmente útil cuando se conoce poco sobre el objeto de estudio y cuando se desea acceder a procesos subjetivos y la perspectiva propia de los actores sociales, como es el caso de nuestro estudio (Krause, 1995).

Muestra

Dada la especificidad de la temática a abordar en este estudio (desarrollo de proyectos por parte de los estudiantes), la muestra fue seleccionada según los principios de pertinencia y adecuación (Flick, 2002), es decir, acorde al aporte que los casos puedan significar en términos del tipo de información que estos representan para el objetivo de la investigación. Por esta razón, se seleccionaron académicos que involucraran estudiantes en sus proyectos, realizaran proyectos en sus cursos o fueran reconocidos por los estudiantes como *puntos de contacto* a quienes dirigirse para poder realizar sus propios proyectos. Se entiende, por tanto, que el desarrollo de proyectos se relaciona, de alguna manera, con los procesos intrínsecos asociados a la innovación y al emprendimiento (Brady y Hobday, 2011).

Dado que la muestra fue intencionada para cumplir con el objetivo de la investigación, no es posible afirmar que los resultados de este estudio son representativos de la opinión de todos los académicos de la FCFM. Sin embargo, el acercamiento de los académicos entrevistados a la realización de proyectos o participación en ellos por parte de los estudiantes permite una mayor profundización en este fenómeno. En vista de lo acotado del universo de estudio y de que se buscaba esta característica particular en la muestra, el muestreo se llevó a cabo a partir de informantes clave en un principio y luego mediante 'bola

de nieve', es decir, a partir de referencias de los mismos entrevistados (Noy, 2008). Considerando lo anterior, se logró generar una muestra compuesta por 21 académicos, heterogénea en términos de su departamento de procedencia y del tipo de jornada laboral que cumplen en la facultad.

Levantamiento de información

Se llevaron a cabo entrevistas semiestructuradas en la medida en que estas presentan una gran capacidad para lograr una riqueza informativa contextualizada y holística (Flick, 2002). Este instrumento de recolección de información se utiliza cuando se asume que el entrevistado tiene un caudal complejo de conocimientos sobre el asunto, y que este conocimiento incluye supuestos que son explícitos e inmediatos, que son expresados espontáneamente al responder a una pregunta abierta, pero que también pueden ser complementados por supuestos implícitos que son más invisibles y en los cuales se debe indagar con preguntas que no necesariamente son planteadas *a priori* (Flick, 2002). Puesto que el fenómeno que se busca observar en este estudio no sólo no ha sido estudiado previamente en este contexto, sino que ha sido poco problematizado, es de esperar que existan varios supuestos implícitos que no han sido incorporados al discurso por parte de los entrevistados, y que pueden surgir a partir de una entrevista semiestructurada. Se utilizó, por tanto, una pauta de entrevista para su aplicación, la cual en primera instancia fue desarrollada considerando el objetivo de la investigación.

Análisis de resultados

Para el análisis de resultados se realizó una codificación abierta, según la cual se trata de expresar los datos y fenómenos en forma de conceptos, asignando anotaciones (códigos) a cada idea expresada por los entrevistados y posteriormente analizando el conjunto de expresiones como un concepto (Flick, 2002).

Resultados

Los resultados se presentarán de acuerdo a las categorías más importantes que nos permiten organizar de mejor manera las percepciones de los profesores con respecto a diversos factores que determinan la promoción de la innovación y el emprendimiento.

Innovación

Respecto al término *innovación*, no se genera resistencia alguna: todos lo perciben como algo positivo y necesario de implementar en la formación de los estudiantes de la facultad. En general, relacionan la innovación con *hacer algo nuevo*, lo cual puede referirse tanto a plantear algo distinto a lo que se encuentra en la industria como a hacer lo mismo con menos recursos. Asimismo, para la mayoría de los académicos, la innovación se relaciona directamente con el desarrollo de ciencia y tecnología, a hacer uso de las capacidades técnicas instaladas en la facultad para generar nuevas *soluciones*. La idea de que la innovación que se engendra en la facultad no puede ser *cualquier* tipo de innovación reafirma el carácter tradicional de la institución. Lo anterior se puede observar en la siguiente cita:

"Si aquí hay gente con una cantidad de privilegios impresionantes en la sociedad, con una fortuna impresionante respecto a las capacidades que pueden tener, no puede ser que lo que salen a hacer al mundo sea a vender ropa." (Profesor 9)

Además, la innovación se observa, para algunos, como parte de un círculo virtuoso que debe generarse entre la industria y la universidad. Se percibe que la industria chilena es incapaz de generar soluciones innovadoras, y para que éstas se generen deben gestarse en el ámbito de la academia, es decir, se vislumbra como parte de la misión de la universidad generar investigación aplicada e innovadora que permita la solución de problemáticas reales.

Sin embargo, también se manifiesta que la facultad no ha logrado aún estar a la altura de esta tarea, ya que son muy pocos los académicos que ven un valor en generar investigación que pueda ser aplicada. Esta opinión se observa claramente en la siguiente cita:

"Nunca ha habido en el departamento, esto de, hacer un camino alternativo, que sea de alguien que se dedique a investigar algo porque le interesa sacar una aplicación de eso y llevarlo a la industria, por ejemplo, a una aplicación industrial, a la creación de una empresa, o a la creación de un servicio, de un producto, etc., que lo lleve al mercado, o que se lleve a la implementación en el ámbito que sea." (Profesor 19)

Emprendimiento

El término 'emprendimiento' genera más polémica entre los entrevistados. Mientras hay quienes lo ven como algo completamente positivo y que se debe fomentar (a pesar de que reconocen que es difícil de implementarlo en la cultura institucional actual), hay quienes lo observan con cierto dejo de desconfianza.

Dadas las características de la muestra, la mayoría de los entrevistados percibe el emprendimiento como algo positivo, pero poco desarrollado en la facultad. Se manifiesta una sensación de, en palabras de un entrevistado, *estar quedándonos atrás* en este tema, respecto a otras universidades. Sin embargo, también se vislumbra una sensación de optimismo, lo que se relaciona en gran medida con el desarrollo del Proyecto Ingeniería 2030. Se empiezan a distinguir ciertas iniciativas en la facultad que van en la línea de fomentar el emprendimiento, así como un mayor interés por parte de los estudiantes por estas temáticas. Asimismo, muchos entrevistados manifiestan que el fomento del emprendimiento viene como iniciativa de las nuevas generaciones de profesores que van llegando, por lo que se aprecia una tendencia hacia esa dirección. En este sentido, se hace el reparo de que estas iniciativas se vislumbran sólo a nivel de facultad, mientras que en el resto de la universidad todavía no se percibe esta tendencia. Sin embargo, en la misma facultad tampoco se advierte el sentido de *urgencia* que, para quienes la perciben de manera positiva, debería tener esta temática, lo cual se puede rescatar de la siguiente cita:

"Mi visión particular es que hay una percepción o una intuición de que son tópicos relevantes, para algunos, otros no tanto, pero yo lo que sí creo en común es que no hay una urgencia, nadie cree que es algo urgente que tengamos que resolver o atacar." (Profesor 9)

Además, los académicos perciben que los estudiantes vislumbran pocas oportunidades para emprender en la facultad, y que se han intentado instalar ciertas estructuras que lo hubieran permitido en el pasado, pero que han fallado. Esto ha llevado a una sensación general de que el *emprendimiento no es para nosotros* y sí para otras universidades, que no cargan con el peso de la dependencia que existe con el Estado, como es el caso de las universidades privadas.

En general, al igual que en el caso del concepto de innovación, el emprendimiento se tiende a relacionar, en el contexto de la facultad, con el desarrollo de ciencia y tecnología. Asimismo, se le da gran importancia al potencial de resolver problemáticas reales que puedan tener los emprendimientos, aunque no se identifique completamente emprendimiento con innovación, sino más bien con la implementación y operación de alguna iniciativa.

Incluso quienes tienen una visión positiva del emprendimiento, manifiestan ciertos reparos al respecto. Por un lado muchos reconocen que no todos los estudiantes pueden ser emprendedores y que hay cierto *riesgo* en inculcarles la necesidad de emprender, ya que la posibilidad de fracaso es tremadamente elevada. Además, observan que es especialmente difícil ser emprendedor en Chile, en la medida en que se percibe una cultura muy conservadora en este sentido: el mercado no espera emprendedores, sino empleados y la innovación y el emprendimiento en general son difíciles de instaurar de manera sustentable en una industria como la chilena, que carece de un ecosistema robusto de innovación y emprendimiento. Un ejemplo de esto es el hecho de que gran parte de la innovación y el emprendimiento son financiados con fondos públicos. Esta visión negativa del ecosistema de emprendimiento en Chile se observa en la siguiente cita:

"(...) hay que asumir que nuestro mercado laboral, no lo promueve mucho [el emprendimiento], la verdad. Nuestro mercado laboral, las empresas, son súper conservadoras, si tú llegas con mucha innovación, te quedan mirando raro y te dicen, 'oye, ya pero, y eso dónde funciona', 'quién lo ha probado', 'quién le saca los errores' (...) Y eso justamente va en contra de la innovación, porque en el fondo te están obligando a usar lo conocido, lo aprobado, lo que tiene soporte, y con el emprendimiento yo creo que es peor." (Profesor 3)

Además, en general se percibe una cultura institucional que presenta una gran resistencia a este nuevo término, por variadas razones. Hay quienes observan que de manera generalizada, en la facultad no se habla de emprendimiento, *no es tema*, puesto que para los académicos escapa a su quehacer y no le dan mayor importancia. En este sentido, se observa un interés mucho mayor por parte de los estudiantes por el tema que de parte de los académicos, quienes en su mayoría no se hacen cargo del interés de los estudiantes por estas temáticas. Los entrevistados señalan acerca de los académicos una mentalidad muy conservadora, científico y, valga la redundancia, académica, y que para la mayoría de ellos el emprendimiento no es algo que se debiera fomentar, porque ocurre de manera espontánea. Esta idea se ve reflejada en la siguiente cita:

"P: Yo creo que los estudiantes están motivados y yo creo que para los profesores es un cacho [problema] más. Y lo digo bien responsablemente. Yo soy uno de los profesores que está metido en temas de tratar de empujar."

E: ¿Un cacho [problema] en el sentido de responsabilidad?

P: No, un cacho [problema]. Algo que no corresponde a lo que uno hace. Porque en el fondo aquí se han contratado investigadores, no se han contratado gente emprendedora, no se han contratado gente innovadora en el sentido de transferencia tecnológica (...)" (Profesor 15)

Por otro lado, los entrevistados identifican también que hay opiniones que más allá de mantenerse neutrales frente al emprendimiento, o no querer involucrarse en estas temáticas, se oponen a él. Hay quienes se oponen porque identifican emprendimiento con lucro, y consideran que esto no se alinea con la misión de la universidad y con el quehacer académico. Para otros, un enfoque en el emprendimiento implicaría además una baja en la calidad técnica de la facultad, ya que se exacerbaban ciertas habilidades que no son las relevantes de desarrollar en un ingeniero, en desmedro de la exigencia técnica. Esta idea se expone en la siguiente cita:

"Los profes más clásicos lo que sentían es que esta cuestión [Proyecto Ingeniería 2030] finalmente estaba casi que hecha para que se bajara la vara, se bajara la exigencia de los alumnos, porque hay que integrar cosas que tienen que ver con habilidades profesionales, habilidades blandas, que les llamaban antes, cachai' [sabes]. (...) Yo creo que siempre se ha mirado con suspicacia, siempre, siempre, como que 'soi' [eres] medio chanta [charlatán], o estai' [estás] sacando la vuelta', y yo creo que va a costar harto [mucho]." (Profesor 4)

Se observa entonces que en gran medida el resquemor de ciertos académicos hacia el tema del emprendimiento se deriva de relacionarlo con habilidades que consideran que no son las que un ingeniero debería desarrollar, y menos aún, uno de la Universidad de Chile. El interés por el lucro, la habilidad de *vender la pomada [engañosamente]*, tener labia, se perciben negativamente y se relacionan directamente con esta temática para los académicos más 'conservadores'. Sin embargo, se observa al mismo tiempo una tendencia al cambio en estas corrientes de opinión:

"Yo creo que en el tema del emprendimiento había más resistencia. Una especie como de discurso, había sospecha de que esto fuera como una especie de... De que debilitara la pureza ingenieril, o como que la hiciera más blanda, o que los intereses comerciales se pusieran sobre los intereses de la innovación, o desarrollo puro, entonces eso yo creo que ha ido cambiando. Yo creo que estamos en posición de que eso está cambiando. Hay gente que tiene más apertura." (Profesor 10)

Académicos

Como se explicaba en la sección anterior, los entrevistados advierten que los académicos de la facultad en general están profundamente desconectados de la innovación y, especialmente, emprendimiento. Esto lo explican a partir del carácter de la academia en general y los incentivos que se imponen en esta esfera: para mantenerse y ascender en este ámbito tan competitivo, la principal tarea del académico es publicar artículos de investigación en revistas de corriente principal de manera regular. Los académicos en general ocupan su tiempo, además de preparar y hacer clases, en conseguir financiamiento para llevar a cabo sus proyectos de investigación, los cuales pocas veces tienen pretensiones de aplicarse a algún emprendimiento o algo que salga de la esfera académica.

“(...) si a ti te evalúan por las clases que haces o por los papers que publicas, tampoco te puedes dedicar a eso [apoyar proyectos estudiantiles], así es que yo creo que la única manera en que sea sustentable OpenLab, es que vaya de la mano con un cambio, por un lado en la manera en que se evalúa a los profesores, y también a los estudiantes.” (Profesor 8)

Además, se percibe que muy pocos académicos, a excepción de los *part-time*, mantienen alguna relación con la industria, con problemáticas reales, y en general, tienen poca experiencia profesional. Se dedican a temáticas de enorme especificidad, y están tan desconectados con el mundo laboral que no vislumbran las oportunidades de aplicación de la investigación que realizan. Esta idea se expone en la siguiente cita, de parte de un profesor *part-time* que se desempeñó mucho tiempo fuera de la universidad:

“Muy pocos profes acá tienen experiencia profesional. Entonces claro, en el mundo de la investigación es súper relevante que tú seas hiper experto en algo súper complejo. Porque eso es lo que te permite destacar. Publicar en un tema que nadie más pública, porque en el mundo profesional los problemas no son teóricamente tan complejos. Si no que, lo difícil es cómo esa cosa técnica se compatibiliza con los recursos que tienes, o con las restricciones de mercado, que tienes una comunidad que no quiere el proyecto. Es la conjunción de cosas la que es compleja. Entonces yo creo que a nuestros ingenieros les hace falta una visión más amplia. O sea, está bien, tú eres ingeniero mecánico, y tienes que resolver los problemas mecánicos, pero el proyecto es mucho más que eso.” (Profesor 3)

En consonancia con lo anterior, el nivel de especificidad de la investigación realizada por los académicos desincentiva también que los académicos se relacionen entre sí y realicen proyectos en conjunto. Este fenómeno se da no sólo a nivel de facultad, sino que incluso a nivel de departamentos: se observa muy poco trabajo en equipo o interdisciplinario, ya que las estructuras que modelan la academia lo desalientan.

Considerando lo anterior, los entrevistados indican que difícilmente los académicos de la facultad se encuentran en una posición como para fomentar la innovación y el emprendimiento, en vista de lo alejados que están ellos mismos de los elementos que permiten su desarrollo, como son el trabajo interdisciplinario y la conexión con problemáticas reales.

Carga académica y nivel de exigencia

La mayoría de los entrevistados se refieren a la carga académica de los estudiantes como uno de los principales obstáculos para que éstos desarrollen proyectos extracurriculares. Consideran que los estudiantes que pueden llevar a cabo proyectos fuera del marco curricular son excepciones, dada la alta demanda en tiempo que implican las actividades curriculares. Además, quienes decidan llevar a cabo estos proyectos se relacionarían con dos tipos de estudiantes: aquellos que están dispuestos a bajar su rendimiento académico o aquellos que son considerados como ‘brillantes’. Algunos de los entrevistados consideran que en la FCFM, más que incentivarse que los estudiantes realicen actividades formativas (en un sentido amplio) fuera de lo curricular, esto es castigado, como se observa en la siguiente cita:

“Así como las facilidades para que los alumnos hagan cosas fuera de Beauchef, en el fondo que están no sé, representando a la universidad en un concurso o haciendo un proyecto externo, a nivel internacional incluso, en vez de ayudarlos se les castiga, cachaí’[sabes]. Es como ‘no, fregaste [no tienes posibilidad], ninguna posibilidad de que el control lo tomes en otra fecha, tienes que dar el examen igual que todos los demás que flojearon [fueron perezosos], o que dieron un certificado falso’.” (Profesor 4)

La contracara de esta situación es que muchos académicos estiman que es difícil realizar proyectos con estudiantes de grado, dada la poca disponibilidad de tiempo que tienen. Es especialmente difícil si estos proyectos tienen contrapartes que fijan ciertos compromisos en su desarrollo:

“Hay un riesgo no menor de contar con estudiantes para elaborar proyectos donde hay contratos de por medio, compromisos con terceros, con gente externa, grandes empresas, etc. En términos, por ejemplo, de cumplimiento de plazos o de control de calidad es muy complejo, o sea, porque el estudiante no tiene muchas veces el tiempo para poder realizarlo.” (Profesor 18)

Por otro lado, se identifica una nueva dificultad. Muchos estudiantes que están entusiasmados con la realización de algún proyecto extracurricular o que quieren dar continuidad a algún proyecto que comenzaron en el marco de algún curso, terminan por abandonarlo porque deben atender a sus labores académicas. Una solución que algunos académicos ven a esta situación es integrar la realización de proyectos en el marco curricular o reconocer la realización de estos proyectos académicamente, créditos académicos, por ejemplo. Lo anterior se refleja en la siguiente cita:

“Al no ser parte de un curso, y al no estar siendo evaluados, la prioridad y la intención de emprender de ellos baja mucho, porque al principio parten el semestre, que pasa todos los semestres... ‘no, queremos continuar el proyecto’, ‘bye, ¿nos pueden ayudar?’, nosotros ‘sí, obvio’, pero llegan a la semana cinco y están reventados con Investigación de Operaciones, con Marketing, con Finanzas, con miles de otros ramos y al final como ya no es parte de un curso, ellos tienen que hacer la elección, o cumple con mis deberes como estudiante, para tratar de salvar mis ramos, me dedico a emprender. Entonces creo que ahí hay una incompatibilidad, entre cómo está diseñada la vida de un estudiante, normal, con el impulso para emprender.” (Profesor 2)

Para muchos de los entrevistados, la alta calidad técnica y científica que caracteriza la formación de la facultad tiene un lado negativo: un nivel de exigencia que impide que los estudiantes lleven a cabo proyectos extracurriculares. Algunos consideran que este nivel de exigencia se anida en (y potencia) una cultura de desconfianza entre los profesores y los estudiantes. Es decir, el profesor considera que fuera del marco curricular lo que el estudiante hace es *flojear [holgazanear]*, por lo que consume todo su tiempo con actividades curriculares, y por su parte el estudiante responde a esto cumpliendo con el mínimo, conformándose con “pasar los ramos”. Esta cultura vuelve estériles los esfuerzos de innovación y emprendimiento. Para muchos de los entrevistados, en lugar de fomentarse estas iniciativas, se las desincentiva, lo que se observa en el cambio de actitud que tienen los estudiantes a lo largo de su carrera, como se enseña en la siguiente cita:

“Mi tesis es que los alumnos al tercer año son muchísimo menos emprendedores e innovadores que los alumnos de primer año. Esa es mi tesis, yo creo que lo que hacemos en vez de ayudarlos, como que los achatamos.” (Profesor 4)

En este sentido, el nivel de exigencia es tal que quienes quieran llevar a cabo proyectos extracurriculares o bien tienen que ser “brillantes”, o correr el riesgo de reprobar ramos o bajar sus notas:

“(…) lo que se tiene que fortalecer es la estructura académica para que eso [innovación y emprendimiento] sea reconocido, y para que no sea un extra, porque si no quizás lo van a poder hacer los estudiantes que son ultra ultra brillantes nomás po’, que pueden tomar tres cursos o cuatro cursos normales, hacer las tareas, los controles, los exámenes, etc… Es como perder el recurso, si les vas a exigir el doble a la gente porque haga innovación, no tiene mucho sentido.” (Profesor 8)

Para algunos, el nivel de exigencia es tal que no sólo es innecesario para la formación de los ingenieros, sino que incluso ha derivado en problemas psicológicos entre el estudiantado:

“El nivel de exigencia, y todo esto se sabe, pero nadie hace nada. O sea tienes una unidad de calidad de vida que tiene tres psicólogos, para seis mil alumnos, es imposible. Y por qué te digo esto, para fundar que el nivel de exigencia es tal, de que hay personas que se matan por el fracaso que va a ser, fracasar en la universidad. Es heavy. Entonces yo creo que eso tiene mucha relación, con la no cultura de emprendimiento que hay acá. Porque en el fondo cómo emprendes si no me dejan respirar (...)” (Profesor 2)

Conclusiones

Una universidad pública, tradicional y de excelencia

Para los entrevistados, el hecho de que la facultad pertenezca a la universidad más tradicional y antigua de Chile, considerada de excelencia en los rankings nacionales, tiene varias implicancias en relación con la posibilidad de fomentar la innovación y el emprendimiento en la institución. En primer lugar, cabe destacar el “rol público” que se le adjudica a la universidad. La universidad tiene la responsabilidad social de ser un motor de desarrollo y abordar las problemáticas sociales que aquejan al país. Esto, por un lado, implica que se debiesen

llevar a cabo iniciativas en la facultad que tuvieran algún impacto en el medio, lo cual, según los entrevistados, hoy no sucede en gran medida. La desconexión con la realidad por parte tanto de estudiantes como académicos es un punto de común acuerdo entre los profesores entrevistados. Por otro lado, este “rol público” implica también que lo que se espera de la Universidad de Chile es distinto a lo que se espera y acepta de otras universidades del país, en el sentido de que, por ejemplo, llevar a cabo proyectos que más que el bien común apunten al lucro y enriquecimiento, a los cuales muchas veces se asocia el término ‘emprendimiento’, no corresponden a esta institución, aunque sí puedan corresponder a otras.

En segundo lugar, la Universidad de Chile se representa en la cultura institucional como altamente prestigiosa y de excelencia. Esto, según los entrevistados, tiene una implicancia que no es favorable al fomento de la innovación y el emprendimiento y que se relaciona con la carga académica que se imprime sobre los estudiantes.

Por último, como preveen Mora y Villareal (2001), ser una institución tradicional y de dependencia estatal conlleva una burocratización de todos los procesos internos lo que es contraproducente para el desarrollo de la innovación y el emprendimiento. Los entrevistados reconocen que los tiempos burocráticos de la institución no se condicen con la rapidez que deben tener los procesos de asociados a la innovación y el emprendimiento, especialmente si se busca impactar al mercado. Sin embargo, no necesariamente relacionan explícitamente este problema con el hecho de que la universidad sea pública, sino que simplemente es una de las características que se le adjudican a la institución.

Carácter academicista de la facultad

Los entrevistados perciben que impera una cultura altamente academicista en la facultad, lo cual podría explicarse por tres factores. En primer lugar, como señalan Guerrero y Urbano (2010), el sistema de incentivos de una universidad es un factor que determina las actitudes hacia el emprendimiento de una comunidad universitaria. En este caso, los incentivos que tienen los académicos apuntan a que éstos se dediquen completamente a la docencia y a la investigación, en la mayoría de los casos, teórica. Se espera de ellos que destaque en su área de *expertise* como investigadores, generando un número de artículos publicados en revistas indexadas, lo que generalmente implica llevar la investigación al máximo grado de especificidad en lugar de cooperar con otros (ya que tampoco tienen incentivos para la cooperación) en buscar aplicaciones prácticas para estos avances científico tecnológicos. Como señala McInnis (2001), las universidades tradicionales favorecen la autonomía individual de los académicos y se identifica con un espacio poco amenazante y seguro para ellos, en el cual pueden realizar investigación teórica que responda a sus motivaciones intrínsecas y pocas veces motivada por incentivos fuera de la investigación misma.

En segundo lugar, la exacerbación del academicismo en la facultad responde también a la manera en que se representa el rol del académico, en cuanto a lo que le corresponde y no hacer. En este sentido, fomentar la innovación y, en especial, el emprendimiento, escapa a

las tareas que se esperan del académico, quien debiera dedicarse en un 100% a la docencia e investigación. Como lo expresa uno de los entrevistados, *pastelero a tus pasteles*: no se puede esperar de los académicos que se hagan cargo de esta nueva empresa que se ha decidido desarrollar en la facultad, ya que en primera instancia no fueron contratados para eso. Como explica Oleksiyenko (2002), exigirles esto podría incluso hacerles percibir el tema del emprendimiento como una amenaza a su forma tradicional de trabajar más que algo que se deba fomentar en la facultad. Asimismo, hay aspectos legales que desmotivarían el desarrollo emprendedor por parte de los académicos en las universidades estatales:

Incluso hay elementos en la propia ley chilena como el Estatuto Administrativo o la Ley de Probidad, que regula el régimen del Funcionario Público, y que podrían impedir que los académicos de universidades estatales realicen actividades emprendedoras dentro de la Universidad sobre ciertos montos bastante bajos para este ámbito (200 UTM). Además, las direcciones jurídicas, con respaldo de la Contraloría General de la República, han establecido un marco estricto y algo desmotivante para las actuaciones de académicos que destinan tiempo en actividades como los spin offs (Jorge Rojas, citado en Gonzalez y Jiménez, 2014, p. 137).

Por último, pareciera ser que los temas de innovación y, particularmente, de emprendimiento son percibidos por los académicos más tradicionales como nuevas tendencias que vienen a disminuir la calidad de lo exigido tanto a académicos como a estudiantes, ya que se relaciona más con el desarrollo de habilidades sociales y comunicacionales, y no puramente con la excelencia científica tecnológica.

Lo que los entrevistados observan, además, es que dicho carácter academicista del cuerpo académico de la facultad permea también la cultura estudiantil: los estudiantes buscan el trabajo solitario y dominar temas altamente específicos, así como rehúyen las actividades que impliquen un desarrollo y uso de sus habilidades sociales y comunicacionales, por considerarlas menos importantes.

Nota

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A systematic review of technology adoption frameworks and their applications

Sahil Koul^{1*} and Ali Eydgahi²

Abstract: The Technology Acceptance Model and the Theory of Planned Behavior have demonstrated pioneering research efforts within the research domain of innovation adoption concerning new technologies. This study consolidated an in-depth literature review of both theoretical frameworks, covering their roots and development over the years within the scholarly community. Also, we reviewed the applicability of these frameworks within the context of emerging technologies of the information age. After a thorough literature review, we concluded that both frameworks are widely used and applicable to various emerging technologies and continue to remain instrumental in the research domain of innovation adoption.

Keywords: technology acceptance model; theory of planned behavior; emerging technologies; innovation adoption; innovation and society.

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Introduction

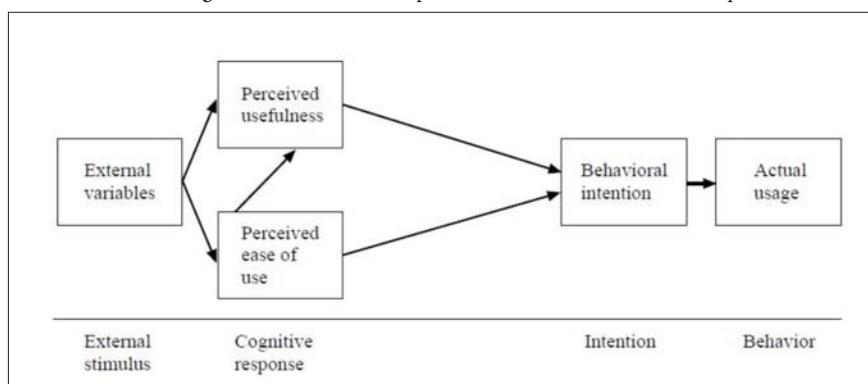
Two theoretical frameworks, Technology Acceptance Model (TAM) and Theory of Planned Behavior (TPB), serve as the foundation of technology adoption studies within various contexts. TAM is a widely utilized theoretical framework for the assessment of how people make decisions regarding new technology adoption. TAM has frequently been used for information systems and other fields (Davis, 1989). TPB is highly recognized and significantly used for marketing research studies (Ajzen, 1991). As such, it is an appropriate model to use to address consumer acceptance of various technologies. Therefore, both TAM and TPB are useful when a study focuses on the potential adoption of an emerging technology. This review paper provides an in-depth examination of the theoretical frameworks of TAM

and TPB. Further, the existing literature focused on innovation adoption for various emerging technologies highlights the application and significance of TAM and TPB models.

Technology Acceptance Model

The goal of TAM is to predict user acceptance and highlight potential design issues before users of the technology interact with the system (Dillon & Morris, 1996; Mohd, Ahmad, Samsudin, & Sudin, 2011). TAM was developed with support from IBM Canada and is rooted in the basic psychological theory known as the Theory of Reasoned Action (TRA; Ajzen & Fishbein, 1980). As shown in Figure 1, TAM demonstrates a pioneering research effort by generating a framework for explaining behavioral intentions and actual behavior of users for new technology adoption.

Figure 1. TAM model. Adapted from Davis & Venkatesh, 1996, p. 20.



Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) are the perceptions of the beliefs users hold about the system (Dillon & Morris, 1996). Davis (1989) defined PU as "the degree to which a person believes that using a particular system would enhance his or her job performance" and PEOU as "the degree to which a person believes that using a particular system would be free of effort" (p. 3). The original study of TAM generated six highly reliable items for both PU and PEOU.

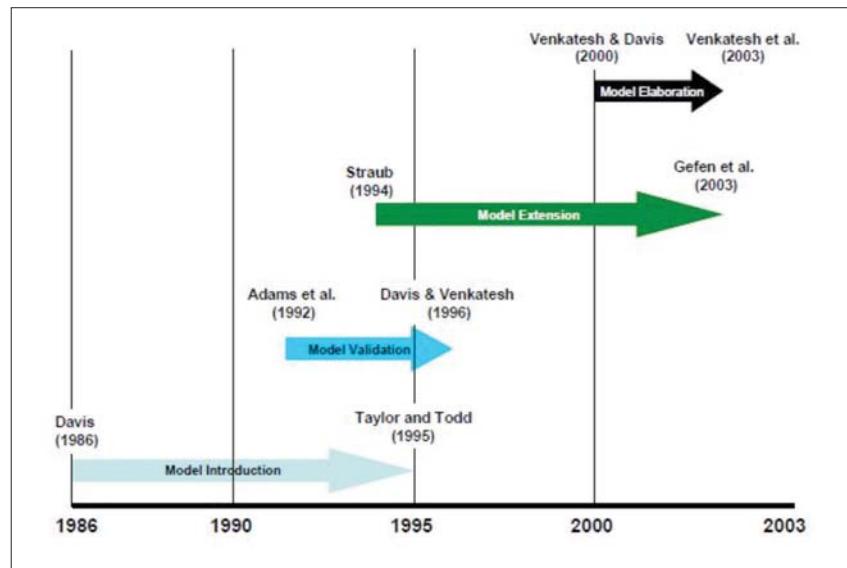
Development of TAM

Various researchers and practitioners have validated the robustness of the TAM instrument in different settings (Davis, 1993; Davis & Venkatesh, 1996; Dillon & Morris, 1996; Lee, Kozar, & Larsen, 2003). Further, in a meta-analysis, Lee et al. (2003) explored 101 research articles and presented a progression map of TAM as shown below in figure 2.

(1) College of Technology, Eastern Michigan University, 109 Sill Hall, Ypsilanti, Michigan 48197, USA. (2) School of Engineering Technology, Eastern Michigan University, 118 Sill Hall, Ypsilanti, Michigan 48197, USA.

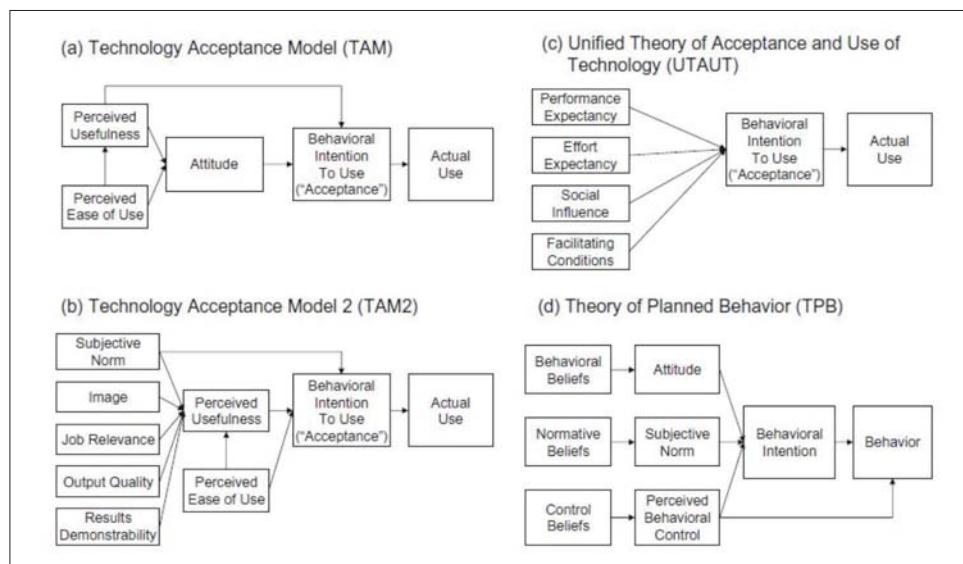
*Corresponding author: skoul@emich.edu



Figure 2. Progression of TAM. Adapted from Lee et al., 2003, p.755.

Venkatesh and Davis (2000), through four longitudinal studies, proposed an extension of the TAM model and established another novel model known as TAM2. This TAM2 model introduced cognitive and social influence processes as a way of measuring usage intentions and perceived usefulness. The results demonstrated that the TAM2 model accounted for 52% of the variance in usage intentions and 60% of the variance in usefulness perceptions (Venkatesh & Davis, 2000). In another study, Venkatesh, Morris, Davis, and Davis (2003) formulated and validated an integrated

model that, was an extension of TAM and termed it a 'Unified Theory of Acceptance and Use of Technology' (UTAUT). An adjusted R² value of 70% found with the UTAUT model outperformed all other previous user acceptance models. The authors concluded that, by utilizing their UTAUT model, interventions could be aimed in advance towards the population who are less inclined to adopt the new technology (Venkatesh et al., 2003). Figure 3 reflects the different extensions of the TAM model enhancements as presented by Holden and Karsh (2010).

Figure 3. Extensions of the TAM model. Adapted from Holden & Karsh, 2010, p. 161

As per the meta-analysis conducted by Yousafzai, Foxall, and Pallister (2007a), the three major factors to which the widespread adoption of TAM can be attributed are a strong theoretical base and robust measurement scales, strong empirical support for the overall explanatory power of the model, and applicability in a wide range of systems and technologies. In this meta-analysis, the summary of 15 years of

studies on TAM revealed a high correlation for the 'field setting' between PU, PEOU, and intention to use various technologies.

Among the few limitations reported in the literature regarding TAM, the most commonly reported limitation is related to self-reported usage (Lee et al., 2003). Furthermore, since TAM is used to predict

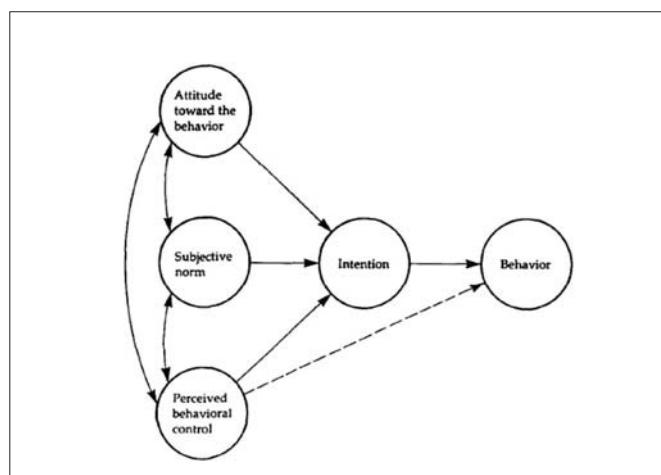
the behavioral intention to accept technology, some researchers believe that there is not enough exposure to the technology before the assessment is carried out (Lee et al., 2003). Moreover, the original model of TAM did not include social influence (Ghazizadeh, Lee, & Boyle, 2012), but the technology under study was of an individualistic nature and independent of the use of others (Dillon & Morris, 1996).

Theory of Planned Behavior

This theory was an improvement upon the TRA (Ajzen & Fishbein, 1980), which looked at predicting individual behavior in volitional situations (Sparks & Shepherd, 1992). TPB focuses mainly on predicting planned human behavior and incorporates the construct of perceived behavioral control (Li, 2010; Montano & Kasprzyk, 2015; Sparks & Shepherd, 1992). The literature has presented sufficient evidence that TPB has an enhanced capability of predicting behavioral intention by adding the perceived behavioral control construct (Madden, Ellen, & Ajzen, 1992). A study comparing the models of TRA and TPB for ten different behavioral scenarios revealed that TPB provided a significantly enhanced explanation of behavioral intentions over TRA due to the inclusion of the perceived behavioral control construct (Madden et al., 1992). Also, Madden et al. (1992) claimed that this increased enhancement is positively correlated to the magnitude of perceived behavioral control.

When individuals have time to plan for their behavior, in order to predict their behavior, we need to understand their intention towards performing that behavior (predictor), which is the summation of Attitude, Subjective Norms, and Perceived Behavior control constructs as shown in Figure 4. Also, if two or more of these constructs are not supporting the behavioral intention, then the likelihood of actually performing that behavior decreases significantly.

Figure 4. Theory of Planned Behavior model. Adapted from Ajzen, 1991, p. 182.



Attitude: The construct of attitude is an individual's own opinion about a given situation. This opinion is formulated through self-analysis gathered via an individual's behavioral beliefs and outcome evaluations (Mathieson, 1991). Attitudes are found to be positive or negative (Agarwal, 2000; Orbell, Hodgkins, & Sheeran, 1997).

Subjective Norms: This construct constitutes the external societal forces acting upon an individual (Agarwal, 2000; Mathieson, 1991; Orbell et al., 1997), such as cultural, referent, and group elements.

Perceived Behavioral Control: This construct reflects if an individual is faced with a difficult or easy task for a given situation (Agarwal, 2000; Orbell et al., 1997) and can be dependent on the available skills and resources required to formulate behavioral intentions (Dillon & Morris, 1996).

Development of TPM

TPB has followed a trajectory similar to the key milestones of TAM development (Venkatesh, Davis, & Morris, 2007). Much of the early research on TPB focused on replicating the results of the original study in different settings, cultures, and for a variety of behaviors (Venkatesh et al., 2007). After that, research focused on establishing the predictive validity of TPB and then eventually competing theoretical perspectives to enhance the richness of the original model (Venkatesh et al., 2007). One such refinement to the original model was achieved by the fusion of TPB and TAM into a novel decomposed model of TPB (DTPB; Taylor & Todd, 1995a; Taylor & Todd, 1995c). The DTPB model presented a more thorough understanding of behavioral intention and a slightly more enhanced explanatory power than the TPB (Taylor & Todd, 1995a; Taylor & Todd, 1995c). The DTPB model distinctly helped in enhancing understanding of not only the design aspects but also the factors relevant to the implementation of the new technology under study.

The scholarly community debates about the reasonable expectation of correlation among TPB constructs. Prediction of behavioral intentions is at the core of the TPB model, and a reasonable expectation regarding the correlation among various constructs of this framework should be around 0.60 (Ajzen, 2011). TPB is a well-known theory to predict adoption intentions in an organizational setting (Taylor & Todd, 1995b). It is not possible, however, to include all the different constructs and variables in one study (Conner & Armitage, 1998). Hence, reasonable expectation is to choose the constructs and variables that are most applicable to the nature of the behavior under study.

Emerging Technologies as Applications of TAM and TPB

The results of the meta-analysis conducted by Arts et al. (2011) revealed important differences between the stages of behavioral intentions and actual behavior. The actual behavior of innovation adoption is more prominent with less complex innovations that reflect higher relative advantage than innovations that are more complex. Also, fewer studies in non-work settings are available in the innovation adoption literature than compared to the work setting (Lu, Yao, & Yu, 2005). Therefore, predicting non-work-related consumer behavior with the help of typical adoption frameworks, such as TAM, TPB, and UTAUT, is worthy of examination (Lu et al., 2005).

TAM was utilized in a study involving 866 Singaporean students from the National University to investigate the consumer attitudes towards

using mobile commerce (Yang, 2005). Regression analysis revealed that PU influences the attitude towards using mobile commerce. This study found that males perceive mobile commerce more favorably than females do. Similarly, another study comparing traditional and advanced mobile services linked the antecedents of behavioral intentions, PU and PEOU, with Social Influence (SI) and perceived benefits (López-Nicolás, Molina-Castillo, & Bouwman, 2008). This study, conducted among 542 Dutch consumers, validated the application of TAM, and predicted acceptance related to advanced mobile services. The authors of this study pointed out that SI might not be as important in voluntary situations as it is in mandatory settings (López-Nicolás et al., 2008).

Drennan, Kennedy, and Pisarski (2005) used PU and PEOU as antecedents to student satisfaction for online learning in management courses and utilizing structure equation modeling. The results of this study confirmed that student satisfaction had a relationship with positive perceptions of online learning technology. This study demonstrated an example of TAM's PU and PEOU constructs successfully establishing a relationship with the intention to use online learning technology. Similarly, Lane and Coleman (2012) applied TAM by looking at PU and PEOU of social networking media, such as Facebook and MySpace, within a group of business students at a U.S. regional university. The results of this study found that higher PEOU led to higher PU, which ultimately led to a higher use of social networking media. Further, Park, Kim, Shon, and Shim (2013), in their study on Smartphone usage in South Korea, applied TAM. They did an in-person survey of 852 individuals, which helped them validate TAM for the context of Smartphone usage in South Korea. However, in contrast to the studies above, Horton, Buck, Waterson, and Clegg (2001) looked at intranet usage in two organizations located in the United Kingdom and found mixed results with applying TAM as a tool in understanding intranet usage.

Innovation adoption study, such as wireless internet services through mobile technology, has revealed a significant relationship between social influences and adoption intentions (Lu et al., 2005). By collecting data from 357 MBA students at Texas A&M University, this study helped advance the understanding of the theoretical determinants of early innovation adoption. Utilizing structural equation modeling, the study revealed the causal relationships between the constructs under study. Moreover, sometimes an innovation can become a symbolic enhancement agent of one's social status (Kulviwat et al., 2009), similar to the behavior reported in young Asians and their use of Smartphones (Lu et al., 2005). In the literature, early adopters are sometimes also known as prompters (Kim & Park, 2011). Besides often making a recommendation, these referent sources even sometimes acquire the technology for other individuals, which in turn influences an individual's attitude of experiencing the innovation (Kim & Park, 2011).

Similarly, in their study on the adoption of high-tech innovations, Kulviwat et al. (2009) concluded that positive SI through positive attitude has a positive influence on the adoption intention of high-tech innovations. This study found an indirect relationship between

SI and adoption intentions. If an organization convinces its consumers that a relevant group endorses a particular innovation, then the organization can potentially influence individuals' attitudes towards that innovation (Kulviwat et al., 2009). Structural equation modeling through a large, Midwestern United States university sample established the relationship among the constructs under study. Furthermore, the relationship between SI and adoption intention was found to be more pronounced when the innovation was consumed publicly (Kulviwat et al., 2009). The authors recommended that further studies on innovation adoption should incorporate SI into a full model of TAM, especially in the context of consumer behavior model and not within the boundaries of organizational environment.

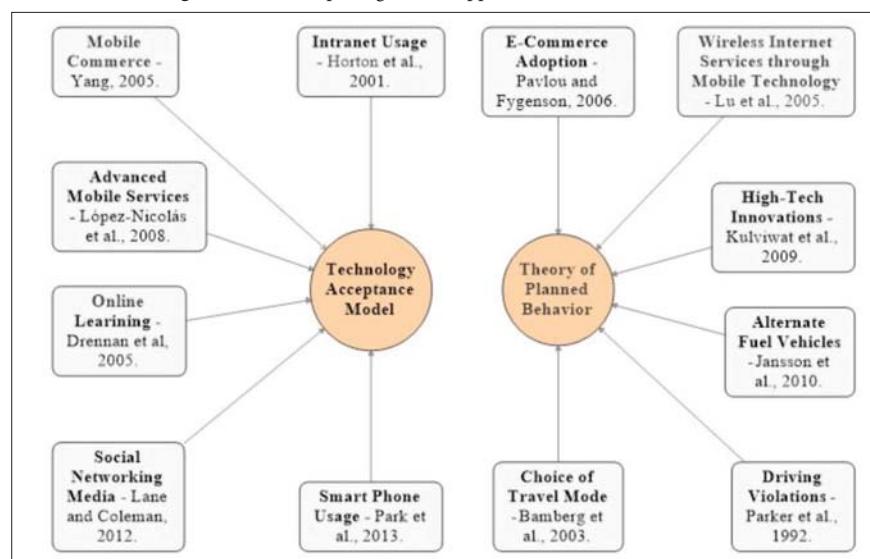
Jansson, Marell, and Nordlund (2010) studied a total of 1,832 alternative fuel vehicle adopters and non-adopters and focused on analyzing their willingness to adopt eco-friendly car technology. The authors found that norms, beliefs, values, and strength of habits determined willingness to adopt eco-friendly car technology. They pointed out that adopters may serve as useful communicators to other individuals, informing the others of their adoption decision. Also, it is likely that, once adopters have adopted the innovation, they are more likely to be open to future innovations as compared to non-adopters (Jansson et al., 2010). Moreover, in pursuit of applying TPB to driver's behavioral intentions to commit specific driving violations, Parker, Manstead, Stradling, Reason, and Baxter (1992) conducted a study on a stratified sample of drivers. The results of this study supported the use of perceived behavioral control, which significantly increased the variance explained in the behavioral intentions of driving violations. Also, the relationship of subjective norm construct and behavioral intentions was found to be stronger than the relationship between attitude and behavioral intentions.

Similarly, in their study on the application of TPB, Ajzen and Driver (1992) found that their model supported the behavior in the context of leisure activities. Regression-based analysis of over 140 students formed the core of the main study that validated their model and its utility in leisure activities. Further, in another attempt to apply TPB, Taylor and Todd (1995b) surveyed 790 consumers at a shopping mall to compare four models, which included three versions of TPB and TRA. These consumers were potentially deciding to adopt the technology VCR-Plus, which was new at the time of the study, and the participants were limited to 18 years or older with a VCR in their household. The results from this study discovered that all four of the models exhibited coherent fit to the data (Taylor & Todd, 1995b). Likewise, Bamberg, Ajzen, and Schmidt (2003) conducted a longitudinal study on the application of TPB as a conceptual framework for the choice of travel mode. The study examined the effects of the intervention (prepaid bus tickets) on the increased usage of bus service among college students. The intervention in this study influenced all three determinants of behavioral intention and doubled the number of students taking the bus to school. The TPB model did successfully predict behavior in both pre and post intervention cases (Bamberg et al., 2003).

In another study on internet purchasing, George (2004) found that the respondents who believed in their self-abilities and considered the

internet trustworthy were more apt to make an online purchase than those respondents who did not possess these beliefs. Once again, the author of this study established the robustness of TPB to explain internet-purchasing behavior. Moreover, on the intention to adopt internet banking in Taiwan, researchers compared TPB (pure and decomposed) and TRA with 425 respondents in their sample (Shih & Fang, 2004). Structural equation modeling analysis revealed that all three of the models provided a decent explanation of the data. The decomposed TPB provided a slightly higher explanation of the variance in behavioral intention, subjective norms, and attitude towards the consumer's adoption of internet banking in Taiwan. Finally, Pavlou and Fygenson (2006), in their longitudinal study, attempted to explain and predict consumers' adoption of e-commerce and validated the predictive power of TPB. The results from this study showed that e-commerce adoption is the function of both product purchasing and information gathering.

Figure 5. Model depicting various applications of TAM and TPB.



The dynamics of the relationship between humans and automation is critical to performance and survival of emerging technologies (Ghazizadeh et al., 2012). Both TAM and TPB will continue to serve as the fundamental means for researchers seeking to study the factors influencing consumers' adoption intentions of various technologies. The literature reveals a wide variety of applications for both of these frameworks across multiple cultures, geographies, and different contexts.

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Final Remarks

Research within the field of innovation adoption often presents a challenge regarding the scarcity of similar studies and consumers' innovation inexperience (Cooper, 1998). With the increase in technological dependence in our lives and global economic interdependence, several researchers associated with academia and industry have been actively involved in studying consumers' adoption intentions of various technologies (Arts, Frambach, & Bijmolt, 2011; Kulviwat, Bruner, & Al-Shuridah, 2009). Figure 5 below shows the consolidated model representing a literature overview on various applications of TAM and TPB.

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Biography

Sahil Koul is currently a Ph.D. candidate in the College of Technology at Eastern Michigan University, Michigan, USA. He received his Master's of Science degree in Automotive Engineering from Lawrence Technological University, Michigan, USA. His research interests are in interdisciplinary areas of automotive technologies, including driverless car technology, technology acceptance and diffusion of emerging technologies, and examining socio-technological interactions. He has over ten years of experience working within the automotive domain and currently works as an engineering manager for a large North American automotive accessory manufacturer.

Ali Eydgahi started his career in higher education as a faculty member at the Rensselaer Polytechnic Institute in 1985. Since then, he has been with the State University of New York, University of Maryland Eastern Shore, and Eastern Michigan University. During 2006–2010, he was Chair of the Department of Engineering and Aviation Sciences, Founder and Director of the Center for 3-D Visualization and Virtual Reality Applications, and Technical Director of the NASA-funded MIST Space Vehicle Mission Planning Laboratory at the University of Maryland Eastern Shore. In 2010, he joined Eastern Michigan University as an Associate Dean in the College of Technology and currently is a Professor in the School of Engineering Technology. He has extensive experience in curriculum and laboratory design and development. Dr. Eydgahi has served as a member of the Board of Directors of Tau Alpha Pi and as a member of advisory and editorial boards for many international journals in engineering and technology. Also, he has served as a member of the review panel for NASA and Department of Education, as a regional and chapter chairman of IEEE, SME, and ASEE, and as a session chair and a member of scientific and international committees for many international conferences.

