



The mediating role of personnel training between innovation and performance: Evidence from the German pharmaceutical industry

El rol mediador de la formación de la mano de obra entre la innovación y el rendimiento empresarial: evidencia en el sector farmacéutico alemán

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ABSTRACT

Purpose – The need for companies to become more innovative has never been greater, because innovation helps them deal with a turbulent environment by providing them a sustainable competitive advantage. In this sense, it has been generally accepted that a successful innovative environment requires a well-trained work force. Nevertheless, the literature showing how personnel training drives the innovation-performance relationship in industries where innovation is a key factor is scarce, especially in high-tech industries such as the pharmaceutical industry. Thus, we build upon existing studies to contribute to the innovation and training-related literature by considering the latter as a mediating variable between innovation and business performance. Hence, we aim to assess the impact of innovation on performance, and bring new insights into the innovation-performance link by including training as a variable that drives the aforementioned relationship.

Design/methodology – We apply the partial least squares structural equation modeling technique to a sample of German pharmaceutical firms. The data were collected in mid-2014 by means of a computer-assisted telephone interviewing (CATI) procedure. As a result, 200 valid responses were obtained from CEOs.

Findings – First, this study demonstrates that both innovation and personnel training have a significant, positive impact on performance. Second, the results suggest that training personnel does indeed positively mediate the innovation-performance link. Hence, our study helps explain how innovation effectively translates into greater levels of performance.

Originality / value – We answer calls to clarify about the innovation-personnel training relationship to generate greater levels of performance in turbulent environments. Furthermore, we assess this fact in the pharmaceutical industry, where paradoxically there is a lack of studies within the aforementioned framework.

Keywords: innovation, pharmaceutical industry, personnel training, performance, mediation, IPMA.

RESUMEN

Objetivo – La necesidad de innovación que tienen hoy en día las empresas nunca fue mayor, dado que la innovación les ayuda a enfrentarse a entornos turbulentos, proporcionándoles una ventaja competitiva sostenible. En este sentido, la comunidad científica defiende que un entorno innovador exitoso necesita de una mano de obra bien formada. No obstante, existe un gap en la literatura a la hora de analizar cómo la formación de la mano de obra impulsa el efecto positivo de la innovación sobre el rendimiento empresarial en entornos donde la innovación es clave, sobre todo en sectores altamente tecnológicos como es el caso del sector farmacéutico. Basándonos en estudios previos, nos apoyamos en la literatura que estudia la innovación y la formación de la mano de obra y consideramos ésta última como una variable que media la relación innovación- rendimiento empresarial. Así, valoramos el impacto de la innovación sobre el rendimiento empresarial y adquirimos nuevas percepciones sobre la relación innovación-rendimiento empresarial incluyendo la formación como una variable que impulsa dicha relación.

Diseño / metodología – Aplicamos una técnica de modelización de ecuaciones estructurales *partial least squares* (PLS-SEM) sobre una muestra de empresas farmacéuticas alemanas. Los datos fueron obtenidos a mediados del año 2014 por medio del procedimiento *computer-assisted telephone interviewing* (CATI). Se obtuvieron 200 respuestas válidas de CEOs.

Resultados – En primer lugar, el estudio demuestra que tanto la innovación como la formación de la mano de obra tienen un efecto positivo y significativo sobre el rendimiento empresarial. En segundo lugar, se demuestra que efectivamente la formación de la mano de obra tiene un efecto mediador sobre la relación innovación- resultados empresariales. Así, nuestro trabajo ayuda a explicar el mecanismo mediante el cual la innovación se transforma eficazmente en un mayor rendimiento empresarial.

Originalidad / valor – Arrojam luz sobre la relación innovación-formación de la mano de obra a la hora de generar altos niveles de resultados empresariales en entornos turbulentos. Además, analizamos esta circunstancia en el sector farmacéutico, un sector en el que paradójicamente existe una escasez de literatura científica en la materia.

Palabras clave: innovación, industria farmacéutica, formación de la mano de obra, rendimiento empresarial, mediación, IPMA.

1. INTRODUCTION

As the world becomes increasingly competitive, companies are under significant pressure to enhance business performance. In this sense, innovation is undoubtedly one of the key performance drivers that can provide a sustainable competitive advantage for businesses, and hence improve their performance (e.g., Subramaniam and Youndt 2005; Beugelsdijk 2008; Krašnicka *et al.* 2018; Kuncoro and Suriani 2018). Accordingly, innovation has become a way of life for many businesses and is indispensable in contemporary organizations (Yeh-Yun Lin and Yi-Ching Chen 2007; Huang *et al.* 2016; Ortiz-Villajos and Sotoca 2018). In fact, in the new hypercompetitive environment that companies are facing, achieving higher levels of innovation might prove to be the only path to survival, especially in high-tech industries such as the pharmaceutical industry (Xu 2015; Castillo-Apraiz *et al.* 2020b).

The concept of innovation is a broad topic (Dadfar *et al.* 2013; Calabrò *et al.* 2019). Innovation gives companies greater flexibility and enables them to protect themselves against unstable scenarios, helping them to seek out new opportunities (March 1991; Posen and Levinthal 2012; Zhang *et al.* 2014; Arzubíaga *et al.* 2019) and better exploit those that already exist (Huang *et al.* 2016; Arzubíaga *et al.* 2019). However, few studies analyze the influence of personnel training as a mediating variable between innovation and company performance (see Barba-Aragón 2014). It is important to examine this relationship, because personnel training is another key element supporting productivity and profitability (Blandy *et al.* 2000; Lyons 2019), and successful overall performance in several settings (e.g., find a meta-analysis in Tharenou *et al.* 2007; Dimovski *et al.* 2008; Ryu and Lee 2016).

We suggest that innovation has a positive influence on both performance and personnel training at a global level. Furthermore, we suggest that the knowledge and skills of an organization's workforce mediates the impact of innovation on performance. Analyzing the mediation effect of personnel training between innovation and performance proves to be especially important in industries such as the pharmaceutical industry, where there is a shortage of qualified staff in specific R&D areas (Frietsch and Neuhäusler 2015), and where innovation is considered to be the very essence of the industry (Bower and Whittaker 1993). We test the hypotheses using PLS-SEM on data from a sample of pharmaceutical firms.

Therewith, we contribute to extant literature in two ways. First, we reinforce the idea that innovation is one of the key performance drivers. Second, and more important, we demonstrate that personnel training has a positive impact on performance and is a relevant factor that enables innovation to translate into a better performance. In doing so we answer calls to clarify about the innovation-personnel training relationship to generate greater levels of innovation (De Saá-Pérez *et al.* 2012; Barba-Aragón 2014).

2. LITERATURE REVIEW AND CONCEPTUAL MODEL

2.1. The impact of innovation on performance

Innovation is a multi-faceted effort (Maravelakis *et al.* 2006) that can be defined as the generation and development of new

products, services, or processes (Damanpour 1991). Different theories and academic fields—e.g., marketing theories, strategic theory, the theory of resources and capabilities—have revealed that innovation is essential for better performance and survival of firms. Hence, in recent times researchers have studied the innovation construct intensively in different settings and contexts (e.g., Arzubíaga 2019; Dziallas and Blind 2019), such as the pharmaceutical industry (García-Morales *et al.* 2008). In this regard, there is plenty of literature positing that innovation plays a key role in enhancing an organization's performance (e.g., Crone and Roper 2001; Li and Atuahene-Gima 2001; Jiménez Jiménez and Sanz Valle 2006; Chen and Huang 2009; Dadfar *et al.* 2013; Huang *et al.* 2016; Vladimirov 2016), effectiveness, and efficiency (Davis and Pett 2002). For example, García-Morales *et al.* (2008) found that innovation has a positive impact on performance, especially on return on assets and market share. Nevertheless, innovation often encompasses a high level of risk and its implementation never assures successful results (Leal-Rodríguez *et al.* 2015; Leal-Rodríguez and Albort-Morant 2016).

Besides productivity-related effects (see for example Guisado González *et al.* 2016), the positive impact of innovation on performance can be primarily explained by the fact that innovation helps companies to differentiate themselves from others (Jansen *et al.* 2006; Arzubíaga *et al.* 2019), which is key for gaining a sustainable competitive advantage (Walker 2004). Innovation is a multifaceted construct (Azar and Ciabuschi 2017) that can take many forms (Gunday *et al.* 2011). Leaving aside the organizational innovation—too broad in scope (Damanpour 1991), and sometimes embracing the other forms (Liao *et al.* 2017)—, product innovation is one of the most prolific topics. The notion of being first with proactive new products, i.e., new product development, is critical to obtaining first mover advantages (Langerak and Hultink 2005), and therefore, market superiority, especially in technology-intensive industries such as the pharmaceutical industry (Xu 2015). A large body of empirical research has investigated new product development and related factors, such as product innovation capability (Sharma and Martin 2018; Iddris 2019). Consequently, there is strong support for the positive relationship between new product development and performance (Damanpour 1991; Fagerberg *et al.* 2005; Lau *et al.* 2010; Rosenbusch *et al.* 2011; Sok and O'Cass 2015). The implementation of a new or significantly improved production or delivery method—process innovation—can have a more hazy effect than product innovation (Gunday *et al.* 2011), but it positively and significantly influences performance too (e.g., Ali *et al.* 2016; Tsinopoulos *et al.* 2018). Marketing innovation has not yet motivated a great deal of research (Medrano and Olarte-Pascual 2016; see the overview in Grimpe *et al.* 2017), but it is widely accepted that developing new marketing techniques enhances firms competitiveness (Ren *et al.* 2009; Gupta *et al.* 2016) and has a positive influence on performance (Chen 2006; Hsu 2011). Hence, it is hypothesized that:

Hypothesis 1: Innovation has a positive impact on performance.

2.2. The impact of personnel training on performance

Training is defined as a systematic development of the competences needed by employees to perform their work

(Dermol and Čater 2013), or as acknowledged by Manoharan *et al.* (2012), "(...) [it] is all about looking ahead and developing practical programmes that result in improved performance" (p. 451). Personnel training is essential for the continuous improvement of the quality of human capital (Zheng *et al.* 2007; Lertxundi and Landeta 2011; Garavan *et al.* 2019). Furthermore, personnel training is said to be one of the most important elements of human resource development (Taylor and Davies 2004; Manoharan *et al.* 2012; Garavan *et al.* 2019). Therefore, as acknowledged by Minbaeva *et al.* (2014), limited investments in training may result in lower levels of knowledge and skills, while training can help developing valuable human capacities, which would enhance performance (Tharenou *et al.* 2007).

As Dermol and Čater (2013) suggested, the success of training depends on two factors: its quality and its volume. Regarding the quality of training, researchers support the idea that with properly trained employees, the company can grow, and as employees develop, so will the company (Williams 1997). Accordingly, the right trainees should be recruited if the desired quality of training is to be achieved. In this sense, trainees must be reliable and effective (Nikandrou *et al.* 2009). Attention should also be paid to proper organizational incentives (Dermol and Čater 2013). Training can be formal or informal, and receiving one type is strongly correlated with the likelihood of also receiving the other (Ng 2005), even though the majority of training an employee receives is normally informal (Blandy *et al.* 2000), which is unplanned, undocumented and largely unstructured (Smith and Hayton 1999). In any case, training should be well-designed, set up in a way that works for the specific company it was designed for (Pluta and Fugate 2009) and relevant to the job (Nikandrou *et al.* 2009). Regarding the volume of training, in developed countries, companies invest a lot in training (Dermol and Čater 2013), primarily in the case of larger companies (Smith and Hayton 1999; Van Smoorenburg and Van der Velden 2000). Some decades ago, training targeted only the upper levels in businesses, but nowadays the majority of employees are trained (Blandy *et al.* 2000; Jarvis *et al.* 2003). The issue of quality personnel seems not to be a matter of education, but rather of competence. Nevertheless, it is true that the ratio between the costs and benefits of training is more favorable for employees with higher levels of education (Blunch and Castro 2005). Thus, employees with low levels of education sometimes get caught in "the low-skill, bad-job trap" (Booth and Snower 1996). Related to this, Van Smoorenburg and Van der Velden (2000) raise the question about the complementarity or substitutability between education and training. Some works (e.g., Blunch and Castro 2005; Van Smoorenburg and Van der Velden 2000) demonstrate that a higher level of education does increase the probability of receiving training.

As stated by Kirkpatrick (2006), training and performance appraisals are close relatives (see also the results of meta-analysis in Tharenou *et al.* 2007), even when some recent studies highlight the need for rigor (Garavan *et al.* 2019; Kwon 2019). Moreover, firms recoup their investments in training many times over (Blandy *et al.* 2000).

Nevertheless, some authors raise doubt on a positive effect of personnel training on performance. For example, some argue that only low percentage of training really ends up being applied in the workplace (Axtell *et al.* 1997; Brown 2005; Velada and Caetano 2007). Similarly, others argue that the success of training is questionable since training is sometimes informal and unplanned (Kotey and Folker 2007).

In any case, personnel training is a key element supporting successful performance (e.g., Blandy *et al.* 2000; Tharenou *et al.* 2007; Dimovski *et al.* 2008; Ryu and Lee 2016), and its benefits have been widely acknowledged in the literature (Platero-Jaime *et al.* 2017; Zheng *et al.* 2007). As the result of training, individual productivity improves, employee commitment to the enterprise increases, the adaptability and flexibility of the workforce is enhanced, changes in business strategy can be made (Smith and Hayton 1999) and employee loyalty to the organization may increase (Taylor and Davies 2004). These features prove to be especially important in industries such as the pharmaceutical industry, where to some extent, there is a shortage of qualified staff in specific R&D areas (Frietsch and Neuhäusler 2015). We hypothesize on a positive relationship between personnel training and performance.

Hypothesis 2: Personnel training has a positive impact on performance.

2.3. The mediating effect of personnel training between innovation and performance

A successful innovative environment requires a committed and well-trained work force that is involved in innovation (Matthews 2002; Chen and Huang 2009; D'Este *et al.* 2014). Thus, a highly qualified workforce increases the probability of innovation (Love and Mansury 2007; Tan and Nasurdin 2011). Precisely, as acknowledged by Shefer and Frenkel (2005), in order to innovate, companies must engage highly skilled labor that is able to cope with complex technological problems, being technology-related skills especially relevant for product and/or process innovations (Gunday *et al.* 2011). In this sense, Li *et al.* (2006) defend there is a positive relationship between personnel training and technological innovation. Specifically, the adoption of new technology is an important driver for employee training, because it is vital for maintaining the absorptive capacity of innovative companies (Zheng *et al.* 2007), that is, their ability to value, assimilate, and apply new external knowledge (Cohen and Levinthal 1990; Lane and Lubatkin 1998). Absorptive capacity, in turn, has a positive impact on both product innovation and process innovation (Murovec and Prodan 2009; Ali *et al.* 2016; Solís-Molina *et al.* 2018). In fact, through labour flexibility, absorptive capacity has a positive impact on organizational innovation, which in turn positively impacts organizational performance (García *et al.* 2018; Zou *et al.* 2018). Similarly, training supports absorptive capacity since it is an effective way of absorbing and managing knowledge (Gray 2006; Najafi-Tavani 2018; Xie *et al.* 2018), and therefore is of great importance to firms competing in R&D-intensive industries such as the biotechnology industry (Stezano and Espinoza 2019).

Turning to our central argument, a highly qualified workforce is very important for the development of new products (Mumford 2000; Lau and Ngo 2004; Langerak and Hultink 2005; Horbach 2010). In fact, an increase in company-level knowledge is directly associated with innovation (Jiménez Jiménez and Sanz Valle 2006), as knowledge can facilitate the successful deployment of an innovation (García-Morales et al. 2008). Concretely, both knowledge stock and knowledge flows enhance innovation (Thornhill 2006).

All in all, training investments and innovation jointly interact to positively enhance company performance. Based on the review of the existing literature, we have formulated the following hypothesis:

Hypothesis 3: Personnel training mediates the impact of innovation on performance.

3. RESEARCH METHODOLOGY

3.1. Sample and data collection

Our population consists of all the German pharmaceutical companies operating under the 2834 SIC code (928 companies), and we obtained their data from the Dun & Bradstreet Database. We chose the pharmaceutical industry because innovation is considered the driving force of the industry and training of personnel is also a key element supporting the successful performance of pharmaceutical companies (Mehralian et al. 2016). We focus on firms from this one industry only to avoid differences in industry characteristics affecting the conditional performance impacts of innovation and personnel training. Concretely, we selected German pharmaceutical companies as the sample for this study, because of the strength of the industry (both in terms of number of competitors and their performance) offering us a potential to come up with a satisfactory sample size and a good worldwide benchmark.

The data were collected in mid-2014 by means of a computer-assisted telephone interviewing (CATI) procedure and stratified proportional sampling of the original population. As a result, 200 valid responses were obtained from CEOs. The sample size available is appropriate in light of the low complexity of the model used (Chin 2010; Hair et al. 2016). Power analyses needed to determine the minimum sample size support this notion (Cohen 1992; Faul et al. 2007).

3.2. Measures

The latent variables in our study require specific items in each measurement model. Consistent with previous research, and with a focus on product, process, and marketing innovation (Gunday et al. 2011), we adapted the existing measurement scales for innovation (Dess and Davis 1984; Covin and Slevin 1989; Davis and Pett 2002; Lin et al. 2007; Gunday et al. 2011) so that the items reflect this construct best. Precisely, we assessed the efforts of firms not only to invest in new production processes but also to explore new products and continually improve existing ones, as well as an item related to the innovation in marketing techniques. Personnel training

was considered a single-item construct that aims to capture personnel training at a global level. Precisely, firms were asked to what extent they insure trained personnel. We shortened the existing measurement scales proposed in prior research for the sake of the questionnaire length, which is of special importance with regard to the target of CEOs, who emphasize the privacy of information (Homburg et al. 2004). The measurement scale for performance was adapted from previous studies (e.g., Akan et al. 2006; Allen and Helms 2006). Precisely, we selected five (reflective) items related to assets, income, revenue, market share and overall performance. All measurement items stem from a questionnaire that uses 5-point Likert scales, ranking from 1 (“far below average”) to 5 (“far above average”).

4. RESULTS OF THE DATA ANALYSIS

The data analysis was performed using the partial least squares structural equation modeling (PLS-SEM) technique (find in Di Pietro et al. 2018 some PLS-SEM related advantages over other techniques), which is a useful multivariate method used in strategic management and marketing, specially due to the early phase of theorizing on the impact of both innovation and personnel training on performance (Richter et al. 2016). This modeling was conducted using the SmartPLS 3 (Ringle et al. 2015) software. Both innovation and performance were defined reflectively, as the causality emanates from the variable to the items (Podsakoff et al. 2006).

Figure 1 presents the structural model produced by the PLS analysis, which indicates the variance of the endogenous variables (R^2) and the path coefficients. Table 1 and Table 2 show the assessment of the measurement model, and Table 3 represents the structural model assessment.

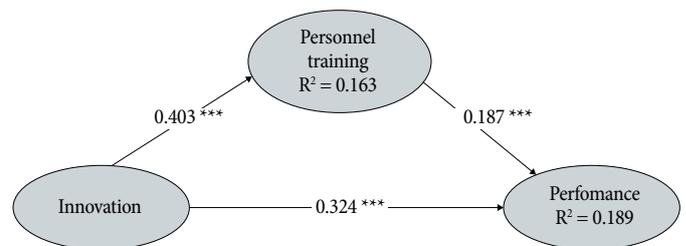


Figure 1
Structural model: Path coefficients and R^2

Note: Lohmöller settings were used.

*** $p < .01$; ** $p < .05$; * $p < .1$.

First, we assessed the measurement model (Chin 2010; Hair et al. 2016) (see Table 1 and Table 2). The assessment of the reliability of internal consistency (CR) indicated that all values were greater than 0.7. Cronbach’s α values were greater than or very close to 0.7. Convergent validity was assessed by means of average variance extracted (AVE) values. All the values were greater than 0.5. We used the HTMT criterion to reliably detect the lack of discriminant validity. In all cases, the values fell below the threshold of 85% (Kline 2011). Following the practice established by Henseler et al. (2014), we calculated the standardized root mean square residual (SRMR), which

is 0.079. This implies that the composite factor model fits the data fairly well, according to [Browne and Cudeck \(1993\)](#). To account for common method bias, survey items related to the dependent and the independent variables were separated within the survey and randomized within blocks to reduce a potential bias from their sequencing.

The next step was to evaluate the structural model (Table 3). The essential criterion for this assessment was the coefficient of determination (R^2). We concluded that the exogenous latent variables had moderate effects on performance, taking into account the research discipline and the simplicity of the model. A bootstrapping procedure was used to analyze the statistical significance of the paths. The effect size (f^2) allows the contribution of the construct to an endogenous latent variable to be assessed. To ascertain the existence of collinearity, the tolerance of each predictor construct (VIF) value was calculated and determined to be greater than 0.2, but less than 5 ([Hair et al. 2011](#)).

Table 1
Evaluation results: Measurement model

Constructs/indicators	Loading	Composite reliability	Cronbach's α	AVE
Innovation		0.804	0.668	0.511
-Develop and refine established products	0.784			
-Innovation in manufacturing process	0.638			
-Innovation in marketing techniques	0.580			
-New product development	0.828			
Performance		0.953	0.938	0.801
-Total asset growth	0.925			
-Net income growth	0.872			
-Overall performance/success	0.906			
-Total revenue growth	0.876			
-Market share growth	0.897			

Note: AVE = Average variance extracted

Table 2
Discriminant validity assessment:
Heterotrait-monotrait ratio of correlations

	Performance	Innovation	Personnel training
Performance	1		
Innovation	0.502	1	
Personnel training	0.326	0.494	1

Table 3
Assessment of the structural model

Endogenous construct	R^2	Q^2
Performance	0.189	0.148
Personnel training	0.163	0.159

Path	Path coefficient	Collinearity (VIF)	f^2	t -value	Bias corrected 95% confidence interval
Innovation → Performance	0.324	1.194	0.109	6.531***	[0.230; 0.423]
Personnel training → Performance	0.187	1.194	0.036	3.272***	[0.071; 0.296]
Innovation → Personnel training	0.403	1.000	0.194	8.627***	[0.314; 0.496]

Note: The cross-validated redundancy measure (Q^2) is derived from the blindfolding procedure with an omission distance of 7. The t -values are derived from the bootstrapping procedure with the pairwise deletion algorithm. VIF = variance inflation factor.

*** $p < .01$; ** $p < .05$; * $p < .1$

Our findings revealed that innovation has a positive influence on both performance (Table 3: path coefficient of 0.324; $p < .01$) and personnel training (Table 3: path coefficient of 0.403; $p < .01$). Therefore, Hypothesis 1 is supported. Similarly, personnel training also has a positive effect on performance (Table 3: path coefficient of 0.187; $p < .01$). Therefore, Hypothesis 2 is supported.

Finally, the mediation effect of personnel training between innovation and performance was analyzed. Since focusing on the significance of the direct relation before and after examining a mediator may be unnecessarily restrictive, we utilized the typology proposed by [Zhao et al. \(2010, Table 4\)](#). We concluded that there is a *complementary mediation*. This result (Table 4) demonstrates a significant indirect effect of personnel training on the innovation-performance path.

Table 4
Mediation

Indirect effect	t -value	Type of Mediation
Personnel training between Innovation → Performance	3.007***	Complementary mediation

Note: The t -values are derived from the bootstrapping procedure with the pairwise deletion algorithm.

*** $p < .01$; ** $p < .05$; * $p < .1$

By focusing on performance, we also conducted an importance-performance matrix analysis (IPMA) to extend the

PLS-SEM results (Höck *et al.* 2010; Ringle and Sarstedt 2016; Hair *et al.* 2019) (Table 5). This analysis shows that innovation has the highest importance, but a relatively low performance. Hence, innovation is a key factor that should be considered if performance is to be improved.

Table 5
Importance-performance matrix analysis (IPMA)

	Importance	Performance
Innovation	0.443	53.925
Personnel training	0.164	72.188

5. DISCUSSION

5.1. Implications for theory

The need for companies to become more innovative has never been greater. The literature traditionally highlights the importance of innovation towards gaining a competitive advantage that would enhance business performance (Vladimirov 2016). For example, the notion of being first with proactive new products, i.e., new product development, is critical to obtaining first mover advantages (Langerak and Hultink 2005), and therefore, market superiority. Accordingly, there is strong support for the positive relationship between new product development and performance (Damanpour 1991; Fagerberg *et al.* 2005; Lau *et al.* 2010; Rosenbusch *et al.* 2011; Sok and O'Cass 2015). In addition, personnel training is another key element supporting successful performance (Blandy *et al.* 2000; Tharenou *et al.* 2007; Dimovski *et al.* 2008; Ryu and Lee 2016) since it enhances organizational learning. Surprisingly, there is a lack of studies that attempt to bring these two drivers of business performance together by considering personnel training as a mediator between innovation and performance. Hence, this study contributes to enhancing the innovation-related literature by including personnel training as a significant mediator in the innovation-performance relationship. Precisely, we examined our proposed relationships in the German pharmaceutical industry.

This first contribution made by this study lies in stressing the importance of innovation in the performance. Developing new products and developing and refining established products is crucial, because it has been identified as the key to the company's success, profit and survival (Sok and O'Cass 2015). Similarly, developing marketing techniques (Chen 2006; Ren *et al.* 2009; Hsu 2011; Gupta *et al.* 2016) and processes (Ali *et al.* 2016; Tsinopoulos *et al.* 2018) positively influences performance too.

The second contribution lies in suggesting that ensuring a company has trained personnel also has a positive impact on the performance. This finding corroborates previous studies (Aw *et al.* 2007; Frietsch and Neuhäusler 2015; McGuirk *et al.* 2015), suggesting that having trained personnel is especially crucial in R&D-intensive sectors —such as the pharmaceutical industry—. The knowledge and skills of an organization's workforce are important resources on which successful organizations invest.

Accordingly, training is a key element in disciplines such as Human Resource Development and Learning and Development (Garavan *et al.* 2019).

Thirdly, the results demonstrate personnel training positively mediates the innovation-performance link. Hence, personnel training is a relevant factor that enables innovation to translate into a better performance, since knowledge can facilitate the successful deployment of an innovation (García-Morales *et al.* 2008). All in all, in line with what was hypothesized, training investments and innovation jointly interact to positively enhance company performance.

Finally, the results of the IPMA (Höck *et al.* 2010; Ringle and Sarstedt 2016; Hair *et al.* 2019) suggest that the construct of innovation has the highest importance, but a relatively low performance as compared to personnel training. Hence, by focusing on innovation, there is certainly room for improvement regarding firms' performance in high-tech industries.

5.2. Implications for management

From a managerial point of view, this study also provides clear indications. As shown in the PLS-SEM results and the IPMA analysis, in turbulent and dynamic environments, practitioners should bet strongly on innovation and should rely on personnel training to enable greater performance within a successful innovative environment. We further develop our arguments.

In the pharmaceutical industry, innovation plays even a more important role than in other industries. Generally speaking, innovation is considered the driving force of the pharmaceutical industry (Malerba and Orsenigo 2015) and is the best approach for pharmaceutical companies to gain a competitive position in the global market (Lin *et al.* 2007). For example, despite the fact that product innovation is highly uncertain (Cooper and Kleinschmidt 1993; Damanpour *et al.* 2009; Leal-Rodríguez and Albort-Morant 2016), developing new products and developing and refining established products is crucial for managers, because it has been identified as the key to the company's success, profit and survival (Sok and O'Cass 2015). This holds true even when firms have abandoned such innovation activities (Tsinopoulos *et al.* 2019). Besides the importance of process innovation (see for example Bauer and Leker 2013; Malerba and Orsenigo 2015), product innovation and marketing innovation are key influencing factors in the biotechnology and pharmaceutical industries (Lin *et al.* 2007), which reinforces the idea that practitioners should bet strongly on innovation, as also shown in our IPMA analysis.

Second, managers should rely on personnel training to enable greater performance within a successful innovative environment. The likelihood of training tends to be different not only between industries in developed and developing countries (Booth 1991; Ng 2005), but also among industries themselves. In this sense, the technological intensity of each sector plays a key role. Subramanian and Zimmermann (2013) concluded that technology-intensive companies are expected to invest in training programs that provide opportunities for professional and personal development. Specifically, the adoption of new technology is an important driver for employee training, because it is vital for maintaining the absorptive capacity of innovative companies (Zheng *et al.* 2007). Thus, in the pharmaceutical

industry, training plays a major role, because innovation is the very essence of the industry, and as a result, the absorptive capacity of the organization needs to be developed (Cockburn and Henderson 1998; Lane *et al.* 2001; Nooteboom *et al.* 2007; Fabrizio 2009).

6. LIMITATIONS AND DIRECTIONS FOR FURTHER RESEARCH

This paper is not free from limitations. First, we considered personnel training as the only variable that mediates the innovation-performance relation. Furthermore, this variable is measured by a single item. Second, only specific aspects of performance were analyzed. Third, respondents were not asked to provide objective measures. As a result, our study inevitably suffers from the normal bias associated with subjective measures. Finally, since we studied German pharmaceutical companies, it must be admitted that the path coefficients could differ significantly across different countries and sectors. Hence, since the same cause can produce different effects in specific circumstances (Ordanini *et al.* 2014; Wu *et al.* 2014), results should be extrapolated to other sectors with caution.

This study establishes new paths for further research. First, future research could include other variables that mediate the innovation-performance relationship to better explain performance. Similarly, by including moderating variables researchers could gain new insights. Second, even if the German pharmaceutical industry offers us a good worldwide benchmark, researchers could conduct similar studies in different industries and countries, with the aim of analyzing the different results. In this regard, future research might investigate how institutional characteristics affect the relations to give us a better understanding of the reasons why results differ among industries. Accordingly, associating the results with the new institutional economy (Williamson 1975; Johannessen 2008) is one way to expand the research reported here. Third, further studies should distinguish between different types of innovation and assess their impact on performance (Naranjo-Valencia *et al.* 2018; Castillo-Apraiz *et al.* 2020a). Similarly, instead of capturing personnel training at a global level, further studies could for example assess how personnel training within specific areas—such as R&D— impacts performance. Fourth, analyzing the relations from within a longitudinal framework would allow a better interpretation of the results. Evaluating possible variations over time would be particularly interesting for assessing the change in the mediating effect of training on the innovation-performance relationship. Finally, further works could focus more on predictive aspects (see for example Shmueli *et al.* 2019; Hwang *et al.* 2020; Liengard *et al.* 2020) or use new analytic tools such as Necessary Condition Analysis (NCA) (see for example Richter *et al.* 2020) to gain new insights.

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