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RESEARCH PAPER

Digital transformation in market research in Peru: a quantitative analysis of process optimization, technological innovation, and customer empowerment

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ABSTRACT

Goal: This study explores the impact of digital transformation on market research companies in Huancayo, Peru, focusing on three critical dimensions: process optimization, technological innovation, and customer empowerment. The objective is to understand how these elements collectively enhance competitiveness and organizational adaptability in dynamic and resource-constrained environments.

Design / Methodology / Approach: A quantitative, cross-sectional design was employed, utilizing multiple regression and correlation analyses. Data were collected from 30 companies, representing the majority of market research firms in Huancayo, where the total population does not exceed 50. The methodological framework incorporated structured surveys and Ordinary Least Squares (OLS) estimations, with robust validation procedures and adherence to statistical assumptions. A power analysis based on Cohen's criteria confirmed a high level of statistical power despite the modest sample size.

Results: The findings reveal that 88.7% of the variability in process optimization is explained by independent variables, with technological innovation showing the strongest impact (coefficient: 0.743, $p<0.001$). Customer empowerment, with the highest mean (17.87) and a strong correlation to digital technologies (0.859), underscores the shift towards customer-centric strategies.

Limitations of the Investigation: The cross-sectional nature of the study restricts causal inference, and the limited sample size—though representative of the local population—may reduce generalizability and sensitivity to subtle effects. Future studies should employ longitudinal designs and larger samples across multiple regions to validate and extend these results.

Practical Implications: The study underscores the importance of integrating digital tools to enhance operational efficiency, foster continuous innovation, and strengthen client engagement. For firms in emerging markets like Peru, particularly in mid-sized cities such as Huancayo, cultivating a culture of digital adaptability and investing in human capital are essential steps toward sustainable competitiveness in the digital era.

Originality / Value: By analyzing digital transformation through a multi-dimensional lens, this research contributes to the literature by providing actionable insights into leveraging technology for operational efficiency and customer empowerment in a developing economy context.

Keywords: Digital transformation; Process optimization; Technological innovations; Customer empowerment.

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1 INTRODUCTION

We live in an era of rapid and continuous technological change that is reshaping how organizations operate. Digital transformation has shifted from being a discretionary initiative to becoming an essential strategic pillar for firms across industries (Kraus *et al.*, 2021; Omol, 2024). This paradigm shift is especially impactful for companies in the field of market research, where adaptability and innovation are indispensable for success. It holds particular significance even in emerging markets such as Peru, as firms must embrace new technologies to remain competitive in a dynamic environment.

Digital transformation extends beyond the mere adoption of new tools, requiring a fundamental reengineering of business processes. (Gouveia *et al.*, 2024) emphasize that true digital transformation involves a comprehensive restructuring of internal workflows and practices, not just the implementation of isolated technologies. Acting as a catalyst for organizational change, such transformation accelerates process improvements and fosters continuous innovation within firms (Aldoseri *et al.*, 2024). As a result, organizations achieve greater operational efficiency while also empowering customers with more choices and enabling more informed decision-making (Martínez-Peláez *et al.*, 2024). This holistic approach underscores that technology-driven change must be accompanied by process optimization and innovation to fully realize its benefits.

The onset of the COVID-19 pandemic marked a critical inflection point in the trajectory of digital transformation, compelling organizations across sectors to adopt digital solutions with unprecedented urgency (Sheng *et al.*, 2021). For numerous firms—particularly those dependent on traditional, face-to-face methodologies—this shift was not merely a strategic enhancement but a necessary response for operational continuity (Reuschl *et al.*, 2022). Parallel developments were observed in other domains, such as public higher education in Peru, where the advancement of digital competencies among faculty members notably improved teaching performance (Raqui-Ramirez *et al.*, 2025). The imposition of strict lockdowns and public health protocols severely restricted in-person interactions, directly impeding conventional data collection methods in market research (Flores-Vilcapoma *et al.*, 2022). In this context, organizations that transitioned promptly to digital platforms were distinctly better equipped to sustain their activities and navigate the disruption caused by the crisis.

In response to pandemic-related restrictions, market research firms pivoted to digital solutions to sustain their work. Key among these were advanced data analytics and online survey platforms, which allowed companies to continue gathering consumer insights despite limited physical contact (Bag *et al.*, 2023; Sheng *et al.*, 2021). This rapid digital pivot not only preserved business continuity but also yielded unexpectedly positive outcomes. Many firms achieved unprecedented levels of process optimization—significantly reducing costs and turnaround times—through these initiatives (Schneider & Kokshagina, 2021). At the same time, clients benefited from more accurate and personalized data, which enabled better-informed decision-making (Aldoseri *et al.*, 2023). The experience of adapting under duress revealed that digital transformation could drive performance improvements beyond mere crisis management, delivering efficiency gains and superior service quality even in turbulent conditions.

Beyond these immediate adjustments, the broader integration of cutting-edge technologies has further transformed the market research industry. Tools such as big data analytics, artificial intelligence, and modern data management systems now enable deeper insights through advanced analytics and predictive modeling, while also automating many routine processes. These capabilities have yielded substantial improvements in operational efficiency and data management for firms that embrace them (Jagatheesaperumal *et al.*, 2022). In practice, this means that market research companies can process larger volumes of data more quickly and accurately, uncover patterns and trends with greater precision, and streamline their internal workflows. By leveraging such technologies, firms not only improve how they handle information but also enhance the quality and speed of the insights delivered to their clients.

Importantly, digital transformation produces multifaceted benefits that span both internal operations and external stakeholder relationships. Recent studies indicate that companies adopting digital platforms report more streamlined processes and improved client relationship management (Lin & Lin, 2023; Wielgos *et al.*, 2021). By eliminating inefficiencies, these digital systems also enable faster, data-driven decision-making, thus enhancing organizational agility (Sayyadi, 2024). At the same time, digital platforms allow more fluid communication with customers and suppliers, fostering greater trust as clients feel understood and valued (L. Yang *et al.*, 2021). Furthermore, the ability to tailor products and services to customer preferences through these technologies has been shown to boost market responsiveness and strengthen customer loyalty (Rane, 2023). Collectively, these improvements illustrate how technology-enabled transformations can make firms more responsive internally while also deepening engagement and confidence among their clientele.

Equally important is the way digital transformation has redefined the role of the customer, who has transitioned from a passive recipient of goods and services to an active participant in the co-creation of value (Bresciani *et al.*, 2021; Lang, 2021; Li *et al.*, 2023). The proliferation of interactive digital platforms has enabled consumers to engage directly with firms, providing feedback, shaping product offerings, and even customizing services according to their preferences. This heightened level of involvement enhances the sense of empowerment and recognition among customers, fostering stronger emotional connections with brands. As a result, organizations that embrace these digital interactions often experience increased trust, loyalty, and customer retention (Z. Yang *et al.*, 2024), reinforcing the strategic value of placing consumers at the center of digital transformation initiatives.

Despite these global advances, the specific effects of digital transformation on the market research industry within developing economies remain insufficiently examined. Contextual elements such as technological infrastructure, organizational culture, and institutional maturity play a decisive role in shaping the success or limitations of digital initiatives in these settings. Evidence from Peruvian enterprises underscores the need to explore how these dynamics unfold in real-world applications (Espina-Romero *et al.*, 2025). Addressing this gap, the present study investigates the implications of digital transformation on market research firms located in Huancayo, Peru. Focusing on three interrelated dimensions—process optimization, technological innovation, and customer empowerment—the research aims to understand how these factors contribute to the adaptability and competitiveness of firms operating in an emerging and increasingly digitized market environment (Hotha, 2023). In doing so, this study offers both theoretical contributions and practical guidance for organizations seeking to align with digital economy demands.

2 LITERATURE REVIEW

Digital transformation is widely recognized as a multifaceted phenomenon that drives changes across an organization's operations, technological capabilities, and customer engagement practices. Prior studies have highlighted that successful digital transformation initiatives often simultaneously improve internal process efficiency, foster innovation, and enhance customer experiences (Bresciani *et al.*, 2021; Kraus *et al.*, 2021). In essence, organizations undergoing digital transformation seek to optimize their processes through advanced technologies while also innovating and becoming more customer-centric. Building on these insights, the present study concentrates on three key dimensions of digital transformation – process optimization, technological innovation, and customer empowerment – as the conceptual foundation for examining digital transformation in Peruvian market research firms. Each of these dimensions is reviewed below, linking established theory to the study's focus.

2.1. Process optimization

Process optimization is widely recognized as a core dimension of digital transformation, especially in service-oriented and emerging-market firms where streamlined operations drive competitive advantage. (Daniel Ajiga *et al.*, 2024)describe process optimization as a firm's capability to leverage digital tools to improve the efficiency of data collection, processing, and analysis related to customers, suppliers, and market information. By revamping workflows and embracing data-driven practices, organizations can eliminate bottlenecks and reduce cycle times, keeping the firm agile and responsive to fast-changing demands. Adopting advanced technologies such as big data analytics and intelligent systems is pivotal in this context, as it enables higher precision and speed in processing information. This in turn supports better decision-making and continuous performance improvements (Javaid *et al.*, 2022; Praful Bharadiya, 2023). In short, digital process optimization initiatives create leaner, more responsive operations that enhance internal efficiency and lay the groundwork for innovation and adaptability.

Empirical evidence further underscores that process optimization through digital transformation directly contributes to greater organizational adaptability and competitiveness. For example, integrating technological innovation with process optimization has been shown to bolster firm performance under turbulent conditions during the COVID-19 disruptions, companies that employed smart systems and knowledge management to digitize processes achieved more efficient workflows, lower costs, and improved data reliability, which in turn strengthened decision-making and resilience (Basit *et al.*, 2023). These efficiency gains translate into superior agility, enabling firms to maintain stable operations and quickly adjust to uncertain environments. (Agustian *et al.*, 2023) likewise highlight that enhancing internal processes with digital tools is crucial for improving organizational performance and the capacity to adapt rapidly to competitive and dynamic market changes. Consistently, studies find that digital transformation efforts centered on

process improvement yield significant competitive benefits. Firms that successfully streamline processes via digital technologies not only boost operational efficiency but also strengthen their market position, as reflected in higher innovation, agility, and sustainable competitive advantage (Sui *et al.*, 2024). Such findings reinforce the notion that optimizing processes with digital solutions is a key pathway through which organizations become more efficient, adaptable, and competitively resilient in today's digital economy.

2.2. Technological innovation

Technological innovation is widely recognized as a central driver of digital transformation, reflecting the capacity of organizations to adopt and integrate novel digital tools, systems, and practices that enhance operational capabilities and redefine value creation (Bresciani *et al.*, 2021) highlight that digital transformation operates as a catalyst for innovation across organizational processes, enabling firms to revise their business models, optimize internal operations, and respond more dynamically to market demands. This view is echoed by (Espina-Romero *et al.*, 2025), who emphasize that in Latin American contexts, technological innovation grounded in internal digital competencies substantially improves organizational agility and performance. From a broader theoretical perspective, (Gong & Ribiere, 2021) argue that technological innovation is not merely a component of digital transformation but constitutes its strategic engine, enabling continuous adaptation in environments marked by volatility and complexity. In service industries, in particular, technological innovation plays a critical role in supporting digital service development and delivery, providing firms with the flexibility to personalize customer experiences and introduce new value propositions at scale.

Empirical research further validates the essential role of technological innovation in enabling successful digital transformation, particularly in emerging economies. (Zhao *et al.*, 2024), drawing on firm-level evidence from China, demonstrate that investments in digital transformation significantly enhance innovation capabilities, especially when firms strategically align their technology adoption with long-term innovation goals. Likewise, (Han *et al.*, 2025) find that the integration of digital technologies facilitates organizational learning, thereby reinforcing firms' capacity for incremental and radical innovation. In the context of Latin America, (Espina-Romero *et al.*, 2025) report that firms which actively develop digital infrastructure and invest in technological training are better equipped to implement transformative innovations and remain competitive. Complementing these findings, (Matarazzo *et al.*, 2021) highlight those dynamic capabilities, such as technological sensing and reconfiguration, are indispensable for translating digital investments into sustained innovation outcomes. Collectively, these contributions confirm that technological innovation is not a peripheral effect but a core mechanism through which digital transformation delivers strategic and operational benefits. For organizations navigating rapid technological shifts, particularly in service-intensive and resource-constrained environments, fostering a culture of technological innovation remains vital to realizing the full impact of digital transformation.

2.3. Customer empowerment

Customer empowerment refers to the strategic involvement of consumers in shaping the value they receive, allowing them to actively participate in the design, customization, and delivery of services. In the context of digital transformation, especially within service industries, consumers have transitioned from passive recipients to co-creators of value. Digital platforms enable interactive and personalized experiences, fostering deeper engagement and greater responsiveness from firms. As (Lamberton & Stephen, 2016) argue, digital tools have increased customers' ability to influence offerings, giving rise to more informed and assertive users. This aligns with the service-dominant logic proposed by (Vargo & Lusch, 2004), which highlights the centrality of customer participation in value creation. In rapidly digitizing markets such as those in Latin America, empowerment is reinforced by the adoption of participatory technologies, self-service systems, and feedback mechanisms that support customer-driven innovation and service adaptation.

Empirical studies confirm that empowerment generates tangible benefits for both consumers and firms. (Auh *et al.*, 2019) demonstrate that involving customers in service processes enhances satisfaction and loyalty, leading to improved performance. (Fuchs & Schreier, 2011) further show that customer participation in product design increases perceived value and reduces innovation risks. (Muneer *et al.*, 2024) extend this notion internally, emphasizing that empowered employees—those equipped with autonomy and digital tools—facilitate more effective and personalized customer interactions. (Veile *et al.*, 2022) contextualize these dynamics within broader digital transformation efforts, noting that companies that engage customers through digital co-creation platforms gain stronger customer relationships and competitive differentiation. Together, these

contributions establish customer empowerment as both a consequence and catalyst of digital transformation, essential for firms operating in dynamic and service-intensive environments.

2.4. Digital transformation

Digital transformation refers to the integration of digital technologies into all areas of an organization, fundamentally reshaping operations, business models, and value delivery, while fostering a culture of innovation and adaptability (Warner & Wäger, 2019). Closely tied to this is the notion of the digital economy, defined as an economy increasingly driven by data, digital platforms, and information and communication technologies (ICT), where connectivity and digitization become central to production and consumption dynamics (Zhang *et al.*, 2022). While most international literature addresses digital transformation from structural or technological standpoints, there is a growing need to adopt approaches that reflect the particularities of Latin American contexts, where institutional, social, and economic disparities shape digital adoption and impact.

In this regard, (Pereira de Moraes *et al.*, 2018) highlight the significance of critically appropriating digital technologies within institutional settings, viewing them not merely as tools for efficiency but as means for producing new subjectivities and enabling inclusive social development. Similarly, (Barbosa & Saisse, 2019) propose a sociotechnical framework for managing digital transformation, emphasizing stakeholder engagement and the adaptation of agile methodologies to complex, dynamic organizational realities. From a business model perspective, (Nakano, 2019) demonstrates that in mature digital environments, sustainable strategies do not necessarily align with dominant technologies, but rather emerge from a nuanced understanding of consumer behavior and market segmentation. These perspectives are particularly pertinent for Peru, where digital transformation in market research firms must address not only technological infrastructure, but also organizational culture, human capital, and the distinctive attributes of the local ecosystem.

3 METHODOLOGY

3.1. Sample

The present study adopts a quantitative, cross-sectional, and non-experimental design. A convenience sample of 30 market research companies based in Huancayo, Peru, was selected due to their recognized expertise and track record in the sector. This methodological approach enables the collection of relevant data to evaluate key elements of organizational performance, ensuring reliability and applicability in similar contexts.

To ensure the accuracy and reliability of the information, a structured questionnaire was used as a survey tool. The data collection instrument underwent a preliminary validation process through pilot testing with a small group, which allowed for adjustment and refinement of the items to ensure their clarity and relevance. In addition, the personnel responsible for administering the questionnaire received training to standardize the procedure and minimize bias. This training was complemented by quality controls during data entry and analysis, which strengthened the statistical verification process and ensured the integrity of the findings.

Table 1 - Main variables

Variable	Dimension	Indicator
Market research	Process optimization (PO)	Utility
		Effectiveness
		Quality
		Measurement
		Customer acceptance and
	Technological innovations (TI)	Confidence
		Security
		Expectations
		Effectiveness
	Customer empowerment (CE)	Confidence
		Guarantee
		Quality
		Requirement
		Experience
Digital transformation	Digital technology	Implementation
		Barriers

		New technology
		Access
	Technological innovation	Innovation strategy
		New product success
		Generated ideas
		Innovation projects
		Benefits
	Digital economy	Average investment
		Demand
		Infrastructure
		Products
		Productivity

Table 1 presents a clear conceptual structure that classifies the main variables involved in digital transformation within the field of market research. Two major categories are identified: market research and digital transformation, each with key dimensions and corresponding indicators. Within market research, process optimization (PO) is assessed through indicators such as utility, effectiveness, quality, and measurement, highlighting the importance of improving operational efficiency and customer satisfaction. The technological innovations (TI) dimension focuses on confidence, security, and expectations, emphasizing the role of technology in enhancing processes and creating value. Additionally, customer empowerment (CE) is analyzed through confidence, quality assurance, and experience, underscoring the shift of consumers towards a more participatory role in the co-creation of products and services.

On the other hand, digital transformation is broken down into three fundamental dimensions: digital technology, technological innovation, and digital economy. Digital technology addresses barriers, implementation, and access to new technologies, reflecting both the challenges and opportunities of digital adoption. Technological innovation is measured through innovation strategies, new product success, and innovative projects, highlighting the need to foster technological development within companies. Finally, digital economy considers factors such as average investment, demand, infrastructure, and productivity, providing a means to evaluate the impact of digitalization on business competitiveness. Taken together, this table offers a comprehensive framework for analyzing how digital transformation influences process optimization, the adoption of advanced technologies, and customer interactions in an evolving business environment.

Although Table 1 presents the indicators associated with each dimension, their operationalization was based on a comprehensive literature review adapted to the Huancayo context. Each indicator was conceptually defined and subsequently translated into measurable variables through validated scales and item sets. For example, the "Utility" indicator within process optimization was assessed using items that measured the perception of process efficiency and relevance, while indicators such as "Confidence" in the dimensions of technological innovation and customer empowerment were measured using Likert-type scales that assessed the level of security and reliability perceived by participants. Furthermore, these instruments were pilot-tested to confirm their clarity, internal consistency, and validity, which supports the robustness of the measurement procedure adopted in the study.

3.2. Research hypotheses

Drawing upon the theoretical framework and the empirical evidence presented in the preceding sections, this study formulates a set of hypotheses aimed at examining the influence of digital transformation on market research companies operating in Huancayo, Peru. These hypotheses are intended to test the relationships between process optimization, technological innovation, customer empowerment, and the digital economy within the context of digital transformation.

H1: Digital transformation has a significant impact on process optimization, technological innovation, and customer empowerment in market research companies in Huancayo, Peru.

H1a: Technological innovation has a positive and significant impact on process optimization in market research companies in Huancayo, Peru.

H1b: Technological innovation has a positive and significant impact on customer empowerment in market research companies in Huancayo, Peru.

H1c: The digital economy has a positive and significant impact on process optimization in market research companies in Huancayo, Peru.

H1d: The digital economy has a positive and significant impact on customer empowerment in market research companies in Huancayo, Peru.

3.2.1 Regression models

For the results, a multiple linear regression model and correlation analysis are used to determine the impact that exists between the dimensions of the variables, as well as their statistical significance. For this, the estimation method will be ordinary least squares, since it is the method that is very important to make a consistent estimate if it meets the conventional assumptions

$$y_i = \beta_{i,0} + \beta_{i,1}x_1 + \beta_{i,2}x_2 + \beta_{i,3}x_3 + \varepsilon_i, \quad \text{for } i = PO, TI, CE \tag{1}$$

Where
y_{PO}: Process optimization
y_{TI}: Technological innovations
y_{CE}: Customer empowerment
x_1: Digital technology
x_2: Technological innovation
x_3: Digital economy
ε_i: Disturbance term, $\varepsilon_i \sim iid(0, \sigma^2)$

The formula shown shows the estimation by Ordinary Least Square (OLS), which is to minimize the Sum of Squared Residuals (SSR) to obtain unbiased, efficient and consistent estimates, with the objective of reducing the difference between the observed dependent variable and the estimated variable.

$$SSR = (y_i^T - \beta_i^T X^T)(y_i - X\beta_i) \tag{2}$$

Where $\beta_i = [\beta_{i,0}, \beta_{i,1}, \beta_{i,2}, \beta_{i,3}]^T$ and $X = [1, x_1, x_2, x_3]$.

$$\beta_i = (X^T X)^{-1} X^T y_i \tag{3}$$

The choice of multiple linear regression is based on the need to quantify and adjust the influence of each predictor, which is essential to answering the research questions posed. Correlation analysis was also used to evaluate the strength and direction of the relationships between the different dimensions, providing a complementary perspective that facilitates the interpretation of the findings and the detection of significant interrelationships.

These methods were considered the most appropriate for the data and objectives of the study, as they allow a comprehensive approach to the complexity of the existing relationships in a setting with limited resources and a small sample. Furthermore, sufficient degrees of freedom were ensured, as 30 observations and three independent variables provide 26 degrees of freedom, which is adequate for the analyses performed.

3.3. Power analysis

To assess the study's statistical power, the approach proposed by Cohen was adopted, providing a robust technical framework for interpreting the results obtained from the regression models. First, the effect size was estimated using the formula:

$$f^2 = \frac{R^2}{(1 - R^2)}$$

where R^2 represents the proportion of variance explained by the model. According to (Cohen, 1992), effect sizes are classified as small ($f^2 = 0.02$), medium ($f^2 = 0.15$), and large ($f^2 = 0.35$). In the present study, the regression model exhibited a considerably high adjusted R^2, resulting in an f^2 value that exceeds the threshold for a large effect. Statistically, this indicates that the model has a high capacity to detect significant differences or relationships through the overall F-test.

The procedure involved applying the above formula to each of the regression models, thereby evaluating the magnitude of the effect in the context of the relationship between the independent variables and the dependent variable. This yielded a quantitative estimate that supports the interpretation of the study's power. However, it is important to note that despite the high statistical power indicated by these calculations, the small sample size ($n = 30$) may lead to an overestimation of the effect sizes. Consequently, this analysis is integrated into the methodological framework as

a critical element that, while confirming the internal robustness of the models, calls for caution in generalizing the findings.

4 RESULTS

4.1 Descriptive statistics

Table 2 - Descriptive statistics

Stats	Process optimization	Technological innovations	Customer empowerment	Digital technology	Technological innovation	Digital economy
N	30	30	30	30	30	30
Max	23	15	23	20	23	23
Min	12	8	12	9	12	13
Mean	16.5667	11.5667	17.8667	13.6333	17.1000	16.9333
D	2.5146	1.9772	2.8495	2.6715	2.6826	2.7908
Variance	6.3230	3.9092	8.1195	7.1368	7.1966	7.7885
P50	16	12	18	13.5	17	16.5
Skewness	0.2775	0.2124	0.0368	0.3682	0.0007	0.7086
Kurtosis	3.2508	2.3795	2.4001	2.7321	2.7801	2.5128
K-S test	0.301	0.487	0.979	0.944	0.591	0.449

Table 2 presents a descriptive analysis of six key dimensions related to digital transformation in market research in Peru, providing a quantitative perspective on the current state of companies in terms of process optimization, technological innovation, and customer empowerment. The results show that CE has the highest mean (17.87), reflecting a strong orientation towards consumer-centered strategies, while TI, with the lowest mean (11.57), suggests a significant opportunity for improvement in the adoption of new technologies. The highest standard deviation is observed in the CE dimension (2.8495), indicating greater dispersion in how companies implement strategies to engage their consumers, whereas the lowest dispersion is found in TI (1.9772), suggesting a more homogeneous degree of implementation in this area.

In terms of data distribution, skewness values are close to zero for most dimensions, suggesting relatively symmetrical distributions, with a slight positive skew in digital economy (0.7086), indicating that some companies are adopting digital technologies more intensively. Kurtosis values, ranging from 2.38 to 3.25, suggest that most dimensions follow an approximately normal distribution, with some heavier tails in PO, which may indicate the presence of extreme values in highly optimized companies. Overall, the results highlight the need to strengthen technological innovation to maintain competitiveness in a digitalized environment, while the considerable variability in customer empowerment underscores the importance of developing more consistent strategies aligned with market expectations.

The values presented in the Kolmogorov–Smirnov (K-S) test row appear to indicate, for each variable, either the test statistic or its associated p-value. Since all of these values are below 1 and presumably above 0.05 (if interpreted as p-values), there is insufficient evidence to reject the null hypothesis of normality for any variable. In practical terms, this finding supports the use of parametric statistical techniques (such as linear regression) without incurring major violations of normality assumptions.

4.2 Statistical analysis

Table 3 - Correlation matrix

	Process optimization	Technological innovations	Customer empowerment	Digital technology	Technological innovation	Digital economy
Process optimization	1.000	-	-	-	-	-
Technological innovations	0.932	1.000	-	-	-	-
Customer empowerment	0.839	0.791	1.000	-	-	-

Digital technology	0.797	0.752	0.859	1.000	-	-
Technological innovation	0.911	0.860	0.863	0.876	1.000	-
Digital economy	0.841	0.845	0.753	0.774	0.747	1.000

Table 3 presents the correlation matrix between six key dimensions related to digital transformation in market research in Peru. A positive correlation is consistently observed across the dimensions, indicating that improvements in one dimension are generally associated with improvements in others. The results reveal a high positive correlation between PO and TI (0.932), suggesting that the adoption of new technologies is a determining factor in improving operational efficiency. Likewise, there is a significant relationship between CE and digital technology (0.859), indicating that the use of digital tools strengthens customer interaction, allowing them greater participation in decision-making processes. These relationships suggest that digital transformation not only impacts internal efficiency but also enhances customer experience and engagement.

On the other hand, the correlation between digital technology and technological innovation is 0.876, showing that the integration of advanced technologies drives innovation capabilities within organizations. However, the lowest relationship is observed between digital economy and CE (0.753), suggesting that although economic digitalization is relevant, its impact on customer perception could still be optimized. Overall, the correlation matrix results highlight the importance of an integrated digital strategy that combines process optimization, technological adoption, and customer experience enhancement to achieve sustainable and competitive market growth.

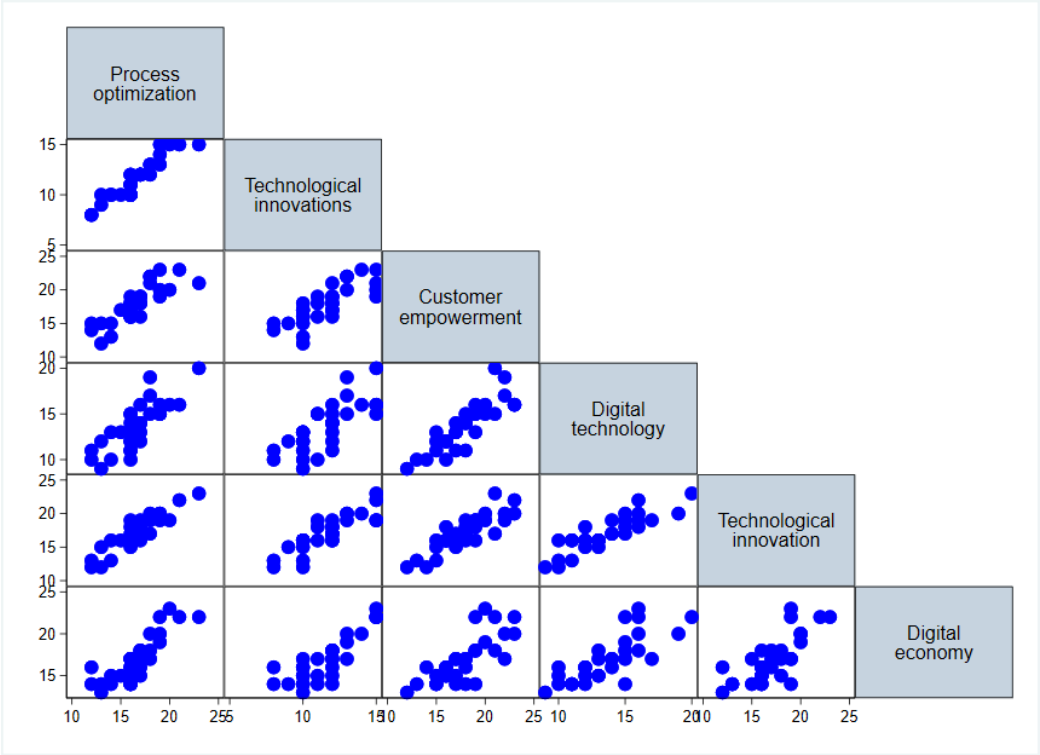

Figure 1 - Scatterplot matrix

Figure 1 presents a scatterplot matrix that visually represents the pairwise relationships between six key dimensions related to digital transformation in market research. The scatterplots reveal a clear positive linear trend among most dimension pairs, indicating strong correlations that align with the findings in the correlation matrix. The strongest relationships are observed between PO and TI, as well as between CE and digital technology, suggesting that companies that adopt technological advancements are likely to achieve higher process efficiency and better customer engagement. The dense clustering of data points along upward slopes confirms the existence of significant associations, supporting the hypothesis that digital transformation positively influences operational and strategic dimensions.

In addition to the strong correlations, the scatterplot matrix highlights some variability in the strength of relationships across different dimensions. For instance, while the relationship between digital economy and CE appears relatively weaker with more dispersed data points, the correlation between TI and digital technology is stronger and more consistent. This suggests that the adoption

of digital technologies is a critical driver of innovation within organizations. The visualization further emphasizes the interconnected nature of digital transformation components, reinforcing the need for an integrated approach that combines technological adoption, process efficiency, and customer engagement to achieve sustained competitive advantage.

4.3 Modelling

Considering the data previously obtained, and according to the objective proposed, multiple regression models will be carried out where the impact between the dimensions of variables and their significance will be determined.

Table 4 - Model Specification by OLS

	(1) Process optimization	(2) Technological innovations	(3) Customer empowerment
Digital technology	-0.211 (-1.61)	-0.206 (-1.63)	0.388 (1.85)
Technological innovation	0.743*** (5.96)	0.521*** (4.33)	0.462* (2.32)
Digital economy	0.381*** (4.18)	0.377*** (4.29)	0.15 (1.03)
Constant	0.299 (0.27)	-0.912 (-0.86)	2.137 (1.22)
F statistic (3,26)	76.89	48.19	34.35
Observations	30	30	30
Adjusted R^2	0.887	0.83	0.775
f^2	7.85	4.88	3.44

Note: t statistics in parentheses, * p<0.05, ** p<0.01, *** p<0.001.

In Table 4, we carry out a modeling of the hypotheses, and with this we decide whether or not there really is a significant impact between the variable dimensions analyzed.

Technological innovation has a coefficient of 0.743 which shows a positive relationship with the three dependent variable dimensions. With a significance level of 5%, the estimated value of the statistic $t(26)$ exceeds the critical value of the table (less than 2.056), the probability of the statistic is less than 5%. Consequently, the value of the regression coefficient is significant.

Through the adjusted R^2 analysis, it is observed that 88.7% of the total variation of the model is due to the linear influence of the variable dimensions, while 11.3% is due to errors for model 1. Similar case for the other models.

Through a significance level of 5%, the estimated value of the global statistic $F(3,26)$ exceeds the critical value of the table (greater than 2.98). Consequently, there is global significance, that is, the independent variables dimension jointly explains the dependent variable dimension for the three models.

Compared with the f^2 thresholds established by (Cohen, 1992), the effect sizes for all three models significantly exceed the threshold for a large effect. However, it is important to interpret these values with caution, given that the small sample size, a consequence of Huancayo's limited business population, could lead to an overestimation of the effects.

Table 5 - Model Specification by OLS p-values

p-value	Heteroscedasticity		Autocorrelation		Normality	Multicollinearity
	BP	White	DW	BG (4)	JB	Mean VIF
Model 1	0.7243	0.2630	1.9942	0.2963	0.4239	4.05
Model 2	0.0363	0.1612	2.6868	0.3007	0.4694	
Model 3	0.0733	0.2807	2.4314	0.1338	0.7917	

Table 5 shows that for model 1 and 3, through a significance level of 5%, the estimated p-value of Breusch-Pagan (BP) test doesn't exceed the critical value, the probability of the statistic is greater

than 5%, therefore there is homoscedasticity, that is, the variance of the residuals is constant.

For model 1, 2 and 3, through a significance level of 5%, the estimated p-value of White test doesn't exceed the critical value, the probability of the statistic is greater than 5%, therefore there is homoscedasticity, that is, the variance of the residuals is constant.

For model 1, 2 and 3, the estimated value of the Durbin-Watson (DW) statistic is close to 2, therefore there is no first-order autocorrelation, that is, the residuals are not correlated.

For model 1, 2 and 3, through a significance level of 5%, the estimated p-value of Breusch-Godfrey (BG) test doesn't exceed the critical value, the probability of the statistic is greater than 5%, therefore, there is no fourth-degree autocorrelation, that is, the covariance of the residuals is not strongly correlated.

For model 1, 2 and 3, through a significance level of 5%, the estimated p-value of Jarque-Bera (JB) test doesn't exceed the critical value, the probability of the statistic is greater than 5%, therefore the residuals have a normal distribution, that is, residuals are correctly estimated.

The mean variance inflation factor (Mean VIF = 4.05) indicates a degree of correlation among the predictors, but it does not reach a level considered critical (generally above 10). Consequently, although moderate multicollinearity is observed, it does not appear sufficiently high to invalidate the model's results.

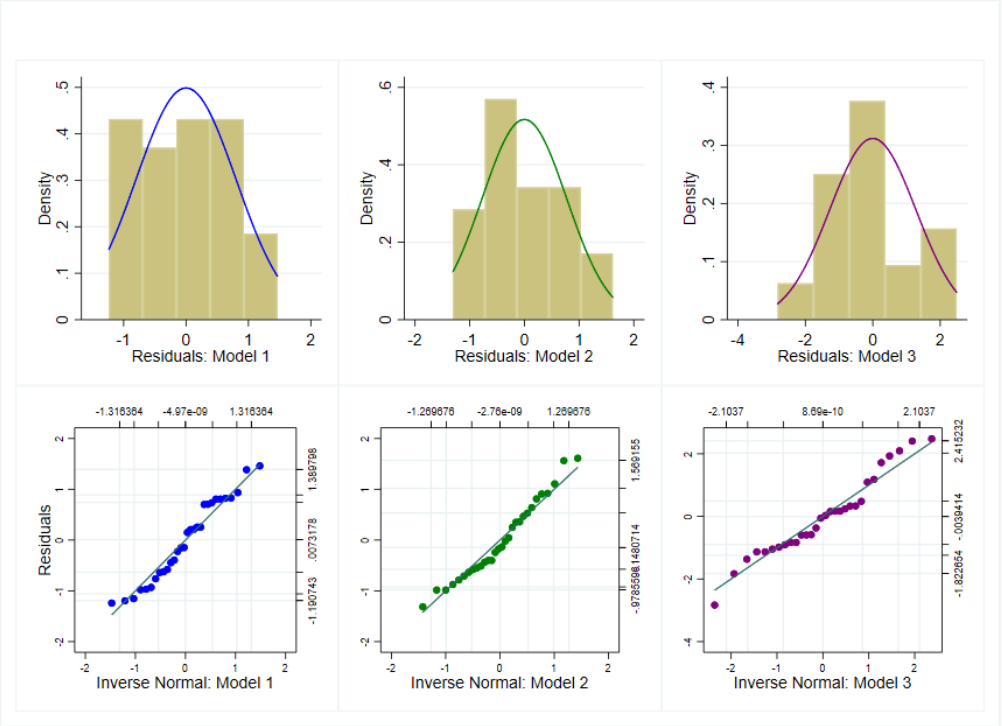

Figure 2. Estimated kernel density and Q-Q plots. Grid lines are 5, 10, 25, 50, 75, 90, and 95 percentiles.

Figure 2 shows a comparison of residual distributions and normality tests for three regression models. The top row presents the kernel density estimates for the residuals, overlaid with a normal curve to assess how closely the residuals follow a normal distribution. For all three models, it can be noted that the estimated kernel density of the residuals produces a normal distribution, so the model can be correctly specified.

Model 1 and Model 2 display a relatively symmetrical distribution around zero, indicating a reasonable fit, while Model 3 shows slight deviations, suggesting that its residuals may not be perfectly normally distributed. The bottom row shows Q-Q plots that compare the observed residuals against the expected normal distribution. In all three models, the residuals mostly align with the 45-degree line, indicating that the assumption of normality is largely met, though slight deviations are visible at the tails, especially in Model 3.

5 LIMITATIONS

In addition to the previously noted cross-sectional nature of the design, it is important to highlight that the small sample size (n = 30) may limit the detection of subtle effects, potentially increasing the risk of a Type II error. In this regard, a power analysis was conducted using the f^2 coefficient derived from the model's adjusted R^2, following the parameters established by (Cohen,

1992). Although the results suggest a high statistical power for the overall model test, it should be noted that in small samples, effect sizes may be overestimated, which could affect the generalization of the findings. This acknowledgment calls for future research with larger and more representative samples to corroborate and extend the results obtained in the present study.

The decision to limit the sample size to 30 companies was informed by both resource constraints and the contextual realities of Huancayo, a city where the total number of market research firms does not exceed 50. While this limitation naturally restricts the generalizability of the findings, it represents the most feasible and contextually appropriate approach given the accessibility and availability of firms in the region. Despite the reduced sample size, the study's findings derived from a rigorous and methodologically sound statistical analysis offer meaningful contributions to the understanding of digital transformation within the market research sector.

It is recognized that working with a small sample may introduce certain limitations, such as the potential overestimation of effect sizes and reduced sensitivity in detecting subtle relationships. Accordingly, the interpretation of the results should be approached with due caution. Nevertheless, the methodological rigor employed and the contextual relevance of the data collected provide a solid foundation for the insights presented. The study thus offers valuable evidence that can inform both academic discourse and future empirical investigations in similarly structured markets or underexplored geographic contexts.

6 DISCUSSION

The findings of this study reinforce the relevance of digital transformation as a key driver of business competitiveness. The high correlation between process optimization and technological innovation (0.932) indicates that the adoption of advanced tools, such as artificial intelligence and Big Data, not only improves operational efficiency but also allows companies to anticipate market demands. These results coincide with previous studies (Aldoseri *et al.*, 2024; Jagatheesaperumal *et al.*, 2022) that highlight the importance of digitalization in reducing costs and operational times.

On the other hand, customer empowerment, evidenced by its high mean (17.87) and significant correlation with digital technologies (0.859), underlines the shift towards a more active and personalized relationship between companies and consumers. This finding aligns with studies such as (Z. Yang *et al.*, 2024), which emphasize the role of digital platforms in promoting customer loyalty and building trust.

However, the lower mean for technological innovations (11.57) suggests that many companies still face barriers to implementing technologies consistently. This poses an area for significant improvement, as the ability to innovate technologically is essential to maintaining competitive advantages in an increasingly complex business environment.

The findings indicate that technological innovation is the strongest predictor of process optimization, which aligns with previous studies that underscore its crucial role in improving operational efficiency through the incorporation of advanced digital tools. In the context of Huancayo, where competition is driven by the need to differentiate themselves in a resource-constrained environment, companies that adopt technological innovations are able to automate tasks, optimize data analysis, and reduce operational errors, contributing to more agile and effective processes. Furthermore, the integration of technology favors the creation of an organizational culture oriented toward continuous improvement, which reinforces the ability of internal processes to adjust and adapt to market changes. These mechanisms partly explain why technological innovation emerges as the determining factor for process optimization in this study, providing a solid foundation for future research in similar settings.

Consequently, the results obtained highlight the need to establish a comprehensive strategy which has the capacity to combine process optimization, customer empowerment and technological innovation, in order to increase the advantages offered by digital transformation. Its adaptation not only contributes to better organizational performance, but also helps this type of companies to be in line with fluctuating market changes.

Table 6 - Theoretical and practical Contributions of the study

Dimension	Theoretical Contribution	Practical Implication
Methodology	Combined application of multiple regression and correlation analysis in a low-density business environment.	Strengthening the validity of predictive models in emerging markets with sample limitations.

Digital Transformation	Empirical evidence on the relationship between technological innovation and process optimization.	Promotion of digitization strategies to improve operational efficiency in local businesses.
Business Management	Expansion of knowledge on the impact of customer empowerment in digital transformation.	Implementation of customer-centric practices to enhance business competitiveness.

Table 6 summarizes the study's main contributions, highlighting both its theoretical advances and practical implications. From a methodological perspective, the combined application of multiple regression and correlation analysis in a low-business-density environment reinforces the validity of the predictive models in emerging markets with sample limitations. From a digital transformation perspective, the findings confirm the key role of technological innovation in process optimization, supporting the need for digitalization strategies in local companies. Finally, in business management, the study expands knowledge about how customer empowerment influences digital transformation, offering a framework for adopting customer-centric practices that improve competitiveness.

7 CONCLUSIONS

Digital transformation today presents itself as a fundamental and transcendental tool for all those companies dedicated to market research, since it allows them to achieve their strategic goals through innovation, process improvement and strengthening interaction with customers. Likewise, this research through statistical analysis reveals how technological innovation and customer empowerment today generate a transcendental impact on the competitiveness of this type of companies, thereby explaining the solid statistical relationship with 88.7% between the study variable dimensions and the impact on business efficiency. Furthermore, the high correlation between technological innovation and operational efficiency (0.932) underlines the importance of adopting advanced technologies to maximize organizational performance.

Digital transformation allows organizations not only to adapt to a competitive environment, but also to position themselves as leaders in their respective markets. Technologies such as Big Data and artificial intelligence have proven to be key tools, offering a significant impact coefficient (0.743, $p<0.001$) in process optimization. This approach also improves the customer experience, as reflected by the high customer empowerment average (17.87), which promotes sustainable and personalized business relationships.

Despite these advances, this study shows barriers in the implementation of technological innovations, highlighting a lower mean in this dimension (11.57). Therefore, it is recommended that companies invest in training their staff and designing digital integration strategies aligned with the needs of their clients. Furthermore, collaboration with technological partners and participation in digital ecosystems could be key to overcoming these challenges.

Future research should prioritize identifying the specific barriers that impede technological adoption, while also examining their implications across broader sectors. Additionally, exploring the role of digital transformation in fostering business sustainability and enhancing organizational resilience will be crucial in an ever-evolving global landscape.

In conclusion, digital transformation is not merely a source of competitive advantage; it has become an essential instrument for achieving efficiency, sustainability, and adaptability in increasingly demanding and dynamic markets.

7.1. Implementation challenges and future research directions

While this study offers actionable insights for market research firms undergoing digital transformation in Peru, several challenges may arise during implementation. First, disparities in digital infrastructure between urban and regional areas may limit the scalability of digital tools, particularly for smaller firms with limited access to cloud platforms or high-speed internet. Second, there may be organizational resistance to change, especially in firms with deeply entrenched analog practices and hierarchical decision-making structures. Building digital capabilities not only requires investment in technology but also in human capital—through continuous training and change management strategies that align with organizational culture. Third, regulatory and data privacy frameworks in Peru are still evolving, and firms may face legal and ethical uncertainties when adopting advanced analytics or client-facing digital platforms.

These implementation challenges highlight the need for future research that explores the conditions under which digital transformation succeeds or fails in the Peruvian service sector. Longitudinal studies could track the impact of specific digital interventions over time, while comparative case studies may uncover best practices across different regions or firm sizes. Moreover, future research could expand the model by integrating variables such as digital leadership, data governance, or organizational learning, which may moderate or mediate the relationships explored in this study. Exploring these dimensions would deepen our understanding of how market research firms in emerging economies can transition toward digitally enabled, client-centered, and innovation-driven models.

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