INFORMATION AND TELECOMMUNICATIONS TECHNOLOGIES

IMPACT OF BUSINESS INTELLIGENCE ON THE ECONOMIC GROWTH OF SMALL AND MEDIUM-SIZED ENTERPRISES (SMES): EVIDENCE FROM THE LIMA PLAZA CASE

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Abstract: In a context where digital transformation is a strategic challenge for the sustainability of small and medium-sized enterprises (SMEs), business intelligence (BI) emerges as a key factor in improving decision-making and fostering competitive advantages. This study analyzed the relationship between the implementation of BI solutions and business growth in 525 SMEs located in Lima, Peru. A quantitative, applied, and experimental methodology was used with descriptive and inferential analysis (Spearman Rho and Wilcoxon tests). The results reveal a strong positive correlation (Rho = 0.775, $p < 0.01$) between BI adoption and SME growth. Limitations include the geographic concentration of the sample, which may affect generalizations to other areas of the country. Nevertheless, the findings contribute to the literature by offering empirical evidence of the real-world effects of BI tools in emerging business environments and suggest that digital capabilities should be promoted in micro and small enterprises. Future research is encouraged to expand the scope to other economic sectors and regions.

Key words: Business intelligence; SME; economic; growth
JEL: M1, M2, O3, O4.
DOI: https://doi.org/10.58861/tae.bm.2025.3.06

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Introduction

In today's business world, business intelligence plays a vitally important role both in visualizing an overview and obtaining competitive advantages, and in surviving in such a rigorous and changing market. In this context, the author Al Daabseh et al. (2023) indicated that it is necessary to understand the crucial activities for an appropriate approach to its application. The objective of this study was to determine the prevalence between the implementation of a business intelligence solution and the growth rate of an SME. The authors Ogliastri et al. (2023) considered it important to evaluate and identify the factors that have the greatest influence on the continuity of business operations. To develop the study, the following actions were carried out: descriptive and inferential analyses were generated for all the variables considered in the study, and hypothesis tests were used to determine the relationship between the implementation of a SBI and growth. This study contributed to the scientific literature by collecting various sources, analyzing them, and generating a body of knowledge on the relationship between business intelligence and the business environment. The business growth index was also identified as a key factor for business development. The study also identified variables that require certain conditions to influence business growth. The following hypothesis was considered: The implementation of a business intelligence solution is significantly related to the growth of SMEs. Furthermore, despite technological advances and the availability of data analysis tools, many small and medium-sized enterprises (SMEs) in Metropolitan Lima still exhibit poor economic growth. This raises the central question of this research: How does the implementation of business intelligence solutions significantly influence the growth of SMEs located in the Lima metropolitan area? This question guides the study to find evidence that allows us to establish a relationship between the two.

1. Related Research

Several recent studies have explored the influence of business intelligence (BI) and digital transformation on the performance of small and medium-sized enterprises (SMEs). Al Daabseh et al. (2023) investigated the relationship between BI capabilities and business outcomes in SMEs, concluding that the strategic use of competitive intelligence improves decision-making and boosts organizational growth. The author emphasizes

that BI enables data to be transformed into competitive advantages, especially in highly uncertain environments. Meanwhile, Azevedo and Almeida (2021) designed a course aimed at decision-makers in SMEs to strengthen their digital capabilities. Their study showed that technical training in BI and data analytics facilitates a better digital transition and promotes a culture of evidence-based decision-making. Along the same lines, Lada et al. (2023) identified the key factors for the adoption of artificial intelligence in Malaysian SMEs, highlighting that technological knowledge, perception of usefulness, and environmental pressure are key determinants. The study suggests that BI adoption is influenced by organizational and attitudinal variables.

Diaz and Galdon (2023) developed a group decision-making model based on ambiguous logic and AHP, applied to measuring the level of digital maturity. They concluded that organizations with greater BI use tend to have higher levels of digital maturity, which translates into better adaptive capacity and strategic vision. Mero et al. (2022) addressed agile logic for the implementation of marketing automation software in startups, finding that the use of advanced digital solutions (including BI platforms) accelerates technological adoption and improves alignment with business objectives. Pelekamoyo and Libati (2023) proposed a smart geolocated application for market predictions aimed at SMEs. They concluded that the use of mobile BI tools improves the accuracy of processed information and strengthens real-time data visualization, contributing to more efficient decisions. Kamaruddin et al. (2020) analyzed data visualization-based business solutions for SMEs, demonstrating that these tools improve financial and operational analysis. The study highlights the need to modernize traditional methods with digital solutions that integrate BI.

Authors Lundberg and Oberg (2021) mention that the concept of business intelligence has been integrated into an organization's control systems in the competitive environment, and its functions include identifying and monitoring the various changes in said environment. Hassani and Mosconi (2021) consider that SMEs have financial limitations, are conservative, inflexible, and do not consider innovation. Likewise, Strilets et al. (2022) consider that SMEs are not prepared for new technologies and expectations. Furthermore, barriers were identified that could limit SMEs when implementing new technologies, including a lack of digital capabilities, skilled labor and financial resources, standardization issues, and cybersecurity issues. Cuevas-Vargas et al. (2016) indicated that the identified factors must be related to the company's specific context. The following

factors were identified: year of operation, initial capital, personnel, sector, partnerships, and access to the international market.

Finally, Silva de Mattos et al. (2023) conducted a systematic review of technological transformation in SMEs, focusing on the adoption of emerging technologies and business model innovation. The authors concluded that the effective integration of tools such as BI is essential to strengthen competitiveness, improve adaptation to the environment, and sustain business growth. Overall, the reviewed studies highlight the positive impact of using business intelligence on organizational performance. There is a lack of applied research in the Latin American context, especially with representative samples of formal SMEs in shopping centers. This research aims to fill this gap by providing empirical evidence on a specific segment of Peruvian SMEs with technological growth potential.

2. Methodology

2.1 Population and Study

The target population for this study is made up of small and medium-sized enterprises (SMEs) located in the Lima Plaza in Metropolitan Lima, Peru. These companies operate in diverse sectors such as technology (IT), services, clothing, and crafts, which allows for capturing a diverse range of levels of digitalization, technological adoption, and organizational performance. A total of 525 active SMEs were identified within the shopping center at the time of the study, which constituted the population framework. To ensure the statistical representation of the results, simple probability sampling with a finite population formula was applied. A confidence level of 95% and a margin of error of 5% were established. The formula used was the following:

$$n = \frac{z^2 Npq}{e^2(N-1)+z^2 pq} \qquad (1)$$

n=sample, z=desv , p=prob. (0.5), q=0.5, N=525, e=0.05 máx. Error

Applying the formula, a sample size of 159 SMEs was obtained, allowing for statistical analyses with sufficient inferential power. The selected units of analysis met the following inclusion criteria: (i) Having been in continuous operation for at least one year, (ii) Belonging to one of the four previously defined sectors, and (iii) Voluntarily agreeing to participate through

informed consent. It should be noted that the sample consists exclusively of SMEs located in the Lima Plaza shopping mall, which could limit the study's external validity. Although it allows for controlling for certain contextual variables at the Lima regional level due to the common nature of SMEs, this geographic delimitation restricts the generalization of the results to other areas of Peru. Further studies in various urban and rural contexts are recommended to compare the findings.

2.2 Types of variables

Eight variables were identified for the study:

Dependent Variable. Growth Index (GI): This variable was composed of business development indicators: revenue growth, staff expansion, product diversification, brand consolidation, infrastructure growth, and management improvement.

Main Independent Variable. Business Intelligence Solutions (SBI): This variable was dichotomous (0 = does not implement / 1 = does implement) and refers to the use of technological tools and platforms for data analysis, visualization, report generation, and evidence-based decision-making.

Complementary or Moderating Variables. These variables were used to characterize the companies and evaluate their potential moderating or controlling effect on the main relationship between SBI and CI. The terms ‘business intelligence solution’ (SBI) and ‘business intelligence’ are considered interchangeable, both referring to the set of technological tools and processes that enable the collection, analysis, and visualization of data to support strategic decision-making.

Table 1
Variables, type and scale

Variable	Abreviatura	Tipo	Escala
Business Intelligence Solution	SBI	Qualitative	Nominal
Growth Rate	IC	Quantitative	Ratio
Years of Operation	AO	Quantitative	Ratio
Initial Capital	CI	Qualitative	Nominal
Amount of Personnel	CP	Qualitative	Ratio
Industry	R	Qualitative	Nominal
Partner CC	SCC	Qualitative	Nominal
Activities Abroad	AE	Qualitative	Nominal

Source: The authors

For the study, an instrument was used to collect data using specific questions and according to the context of the variables under study. These questions are necessary for statistical calculations and obtaining results. To validate the instrument, Cronbach's alpha coefficient was calculated, obtaining a value of 0.84, indicating a high level of reliability. The authors Tavakol y Dennick (2011) specified that it is a statistical measure used to evaluate the internal reliability of a set of questions. The study was developed in an applied way, the authors González and Rojas (2020) specified that the applied type of study emphasizes the theoretical framework and with this, theories or updates to what was presented can be formulated. Likewise, according to the authors Hernández-Sampieri and Mendoza (2018), the applied type study aims to incorporate new knowledge and grow scientific understanding. The study was developed with an experimental design, and a quantitative approach.

3. Results

3.1 Data organization

Data analysis was carried out in two fundamental stages. The first consisted of preliminary information processing. Authors Romero et al. (2022) argue that adequate structuring of the database is essential to ensure the internal validity of the study. The second stage included statistical analysis, applying descriptive and inferential tests. This phase incorporated nonparametric tests such as Spearman's correlation and the Wilcoxon test, which are appropriate for non-normal data and distributions, as proposed by Tavakol and Dennick (2011) in studies that seek to guarantee the reliability of measurements. Furthermore, scientific rigor is not limited to technical or statistical aspects but must be accompanied by fundamental ethical principles. In this sense, Hirsch and Navia (2018) emphasize that all research must respect the principles of responsibility, confidentiality, informed consent, and accuracy of sources. Toro et al. (2023) identified specific ethical challenges in the Latin American context, such as the need to strengthen institutional capacities. Finally, Gamboa-Bernal (2024) highlighted the relevance of bioethics in scientific research, proposing an approach that integrates human rights and social justice as fundamental pillars for ethical conduct in research.

The results were processed and analyzed using the SPSS tool, which is precise for the analysis of data and complex processes. Thus, descriptive and inferential results were obtained, with correlations generated using the Spearman's Rho test. Osada et al. (2021) emphasize the importance of establishing correlations between variables to identify causes and trends related to a specific topic. Similarly, Palella and Martins (2006) indicate that relevant variables are those that guide the development of a study, but they depend greatly on the environment where it was executed and the way in which the data were obtained. In this sense, it is specified that it is a nonparametric test with abnormal distribution. Likewise, the Kolmogorov-Smirnov normality test was considered, which was indicated by Landa and Arriaga (2017) to verify whether the sample scores do not follow a normal distribution, proceeding to be considered a nonparametric test. Authors Lee and Jeong (2016) specified that it allows for the identification of significant deviations from the normal distribution. The results indicated that they did not meet the assumption of normality, so nonparametric statistical tests such as Spearman and Wilcoxon were used for inferential analysis.

Table 2
Normality test

	Kolmogorov-Smirnov Estadistico	gl	Sig.
SBI	,445	159	,000
Indice	,219	159	,000

Source: The authors, SPSS Output

Table 2 presents the results obtained using the Kolmogorov-Smirnov normality test, considering the variables: SBI and CI. The p-value was = 0.000 < α = 0.05. Furthermore, a normal distribution was not obtained, so the Spearman correlation coefficient (nonparametric) was used, which is recommended by Lamb et al. (2017).

3.2 Descriptive results

Authors Torrico et al. (2018) specify that descriptive statistics allow a data set to be described and managed to facilitate the analysis of the results obtained from the application of the instruments. The study was conducted with data from a sample of 159 SMEs. To identify descriptive results, 5 reference variables were used: SBI, AO, IC, R and SCC.

Table 3
Results SBI

		Frecuencia	%	% valido	% acumulado
Válido	0	47	29,6	29,6	29,6
	1	112	70,4	70,4	100,0
	Total	159	100,0	100,0	

Source: The authors, SPSS Output

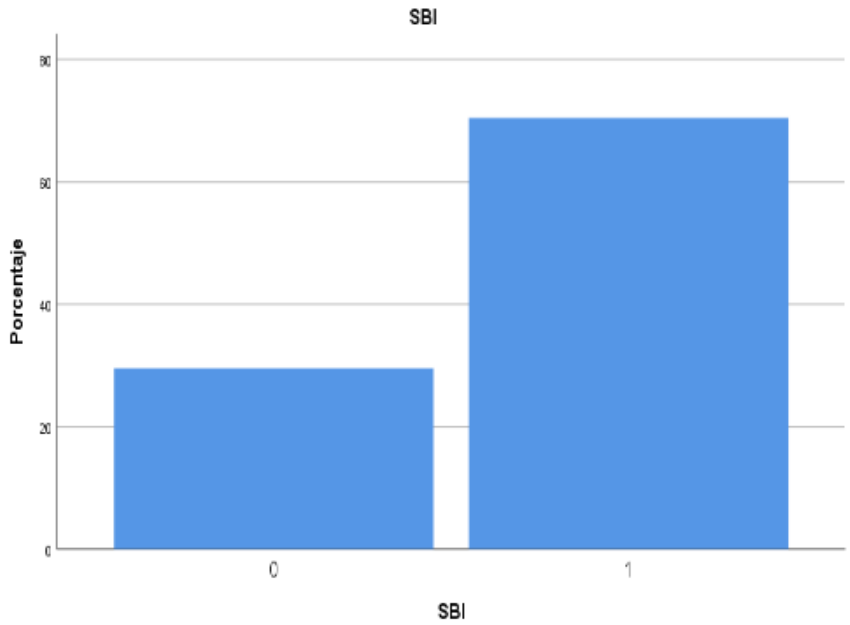

Figure 1. Results SBI
Source: The authors, SPSS Output

Table 3 shows results obtained for the SBI variable, showing that 112 SMEs (70.4%) had implemented a business intelligence solution, while 47 SMEs (29.6%) stated that they had not. The total was 159 SMEs (100%).

Table 4
Results AO

		Frecuencia	%	% valido	% acumulado
Válido	1	46	28,9	28,9	28,9
	2	32	20,1	20,1	49,1
	3	1	,6	,6*	49,7
	4	9	5,7	5,7	55,3
	5	34	21,4	21,4	76,7
	6	26	16,4	16,4	93,1
	10	11	6,9	6,9	100,0
	Total	159	100,0	100,0	

Source: The authors, SPSS Output

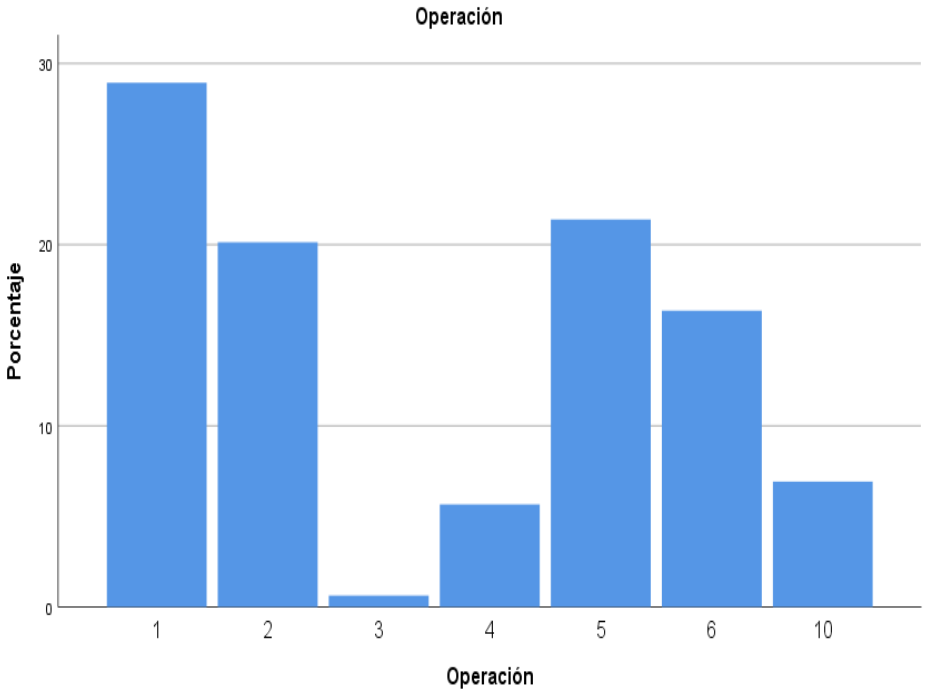

Figure 2. Results AO
Source: The authors, SPSS Output

Table 4 presents results for the variable AO, showing that the largest number was 46 SMEs (28.9%), which had been in commercial operation for 1 year, and the smallest number was 1 SME (0.6%), which had been in commercial operation for 3 years. The total was 159 SMEs (100%).

Table 5
Results IC

		Frecuencia	%	% valido	% acumulado
Válido	0	24	15,1	15,1	15,1
	1	4	2,5	2,5	17,6
	2	33	20,8	20,8	38,4
	3	30	18,9	18,9	57,2
	4	10	6,3	6,3	63,5
	5	56	35,2	35,2	98,7
	6	2	1,3	1,3	100,0
	Total	159	100,0	100,0	

Source: The authors, SPSS Output

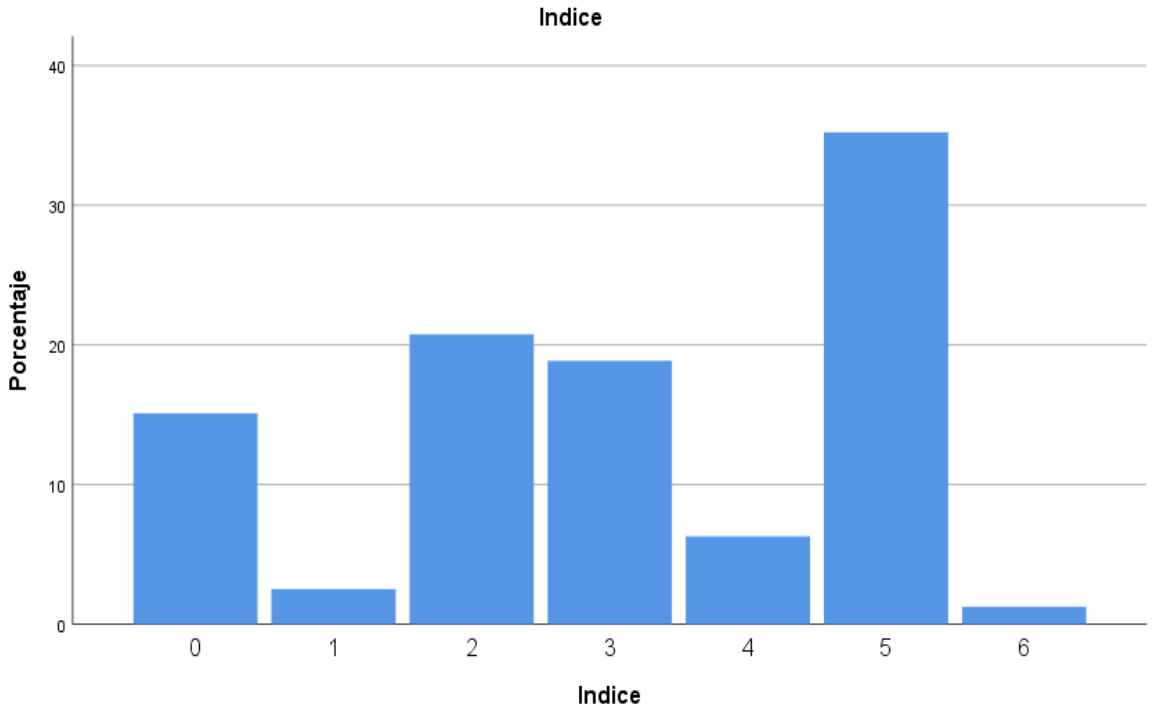

Figure 3. Results IC
Source: The authors, SPSS Output

Table 5 presented descriptive results of the IC variable, where it was found that the largest number was 56 SMEs (35.2%), which have an IC of 5 and the smallest number was 2 SMEs (1.3%), which have an IC of 6. Likewise, it was identified that 26 SMEs (15.1%) have an IC of 0. The total was 159 SMEs (100%).

Table 6
Results R

		Frecuencia	%	% valido	% acumulado
Válido	Artesanía	28	17,6	17,6	17,6
	Ropa	34	21,4	21,4	39,0
	Servicios	17	10,7	10,7	49,7
	TI	80	50,3	50,3	100,0
	Total	159	100,0	100,0	

Source: The authors, SPSS Output

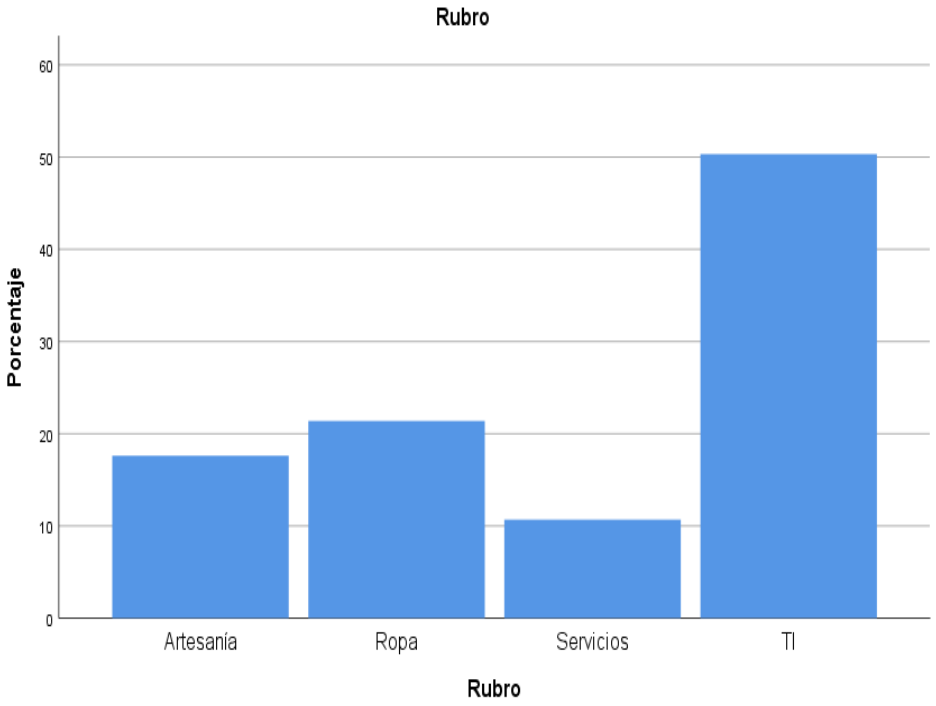

Figure 4. Resultads R
Source: The authors, SPSS Output

Table 6 presented descriptive results of the variable sector (R), where it was found that the largest number is 80 SMEs (53.3%), which are in the IT sector and the smallest number is 17 SMEs (10.7%), which are in the services sector. The total sample under study was 159 SMEs (100%).

Table 7
Results SCC

		Frecuencia	%	% valido	% acumulado
Válido	0	54	34,0	34,0	34,0
	1	105	66,0	66,0	100,0
	Total	159	100,0	100,0	

Source: The authors, SPSS Output

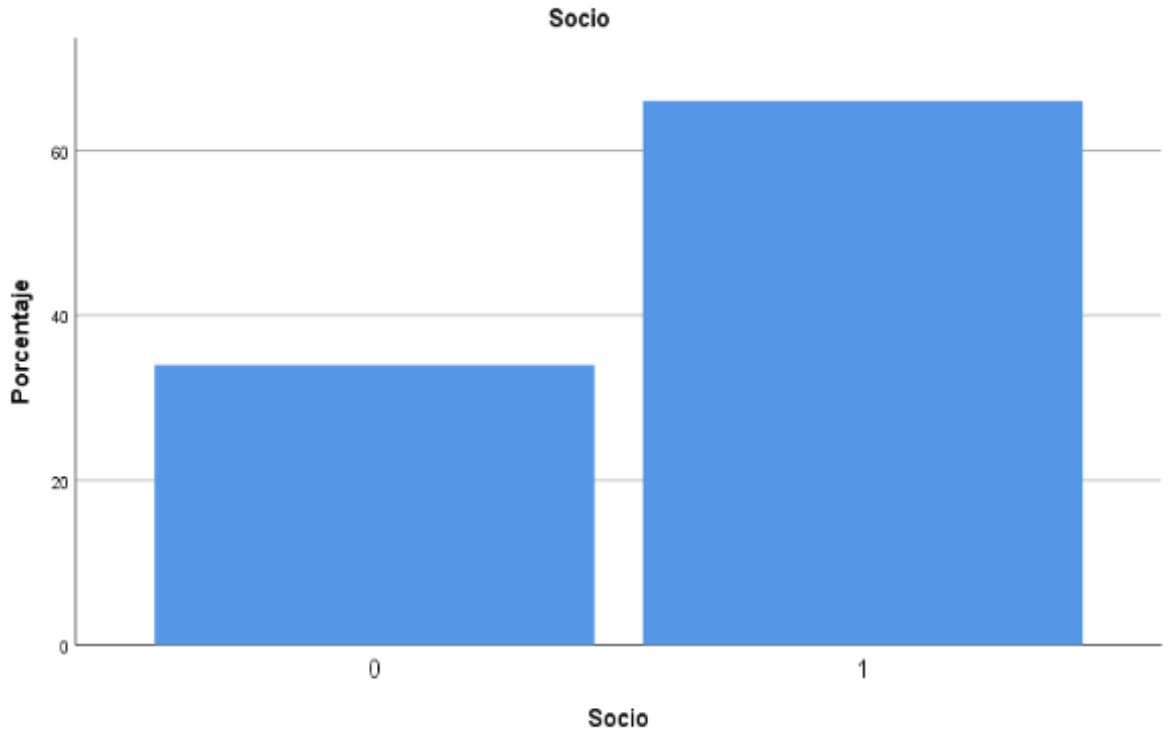

Figure 5. Resultados SCC
Source: The authors, SPSS Output

Table 7 presents descriptive results for the variable "chamber of commerce member" (CCM), showing that 105 SMEs (66.0%) belong to the chamber of commerce, and 54 SMEs (34.0%) state that they do not. The total sample size studied was 159 SMEs (100%).

The sample consisted of 159 companies located in the Lima Plaza gallery, with sectoral diversity represented mainly in the technology (IT), services, clothing, and crafts sectors. Regarding company age, 42.8% reported being between 5 and 10 years old, while 33.1% reported less than 5 years, demonstrating a prevalence of young or emerging businesses. In terms of initial capital, 55.3% had investments of up to S/10,000, suggesting a predominance of micro-business-based ventures.

Regarding the adoption of business intelligence (BI) solutions, it was found that 70.4% of the surveyed SMEs implemented some type of BI tool, ranging from advanced spreadsheets to commercial platforms such as Power BI, Tableau, or custom developments. Of these companies, 35.2% had a growth index of 5 out of 6, indicating outstanding business performance. This trend supports the hypothesis of a potential positive association between BI use and organizational growth. Regarding the growth index (GI), a positive

skewed distribution was observed. The majority of companies (61.6%) had scores between 4 and 6, reflecting a favorable perception of business expansion and sustainability, particularly in areas such as increased sales, employee recruitment, process digitization, and brand recognition. Regarding staff size, 67.9% of companies operate with fewer than 10 employees, while only 4.4% have more than 50 employees. This structure confirms that Lima Plaza's business network is mostly made up of micro and small businesses, with limited scaling capabilities but with growth potential through technological innovation.

Another relevant finding was the limited institutional ties: only 38.4% of companies are affiliated with a chamber of commerce or trade association, which could limit access to support programs, business training, or financing. Furthermore, only 9.4% reported participating in international fairs or export activities, reflecting a low level of internationalization.

Finally, the analysis identified a gap in technical training in business intelligence, as more than 40% of respondents indicated they lack formal knowledge in the strategic use of data. This represents a key opportunity for training, incubation, and competitive development programs.

3.3 Inferencial results

Procedures for Hypothesis Testing

To test the hypothesis, it was necessary to verify whether there was a relationship between an SBI and the CI. In this regard, the analysis was resolved by calculating the values of the aforementioned variables and performing a test on them, which was performed using a statistical measure to identify whether there were significant differences between the variables. Likewise, the Kolmogorov-Smirnov normality test determined that the data did not have a normal distribution; therefore, the Spearman correlation was used to determine the relationship between the variables and the nonparametric Wilcoxon statistical measure.

Hypothesis Formulation

H0: There is no relationship, H1: There is a relationship

Statistical Significance Level and Confidence Level

The Kolmogorov-Smirnov normality test determined that a p-value of $0.000 < \alpha = 0.05$ for the SBI and IC variables. The results showed that the distribution was not normal. Resolving this test, the results obtained are:

Table 8
*Cross table SBI * IC*

		Indice							Total
		0	1	2	3	4	5	6	
SBI	0	24	4	19	0	0	0	0	47
	1	0	0	14	30	10	56	2	112
Total		24	4	33	30	10	56	2	159

Source: The authors, SPSS Output

Table 9
Wilcoxon nonparametric test

	SBI * IC
Z	-1,886[b]
Sig.	.045

Source: The authors, SPSS Output

The results confirm that the Wilcoxon statistical test yielded a significance level of 0.045, which is <0.05. This test confirms that the null hypothesis is rejected and the alternative hypothesis is accepted. In this sense, it is confirmed that there is indeed a relationship between the implementation of a SBI and the CI.

Table 10
Correlation between SBI – IC variables

			SBI	Indice
Rho de Spearman	SBI	Coef correl	1,000	,775
		Sig. (bilateral)	.	,000
		N	159	159
	Índice	Coef correl	,775	1,000
		Sig. (bilateral)	,000	.
		N	159	159

Source: The authors, SPSS Output

Spearman's rho test and the correlation coefficient identify the degree of relationship between the implementation of a SBI and CI. It was found that $p = 0.000 < \alpha = 0.01$, thus rejecting the null hypothesis and accepting the alternative hypothesis. A rho value of 0.775 indicates a strong positive correlation. Furthermore, a significant relationship between SBI implementation and CI is confirmed. In other words, the implementation of a business intelligence solution in SMEs at the Lima Plaza gallery will increase the growth rate of SMEs at the Lima Plaza gallery.

4. Discussion

The results obtained in this study reveal a significant and positive correlation between the implementation of business intelligence (BI) solutions and the growth index (GI) in the SMEs analyzed. This relationship was demonstrated by the Spearman correlation coefficient (Rho = 0.775, $p < 0.01$) as well as the nonparametric Wilcoxon test ($p = 0.045$), which reinforces the hypothesis regarding the favorable impact of BI on business performance.

These findings are consistent with previous studies such as that of Al Daabseh et al. (2023), which highlights that BI capabilities, when well aligned with strategic objectives, allow for the generation of actionable information that drives competitive advantage. Likewise, Azevedo and Almeida (2021) conclude that the effective adoption of BI depends on the training of decision-making personnel, a critical variable also observed in this study, where many companies without BI exhibit low growth and weak institutional connection. Regarding the company profile, it was observed that 70.4% of the surveyed SMEs have implemented BI solutions, while 35.2% of them have a growth index of 5 out of 6, indicating favorable business performance.

The economic sector also had an impact: companies dedicated to the technology (IT) sector, which represented 50.3% of the sample, had a higher proportion of BI adoption and a higher growth rate. This pattern suggests that affinity with technology is a factor facilitating adoption. Similar results were reported by Lada et al. (2023), who found that the technological environment and prior knowledge influence the decision to implement advanced analytics tools. However, barriers to BI implementation were also evident. Companies that have not adopted these solutions reported financial limitations, poor training, and limited membership in chambers of commerce, factors that have also been identified as obstacles in the literature (Pelekamoyo & Libati, 2023). This highlights the need for public policies aimed at strengthening technological access and digital literacy to reduce the competitive gap between digitalized and non-digitalized companies.

Regarding the analysis of complementary variables such as initial capital, years of operation, and international participation, it was found that companies with more than five years of experience and with higher-than-average initial capital have a higher adoption of BI. This pattern corroborates what Díaz and Galdon (2023) indicated, who assert that companies with greater structural maturity are more likely to invest in digital transformation. Finally, it is noteworthy that the growth index used as a dependent variable allows for the evaluation of not only sales or personnel expansion but also the operational improvement perceived by business owners. Therefore, the positive correlation between SBI and IC provides relevant evidence on the real usefulness of business intelligence in emerging business environments.

5. Conclusions

Data analysis required statistical processing and analysis. The Kolmogorov-Smirnov normality test was used, and the Spearman's Rho test was used to correlate variables. The descriptive results for the SBI variable are presented in terms of 112 SMEs (70.4%) that implemented a SBI and 47 SMEs (29.6%) that did not. For the CI variable, the highest number was 56 SMEs (35.2%), with a CI of 5, and the lowest was 2 SMEs (1.3%), with a CI of 6. Likewise, 26 SMEs (15.1%) were identified as having a CI of 0. The total was 159 SMEs (100%). The Wilcoxon statistical test yielded results with a significance level of 0.045, <0.05. In this sense, it is confirmed that there is a relationship between the implementation of a SBI and the CI. The results obtained with the Spearman's Rho test were p = 0.000; the null hypothesis was rejected, and the alternative hypothesis was accepted. The value of Rho = 0.775 indicates a strong positive correlation. In this sense, it is confirmed that there is a highly significant relationship between the implementation of a SBI and the CI. The study confirms that the implementation of a business intelligence solution in the SMEs of the Lima Plaza gallery will increase the growth rate of SMEs in the Lima Plaza gallery.

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ISSN 0861 - 6604
ISSN 2534 - 8396

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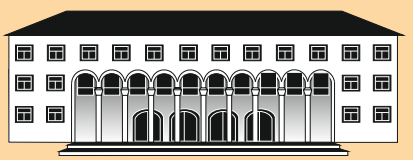

PUBLISHED BY
D. A. TSENOV ACADEMY
OF ECONOMICS - SVISHTOV

3/2025

BUSINESS management 3/2025

The printing of the issue 3-2025 is funded with a grand from the Scientific Research Fund, Contract KP-06-NP6/29/04.12.2024 by the competition "Bulgarian Scientific Periodicals - 2025".

Submitted for publishinq on 16.09.2025, published on 18.09.2025,
format 70x100/16, total print 80

BUSINESS management

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Year XXXV * Book 3, 2025

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