

---- EARLY VIEW ----

## PRODUCT INNOVATION PERFORMANCE: ANALYSIS OF MEASURES AND MEASUREMENT SCALES APPLIED TO SMES.

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### ABSTRACT

**Objective:** The article presents the analysis of measures and scales of product innovation performance adopted in studies on micro, small, and medium-sized enterprises (SMEs). **Methodology/approach:** It is an exploratory and qualitative descriptive research. The methodology consists of a systematic bibliographic review, examining articles from the Capes database, published from 1990 to December 2020. **Main results:** The research identified 92 articles addressing product innovation performance. Objective measures (proxies) were used in 41 of them, while 51 adopted psychometric scales. Among the studies analyzed, 7 different psychometric scales were developed to measure product innovation performance in SMEs. **Theoretical/methodological contributions:** The growing research on the importance of innovation management in SMEs emphasizes the need to measure the performance of organizations' actions to innovate. However, the measures adopted to assess product innovation performance still diverge regarding the form, involving different variables. This research's findings intend to direct researchers to appropriated measures in studies involving SMEs. **Relevance/originality:** The concern on product innovation has grown in recent years especially due to the urgent need for innovation. In this context, it is crucial to expand the knowledge on tools to analyze product innovation performance. **Social/management contributions:** The article offers information and tools for SME managers to analyze the measurement of product innovation performance.

**Keywords:** Product innovation performance. Measurement scale. Innovation management. Small and medium enterprises.



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## DESEMPENHO DA INOVAÇÃO DE PRODUTO: ANÁLISE DE MEDIDAS E ESCALAS DE MENSURAÇÃO PARA APLICAÇÃO EM PME

### RESUMO

**Objetivo:** apresentar a análise das medidas e escalas de desempenho da inovação de produto, aplicadas em estudos sobre as micro, pequenas e médias empresas (PME). **Metodologia/abordagem:** pesquisa de caráter exploratório e qualitativo-descritivo, que utilizou como método de investigação a revisão bibliográfica sistemática, a partir de artigos encontrados na base de dados da Capes, no corte temporal entre os anos de 1990 e 2020 (dezembro). **Principais resultados:** 92 artigos sobre o desempenho da inovação de produto foram identificados, sendo que 41 utilizaram medidas objetivas (chamadas de *proxies*) e 51, escalas psicométricas. Destes últimos, sete escalas foram desenvolvidas e replicadas em estudos com PME. **Contribuições teóricas/metodológicas:** tendo em vista a crescente importância da gestão da inovação nas PME, e considerando a divergência entre as formas e as variáveis utilizadas na mensuração do desempenho das ações organizacionais em prol da inovação de produtos, esta pesquisa aponta as medidas mais adequadas a essa análise. **Relevância/originalidade:** a busca pela inovação de produtos tem crescido nos últimos anos, o que torna necessário e urgente – como evidencia esta pesquisa – o conhecimento das ferramentas de análise do desempenho das inovações realizadas. **Contribuições sociais/para a gestão:** este artigo proporciona aos gestores das PME informações e ferramentas para a análise dos esforços na mensuração do desempenho da inovação de produtos nas PME.

**Palavras-chave:** Desempenho da inovação de produto. Escala de mensuração. Gestão da inovação. Micros, pequenas e médias empresas.

### 1. INTRODUCTION

The importance of micro, small, and medium-sized enterprises (SMEs) for economic development is a consensus in the literature (Aksoy, 2017; Sarpong & Teirlinck, 2018; Muñoz-Pascual, Curado & Galende, 2019). SMEs stand out especially for job creation and protection against economic recession. These companies are the main contributors to the maintenance of countries' gross domestic product (Aksoy, 2017; Haddad, Williams, Hammoud & Dwyer, 2019) and help promote sustainable growth, especially in developing countries (Muñoz-Pascual, Curado & Galende, 2019). For SMEs, adopting innovation strategies is essential for competitiveness and superior performance (Beyene, Shi, & Wu, 2016; Aksoy, 2017; Haddad et al., 2019; Muñoz-Pascual, Curado & Galende, 2019; Lukovszki, Rideg, & Sipos, 2020).

Authors such as Rosli and Sidek (2013) and Lukovszki, Rideg, and Sipos (2020) reinforce that innovation is crucial to SMEs to maintain competitive advantages, which implies specific investments in this area, as observed in the studies by Bakar and Ahmad (2010), Beyene, Shi, and Wu, (2016), Aksoy (2017), Sarpong and Teirlinck (2018), Haddad et al. (2019), Muñoz-Pascual, Curado, and Galende (2019), and Lukovszki, Rideg, and Sipos (2020). Even though SMEs have limited operational and resource characteristics (Bakar & Ahmad, 2010), properly allocated resources lead to superior performance by promoting the creation of valuable products to consumers (Bakar & Ahmad, 2010; Lukovszki, Rideg & Sipos, 2020).

Therefore, product innovation provides the best result for SMEs' performance compared to other types of innovation (Bakar & Ahmad, 2010; Beyene, Shi, & Wu, 2016; Sarpong & Teirlinck, 2018). SMEs need to understand product innovation dynamics, develop innovation strategies and processes, and learn how to measure product innovation performance (PIP) to achieve better results (Hanachi, 2015). However, measuring PIP is a challenge due to the diversity of methods and lack of standards regarding



such measurement (Henttonen, Ritala, & Jauhiainen, 2011; Hanachi, 2015). The forms of measuring diverge in the nature of the data, adopting objective data or psychometric scales (Alegre & Chiva, 2008; Forfuri & Tribó, 2009).

The measurement with objective data is carried out using proxies, i.e., a number or percentage that gives a value to what has to be measured (Bakar & Hamad, 2010). As for psychometric scales, they are developed by asking respondents to evaluate the organization's performance compared to competitors (Tsai, Hsu, & Fang, 2012). Psychometric scales are essential when there is a lack of systematic, audited, and reliable data on PIP, which can often occur in SMEs (Cheng et al., 2015).

In studies of PIP in SMEs, the particularities of the product innovation process grant special importance to the use of multidimensional psychometric measures (Bakar & Hamad, 2010; Hanachi, 2015). The different points of view found in the literature on the subject suggests a lack of progress in understanding the process around PIP (Tsai, Hsu, & Fang, 2012). Also, the low progress is aggravated when objective measures are used as the only way to assess PIP (O'Regan & Ghobadian, 2004; Ulusoy & Yegenoglu, 2005; Alegre, Lapiedra, & Chiva, 2006; Heidt, 2008; Bakar & Hamad, 2010; Hanachi, 2015).

The lack of a theoretical consensus on measuring PIP stimulates studies trying to explain and analyze the different existing measurement forms. In this sense, the literature review on measuring PIP gains importance, as it subsidizes researchers with information on the topic and contributes to developing the body of knowledge (Tranfield, Denyer & Smart, 2003). The literature review also allows actors in the field to decide which measure they can employ in specific cases.

This research seeks to identify the measures to assess PIP used in articles from journals available in the database of the Brazilian Coordination for the Improvement of Higher Education Personnel (Capes). This study also analyzes the measures and psychometric scales applied to SMEs. This research contributes to future studies on the theme by expanding the knowledge on the measures developed and validated and on the measurement scales used in the literature.

## **2. THEORITICAL FRAMEWORK**

Research on new product development emerged in the Massachusetts Institute of Technology (MIT) in the 1970s. Since 1985 there has been a considerable increase in new product development research, emphasizing structures and processes (Brown & Eisenhardt, 1995). At the same time as researching the history of new product development, it is crucial to explore how to measure the new products' success and failure (Cooper & Kleinschmidt, 1995; Griffin & Page, 1992). Research focusing on operation sought to assess these products' financial performance (Brown & Eisenhardt, 1995).

In 1997, the OSLO Manual of the Organization for Economic Co-operation and Development (OECD) was launched, offering a structure of concepts, definitions, and methodologies to help understand the innovation process. The OSLO Manual presented a scale to assess the innovation's economic goals (OECD-EUROSTAT, 1997) and served as a basis for studies on innovation performance (Yam et al., 2004; Alegre, Lapiedra & Chiva, 2006).

Measurements of product innovation performance (PIP) emerged from studies of new product performance and innovation performance and gained prominence after the article by Alegre, Lapiedra, and Chiva (2006). Since then, the development of PIP measurement has considered several measuring elements to overcome the lack of standards (Henttonen, Ritala, & Jauhiainen, 2011; Hannachi, 2015).

Defined as the financial and non-financial results of the organizations' product innovation efforts (Bakar & Hamad, 2010), PIP has been assessed both through inputs (such as ideas, intensity R&D activities) and outputs (product performance, process performance, financial performance) (Garcia & Calantone, 2002; Valadares, 2012; Grumbaum & Stenge, 2013).



PIP also involves capturing objective data (financial performance and number of patents, for example) and measures of perception (perception about competitors and performance) using psychometric scales (Alegre & Chiva, 2008; Fosfuri & Tribó, 2009). Table 1 presents examples of performance measures for product innovation regarding inputs and outputs.

<b>PIP measurement – inputs</b>	
<b>Type of measure</b>	<b>PIP measurement</b>
<b>Objective</b>	Number of new ideas, intensity of R&D activities (new patents, new products)
<b>Psychometric</b>	Performance, innovation, products, and processes – product improvement and adaptation, existing processes, organizational technologies and structures, strategic guidelines
<b>PIP measurement – outputs</b>	
<b>Type of measure</b>	<b>PIP measurement</b>
<b>Objective</b>	Product innovation performance (percentage increase in sales) and processes (production performance) Financial performance (profitability)
<b>Psychometric</b>	Product innovation performance regarding efficiency and effectiveness Financial, market, and technical performance; client and strategic performance

**Table 1.**

Examples of PIP measurements regarding inputs and outputs.

Source: Elaborated by the authors based on Alegre, Lapiedra, and Chiva (2006); Bakar and Ahmad (2010); Chen et al. (2015); Hanachi (2015).

The literature points out the need to adopt a multidimensional approach to assess PIP, i.e., an approach that does not consider only financial and objective data (Dewagan & Godse, 2014). The importance of measuring the success of product development in a multidimensional way can be identified in the seminal studies on the new products’ performance (Griffin & Page, 1993). The next section presents the study’s methodology.

### **3. METHOD**

This qualitative and descriptive exploratory research used systematic review (Tranfield, Denyer, & Smart, 2003). The systematic review occurred in three stages following the guidelines of Tranfield, Denyer & Smart (2003): 1) planning the review; 2) conducting the review; 3) reporting and dissemination, structuring a descriptive and analytical report. Steps 1 and 2 are presented below, and step 3 is presented in the research results.

The planning stage started by defining the study’s scope, i.e., exploring product innovation performance (PIP) scales. A brief bibliographic search of the Capes database was conducted to obtain an overview of the topic and find existing reviews. This step revealed that 1) articles on the topic gained prominence after 1990 (therefore, this was adopted as the first year of the period analyzed), and 2) no systematic reviews on scales to assess PIP were found.

The protocol included the definition of keywords, the criteria to include studies in the review, and the definition of the database researched. A spreadsheet was organized in Excel® to organize the information about the studies’ year, authors, reference, abstract, methodology, the type of article



regarding data collection (objective measures or psychometric scales), and the method of analysis. The research focused on studies published in journals available in the Capes database between 1990 and 2020. The terms “product innovation performance” and “product innovation results” were used, searching them in the title, abstract, and keywords. The research identified 316 articles, and the preliminary analysis was carried out by reading the abstract and the research method.

The search and inclusion criteria were applied by relocating the articles that addressed only the themes “new product performance” and “innovation performance” in a new spreadsheet. During the reading, it was observed that although seminal authors often appear in the articles, the reference authors vary in each topic’s – new product performance, innovation performance, and PIP – theoretical development.

A co-citation analysis was conducted to confirm the preliminary observations, using the Ucinet 6.618@ software, and the sample was formed with only articles that cited another article (at least once) in the Capes database. The co-citation analysis allows visualizing valid representations of a scientific domain’s intellectual structure. The analysis assumes that when two or more documents are cited together in a later work, they are addressing similar topics (Miguel, Moya-Anegón, & Herreno-Solana, 2008). Figure 1 shows the result of the co-citation analysis discussed in the next section.

The analysis was carried out by reading the articles addressing PIP in full, examining the characteristics of the measures adopted (objective or based on psychometric scales) and the authors referenced. It is important to highlight that psychometric scales are widely used to measure various psychological and social phenomena, which cannot be directly assessed (Develis, 2016). The study observed 51 articles using a psychometric scale to assess PIP and 41 articles adopting objective measures, forming a sample of 92 studies. The next section presents the results regarding the measures and how they were adopted in the literature.

#### 4. RESULTS AND ANALYSIS

This section starts by presenting the results of the co-citation analysis (Figure 1).

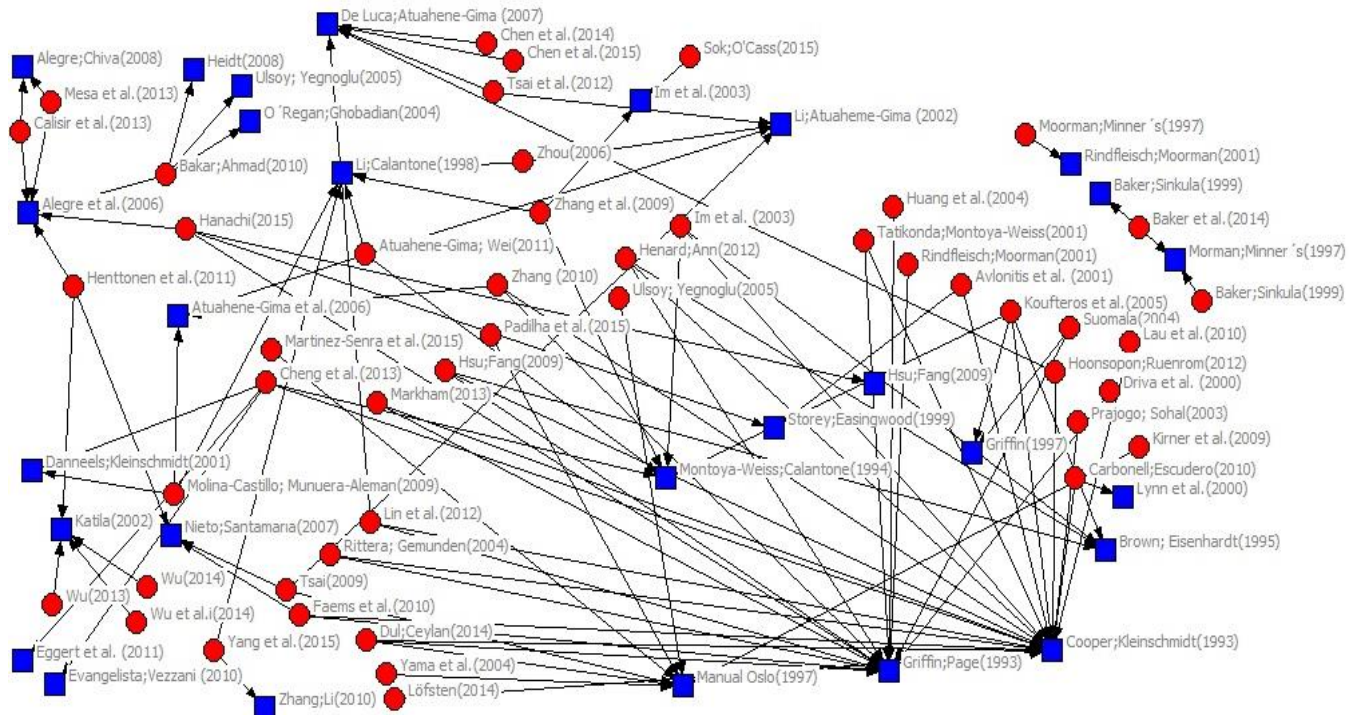


Figure 1.

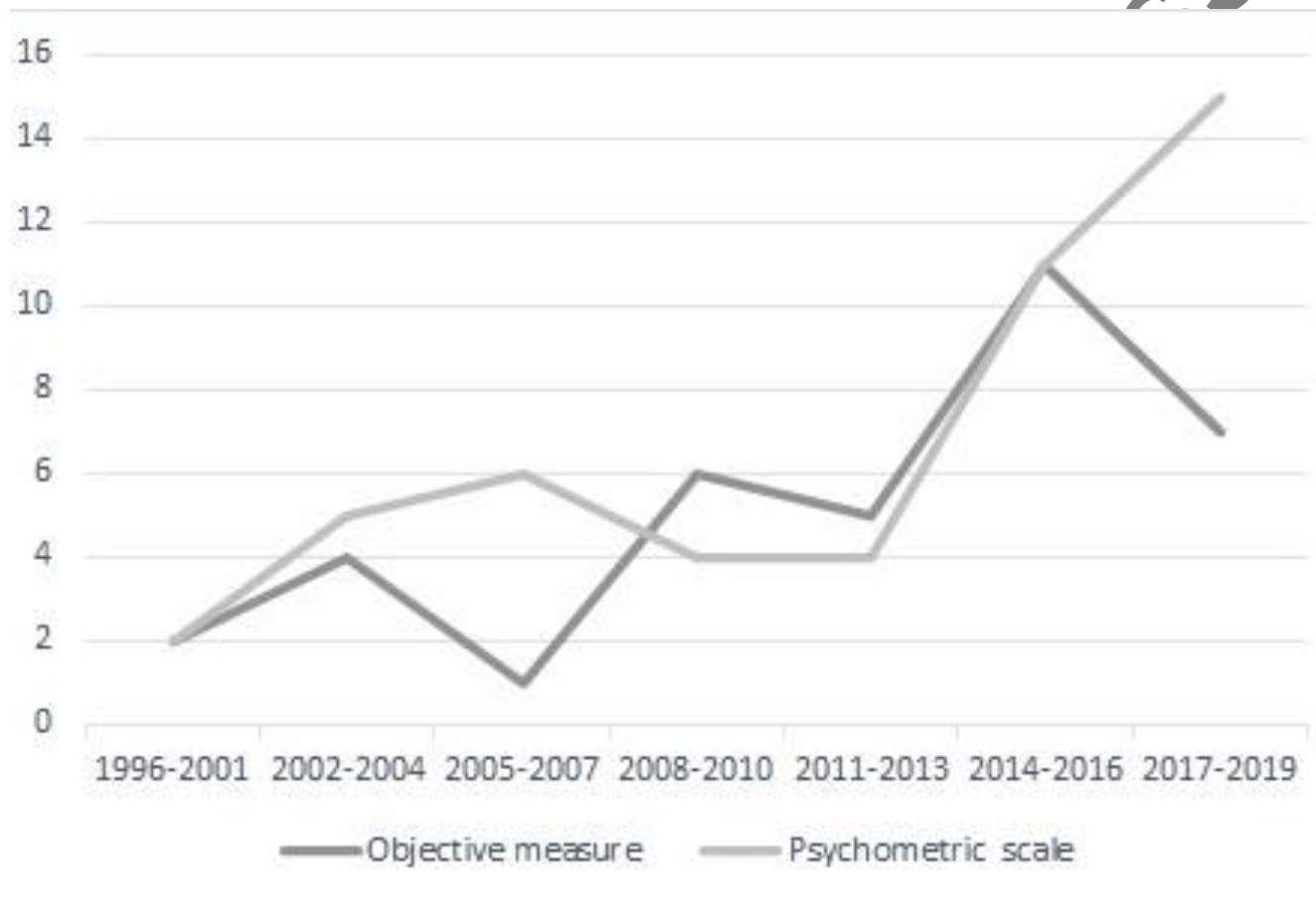
Result of co-citation analysis

Source: Elaborated by the author based on research data and structured using the Ucinet 6.618@ software



The co-citation analysis allows visualizing the relationship between the OSLO manual (OECD-EUROSTAT, 1997) and seminal authors (Cooper & Kleinschmidt, 1993; Griffin & Page, 1993; Montoya-Weiss & Calantone, 1994; Brown & Eisenhardt, 1995). Also, it is possible to separate the authors who address innovation performance and new product performance (few studies on the right of Figure 1) from those focused on product innovation performance (PIP) (most studies on the left of Figure 1). Although the studies by Dannels and Kleinschmidt (2001), Katila (2002), Li and Atuahene-Gima (2002), and Im et al. (2003) address new product performance, they were cited in studies on PIP and, therefore, were kept among them.

Chart 1 shows the evolution of studies addressing PIP between 1990 and 2020, dividing them into studies using objective measures and studies using psychometric scales.



**Chart 1.**  
Articles' frequency distribution per year and type of measure  
Source: Elaborated by the authors

The article's frequency in Chart 1 showed that sometimes objective measures and sometimes psychometric scales stood out, the latter used in the majority of articles published in the period from 2016 to 2020. In the subsection below, objective measures and psychometric scales were observed, detailing the measurement applied in the context of SMEs.

#### 4.1 ANALYSIS OF STUDIES THAT USE OBJECTIVE MEASURES

Objective measures are reflected by proxy, that is, a number or percentage that attributes value to what one wants to measure so that each measure can have more than one proxy for its identification. Table 2 presents the objective measures as well as the authors who used them.



Objective measure	Authors
Profitability	Lynn, Reilly, and Akgun (2000); Belderbos, Carree, and Lokshin (2004); Molina-Castillo and Munuera-Aleman (2009); Evangelista and Vezzani (2010); Carbonell and Escudero (2010); Atuahene – Gima, and Wei (2011); Inauen, and Schenker-Wicki (2012); Wu, Wang, and Li (2014); Löfsten (2014); Liu and Atuahene-Gima (2018).
Market share	Lynn, Reilly, and Akgun (2000); Molina-Castillo and Munuera-Aleman (2009); Carbonell and Escudero (2010); Faems et al. (2010); Atuahene – Gima and Wei (2011); Köhler, Sofka, and Grimpe (2012); Lin, Che, and Ting (2012); Yang, Sun, and Yang (2015); Irvanti et al. (2020).
Sales performance	Lynn, Reilly, and Akgun (2000); Danneels and Kleinschmidt (2001); Katila (2002); Belderbos, Carree, and Lokshin (2004); Rittera and Gemünden (2004); Fosfuri and Tribó (2008); Tsai (2009); Molina-Castillo and Munuera-Aleman (2009); Evangelista and Vezzani (2010); Carbonell and Escudero (2010); Atuahene – Gima and Wei (2011); Köhler, Sofka, and Grimpe (2012); Lin, Che, and Ting (2012); Löfsten (2014); Charterina, Basterretxea, and Landeta (2015); Wu, Wu, and Si (2016); Kobarg, Stumpf-Wollersheim and Welpé (2017); Lee, Joo, and Kim (2017); Maria, Freitas and Fontana (2017); Sarpong and Teirlinck (2018); Liu and Atuahene-Gima (2018); Paula and Silva (2020); Shang, Haiyun Yu, and Ma (2020).
Production performance	Rittera and Gemünden (2004); Tavassoli and Bengtsson (2018).
Percentage of sales growth due to innovative products	Yam et al. (2004); Faems et al. (2010); Zhang and Li (2010); Eggert, Hogreve, and Muenkhoff (2011); Wu (2013); Wu, Wang, and Li (2014); Wu (2014); Dul and Ceylan (2014); Uwizeyemungu, Poba-Nzaou and St-Pierre (2015); Bianchi et al. (2016); Si, Liu, and Cao (2020); Vicenzi et al. (2020).
Degree of novelty of innovation	Nieto and Santamaría (2007); Estrada, Faems and Faria (2016).
Percentage of client’s satisfaction	Molina-Castillo and Munuera-Aleman (2009).
Relative contribution of innovative products’ revenues in the total revenues	Henard and Mcfadyen (2012).
Number of patents	Löfsten (2014).

**Table 2.**

Objective measures identified in the research and authors who used them

Source: Elaborated by the authors.

Profitability was measured considering the percentage of increase in profits due to the sale of innovative products (Lynn, Reilly & Akgu, 2000; Belderbos, Carree & Lokshin, 2004), net profit and net profit margin (Molina-Castillo & Munuera-Aleman, 2009), the extent of achievement of return on assets objectives (percentage), the extent of achievement of profit margin objectives (percentage), and the extent of achievement of return on investment objectives (percentage) (Atuahene-Gima & Wei, 2011; Liu & Atuahene-Gima, 2018). Inauen and Schenker-Wicki (2012) defined an overall financial performance index, and Löfsten (2014) used the return on capital employed.

Market share was measured using the percentage increase in market share, sales volume, and market penetration (Molina-Castillo & Munuera-Aleman, 2009). It was also measured by the extent of



achievement of market share objectives (Atuahene-Gima & Wei, 2011) and the proportion of innovative products' turnover in a given year compared to previous years (Faems et al., 2010).

Sales performance was measured considering the percentage of sales growth due to innovative products (Katila, 2002; Belderbos, Carree, & Lokshin, 2004; Wu, Wu, & Si, 2016; Lee, Joo & Kim, 2017; Sarpong & Teirlinck, 2018), the extent of achievement of sales objectives (Atuahene-Gima & Wei, 2011), and percentage of turnover of innovative products (Kobarg, Stumpf-Wollersheim, & Welpel, 2017; Maria, Freitas, & Fontana, 2017).

Production performance was measured considering the cost reduction in relation to product improvement (Belderbos, Carree, & Lokshin, 2004) and productivity per employee, represented by the sales value of innovative products divided by the total number of employees (Tsai, 2009).

The percentage of sales growth due to innovative products was expressed as a percentage of the company's innovative products over a given period (Yam et al., 2004; Bianchi et al., 2016). It was also measured as an index that includes, in percentage, the sales of products considered new to the market and the sales of products considered new to the organization (Dul & Ceylan, 2014; Uwizeyemungu, Poba-Nzaou, & St- Pierre, 2015).

The degree of novelty of innovation was measured considering a criterion based on the product's innovation characteristics to distinguish a greater or lesser degree of innovation (Nieto & Santamaria, 2007; Estrada, Faems, & Faria, 2016).

The client's satisfaction was measured considering both the percentage of satisfaction and the increase in client's loyalty (Castillo & Aleman, 2009).

The relative contribution of innovative products' revenues in the total revenues was calculated considering revenue from sales of innovative products divided by total revenue (Henard & Ann, 2012).

The number of patents considered patents, copyrights, and licenses obtained in a certain period (Löfsten, 2014).

Among the objective measures found in the studies on SMEs were sales performance (Lee, Joo, & Kim, 2017; Sarpong & Teirlinck, 2018) and the percentage of sales growth due to innovative products (Uwizeyemungu, Poba-Nzaou, & St-Pierre, 2015). The psychometric scales found are detailed below.

**4.2 Analysis of Studies Using Psychometric Scales**

Psychometric scales ask respondents to assess the extent to which PIP occurs in the organization, frequently using a Likert scale (Tsai, Hsu, & Fang, 2012). Table 3 presents the psychometric scales found and the studies that used them.

Scales created	Studies using the scales
Gemunden, Ritter, and Heydebreck (1996)	Charterina, Basterretxea and Landeta (2016); Zaefarian, Forkmann, Mitrega, and Henneberg (2017).
Li and Atuahene-Gima (2002)	Atuahene-Gima et al., (2006); De Luca and Atuahene-Gima (2007); Molina-Castillo and Munuera-Aleman (2009); Tsai, Hsu, and Fang (2012); Chen et al. (2014); Chen et al. (2015); Sattayaraksa and Boon-itt (2018); Zhang, M.; Qi, Y.; Wang, Z.; Pawar, K. S.; Zhao, X. (2018); Iddris (2018); Hu, Tang, and Motohashi (2020); Petrovici et al. (2020); Tang et al. (2020).





Im, Nakata, Park, and Ha (2003)	Zhang et al. (2009); Sok and O’Cass (2015);
Alegre, Lapiedra and Chiva (2006)	Alegre and Chiva (2008); Bakar and Ahmad (2010); Henttonen, Ritala and Jauhiainen (2001); Calisir, Gumussoy and Guzelsoy (2013); Fernández-Mesa et al. (2013); Hannachi (2015); Padilha, Gomes and Machado (2015); Uğurlu and Kurt (2016); Padilha and Gomes (2016); Nwachukwu, Chladkova and Fadeyi (2017); Curado, Muñoz-Pascual and Galende (2018); Muñoz-Pascual, Curado and Galende (2019).
Bakar and Ahmad(2010);	Not applied in other studies
Cheng, Chang, and Li (2013)	Not applied in other studies
Hannachi (2015)	Manthey, Verdinelli, Rossetto, and Carvalho (2016).
Beyene, Shi, and Wu (2016)	Not applied in other studies
Silva, Mathrani, and Jayamaha (2016)	Not applied in other studies
Falasca, Zhang, Conchar, and Li (2017)	Not applied in other studies
Yusr, Mokhtara, Abaid, Perumal, and Fauzia (2018)	Not applied in other studies
Mostaghel, Oghazi, Patel, Parida, and Hultmane (2019)	Not applied in other studies

**Table 3.**

Scales developed to measure PIP and studies that adopted these scales

Source: Elaborated by the authors

The first scale developed to measure PIP was created by Alegre, Lapiedra, and Chiva (2006). The scales by Li, Atuahene-Gima (2002) and Im et al. (2003) were developed to measure new product performance but have been used in studies on PIP. The dimensions used in the psychometric scales are presented below.

For Gemunden, Ritter & Heydebreck (1996), the financial performance was researched through the interviewee’s perception of the innovative products that achieved commercial success. Li and Atuahene-Gima (2002) explored the perception of return on investment in innovative products, the profits obtained, and the return on assets, in comparison with competitors. Im et al. (2003) asked respondents to assess the relative profitability of new products, while Alegre, Lapiedra, and Chiva (2006) examined the economic objectives of innovation, which represents the effectiveness of product innovation. Cheng, Chang, and Li (2013) sought to verify whether innovative products obtained greater profitability than other products of the company.

Bakar and Ahmad (2010) measured profitability and Hanachi (2015) assessed the profits achieved by innovative products in relation to the company’s other products. Silva, Mathrani, and Jayamaha (2016) sought to verify whether innovative products achieved profit, market share, and pricing objectives. Falasca et al. (2017) verified whether the profit targets for innovative products had been achieved compared to those of competitors. Mostaghel et al. (2019) sought the revenue generated by innovative products.



Product performance was assessed by Li and Atuahene-Gima (2002) based on the development of new products, the variety of new product lines, and the increase in the number of new products introduced. Alegre, Lapiedra, and Chiva (2006) measured product innovation’s efficiency, taking into account the cost and time of innovation. Bakar and Ahmad (2010) measured changes in the introduction of new products, the replacement of products, and the extension of the product range. Yusr et al. (2018) verified the number of new product launches in relation to competitors, as well as the incentive to generate new ideas.

Bakar and Ahmad (2010) measured process performance through the product’s quality, how long it takes to develop the product and introduce it in the market, and after-sales services. Silva, Mathrani, and Jayamaha (2016) verified the product’s quality in terms of customer satisfaction, improvement in relation to competing products, and compliance with previous technical specifications.

Im et al. (2003) measured client performance observing the market share for all new products in the previous 12 months, while Bakar and Ahmad (2010) examined the degree of satisfaction with innovative products. Hanachi (2015) measured customer satisfaction and customer loyalty regarding innovative products. Mostaghel et al. (2019) focused on sales targets and market share, customer satisfaction, the incremental benefit of the product to the customer, and whether the innovative product offers advantages over competitors.

Sales performance was measured by Li and Atuahene-Gima (2002) and Im et al. (2003) by verifying the return on sales. Bakar and Ahmad (2010) examined the evolution of the market share, as well as the opening of new markets. Cheng, Chang, and Li (2013) and Hanachi (2015) sought to verify whether innovative products led to sales growth compared to other products.

Technical performance was measured by Bakar and Ahmad (2010) using new techniques and technologies in the introduction of innovative products. Hanachi (2015) researched whether the quality of innovative products is superior, also observing their launch deadlines, budget, and sustainability. Silva, Mathrani, and Jayamaha (2016) also sought to verify if product development remained within the expected timeframe.

Li and Atuahene-Gima (2002) studied overall performance observing the competitors regarding the company’s growth rate and reputation over the years. Hanachi (2015) measured strategic performance regarding the competitive advantage that innovative products provide, the achievement of goals in general, and the improvement in the company’s reputation. Table 4 shows the scales identified and the dimensions used in each study to measure the PIP.

<b>Scales</b> <b>Dimensions</b>	Gemunden, Ritter and Heydebreck (1996)	Li and Atuahene-Gima (2002)	Im et al. (2003)	Alegre, Lapiedra and Chiva (2006)	Bakar and Ahmad (2010)	Cheng, Chang and Li (2013)
Financial performance	X	X	X	X	X	X
Product performance		X		X	X	
Process performance					X	
Client performance			X		X	
Sales performance		X	X		X	X
Technical performance					X	
Overall performance		X				



Strategic performance						
<b>Scales Dimensions</b>	Hanachi (2015)	Beyene, Shi and Wu (2016)	Silva, Mathrani, and Jayamaha (2016)	Falasca et al. (2017)	Yusr et al. (2018)	Mostaghel et al. (2019)
Financial performance	X		X	X		X
Product performance		X			X	
Process performance			X			
Client performance	X					X
Sales performance	X	X				
Technical performance	X		X			
Overall performance						
Strategic performance	X					

**Table 4.**

Scales (by authors) and dimensions used to measure PIP.

Source: Developed by the authors

Among the twelve psychometric scales found, four were developed to be applied in the context of SMEs: Bakar and Ahmad (2010); Beyene, Shi, and Wu (2016); Yus et al. (2018); Mostaghel et al. (2019). Three psychometric scales were developed to be applied in medium and large organizations, and other studies adopted them to examine SMEs. It was the case of Li and Atuahene-Gima’s (2002) scale – applied in Sattayaraksa and Boon-itt (2018) and Iddris (2018); Alegre, Lapiedra, and Chiva’s (2006) scale – applied in Bakar and Ahmad (2010), Padilha and Gomes (2016), and Muñoz-Pascual, Curado, and Galende (2019); and the Hannachi’s (2015) scale – applied in the study by Manthey et al. (2016).

The psychometric scales developed and applied to SMEs are presented below, detailing their objective and measurement objects.

Li and Atuahene-Gima’s (2002) scale: The authors investigated the effect of the product innovation strategy on the performance of new technologies in China. The scale was developed to measure innovation and performance strategy and the measures were applied with a 5-point Likert questionnaire in 184 companies. Although the scale was not developed to measure PIP, it was adopted by Sattayaraksa and Boon-itt (2018) and Iddris (2018) in the context of SMEs.

Alegre, Lapiedra, and Chiva’s (2006) scale: The authors were the first to develop a scale to measure PIP. The scale considers PIP’s effectiveness and efficiency. Innovation effectiveness is the economic result of product innovation or the economic importance of the innovation process outputs. Before launching the survey, we conducted a pre-test with several members of the A 7-point Likert scale was used to evaluate performance against the main competitors’ results, applied in 132 biotechnology industries with more than three years of existence.

Bakar and Ahmad’s (2010) scale: the authors measured PIP with a scale adapted from O’Regan and Ghobadian (2004), Ulusoy (2005), Heidt (2008), and Alegre, Lapiedra, and Chiva (2006). In addition, they used some objective measures, such as the company’s profit, sales, and the number of employees. The research population included 700 SMEs from Malaysia.

Hannachi’s (2015) scale: Hanachi developed a study analyzing the PIP’s measurement scales



developed by Griffin (1996), Hsu and Fang (2009), Alegre et al. (2006), Blindenbach & Ende (2010), and Storey and Easingwood (2009). During the qualitative and quantitative study, the scale was applied empirically in 100 biotechnology industries to test its validity and reliability. The study rejected the language adopted by Alegre et al. (2006) for not considering essential elements such as improving quality and customer satisfaction.

Beyene, Shi & Wu's (2016) scale: The authors developed the scale based on studies by Menguc and Auh (2010) and Wang and Wang (2012). The questionnaire was developed using a 5-point Likert scale, and respondents were asked to compare the PIP with that of the main competitor. Ethiopian SMEs produced 432 responses, analyzed using structural equation modeling.

Yusr et al.'s (2018) scale: The study was conducted with 134 SMEs from Malaysia. The statistical approach used multivariate analysis and the PLS software, reflecting the instrument's validity and reliability.

Mostaghel et al.'s (2019) scale: The scale contained ten indicators applied to 148 Swedish manufacturing SMEs, whose result attested to the reliability of the research questionnaire. The next topic presents the discussion of the results.

## **5. DISCUSSION**

Cooper and Kleinschmidt (1993) and Griffin and Page (1993), among others, have emphasized the importance of considering more than only objective measures in studies on innovation performance. However, researchers analyzing product innovation performance (PIP) continue to focus on a few of these measures (up to four of them), limiting their measurement approach. In studies on SMEs, three factors hinder the exclusive use of objective measures:

- 1) Objective measures do not encompass the product innovation process in a multidimensional way;
- 2) The information necessary to obtain the objective measures may not be available;
- 3) The difficulty in providing the information can lead to a low response rate of the questionnaire.

Tsai (2009) exemplifies the problem of assessing PIP only with financial measures, focusing on sales volume due to its unidimensionality. For the author, this measure does not reflect the element to be assessed because the volume of sales is correlated to the company's size, i.e., larger companies tend to present greater volume.

In this sense, the unidimensional approach to measuring new product performance does not encompass the product innovation process. The exclusive use of objective measures such as financial performance becomes particular to what is measured – for example, profit – and not to what one wants to measure – innovation performance (Cooper & Kleinschmidt, 1995). The OSLO Manual (OECD-EUROSTAT, 1997) also points to possible challenges of seeking financial performance data. One of them is that answers to questions about innovation expenses are among the most difficult and time-consuming to obtain.

This challenge is mainly related to the cost of the answer. Even if a department offers information, the innovation activity may be manifested throughout the organization. Also, expenses with various innovation activities may not be available directly in companies' accounting systems, which would probably take time to be gathered and may reduce response rates the more detailed they are (OECD-EUROSTAT, 1997). Bakar and Hamad (2010) point out that a low response rate may also occur due to the reluctance to share financial data, which is often considered confidential in privately-owned companies such as SMEs.



Therefore, surveys with SMEs should analyze objective measures and, combine, if necessary, financial (sales performance) and non-financial proxies (customer satisfaction). Considering the importance of looking at performance from different perspectives (Bakar & Hamad, 2010) it is important that psychometric scales are used together with objective measure, increasing the reliability of the measure with the assessed construct.

According to Hanachi (2015) and as suggested in the literature review, each model of PIP measurement has its conceptual differences, as well as differences on which items to adopt and how to group them. Therefore, researchers must carefully analyze the scales to be used. Studies with SMEs should use scales developed for SMEs or tested in this research population. Regardless of the scale adopted, PIP researchers must be aware of the diversity of scales and measures to assess the construct, using them adequately to their research goals and problems, which is the main objective of this study.

## 6. FINAL CONSIDERATIONS

The measurement of product innovation performance (PIP) is relevant in research on strategy and innovation management. However, this assessment is challenging due to the lack of standards and the many measures adopted in the literature. This research highlighted these various measures and their use and impact within the scope of SMEs, examining the literature published between 1990 and December 2020 in journals available in the Capes databases. A systematic literature review was conducted, revealing a growing interest of academia on PIP in the context of SMEs. The literature also showed that information has been gathered considering objective measures (with data collected using proxies) and psychometric scales (data collected based on the perception of respondents).

As for objective measures, the literature shows criticisms towards the exclusive use of financial data or measuring profitability to evaluate PIP, a practice that limits the assessment when it comes to SMEs. The literature review observed that studies with SMEs using objective measures encompass sales performance measures and percentage of sales growth due to innovative products. Among the measurement using psychometric scales, the study observed seven scales developed and applied in the literature assessing PIP in the context of SMEs. The analysis allowed us to see differences in the scales' constitution, differences regarding the concept, and how PIP dimensions are grouped. Given the scales' multidimensional and perceptive nature, their adoption in SMEs is promising, overcoming the limitations of the exclusive use of objective measures.

The co-citation analysis method revealed that although studies on innovation performance, new product performance, and PIP emerge from the same research set, the three topics have been developed by referencing different authors, suggesting the adoption of different theoretical directions. In this sense, we suggest future research that broadens the citation analysis on the topic by exploring other databases and performing quantitative analysis with cluster analysis techniques. This would expand the perception portrayed in this study around the different directions taken by studies on new product performance, innovation performance, and PIP.

Finally, further research expanding the database should be carried out to find other psychometric scales that measure PIP. This research contributes to map and gather information in order to perform a meta-analysis in the area.

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