Technological Innovation in Colombian Small Firms: A Gender Multi-Group Analysis

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Abstract

Background: Studies on innovations have been focused on teams, institutions, and organisations without accounting for the role of the executive's gender. **Objectives**: This research aims to analyse how small Colombian firms manage technological innovation from the perspective of the gender of executives. **Methods/Approach:** A quantitative approach and cross-sectional, non-experimental design through Structural Equation Models with PLS-SEM was used. We self-administered a survey randomly to gather data from 145 small firms' owners or managers in the department of Bogota, Colombia. **Results:** The results obtained from multi-group analysis evidence that process innovation has a strong and significant positive impact on the innovation of products, and no significant differences were found when comparing the performance of male executives versus female executives. However, descriptive statistics showed that female executives give more importance to the process and product innovation activities, and they demonstrated to manage a better product innovation performance than male executives. **Conclusions:** The evidence reveals that female executives are more committed to developing new products and choose to acquire new skills or equipment to develop products and processes. It is, therefore, essential to eliminate organisations' cultural stereotypes and take advantage of women's potential in management leadership.

Keywords: product innovation; process innovation; executives gender; multi-group analysis; PLS-SEM; IPMA.
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Introduction

According to the literature, Innovation is considered one of the key strategies to boost economic growth and thus develop wealthy countries (Cuevas-Vargas et al., 2021; Fagerberg et al., 2005; Verspagen, 2009). Moreover, since innovation is seen as a critical element of an organisation's success and survival (Damanpour et al., 2001), innovation management should not only be a responsibility but an obligation for current business managers (Christensen, 1999). Proper innovation management can help enterprises adapt swiftly to current market changes (Khazanchi et al., 2007). Additionally, Alsos et al. (2013) contend that more attention should be paid to incremental innovation processes and process-oriented innovations that are undertaken at the lowest levels of organisations.

Studies on innovation processes often focus on teams, institutions, and organisations without accounting for the role of gender. Ranga et al. (2010) argue that gender is generally seen as a peripheral component of innovation. However, during the last few years, greater attention has been paid in practice and academia to the differences between men and women in business management. As a result, studies based on gender in innovation have recently gained momentum among management and entrepreneurship researchers (Arun et al., 2020; Ranga et al., 2010; Vafaei et al., 2021). Still, as stated by Alsos et al. (2013), Arun et al. (2020), and Ranga et al. (2010), the role of innovative female executives in technological change and innovation is underestimated due to the implicit and socially construed belief that men are more innovative than female entrepreneurs as per traditional gender roles. Yet it is not women who are incapable of innovating but organisational practices that condition or inhibit female innovation.

Scientific evidence shows that, as a sociodemographic feature of enterprise executives, gender influences the executives' decisions and, therefore, the actions taken by the organisations led by them (Hambrick et al., 2013). Hence, enterprises need to consider and incorporate gender-related features into their operations (Selvarajan et al., 2015). As Charlo Molina et al. (2012) show, both men and women contribute their values to the transformation and management of organisations through governance and leadership. Besides, the representation of women in managerial positions is positively linked with innovation (Vafaei et al., 2021).

The technology sector offers a historical framework for exploring gender practices in networks. As one of the earliest researchers of the role of the gender of executives in technological innovation, Rothschild (1983) contended that technological development was more linked to men since boards of directors were chiefly male, with women who did not understand the contents and the management of technological change; also, technology has been predominantly male, that is to say, technological devices are created with male values without considering female needs. Feminist technological research has shown that men make the key decisions related to technological development (Berger et al., 2015). In part, this can be explained because, after university, women have difficulties getting majors in information technology courses (Zhang et al., 2021).

The participation of women in innovation activities has mostly remained unchanged in the last few decades. However, some authors like Danilda et al. (2011), Expósito et al. (2021), Østergaard et al. (2011), Vafaei et al. (2021), and Woodman et al. (1993) have shown the relationship between innovation and gender. They argue that gender diversity is fundamental and beneficial to problem resolution; therefore, teams should have balanced participation of men and women. This balance—reinforced by gender diversity—substantially increases innovation in creating new things. As a result, the relationship between the incorporation of women into senior management positions and an organisation's financial performance can now be accounted for.

In that sense, the gender of executives can influence process innovation and, therefore, product innovation. For example, Vafaei et al. (2021) found a significant relationship between women's participation in managerial positions and firms' innovation activities. This finding supports calls for more diversity since the higher the participation of women on boards, the higher the levels of investment in innovation. On the other hand, Alsos et al. (2013) conclude the roles of men and women in the innovation pipeline are different: male executives are overwhelmingly active in technology start-ups and venture capital firms, while female executives are most active in technological transfer offices. Furthermore, Arun et al. (2020) found in their research on gender and innovation in India that organisational and marketing innovation is greater than product and process innovation in SMEs where women are in charge.

We conducted several searches in the Scopus and Web of Science databases. It was found that there are many results for the term "gender" because many subject areas study this term. However, results within the subject areas of business and/or management are significantly fewer. The contrary applies to the term "innovation," which shows more results in the subject areas of business and/or management. Nevertheless, few studies support the relevant role of females as owners or executives in the innovation creation process (Zastempowski et al., 2021), such as Na et al. (2019), Teruel et al. (2017), Wu et al. (2021) who studied the gender effect on innovation activities.

Our research contemplates three key contributions. The first is to provide empirical evidence for the relationship between process and product innovation—using the gender of executives as the moderating variable—in Colombian MSMEs. The second contribution is to apply a methodology that is different from the ones used in previous research: proving the theoretical model through construct validation by confirmatory factor analysis (CFA) and testing the hypotheses through multi-group analysis (MGA) using variance-based structural equations modelling (PLS-SEM). The third contribution is to provide empirical evidence for the importance and performance of the variables used to measure process innovation on product innovation through a map analysis (IPMA).

Our empirical study aims to determine how this kind of enterprise manages technological innovation and how process innovation influences product innovation from the standpoint of the gender of executives. Researchers need to ask themselves if the gender of executives substantially impacts technological innovation in Colombian MSMEs and what the implications are. Following this question, our quantitative research was undertaken in Bogota (Colombia) between February and April of 2018, with a sample of 145 MSMEs, of which 96 were run by men and 49 by women.

The present article is arranged as follows: After (1) the introduction, (2). A literature review of the relationship between process and product innovation. After that, (3) the methodology is presented, including sample design, reliability and validity of the scales. (4) Results and hypotheses tests are provided in this part. (5) research results are discussed from a theoretical and managerial perspective. Finally, (6) the conclusions, which include the implications, limitations, and recommendations for future studies, are outlined.

Literature review

An enterprise's interest in process and product innovation lies mainly in the perceived attributes of each innovation; the adoption of product innovations receives more attention since these are more visible than process innovations—while innovations in processes are associated with the production process, and to the supply and operations, innovations in products are the results themselves (Oke, 2007). Dwivedi et al. (2021) suggest that firms that can innovate rapidly need to realise the critical success factors of new product development to achieve competitive advantages. Ul Hassan et al. (2013) found that the four types of innovation (process, product, organisational, and marketing) are linked, and process innovation positively affects product innovation. In turn, an empirical study involving 159 industrial enterprises in Spain by Camisón et al. (2014) evidenced the relationship between product and process innovation and found that this relationship significantly influences organisations. Expósito et al. (2021) obtained data from 1,425 Spanish SMEs, of which they found complementarities among process, product and organisational innovations. Based on the arguments, we propose the following hypothesis:

- *H_1: Process innovation positively influences product innovation in Colombian small enterprises.*

Innovation contemplates knowledge and learning at every stage—this propitiates invention and leads the participants (men and women) to obtain innovative capacities (Robledo et al., 2010). Consequently, the participants are a fundamental part of the innovation process since men and women have different personal and professional experiences that shape their strategic innovation methods (Manolova et al., 2007). It has been shown that enterprises that have a greater absorption capacity—which allows them to exploit internal knowledge through learning and interaction—are the ones that have a greater variety of knowledge, skills, and experiences among their employees (Van der Vegt et al., 2003). Therefore gender turns out to be a factor that benefits innovation in enterprises since it implies an increase in knowledge and a higher probability of new ideas (Østergaard et al., 2011). Considering specifically product and process innovation, an empirical study with 205 technological SMEs in Spain by Ruiz-Jiménez et al. (2016) confirmed that gender positively influences product and process innovation. However, Expósito et al. (2021) and Foss et al. (2013) argue that both men and women can innovate within different types of innovation, but women make executive decisions in small-sized enterprises. Mendonça et al. (2020) evidence that gender negatively affects the probability of innovating, with women being 30 percent less likely to develop products or services for personal use. Olson et al. (2003) state that men who own enterprises have a better business performance than women in terms of the financial measures used to create innovation.

Furthermore, Díaz-García et al. (2013) stress that these two kinds of innovation (product and process) are positively related and the capacities of individuals, with the link mediated by gender being the stronger one; they also contend that the attributes of men make them swifter in terms of decision-making than women. Expósito et al. (2021) observe that the gender of executives influences process innovations. Based on the above arguments, we propose the following hypothesis:

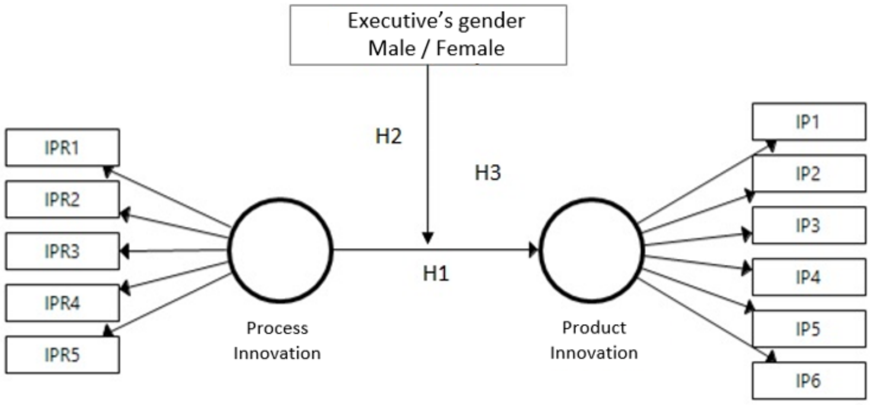
- *H_2: Process innovation positively influences product innovation in Colombian small enterprises run by men.*

On the other hand, female executives can contribute to organisations with perspectives, workstyles, and experiences that are exclusive to them (Huse et al., 2006), thereby helping attain better knowledge management to foster innovation (Attah-Boakye et al., 2020; Torchia et al., 2011; Zouaghi et al., 2020). However, female executives frequently have a close male presence that persuades them; when there are more men than women, women face the unanimous opinion of a group and tend to abide by it (Attah-Boakye et al., 2020; Torchia et al., 2011). Women tend to innovate more in the organisational sphere when independent of men but are not completely from technological innovation in products and processes (Zouaghi et al., 2020). They also participate in product and service innovation by innovating everywhere, from supplies to processes (Idris, 2009). Vafaei et al. (2021) found in their research in Australia that the participation and proportion of women on boards are related to several measures of firms' innovation activity. Based on these arguments, we propose the following hypothesis:

- *H_3: Process innovation positively influences product innovation in Colombian small enterprises run by women.*

Figure 1 shows the theoretical research model that leads to formulating the three hypotheses.

Figure 1
Theoretical model



Source: Author's illustration

Methodology

We undertook an empirical study of the explanatory kind—with predictive, no experimental, cross-sectional, descriptive design, and a quantitative approach—through variance-based structural equation modelling (PLS-SEM) using the Smart PLS 3.3.3 statistics software (Ringle et al., 2015) since this statistical technique allows solving problems related to the lack of data normality because it uses nonparametric testing (Hair et al., 2017). It is important to note that first, we evaluated the measurement model and then the structural model was evaluated with the total sample; then, the multi-group analysis technique was performed to demonstrate the capacity of gender as a moderating variable in PLS-SEM. Lastly, we used partial least squares multi-group analysis (PLS-MGA) (Henseler et al., 2009) to assess whether there are significant differences in the gender of executives regarding the management of technological innovation in Colombian small enterprises.

Sample design and data gathering

This study took as reference the database of the Bogota Chamber of Commerce (2018), considering the population of the registered firms in the department of Bogota (Colombia) that have between 1 and 200 workers. A total of 740,069 micro-sized, small-sized, and medium-sized enterprises are registered. After estimating the sample with a 95 per cent confidence interval and a six per cent margin of error, we obtained a sample of 267 enterprises.

Using the simple random sampling technique, we gave a survey between February and April of 2018 to the owners or managers of the enterprises that were selected from the sample, obtaining in the end only 145 valid surveys—which represent the definitive sample for this research.

It should be clarified that, according to the sample's distribution, 47.6 per cent of enterprises are micro-enterprises, 47.6 per cent are small enterprises, and only 4.8 per cent are medium-sized enterprises. Additionally, 53.2 per cent are not family enterprises while 46.9 per cent are family enterprises; moreover, 66.2 per cent are run by men and only 33.8 per cent are run by women; and the sector with the highest representation is services (55.2 per cent), while the remaining belong to the manufacturing (production) sector.

Variables

To measure process innovation, we used the latent variable as the technological innovation construct, a scale used by Cuevas-Vargas (2016) as adapted from Liao et al. (2007).

To measure product innovation, we used a reflective latent variable as the technological innovation construct, taken from the scale used by Cuevas-Vargas (2016) as adapted from Liao et al. (2007). This is measured using six indicators with a Likert scale from one to five—ranging from strongly disagree to agree strongly.

To measure the control variable gender, a dummy variable was used to identify the business owner or executive gender, such that 1 indicated male and 2 represented female.

Reliability and validity of the constructs

To assess the reliability and validity of the constructs, we estimated the measurement model using the algorithm of PLS-SEM with the Smart PLS 3.3.3 statistics software (Ringle et al., 2015).

The results of this study (Table 1) reveal that both constructs have high internal consistency—the composite reliability (CR) is above the 0.708 value mentioned by Hair et al. (2017); likewise, for each of the constructs, Cronbach's Alpha (CA) (Cronbach, 1951) is greater than 0.7, as recommended by Hair et al. (2017), and Nunnally et al. (1994), and it is also higher than the 0.5 average variances extracted (AVE) (Fornell et al., 1981; Hair et al., 2012). Moreover, we found that the standardised factor loadings of the indicators are higher than 0.708 (Hair et al., 2017), and they are significant ($p<0.001$), which ensures the commonality of each item; and, since the AVE values are above 0.5, all the used scales have convergent validity (Hair et al., 2017).

Table 1
Assessment of the measurement model for the total sample and the two subsamples based on the executive's gender

Constructs	Indicator	Convergent Validity		Internal Consistency Reliability		
		Factor Loadings	t-value	AVE	CR	CA
		>0.708	>2.57	>0.5	>0.7	>0.7
Process Innovation[1]	IPR1	0.838	27.582	0.770	0.944	0.925
	IPR2	0.910	44.929			
	IPR3	0.903	47.522			
	IPR4	0.837	25.178			
	IPR5	0.896	44.843			

Product Innovation[1]	IP1	0.885	29.329	0.787	0.957	0.946
	IP2	0.819	30.043			
	IP3	0.933	62.672			
	IP4	0.905	32.657			
	IP5	0.876	45.688			
	IP6	0.900	34.005			
Process Innovation[2]	IPR1	0.852	22.318	0.777	0.946	0.928
	IPR2	0.915	36.518			
	IPR3	0.909	48.306			
	IPR4	0.826	19.625			
	IPR5	0.902	45.839			
Product Innovation[2]	IP1	0.900	42.210	0.807	0.962	0.952
	IP2	0.882	27.357			
	IP3	0.927	53.881			
	IP4	0.891	21.180			
	IP5	0.887	29.157			
	IP6	0.903	45.736			
Process Innovation[3]	IPR1	0.813	8.309	0.759	0.940	0.921
	IPR2	0.905	13.902			
	IPR3	0.893	14.090			
	IPR4	0.860	9.709			
	IPR5	0.883	14.068			
Product Innovation[3]	IP1	0.865	11.893	0.752	0.948	0.933
	IP2	0.709	60.14			
	IP3	0.940	13.866			
	IP4	0.903	13.011			
	IP5	0.848	9.137			
	IP6	0.898	13.395			

Note: [1]Total sample N=145; [2]Male executives N=96; [3]Female executives N=49
Source: Authors' work based on results obtained with Smart PLS 3. Ringle et al. (2015)

The discriminant validity was calculated using two criteria shown in Table 2. Firstly, above the diagonal, we find the Heterotrait-Monotrait ratio of correlations (HTMT85) test (Henseler et al., 2015), which is considered a well-performing test for assessing the discriminating validity (Cuevas-Vargas et al., 2019, 2022); also, upon computing the complete bootstrapping, we found that the correlation values between the variables are below 0.85 (Clark et al., 1995; Henseler et al., 2015; Kline, 2011). Secondly, the test of Fornell-Larcker was estimated by taking as reference the square root of each of the construct's AVE, whose values—in bold—represent the table's diagonal; and along with this criterion, the values of the correlations are below the value of the square root of the AVE (Fornell et al., 1981), as can be seen below the diagonals.

Table 2
Discriminant validity of the variables for the total sample and the two subsamples based on the executive's gender

Constructs[1]	**Process Innovation**	**Product Innovation**
	AVE= 0.770	AVE= 0.787
Process Innovation	**0.877**	0.745
Product Innovation	0.702	**0.887**
Constructs[2]	Process Innovation	Product Innovation
	AVE= 0.777	AVE= 0.807
Process Innovation	**0.881**	0.823
Product Innovation	0.779	**0.898**

Constructs[3]	Process Innovation	Product Innovation
	AVE= 0.759	AVE= 0.752
Process Innovation	**0.871**	0.572
Product Innovation	0.547	**0.867**

Note: [1]Total sample N=145; [2]Male executives N=96; [3]Female executives N=49
NOTE: The numbers on the diagonal (in bold) signify the AVE's square root values.
Source: Authors' work based on Smart PLS 3 outcomes. Ringle et al. (2015)

Based on the criteria evaluated above, we can conclude that the present study's data are valid and reliable for testing the research hypotheses and implementing PLS-MGA.

Results

First, we estimated the descriptive statistics (found in Table 3). These statistics emphasise the observable variables of each of the constructs given more relevance by the executives or owners of micro, small, and medium-sized enterprises in Colombia through each variable's arithmetic mean.

Table 3
Descriptive statistics

ID	Variable	Total N=145		Male Executive N=96		Female Executive N=49	
		Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev
IPR1	Different operations procedures	3.71	*1.37*	**3.73**	*1.36*	3.69	*1.41*
IPR2	Acquisition of new skills or equipment	3.69	*1.37*	3.67	*1.39*	**3.75**	*1.34*
IPR3	Development of manufacturing or operations processes	3.17	*1.30*	**3.17**	*1.39*	3.16	*1.12*
IPR4	Flexible for developing products	3.68	*1.38*	3.64	*1.42*	**3.75**	*1.29*
IPR5	Processes lead to imitation from competitors	3.00	*1.18*	3.00	*1.23*	**3.02**	*1.07*
IP1	Development of new or improved products/services	3.46	*1.34*	3.32	*1.34*	**3.73**	*1.33*
IP2	Profit from new products/services	3.03	*1.36*	**3.04**	*1.32*	3.02	*1.43*
IP3	New products/services lead to imitation from competitors	3.12	*1.21*	3.02	*1.23*	**3.32**	*1.16*
IP4	Launching products/services faster than the competition	2.93	*1.16*	2.86	*1.20*	**3.08**	*1.09*
IP5	More R&D capacities than competitors	2.79	*1.11*	2.71	*1.10*	**2.93**	*1.12*
IP6	Development of novel abilities to transform existing products into new ones	3.18	*1.28*	3.06	*1.25*	**3.42**	*1.30*

Source: Authors' work based on results obtained with Smart PLS 3. Ringle et al. (2015)

Regarding process innovation, we found that the women who are the owners or executives of the surveyed enterprises give more importance to process innovation. Three of the five variables used to measure this kind of technological innovation had scores above the mean process innovation score of Colombian small enterprises. Women decide to acquire new abilities or equipment with a 3.75 mean, are flexible in developing products with a 3.75 mean, and their processes lead competitors to imitate them with a 3.02 mean. In turn, male executives focus more on having different operational procedures with a 3.72 mean; and the development of manufacturing or operations processes with a 3.17 mean.

We found that the women who are the owners or executives of the surveyed enterprises give more importance to product innovation. Five of the six variables used to measure this technological innovation construct had scores above the mean product innovation score of Colombian small enterprises. Women focus more on developing or improving products or services with a 3.73 mean; they develop skills to transform existing products into new ones with a 3.42 mean; they work towards creating new products or services that lead competitors to imitate them with a 3.32 mean; they strive to launch products or services faster than the competition with a 3.08 mean, and their R&D is better than that of their competitors with a 2.93 mean. In turn, male executives' profit from developing new products or services with a 3.04 mean.

To test our research hypotheses, we analysed the structural model using the bootstrapping procedure with 5,000 subsamples (Hair *et al.*, 2017); as seen in Table 4, these outcomes evidence that the structural model has the explanatory capacity and predictive relevance because, in the original model, 49.3 per cent of product innovation can be explained by process innovation in Colombian small enterprises (R^2 = 0.493); in model 2, 60.7 per cent of product innovation can be explained by process innovation in Colombian small enterprises run by men (R^2 = 0.607); and, in model 3, 29.9 per cent of product innovation can be explained by process innovation in Colombian small enterprises run by women (R^2 = 0.299).

Table 4
Structural model results with PLS-SEM

Hypothesis	Path	Standardised coefficient β	*t-value*	p-value	R^2
H_1: Process innovation positively influences product innovation in Colombian small enterprises.	Process innovation → Product innovation	0.702***	8.797	0.000	0.493
H_2: Process innovation positively influences product innovation in Colombian small enterprises run by men.	Process innovation managed by men → Product innovation	0.779***	9.741	0.000	0.607
H_3: Process innovation positively influences product innovation in Colombian small enterprises run by women.	Process innovation managed by women → Product innovation	0.547***	3.228	0.000	0.299

*Note: Significance: *** = p<0.001; ** = p<0.05; Adjusted R2 values: >0.20 = Weak; >0.33 Moderate; >0.67 = Substantial (Chin, 1998, cited in* Cuevas-Vargas *et al.*, 2019, p. 9)
Source: Authors' work based on results obtained with Smart PLS 3. Ringle et al. (2015)

We can infer from the results that product innovation (an endogenous construct in the three models) has explanatory power since the values of R^2 are above 0.2 (Chin, 1998; Hair et al., 2017), and so the model has a good level of quality. Thus, its results allow for business decision-making. Furthermore, the goodness of fit (GoF) test was estimated to assess the model fit (Wetzels et al., 2009) because the GoF is very useful for PLS-MGA when we need to compare PLS-SEM outcomes of different data sets for the same path model (Henseler and Sarstedt, 2013). The GoF index for PLS-SEM is assessed using the average of the AVE values obtained in the first stage of the measurement model and the average R^2 value through the following equation GoF = $\sqrt{AVE * R^2}$. It is highlighted that according to Wetzels et al. (2009, p. 187), the critical values for measuring the GoF analysis results are: "GoF_{small} (0.1); GoF_{medium} (0.25); GoF_{large} (0.36)". In this regard, our model showed a GoF value of 0.619, considered a very good (GoF_{large}) model fit (Wetzels et al., 2009). Additionally, the predictive power of the model was determined, and the standardised root mean square residual (SRMR) composite factor model was assessed with a value of 0.055, which is below the threshold value of 0.08, confirming that the structural model is significant (Hair et al., 2018).

Regarding the first hypothesis (H_1), the results in Table 4 (β = 0.702, p <0.001) indicate that process innovation has positive and significant effects on product innovation. Therefore, H_1 is supported since we found that process innovation has a 70.2 per cent impact on product innovation in Colombian small enterprises. As for H_2, the results indicate that process innovation managed by male executives has positive and significant effects on product innovation (β = 0.779, p <0.001). Thus, H_2 is supported because, when managed by men, process innovation has a significant (77.9 per cent) impact on process innovation in Colombian MSMEs. Concerning hypothesis H_3, the results indicate that process innovation managed by female executives has positive and significant effects on product innovation (β = 0.547, p <0.001). Thus, H_3 is supported, for we found that, when managed by women, process innovation has a 54.7 per cent impact on product innovation in Colombian MSMEs.

Multi-group analysis

According to Hair et al. (2018), a PLS-SEM multi-group analysis needs to be applied when the research aims to explore differences that can be explained by observable characteristics, as in our study is the case of gender. For this reason, assessing PLS-SEM multi-group analysis substantively improves the ability to identify significant differences in multiple relationships through groups. The multi-group analysis comprises the division of the sample according to the categorical variable (gender). Group 1 comprises male executives or owners (96 cases), and group 2 comprises female executives or owners (49 cases). Each group was estimated separately, and the results are presented in Table 5. In this sense, the effect of process innovation on product innovation is much stronger among male executives ($p1^{(1)}$ = 0.779) than female executives ($p1^{(2)}$ = 0.547), for this reason, it is important to note that disregarding heterogeneity may affect the underlying model (Hair et al., 2018; Sarstedt et al., 2009).

In this research, a multi-group comparison was undertaken, as suggested by Henseler and Fassott (2010). It is highlighted that this approach was used to verify the moderating role of executives' gender in the relationship between process and product innovation in small Colombian firms. However, before comparing path estimates across groups, metric invariance of the constructs measures must be ensured. Factor loadings for the same indicators must be invariant between the groups of female and male executives. This means that the effect of gender, in its moderating role, is restricted to the path coefficients of the structural model.

For this reason, it was necessary to perform the permutation-based method for PLS-MGA to the standardised factor loadings (Chin et al., 2010). The results show that only one of the 11 indicators presents significant differences between the groups (IP2, difference = 0.178, Permutation p-value = 0.018). Therefore, there is metric invariance.

Furthermore, to perform the multi-group analysis, Henseler et al. (2016) recommend first check and, consequently, confirming the stability of the invariance using the procedure of the measurement invariance of composite models (MICOM), following the three steps: (1) configurational invariance, (2) compositional invariance (see table

5), and (3) equality of composite mean values and variances (see Table 6). In this regard, the results presented in Tables 5 and 6 demonstrate that all conditions were met. Hence, full measurement invariance is established (Hair et al., 2018). First, according to configurational invariance, both groups (male and female) have equal indicators, handling of data, and algorithm settings; regarding the compositional invariance, when comparing original correlations between the composite values obtained from group 1 (male) and group 2 (female), the value of the original correlation was equal or greater than 5 per cent quantile of the empirical distribution of the correlations between the composite values of group 1 and group 2. Hence, the compositional invariance is established; finally, concerning the equal mean values and invariances, the results indicate that both the mean original difference lies between the bounds of the confidence interval, and the variance of the original differences lies between the confidence interval boundaries; therefore, full measurement invariance is confirmed (Hair et al., 2018; Henseler et al., 2016).

Table 5
Measurement invariance of composite models (MICOM) procedure (steps 1 and 2)

Construct	Configural Invariance	Compositional Invariance Assessment		
		Original Correlation	5.0%	Compositional Invariance
Process innovation	Established	1.000	0.999	Established
Product innovation	Established	0.999	0.999	Established

Source: Authors' work based on results obtained with Smart PLS 3. Ringle et al. (2015)

Table 6
Measurement invariance of composite models (MICOM) procedure (step 3)

	Full measurement model invariance assessment					
	Mean - Original Difference	Confidence interval	Equality of means	Variance - Original Difference	Confidence interval	Equality of variances
Process innov.	-0.030	[-0.343, 0.342]	Equal	0.223	[-0.423, 0.516]	Equal
Product innov.	-0.236	[-0.344, 0.348]	Equal	0.090	[-0.416, 0.477]	Equal

Note Results based on a two-tailed permutation test at a 5% confidence level [2.50%, 97.50%]; *Source:* Authors' work based on results obtained with Smart PLS 3. Ringle et al. (2015)

To identify whether there are significant differences between the groups, a multi-group analysis (Sarstedt et al., 2011) was carried out, using the nonparametric test of the PLS-MGA approach that builds on bootstrapping results of each data group (Henseler et al., 2009). However, upon assessing the model through PLS-MGA, with 5,000 subsamples, we found no statistically significant differences in the gender of executives regarding technological innovation management in Colombian small enterprises, as seen in Table 7. According to Sarstedt et al. (2011), a result is significant with a five percent error probability if the p-value is below 0.05 or above 0.95. In this study, we obtained ($\beta = 0.232$, $p = 0.102$) difference. Therefore, there is no statistically significant difference in technological innovation management based on the gender of executives in Colombian small enterprises.

Table 7
Multigroup analysis with PLS-SEM

Path Relation	Path Coefficient Male Group	Path Coefficient Female Group	Path Coefficient Difference	*p-value* Male vs Female
Process innovation → Product innovation	0.779***	0.547***	0.232 N.S.	0.102

*Note: Significance: *** p<0.001; **p<0.05; N.S.= Non-significant*
Source: Authors' work based on results obtained with Smart PLS 3. Ringle et al. (2015)

Lastly, to better compare the group-specific results of a PLS-SEM-based multi-group analysis, as suggested by Hair et al. (2017, p. 280), we used the importance-performance map analysis (IPMA) (Hair et al., 2018; Höck et al., 2010; Rigdon et al., 2011), upon carrying out the importance-performance map analysis we found that product innovation had a 52.1 performance and process innovation had a 60.6 performance with a 0.67 importance—as shown in Table 8. This means that for each point that process innovation performance increases, product innovation performance increases by 0.699. That is to say, if Colombian MSMEs improve their process innovation performance from 60.55 to 61.55, then product innovation will improve from 52.12 to 52.79.

Table 8
An importance-performance analysis of exogenous variables on product innovation

Samples	Total N=145			Male Executive N=96			Female Executive N=49		
Value of product innovation performance	52.1			49.8			57.2		
Exogenous variables	Prf.	Imp.	Pred.	Prf.	Imp.	Pred.	Prf.	Imp.	Pred.
(Latent) process innovation	60.6	.67	52.8	60.4	.72	50.6	60.9	.55	57.7
Different operations procedures	67.9	.11	52.2	68.2	.13	49.9	67.3	.07	57.3
Acquisition of new skills or equipment	67.4	.13	52.2	66.7	.14	49.9	68.8	.11	57.3
Development of manufacturing or operations processes	54.3	.14	52.2	54.4	.15	49.9	54.0	.12	57.3
Flexible for developing products	67.0	.12	52.2	64.2	.13	49.9	68.8	.101	57.3
Processes lead to imitation from competitors	50.2	.16	52.2	50.0	.17	50.0	50.5	.13	57.3

Note: Prf. = Performance of exogenous variables; Imp. = Importance of exogenous variables represented by the value of non-typified Beta; Pred. = Prediction for product innovation performance (endogenous variable).
Source: Authors' work based on results obtained with Smart PLS 3. Ringle et al. (2015)

When comparing product innovation performance according to the gender of executives, we found that product innovation managed by female executives had a better performance than when managed by male executives (57.2 vs 49.8, respectively). Nevertheless, the importance of process innovation is greater when managed by men than when managed by women (0.72 vs 0.55). Hence, for each point that process innovation performance increases, product innovation will improve according to the importance value.

Likewise, we determined the importance and the performance of each manifest variable we used to measure process innovation. According to the interpretations of owners or managers, the most important and best-performing variables in product innovation in Colombian MSMEs are the different operations procedures and the development of manufacturing or operations processes when managed by male executives; moreover, it is noticeable that process innovation is more important when managed by male executives, which means that for each point that the manifest variables used to measure process innovation increase, there will be a higher performance increase or improvement in terms of product innovation. Therefore, executives in Colombian MSMEs need to continue strengthening these variables since every performance increase in any of these indicators (manifest variables) will increase product innovation importance for the value that corresponds to the improved indicator.

Discussion

Regarding the influence of process innovation on product innovation, findings obtained using PLS-SEM show sufficient empirical evidence to demonstrate the significant influence of the process on product innovation in Colombian MSMEs. This is in line with Expósito et al. (2021), who found complementarities among process, product, and organisational innovations. In addition, they investigate the role of gender on the CEO's decision to introduce product, process and organisational innovations concurrently. Moreover, our results confirm Oke's (2007) findings, namely that British service enterprises must develop new processes that guarantee success to attain incremental product or service innovations. Likewise, our results confirm what Li et al. (2007) found in Chinese enterprises: that process innovation is linked to product innovation. They also match results obtained by Gunday et al. (2011) in Turkey, Ul Hassan et al. (2013) in Pakistan, Camisón et al. (2014), and Expósito et al. (2021) in Spain, and since all these studies concluded that innovation in the process has a strong significant influence on product innovation.

As for the influence of process innovation on product innovation when managed by male executives, our findings confirm that gender has a positive influence on product and process innovation, as shown too by Expósito et al. (2021) from a survey on the topic of competitiveness of Spanish SMEs and Ruiz-Jiménez et al. (2016) in their study with technological SMEs in Spain; our findings also match those of Olson et al. (2003), since male enterprise owners tend to have a better business performance than women when it comes to implementing financial measures to innovate. They ratify the positive relationship among process innovation, product innovation, and the capacities of the individuals that manage them. Male executives possess characteristics that orient them towards swifter decision-making than women (Díaz-García et al., 2013; Expósito et al., 2021). In the same vein, Mendonça et al. (2020) results show that females are less likely to innovate and to decide on more technology-oriented fields of study (Zhang et al., 2021).

Lastly, concerning the influence of process innovation on product innovation when managed by female executives, our results match those of Vafaei et al. (2021). Their findings show that gender diversity and innovation measures are positively and significantly related to patents and R&D in the high-tech sector. Idris (2009) found that even though female executives tend to innovate more in the organisational sphere when they are independent of men, they also undertake technological innovations. Moreover, female executives can attain better knowledge management for innovating, as Torchia et al. (2011) shows. Unfortunately, limited access to the financial system becomes an obstacle to creating their firm and inhibits their participation in entrepreneurial activities (Lechman et al., 2020). Our findings also match those of Olson et al. (2003) since male enterprise owners tend to have a better business performance than women when implementing innovative financial measures. Likewise, higher representation of women on boards feel less need to innovate; for this reason, the gender issue is regularly presented as a problem of women's underperformance because female executives are seen as less innovative than male executives but do not find contradictory evidence (Alsos et al., 2013, p. 248).

Given the impact of this gender gap, it is necessary to design strategies that encourage women to engage in innovation practice (Mendonça et al., 2020), such as risk-taking, self-confidence, greater educational level, proactivity, and R&D cooperative behaviour (Expósito et al., 2021).

In this regard, our findings are an important contribution to the study of the role of gender in technological innovation. On the one hand, the outcomes reveal that small Colombian firms with greater process innovation have better product innovation, which will be reflected in their business performance. On the other hand, technological innovation is higher in firms led by men, and however, companies led by women demonstrated to have better product innovation performance. Hence, the promotion of entrepreneurial orientation among women in which proactivity, innovativeness and risk-taking are favoured will increase the success of their firms in financial results; moreover, overcoming some gender barriers was associated with lower performance when compared with male-owned enterprises (Criado-Gomis et al., 2020).

From the gender perspective, the fostering and involvement of females in management positions, seen as an opportunity for organisations to improve their innovation activities, particularly technological innovation, can be framed within policies for women's economic empowerment. In addition, it is suggested that these actions be included to achieve the effective and equal participation of women in leadership in all spheres, such as political, social, economic, academic, and business, as Criado-Gomis et al. (2020) mention. These initiatives currently result in governmental objectives, such as the gender-related goal 5.5 of the 2030 Agenda for Sustainable Development (United Nations, 2015).

Conclusion

This empirical study involved an in-depth analysis of the relationship between process innovation and product innovation using the gender of executives as a moderator in the context of Colombian MSMEs. The literature we used comprises studies specifically focused on product innovation and process innovation—for example, Ruiz-Jiménez et al. (2016) confirmed that gender positively influences product and process innovation in this kind of firm. We also reviewed works like Expósito et al. (2021), Foss et al. (2013), and Olson et al. (2003), who explains that both males and female can innovate in diverse innovation spheres. However, they show differences in business performance.

On the other hand, the application of a methodology to prove the theoretical model through the validation of constructs by confirmatory factor analysis (CFA) and hypothesis-testing through PLS-SEM, and with partial least squares multi-group analysis (PLS-MGA) to identify whether the differences between the groups are statistically significant. Moreover, the importance-performance matrix analysis (IPMA) allowed us to provide empirical evidence for the importance and performance of variables used to measure process innovation's effect on product innovation. We found that process innovation is higher in Colombian enterprises—and when male executives manage it, it positively and significantly affects product innovation.

Nevertheless, the outcomes indicate that process innovation managed by female executives positively and significantly affects product innovation. The surveyed enterprises run by women give more importance to process innovation. That is to say, they focus more on developing new or improved products/services, are more capable of transforming existing products into new ones, and strive to acquire new skills or equipment to develop products and processes. In turn, enterprises run by men obtain higher profits from the development of new products/services. Still, we found no significant differences in the gender of executives when it comes to technological innovation management in Colombian small enterprises.

The outcomes may be explained by the fact that the presence of females in enterprises seeking technological innovations is not as big as that of men. According to data from the Women, Science, and Innovation Observatory (2020), women comprise half of the employed population with higher education and half of the employed population that work jobs defined by the OECD as belonging to science and technology (technical, professional, scientific, and intellectual). Nevertheless, female representation in the population directly employed in high and medium-high technology business sectors drops to 26 per cent for general staff and 31 per cent for workers that participate directly in R&D activities.

The main conclusion, therefore, is not that women innovate less but that their participation in enterprises that promote technological innovation is smaller when compared to that of men. This is due to cultural stereotypes, fear of failure, and lack of trust in their potential in the high-technology sector and senior leadership. Thus, senior leaders need to integrate more women, allowing for greater diversification in innovation.

As for its limitations, this research has a low number of respondents, which restricts the generalisation of results. A larger population comprising other regions could help expand our findings in a promising set of new studies. Another limitation is that this is a cross-sectional study—the data was gathered in a single moment. We recommend that future research projects engage in longitudinal studies to identify the relation between process innovation and product innovation using the gender of executives and their level of professionalisation as the moderating variable over time.

Furthermore, this study only contemplated MSMEs from Bogota, leaving aside bigger enterprises and those from other Colombian regions. Thus, we recommend that future studies consider enterprises from other regions and different sizes to assess whether enterprise size and location impact the studied relationships.

Finally, we recommend that future research assess how knowledge management and open innovation management affect technological innovation in these kinds of organisations when they are run by female executives—to contribute to the scientific literature on gender studies.

References

1. Alsos, G. A., Ljunggren, E., Hytti, U. (2013), "Gender and innovation: state of the art and a research agenda", International Journal of Gender and Entrepreneurship, Vol. 5 No. 3, pp. 236-256.
2. Arun, T. M., Joseph, R. P., Akram, M. (2020), "Entrepreneur's gender and firm innovation breadth: An institution-based view of SMEs in an emerging market context", International Journal of Innovation Management, Vol. 24 No. 7, pp. 1-31.
3. Attah-Boakye, R., Adams, K., Kimani, D., Ullah, S. (2020), "The impact of board gender diversity and national culture on corporate innovation: A multi-country analysis of multinational corporations operating in emerging economies", Technological Forecasting and Social Change, Vol. 161.
4. Berger, L., Benschop, Y., van den Brink, M. (2015), "Practising Gender When Networking: The Case of University – Industry Innovation Projects", Gender, Work and Organization, Vol. 22 No. 6, pp. 556-578.
5. Bogotá Chamber of Commerce (2018), "Bases de datos e información empresarial", Cámara de Comercio de Bogotá, available at https://www.ccb.org.co/Fortalezca-su-empresa/Temas-destacados/Bases-de-datos-e-informacion-empresarial (15 August 2022)

6. Camisón, C., Villar-López, A. (2014), "Organisational innovation as an enabler of technological innovation capabilities and fi rm performance", Journal of Business Research, Vol. 67 No. 1, pp. 2891-2902.
7. Charlo Molina, M. J., Núñez Torrado, M. (2012), "La mujer directiva en la gran empresa española: perfil, competencias y estilos de dirección", Estudios Gerenciales, Vol. 28 No. 124, pp. 87-105.
8. Chin, W. W. (1998), "The partial least squares approach to structural equation modeling", in Marcoulides, G. A. (Ed.), Modern Methods for Business Research, Mahwah, Lawrence Erlbaum Associates Publishers, pp. 295-358.
9. Chin, W. W., Dibbern, J. (2010), "An Introduction to a Permutation Based Procedure for Multi-Group PLS Analysis: Results of Tests of Differences on Simulated Data and a Cross Cultural Analysis of the Sourcing of Information System Services Between Germany and the USA", in Esposito Vinzi, V., Chin, W. W., Henseler, J., Wang, H. (Eds.), Handbook of Partial Least Squares, Springer-Verlag Berlin Heidelberg, pp. 171-193.
10. Christensen, C. M. (1999), "Innovation and the General Manager", Boston, Irwin/McGraw-Hill.
11. Clark, L. A., Watson, D. (1995), "Constructing validity: Basic issues in objective scale development.", Psychological Assessment, American Psychological Association, Vol. 7 No. 3, pp. 309-319.
12. Criado-Gomis, A., Iniesta-Bonillo, M. A., Cervera-taulet, A., Ribeiro-Soriano, D. (2020), "Women as Key Agents in Sustainable Entrepreneurship: A Gender Multigroup Analysis of the SEO-Performance Relationship", Sustainability, Vol. 12 No. 3, p. 1-17.
13. Cronbach, L. J. (1951), "Coefficient alpha and the internal structure of tests", Psychometrika, Vol. 16 No. 3, pp. 297-334.
14. Cuevas-Vargas, H. (2016), "La Influencia de La Innovación y La Tecnología En La Competitividad de Las Pymes Manufactureras Del Estado de Aguascalientes", Universidad Autónoma de Aguascalientes, available at https://bit.ly/3r8qiDW (15 August 2022)
15. Cuevas-Vargas, H., Aguirre, J., Parga-Montoya, N. (2022), "Impact of ICT adoption on absorptive capacity and open innovation for greater firm performance. The mediating role of ACAP", Journal of Business Research, Vol. 140 No. February 2022, pp. 11-24.
16. Cuevas-Vargas, H., Fernandez-Escobedo, R., Cortes-Palacios, H. A., Ramirez-Lemus, L. (2021), "The Relation Between Adoption of Information and Communication Technologies and Marketing Innovation as a Key Strategy to Improve Business Performance", Journal of Competitiveness, Vol. 13 No. 2, pp. 23-40.
17. Cuevas-Vargas, H., Parga-Montoya, N., Fernández-Escobedo, R. (2019), "Effects of Entrepreneurial Orientation on Business Performance: The Mediating Role of Customer Satisfaction - A Formative - Reflective Model Analysis", SAGE Open, Vol. 9 No. 2, pp. 1-14.
18. Damanpour, F., Gopalakrishnan, R. (2001), "The dynamics of the adoption of product and process innovations in organisations", Journal of Management Studies, Vol. 38 No. 1, pp. 45-65.
19. Danilda, I., Thorslund, J. G. (2011), "Innovation & Gender", Vinnova.
20. Díaz-García, C., González-Moreno, A., Sáez-Martínez, F. J. (2013), "Gender diversity within R&D teams: Its impact on radicalness of innovation", Innovation: Management, Policy and Practice, Vol. 15 No. 2, pp. 149-160.
21. Dwivedi, R., Karim, F. J., Starešinić, B. (2021), "Critical Success Factors of New Product Development: Evidence from Select Cases", Business Systems Research, Vol. 12 No. 1, pp. 34-44.
22. Expósito, A., Sanchis-Llopis, A., Sanchis-Llopis, J. A. (2021), "CEO gender and SMEs innovativeness: evidence for Spanish businesses", International Entrepreneurship and Management Journal, International Entrepreneurship and Management Journal, pp. 1-38.
23. Fagerberg, J., Mowery, D. C., Nelson, R. R. (2005), "The Orford Handbook of Innovation", New York, Oxford University Press.
24. Fornell, C., Larcker, D. F. (1981), "Evaluating Structural Equation Models with Unobservable Variables and Measurement Error", Journal of Marketing Research, Vol. 18 No. 1, pp. 39-50.

25. Foss, L., Woll, K., Moilanen, M. (2013), "Creativity and implementations of new ideas Do organisational structure , work", International Journal of Gender and Entrepreneurship, Vol. 5 No. 3, pp. 298-322.
26. Gunday, G., Ulusoy, G., Kilic, K., Alpkan, L. (2011), "Effects of innovation types on firm performance", International Journal of Production Economics, Vol. 133 No. 2, pp. 662-676.
27. Hair, J. F., Hult, G. T. M., Ringle, C. M., Sarstedt, M. (2017), "A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)", 2nd ed., Thousand Oaks, SAGE Publications.
28. Hair, J. F., Sarstedt, M., Ringle, C. M., Gudergan, S. P. (2018), "Advanced Issues in Partial Least Squares Structural Equation Modeling (PLS-SEM)", Thousand Oaks, SAGE Publications.
29. Hair, J. F., Sarstedt, M., Ringle, C. M., Mena, J. A. (2012), "An assessment of the use of partial least squares structural equation modeling in marketing research", Journal of the Academy of Marketing Science, Vol. 40 No. 3, pp. 414-433.
30. Hambrick, D. C., Mason, P. A., Mason, P. A. (2013), "Upper Echelons: The organisation as a reflection of its top managers", The Academy of Management Review, Vol. 9 No. 2, pp. 193-206.
31. Henseler, J., Fassott, G. (2010), "Testing Moderating Effects in PLS Path Models: An Illustration of Available Procedures", in Esposito Vinzi, V., Chin, W. W., Henseler, J., Wang, H. (Eds.), Handbook of Partial Least Squares, Springer-Verlag Berlin Heidelberg, pp. 713-735.
32. Henseler, J., Ringle, C. M., Sarstedt, M. (2015), "A new criterion for assessing discriminant validity in variance-based structural equation modeling", Journal of the Academy of Marketing Science, Vol. 43 No. 1, pp. 115-135.
33. Henseler, J., Ringle, C. M., Sarstedt, M. (2016), "Testing measurement invariance of composites using partial least squares", International Marketing Review, Vol. 33 No. 3, pp. 405-431.
34. Henseler, J., Ringle, C. M., Sinkovics, R. R. (2009), "The use of partial least squares path modeling in international marketing", Advances in International Marketing, Vol. 20 No. 2009, pp. 277-319.
35. Henseler, J., Sarstedt, M. (2013), "Goodness-of-fit indices for partial least squares path modeling", Computational Statistics, Vol. 28, pp. 565-580.
36. Höck, C., Ringle, C. M., Sarstedt, M. (2010), "Management of multi-purpose stadiums: importance and performance measurement of service interfaces", International Journal of Services Technology and Management, Vol. 14 No. 2/3, pp. 188-207.
37. Huse, M., Solberg, A. G. (2006), "Gender-related boardroom dynamics. How Scandinavian women make and can make contributions on corporate boards", Women in Management Review, Vol. 21 No. 2, pp. 113-130.
38. Idris, A. (2009), "Management styles and innovation in women-owned enterprises", African Journal of Business Management, Vol. 3 No. 9, pp. 416-425.
39. Khazanchi, S., Lewis, M. W., Boyer, K. K. (2007), "Innovation-supportive culture: The impact of organisational values on process innovation", Journal of Operations Management, Vol. 25, pp. 871-884.
40. Kline, R. B. (2011), "Principles and Practice of Structural Equation Modeling", New York, Guilford publications.
41. Lechman, E., Popowska, M. (2020), "Enhancing women's engagement in economic activities through information and communication technology deployment: evidence from Central – Eastern European countries", Gender, Technology and Development, Routledge, Vol. 24 No. 3, pp. 314-340.
42. Li, Y., Liu, Y., Ren, F. (2007), "Product innovation and process innovation in SOEs: evidence from the Chinese transition", The Journal of Technology Transfer, Vol. 32 No. 1, pp. 63-85.
43. Liao, S. H., Fei, W. C., Chen, C. C. (2007), "Knowledge sharing, absorptive capacity, and innovation capability: An empirical study of Taiwan's knowledge-intensive industries", Journal of Information Science, Vol. 33 No. 3, pp. 340-359.
44. Manolova, T. S., Carter, N. M., Manev, I. M., Gyoshev, B. S. (2007), "The differential effect of men and women entrepreneurs' human capital and networking on growth expectancies in Bulgaria", Enterpreneurship Theory and Practice, Vol. 31 No. 3, pp. 407- 426.
45. Mendonça, J., Reis, A. (2020), "Exploring the mechanisms of gender effects in user innovation", Technological Forecasting and Social Change, Vol. 155.

46. Na, K., Shin, K. (2019), "The Gender Effect on a Firm's Innovative Activities in the Emerging Economies", Sustainability, Vol. 11, pp. 1-24.
47. Nunnally, J. C., Bernstein, I. H. (1994), "Psychometric Theory", New York, McGraw-Hill.
48. Oke, A. (2007), "Innovation types and innovation management practices in service companies", International Journal of Operations & Production Management, Vol. 27 No. 6, pp. 564-587.
49. Olson, P. D., Zuiker, V. S., Danes, S. M., Stafford, K., Heck, R. K. Z., Duncan, K. A. (2003), "The impact of the family and the business on family business sustainability", Journal of Business Venturing, Vol. 18, pp. 639-666.
50. Østergaard, C. R., Timmermans, B., Kristinsson, K. (2011), "Does a different view create something new? The effect of employee diversity on innovation", Research Policy, Vol. 40, pp. 500-509.
51. Ranga, M., Etzkowitz, H. (2010), "Athena in the World of Techne: The Gender Dimension of Technology , Innovation and Entrepreneurship", Journal of Technology Management and Innovation, Vol. 5 No. 1, pp. 1-12.
52. Rigdon, E. E., Ringle, C. M., Sarstedt, M., Gudergan, S. P. (2011), "Assessing Heterogeneity in Customer Satisfaction Studies: Across Industry Similarities and within Industry Differences", in Sarstedt, M., Schwaiger, M., Taylor, C. R. (Eds.), Advances in International Marketing, Vol. 22, Emerald Group Publishing, pp. 169-194.
53. Ringle, C. M., Wende, S., Becker, J.-M. (2015), "SmartPLS 3", SmartPLS GmbH, Boenningstedt.
54. Robledo, J. V., López, C. G., Zapata, W. L., Pérez, J. D. V. (2010), "Desarrollo de una Metodología de Evaluación de Capacidades de Innovación", Perfil de Coyuntura Económica, No. 15, pp. 133-148.
55. Rothschild, J. (1983), "Machina Ex Dea: Feminist Perspectives on Technology", New York, Pergamon.
56. Ruiz-Jiménez, J. M., Fuentes-Fuentes, M. M. (2016), "Management capabilities, innovation, and gender diversity in the top management team: An empirical analysis in technology-based SMEs", BRQ Business Research Quarterly, ACEDE, Vol. 19 No. 2, pp. 107-121.
57. Sarstedt, M., Henseler, J., Ringle, C. M. (2011), "Multigroup analysis in partial least squares (PLS) path modeling: Alternative methods and empirical results", Advances in International Marketing, Vol. 22, pp. 195-218.
58. Sarstedt, M., Schwaiger, M., Ringle, C. M. (2009), "Do We Fully Understand the Critical Success Factors of Customer Satisfaction with Industrial Goods ? - Extending Festge and Schwaiger' s Model to Account for Unobserved Heterogeneity", Journal of Business Market Management, Vol. 3, pp. 185-206.
59. Selvarajan, T. T., Slattery, J., Stringer, D. Y. (2015), "Relationship between gender and work related attitudes: a study of temporary agency employees", Journal of Business Research, Vol. 68 No. 9, pp. 1919-1927.
60. Teruel, M., Segarra-Blasco, A. (2017), "The Link between Gender Diversity and Innovation: What is the Role of Firm Size?", International Review of Entrepreneurship, Vol. 15 No. 3, pp. 319-340.
61. Torchia, M., Calabro, A., Huse, M. (2011), "Women Directors on Corporate Boards: From Tokenism to Critical Mass", Journal of Business Ethics, Vol. 102, pp. 299-317.
62. Ul Hassan, M., Shaukat, S., Nawaz, M. S., Naz, S. (2013), "Effects of innovation types on firm performance: an empirical study on Pakistan's manufacturing sector", Pakistan Journal of Commerce and Social Sciences, Vol. 7 No. 2, pp. 243-262.
63. United Nations (2015), "THE 17 GOALS | Sustainable Development", Sustainable Development Goals, available at https://sdgs.un.org/goals (30 November 2021)
64. Vafaei, A., Henry, D., Ahmed, K., Alipour, M. (2021), "Board diversity: female director participation and corporate innovation", International Journal of Accounting and Information Management, Vol. 29 No. 2, pp. 247-279.
65. Van der Vegt, G. S., Janssen, O. (2003), "Joint Impact of Interdependence and Group Diversity on Innovation", Journal of Management, Vol. 29 No. 5, pp. 729-751.
66. Verspagen, B. (2009), "Innovation and economic growth", The Oxford Handbook of Innovation, New York, Oxford University Press.

67. Wetzels, M., Odekerken-Schröder, G., van Oppen, C. (2009), "Using PLS Path Modeling for Assessing Hierarchical Construct Models: Guidelines and Empirical Illustration", MIS Quarterly, Vol. 33 No. 1, pp. 177-195.
68. Woodman, R. W., Sawyer, J. E., Griffin, R. W. (1993), "Toward a Theory of Organizational Creativity", Academy of Management Review, Vol. 18 No. 2, pp. 293-321.
69. Wu, Q., Dbouk, W., Hasan, I., Kobeissi, N., Zheng, L. (2021), "Does gender affect innovation? Evidence from female chief technology officers", Research Policy, Vol. 50 No. 9.
70. Zastempowski, M., Cyfert, S. (2021), "Impact of entrepreneur's gender on innovation activities. The perspective of small businesses", PLoS ONE, Vol. 16 No. 10, pp. 1-24.
71. Zhang, Y., Gros, T., Mao, E. (2021), "Gender Disparity in Students' Choices of Information Technology Majors", Business Systems Research, Vol. 12 No. 1, pp. 80-95.
72. Zouaghi, F., Garcia-Marco, T., Martinez, M. G. (2020), "The link between R&D team diversity and innovative performance: A mediated moderation model", Technological Forecasting and Social Change, Vol. 161.

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