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# The Effect of Technological Competence and Knowledge Management on Sustainable Organizational Performance

Syed Shahid Hussain, Alia Ahmed, Abdul Rauf Qureshi

## Chronicle

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**Syed Shahid Hussain, Alia Ahmed, Abdul Rauf Qureshi** are currently affiliated with Department of *National College of Business Administration & Economics, Lahore, Pakistan*.

***Corresponding Author:**
**Email:** sshahidhusain@gmail.com

## Abstract

This research article investigates the impact of Knowledge Management (KM), Technological Competence (TC) on Sustainable Organizational Performance (SOP), with a by examining the mediating role of OI. Using a sample of 314 respondents from IT-based companies and software houses, the research explores how KM and TC contribute to enhancing SOP with OI serving as a mediator in these relationships. The study employs SEM to test the direct and indirect associations of the study variables. The research findings show positive interconnections between KM and SOP, TC and SOP and OI and SOP. Furthermore, OI is found to mediate the relationship between KM and SOP as well as between TC and SOP emphasizing its pivotal role in enhancing sustainable performance. The study underscores the importance of integrating KM practices and technological capabilities with OI acting as a key enabler, to achieve sustainable organizational performance. These insights offer valuable guidance for managers seeking to leverage knowledge management and technological innovation to drive long-term success in this digital age.

**Keywords:** Knowledge Management (KM), Technological Competence (TC), Organizational Innovation (OI), Sustainable Organizational Performance (SOP) and Structural Equation Modeling.



# INTRODUCTION

In the fast-paced and constantly evolving business landscape, to achieve sustainable organizational performance has become a strategic priority for firms across industries. Sustainability, in the realm of business, refers to the capability of organizations to thrive economically, socially, and environmentally over the long term (Guerci *et al*., 2023). Organizations that prioritize sustainability can achieve competitive advantages by lowering costs, boosting operational effectiveness and strengthening their reputation with consumers, investors and other stakeholders (Hassan *et al*., 2023). Central to this pursuit of sustainable performance are three critical enablers: technological competence, knowledge management (KM), and organizational innovation. These elements help organizations develop innovative solutions, optimize their processes, and align their strategies with sustainability goals.

Technological competence enables firms to adopt and integrate advanced technologies that improve resource efficiency, minimize waste, and facilitate environmental sustainability (Xu *et al*., 2023). Knowledge management, on the other hand, supports the creation, sharing, and application of knowledge that is crucial for fostering innovation and making informed decisions related to sustainability (Martínez-Torres *et al*., 2023). Organizational innovation, which includes the development of new

processes, products, and business models, plays a vital role in enabling firms to meet evolving market demands, regulatory requirements, and environmental challenges (Santos-Vijande *et al*., 2021). While these three variables are widely recognized as crucial drivers of organizational success, there is limited research that comprehensively examines how they collectively influence sustainable organizational performance, particularly in contemporary settings characterized by rapid technological advancements and increasing sustainability expectations.

The concept of sustainable organizational performance is increasingly recognized as a multi-dimensional construct that includes economic, environmental, and social dimensions (Hassan *et al*., 2023). For IT companies, achieving sustainability often involves optimizing resource utilization, reducing operational costs, fostering innovation, and improving their environmental and social footprints (Santos-Vijande *et al*., 2021). Technological competence plays an essential role enabling IT companies to adopt and integrate advanced technologies that drive efficiency, facilitate green innovations, and enhance overall performance (Xu *et al*., 2023). Similarly, knowledge management in IT-intensive firms involves the efficient creation, sharing and utilization of knowledge to foster innovation and improve decision-making (Martínez-Torres *et al*., 2023). Finally, organizational innovation in software houses and IT companies is key to staying competitive by introducing new products, services, and solutions that address both market demands and sustainability challenges (Gupta *et al*., 2022).

In recent years, the information technology (IT) sector has emerged a critical driver of financial growth and innovation worldwide. Among the diverse segments of the IT industry, software houses and IT-intensive companies play a pivotal role in shaping the technological landscape not only by contributing to economic development but also by driving innovations that support sustainability across various sectors. In the context of Pakistan, a rapidly developing region in South Asia, the IT sector is growing at an unprecedented rate, with a particular focus on software development and technology solutions (Sajjad *et al*., 2022). As these companies evolve, the integration of technological competence**,** knowledge management (KM), and organizational innovation has become crucial for ensuring sustainable organizational performance in an increasingly competitive and environmentally conscious global market.

In the Punjab region of Pakistan, where the IT sector is flourishing, it is essential for software houses and IT-intensive companies to understand how these three elements technological competence, knowledge management, and organizational innovation interact and contribute to long-term sustainable performance. Despite the growing significance of these factors in IT companies globally, there is limited research focusing specifically on their impact in the context of the Punjab IT industry. This research paper intends to fill this gap investigating their role in achieving sustainable organizational performance in IT based firms in Punjab, Pakistan.

## Problem Statement

While technological competence, knowledge management, and organizational innovation are widely recognized as critical drivers of organizational success, there is a lack of comprehensive studies examining how these variables collectively influence sustainable performance, particularly in the IT industry in Pakistan. Although, some researches explored the independent impacts of these elements on performance

(Camisón & Villar-López, 2022) but few studies have considered their combined effects and how they mediate one another to improve sustainability outcomes in IT-intensive firms. Moreover, while the concept of organizational innovation as a mediator has been highlighted in some studies (Murat & Guler, 2023), its specific role in linking technological competence and knowledge management to sustainable performance in the context of the IT sector remains less focused. Therefore, this research aims to explore the dynamics between these three critical variables and how they contribute to sustainable performance in software houses and IT companies.

## Research Significance

This research study is significant with respect to both practical and theoretical terms. From a practical perspective, it gives useful insights for IT managers, policymakers and business leaders in Punjab, Pakistan, by identifying key strategies for achieving sustainable organizational performance. The findings will help software houses and IT-intensive companies optimize their technological capabilities, improve their knowledge management practices, and enhance their innovation strategies to achieve better sustainability outcomes, thereby increasing their competitive advantage in both national and international markets (Raimo *et al*., 2022). Moreover, by understanding the mediating role of organizational innovation, firms can better align their innovation efforts with technological and KM plans and strategies to ensure the long-term success.

Whereas from a theoretical standpoint, this research is an addition providing an integrated framework that explores the combined impact of technological competence, knowledge management, and organizational innovation on sustainable organizational performance. It also subsidizes to the growing body of research on sustainability specifically in the IT sector by highlighting the importance of these three factors in driving long-term performance and innovation in emerging markets like Punjab, Pakistan. This study further enriches sustainability research by offering a contextualized understanding of how these drivers function within the specific socio-economic environment of the Punjab IT sector.

In this section, research background, its importance, significance, problem statement and the research questions are discussed. Whereas, the next section discusses about the relevant literature to get insight about the variables and constructs used in the previous studies. The section-3 will discuss the methodology of this study by expressing about the research approach, methods, statistical tools and techniques for data collection and analyses. The subsequent section-4 discusses results of the study and in the last section, discussion, implications, limitations and conclusion in line with the research objectives and literature. The implications, limitations and conclusion will also be included in the last section.

# LITERATURE REVIEW

The pursuit of sustainable organizational performance has become a central objective for firms aiming to succeed in a progressively competitive and eco-conscious global market. The literature highlights several key drivers in achieving this goal, including technological competence, knowledge management (KM) and organizational innovation. Technological competence refers to an ability to incorporate and apply technological tools effectively which enhances efficiency and sustainability (Bohorquez

& Esteves, 2022). Knowledge management (KM) plays a crucial role by enabling organizations to effectively capture, share and apply knowledge to drive continuous improvement and innovation (Singh *et al*., 2021). Organizational innovation which encompasses the introduction of new processes, products or business models, has been linked to long-term performance sustainability by helping firms adapt to evolving market conditions and sustainability requirements (Gupta *et al*., 2022).

This chapter reviews the literature on each of these key concepts individually before examining how they collectively contribute to sustainable organizational performance which has become a significant strategic priority for contemporary organizations. This research article is an attempt to examine the effect of knowledge management and technological competence on organizational innovation enabling organizations for sustainable performance.

## Sustainable Organizational Performance

The sustainable organizational performance (SOP) refers to a company's capacity to attain long-term success by incorporating economic, environmental, and social sustainability into its operations and strategies (Guerci *et al*., 2023). Sustainable performance is characterized by financial profitability, reduced environmental impact and positive contributions to societal well-being (Hassan *et al*., 2023). Attaining sustainability in organizational performance entails a equilibrium between meeting short and long term financial goals.

Recent literature emphasizes that sustainable performance is not only about minimizing negative environmental and social impacts but also about creating new opportunities for value generation through innovation, efficiency and stakeholder engagement (Santos-Vijande *et al*., 2021). For instance, organizations that integrate sustainability into their business models, such as adopting circular economy principles, tend to achieve superior performance in the long run (Raimo *et al*., 2022). Furthermore, organizations with strong commitments to sustainability often see improved employee satisfaction, customer loyalty, and brand reputation, contributing in sustainable financial performance (Guerci *et al*., 2023). According to Guerci *et al*. (2023), organizations that prioritize sustainability in their business strategies tend to perform better financially while minimizing their environmental footprints. Moreover, Hassan *et al*. (2023) concluded that organizations that assimilate sustainability into their operational strategies, are more resilient and competitive in the marketplace.

## Knowledge Management and Sustainable Organizational Performance

Knowledge management (KM) involves the process of creating, storing, sharing and applying organizational knowledge to enhance decision-making, problem-solving and innovation (Singh *et al*., 2021). In recent years, KM has emerged as a critical enabler of sustainable organizational performance as it helps firms respond to rapidly changing market environments, regulatory challenges and customer expectations. Effective KM practices such as knowledge sharing, collaborative learning and continuous improvement are essential for promoting sustainability within organizations (Martínez-Torres *et al*., 2023). Research indicates that KM is particularly valuable in fostering sustainability by facilitating the adoption of green technologies, optimizing resource use and improving operational efficiency (Alavi & Leidner, 2023). For example, knowledge-sharing networks and communities of practice can drive environmental innovations,

reduce waste and create value for the firm as well as the society (Nayak *et al*., 2023). Furthermore, KM systems enable organizations to harness both internal and external knowledge, ensuring that firms can adapt to new sustainability trends and compliance standards (Mazzola *et al*., 2022).

Previous studies have also emphasized on the role of KM in promoting organizational learning which is essential for continuous improvement in sustainability practices (Bhatia & Zaveri, 2023). The literature repeatedly highlights a number of recent studies emphasizing the crucial role of knowledge management in sustained performance. According to Alavi and Leidner (2023), effective KM practices have been linked to higher organizational sustainability by ensuring that critical knowledge flows throughout the organization, supporting both innovation and resource optimization. Similarly, Martínez-Torres *et al*. (2023) found that KM practices that encourage collaboration and information sharing significantly improve firms' ability to address environmental and operational challenges.

## Technological Competence and Sustainable Organizational Performance

Technological competence is an ability to effectively acquire, utilize and integrate advanced technologies into organizational operations (Bohorquez & Esteves, 2022). In the context of sustainability, technological competence plays a fundamental role in optimizing processes, reducing environmental impacts, and driving innovation (Xu *et al*., 2023). The extant literature expounds that the technological advancements are becoming increasingly central to business operations. The firms with high technological competence are better equipped to develop sustainable products and services, enhance operational efficiency and adapt to changing market conditions (Raimo *et al*., 2022).

Technological competence is particularly important for green innovation, as firms use technology to improve energy efficiency, minimize waste and reduce carbon emissions (Lu *et al*., 2022). For example, firms investing in renewable energy technologies, smart manufacturing systems or sustainable supply chain technologies can achieve both cost reductions and improved environmental performance (Raimo *et al*., 2022). Furthermore, digital transformation driven by technological competence can enable firms to meet sustainability goals by enhancing data analysis, improving decision-making, and streamlining operations (Feng *et al*., 2023). A study by Xu *et al*. (2023) highlighted that technological competence directly correlates with improved sustainable performance, particularly in the green industry by enabling firms to develop environmentally-friendly technologies. Additionally, Raimo *et al*. (2022) emphasized that technological competence allows organizations to reduce inefficiencies which contributes significantly to long-term sustainability goals.

## Organizational Innovation and Sustainable Organizational Performance

Organizational innovation is a key driver of sustainable performance, encompassing new product innovations, process improvements and business model adaptations aimed at creating value while addressing environmental and societal needs (Gupta *et al*., 2022). Organizational innovation has been identified as a critical capability for enhancing sustainability, as it enables firms to develop new solutions that minimize environmental impact, reduce costs, and improve social responsibility (Hassan *et al*., 2023). Recent

studies underscore that innovation particularly in sustainability-related areas such as energy efficiency, waste management, and resource optimization leads to improved organizational performance by helping companies stay competitive and compliant with sustainability regulations (Santos-Vijande *et al*., 2021).

Moreover, innovative corporations are well placed to capture market opportunities, develop new revenue streams and differentiate themselves from competitors through their sustainability efforts (Camisón & Villar-López, 2022). Organizational innovation also enables firms to adapt to disruptive technological changes and address the challenges postured by environmental variation, regulatory pressure and shifting consumer preferences (Feng *et al*., 2023). Gupta *et al*. (2022) emphasized that firms engaging in sustainable innovation not only improve their operational efficiencies but also enhance their market competitiveness by meeting the growing demand for eco-friendly products. Similarly, Camisón and Villar-López (2022) highlighted the importance of organizational innovation in fostering long-term sustainability. Concluding the discussion above, following may be the main objectives of this research article:

## Research Objectives

1. To examine the role of technological competence in achieving sustainable organizational performance in software houses and IT-intensive companies in Punjab.
2. To investigate how knowledge management practices, influence sustainable organizational performance in the IT industry of Punjab, Pakistan.
3. To explore the role of organizational innovation in linking technological competence and knowledge management to sustainable performance.
4. To develop a comprehensive framework that integrates technological competence, knowledge management, and organizational innovation as key drivers of sustainable organizational performance in the IT sector of Punjab.

## Theoretical Framework and Hypotheses

While there is extensive research on the individual effects of technological competence, knowledge management and organizational innovation on performance but few studies have focused on the intersection of these factors within the context of the IT sector. The IT industry is rapidly evolving and understanding how these drivers interact to foster continuous performance is important for local industry to achieve competitive advantage and long-term success (Sajjad *et al*., 2022). Furthermore, although previous studies have suggested the potential mediating role of organizational innovation between technological competence and organizational outcomes (Murat & Guler, 2023) but little research found in the literature which has specifically addressed this mediation in the IT context. This study fills this gap by offering a holistic approach that investigates the joint impact of these variables on sustainable organizational performance in Punjab's software houses and IT-intensive firms. Keeping in view the extant literature, discussion and importance of the study, the following theoretical framework is formulated for further investigations:

## Hypotheses

As discussed above the roles and importance of technological competence (TC), knowledge management (KM) and organizational innovation (OI) to achieve sustained

performance, following hypotheses are formulated to examine the assumptions empirically.

**H1:** There is a mediating effect of organizational innovation (OI) between the relationship of technological competence and sustainable organizational performance.

**H2:** There is a positive mediating role of organizational innovation (OI) between the relationship of knowledge management and sustainable organizational performance.

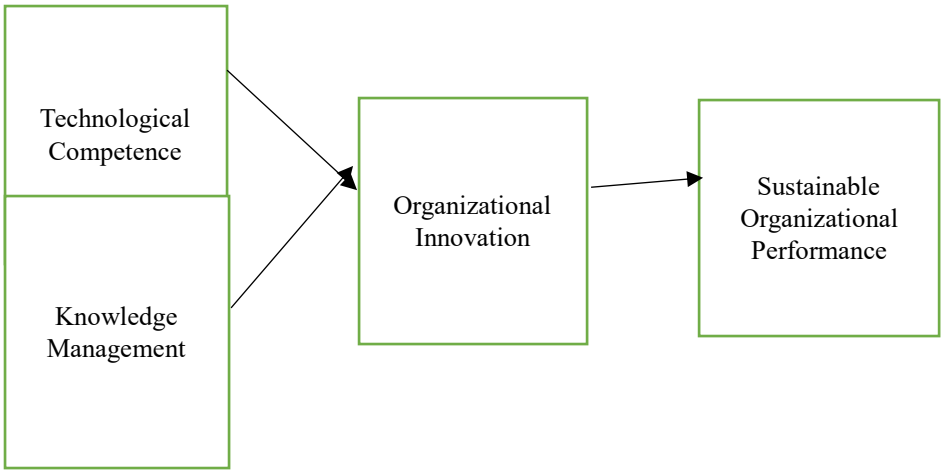


**Figure1:**
**Mediating role of organizational innovation**

# METHODOLOGY

This research article is an attempt to investigate empirically the effect of technological competence, knowledge management and organizational innovation on sustainable organizational performance (SOP). This section describes the research design, target population and sample, data collection methods, measurement tools and statistical techniques for data analysis.

## Research Design

The study follows a quantitative research framework through a cross-sectional approach to collect data from the IT-intensive companies and software houses in the province of Punjab, Pakistan. This design is appropriate for testing the hypotheses formulated to investigate the associations among the constructs of technological competence, knowledge management, organizational innovation and sustainable organizational performance. The use of structural equation modeling (SEM) will enable testing of both direct and indirect relationships among the research constructs (Hair *et al*., 2017). Given the complex nature of the study, SEM allows for a robust analysis of multiple constructs and their relationships simultaneously.

## Population and Sampling Techniques

The professionals and managers in IT-intensive organizations and software houses operating within the province of Punjab, Pakistan were targeted to test the hypotheses. Random sampling technique is used to collect data because the number of companies

and employees are unknown (Alvi, M. 2016). The sample size required for statistical analysis is determined through Cohen's (1992) power analysis. Based on this analysis and the desired effect size, a sample of 314 respondents is targeted. This sample size ensures sufficient statistical power for SEM and enriches the generalizability of the results.

## Data Collection

Data collection was carried out in two phases using a multi-wave survey design. The first phase (T1) focuses on the collection of data related to knowledge management (KM), technological competence and organizational demographics. The second phase (T2), conducted two weeks later, captures responses regarding organizational innovation (OI), and sustainable organizational performance (SOP). To minimize common biases, a time-lagged design is employed (Podsakoff *et al*., 2012) as this approach allows for a more accurate evaluation of causal relationships. Questionnaires were distributed using all communication channels i.e., online platform and emails to maximize accessibility and response rates. Moreover, paper-based questionnaires were also provided to organizations by visiting them personally.

## Measurement Instruments

The well-established instruments are adopted from the literature for this research. The Knowledge Management (KM) is measured using the scale of Kearns, G. S., & Sabherwal, R. (2006), which includes items related to knowledge sharing, knowledge creation, and knowledge application. Technological Competence (TC) is measured using the scale developed by Danneels, E. (2008), focusing on technological capabilities, integration of new technologies and the utilization of existing technological resources. Organizational Innovation (OI) is assessed by using the scale developed by Weerawardena, J. (2003) which includes items reflecting product, process and business model innovation.

The last one is dependent construct which is Sustainable Organizational Performance (SOP), it is assessed through the framework provided by Aguirre-Urreta *et al*. (2021), which includes environmental, economic, and social performance dimensions. Each of the item included in the scale consists of 5 items, rated on a Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). The measuring items were pre-tested for clarity and reliability through a pilot survey conducted on a small sample of 30 respondents.

## Data Analysis

The collected data is investigated in the next chapter by using SPSS and AMOS statistical tools. In this analysis, an overview of the sample is given through descriptive statistics in which means, standard deviations and frequencies were calculated. The reliability and validity of the model were assessed using Confirmatory Factor Analysis (CFA) (Anderson & Gerbing, 1988). Internal consistency was evaluated by using Cronbach's alpha and composite reliability (CR) tests while convergent validity was tested through average variance extracted (AVE). Moreover, discriminant validity was examined by applying the Fornell-Larcker criterion and calculating the Heterotrait-Monotrait ratio (Henseler *et al*., 2015).

The hypotheses were tested using SEM to analyze both direct as well as indirect relationships. The fit of the model was assessed through Chi-square ($\chi^2$), Root Mean Square Error of Approximation (RMSEA), Comparative Fit Index (CFI) and Standardized Root Mean

Residual (SRMR) tests (Hu & Bentler, 1999). Furthermore, bootstrapping was employed to evaluate the significance of the mediation effects proposed in the model (Preacher & Hayes, 2008).

# DATA ANALYSIS AND RESULTS

The process of data analysis to investigate the research queries through hypotheses is discussed in this section. The relationships between technological competence (TC), knowledge management (KM), organizational innovation (OI) and sustainable organizational performance (SOP) have been investigated using various statistical tools and techniques. Moreover, the proposed models and hypotheses including both the direct as well as indirect effecting the relationships among the constructs have also been investigated in this section. The survey data are analyzed using advanced statistical methods, including descriptive statistics, CFA and SEM, facilitated by SPSS 23.0 and AMOS 23.0 software.

To examine the mediation effects, the bootstrapping technique was employed with 10,000 bootstrap samples and a 95% confidence interval following the guidelines of Iacobucci et al. (2007). These methods enable a thorough evaluation of both the measurement and structural models providing a profounder understanding of how key variables interact and influence sustainable performance in organizations. The findings are discussed in terms of their theoretical and practical implications, offering insights into the mechanisms by which organizational capabilities contribute to sustainable performance.

## Demographics

The survey considered four key demographic factors: gender, age, education, and work experience. A total of 314 individuals from selected IT companies and software houses participated by completing the self-administered questionnaires. Regarding gender, the distribution was categorized as 1=male and 2=female with 83% (n=260) of the respondents being male and 17% (n=54) female. The age distribution was segmented into five categories: 1=20-29 years, which accounted for 23% of respondents (n=72); 2=30-39 years, representing 37% (n=116); 3=40-49 years, with 32% (n=101) of participants; and 4=50-60 years, which comprised 8% (n=25) of the sample.

For the educational background, respondents were classified into three groups: 1=Intermediate/ADP (12-14 years of education), 2=Undergraduate (16 years of education), and 3=Masters or higher (18 years of education and above). The breakdown showed that 13% (n=40) had an intermediate level education, 61% (n=192) were undergraduates, and 26% (n=82) held a Master's degree or higher. Finally, work experience was categorized into three brackets: 1=1-3 years, 2=6-10 years, and 3=11 years and above. The distribution of experience was as follows: 37% (n=116) had 1-5 years of experience, 43% (n=135) had 6-10 years, and 20% (n=63) had over 10 years of professional experience.

## Normality Test

Data normality tests play a vital role in ensuring the accuracy and validity of statistical analyses, especially when investigating complex relationships between variables, such as the connection between Knowledge Management (KM) practices and organizational

performance. As noted by Kline (2005), the assumption of normality is fundamental for techniques like Structural Equation Modeling (SEM) and factor analysis which are commonly used to examine dynamic capabilities and their influence on Sustainable Organizational Performance (SOP).

**Table 1:**
**Demographics**

| Demographics | Dimension | Frequency | Percentage (%) |
|---|---|---|---|
| Gender | Male | 260 | 83% |
| | Female | 54 | 17% |
| Age | 20-29 Years | 72 | 23% |
| | 30-39 Years | 116 | 37% |
| | 40-49 Years | 101 | 32% |
| | 50-60 Years | 25 | 8% |
| Education | Intermediate/ADP (12-14 years) | 41 | 13% |
| | Undergraduate (16 years) | 192 | 61% |
| | Graduate/Masters and above (18 years and above) | 81 | 26% |
| Experience | 1-5 Years | 116 | 37% |
| | 6-10 Years | 135 | 43% |
| | 11 Years or above | 63 | 20% |

**Table 2:**
**Normality Analysis**

| Variable | Min | Max | Skew | C.R. | Kurtosis | C.R. |
|---|---|---|---|---|---|---|
| OI1 | 1.000 | 5.000 | -.501 | -3.623 | -.346 | -1.251 |
| OI2 | 1.000 | 5.000 | -.807 | -5.836 | .254 | .918 |
| OI3 | 1.000 | 5.000 | -.663 | -4.799 | -.364 | -1.318 |
| OI4 | 1.000 | 5.000 | -.702 | -5.081 | -.175 | -.634 |
| OI5 | 1.000 | 5.000 | -.748 | -5.412 | -.232 | -.840 |
| OI6 | 1.000 | 5.000 | -.833 | -6.026 | .048 | .173 |
| OI7 | 1.000 | 5.000 | -.833 | -6.028 | .238 | .862 |
| OI8 | 1.000 | 5.000 | -.831 | -6.013 | .284 | 1.027 |
| TC1 | 1.000 | 5.000 | -1.235 | -8.937 | 1.537 | 5.561 |
| TC2 | 1.000 | 5.000 | -.788 | -5.701 | -.133 | -.482 |
| TC3 | 2.000 | 5.000 | -.513 | -3.714 | -.460 | -1.663 |
| TC4 | 1.000 | 5.000 | -.980 | -7.086 | .899 | 3.253 |
| SOP6 | 1.000 | 5.000 | -.283 | -2.046 | -.558 | -2.017 |
| SOP5 | 1.000 | 5.000 | -.338 | -2.444 | -.775 | -2.804 |
| SOP4 | 1.000 | 5.000 | -.308 | -2.227 | -.643 | -2.327 |
| SOP3 | 1.000 | 5.000 | -.221 | -1.597 | -.462 | -1.670 |
| SOP2 | 1.000 | 5.000 | -.254 | -1.837 | -.474 | -1.715 |
| SOP1 | 1.000 | 5.000 | -.188 | -1.357 | -.454 | -1.644 |
| KM1 | 1.000 | 5.000 | -.464 | -3.353 | -.636 | -2.301 |
| KM2 | 1.000 | 5.000 | -.489 | -3.535 | -.457 | -1.653 |
| KM3 | 1.000 | 5.000 | -.473 | -3.423 | -.506 | -1.830 |
| KM4 | 1.000 | 5.000 | -.357 | -2.581 | -.663 | -2.397 |
| KM5 | 1.000 | 5.000 | -.468 | -3.383 | -.626 | -2.265 |
| Multivariate | | | | | 66.503 | 9.472 |

## Descriptive Statistics

Descriptive statistics play a crucial role in summarizing and providing insights into the key characteristics of the sample population in this study. As highlighted by Bickel and Lehman (1975), these statistics offer valuable understandings into the central tendencies and

variability of the data that are crucial for examining how various variables relate to Knowledge Management (KM) practices and Sustainable Organizational Performance (SOP). Measures such as means and medians provide an understanding of the data's central location while standard deviations and inter-quartile ranges help assess the spread and dispersion of the data points. According to Sekaran (2000), frequency and percentage distributions are particularly useful for summarizing categorical data such as the variables in this study—SOP, KM, OI, and T).

By analyzing these variables, the study seeks to identify patterns and relationships, offering deeper insights into how KM practices contribute to organizational performance (Ferreira & Oliveira, 2014). The mean and standard deviation were computed to gain a clearer understanding of the demographic characteristics of the sample population, including gender, age, education and job experience. These demographic factors are crucial for evaluating the diversity within the sample and understanding how various elements might affect the relationships amongst KM, TC, OI and SOP outcomes. Table 4.4 provides a summary of the values for mean and standard deviation.

**Table 3:**
**Descriptive Statistics**

| No. | Variables | Mean | SD |
|---|---|---|---|
| 1 | Sustainable Organizational Performance | 3.28 | 0.84 |
| 2 | Organizational Innovation | 3.78 | 0.86 |
| 3 | Technological Competence | 3.97 | 0.87 |
| 4 | Knowledge Management | 3.42 | 0.92 |

## Construct Reliability

Reliability and internal consistency of the instrument tested by calculating Cronbach's alpha values for each of the research constructs i.e., Knowledge Management (KM), Technological Competence (TC), Organizational Innovation (OI) and Sustainable Organizational Performance (SOP). As per standard, the Cronbach's alpha value should be 0.70 or above to demonstrate internal consistency among the items of the scale (Nunnally and Bernstein, 1994). A pretest was conducted to ensure that the respondents of this research fully understood the questions of the survey questionnaire as they were asked (Brislin, 1980). The questionnaire included various measures that had been validated in previous studies for their reliability as mentioned earlier.

To assess the reliability of the adopted survey, 25 copies were distributed into the respondents from selected companies who responded to give their feedback on the variables used in the instrument. The internal consistency of the adopted instrument was examined by calculating Cronbach's alpha values which is required to be equal or greater than 0.7. The Cronbach's alpha values for each variable were found to be well above the threshold of 0.7 indicating that the questions within all constructs are measuring reliably the underlying concepts. These values suggest that the questionnaire items are internally consistent, making them suitable for further analysis.

Nevertheless, the instrument demonstrates strong reliability ensuring that the constructs used to explore the relationships between KM, Competences, Innovation, and Sustainable Organizational Performance are measured accurately and consistently (Field, 2013).

**Table 4:**
**Construct Reliability**

| Variables | No. of Items | Cronbach's Alpha |
|---|---|---|
| Sustainable Organizational Performance | 6 | 0.87 |
| Organizational Innovation | 8 | 0.94 |
| Technological Competence | 4 | 0.94 |
| Knowledge Management | 5 | 0.88 |

## Correlation Analysis

According to McMillan (1993), correlation values 0.1-0.3 represent a weak association, 0.3-0.7 indicates a moderate connection and values above 0.7 denote a strong relationship. Moreover, the p-value is calculated to find out the statistical significance amongst the relationships. The p-value less than 0.05 indicates that the relationship is statistically significant. Thus, in this study, bivariate Pearson correlation coefficients (r) along with their respective p-values were also calculated for all variables and found significant. The participants from IT-based companies and software houses were asked to respond to a Likert scale ranging from 1 to 5 reflecting the extent to which they agreed or disagreed with statements concerning Knowledge Management (KM), Technological Competence (TC), Organizational Innovation (OI) and Sustainable Organizational Performance (SOP). These constructs are central to understanding how organizations can utilize KM practices to improve long-term performance. The statistical results indicate significant correlations among all study variables. For example, SOP is positively correlated with OI ($r = 0.33$, $p \leq 0.01$), TC ($r = 0.28$, $p \leq 0.01$), and KM ($r = 0.33$, $p \leq 0.01$). Similarly, OI shows significant correlations with TC ($r = 0.35$, $p \leq 0.01$), and KM ($r = 0.31$, $p \leq 0.01$). Moreover, TC correlates with KM ($r = 0.22$, $p \leq 0.01$). Table 4.7 provides a detailed summary of the correlation analysis.

**Table 5:**
**Correlation Analysis**

| Variables | Mean | SD | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|---|
| Sustainable Organizational Performance | 3.28 | 0.84 | (.87) | | | |
| Organizational Innovation | 3.78 | 0.86 | .337** | (.94) | | |
| Technological Competence | 3.97 | 0.87 | .282** | .359** | (.94) | |
| Knowledge Management | 3.40 | 0.87 | .334** | .315** | .227** | (.88) |

$p \leq 0.01$, *. $p \leq 0.05$. Parentheses forming diagonal represent Cronbach's alpha (α).

## Construct Validity

The construct validity is a degree to which an instrument reveals that the theoretical construct measures what it intends to measure (Cronbach & Meehl, 1955). It is essential for ensuring that the instruments and variables used in a study are consistent with the conceptual definitions of the constructs being assessed. In this research, construct validity was evaluated through both EFA and CFA. Firstly, EFA was conducted to identify underlying dimensions of the main constructs i.e., Knowledge Management (KM), Technological Competence (TC), Organizational Innovation (OI) and Sustainable Organizational Performance (SOP). This step ensured that the items effectively captured these constructs (Hair et al., 2010). Subsequently, CFA was used to confirm the factor structure by assessing the alignment between the proposed model and the observed data. Strong factor loadings and favorable model fit supported the construct validity of the proposed conceptual model. Consequently, it ensures that the study variables

accurately represented their theoretical constructs, thus confirming both the reliability and validity (Bagozzi & Yi, 1988).

## Exploratory Factor Analysis

EFA is particularly useful at the initial stages of research, where the objective is to recognize the number and nature of latent variables that underlie a collection of observed indicators. In this study, EFA was employed to investigate the dimensionality of constructs related to Knowledge Management (KM), Technological Competence (TC), Organizational Innovation (OI), and Sustainable Organizational Performance (SOP). It facilitates the identification of groups of inter-correlated constructs denoted to as factors or latent variables that can explain the relationships among observed phenomena. The technique operates by analyzing covariance relationships among the variables to interpret these latent dimensions. The findings from the EFA confirmed that the variables loaded on to their respective factors as anticipate which establishes a solid foundation for the subsequent CFA and SEM.

**Table 6:**
**Exploratory Factor Analysis**

| Items | Organizational Innovation (OI) | Sustainable Organizational Performance (SOP) | Technological Competence (TC) | Knowledge Management (KM) |
|---|---|---|---|---|
| OI1 | .755 | | | |
| OI2 | .784 | | | |
| OI3 | .761 | | | |
| OI4 | .808 | | | |
| OI5 | .800 | | | |
| OI6 | .788 | | | |
| OI7 | .803 | | | |
| OI8 | .769 | | | |
| SOP1 | | .717 | | |
| SOP2 | | .756 | | |
| SOP3 | | .718 | | |
| SOP4 | | .713 | | |
| SOP5 | | .802 | | |
| SOP6 | | .713 | | |
| TC1 | | | .878 | |
| TC2 | | | .887 | |
| TC3 | | | .871 | |
| TC4 | | | .871 | |
| KM1 | | | | .817 |
| KM2 | | | | .812 |
| KM3 | | | | .777 |
| KM4 | | | | .773 |
| KM5 | | | | .723 |

## Confirmatory Factor Analysis

CFA is a statistical technique used to evaluate the data fits to a hypothesized measurement model, which specifies the associations between observed variables and the underlying latent variables (Hair *et al*., 2010). In this article, CFA was employed to validate the measurement model for key constructs, including Knowledge Management (KM), Technological Competence (TC), Organizational Innovation (OI) and Sustainable Organizational Performance (SOP). CFA enables the evaluation of construct validity by examining how well the observed indicators reflect the theoretical constructs (Byrne,

2010). The CFA results provide evidence of the reliability and validity of the model confirming that the items sufficiently represent the intended latent variables and support the subsequent structural analysis. The main model fit indices such as the CFI and RMSEA, were used to assess the goodness-of-fit (Kline, 2016). Before evaluating the structural model, the model must first be evaluated as emphasized by Anderson and Gerbing (1988). The results from the suggested 6-factor model, presented in Table 4.9 show that it provides a good fit to the data with fit indices as follows: $\chi 2 = 1819.210$, df = 845, $\chi 2/df = 2.153$, RMSEA = 0.061, CFI = 0.90, and NNFI = 0.90.

These values meet the recommended criteria: $\chi 2/df < 3$, RMSEA < 0.08, CFI ≥ 0.90, and NNFI ≥ 0.90 (Hu & Bentler, 1999). Additionally, both CFI and NNFI values greater than or equal to 0.90 are considered acceptable (Cheung & Rensvold, 2002). In contrast, the one-factor model provided a poor fit ($\chi 2 = 6581.591$, df = 860, $\chi 2/df = 7.653$, RMSEA = 0.146, CFI = 0.513, NNFI = 0.480), further supporting the choice to proceed with the 6-factor model. The factor structures examined were as follows:

a. SOP, OI, TC and KM, all put into one factor.

b. KM, TC and SOP united as one factor. OI as second factor.

c. KM and TC united as one factor. SOP as second factor. OI as third factor.

d. KM, TC, OI and SOP as one factor.

**Table 7:**
**Confirmatory Factor Analysis**

| Variables | $\chi^2$ | d.f | Ratio $\chi^2$ / d.f | CFI | NNFI | RMSEA |
|---|---|---|---|---|---|---|
| 1-factor frame[a] | 3220.021 | 229 | 14.061 | 0.443 | 0.385 | 0.204 |
| 2-factor frame[b] | 1947.590 | 227 | 8.580 | 0.680 | 0.643 | 0.156 |
| 3-factor frame[c] | 1574.807 | 225 | 6.999 | 0.749 | 0.718 | 0.138 |
| 4-factor frame[d] | 500.851 | 222 | 2.256 | 0.948 | 0.941 | 0.063 |

## Factor Loading

Factor loading represents the correlation among observed variables and respective latent variables that play a vital role to examine the validity of a measurement model in CFA. It indicates the degree to which each observed variable contributes to its corresponding latent factor (Hair et al., 2010). Higher factor loadings reflect a stronger relationship between the observed variable and the latent construct it is designed to measure. Generally, factor loadings greater than 0.70 are considered satisfactory, indicating that the observed variables have a strong association with the latent constructs (Nunnally & Bernstein, 1994). This threshold aids researchers in identifying the most effective variables for representing the underlying constructs, thereby improving the overall validity of the model.

In this study, the factor loadings for the constructs of Knowledge Management (KM), Technological Competence (TC), Organizational Innovation (OI), and Sustainable Organizational Performance (SOP) were analyzed to confirm that the items within each construct accurately measured the intended concepts. The results revealed high factor loadings for all variables, providing evidence that the conceptual model is valid as well as reliable for subsequent analysis. Table 4.8 displays the factor loading values all of which are greater than or very close to 0.7.

**Table 8:**
**Factor Loading**

| Items | Organizational Innovation (OI) | Sustainable Organizational Performance SOP) | Knowledge Management (KM) | Technological Competence (TC) |
|---|---|---|---|---|
| OI1 | .746 | | | |
| OI2 | .810 | | | |
| OI3 | .806 | | | |
| OI4 | .820 | | | |
| OI5 | .849 | | | |
| OI6 | .827 | | | |
| OI7 | .838 | | | |
| OI8 | .809 | | | |
| SOP1 | | .669 | | |
| SOP2 | | .749 | | |
| SOP3 | | .721 | | |
| SOP4 | | .754 | | |
| SOP5 | | .797 | | |
| SOP6 | | .663 | | |
| KM1 | | | .821 | |
| KM2 | | | .794 | |
| KM3 | | | .781 | |
| KM4 | | | .751 | |
| KM5 | | | .729 | |
| TC1 | | | | .890 |
| TC2 | | | | .934 |
| TC3 | | | | .858 |
| TC4 | | | | .867 |

## Evaluation of Measurement Model

The estimation of the model involves assessing the reliability as well as validity to ensure that the instruments accurately measure the intended constructs. Reliability is typically evaluated using Cronbach's alpha and composite reliability (CR) with values above 0.7 indicating acceptable internal consistency (Hair et al., 2017). Convergent validity is examined through the average variance extracted (AVE) as the values exceeding 0.5 deemed acceptable (Fornell & Larcker, 1981). Discriminant validity is checked by using the Fornell-Larcker criterion and the Heterotrait-Monotrait ratio (Henseler et al., 2015).

Nonetheless, the factor loadings should also be significant (usually above 0.7) to ensure that the measurement items are strong indicators of their respective constructs (Anderson & Gerbing, 1988). The goodness-of-fit tables like CFI, RMSEA and SRMR are also used to confirm that the model fits the data well (Hu & Bentler, 1999). These steps have helped to ensure that the measurement model is reliable, valid and appropriate for use in structural equation modeling (SEM).

**Table 9:**
**Convergent and Discriminant Validity**

| | CR | AVE | MSV | MaxR (H) | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|---|---|---|
| TCA | 0.937 | 0.788 | 0.149 | 0.943 | (0.888) | | | |
| KMA | 0.883 | 0.602 | 0.167 | 0.960 | 0.252 | (0.776) | | |
| OIA | 0.940 | 0.662 | 0.243 | 0.976 | 0.386 | 0.344 | (0.814) | |
| SOPA | 0.870 | 0.529 | 0.169 | 0.984 | 0.310 | 0.375 | 0.371 | (0.727) |

1. The values in diagonal are the square root of AVE

2. TCA – Technological Competence Average, KMA – Knowledge Management Average, OIA – Organizational Innovation Average and SOP – Sustainable Organizational Performance

3. Correlation is significant at 0.01 level (2-tailed)

## Common Method Bias

Both qualitative and quantitative methods were used to minimize common method bias, in line with recommendations from the literature. To further address this issue, a multi-wave survey approach was employed (Podsakoff *et al*., 2012). The data collection process was carried out in two stages using a time-lagged research design. In the first phase (T1), data on knowledge management and demographic variables were gathered. The second phase (T2), which occurred 15 days later, focused on technological competence, marketing competence, organizational innovation, big data analytics, and sustainable organizational performance. In addition to the multi-wave survey method, Harman's single-factor test has also been applied (Podsakoff *et al*., 2003) to detect common biases. The results revealed no significant common method bias, as the single latent factor explained only 28.8% of the total variance, well below the 50% threshold suggested by Mattila and Enz (2002).

## Path Analysis

Path analysis is used to investigate the direct and indirect associations among the variables in a conceptual model commonly used within the framework of SEM. This method is used to test causal relationships amongst observed variables to get insights for the strength and direction of these associations (Kline, 2016). Path analysis can assess direct effects (e.g., the impact of one variable on another) as well as indirect effects (e.g., the influence of one variable on another via a mediator) (MacKinnon, 2008). It operates under the postulation that associations between variables are linear and is particularly useful in validating theoretical models with a clear causal structure (Schumacker & Lomax, 2016). Recent developments in path analysis have enabled the inclusion of more complex models, such as those that account for non-linear relationships and latent variables (Hair et al., 2021). By clarifying the interactions among variables, path analysis is a powerful tool for testing theoretical frameworks and advancing research in fields such as organizational behavior, marketing, and psychology. In this study, the analysis fully supported to both the hypotheses with positive relationships as shown in Table 4.10. Both the hypotheses are indirect relationships as KM→ OI→SOP and TC→ OI→ SOP. The results in Table 4.11 confirmed that both of these indirect relationships are positive.

**Table 10:**
**Path Analysis**

| | | 95% confidence intervals for Bootstrap BCa | | | |
|---|---|---|---|---|---|
| Hypotheses | Results | Estimate | Lower | Upper | P |
| H1 | TC→ SOP | .153 | .049 | .259 | .021 |
| | TC→ OI→ SOP | .059 | .028 | .113 | .006 |
| H2 | KM→ SOP | .446 | .131 | .353 | .015 |
| | KM→OI→ SOP | .046 | .016 | .085 | .009 |

"BCa: bias-corrected and accelerated bootstrapping confidence intervals. Estimate based on 10,000 bootstrap samples."

SOP: Sustainable Organizational Performance// OI: Organizational Innovation//TC: Technological Competence // KM: Knowledge Management

# DISCUSSION AND IMPLICATION

This research article was was an attempt to explore the relationships between Knowledge Management (KM), Technological Competence (TC), Organizational Innovation (OI) and Sustainable Organizational Performance (SOP) in IT-intensive organizations and software houses operating in the province of Punjab, Pakistan. This research especially examined the mediation of OI between KM and SOP and between TC and SOP. The results of the study have confirmed that KM significantly influences on both OI and SOP supporting as a fundamental enabler of organizational success. Furthermore, TC positively influences SOP accentuating the importance of technological capabilities in driving sustainable performance. The results also supported the mediation effect of OI between KM and SOP as well as between TC and SOP. It indicates that the organizational innovation plays a pivotal role in translating knowledge management and technological competence enabling organizations for enhanced sustainable performance. Hence, this study underwrites to a deeper understanding of how organizational capabilities interrelate to foster sustainable performance.

## Theoretical Implications

This research article espouses the existing body of research through empirical investigation of the crucial role of OI in the relationship of KM, TC and SOP. The results reinforce the idea that innovation is not just an outcome but a critical enabler of organizational success. This supports the theory that KM and TC when effectively integrated into an organization's innovation strategy it leads to better performance outcomes. The study also aligns with the Resource-Based View (RBV) which suggests that firms gain competitive edge by effectively leveraging internal resources such as knowledge and technology. By showing that KM and TC enhance SOP through innovation, this research augments to the body of work on how organizational capabilities can be leveraged for sustainable performance. Nevertheless, the positive mediating role of OI between KM and SOP and between TC and SOP emphasizes the importance of innovation in translating capabilities into actual organizational success, reflecting the work of Chen *et al*. (2022) who argued that innovation is a key driver of long-term organizational performance.

## Practical Implications

The findings highlight the importance of integrating KM practices with technological advancement and innovation strategies. Managers in IT-based organizations should focus on fostering an environment that encourages knowledge sharing, technological proficiency and innovative thinking. Consequently, organizations can enhance their long-term performance and adaptability in competitive landscape. The results suggest that innovation is not a mere byproduct of KM or TC but a crucial mediator that amplifies the positive effects of these capabilities on SOP. Therefore, organizations should prioritize creating a culture of innovation supported by strategic KM practices and technological advancements to achieve sustainable performance outcomes.

### Limitations and Future Research

Notwithstanding, very useful contributions, there are a few limitations observed while carrying out this research. Firstly, the research was conducted solely within IT-based organizations which may be a limitation for the generalizability for other sectors or industries. Thus, the future research can repeat this study in various contexts to assess the transferability of the findings. Secondly, since this study has emphasized on the research constructs; KM, TC, OI, and SOP but there many other factors need to be considered such as leadership styles, external environment and organizational culture etc. It is therefore, recommended for future researchers to explore the interaction between these factors and their collective impact on organizational performance. Lastly, this study has used a cross-sectional approach which provides an insight about the relationships at one point in time. Hence, it would be worthwhile if longitudinal studies could be carried out in future to get a deeper understanding of the dynamic nature of these relationships over time, especially in the context of rapidly changing technological environments.

## CONCLUSION

This research article provides very useful understandings about the interrelationships between Knowledge Management (KM), Technological Competence (TC), Organizational Innovation (OI) and their collective impact on Sustainable Organizational Performance (SOP). The findings indicate that both KM and TC are important drivers of SOP influencing it directly as well as indirectly emphasizing the mediating role of OI. These results highlight the essential role that innovation plays in facilitating the transformation of KM and TC into long term organizational success. Notwithstanding, effective leveraging of knowledge, technology and innovation, can not only enhance organizational operational efficiency but also create sustainable competitive advantages. In the current fast-paced and evolving business environment, the capability to innovate and integrate these critical elements can significantly enhance an organization's agility and overall sustainable performance. This phenomenon accentuates the importance of nurturing a culture of continuous innovation and technological advancement which may be helpful in fostering adaptability capabilities in organizations to cope up with the changing market conditions and sustain their growth over time.

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