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Process and product innovation in the Spanish construction industry: the mediating role of organizational innovation

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A B S T R A C T

Innovation in the construction industry is affected by the incorporation of new technologies that allow a change in the way of working in the Architecture, Engineering and Construction industry. The objective of this paper is to analyze the behavior of the main innovations (product, process and organizational) through a PLS model applied to the Spanish construction industry. The results applied to 257 companies indicate that organizational innovation exerts a mediating effect on the relationship between process and product innovation. Therefore, this research contributes to a better understanding of the innovative behavior of the Spanish construction sector and demonstrates the importance of managing a plan for organizational innovation.

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1. Introduction

The Royal Academy of the Spanish Language defines innovate as "To change or alter something, introducing novelties", and defines innovation as "Creation or modification of a product, and its introduction in a market". In the construction industry, innovation is a complex process that directly and indirectly involves other industries and many factors (technology, knowledge, collaboration, etc.). Innovation can be seen as an iterative process: "the introduction of a new or significantly improved product (good or service) such as a process, a marketing method, a new organizational method, company internships, organization in the workplace or external relationships". Therefore, innovation has been identified as a consequence of introducing new products, processes, markets, organizational structures and new services. According to Organization for Economic Co-operation and Development (OECD, 2005), four different types of innovation can be defined:

- *Innovation in products/services*: that is, the introduction of new products or services or the

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improvement of existing ones. It is an innovation in the commercial portfolio and in the proposal to the market.

- *Innovation in procedures and processes*: introduction of a new production or commercial process or improvement of existing ones. This would be innovation in the functioning and operation, whether productive, commercial or relational, including improvements related to the information systems that support the processes.
- *Innovation in marketing*: through contributions or improvements in terms of promotions, packaging, positioning, invoicing, etc., in other words, in the way in which the products are presented on the market.
- *Organizational innovation*: focusing on business management practices and methods.

The different forms of innovation which have been selected for this research are: process innovation, product innovation and organizational innovation. These three types have been chosen due to the similarities there are between them. Nevertheless, how they are each encouraged depends solely on what each company's internal strategic decisions are. Marketing innovation (markets, etc.) has not been included as this is more related to the business strategy factors needed to compete in the market. However, changes in product innovation or processes can evidently generate changes in business model innovation. Because of this, it is quite relevant to analyze the innovation processes the construction industry is undergoing. However, classifying innovation is not an easy task due to the connections that exist between them, such as new products being incorporated in business innovation. Or the fact that certain forms of business innovation could require organizational changes within firms. Innovation literature has also tried to obtain models that explain the variables that enhance the innovative capacities of companies in the construction industry. Therefore, this study aims to answer the following research questions for firms in the construction sector:

(1) What are the relationships between process innovation, product innovation and organizational innovation in the Spanish construction industry?

Therefore, the aim is to analyze the impact of innovations to understand the innovation process in the Spanish construction industry. In short, the objective is to acquire a greater knowledge of innovative process in the Spanish construction industry. To achieve this objective, section 2 shows a literature review and research gap, as well as the research model and hypotheses proposed. Section 3 includes a description of the research methodology. Section 4 shows the results of data analysis and the research results obtained. Finally, section 5 explains the discussion and then, in section 6, conclusions are made including contributions, limitations and future research.

2. Literature Review

2.1 Innovation in the construction industry

The literature has tried to study innovation processes to improve the competitiveness of construction companies, but obviously the results of the different studies depend on the country where the research is carried out. Table 1 shows a summary by country of the research on the innovation process in the construction industry. The search was conducted in powerful databases such as Scopus, Web of Science and Google Scholar, using keywords such as "construction innovation" and "organizational, product or process innovation".

To classify innovation, is possible to group all four types into two: technological innovation and non-technological innovation. Technological innovations are the activities needed to carry out a product or process innovation, about very different activities (scientific, technological, organizational, financial, commercial) which are all interconnected, with the aim of finding innovation in the market [24]. Non-technological innovations occur within a company and encompass organizational innovation and commercial innovation activities. However, in literature, it is found that innovation output can be identified as both technical innovation output (processes or products) or organizational innovation output [25].

In the construction industry, some authors consider that technical innovation is influenced by organizational innovation due to products and processes being affected by changes in the organizational or structural management [26]. Another way innovation can be classified is by focusing on how new the innovation is, giving rise to two types: radical innovations and incremental innovations. Radical innovations are those which involve introducing a completely new product or process to the market, as they differ significantly from existing products in terms of purpose, features,

Table 1. Research on the innovation in the construction industry

Country	Conclusions
México	Quality in construction processes has a greater impact than technology, technology being a tool to enhance competitiveness [1].
Chile	Innovation in construction can be introduced as a systematized process to be applied as a basis for technology transfer and knowledge management [2]. Innovate in companies in the construction sector, the most feasible is from the point of view of processes and organizational structure and the factors that do not favor innovation are the lack of culture, an inflexible organizational structure, the scarcity of resources and low managerial capacity [3].
United Kingdom	All construction companies can introduce innovation, regardless of their size, small ones driven by survival and prosperity, while large companies by global competition. [4]
China	Construction industry performs poorly in innovation [5]. Large companies have the greatest potential to innovate in technological innovation [6].
Turkey	Analyzes the relationships between the level of collaboration, technological capacity and innovation activity in construction companies Turkey. The empirical results show that collaboration has a significant impact on technological innovation and that this relationship is mediated by technological capabilities [7].
Spain	Analyze the impact of strategic capabilities on innovation and performance, with human capabilities being the most influential in improving competitiveness [8]. Studies on SMEs in the construction sector show that knowledge management capacity has a positive influence on innovation [9]. Innovation is able to generate a positive effect on the performance and external performance of companies in the construction industry [10].
Canada	Innovative behavior varies depending on the size of the company and that, in practice, business results undergo a great innovation strategy [11].
Australia	Analyses which factors make road construction companies innovate, finding that technical capacity improves when combining commercial strategy with a greater use of technology [12]. Other research has been done on what can obstruct product innovation in roads at an industrial firm level [13]. The propensity to innovate stems lies in cultural factors, which are influenced by business relationships based on trust as well as the technical capacity of human resources in technological development [14].
Netherlands	Construction companies tend to innovate in processes, where supplier industries improve their product innovation. Innovation in construction activities is still technology-driven rather than market-driven, with new regulations being able to boost new innovations [15].
United States	From a construction project viewpoint, the better the communication is amongst project team members, integrating efficiency in design and construction, the better the results in construction projects will be, in terms of quality, cost and safety, meaning they are both innovative and competitive at the same time [16].
Hong Kong	There are links between a buildup of intangible assets (human capital, social capital and relational capital), firm performance and innovation for the construction contractors [17].
Portugal	Analyses the relationship between performance, excellence, and innovation in Portugal [18], innovation and its effect on productive efficiency [19], the improvement and measurement of innovation to assess operational performance and performance [20]. The competitive position and financial performance of Portuguese contractors [21]
Germany	Innovation performance construction firms [22].
Singapore	The relationship between types of innovations and types of performance in Singaporean construction firms [22, 23].

and components. Incremental ones are improvements on existing products or processes and, therefore, bring less novelty. From the above perspective, [27] classifies innovation in the construction industry as incremental innovation, because improvements are produced by changes in scientific or technological knowledge, improvements in construction systems and procedures, as well as in materials and components. Other authors, from the perspective of radical and/or incremental innovations, consider that improvements in innovation in the construction industry (e.g., improvements in productivity, safety and quality of working conditions, profitability and competitiveness) are caused by incremental innovations [28]. On the other hand, authors who consider it is essential to apply innovation, see it as a key to gaining competitive advantages [29], since, in construction activities, the current innovation gap, compared to other sectors, affects the industry in terms of competitiveness [30]. Therefore, there is a great interest in determining how to improve innovation in the construction industry [16], are influenced by business relationships based on trust as well as the technical capacity of human resources in technological development.

Process innovations are improvements applied in construction methods or systems that are designed or developed for carrying out traditional construction operations [31]. Other studies analyze what innovation could be stopped by on a project level [32]. In general, process innovation is related to advances in technology. Nowadays, it is indisputable that Building Information Modelling (BIM) technology or methodology has been the biggest technological advance in the Architecture, Engineering and Construction (AEC) sector, affecting project designers, product manufacturers, etc. Currently, it is not uncommon to see how manufacturers in the sector have been developing their construction product catalogues in downloadable format for engineers/architects to use in their BIM projects. From a BIM perspective, one can speak of the concept of systemic innovation within the sector [33].

Systematic innovation assumes that the use of a methodology and BIM is a collaborative working process and establishes a methodology for the different agents in a construction Project. Therefore, it can be stated that BIM favors systemic innovation within the sector. Other research seeks to investigate the results of innovation in the AEC sector. Innovation performance depends on the promotion of any type of innovation, both technological and non-technological, and for this to happen, both external (supply chain, customer requirements, etc.) and internal (culture, values, etc.) knowledge must be considered [34]. Other authors consider that innovation management in the construction depends on instrumental variables such as organizational culture, strategy, structure/process, and specific innovation promotion measures [35].

Other authors consider that the type of strategy adopted to foster innovation is fundamental, as the intangible includes internal knowledge routines and skills related to organizational innovation [36]. Finally, it should be noted that literature also includes studies that analyze innovation in collaborative environments in construction companies and that considers collaboration between companies to be a critical factor for innovation in construction [37].

On the other hand, in the case of Spain, some research has been carried out in recent years on dealing with different topics related to innovation and construction activities, such as: innovation and competitiveness [38], the standardization of innovation and its effect on company organization, knowledge management, business profitability and customer satisfaction [39]; innovation and concentration as the main strategic tool and generating an economic scale [40], and the systematization of innovation and business competitiveness [41]. It should be borne in mind that previous research was carried out in Spain in a context where BIM did not play a relevant role in the construction sector. Recently, there has been research which has analyzed the influence of BIM on innovation in the construction sector [42], and recent research that explains how the use of BIM technology generates different types of innovation in the construction sector [43].

2.2 Research hypothesis

Process innovation in the construction sector was carried out by [44], where it was analyzed in construction systems through the application of the Japanese methodology of construction without losses, known as "Lean Construction". This methodology applied in construction processes was shown to increase production efficiency in all processes, as it reduces costs and time by reducing waste (wastefulness) and establishes an efficient consumption of organizational resources on the job site. Therefore, process innovation and organizational innovation are related. Other authors suggest that construction companies can develop their competitive advantage by making productivity improvements that lead to reduced construction costs and/or faster execution times [45]. In the construction sector, some authors consider that technical innovation (processes and products) is influenced by organizational innovation, because changes in the organizational or structural management of the company affect processes and products [46]. Therefore, the following research hypotheses have been considered:

H1: In industry construction, process innovation has an effect on product innovation, which is positively mediated by organizational innovation.

From these hypotheses, the research model in Figure 1 was formulated. The proposed model contains an independent variable "process innovation" (inproc), a mediating variable "organizational innovation" (inorg) and a dependent variable "product innovation" (inprod). it is noted that control variables are used for each variable shown in the model. According to literature, the factors which affect innovation and aim to be at the same level as the characteristics of a company are studied with the purpose of improving knowledge on innovative process. This obliges researchers to take these variables into account in their research models, as literature confirms their relation-

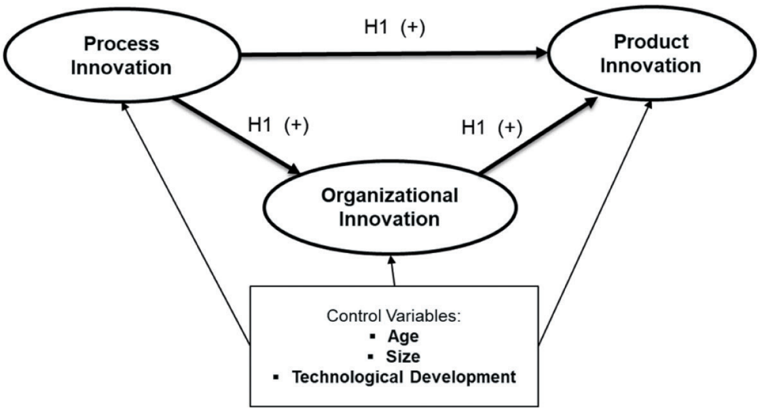

Figure 1. Research model and hypothesis

ship with innovation. Therefore, in this research the following has been considered: the size of the company (size), the age of the company (aniocrea) and the technological development of the company (destec). Although there are more factors that affect innovative behavior (e.g. collaboration, training of employees, degree of internationalization, sector, etc.) only the most significant ones have been considered.

3. Research method

This study on innovation in the construction industry is developed in Spain. The Technological Innovation Panel (PITEC) is a panel-type database which allows Spanish companies technological innovation activities be monitored, being a result of a joint effort made by the National Institute of Statistics (INE) and the Spanish Foundation for Science and Technology as well as advice from a group of academic experts" [47].

3.1 Global approach

Having reviewed the literature theoretical foundations being laid, the research methodology used in this study is explained as follows. First, the population under study and the selection of the sample are described. Next, the measurement of the variables under study is described. Subsequently, the statistical technique selected for data analysis is justified. This research follows an exploratory design [48], as it is used for the purpose of exploring the research problem proposed, which, given its characteristics requires a predictive causal method. The research model proposed is empirically contrasted by means of structural equations to explain the objective of this research.

3.2 Sample and data collection

The data used in this research has been taken from the PITEC database, which provides anonymous microdata to Spanish companies who carry out innovative and/or R+D research projects, prepared by National Statistics Institute (INE in Spanish), as well as the Spanish Foundation for Science (FECYT in Spanish) and the assessment of a group of academic experts. A sample of 257 construction companies in Spain from 2014 to 2016 were the population under study which proved the research hypotheses. The latest available panel data offered by PITEC are from 2016 (last published database), specifically from 12,849 companies, of which under heading 028 Construction (Activity CNAE 2009) there are 257 companies. Taking this sample of construction activity in Spain as a reference, a series of variables are analyzed to relate them and obtain relevant results with regards to innovation. Out of the 257 companies on which is based the innovation study, in Table 2, the descriptive characteristics of the sample can be observed, classifying them by type of company: small (less than 50 workers), medium (from 50 to 250 workers) or large (more than 250 workers).

3.3 Measurement of variables

The variables used, taken from the PITEC panel database, are shown in Table 3. Some variables measure the reference year (t) and others measure two years, the reference year and the two previous years (t-2). The results of the variables that affect only companies in the construction sector with code 0028 according to CNAE-2009 data have been taken. In total 257 companies have been included in the study.

Table 2. PITEC Sample variables

257 construction companies	PITEC variables used Year 2016	Size		
		Small (<50)	**Medium (50-250)**	**Large (>250)**
number of company samples	size	108	84	65
average turnover	number	2.594.324,00 €	30.156.220,00 €	193.985.364,00 €
average investment	investment	15.028,00 €	358.924,00 €	6.805.045,00 €
average size (no. of employees)	size	16	126	1079
operating in national market	natmark	70	65	63
operating in eu market	mdoue	23	31	47
operating in other countries (non eu)	otropais	17	30	33
internal expenses r+d average	intexrd	5%	19%	20%
average r+d personnel	avrdper	3%	7%	10%
cooperating with other companies	cooperate	8	23	30
own patents	patoepm+patuspto	1	6	38

Table 3. PITEC variables used in the study. Data from the latest PITEC report from the Spanish government

Indicator	**Description** [All variables have been taken from the Panel of Technological Innovation (PITEC_2016)]	Reference year
actin	CNAE activity in 2009: all belonging to 0028 (CONSTRUCTION) = total 257 companies	2016
objec2	Objective importance tech. Inn.: Replacing old products or processes	2016
memcogroup	Membership in company group	2016
coopera	Cooperating from (t-2) to t* with other companies	2014-2016
exportv	Export volumen, intracommunity deliveries excluded	2016
intracom	Sales in EU, AELC or EU candidate countries (intracommunity deliveries)	2016
	Organizational innovation	
inorg1	Organizational innovation from (t-2) to t*: New business practices in work organization or business procedures	2014-2016
inorg2	Organizational innovation from(t-2) to t*: New organizational methods in the company workpace with the aim to improve responsibility and decisión-making management	2014-2016
inorg3	Organizational development from (t-2) to t*: New management methods with regards to relationships with external companies or public institutions	2014-2016
	Product innovation	
ingood	Goods innovation from (t-2) to t*	2014-2016
inserv	Service innovation from (t-2) to t*	2014-2016
inprod	Product innovation from (t-2) to t*	2014-2016
	Innovation processes	
insupp	Process innovation from (t-2) to t*; Supporting processes	2014-2016
inmanu	Process innovation from (t-2) to t*: production or manufacturing methods	2014-2016
inlogis	Process innovation from (t-2) to t*: logistic systems	2014-2016
inproc	Process innovation from (t-2) to t*	2014-2016
	Control variables	
size	Number of employees at the time	2016
age (anicrea)	Business start date / to origen	2016
destec	Technological development	2016

*t = year of reference 2016; t-2 = last 2 years

3.4 Data analysis

The Partial Least Squares (PLS) regression technique has already been used to analyze the impacts between variables in innovation processes in the construction industry [49]. The PLS technique is the most adequate for statistical data in this research for several reasons. PLS is primarily intended for causal predictive analysis, where the problems explored are complex and prior theoretical knowledge is scarce [50]. PLS does not require assumptions about data distributions and employs a principal component-based estimation approach and PLS is suitable for formative constructs [51]. PLS is a causal predictive approach that emphasizes prediction when estimating statistical models whose structures are designed to provide causal explanations [52]. It should be noted that the PLS technique can be used for both predictive research and exploratory purposes [53]. This study uses SmartPLS version 3 software. Model estimation is completed in two steps [54]. In the first step, the measurement model is analyzed, where the link between the indicators and the variable they represent is verified. In the second step, the structural model is analyzed, where the validity of the relationships between the variables in the model is examined. The tests to be performed in the first step for the measurement model depend on the nature of the direction of causality between the indicator and the construct. In this model, all variables have formative specifications as the indicators directly help create the variable, i.e., the direction of causality goes from the indicators to the variable measured or construct. A variable with formative indicators implies that the indicators need not be highly correlated with each other, because each indicator captures different aspects of the variable that can occur independently [55]. Therefore, for the measurement model with formative indicators, the weights of each indicator, their level of significance with a Bootstraping test and possible collinearity problems should be assessed by evaluating the variance inflation factor (VIF) [56]. This last analysis is important to assess whether there is conceptual redundancy among the indicators [57], i.e. some of the indicators are measuring the same facet of the variable they represent. For the structural model, the relationships between the variables proposed in the research model are validated through path coefficients (β), their level of statistical significance with a Bootstrap test with 5000 subsamples and the coefficient of determination R^2 of the variables is explained below.

4. Results

4.1 Measurement model

Table 4 shows the measurement model results with formative indicators, where the content validity of the indicators is assessed in the variable they

Table 4. Measurement model results

Indicators	Weight	T-value	VIF
Innovation processes			
insup	0.455***	3.787	1.121
inmanu	0.605***	4.415	1.146
inlogis	0.353**	2.991	1.045
inproc	-	-	-
Product innovation			
ingoods	0.460***	3.688	1.133
inserv	0.745***	7.360	1.133
inprod	-	-	-
Organizational innovation			
inorg1	0.592***	3.787	1.548
inorg2	0.085n.s.	0.503	1.623
inorg3	0.546***	3.459	1.267
Control variables			
size (size)	1.000	0.000	1.000
age (anicrea)	1.000	0.000	1.000
destec	1.000	0.000	1.000

***p< 0.001; **p< 0.01; *p< 0.05 (based on t (4999), one-tail test).
t (0.05, 4999) = 1.645; t (0.01, 4999) = 2.327; t (0.001, 4999) = 3.092; n.s.=not significant

represent through weight of the indicator (Weight) and its statistical significance (T-value). To ensure the absence of collinearity between the indicators and the construct they represent, VIF is assessed, where its value must be under 3 [58]. In this case, all the VIF values obtained were below 3, except inprod (VIF=6.063) and inproc (VIF=7.643), which were eliminated to avoid collinearity problems. Having a very close weight to zero, an indicator is observed in search for inorg2, which have not been eliminated from the model despite not being statistically significant, as they conceptually contribute to the construction of the variable they represent.

4.2 Structural model and hypothesis contrast

To contrast the mediation hypotheses, the direct effects model (Figure 2) was assessed first, where it was found that the direct relationship between process innovation and product innovation was indeed significant.

Secondly, the mediated effects model (Figure 3) was assessed, introducing the mediating variable: organizational innovation. The structural analysis assesses the strength of the relationships established between the different variables in the model. For this purpose, the level of statistical significance of the structural paths "β" or Path coefficients, and R^2 for dependent variables are assessed. Table 5 shows the results of the structural model, the mediation analysis, and the hypothesis testing. Regarding the control variables, firm size was found to be statistically significant with respect to organizational innovation and process innovation, and not statistically significant for product innovation. Regarding the age of the company, it was not statistically significant for product innovation and organizational innovation but was statistically significant for process innovation. Regarding technological development, it was statistically significant for process innovation and product innovation and not significant for organizational innovation.

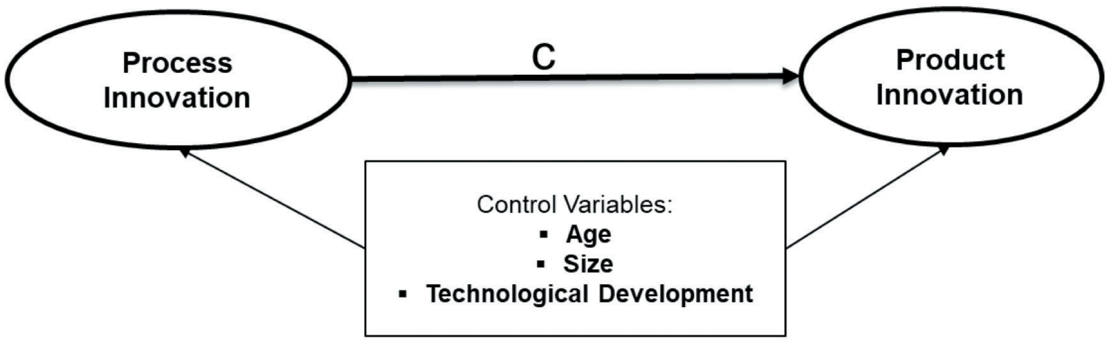

Figure 2. Direct effects model

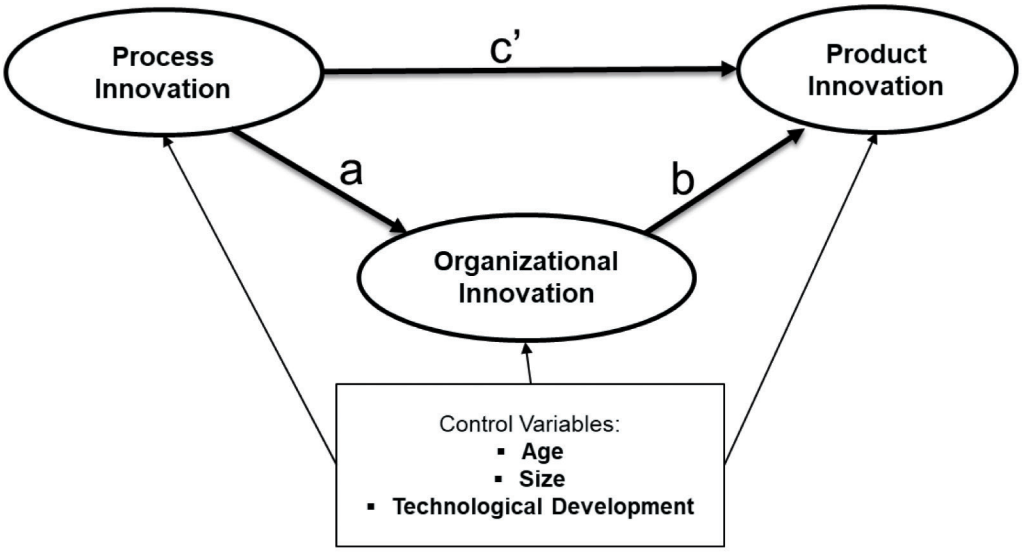

Figure 3. Mediated effects model

Table 5. Structural model results, mediation analysis and hypothesis contrast

Direct effects model	**Path Coefficient "β" (T-Value)**
VIF (inproc→ inprod)	c= 0.327 (3.463)
Innovation processes	R^2=21.1%
PRODUCT INNOVATION	R^2=32.9%
Mediated effects model	**Path Coefficient "β" (T-Value)**
VIF (inproc→ inprod)= 1.420	c' =0.260** (2.550)
VIF (inproc→ inorg)= 1.264	a = 0.338*** (3.511)
VIF (inorg→ inprod)= 1.362	b =0.195* (1.870)
INNOVATION PROCESSES	R^2=20.9%
PRODUCT INNOVATION	R^2=35.4%
ORGANIZATIONAL INNOVATION	R^2=26.6%
Control variables → Innovation variables: VIF; Path Coefficient "β" (T-Value)	
size→ inproc: 1.125; 0.168* (2.303)	destec→ inorg:1.277; 0.032n.s. (0.427)
size→ inproc:1.264; 0.179* (1.781)	age→ inprod: 1.161: 0.000n.s. (0.002)
destec → inproc:1.183; 0.272**(3.001)	size→ inprod: 1.413; 0.114n.s. (0.954)
age→ inorg:1.161; -0.023n.s. (0.321)	destec→ inprod: 1.278; 0.245** (3.019)
size→ inorg:1.304; 0.282***(2.379)	
Variance explained VAF = (Indirect effect/Total effect) × 100 = **20.22%**	
Indirect effect = (a × b)	
Total effect = direct effect + indirect effect = c'+ (a × b)	
Hypothesis contrast: H1(+): INPROC→ INORG → INPROD	Contrasted **Yes**

***p< 0.001; **p< 0.01; *p< 0.05 (based on t (4999), one-tail test).
t (0.05, 4999) = 1.645; t (0.01, 4999) = 2.327; t (0.001, 4999) = 3.092; n.s.=not significant

Finally, the VAF value (variance accounted for) in the mediated effects model is calculated to determine the strength of mediation. If the VAF value is greater than 80% it is full mediation and if the VAF value is between 20% and 80% it is partial mediation [59]. Therefore, given that the VAF value was 20.22%, the relationship between process innovation and product innovation was partially mediated organizational innovation. If the R^2 values (0.75, 0.50 and 0.25) were considered (substantial, moderate, and mild) values [60]. Therefore, the values obtained go from moderate to mild to explain the innovative process in the construction industry in Spain.

5. Conclusions

This study investigates the relationship between process innovation, product innovation and organizational innovation in the construction industry in Spain and collected panel data from PITEC Spain in the study. The significance of the model was assessed using PLS-SEM (structural equation modelling). The results of the study revealed that management strategies, procedures and working methods (i.e., organizational innovation) have a mediating effect on the direct relationship in the impact between process innovation and product innovation. This study adds to the current literature on innovation in construction management. First, this study validates organizational innovation as an influential mediator between process innovation and product innovation. Second, this study provides substantial practical implications for managers to reflect on organizational practices in methods and procedures as a source of generating innovation. The study adds to the current PLS-SEM literature as a model for evaluating mediating relationships. The primary contributions of this research are the development of a new model for understand innovation management in construction, so a new theoretical framework and an emphasis that, in the construction industry, there is a strong need for new ways of thinking about innovation management. The results show that process innovation is not enough to improve product innovation due to product innovation improving when organizational innovation is fostered, despite process innovation still having a modest direct effect on product innovation in the mediation scenario. Therefore, the model explains that the improvement of product/service innovation aspects also depends on which organizational routines are established. The findings in this paper have implications for a better understanding of the innovation process in the Spanish construction industry. However, this work has its limitations, as it would be interesting to know how design-related aspects (sustainability, energy efficiency, etc.), qualities that are highly valued by customers today, influence product innovation. It would also be necessary to add more control variables to the model, such as: entrepreneurship, culture, leadership, knowledge management, customer satisfaction, collaboration, etc., as the literature has shown that all these types of intangible variables are drivers of innovation performance. Among the main reasons why literature does not provide conclusive results on the relationships between process innovation and product innovation is the existence of an infinite number of variables that can intervene in this relationship. This paper finds that organizational innovation promotes intangibles that confer strategic value, and at the same time drives technological innovation. In this sense, the main contribution of this work is to show that the relationship between process innovation and product innovation is not direct but is mediated by the promotion of organizational innovation in the construction sector in Spain. Future lines of research should establish different studies with respect to the research model proposed, on the one hand, applying it only to construction companies in the sector and, on the other hand, only to manufacturing companies in the sector, as perhaps in this way knowledge about the innovative process in the construction industry in Spain could be filtered even further. Finally, it is possible to apply the proposed model to the construction industry in other countries to obtain conclusions by region by analyzing innovative behavior through the model proposed in this paper.

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