"Effects of the implementation of information technologies on the productivity of service companies in Ecuador"

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EFFECTS OF THE IMPLEMENTATION OF INFORMATION TECHNOLOGIES ON THE PRODUCTIVITY OF SERVICE COMPANIES IN ECUADOR

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Abstract

Information technologies (IT) have become a fundamental pillar for contemporary organizations, driving not only operational efficiency and automation, but also improving decision-making processes. The objective of this study was to measure the influence of the three dimensions of IT (devices, functionalities, and potentialities) on the two dimensions of productivity (service performance and performance of business processes) in service sector companies in Ecuador. Primary data were collected from 375 Ecuadorian companies at a single moment in the service sector, a sector chosen for being the one that contributes the most to the country's economy, using a non-experimental research design. Data analysis was performed using SPSS statistical software, with binary logistic regressions and the Nagelkerke pseudo-R^2 test to evaluate the explanatory power of the variables. The results indicate that IT, evaluated through its three dimensions (devices, functionalities, and potentialities), positively influences service performance by 44.80%. Similarly, these three dimensions positively influence 39.15% of the performance of business processes, empirically demonstrating that implementing IT allows achieving higher productivity levels in service companies in developing countries.

Keywords productivity, information technology, innovation, technological integration, strategic alignment, service industry

JEL Classification O32, O14, L23, M11

INTRODUCTION

The evolution of information technology (IT) has transformed the global economy, improving productivity and competitiveness across all industries (Mlynář & Arminen, 2023). Developed countries lead the way in IT integration, optimizing processes and driving efficiency (De Araujo & Christoforo, 2023), while in developing countries its incorporation is slower, due to factors such as investment, management skills or culture (Ochinanwata et al., 2024). In Latin America, the services sector represents 65.96% of GDP, and this sector is increasingly leveraging IT for innovation and management (Liu et al., 2024; Elf et al., 2022). The strategic use of IT in services strengthens competitiveness and adaptability, driving operational optimization and fostering innovation through technological platforms (Tu et al., 2023).

There is no doubt about the importance of IT in business productivity. Cirillo et al. (2023) stressed that IT investments, when aligned with organizational restructuring, significantly improve productivity. The World Economic Forum (2014) reported that a 10% increase in digital bandwidth could boost GDP by 0.25%, underlining the importance of digital infrastructure. Furthermore, IT adoption in developed countries has been shown to increase productivity by up to seven times

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compared to companies lacking such integration (Afflerbach, 2015; Liu et al., 2013). However, IT implementation is not straightforward to achieve; for example, poorly structured processes and limited information sharing can hinder effective IT adoption (Turyadi et al., 2023). Effective communication is crucial for strategy development and IT implementation, as these technologies facilitate the continuous exchange of information, essential for informed decision-making and organizational decentralization (Hsieh & Vergne, 2023). In this sense, the research question is whether information technologies through devices, functionalities, and potentialities positively influence the productivity of service companies.

1. LITERATURE REVIEW AND HYPOTHESES

The positive impact of information technology (IT) on organizational productivity has been widely recognized, particularly in developed countries where IT facilitates the decentralization of decision-making processes (Wang et al., 2023). This decentralization enables organizations to respond more efficiently to changing conditions, enhancing strategic agility and performance (Chege et al., 2020; Szymkowiak et al., 2021). However, in developing countries, IT's effect on productivity is often limited due to the persistence of centralized decision-making, which hinders flexibility and responsiveness, thereby reducing the potential benefits of IT in dynamic environments. Understanding the impact of IT in these regions remains critical.

Beyond productivity, IT significantly contributes to firms' competitive advantage. Cao and Hoffman (2011) emphasize the importance of IT for connecting organizations through mergers, strategic alliances, and optimizing client-supplier interactions (Rennings et al., 2023). Human resources play a central role in this process, as expertise is required to manage IT systems effectively within and across organizational boundaries (Bansal et al., 2023). Without strategic alignment between technology and skilled personnel, the benefits of IT may remain unrealized.

Ghobakhloo et al. (2012) argue that IT drives socio-economic change by enabling firms to share valuable information with the community, improving decision-making on pricing, market expansion, and product development. This aligns with Prokopenko's (1987) definition of productivity as the measure of how effectively organizations achieve objectives while optimizing resources such as capital, technology, and human skills (Afflerbach, 2015; Ballestar et al., 2022).

IT's implementation enhances three critical areas: (a) exploiting market opportunities, (b) transforming operational processes, and (c) training employees to manage IT systems effectively. These advancements improve adaptability and competitive advantage in the digital era (Orlikowski & Iacono, 2001). Effective IT integration strengthens decision-making, planning, and control, while structural changes in organizations are required to align IT with management processes (Arvanitis & Loukis, 2015; Kumar, 2004).

Although IT enhances productivity, some researchers warn that simple IT implementation does not guarantee improvements (Afflerbach, 2015; Brynjolfsson & Hitt, 2003). Structural factors such as administrative inertia, inaccurate IT capital measurement, and time lags in technology adoption can hinder the full realization of IT's potential benefits (Bertschek et al., 2013). Hitt and Brynjolfsson (1996) suggest that the proper integration of IT into an organization's framework, coupled with effective knowledge management and administrative practices, is critical to unlocking productivity gains.

Research has shown that IT, particularly in service sectors, can catalyze innovation and enhance organizational growth (Hwang et al., 2015). However, inefficient implementation and inadequate staff training remain major obstacles (Dedrick & Kraemer, 2001). To realize IT's productivity potential, organizations must not only invest in cutting-edge technologies but also ensure proper system integration and workforce development. The strategic use of IT devices (e.g., computers, mobile devices) and functionalities (e.g., cloud storage, e-commerce) is essential for aligning IT with organizational processes and driving improved performance (Kraemer & Dedrick, 2001).

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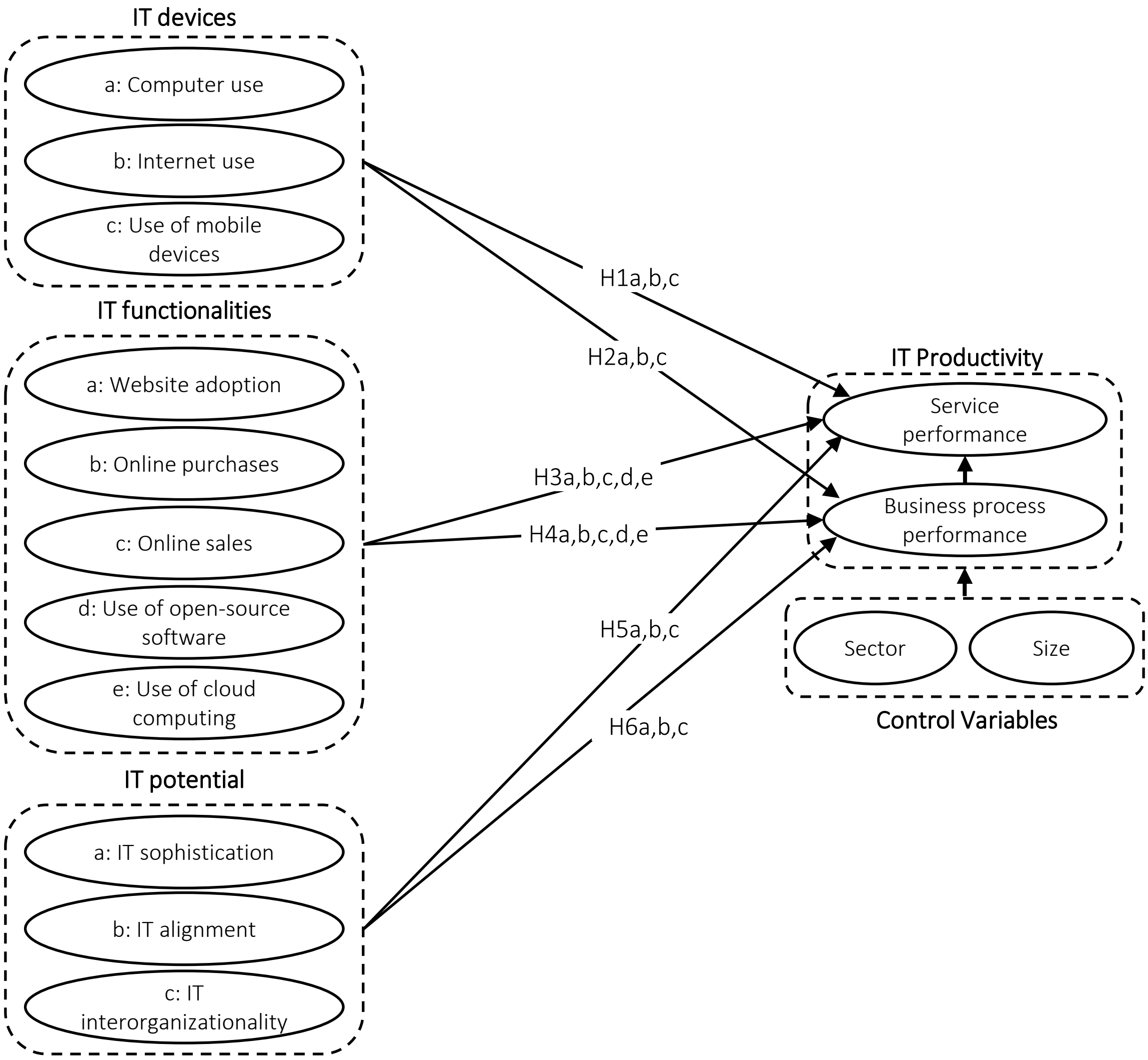

Figure 1. Conceptual model

Despite widespread agreement on the positive impact of information technology on organizational productivity, unresolved issues remain. One major contradiction lies in the differing effects of IT between developed and developing countries. In developed nations, IT significantly enhances productivity by decentralizing processes and optimizing operations (Wang et al., 2023; Chege et al., 2020), while in developing countries, its impact is limited due to persistent centralization in decision-making, restricting organizational flexibility (Szymkowiak et al., 2021).

Moreover, some studies assert that IT investment directly improves productivity (Cirillo et al., 2023), while others argue that these improvements are not automatic without proper integration and staff training (Afflerbach, 2015; Bertschek et al., 2013). Additionally, uncertainty remains regarding how contextual factors – such as technological infrastructure and human capabilities – affect IT's effectiveness in enhancing performance across different sectors and regions (Hitt & Brynjolfsson, 1996).

These contradictions justify the need for further research in developing economies, where structural and cultural factors hinder the full adoption of IT. This study focuses on assessing the impact of IT on the productivity of service sector companies in Ecuador (Figure 1). Given the importance of this sector to the Ecuadorian economy, it is crucial to understand how IT can optimize its performance and competitiveness within an emerging digital infrastructure. By addressing these gaps, this study aims to contribute to the literature by identifying the conditions under which IT adoption can yield tangible productivity and competitiveness benefits in developing economies:

H_1(a,b,c): IT devices positively impact service performance in service companies in Ecuador.

H_2(a,b,c): IT devices positively impact business process performance in service companies in Ecuador.

H_3(a,b,c,d,e): IT functionalities positively impact service performance in service companies in Ecuador.

H_4(a,b,c,d,e): IT functionalities positively impact business process performance in service companies in Ecuador.

H_5(a,b,c): IT capabilities positively impact service performance in service companies in Ecuador.

H_6 (a,b,c): IT capabilities positively impact business process performance in service companies in Ecuador.

H7: The performance of business processes positively affects the performance of services in service companies in Ecuador.

In the hypotheses, the elements corresponding to each information technology have been identified in an abbreviated manner using letters (a, b, c; a, b, c, d, e; a, b, c), which is related to what is shown in Figure 1.

2. METHODOLOGY

This non-experimental analysis focused on observing variables through refined and precise information (Hernández et al., 2010). It was explanatory in nature, used deductive logic, and adopted a quantitative approach within a positivist paradigm. The study was cross-sectional, using both primary data sources, with results applied to the services sector in Ecuador. A structured survey was conducted to collect relevant information, with the aim of developing a robust and reliable model.

The study population consisted of a wide variety of service sector firms located in urban areas, focusing on the five largest sectors of the service industry, which together contribute more than $3 billion to the sector: a) professional, technical, and administrative services (consultants); b) real estate; c) transportation and warehousing; d) health and social services; and e) financial services. To be included in the study, firms had to have been in operation for at least three years and invest a minimum of 1% of their sales in information technology (IT). In total, the population included 11,115 firms, ensuring a robust and representative analysis of the sector. Ethical principles were respected throughout the study, and informed consent was obtained from participants for primary data collection.

A systematic random sampling technique was used to ensure a comprehensive representation of each company within the sample (Hernández et al., 2010). Using the finite population formula, with a 50% probability of success, a 5% margin of error, and a 95% confidence level, the sample size was determined at 375 companies evenly distributed across all strata. Data collection was carried out in Quito and Guayaquil, the cities with the highest concentration of service provider companies in Ecuador.

For data collection, structured demographic questions organized into two sections were used: (a) general company information and (b) performance metrics. The questionnaire was adapted from Hwang et al. (2015) to assess the use of information technology (IT) devices, functionalities, and potentialities and to measure productivity-related constructs. Productivity was assessed through two constructs: (a) new service performance and (b) business process performance, both assessed using binary scales (Sabherwal & Jeyaraj, 2015).

The IT device dimension encompassed three components: (a) computer use, (b) Internet connectivity, and (c) mobile devices. Five components were identified to measure IT capabilities: (a) e-commerce to facilitate online transactions, (b) website development to enhance digital presence, (c) cloud-based data storage for efficient data management, (d) open-source software for system development, and (e) advanced IT analytics for performance evaluation (Hwang et al., 2015). These capabilities are essential to assess the influence of IT on productivity, enabling organizations to

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seamlessly integrate IT into administrative processes and improve overall performance (Kraemer & Dedrick, 2001; Paulraj et al., 2008). IT potentials were assessed across three critical elements:

- IT sophistication, reflecting the advancement and adaptability of IT solutions,
- IT alignment, including investments in efficiency tools such as customer relationship management (CRM), enterprise resource planning (ERP), and business intelligence (BI) systems, and
- interorganizational IT integration, involving technologies such as electronic data interchange and supply chain management systems (Tallon et al., 2000).

On-site surveys were conducted after obtaining managers' consent, and confidentiality was ensured by providing the questionnaire in advance. The questionnaire, designed to minimize errors and comprised of 80% objective questions, took approximately 25 minutes to complete.

Three types of validity were used: (a) content, (b) internal, and (c) external (Louviere et al., 2004). Content validity was ensured by the judgment of experts in the field of IT in the service sector. Internal validity verified the functional relationship between the dependent and independent variables, aligning the results with theory (Kjaer, 2005). Finally, external validity was confirmed to ensure that the results are generalizable and applicable in different contexts, checking the significance of the model coefficients (Hernández et al., 2010).

The responses were coded and processed using SPSS and Eviews software. The data were meticulously checked for accuracy before statistical analysis, which enhanced the reliability and validity of the findings. This paper employed binary logistic analysis to examine information technology (IT). The main objective was to identify the key determinants for investing in technological devices to improve productivity in service firms.

The following formula was used to measure the impact of IT on new service performance:

$$\textit{Service performance}\left(X_1, X_2, \ldots, X_{11}\right) = \frac{1}{1+e^{-\left(\beta_0+\beta_1 X_1+\beta_2 X_2+\ldots+\beta_{12} X_{12}\right)}}. \quad (1)$$

In this context, X_1, X_2, and X_3 pertain to the variables associated with information technology devices; X_4, X_5, X_6, X_7, and X_8 relate to the variables concerning information technology functionalities. Additionally, X_9, X_{10}, and X_{11} represent the variables related to the potential of information technologies.

The following is the formula for business process performance:

$$\textit{Business process performance}\left(X_1, X_2, \ldots, X_{11}\right) = \frac{1}{1+e^{-\left(\beta_0+\beta_1 X_1+\beta_2 X_2+\ldots+\beta_{11} X_{11}\right)}}, \quad (2)$$

where X_1, X_2 and X_3 belong to the items of information technology devices; X_4, X_5, X_6, X_7 and X_8 correspond to the information technology functionalities items and X_9, X_{10} and X_{11} are part of the IT potentiality items.

3. RESULTS

Organizations are increasingly investing in various IT assets, such as mobile devices, open-source software, cloud computing solutions, and integrated mobile technologies while ensuring alignment between IT initiatives and business practices. These strategic investments are essential for the effective integration of IT into organizational operations, encompassing the dimensions of devices, functionalities, and potentialities, all crucial for driving productivity enhancements. The analysis aims to identify the critical factors influencing the allocation of funds for technological acquisitions, focusing on how these investments can augment productivity within service-oriented firms. By examining the interplay between IT investments and organizational effectiveness, this study provides a framework for understanding the optimal allocation of resources in technology to achieve substantial productivity gains. Ultimately, it underscores the importance of aligning technological advancements with organizational objectives, fostering an environment conducive to innovation and competitive advantage in an increasingly digital landscape.

3.1. Descriptive results

The initial analysis focused on the main variables of the model, broken down by city. The sample included 375 service firms in Quito (206) and Guayaquil (169), selected through systematic random sampling. In 2022, these companies generated an average income of $568,326.96 and an average profit of $116,298.48, which corresponds to a net margin of 20.46% derived from innovations or new services. Guayaquil stood out as the city with the highest generation of income and profits compared to Quito (Table 1).

Both univariate and multivariate normality tests were performed. In the univariate analysis, the interquartile range, which is the difference between the 75th and 25th percentiles, was calculated, along with the standard deviation of each variable. If the ratio between the interquartile range and the standard deviation approaches 1.3, the data are considered to be approximately normal (Lantz et al., 2016). Table 2 shows that the values of this ratio are close to 1.3, which indicates univariate normality in the continuous variables (Othman et al., 2015). Additionally, logarithms were applied to the continuous variables to linearize the functions and reduce mathematical scaling, and the skewness and kurtosis results ranged from +1.20 to –1.20, supporting univariate normality (Lantz et al., 2016).

Table 2. Data normality analysis

Parameters	IITD	IITF	ITP	NSP	BPP
Percentile – Q1	6.1628	4.3780	4.2836	7.1453	5.3144
Percentile – Q3	7.8904	6.8976	7.3244	8.2786	6.7433
Interquartile range	1.7276	2.5197	3.0407	0.9110	1.1469
Standard deviation	1.3607	1.9161	2.6199	1.1333	1.4288
Normal	1.2696	1.3150	1.1606	1.2440	1.2458

Note: IITD = Investment in information technology devices; IITF = Investment in information technology functionalities; ITP = Investment in investment technology potentials; NSP = New service performance; BPP = Business process performance.

In addition, multivariate normality tests were performed using the Henze-Zirkler test (Lantz et al., 2016). This test proposes the multivariate normality of the data as the null hypothesis, while the alternative indicates the opposite (Marmolejo-Ramos & González-Burgos, 2013). With a confidence level of 95%, it is decided not to reject the null hypothesis (H_0) if the *p*-value is greater than 0.05; Otherwise, H_0 is rejected in favor of the alternative hypothesis (H_1) (Hernández et al., 2010). The *p*-value obtained was 0.127, which indicates that H_0 is not rejected, confirming the multivariate normality of the data analyzed (Othman et al., 2015).

Subsequently, a unit root test was conducted on all the explanatory and endogenous variables of the model to determine their stationarity, as pro-

Table 1. Descriptive statistics of continuous variables by city

Variables		N	Average	IC (95%)	
				Lower limit	Upper limit
Investment in information technology devices	Quito	206	$112,469.55	$76,993.14	$147,945.96
	Guayaquil	169	$139,592.19	$85,271.95	$193,912.43
	Total	375	$124,692.82	$93,525.40	$155,860.24
Investment in information technology functionalities	Quito	206	$49,806.54	$32,772.54	$66,840.55
	Guayaquil	169	$34,095.41	$23,360.58	$44,830.24
	Total	375	$42,726.06	$32,205.81	$53,246.31
Investment in investment technology potentials	Quito	206	$65,686.72	$42,903.02	$88,470.43
	Guayaquil	169	$93,828.37	$56,923.00	$130,733.74
	Total	375	$78,369.23	$57,608.06	$99,130.40
Total sales for new services	Quito	206	$454,947.10	$313,391.25	$763,908.79
	Guayaquil	169	$918,108.29	$473,071.70	$1,174,424.84
	Total	375	$568,326.96	$422,324.87	$765,742.85
Net profit from new services	Quito	206	$91,888.93	$49,632.83	$118,351.18
	Guayaquil	169	$192,071.99	$62,235.76	$288,364.87
	Total	375	$116,298.48	$72,328.67	$189,038.32

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posed by Kruiniger (2013). The application of this methodology yielded results indicating that the *p*-values for all analyzed variables were less than 0.05. This allows for the rejection of the null hypothesis (H_0), which posits the presence of unit roots and, consequently, the non-stationarity of the variables. Therefore, the alternative hypothesis (H_1) is accepted, demonstrating that the variables in question are stationary. This finding is crucial for ensuring the validity of the subsequent analyses conducted in the study (Table 3).

Table 3. Unit root tests for the individual variables of the model

In levels	IITD	IITF	ITP	NSP	BPP
With a lag and a tendency					
Breitung test	2.187	0.639	–0.426	–0.063	0.167
p-value	0.986	0.739	0.335	0.475	0.567
In first difference	ΔIITD	ΔIITF	ΔITP	ΔNSP	ΔBPP
With a lag and a tendency					
Breitung test	–18.748	–6.409	–22.000	–28.913	–17.404
p-value	0.000	0.000	0.000	0.000	0.000

Note: IITD = Investment in information technology devices; IITF = Investment in information technology functionalities; ITP = Investment in investment technology potentials; NSP = New service performance; BPP = Business process performance.

3.2. Inferential results

The study proposed a new model consisting of thirteen items distributed across four constructs: (a) IT devices, (b) IT functionalities, (c) IT potentialities, and (d) productivity. Each item was measured using binary scales, where zero represented "no" and one represented "yes." To ensure the internal reliability of the instrument, Cronbach's alpha values were employed, and with values exceeding 0.7, the literature confirms the internal consistency of the scales (Chión & Vincent, 2016; Hair et al., 2010).

A binary logit model was used to analyze the data, with model fit assessed through the Nagelkerke R^2 and the estimated coefficients of the independent variables (Hair et al., 2010). The findings of the proposed model focused on new service performance are detailed in Table 4. Based on the analysis, all hypotheses are statistically supported (*p*-value < 0.05), except for H1a, H3b, H5b, and H5c. Notably, internet usage (H1b), mobile device adoption (H1c), website development (H3a), online sales (H3c), open-source software implementation (H3d), cloud technology utilization (H3e), IT sophistication (H5a), and business process performance (H7) demonstrate a significant and positive relationship with new service performance (Fuhrer et al., 2003).

This indicates that there is a higher likelihood of improved service performance in firms when the independent or exogenous variables (binary) in the model are equal to one. Consequently, the model provides valuable insights into the key factors that influence service productivity, emphasizing the role of IT integration in driving organizational success.

Regarding model fit, the Nagelkerke R^2 is 0.4480, indicating that the proposed exogenous variables explain 44.80% of the variation in the endogenous variable (new service performance). Additionally, Table 4 presents the significance value of the Omnibus test ($p < 0.05$), suggesting that the coefficients of the exogenous variables are significantly different from zero. Furthermore, the significance value of the Hosmer-Lemeshow test (0.495) confirms an adequate overall fit of the proposed binary logistic model (Fagerland & Hosmer, 2016). This implies that the model's predictions align well with the observed outcomes, reinforcing the robustness of the variables selected to explain new service performance. The combination of these statistical indicators demonstrates that the model provides a reliable framework for understanding how IT-related factors contribute to service productivity in organizations.

Table 5 presents the results concerning the performance of business processes within firms, taking into account IT devices, functionalities, and potential (Oliner & Daniel, 2000). The analysis indicates that the use of the Internet (H2b), mobile devices (H2c), online purchases (H4b), online sales (H4c), open-source software (H4d), cloud technology (H4e), IT sophistication (H6a), and IT alignment (H6b) demonstrate a significant and positive relationship with business process performance in service-oriented companies (Hwang et al., 2015).

However, no support was found for the hypotheses regarding the use of computers (H2a), website adoption (H4a), and IT interorganizationality

Table 4. Dependent variable (service performance) as a function of IT devices, functions, and potentialities

Hypothesis		Coefficient	Wald	p-value
IT devices				
H1a	X_1: Computer use → Performance of products and services	–0.469	0.924	0.336
H1b	X_2: Internet use → Performance of products and services	1.128	9.329	0.002***
H1c	X_3: Use of mobile devices → Performance of products and services	1.254	11.561	0.001***
IT functionalities				
H3a	X_4: Website adoption → Performance of products and services	1.226	12.209	0.000***
H3b	X_5: Use of online shopping → Performance of products and services	–0.098	0.080	0.778
H3c	X_6: Use of online sales → Performance of products and services	1.067	8.416	0.004***
H3d	X_7: Use of open-source software → Performance of products and services	0.830	4.933	0.026**
H3e	X_8: Use of cloud computing → Performance of products and services	1.016	8.643	0.003***
IT potentials				
H5a	X_9: IT sophistication → Performance of products and services	0.765	4.201	0.040**
H5b	X_{10}: IT alignment → Performance of products and services	–0.003	0.000	0.994
H5c	X_{11}: Interorganizationality of IT → Performance of products and services	0.252	0.339	0.560
Business process performance				
H7	X_{12}: Business process performance → Performance of products and services	0.844	4.344	0.037**
Product and service performance (R^2 of Nagelkerke = 0.4480)				
Omnibus test		$\chi2$ = 119.332		Sig. = 0.000***
Hosmer and Lemeshow test		$\chi2$ = 7.388		Sig. = 0.495

Note: Dependent variable "Performance of new services"; * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$.

(H6c), as these variables did not yield significant results when correlated with business process performance. This indicates that while certain IT investments and functionalities are critical drivers of business process improvements, not all technological factors contribute equally to organizational efficiency. The findings suggest that service-oriented firms should prioritize specific IT dimensions, such as mobile technologies and cloud-based solutions, to optimize business processes and achieve enhanced operational outcomes.

Regarding model fit, the Nagelkerke R^2 is 0.3915, indicating that the proposed exogenous variables explain 39.15% of the variation in the endogenous variable (business process performance). Similar to the previous model, the significance value from the Omnibus test (p-value < 0.05) confirms that the coefficients of the exogenous variables are statistically different from zero. Additionally, the Hosmer and Lemeshow test yielded a significance value of 0.3843, demonstrating that the model exhibits a satisfactory overall fit (Fagerland & Hosmer, 2016). These results suggest that the model effectively captures the relationships between IT investments and business process performance, providing a robust framework for understanding how technological functionalities contribute to organizational efficiency. While the model does not explain all variations, the relatively high R^2 value, and the significant test results indicate that the model's predictive power is strong, making it a reliable tool for evaluating the role of IT in enhancing business processes in service-oriented firms.

Table 6 presents the results of the control variables and their influence on the model's dependent variables. The analysis indicates no statistically significant relationship between firm size and the dependent variables. However, the type of service firm significantly affects the performance of new services, with a significance level of $p < 0.05$, while it does not have a significant effect on business process performance. This finding suggests that, while firm size does not appear to be a determinant of productivity outcomes, the specific nature of the service sector is pivotal in determining the effectiveness of new service offerings. The significant impact of the service type highlights the sector's role in shaping the success of technological investments aimed at enhancing innovation and the delivery of new services. Conversely, the absence of a significant relationship with business process performance implies that improvements

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Table 5. Dependent variable (business process performance) depending on the devices, functions, and potentials of IT

Hypothesis		Coefficient	Wald	p-value
IT devices				
H2a	X1: Computer use → Business process performance	0.051	0.026	0.8708
H2b	X2: Internet use → Business process performance	1.27	23.77	0.0000***
H2c	X3: Use of mobile devices → Business process performance	0.82	9.21	0.0024***
IT functionalities				
H4a	X4: Website adoption → Business process performance	–0.204	0.493	0.4825
H4b	X5: Use of online shopping → Business process performance	0.94	13.06	0.0003***
H4c	X6: Use of online sales → Business process performance	0.69	6.47	0.0110**
H4d	X7: Use of open-source software → Business process performance	0.74	7.71	0.0055***
H4e	X8: Use of cloud computing → Business process performance	0.58	4.46	0.0346**
IT potentials				
H6a	X9: IT sophistication → Business process performance	0.51	3.96	0.0466**
H6b	X10: IT alignment → Business process performance	0.57	4.31	0.0380**
H6c	X11: Interorganizationality of IT → Business process performance	0.408	1.437	0.2307
Performance of business processes (R^2 of Nagelkerke= 0.3915)				
Omnibus test		$\chi2 = 127.607$		Sig. = 0.000***
Hosmer and Lemeshow test		$\chi2 = 8.5215$		Sig. = 0.3843

Note: Dependent variable "Business Process Performance"; * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$.

Table 6. Summary of results for control variables

Hypothesis		Coefficient	Wald	p-value
Control	Type of service company → Business process performance	0.092	1.484	0.2247
	Size of the company → Business process performance	0.000	0.104	0.7863
	Type of service company → Performance of new and services	0.9211	45.9302	0.000***
	Size of the company → Performance of new and services	–0.859	7.478	0.1544

Note: * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$.

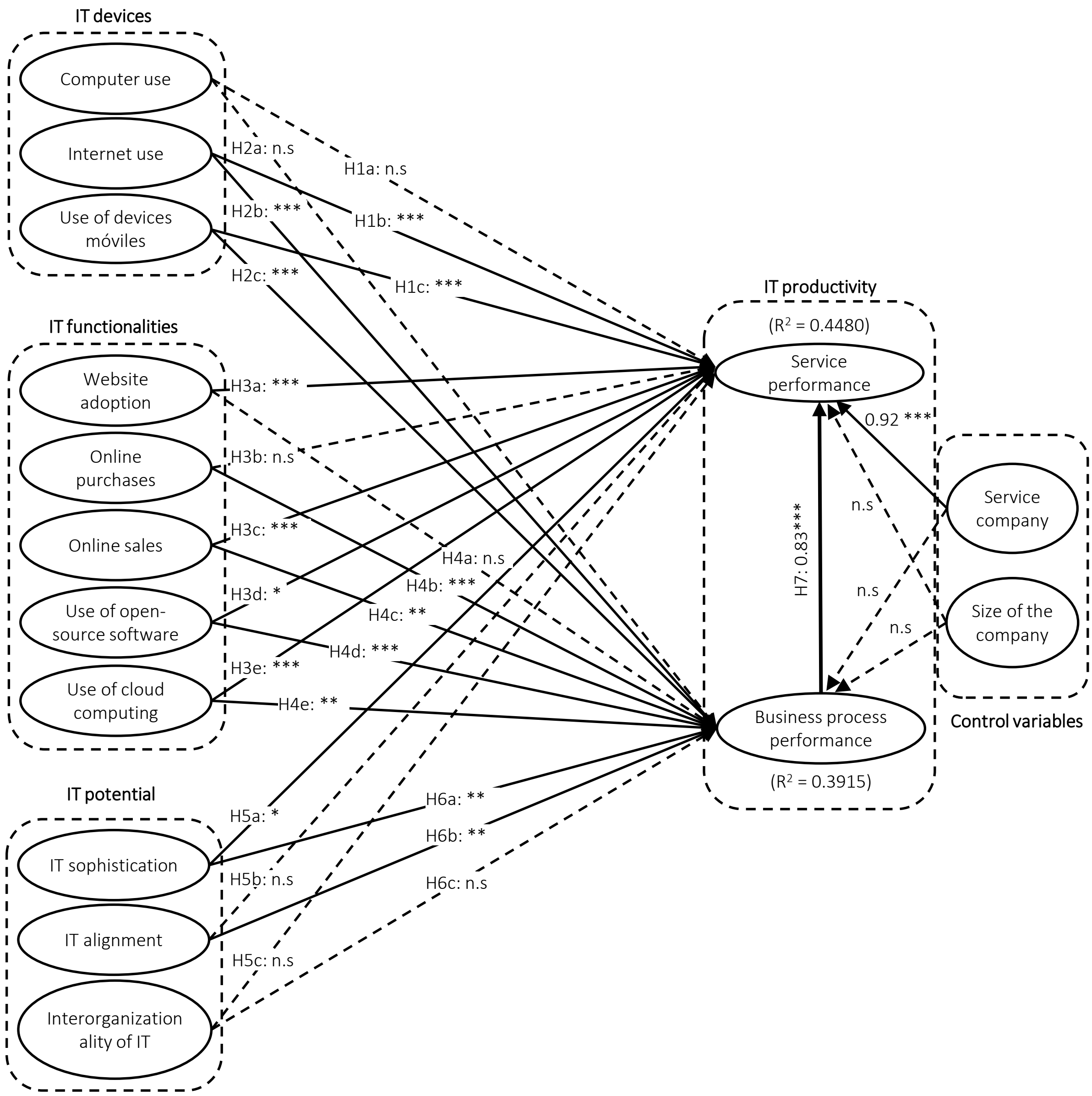
in operational efficiency may be influenced by other factors beyond sectoral characteristics, such as the level of internal integration of IT systems or the sophistication of the technology employed.

Figure 2 presents the consolidated results of both models, showing the impact of IT devices, functionalities, and potentialities on productivity dimensions, including new service performance and business process performance. It also highlights the relationship between business process performance and new services, as well as the influence of control variables, such as firm size and business sector. The analysis reveals that while firm size does not significantly affect productivity, the business sector plays a critical role in determining new service success. Additionally, IT investments in devices and functionalities significantly enhance both service innovation and operational efficiency, demonstrating the crucial role of technology in driving productivity improvements, especially in service-oriented firms.

4. DISCUSSION

This study aimed to determine the influence of information technologies (devices, functionalities, and potentialities) on productivity (performance of new services and performance of business processes) in Ecuadorian service companies. It was determined together that the devices, functionalities, and potential influence positively and significantly ($R^2 = 0.448$) on the performance of new services. This suggests that information technologies are determinants of achieving higher levels of performance in new services implemented by companies. These results are aligned with the findings obtained by Dedrick et al. (2011), who found that a robust technological infrastructure not only improves productivity but also allows service companies to generate competitive advantages.

A more detailed analysis revealed that the devices that service company managers best perceive are the use of the Internet ($p = 0.002$) and the use of



Note: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$ in tests of two colas, n.s.= not significant.

Figure 2. Final model

mobile devices (p = 0.001), while the use of computers (p = 0.336) did not find support among the informants. This shows that to achieve better performance in the new services, the Internet and mobile devices are used, as they are more versatile and keep the managers, workers, and clients of the companies connected. The results are supported by Patel et al. (2021), who found that the devices allow greater communication and control between the areas and workers of the companies. Likewise, the functionalities that allow achieving better levels of performance of the new services are the adoption of websites (p = 0.000), use of online sales (p = 0.004), use of open-source software (p = 0.026), and use of cloud computing (0.003); there was no support for the use of online purchases (p = 0.778). This shows that there is greater acceptance of the functionalities of information technologies over which there is some control, while there is no trust in external functionalities, over which there is no control. The results align with those found by Liu, Hofmann Trevisan et al. (2022), who determined that functionalities promote high performance levels for small businesses in developing economies. The support was found for IT sophistication (p = 0.040), but not for IT alignment

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($p = 0.994$) and IT interorganizationality ($p = 0.560$). These results show that in terms of IT potentialities, service companies have a lot to work on since there is no alignment with the structure of the organization nor collaborative work with other organizations. These results differ to a certain extent from those found by Liu, Yang et al. (2022), who, in the Chinese context, found that IT potentialities allow for substantially improving the performance of environmentally responsible companies.

On the other hand, it has been found that devices, potentials, and functionalities together have a positive and moderate influence ($R^2 = 0.3915$) on the performance of business processes. This shows that IT has a significant impact on the management and improvement of processes in service companies in Ecuador. Regarding potentials, support was found for the use of the Internet ($p = 0.000$) and the use of mobile devices ($p = 0.0024$), and no support was found for the use of computers ($p = 0.8708$). This shows that companies mostly resort to the use of mobile devices and online communication in their processes. In terms of functionalities, support was found for the use of online shopping ($p = 0.0003$), use of online sales ($p = 0.0110$), use of open-source software ($p = 0.0055$), and use of cloud computing ($p = 0.0346$), while no support was found for the adoption of a website ($p = 0.4825$). These results indicate that in terms of processes, companies are adopting various strategies that allow them to reach the customer and be more visible. In terms of potential, support was found for IT sophistication ($p = 0.0466$) and IT alignment ($p = 0.0380$), and no support was found for IT interorganizationality ($p = 0.2307$). This shows that companies are making efforts to improve their internal processes, but not the collaboration with other companies.

The results of this study emphasize the critical impact of information technology (IT) on firm productivity, even in developing countries such as Ecuador. These findings, while based on the Ecuadorian context, align with evidence from developed nations (Dedrick et al., 2011). Ecuadorian firms that use IT achieve competitive advantages and improve productivity, profitability, and market positioning in the long term (Kleis et al., 2012; Paulraj et al., 2008). However, small and medium-sized enterprises (SMEs) in the service sector face significant challenges due to high investment costs and rapid depreciation of technology, which often result in inadequate returns (Dedrick & Kraemer, 2001). Furthermore, the pace of technological change requires substantial investment in training and skilled personnel to ensure effective adoption of IT, which increases the risk of financial instability as firms may adopt systems that will soon become obsolete (Becchetti et al., 2003).

The theoretical implications emphasize the strategic importance of information technology in improving organizational productivity and competitiveness, even in developing economies such as Ecuador. The findings reinforce existing theories that link IT adoption to improvements in operational efficiency and long-term profitability (Dedrick et al., 2011; Kleis et al., 2012). This study expands the theoretical understanding of how firms can overcome barriers to IT investment in emerging markets, where high costs and rapid technological obsolescence present constant challenges (Dedrick & Kraemer, 2001). Furthermore, the paper highlights the critical need for strategic alignment between organizational objectives and IT integration. It emphasizes collaboration between IT executives and managers to effectively incorporate technology into all business processes, supporting theories on improving information flow and decision-making (Tallon et al., 2000). Furthermore, this study contributes to the literature on decentralization and organizational agility by advocating the creation of virtual firms with flexible structures that enhance internal communication and external relationships (Ghobakhloo et al., 2012). This aligns with theoretical frameworks on leveraging IT to quickly adapt to market changes and optimize digital interactions.

The practical implications underscore the importance of strategic IT investments for companies seeking to improve productivity and competitiveness, especially in developing countries like Ecuador. Business leaders must align IT infrastructure with organizational goals to ensure seamless integration, thereby improving decision-making and operational efficiency. In addition, companies must invest in staff training to effectively leverage new technologies and mitigate the risks associated with technological obsolescence. Managers should establish clear metrics, such as return on investment (ROI), to assess the financial impact of IT projects. Small and medium-sized enterprises (SMEs) should consider partnerships with digital platforms to reduce costs and improve e-commerce capabilities while fostering decentralized decision-making and improving communication to respond more agilely to market demands.

The study presents intriguing findings; however, it is not without limitations. One notable limitation is the geographic and sectoral context, as the study focuses exclusively on service firms in Ecuador. This approach may restrict the applicability of the results to other sectors or regions characterized by distinct economic, social, and technological attributes. Future research could expand the analysis to encompass multiple regions and sectors, such as manufacturing and agriculture, to investigate how the impact of information technology (IT) varies in different contexts. International comparative studies would also be valuable in determining whether the dynamics identified in Ecuador are representative of those of other developing countries.

Another potential limitation is the sample size. Although the study selected relevant companies, the limited sample size may affect the generalizability of the results and their statistical robustness. Future research could address this limitation by increasing the sample size to include a broader range of companies, both large and small, across diverse economic sectors. Such an approach would improve representativeness and could enhance the external validity of the findings, providing a more comprehensive understanding of the impact of IT on various organizational structures.

CONCLUSION

This study evaluated the impact of the implementation of information technology (IT) on the productivity of service companies in Ecuador. The results show that IT, through devices, functionalities, and potentialities, has a significant influence on the performance of new services and on the performance of business processes. These findings underline the relevance of IT not only in optimizing processes but also in improving productivity and competitiveness in the service sector. This analysis highlights that not only are infrastructure and technological devices determinants of achieving higher levels of productivity, but functionalities, in terms of operability and usability, also play a crucial role. In addition, this study adds a new dimension to the literature by including the potentialities of IT, an aspect that requires further exploration, especially in the context of developing economies.

The paper thus offers an empirical basis that suggests to business managers in Ecuador the importance of investing in IT, with an emphasis on mobile technologies, the Internet, and digital platforms for business management. It is also suggested that efforts be made to strategically align IT with the organizational structure and foster inter-company collaboration since this translates into higher levels of productivity and adaptability in a highly dynamic environment. Finally, the research community is urged to delve deeper into the study of new devices, functionalities, and emerging potentials in the field of IT, considering the rapid technological evolution and the need for service companies to maintain a leadership position in the face of global changes.

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Writing – review & editing: María Elena Romero Montoya, Víctor Hugo González Jaramillo.

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