INTERNATIONAL JOURNAL OF ACADEMIC RESEARCH IN BUSINESS & SOCIAL SCIENCES

Vol 15, Issue 4, (2025) E-ISSN: 2222-6990

ERP Implementation Impacts on SME's Competitive Advantage: An Evidence from Pakistan's SME Sector

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To Link this Article: http://dx.doi.org/10.6007/IJARBSS/v15-i4/25269 DOI:10.6007/IJARBSS/v15-i4/25269

Published Date: 30 April 2025

Abstract

Numerous researchers have dedicated efforts to explore explanations for the implementation of Enterprise Resource Planning (ERP) systems, aiming to identify the factors that influence their successful adoption. However, little emphasis has been given to the impacts of ERP implementation on organizational competitive advantage specifically in the context of Pakistani small and medium-sized enterprises (SMEs). An empirical study was carried out to explore the various dimensions of ERP system implementation impacts and to determine the connection between these factors and the competitive advantage of small and medium-sized enterprises (SMEs) in Pakistan. Results revealed that the factors related to ERP system implementation impacts which includes ERP system quality, ERP information quality, ERP service quality, individual productivity, workgroup productivity, cost management and sales management were significantly associated with the competitive advantage

Keywords: ERP Systems, ERP Implementation, ERP Implementation Impacts Organizational Competitive Advantage, IS Success Model, SMEs, Pakistan

Introduction

In recent years, Information Technology (IT) and Information Systems (IS) have become pivotal in the business landscape. With the rise of global competition, many advanced information systems have emerged, notably Enterprise Resource Planning (ERP) systems. These systems, often referred to as enterprise systems, are designed to integrate both functional and operational processes within a company's value chain. ERP systems are comprehensive software solutions that promise to unify all information flowing through an organization encompassing financial, human resources, supply chain, and customer data (Amini & Abukari, 2020; Li, 2021). The primary goal of ERP systems is to consolidate various business processes into a single enterprise-wide solution, enhancing data consistency and the integration of modular applications (Mahar et al., 2020; Wahab & Nor, 2023). A significant advantage of ERP systems lies in their ability to streamline workflows across different departments, ensuring smooth transitions and expedited process completion. This capability allows for effective tracking of inter-departmental activities, minimizing the risk of overlooked tasks as long as all business activities are conducted in accordance with established information processing protocols (MANDAVA, 2024). The effective implementation of ERP systems results in improved planning, better decision-making, and enhanced overall performance for organizations, while also opening up opportunities for growth. These systems act as vital instruments that elevate organizational efficiency and help sustain a competitive advantage (Elgohary, 2019; Pamungkas & Iskandar, 2021).

The adoption of ERP systems among SMEs in Pakistan has gained momentum, yet there is limited empirical research on how these implementations impact business performance and competitiveness in the local context (Malik & Khan, 2021). ERP systems encompass various components, such as quality management, productivity, sales optimization, and cost control, all of which can directly influence a company’s ability to innovate, reduce operational redundancies, and respond more effectively to market demands (Amini & Abukari, 2020; Cebekhulu & Ozor, 2022). Implementing ERP systems requires significant investment, organizational restructuring, and a long-term commitment, which can pose risks for smaller enterprises with constrained budgets and resources (Mahmood et al., 2020; Huseyn et al., 2024).

This study examined the impacts of ERP system implementation on the competitive advantage of SMEs in Pakistan, focusing on dimensions such as ERP quality, productivity and financial management. By investigating these impacts, the research aims to provide insights into how ERP systems can serve as a strategic tool for SMEs, helping them overcome market challenges and leverage internal efficiencies to improve their standing in the competitive landscape. The findings could be beneficial for SMEs considering ERP adoption and could contribute to a better understanding of ERP's role in fostering business growth and sustainability in Pakistan’s SME sector. The subsequent sections provide a review of the relevant literature, followed by the presentation of theories taken, research model and hypotheses. The research methodology employed for the study is then discussed in detail. This is succeeded by an explanation of the data analysis and findings in the results section. Finally, the study concludes by discussing its implications, acknowledging its limitations, and offering recommendations for future research.

Literature Review

This section focuses on studies related to ERP implementation and is divided into five parts. The first part addresses the ERP system, the second examines the ERP implementation lifecycle, the third explores the evolution of ERP systems, the fourth discusses ERP in the context of developing countries, and the fifth specifically highlights ERP in Pakistan.

ERP System

In modern era of technological advancements, ERP systems have become a vital IT solution for enterprises of all sizes, across both public and private sectors. As a strategic tool, ERP systems enable organizations to gain a competitive edge by optimizing resources, streamlining operations, and supporting business processes (Attri & Panwar, 2018; Hodak, 2021). These multi-module software systems integrate key management and business processes within or beyond enterprise boundaries (M. Ali & Miller, 2017), and utilize extensive databases to collect and share information across various modular applications (Estefania et al., 2018). ERP systems automate a wide range of functions, including sales, marketing, inventory, project management, supply chain, and human resources, from a unified IT architecture (Al Mahrami & Hakro, 2018; Sebayang et al., 2021). They enhance productivity by fostering inter-departmental communication, centralizing administrative tasks, and reducing IT costs (Rouhani & Mehri, 2018; Marsudi & Pambudi, 2021).With the growing need for updated business information to support strategic decision-making, the global demand for ERP systems continues to rise, driven by advancements in technology and evolving organizational requirements (Ramli & Widayat, 2017; Osnes et al., 2018; Elgohary, 2019; Alaskari et al., 2019; AboAbdo et al., 2019). The future of ERP systems appears promising, with expectations of expanding beyond traditional organizational boundaries (Estefania et al., 2018; Almahamid, 2019; Marsudi & Pambudi, 2021).

Evolution of ERP System

The evolution of Enterprise Resource Planning (ERP) systems spans over five decades, driven by advancements in technology to enhance business efficiency (De Almeida et al., 2018; Katuu, 2020). Originating in the 1960s as inventory control systems or BOM processors, ERP focused on integrating departments to improve revenue and streamline processes (Bjelland & Haddara, 2018; Goldston, 2020). In the 1970s, Material Requirements Planning (MRP) emerged, enabling efficient scheduling and sub-assembly management (Tang & Xu, 2021; De Brabander et al., 2022). By the 1980s, MRP evolved into MRP-II, addressing broader manufacturing processes and resource management, including scheduling and capacity optimization (Kiran, 2019; Schönsleben, 2023). In the 1990s, ERP systems integrated all business functions in dynamic environments, supporting global competitiveness and operational centralization (Stancu & Drăguţ, 2018; Sikder, 2022). The 2000s saw the rise of extended ERP (E-ERP), leveraging web-based technologies to connect supply chain, customer relationship, and e-commerce functionalities (Marika et al., 2018; Saxena & Verma, 2022). In the 2010s, ERP-II introduced cloud-based, collaborative systems enhancing resource planning, transparency, and integration across enterprises, incorporating advanced capabilities like workflow and knowledge management (Haddara & Constantini, 2020; Dziembek, 2021). This evolution reflects ERP's progression from internal resource optimization to a comprehensive, web-enabled system for enterprise-wide collaboration and efficiency (Arena et al., 2020; Yumatova & Fomina, 2022).

ERP Implementation Life Cycle

The ERP implementation life cycle comprises three phases: pre-implementation, implementation, and post-implementation. The pre-implementation phase focuses on project chartering, system selection, team formation, budgeting, and scheduling, with careful evaluation of vendors and consultants being critical to avoid project failure (Alsulami et al., 2016; Harwood, 2017). In SMEs, this phase is particularly vital due to resource constraints, and external consultants often play a key role (Zach et al., 2014; Wolters et al., 2018). The implementation phase involves getting the system operational, user training, data migration, and customization, with top management involvement and vendor support being crucial for success (Gholamzadeh et al., 2018; Kocaaga et al., 2018). SMEs rely heavily on vendor expertise and consultancy due to the complexity of ERP systems (Gupta et al., 2018). The post-implementation phase focuses on stabilizing the system, addressing bugs, and enhancing user skills, ultimately evaluating the system's impact on competitive advantage and organizational performance (Ruivo et al., 2014; Kvillert & Reijonen, 2018). Errors in earlier phases often surface here, highlighting the importance of thorough planning and execution across all phases (Göhrig et al., 2017; Sumner, 2018).

ERP in Developing Countries

In developing countries, ERP adoption is essential for organizations to improve competitiveness and achieve strategic goals but faces significant challenges such as limited infrastructure, skills, economic capacity, and cultural barriers (Dezdar, 2017; Azizi & Doost, 2018). Slow implementation rates compared to developed nations are influenced by factors like inadequate user training, lack of consultancy services, and resistance to cultural and process changes (Osnes et al., 2018; Mahmood et al., 2020b). Case studies in Kenya, Sri Lanka, Libya and Pakistan highlight issues such as high costs, complex business processes, and user related issues (Akeel et al., 2013; Kazmi, 2016; Githiga, 2018; Herath, 2018). Despite these challenges, successful ERP implementation is achieved through critical success factors like top management support, effective project management, vendor quality, and organizational culture, as seen in studies from Iran, the Middle East, and Malaysia (Almahamid & Awsi, 2015; Dezdar, 2017; Thiak, 2018). ERP implementation success depends on system, service, and information quality, as well as knowledge sharing and adaptability, with user-generated workarounds often addressing system misfits (Chou et al., 2014; Malaurent & Avison, 2015; Hsu et al., 2015).

ERP in Pakistan

ERP systems are implemented by organizations in both developed and developing countries to improve business performance. Pakistani organisations were unaware of ERP systems, but in recent years, both public and private sectors have adopted ERP solutions as Oracle, JD Edwards, Microsoft Dynamics, and SAP (Awan et al., 2021). Leading ERP consulting companies in Pakistan include Abacus and System Limited (LODHI, 2016; System Limited (2019). Research in Pakistan has predominantly focused on Critical Success Factors (CSFs) for ERP implementation, identifying factors such as top management commitment, user involvement, business process alignment, communication, training, and IT infrastructure as essential for successful ERP adoption (Abbas, 2015; Ahmed et al., 2017; Junaid et al., 2021; Rana et al., 2021). Studies have highlighted that organizational support, clear business plans, and a motivated workforce are crucial, especially in SMEs, which face challenges such as a lack of skilled consultants and integration issues (Ijaz et al., 2014; Jamil & Qayyum, 2015; Junaid et al., 2021).

While most of the ERP research in Pakistan revolved around CSFs related to ERP implementation, studies have also explored ERP's impact in different sectors such as higher education, banking and large scale organisations. ERP systems have been shown to positively impact organizational structure and resource management, although challenges such as resistance to change and lack of employee participation persist (Nizamani et al., 2015; Nizamani et al., 2017; Asif et al., 2024). In SMEs, ERP implementation has led to better product planning, reduced corruption, and faster access to critical information, despite challenges related to infrastructure and costs (Kazmi, 2016). Overall, while ERP implementation has brought numerous benefits, the success of these systems is often contingent on factors such as leadership support, training, and organizational culture (Ijaz et al., 2014; Naeem et al., 2017).

Theoretical Background

This section discussed the theories that serve as the foundational basis for the research model developed in this study.

Resource Based View Theory (RVB)

The Resource-Based View (RBV) theory posits that firms achieve competitive advantage and long-term performance by utilizing unique resources that are valuable, rare, inimitable, non-substitutable, and imperfectly mobile (Barney, 1991; Wade & Hulland, 2004). These resources include tangible assets (e.g., hardware, infrastructure), intangible assets (e.g., software, patents), and capabilities that transform inputs into outputs, enhancing efficiency and effectiveness (Barney, 1991; Hamdoun, 2020; Gerhart & Feng, 2021). ERP systems are considered as valuable resources under RBV, as they require significant investments, skills, and organizational commitment, making them difficult to replicate (Tarigan et al., 2020). By embedding ERP systems into business processes, firms can enhance capabilities, optimize resource deployment, and sustain competitive advantage (Heredia-Calzado & Duréndez, 2019; Safari & Saleh, 2020). In the context of SMEs in Pakistan, this study leverages RBV to conceptualize ERP implementation as a unique resource for improving performance and achieving competitive advantage. This framework aligns with RBV's emphasis on leveraging heterogeneous, immobile resources to enhance organizational capabilities and performances.

DeLone and McLean (D&M) Theory of Information System Success

The DeLone and McLean (D&M) Theory of Information System Success, widely used for assessing IS success, outlines six original constructs system quality, information quality, system use, user satisfaction, individual impact, and organizational impact highlighting their interdependence (DeLone & McLean, 1992; Kaur & Chauhan, 2018). Updated in 2003, the model added service quality, combined "Intention to Use" with "Use," and replaced "Individual Impact" and "Organizational Impact" with "Net Benefits" to encompass IS benefits across individual, group, organizational, and societal levels (DeLone & McLean, 2003; Petter & McLean, 2009). Studies applying the D&M model for ERP success emphasize the significance of system quality, information quality, and service quality, with added factors such as top management support and business process reengineering enhancing ERP outcomes (Hsu et al., 2015; Nizamani et al., 2017). Integrations with frameworks like TAM and TOE have further demonstrated the model's robustness in explaining ERP success at all implementation stages, highlighting user satisfaction and perceived usefulness (Bento & Costa, 2013; Wibowo & Sari, 2018). This study employs the D&M model as a secondary framework to assess ERP's impact on user and workgroup productivity, financial management and SME competitive advantage, aligning with its focus on individual and organizational net benefits, making it an ideal fit for evaluating ERP implementation in SMEs.

Enterprise System Success (ESS) model

The Enterprise System Success (ESS) model, introduced by Gable et al. (2003), refines the D&M model by focusing on "System Quality," "Information Quality," "Individual Impact," and "Organizational Impact," while excluding constructs like "Intention of Use" and "Service Quality" to measure ERP success comprehensively (Gable et al., 2003; Gable et al., 2008). Recognized for its validity and applicability, the ESS model evaluates the net benefits of IS from the perspective of key user groups (Candra, 2012; Harr et al., 2019). It has been applied in various studies, such as by Candra (2012), who found knowledge capability positively influences ERP implementation success; Ali (2014), who identified success measures in New Zealand's largest telecommunications organization; and Ghazali et al. (2019), who highlighted the mediating role of knowledge management and leadership styles in post-implementation success. This study adopts the ESS model to assess ERP's impact on SME competitive advantage, integrating it with the D&M model to form a holistic framework for evaluating ERP implementation .

Research Model and Hypotheses

This section focuses on outlining the conceptual framework and formulating the hypotheses for the proposed model.

Research Model

Figure 1 illustrates the impact of successfully implementing ERP systems on enterprises, particularly in achieving competitive advantage. This study introduces a research model based on an in-depth review of selected ERP system literature. The proposed model identifies seven independent latent variables within the ERP implementation construct. Five of these variables are ERP system quality, ERP information quality, ERP service quality, individual productivity, and workgroup productivity are adapted from the D&M model and the enterprise systems success model. Additionally, two new constructs, cost management and sales management, specifically related to financial management, have been incorporated. These seven independent latent variables are identified as critical precursors to enterprise competitive advantage, which serves as the dependent variable. The research model highlights how ERP system implementation enhances organizational capabilities and competitive advantage, ultimately improving organizational performance and productivity.

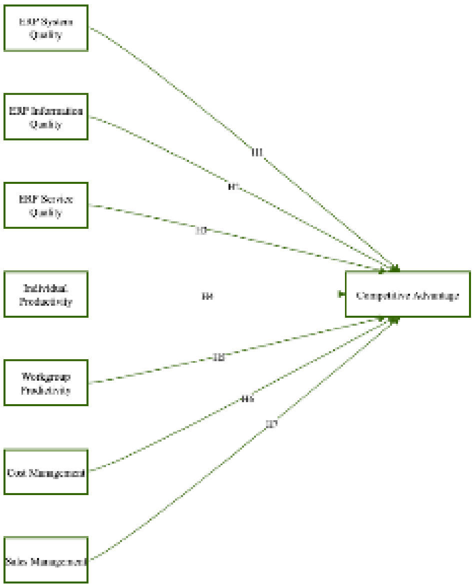

Figure 1: Research model

Hypotheses

Implementing an ERP system is often the most significant investment on organization in terms of information systems and in many cases this process is considered to be the largest corporate project (Shibly et al., 2022). This is especially common among SMEs in developing economies, where many operational and managerial processes are yet to be automated, and legacy systems are not as deeply embedded as they are in more developed business environments (AL-Shboul, 2019). ERP systems enable organizations to process, track, and capture a wide range of key performance indicators in near real-time, allowing managers to coordinate and oversee decision-making across the enterprise effectively (Ahmed, 2022). Thus, a successful ERP system implementation magnifies organizational capabilities. Besides, ERP systems offer major changes in culture and Behavior models which are the main sources of economic advantages (Estébanez, 2021). We, for that reason, expect a significant relationship between ERP implementation to these structures. Accordingly, we propose the following hypothesis:

Hypothesis H1: "ERP system quality has a positive impact on SME's competitive advantage".

ERP systems are seen as technological advancement to achieve competitive advantage. ERP system quality is the key to achieve success, the better the system quality the better it will be implemented which is a key ingredient of achieving competitive advantage. Numerous researchers have tested ERP system quality with competitive advantage and found that ERP system quality has relationship with competitive advantage (Hsu et al., 2015; Nizamani et al., 2017; Chaveesuk & Hongsuwan, 2017; Ravasan et al., 2018). Hence, through understanding of literature, ERP system quality has a relationship with competitive advantage.

Hypothesis H2: "ERP information quality has a positive impact on SME's competitive advantage".

ERP information quality is the main ladder to gain competitive advantage for an enterprise. As ERP information quality is the key of achieving goals and objectives of organisation, as information obtain by nearby system is vital for enterprise to conduct business operations. The quality of information depends upon the usage of ERP accurately. The more precise the information is the better it is for execution and easier for enterprise to process and achieve its goals. Many studies have proven that there is a causal relationship between ERP information quality and competitive advantage (Balić et al., 2022). Several studies claimed, based on their conceptual models that ERP information quality is positively related to competitive advantage (Hsu et al., 2015; Mekonnen et al., 2022; Batada, 2023).

Hypothesis H3: "ERP service quality has a positive impact on SME's competitive advantage".

Service provided by ERP system is vital for its success, whenever any ERP system is implemented in enterprise the most effective way it can impact is through its services. ERP service quality has a direct influence on competitive advantage, the better the service the better the organisation success rate. Numerous studies have shown there is a causal effect between ERP service quality and competitive advantage (Hsu et al., 2015; Irawan & Syah, 2017; Akrong et al., 2022).

Hypothesis H4: "Individual productivity achieved through ERP has a positive impact on SME's competitive advantage'.

The implementation phase of ERP has a wide range impact on individual productivity. As ERP system is implemented within enterprise the first and foremost impact it has is on individual's workflow efficiency and productivity. An individual utilises ERP system to perform daily routine tasks as well as complex business processes. Numerous research has shown that there is a positive causal effect between individual productivity and competitive advantage (Soliman & Karia, 2017; Ravasan et al., 2018; Akrong, Shao, et al., 2022).

Hypothesis H5: "Workgroup productivity achieved through ERP has a positive impact on SME's competitive advantage'.

ERP implementation has a significant impact on interdepartmental or work groups. ERP system makes it easy for departments/workgroups to have better understanding and collaboration in performing business tasks. ERP system implementation phase generates a better working environment that connects departments with each other through smooth flow of information via its networks feature. The workgroup productivity is increased when ERP system is implemented in enterprise as proven in numerous studies in management literature (Soliman & Karia, 2017; Ravasan et al., 2018; Batada, 2023).

Hypothesis H6: "Cost management achieved through ERP has a positive impact on SME's competitive advantage'.

When ERP system is implemented in small and medium scale enterprises, the first and foremost task for the management is to utilise it in cost management. As cost management is the key to save revenue as the enterprise implement information technology to cut costs and generate more profit. Evidently, it is managed through ERP systems as ERP has a proper module for cost management. Studies have shown that there is a positive impact of ERP implementation in cost management of enterprise (Junior et al., 2019; Ma, 2020; Jayamaha et al., 2023).

Hypothesis H7: Sales management achieved through ERP has a positive impact on SME's competitive advantage'.

In small and medium scale enterprises sale management is vital which is based on the amount of sale and profit it generates. In enterprise sale management plays a vital role in finances. As everything depends upon sales and cost of product made by enterprise. When ERP system is implemented in enterprise, the first and foremost goal for it is to organise sales management tasks and processes. Numerous studies have shown that sales management has a positive impact on ERP implementation phase to gain competitive advantage (Junior et al., 2019; UNGUREANU, 2022; Shakkur, 2023).

Research Methodology

This section discusses on how the data have been collected and the methodologies were employed to examine the research model.

Data Collection and Sampling

To collect data, an online survey was conducted using Google forms, targeting SMEs in Pakistan that had implemented ERP systems in their business processes. The focus of this study was small and medium-sized enterprises that adopted ERP systems for the first time between 2017-2023. This timeframe was considered suitable because prior research indicates that performance benefits from ERP implementation typically materialize only after several years of usage (Hietala, 2020). The unit of analysis in this research was the "firm," and an initial sample of 400 enterprises was identified and contacted using databases provided by Systems Limited, Abacus, SMEDA, and the Pakistan Stock Exchange. Out of these, 266 enterprises agreed to participate in the survey. After data collection, 10 incomplete or invalid responses were excluded due to inconsistent information, leaving 256 valid responses, resulting in a final response rate of 64%.

PLS-SEM is valued for its capability to analyse small sample sizes, making it an effective approach when large samples are difficult to obtain (Hair Jr et al., 2021). However, this does not negate the importance of adhering to sample size requirements, as an adequate sample size is crucial for ensuring reliable results and generalizing findings (Hair et al., 2014). Small sample sizes may limit generalizability and a minimum of 200 is often suggested for SEM-PLS (Basbeth et al., 2018). In this study, researchers followed established guidelines by determining a sample size of 381, based on the Krejcie and Morgan (1970) table, to represent Pakistani SMEs effectively. Furthermore, SEM guidelines recommend a sample size that is 5-20 times the number of paths estimated in the model (Krejcie & Morgan, 1970). Considering the SME population of approximately 60,000 for ERP implementation, this sample size calculation ensured robust and valid data.

Measurement Instruments

The data used to test the hypotheses were obtained through a web-based survey using a two-part questionnaire. While part one is related to demographic information which includes SME sector, types of ERP system, designation, gender, experience with ERP and ERP implementation duration. Part two involved a set of questions related to variables which measures the impacts of ERP system on SMEs namely ERP system quality, ERP information quality, ERP service quality, individual productivity, workgroup productivity, cost management, sales management and competitive advantage. Items were rated on a 5-point Likert scale, bouncing from 1 = "strongly disagree" to 5 = "strongly agree". All measures were adapted from prior scales, including: ERP system consist of system quality, service quality, information quality (DeLone & McLean, 2003; Gable et al., 2003; Ifinedo & Nahar, 2006; Ifinedo, 2006; Zare & Ravasan, 2014; Ravasan & Rouhani, 2018), individual productivity (DeLone & McLean, 2003; Gable et al., 2003; Ifinedo & Nahar, 2006; Ifinedo, 2006; Zare & Ravasan, 2014; Ravasan & Rouhani, 2018), workgroup productivity (DeLone & McLean, 2003; Ifinedo & Nahar, 2006; Ifinedo, 2006; Zare & Ravasan, 2014; Ravasan & Rouhani, 2018), cost and sales management (Singla, 2008; Laar et al., 2015; Amir et al., 2016; Junior et al., 2019; Chunawalla, 2021) and competitive advantage (Raharjo & Perdhana, 2016; Alomari et al., 2018; Falahat et al., 2020). The implementation of ERP systems was conceptualized as seven independent and one dependent construct. The measurement included seven items for each scale. Nevertheless, some items were removed as they showed a weak loading or loaded in two different factors. Overall, 56 items were applied to measure.

Data Analysis Method

In this research, we proposed a structural equation model to investigate the relationships among ERP implementation and organizational competitive advantage based on a hypothetical research model. The data analysis for this study was conducted using Smart PLS 4 (Partial Least Squares Structural Equation Modeling) and SPSS 24 (Statistical Package for the Social Sciences) to ensure robust evaluation of the measurement and structural models, as well as descriptive and inferential statistics. First, the raw data underwent preliminary screening in SPSS 24 to address missing values, outliers, and normality assumptions. Descriptive statistics, including means, standard deviations, and frequency distributions, were computed to summarize the demographic and primary variables. Next, the measurement model was assessed in Smart PLS 4 to evaluate construct validity and reliability. Convergent validity was examined using factor loadings (>0.7), average variance extracted (AVE >0.5), and composite reliability (>0.7), while discriminant validity was verified via the Heterotrait-Monotrait (HTMT) ratio (<0.85) and Fornell-Larcker criterion. Subsequently, the structural model was analysed to test hypothesized relationships, with path coefficients, coefficient of determination (R^2), and predictive relevance (Q^2) calculated. Bootstrapping (5,000 resamples) was applied to determine the significance of paths ($p < 0.05$).

Results

This section discusses the analysis results using the five methods including data screening process, demographic profiling, descriptive statistics, evaluation of measurement model and evaluation of structural model.

Data Screening Process

In SEM-PLS, data collection is crucial, and addressing issues in data screening like missing values, suspicious response patterns, outliers, and data distribution is essential for accurate analysis. Missing data which often is problematic in survey-based social science research, was mitigated in this study by using an online survey requiring compulsory responses. Suspicious response patterns, such as straight-line or diagonal marking, were identified and eliminated to ensure response reliability (Niessen et al., 2016; Lawlor et al., 2021). Outliers, which can distort multivariate analysis, were detected using IBM SPSS box plots and subsequently removed (Boukerche et al., 2020). While PLS-SEM does not require normality, extreme non-normality can affect parameter significance; thus, skewness and kurtosis were examined and found within acceptable thresholds (+3 for skewness, +10 for kurtosis), confirming data normality (Knief & Forstmeier, 2021).

Demographic Characteristics

Demographic characteristics are a crucial element in social science research, aiding policymakers in generalizing findings. This study collected demographic data on gender, age, SME sector, ERP system type, designation, user experience, and ERP implementation time. The results indicate that male respondents (63.4%) outnumber females (36.2%), reflecting Pakistan's SME workforce, where women predominantly work in education and healthcare. Most respondents (34.6%) were aged 26-35, aligning with Pakistan's youth-dominated workforce. The service sector had the highest representation (44.1%), highlighting its technological advancement . Oracle (36.6%) and SAP (34.3%) were the most used ERP systems due to their reliability and impact. Employees (35.8%) were the predominant ERP users, underlining their role in implementation operations. Regarding user experience, most had 4-6 years (29.1%), emphasizing the importance of expertise in ERP adoption, given SMEs' budget constraints. The highest ERP implementation period was 4-6 years (33.5%), demonstrating SMEs' long-term commitment to technological adoption for efficiency and competitiveness.

Descriptive Statistics

Table 1 presents descriptive statistics for the eight latent constructs evaluated in this study, comprising average item means, average standard deviations, and pooled standard deviations. Each construct was operationalized using seven items, as denoted in the item range. Mean scores ranged from 3.71 (Competitive Advantage) to 4.07 (Sales Management), reflecting a generally positive evaluation across constructs. The greatest dispersion, indicated by the pooled standard deviation, was observed in Competitive Advantage (0.958), whereas Sales Management exhibited the least variability (0.864). Reporting both average and pooled standard deviations facilitates a dual-level interpretation of item-level variability and construct-level precision. While average SDs provide a conventional summary of item dispersion, pooled SDs offer a more robust estimate by accounting for combined within-construct variance (Mishra et al., 2019; McGrath et al., 2020). These results confirm acceptable consistency in measurement and support the constructs’ reliability for subsequent multivariate analyses, including regression and structural equation modeling (SEM).

Table 1
Descriptive Statistics of Constructs

Construct	Avg. Mean	Average SD	Pooled SD	Item Range
ERP System Quality	3.76	0.94	0.942	SQ1–SQ7
ERP Information Quality	3.88	0.93	0.933	IQ1–IQ7
ERP Service Quality	3.87	0.91	0.917	SRQ1–SRQ7
Individual Productivity	3.92	0.88	0.880	IP1–IP7
Workgroup Productivity	3.85	0.88	0.880	WP1–WP7
Cost Management	3.90	0.90	0.901	CM1–CM7
Sales Management	4.07	0.86	0.864	SM1–SM7
Competitive Advantage	3.71	0.96	0.958	CA1–CA7

Evaluation of Measurement Model

The measurement model was rigorously evaluated to establish the reliability and validity of the constructs. This evaluation included an assessment of internal consistency, indicator loadings, and tests of convergent and discriminant validity, in accordance with the recommendations of Hair et al. (2019). Construct reliability and indicator relevance were examined using Partial Least Squares Structural Equation Modeling (PLS-SEM). As presented in Table 2 all item loadings exceeded the recommended threshold of 0.70, indicating satisfactory indicator reliability (Hair Jr et al., 2021). Furthermore, internal consistency was confirmed through Cronbach's alpha (α) and composite reliability (CR), both of which exceeded the accepted minimum value of 0.70 (Chan & Lay, 2018; Hajjar, 2018), thereby demonstrating strong reliability across the 56 measurement items. In addition, convergent validity reflecting the degree to which multiple items measuring the same construct are in agreement with was assessed through the Average Variance Extracted (AVE), a key metric for evaluating construct validity (Amora, 2021). As shown in Table 2, all constructs reported AVE values above the recommended threshold of 0.50, thus confirming convergent validity. Moreover, collinearity, which refers to high correlation among latent constructs must be assessed before evaluating path coefficients (Vanhove, 2021). In this regard, the Variance Inflation Factor (VIF) was used to detect collinearity, calculated as the reciprocal of tolerance (Hair et al., 2021). A tolerance value of 0.20 equals a VIF of 5; thus, VIF values above 5 indicate collinearity concerns (Kock, 2017), and indicators with VIF > 5 should be removed (Mohammed et al., 2021). In this study, all VIF values ranged between 1.175 and 2.215; therefore, no collinearity issues were present in the model.

Table 2
Reliability, Validity and Collinearity

Construct	Codes	Loading	VIF	CA	CR	AVE
ERP System Quality	SQ1	0.808	2.050	0.836	0.858	0.529
	SQ2	0.724	1.656			
	SQ3	0.764	1.729			
	SQ4	0.711	1.639			
	SQ5	0.729	1.433			
	SQ6	0.779	1.490			
	SQ7	0.763	1.744			
ERP Information Quality	IQ1	0.705	1.592	0.800	0.822	0.546
	IQ2	0.761	1.831			
	IQ3	0.722	1.637			
	IQ4	0.751	1.835			
	IQ5	0.773	1.811			
	IQ6	0.728	1,714			
	IQ7	0.830	1.679			
ERP Service Quality	SRQ1	0.782	1.654	0.881	0.883	0.522
	SRQ2	0.810	2.215			
	SRQ3	0.731	1.651			
	SRQ4	0.706	1.609			
	SRQ5	0.728	1.717			
	SRQ6	0.729	1.728			
	SRQ7	0.735	1.629			
Individual Productivity	IP1	0.751	1.394	0.833	0.837	0.508
	IP2	0.721	1.501			

	IP3	0.713	1.552			
	IP4	0.722	1.576			
	IP5	0.704	1.654			
	IP6	0.760	1.881			
	IP7	0.799	1.756			

Continue Table 2: Reliability, Validity and Collinearity

Workgroup Productivity	WP1	0.753	1.268	0.759	0.769	0.518
	WP2	0.764	1.309			
	WP3	0.776	1.378			
	WP4	0.790	1.283			
	WP5	0.794	1.350			
	WP6	0.783	1.435			
	WP7	0.822	1.653			
Cost Management	CM1	0.717	1.350	0.867	0.889	0.530
	CM2	0.730	1.373			
	CM3	0.701	1.305			
	CM4	0.763	1.323			
	CM5	0.733	1.463			
	CM6	0.746	1.836			
	CM7	0.703	1.864			
Sales Management	SM1	0.745	1.733	0.717	0.735	0.521
	SM2	0.716	1.609			
	SM3	0.744	1.634			
	SM4	0.717	1.532			
	SM5	0.753	1.743			
	SM6	0.709	1.758			
	SM7	0.767	1.472			
Competitive Advantage	CA1	0.732	1.175	0.808	0.874	0.554
	CA2	0.721	1.185			
	CA3	0.779	1.285			
	CA4	0.804	1.353			
	CA5	0.734	1.225			
	CA6	0.774	1.643			
	CA7	0.783	1.754			

Discriminant validity was assessed using three complementary techniques: cross-loadings, “the Fornell and Larcker criterion” and “the Heterotrait-Monotrait (HTMT) ratio”. Firstly, assessment of indicators' cross loadings was examined, where each indicator should load higher on its associated construct than on others (Hair et al., 2021). If cross loadings exceed outer loadings, discriminant validity issues arise (Rasoolimanesh, 2022). Table 3 shows that each indicator’s outer loading exceeds its cross loadings. Thus, discriminant validity confirmed via cross loading analysis.

Table 3
Cross-loadings

	SQ	IQ	SRQ	IP	WP	CM	SM	CA
SQ1	***0.808***	0.207	0.404	0.327	0.427	0.414	0.444	0.351
SQ2	***0.724***	0.433	0.497	0.474	0.292	0.338	0.289	0.442
SQ3	***0.764***	0.421	0.394	0.474	0.335	0.376	0.395	0.350
SQ4	***0.711***	0.304	0.477	0.449	0.343	0.338	0.450	0.431
SQ5	***0.729***	0.380	0.463	0.395	0.406	0.328	0.260	0.401
SQ6	***0.779***	0.437	0.350	0.488	0.386	0.228	0.339	0.449
SQ7	***0.763***	0.456	0.376	0.445	0.391	0.343	0.323	0.424
IQ1	0.478	***0.705***	0.387	0.411	0.401	0.387	0.360	0.498
IQ2	0.351	***0.761***	0.413	0.472	0.395	0.361	0.453	0.495
IQ3	0.446	***0.722***	0.325	0.448	0.321	0.359	0.413	0.319
IQ4	0.499	***0.751***	0.233	0.306	0.301	0.299	0.321	0.494
IQ5	0.309	***0.773***	0.356	0.439	0.457	0.389	0.453	0.329
IQ6	0.471	***0.728***	0.361	0.407	0.418	0.397	0.382	0.484
IQ7	0.343	***0.830***	0.373	0.315	0.474	0.432	0.420	0.463
SRQ1	0.482	0.446	***0.782***	0.427	0.353	0.343	0.370	0.394
SRQ2	0.382	0.480	***0.810***	0.356	0;418	0.376	0.461	0.458
SRQ3	0.494	0.428	***0.731***	0.412	0.357	0.355	0.443	0.449
SRQ4	0.448	0.481	***0.706***	0.424	0.298	0.232	0.391	0.405
SRQ5	0.479	0.318	***0.728***	0.307	0.365	0.371	0.447	0.425
SRQ6	0.471	0.494	***0.729***	0.399	0.481	0.369	0.476	0.401
SRQ7	0.331	0.243	***0.735***	0.468	0.302	0.420	0.429	0.442
IP1	0.457	0.488	0.381	***0.751***	0.419	0.321	0.441	0.329
IP2	0.481	0.396	0.432	***0.721***	0.486	0.381	0.469	0.314
IP3	0.454	0.469	0.433	***0.713***	0.497	0.446	0.319	0.378
IP4	0.300	0.475	0.484	***0.722***	0.495	0.469	0.322	0.288
IP5	0.464	0.380	0.381	***0.704***	0.398	0.392	0.418	0.340
IP6	0.455	0.374	0.458	***0.760***	0.384	0.390	0.396	0.365
IP7	0.499	0.444	0.459	***0.799***	0.445	0.423	0.315	0.343
WP1	0.417	0.474	0.380	0.434	***0.753***	0.448	0.449	0.345
WP2	0.317	0.238	0.304	0.384	***0.764***	0.275	0.387	0.223
WP3	0.453	0.430	0.404	0.309	***0.776***	0.371	0.304	0.313
WP4	0.398	0.369	0.356	0.420	***0.790***	0.425	0.472	0.259
WP5	0.244	0.211	0.232	0.300	***0.794***	0.277	0.433	0.255
WP6	0.324	0.435	0.311	0.211	***0.783***	0.417	0.233	0.436
WP7	0.230	0.232	0.412	0.233	***0.822***	0.236	0.400	0.300

Continue Table 3: Cross-loadings

CM1	0.289	0.370	0.306	0.418	0.333	***0.717***	0.403	0.354
CM2	0.323	0.367	0.383	0.400	0.430	***0.730***	0.478	0.360
CM3	0.415	0.385	0.321	0.465	0.297	***0.701***	0.418	0.339
CM4	0.388	0.357	0.350	0.417	0.476	***0.763***	0.463	0.440
CM5	0.211	0.332	0.255	0.311	0.144	***0.733***	0.322	0.321
CM6	0.466	0.366	0.432	0.277	0.266	***0.746***	0.422	0.264

CM7	0.300	0.200	0.266	0.423	0.345	***0.703***	0.253	0.345
SM1	0.446	0.413	0.366	0.301	0.417	0.491	***0.745***	0.402
SM2	0.404	0.402	0.389	0.436	0.448	0.437	***0.716***	0.371
SM3	0.413	0.398	0.334	0.417	0.436	0.448	***0.744***	0.438
SM4	0.458	0.405	0.350	0.496	0.487	0.387	***0.717***	0.439
SM5	0.438	0.373	0.361	0.342	0.498	0.309	***0.753***	0.435
SM6	0.304	0.344	0.328	0.307	0.456	0.391	***0.709***	0.297
SM7	0.451	0.399	0.377	0.472	0.448	0.385	***0.767***	0.378
CA1	0.431	0.348	0.310	0.362	0.344	0.410	0.421	***0.732***
CA2	0.417	0.475	0.467	0.373	0.217	0.353	0.418	***0.721***
CA3	0.487	0.481	0.303	0.361	0.319	0.390	0.387	***0.779***
CA4	0.344	0.311	0.200	0.443	0.124	0.399	0.135	***0.804***
CA5	0.411	0.433	0.312	0.322	0.218	0.411	0.432	***0.734***
CA6	0.266	0239	0.433	0.244	0.441	0.255	0.155	***0.774***
CA7	0.488	0.400	0.215	0.411	0.332	0.366	0.443	***0.783***

According to Fornell & Larcker (1981), discriminant validity is established when the square root of each construct's average variance extracted (AVE) exceeds its correlations with other constructs. This conservative method, known as the Fornell-Larcker (FL) criterion, assesses discriminant validity by comparing the square root of AVE with inter-construct correlations (Ab Hamid et al., 2017). As shown in Table 4, all diagonal values (square roots of AVEs) were greater than the corresponding off-diagonal correlations, confirming discriminant validity at the construct level. This finding aligns with the recommendations of Cheung et al. (2023) and supports the validity of the measurement model.

Table 4
Fornell-Larcker Criterion

	CA	**CM**	**IP**	**IQ**	**SM**	**SQ**	**SRQ**	**WP**
CA	***0.745***							
CM	0.517	***0.728***						
IP	0.500	0.581	***0.712***					
IQ	0.674	0.505	0.596	***0.739***				
SM	0.548	0.606	0.665	0.542	***0.722***			
SQ	0.599	0.487	0.680	0.675	0.598	***0.722***		
SRQ	0.663	0.467	0.620	0.522	0.498	0.515	***0.728***	
WP	0.405	0.535	0.609	0.534	0.631	0.556	0.505	***0.720***

The HTMT ratio was calculated to provide additional evidence of discriminant validity. HTMT is defined as the average of Heterotrait-Monotrait correlations relative to monotrait-heteromethod correlations(Ab Hamid et al., 2017). Values below the threshold of 0.85 indicate sufficient construct separation (Voorhees et al., 2016; Roemer et al., 2021). As shown in Table 5, all HTMT ratios fell below the critical value, confirming the discriminant validity.

Table 5
Heterotrait-Monotrait Ratio

	CA	CM	IP	IQ	SM	SQ	SRQ	WP
CA								
CM	0.788							
IP	0.718	0.771						
IQ	0.738	0.651	0.715					
SM	0.762	0.778	0.806	0.632				
SQ	0.723	0.599	0.748	0.755	0.580			
SRQ	0.818	0.615	0.802	0.777	0.697	0.826		
WP	0.612	0.741	0.810	0.669	0.820	0.703	0.654	

Evaluation of Structural Model

The structural (inner) model was assessed to examine the explained variance, relevance of variables, and the significance of the hypothesized relationships between constructs. Following the guidelines of Hair et al. (2019), key evaluation metrics were employed to assess the model's explanatory power, the strength of inter-variable relationships, and the presence of multicollinearity. These metrics included the coefficient of determination (R^2), effect size (f^2), and predictive relevance (Q^2). The proposed model provides a substantial explanation for the relationship between ERP system implementation impacts and competitive advantage in the SME sector, as illustrated in Table 6. Specifically, the R^2 and adjusted R^2 values indicate that the predictors in the model explain 57.6% and 54.7% of the variance, respectively. While the magnitude of these values may be influenced by model complexity, predictor variables, and sample size, they nonetheless suggest that the model is competent in capturing the underlying phenomena. To assess the contribution of each predictor, effect size values (f^2) were analysed. These ranged from 0.050 to 0.253, indicating medium-level effects. A higher f^2 value signifies a stronger impact of a predictor on the dependent variable's variance. The predictive relevance (Q^2) of the model was also confirmed using the blindfolding procedure, yielding a Q^2 value of 0.501—well above zero—thus affirming the model's predictive validity. Furthermore, multicollinearity was assessed through Variance Inflation Factor (VIF) values, with none exceeding the threshold of 3. This indicates that there was no evidence of multicollinearity among the predictor variables.

Table 6
Structural Model Evaluation

Constructs	R^2	R^2 adjusted	f^2	Q^2
System Quality (SQ)	-	-	0.153	-
Information Quality (IQ)	-	-	0.253	-
Service Quality (SRQ)	-	-	0.168	-
Individual Productivity (IP)	-	-	0.050	-
Workgroup Productivity (WP)	-	-	0.064	-
Cost Management (CM)	-	-	0.170	-
Sales Management (SM)	-	-	0.178	-
Competitive Advantage (CA)	0.574	0.547	-	0.501

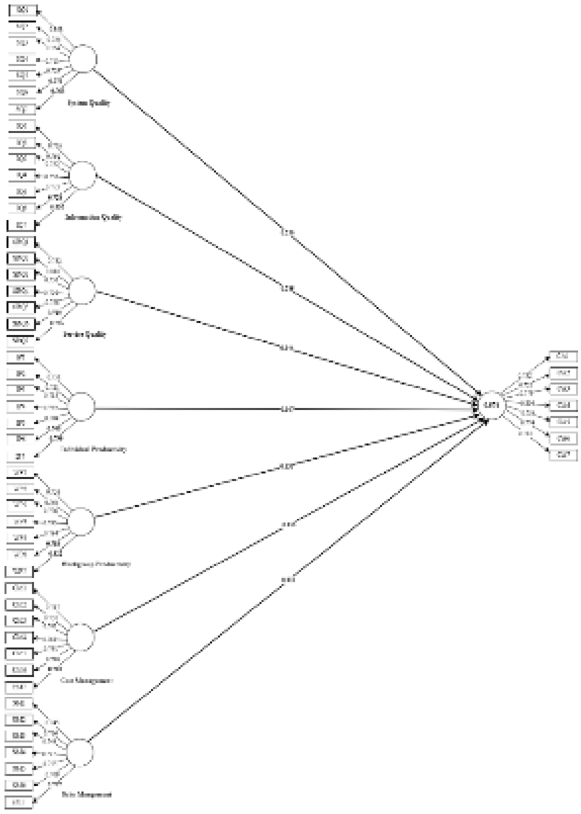

Figure 2: Path coefficient, R^2 and loadings

The significance of the structural relationships among the study variables was evaluated using the bootstrapping method with 5,000 resamples, in accordance with the recommendations of Hair et al. (2019). The results, summarized in Table 8, confirm that all hypothesized relationships are statistically significant, thereby supporting all proposed hypotheses. Hypothesis 1 posited that ERP system quality (SQ) has a positive impact on SMEs' competitive advantage (CA) in Pakistan. This hypothesis was supported ($\beta = 0.236$, $t = 2.672$, $p < 0.05$). Hypothesis 2 proposed that ERP information quality (IQ) positively influences competitive advantage. The analysis confirmed this relationship ($\beta = 0.285$, $t = 3.302$, $p < 0.05$). Hypothesis 3 examined the effect of ERP service quality (SRQ) on competitive advantage. The findings indicated a positive and significant relationship ($\beta = 0.144$, $t = 1.835$, $p < 0.05$). Hypothesis 4 focused on individual productivity (IP) derived from ERP implementation. Results supported the hypothesis ($\beta = 0.107$, $t = 1.877$, $p < 0.05$). Hypothesis 5 suggested that workgroup productivity (WP) gained from ERP use has a positive impact on competitive advantage. This relationship was statistically significant ($\beta = 0.133$, $t = 2.320$, $p < 0.05$). Hypothesis 6 tested whether effective cost management (CM) achieved through ERP positively affects competitive advantage. The results confirmed this ($\beta = 0.156$, $t = 2.676$, $p < 0.05$). Hypothesis 7 proposed that effective sales management (SM) via ERP implementation contributes positively to competitive advantage. The relationship was strongly supported ($\beta = 0.231$, $t = 3.219$, $p < 0.05$). In conclusion, all seven hypotheses were statistically supported, affirming the structural model's robustness. These outcomes are further illustrated in Figures 2, 3 and detailed in Table 7.

Table 7
Hypothesis Testing

Structural Path	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	Coef (β) (T-statistics)	P Value	Remarks
H1: SQ→CA	0.236	0.228	0.088	0.236, 2.672	0.004	Supported
H2: IQ→CA	0.285	0.270	0.086	0.285, 3.302	0.000	Supported
H3: SRQ→CA	0.144	0.142	0.078	0.144, 1.835	0.033	Supported
H4: IP→CA	0.107	0.102	0.078	0.107, 1.877	0.034	Supported
H5: WP→CA	0.133	0.125	0.057	0.133, 2.320	0.010	Supported
H6: CM→CA	0.156	0.159	0.058	0.156, 2.676	0.004	Supported
H7: SM→CA	0.231	0.232	0.72	0.231, 3.219	0.001	Supported

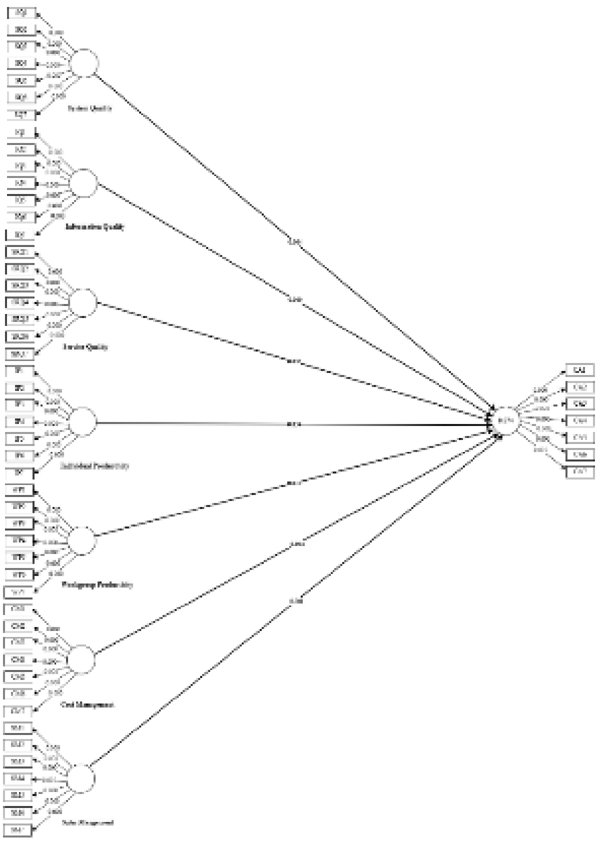

Figure 3: Coefficient significance test (p-values) and R^2 value

Discussion

This research aimed to evaluate ERP implementation impact on competitive advantage in the context of SMEs in Pakistan, applying the Resource-Based View (RBV) theory, the DeLone and McLean (D&M) Information Systems Success Model end the enterprise system success model (ESS). The findings of the study reveal that key ERP system dimensions—including system quality, information quality, service quality, individual productivity, workgroup productivity, cost management, and sales management—significantly influence competitive advantage during ERP implementation. These findings support and extend previous empirical studies and theoretical models in the domain of ERP success.

ERP System Quality, Information Quality, and Service Quality

The study confirms that ERP system quality plays a vital role in influencing ERP implementation success. high system quality, encompassing the technical soundness and reliability of ERP software, facilitates smooth adoption, minimizes operational friction, and enhances organizational performance. These results are consistent with earlier works e.g., Soliman & Karia (2017) and Ravasan et al. (2018), validating the system quality's role as a critical antecedent to competitive advantage. Similarly, information quality was found to be a significant driver of competitive advantage. High-quality, accurate, timely, and relevant information derived from ERP systems enables better decision-making and operational efficiency. This aligns with findings from studies such as Tarigan et al. (2021) and Balić et al. (2022), confirming that ERP-generated information quality is central to enterprise success, particularly in data-driven environments. ERP service quality, defined by the technical support provided to users, also emerged as a strong influencer of ERP implementation impact. Effective support services reduce user frustration, minimize system downtime, and foster a culture of technological acceptance. This echoes the empirical evidence from Khand & Kalhoro (2020) and Sheik & Sulphey (2020), underscoring service quality as a foundational element of ERP-enabled competitive advantage.

Individual and Workgroup Productivity

The research extends the ERP success discourse by emphasizing the roles of individual and workgroup productivity. ERP systems that support user tasks and streamline workflows significantly enhance personal and collective efficiency. The results affirm that individual productivity boosts user satisfaction and job performance, aligning with studies like Kabir (2020) and Ajalli & Jafargholi (2023). Workgroup productivity, a relatively underexplored construct, was found to be crucial in achieving competitive advantage. ERP systems facilitate collaboration and coordination among departments, enabling better resource sharing and project alignment. This is consistent with findings by Aini et al. (2020) and Ahmed & Mahalik (2021), reinforcing the idea that ERP systems act as central nervous systems connecting all organizational units.

Financial Dimensions: Cost and Sales Management

Cost and sales management are strategic imperatives for any enterprise, especially SMEs. The study reveals that ERP systems significantly improve cost control by offering tools for better budgeting, forecasting, and expenditure tracking. This aligns with the findings of Andrieș & Ungureanu (2022) and Jayamaha et al. (2023), confirming that effective cost management is a powerful antecedent of ERP success and enterprise competitiveness. Sales management, another critical module of ERP, also demonstrated a strong impact on competitive advantage. The ability to monitor, evaluate, and strategize around sales performance allows firms to respond more dynamically to market changes. These findings support those of Junior et al. (2019) and Atanasov (2022), reinforcing the relevance of ERP systems in supporting financial and market-oriented goals.

Theoretical Contributions

This study contributes to the theoretical body by validating the RBV, D&M and ESS models in the context of Pakistani SMEs. It affirms that ERP systems function as strategic resources that, when effectively deployed, contribute to sustainable competitive advantage. Furthermore, it supports the notion that ERP system attributes (quality, service, and productivity) act as performance enablers rather than mere operational tools.

Practical Implications

For SME managers and decision-makers, the findings underscore the need to invest not only in ERP adoption but also in enhancing system quality, ensuring high data integrity, providing strong technical support, and training users effectively. Emphasizing user productivity and interdepartmental coordination can yield substantial performance gains. Additionally, leveraging ERP for financial functions like cost and sales management can directly improve profitability and competitiveness.

Conclusion

This study examined the impact of ERP implementation on competitive advantage within Pakistani SMEs, using the Resource-Based View (RBV) theory, the DeLone and McLean (D&M) model, and the Enterprise System Success (ESS) model. A comprehensive framework was developed incorporating seven key antecedents of ERP implementation impacts namely ERP system quality, information quality, service quality, individual productivity, workgroup productivity, cost management, and sales management. Based on survey data from 256 ERP users across Pakistan's SME sector, the findings confirmed that all seven antecedents significantly contribute to competitive advantage during ERP implementation. This study contributes theoretically by extending existing ERP models with new constructs and offers practical insights for SME owner, employees and managers in selecting and implementing ERP systems effectively. However, limitations such as the geographic scope, cross-sectional design are caution in generalization. Future research should explore additional moderators, adopt longitudinal or mixed-method approaches, and extend the study to other regions or enterprise sizes to enhance the generalizability and depth of insights. In conclusion, ERP systems, when implemented with a strategic focus on quality, productivity, and financial management, serve as powerful tools for SMEs to achieve and sustain competitive advantage in today's dynamic business environment.

This study offers valuable theoretical and contextual contributions to the ERP literature and SME research in developing economies. By integrating the Resource-Based View (RBV), DeLone and McLean's IS Success Model, and the Enterprise System Success (ESS) framework, this research provides a holistic model to evaluate ERP implementation outcomes in SMEs—an area that has been underexplored in existing literature. The theoretical extension of ERP success metrics to include cost and sales management broadens the understanding of ERP's role beyond technical success to strategic performance. Contextually, this study addresses a significant research gap by focusing on Pakistan's SME sector, where empirical evidence remains scarce despite rapid ERP adoption. The findings offer practical implications for SME managers and policymakers in similar economies, highlighting ERP systems as a catalyst for productivity, financial control, and sustainable competitive advantage.

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