APTISI Transactions on Technopreneurship (ATT)
Vol. 8, No. 1, March 2026, pp. 268−283
E-ISSN: 2656-8888 | P-ISSN: 2655-8807, DOI:10.34306

Technology-Driven Resource Utilization and Integration to Enhance Firm Performance

Muhammad Dharma Tuah Putra Nasution[1*], Yossie Rossanty[2], Ramadhan Harahap[3], Aulia Ramadhan Tanjung[4], Thorique Akbar Maulana Nasution[5]
[1,2,3,4]Department of Management, Universitas Pembangunan Panca Budi, Indonesia
[5]Faculty of Economics and Management, Universiti Kebangsaan Malaysia, Malaysia
[1]dharmatuah@gmail.com, [2]yosunpab@gmail.com, [3]ramadhan.rahman41@yahoo.com, [4]auliaramadant@gmail.com, [5]thoriqnasution7@gmail.com
***Corresponding Author**

Article Info

Article history:

Submission July 25, 2024
Revised February 10, 2025
Accepted December 22, 2025
Published January 23, 2026

Keywords:

Resource Utilization
Resource Integration
Firm Performance
Resource Based Theory

ABSTRACT

Rapid digital transformation has increased the need for firms to optimize how technological resources are utilized and integrated to enhance performance, particularly among Small and Medium-sized Enterprises (SMEs) facing resource constraints. Although prior research highlights the value of digital adoption, less is known about how resource integration mechanisms convert technology-driven utilization into sustainable performance outcomes. This study aims to examine the effect of technology-driven resource utilization on firm performance and to test the mediating role of resource integration within the Resource-Based View (RBV) framework. A quantitative research design was applied using survey **data collected from 233 firms** undergoing digital transformation across various industries. The hypothesized relationships were analyzed using Structural Equation Modeling (SEM) with SmartPLS. The analysis followed standard PLS-SEM procedures, including measurement model assessment for reliability and convergent validity, and structural model evaluation to test path significance and mediation effects. **The results show** that technology-driven resource utilization has a significant positive effect on firm performance. Resource integration also significantly improves firm performance and partially mediates the relationship between resource utilization and performance, indicating that digital resources contribute more effectively when embedded into coordination routines, aligned workflows, and knowledge-sharing mechanisms. **This study concludes** that dynamic resource integration is a critical capability for translating technology-driven resource utilization into sustainable firm performance, extending RBV by emphasizing integration capability as a strategic asset. Limitations include the cross-sectional design and SME-focused sample; future studies should employ longitudinal designs and broader industry contexts.

DOI: https://doi.org/10.34306/att.v8i1.472

1. INTRODUCTION

In today's competitive business landscape, firms seek innovative ways to optimize resource utilization and enhance performance. Digital transformation and automation have reshaped business processes, yet many organizations struggle to fully leverage these advancements for sustained competitive advantage [1]. Given

these challenges, previous studies have explored strategies to improve resource utilization [2]. Understanding how firms efficiently integrate internal and external resources remains a crucial research area in strategic management.

Research has highlighted the role of resource integration in fostering co-creation between firms and clients, demonstrating that strong integration capabilities enhance resource utilization [3]. The combination of internal and external resources contributes to value creation and firm performance [4]. Knowledge integration is also critical for business adaptability in dynamic environments [5]. While these studies provide valuable insights, they largely examine resource utilization broadly without addressing how technology-driven approaches optimize resource deployment [6].

This research focuses on technology-driven resource utilization such as social media, e-commerce and other digital platforms to enhance efficiency and performance. As firms increasingly adopt digital solutions, collaboration among organizations becomes crucial to integrating resources effectively and achieving a competitive edge. Despite extensive literature on resource capabilities, gaps remain in understanding how firms optimize technology-driven resource utilization to adapt to market changes [7]. While resource capabilities are widely studied, empirical evidence on specific strategies for maximizing technological efficiency is still limited [8].

A related gap involves interfirm networks and collaborative approaches in strengthening the relationship between resource integration and firm performance [9]. Prior research, largely rooted in the Resource-Based View (RBV), has not sufficiently explored how firms in technology-driven industries integrate resources strategically. Beyond collaboration, the practical implications of technology-driven resource utilization remain underexamined, particularly in emerging markets where firms face resource constraints [10]. Understanding how firms develop integrative capabilities in these contexts is essential for generating robust theoretical and managerial insights.

Moreover, digital transformation reshapes resource integration strategies, necessitating firms to realign their approaches to technological adaptation [11]. Firms must develop dynamic capabilities to effectively navigate digital transformation and integrate technological resources efficiently.

This study aims to examine the impact of technology-driven resource utilization on firm performance, focusing on the role of resource integration. Specifically, it seeks to analyze how firms leverage technological driven resource to enhance strategic resource management and maintain a competitive edge in an evolving business environment.

By addressing these gaps, this research advances academic discourse and provides actionable insights for firms harnessing digital transformation in resource management. This study contributes to both theoretical advancements and practical applications in strategic resource management. It offers valuable guidance for academics, industry leaders, and policymakers in optimizing resource utilization, digital transformation, and integration for sustainable competitive advantage. Ultimately, this research enhances the understanding of how firms can leverage technology-driven resource utilization and integration to navigate contemporary business challenges and maintain competitiveness in an increasingly digital world.

This study aligns with the Sustainable Development Goals (SDGs), particularly SDG 8 (Decent Work and Economic Growth) [12] and SDG 9 (Industry, Innovation, and Infrastructure) [13]. By examining how technology-driven resource utilization and integration influence firm performance, this research supports sustainable economic growth through improved productivity, innovation, and organizational efficiency, especially among Small and Medium-sized Enterprises (SMEs). Effective integration of digital resources enables SMEs to enhance competitiveness, resilience, and value creation, which are essential for inclusive economic development. Moreover, this study contributes to SDG 9 by highlighting the role of digital capability and resource integration in strengthening innovation-driven business processes and supporting sustainable industrial development in emerging economies.

2. LITERATURE REVIEW

The RBV has long been established as a foundational theory in strategic management, emphasizing the role of firm-specific resources in achieving sustainable competitive advantage. According to RBV, firms can outperform competitors by possessing Valuable, Rare, Inimitable, and Non-substitutable (VRIN) resources that are effectively leveraged within the organization [14]. However, while prior studies have extensively examined physical and human resources, there is still a gap in understanding how technology-driven resource utilization

influences firm performance-particularly in the context of SMEs in emerging economies. Recent advancements in digital transformation have introduced new types of firm-specific resources, such as Artificial Intelligence (AI), cloud computing, data analytics, and digital platforms, which have become crucial for business success in highly competitive markets [15]. Unlike traditional tangible assets, these technology-driven resources enable firms to scale operations efficiently, improve decision-making, and enhance customer engagement. However, merely possessing digital resources does not guarantee performance improvements; firms must develop the capabilities to integrate and optimize these resources within their strategic framework [16].

2.1. Technology-Driven Resource Utilization and Firm Performance

The strategic role of technology-driven resource utilization in enhancing firm performance is increasingly emphasized within the RBV, which posits that firms leveraging technological assets such as AI, cloud computing, and big data analytics can achieve competitive advantage through optimized resource deployment [17, 18]. Prior research shows that digitally enhanced resource management improves operational efficiency, decision-making quality, and market adaptability, yet existing studies predominantly focus on large enterprises, leaving limited empirical evidence on how SMEs, particularly in emerging economies, utilize technology to improve performance [19]. Technology-driven resource utilization enables firms to maximize existing resources through automation, data-driven decision-making, and inter-organizational collaboration, while digital transformation strengthens resource integration, knowledge-sharing, and innovation [20]. AI-powered analytics support operational optimization and supply chain efficiency, whereas cloud computing facilitates scalable operations and cost reduction [15, 21]. However, technology adoption alone does not guarantee superior performance without structured integration mechanisms and strategic alignment between digital capabilities and organizational objectives. This challenge is more pronounced in SMEs due to resource constraints, digital literacy gaps, and infrastructural limitations, necessitating the use of cost-effective solutions such as e-commerce platforms, mobile payment systems, and cloud-based collaboration tools [22]. Despite growing evidence on the technology performance relationship, limited attention has been given to how firms in resource-constrained environments develop digital adoption strategies [23], a gap addressed by this study through examining how SMEs strategically implement digital technologies to enhance performance and mitigate competitive disadvantages.

H1: Technology-driven resource utilization positively influences firm performance.

2.2. Technology-Driven Resource Utilization and Resource Integration

The RBV emphasizes that firms achieve sustained competitive advantage by effectively utilizing and integrating VRIN resources, where resource integration refers to a firm's ability to align and optimize internal resources to create performance-enhancing synergies [24]. Technology-driven resource utilization strengthens resource integration by improving information flows, automating coordination, and enhancing interdepartmental collaboration through digital platforms, cloud-based systems, and AI-driven analytics [25, 26]. This capability is particularly critical for SMEs, which face resource constraints and rely on cost-effective digital solutions to streamline processes and improve adaptability [27]. Unlike large enterprises with advanced IT infrastructures, SMEs often adopt scalable strategies such as cloud-based collaboration tools, mobile-first applications, and AI-enhanced Customer Relationship Management (CRM) systems to overcome financial and technical limitations [28]. However, the relationship between technology-driven resource utilization and resource integration is not automatic, as firms must develop structured integration mechanisms to embed digital tools into workflows and enable coordination and knowledge transfer. Without such mechanisms, technology acquisition may lead to inefficiencies rather than improved resource management [29], a challenge intensified by limited digital infrastructure and workforce literacy in SMEs [30]. While large firms typically invest in customized IT architectures and automation, SMEs benefit more from affordable and modular solutions such as open-source AI models that support integration while minimizing investment costs. Despite growing research on digital transformation, limited attention has been given to how technology-driven resource utilization enhances resource integration in SMEs and emerging economies [31]. Addressing this gap, this study examines how SMEs develop digital integration strategies to optimize resource utilization and improve firm performance, leading to the following hypothesis:

H2: Technology-driven resource utilization positively influences the integration of resources within the organization.

2.3. Resource Integration and Firm Performance

The RBV emphasizes that superior firm performance is achieved not only through the acquisition of valuable resources but through their effective integration to enhance operational efficiency, innovation, and market adaptability [17, 18]. Resource integration, encompassing both internal and external dimensions, enables firms to optimize knowledge transfer, streamline processes, and strengthen strategic decision-making, thereby supporting sustained competitive advantage [32]. Internal integration involves cross-departmental collaboration, shared data platforms, and standardized operational frameworks that align human capital, financial resources, and technological assets to improve efficiency and productivity [33]. External integration refers to collaboration with suppliers, strategic partners, and technology providers, allowing firms to access complementary capabilities, enhance innovation, improve supply chain performance, and expand into new markets [34–36]. Empirical evidence shows that firms with high levels of resource integration achieve superior performance by maximizing resource complementarities, enhancing organizational agility, and fostering continuous innovation [37]. The integration of AI-driven decision-support systems and cloud-based collaboration tools further improves process efficiency, reduces operational costs, and strengthens competitiveness [38, 39]. However, many SMEs face fragmented resource structures, limited integration frameworks, and insufficient technological expertise, constraining their ability to fully leverage available resources [40]. Unlike large enterprises, SMEs must rely on scalable integration solutions and strategic knowledge-sharing mechanisms to achieve cost-efficient coordination. Therefore, based on RBV and prior empirical findings, this study proposes the following hypothesis:

H3: Resource integration positively impacts firm performance.

2.4. The Mediating Role of Resource Integration

The Resource-Based View (RBV) emphasizes that firm performance depends not only on resource possession but also on the capability to integrate and utilize resources effectively [6, 41]. Resource integration plays a critical mediating role by aligning technology-driven resource utilization with strategic objectives, thereby enhancing operational efficiency and business outcomes [42]. Technology-driven resource utilization alone does not necessarily improve firm performance unless supported by effective integration mechanisms that enable firms to fully leverage digital capabilities [43]. Firms that successfully integrate AI-driven analytics, cloud computing, and digital ecosystems experience improved knowledge transfer, collaboration, and innovation, ensuring that technology investments translate into better decision-making and cost optimization [44, 45]. For instance, the integration of real-time data analytics into supply chain management enables proactive decision-making, reduces inefficiencies, and enhances market responsiveness. However, performance outcomes vary depending on integration capability: firms with strong integration achieve value creation through seamless workflows, cross-functional coordination, and digital process optimization, while firms with weak integration face fragmented adoption, data silos, and inefficiencies [46, 47]. Despite its importance, existing research has not sufficiently examined the mediating role of resource integration between technology-driven resource utilization and firm performance, particularly in SMEs, as most studies focus on large enterprises with mature digital infrastructures. Addressing this gap, this study examines how SMEs in emerging economies leverage resource integration to translate digital resource utilization into competitive advantage, leading to the following hypothesis:

H4: Resource integration significantly mediates the relationship between technology-driven resource utilization and firm performance.

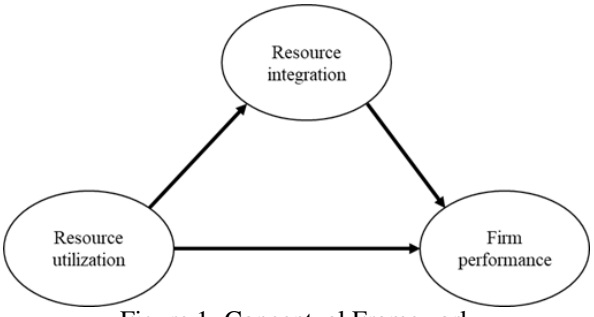

Figure 1. Conceptual Framework

The conceptual framework of this study illustrates the relationships between technology-driven resource utilization, resource integration, and firm performance. Drawing from the RBV, the framework hypothesizes that technology-driven resource utilization positively influences resource integration, which subsequently enhances firm performance. Additionally, resource integration serves as a mediating factor in this relationship. Figure 1 presents the conceptual model that visually represents these hypothesized relationships.

3. RESEARCH METHODOLOGY

3.1. Research Design

This study employs a quantitative research design utilizing Structural Equation Modeling (SEM) with SmartPLS to examine the relationships between technology-driven resource utilization, resource integration, and firm performance. The SEM approach is chosen due to its ability to handle complex models with multiple constructs and indicators while accommodating measurement errors [48]. SmartPLS is particularly suitable for exploratory studies and non-normally distributed data, making it a robust tool for analyzing latent constructs in business research [49].

Compared to Covariance-Based SEM (CB-SEM) using AMOS or LISREL, PLS-SEM is preferred because it focuses on predictive modeling and maximizing explained variance rather than just testing model fit [48]. The method has been widely used in strategic management and business performance research to evaluate relationships among latent variables.

3.2. Sampling and Data Collection

The target population consists of firms undergoing digital transformation in various industries, including manufacturing, services, and IT-based enterprises. A random sampling technique is employed, selecting firms actively integrating technology into their resource management strategies. A total of 233 firms participated in the study, with data collected through structured surveys administered to managers and business owners. The survey instrument was designed based on validated measurement scales from previous studies, ensuring reliability and content validity.

Most participants were between the ages of 20 and 40. The largest subgroup consisted of those aged 30-40 years, accounting for 40.80% of the respondents. The second-largest subgroup was individuals aged 20-30 years, making up 39.91% of the participants. The survey revealed that the largest proportion of respondents had a bachelor's degree (41.70%), although a significant number had completed high school (29.15%) or obtained a diploma (23.77%). Respondents had a range of work experience, with the majority having between 3 to 6 years of experience (36.77%) and 6 to 9 years of experience (30.50%). The gender distribution was nearly balanced, with a slightly higher proportion of males (53.8%) compared to females (46.2%). In general, this profile indicates that the individuals surveyed are mostly young to middle-aged, with a considerable degree of education and varied work experience. This demonstrates a commendable amount of variety and potential within the scope of this research.

3.3. Measurement and Instrumentation

The study utilizes multi-item scales adapted from prior validated studies to measure each construct:

- Technology-Driven Resource Utilization: Measured using indicators related to social media, e-commerce and others digital platforms [26].
- Resource Integration: Captures the alignment and coordination of resources across business processes.
- Firm Performance: Includes financial growth, innovation outcomes, and operational efficiency.

A Likert scale (1-5) is used for all constructs, following best practices in business performance measurement. Pre-tests and expert validations were conducted to refine survey items before full deployment.

3.4. Data Analysis Technique

The analysis follows a two-step approach in SmartPLS: Measurement Model Assessment - Evaluates construct reliability, validity, and discriminant validity using Composite Reliability (CR), Average Variance Extracted (AVE), and Fornell-Larcker criteria. Structural Model Assessment - Examines path coefficients, R^2 values, effect sizes (f^2), and predictive relevance (Q^2) to test hypotheses [50]. To strengthen the model

robustness, bootstrapping with 5000 resamples is applied to assess statistical significance. Additionally, multicollinearity checks using the Variance Inflation Factor (VIF) ensure that predictor variables are independent. The investigation adhered to stringent ethical standards, including the preservation of data confidentiality and the acquisition of consent.

4. RESULT AND DISCUSSION

4.1. Non Response Bias Analysis

Non-response bias is a potential concern in survey-based research, as systematic differences between early and late respondents may introduce bias into the study findings. To assess this, we conducted a non-response bias analysis by comparing the responses of early respondents (G1 = 67) and late respondents (G2 = 156) across three key variables: Firm Performance (FP), Resource Integration (RI), and Resource Utilization (RU). Table 1 provides the mean values, p-values, and statistical significance of the differences between the two groups.

Table 1. Non response Bias

Variables	Mean (G1=67)	Mean (G2=156)	p-value	Remarks
FP	3.7433	3.9449	0.098	Not Significant
RI	3.9433	3.9614	0.861	Not Significant
RU	3.9612	4.0705	0.283	Not Significant

The results indicate that there are no statistically significant differences between early and late respondents in Firm Performance ($p = 0.098$), Resource Integration ($p = 0.861$), and Resource Utilization ($p = 0.283$). Since all p-values exceed the 0.05 significance threshold, this suggests that the observed variations in responses are likely due to random fluctuations rather than systematic biases in respondent behavior. This aligns with recent studies on survey methodology, which suggest that when response timing does not significantly alter key variables, the risk of non-response bias is minimal.

4.2. Common Method Bias Analysis

In this study, we addressed Common Method Bias (CMB) by employing the full collinearity assessment approach as recommended by [51]. This method involves calculating the Variance Inflation Factors (VIFs) for each latent variable in the model to assess both vertical and lateral collinearity. A VIF value exceeding 3.3 suggests the presence of pathological collinearity and potential CMB. In our analysis, the VIFs for resource utilization, resource integration, and firm performance were all below 3.3, indicating the absence of significant collinearity issues and suggesting that our model is free from common method bias. This approach aligns with recent methodological literature emphasizing the importance of assessing and addressing common method bias to ensure the validity of research findings. By confirming that all VIFs are below the specified threshold, researchers can be more confident that their results are not unduly influenced by the data collection methods employed. Therefore, based on this analysis, we conclude that our data is free from common method bias, supporting the validity and reliability of our findings.

4.3. Measurement Model

Table 2 presents the factor loadings for the latent constructs: Firm Performance (FP), Resource Integration (RI), and Resource Utilization (RU). Factor loadings measure the correlation between observed indicators and their underlying latent variables, indicating how well each indicator represents its respective construct.

Table 2. Factor loading

Variables	Firm Performances	Resource Integration	Resource Utilization
FP1	0.806	-	-
FP2	0.858	-	-
FP3	0.785	-	-
FP4	0.787	-	-
FP5	0.808	-	-

RI1	-	0.750	-
RI2	-	0.723	-
RI3	-	0.777	-
RI4	-	0.765	-
RI5	-	0.716	-
RU1	-	-	0.763
RU2	-	-	0.765
RU3	-	-	0.767
RU4	-	-	0.819
RU5	-	-	0.726

In structural equation modeling (SEM), factor loadings above 0.70 are generally considered acceptable, as they indicate that the indicator explains a substantial portion of the variance in the latent construct [48]. However, in exploratory research contexts, loadings above 0.60 can also be considered acceptable. In this study, the factor loadings for Firm Performance (FP) range from 0.785 to 0.858, suggesting that each indicator strongly represents the latent construct. Similarly, the loadings for Resource Integration (RI) range from 0.716 to 0.777, indicating a solid representation of the construct by its indicators. Furthermore, the loadings for Resource Utilization (RU) range from 0.726 to 0.819, demonstrating that the indicators effectively capture the essence of the construct.

These findings align with prior studies emphasizing the importance of strong factor loadings in validating measurement models within SEM. High factor loadings confirm that the selected indicators are appropriate representations of their respective constructs, ensuring the reliability and validity of the measurement model. Moreover, factor loadings within the acceptable range indicate that the measurement model exhibits strong convergent validity, reinforcing its suitability for further structural model analysis.

The robust factor loadings observed across all constructs in this study suggest that the measurement model is well-specified, strengthening confidence in the subsequent structural model analyses. Given that all factor loadings exceed the recommended thresholds, the results indicate that Firm Performance, Resource Integration, and Resource Utilization are effectively measured by their respective indicators, supporting the validity of the measurement model in this study. This finding is crucial in ensuring that the constructs accurately capture the theoretical framework and contribute to the overall rigor of the study [48].

Table 3 presents the Composite Reliability (CR), Cronbach's Alpha (α), and Average Variance Extracted (AVE) values for the three latent constructs: Firm Performance (FP), Resource Integration (RI), and Resource Utilization (RU). These measures assess the internal consistency, reliability, and convergent validity of the measurement model.

Table 3. Composite Reliability, Cronbach's Alpha and AVE

Variable	Composite Reliability	Cronbach's Alpha	AVE
Firm Performances	0.904	0.868	0.655
Resource Integration	0.863	0.802	0.557
Resource Utilization	0.878	0.828	0.591

The findings indicate that all three constructs exhibit high reliability and validity, as demonstrated by their Composite Reliability (CR) values exceeding the recommended threshold of 0.70, which ensures internal consistency [48]. Cronbach's Alpha (α), a widely used metric for assessing scale reliability, also exceeds the acceptable threshold of 0.70, indicating strong internal consistency among measurement items. Moreover, the AVE values surpass the minimum required threshold of 0.50, suggesting that the latent constructs capture a substantial amount of variance from their indicators.

For Firm Performance (FP), the CR value of 0.904 and Cronbach's Alpha of 0.868 indicate a high degree of reliability, while its AVE of 0.655 confirms strong convergent validity. Similarly, Resource Integration (RI) demonstrates adequate reliability (CR = 0.863, α = 0.802) and acceptable convergent validity (AVE = 0.557). Although its AVE is lower than the other constructs, it still meets the minimum threshold of 0.50, ensuring that the indicators meaningfully represent the construct. Resource Utilization (RU) also exhibits high reliability (CR = 0.878, α = 0.828) and sufficient convergent validity (AVE = 0.591).

These results align with prior research emphasizing the importance of CR, α, and AVE in validating measurement models in SEM. Previous literature has found that AVE values above 0.50 and CR values exceeding 0.70 confirm strong convergent validity, supporting the robustness of the constructs used in this study. Moreover, Cronbach's Alpha values above 0.80 indicate that the internal consistency of the measurement items is high, further strengthening the reliability of the constructs.

The high reliability and validity of the constructs in this study confirm the robustness of the measurement model, ensuring that the variables used to assess Firm Performance, Resource Integration, and Resource Utilization accurately represent the theoretical constructs. These findings provide a strong foundation for subsequent structural model analysis, reinforcing the study's credibility in examining the relationships between the key constructs. Since all CR, α and AVE values exceed recommended thresholds, the measurement model satisfies SEM validation criteria, ensuring that the constructs can be used reliably in further hypothesis testing and path analysis.

Table 4 presents the discriminant validity assessment for the constructs Firm Performance (FP), Resource Integration (RI), and Resource Utilization (RU) using the Fornell-Larcker criterion. Discriminant validity ensures that each construct in the model is empirically distinct from other constructs, reinforcing the validity of the measurement model. The diagonal values in the table represent the square roots of the Average Variance Extracted (AVE) for each construct, while the off-diagonal values indicate the correlations between the constructs.

Table 4. Discriminant Validity Using Fornell-Larcker Criterion

Variable	Firm Performances	Resource Integration	Resource Utilization
Firm Performances	0.809	-	-
Resource Integration	0.449	0.747	-
Resource Utilization	0.373	0.439	0.769

Discriminant validity is confirmed when the square root of the AVE for each construct is higher than its correlations with other constructs. In this study, Firm Performance (FP) has an AVE square root of 0.809, exceeding its correlations with Resource Integration (0.449) and Resource Utilization (0.373). Similarly, Resource Integration (RI) has an AVE square root of 0.747, higher than its correlations with Firm Performance (0.449) and Resource Utilization (0.439). Resource Utilization (RU) also demonstrates discriminant validity, with an AVE square root of 0.769, surpassing its correlations with Firm Performance (0.373) and Resource Integration (0.439). These results indicate that each construct shares more variance with its own indicators than with other constructs, satisfying the Fornell-Larcker criterion for discriminant validity.

These findings align with prior research emphasizing the necessity of discriminant validity in SEM-based models to ensure that latent constructs are conceptually distinct [48]. A well-validated construct should demonstrate higher AVE values compared to its correlations with other constructs, reinforcing measurement accuracy and minimizing multicollinearity. Studies have also highlighted the importance of strong discriminant validity in enhancing predictive accuracy and theoretical rigor, which is essential in business and management research.

The establishment of discriminant validity in this study confirms that Firm Performance, Resource Integration, and Resource Utilization are empirically distinct constructs while maintaining theoretical interrelationships. This strengthens the credibility of the measurement model, ensuring that the structural relationships tested in this study remain valid. By demonstrating clear construct boundaries, the model supports further hypothesis testing and path analysis, contributing to the broader discourse on resource-based theory and firm performance.

Table 5 presents the discriminant validity assessment for Firm Performance (FP), Resource Integration (RI), and Resource Utilization (RU) using the Heterotrait-Monotrait Ratio (HTMT). HTMT is a more stringent criterion compared to the Fornell-Larcker approach, as it evaluates whether constructs are empirically distinct based on the correlations between their indicators.

Table 5. Discriminant Validity Using Heterotrait-Monotrait Ratio (HTMT)

Variable	Firm Performances	Resource Integration
Resource Integration	0,524	-
Resource Utilization	0,432	0,524

The HTMT values indicate the correlation ratios between constructs, with lower values suggesting greater distinctiveness. In this study, the HTMT values for Firm Performance (FP) and Resource Integration (RI) is 0.524, Firm Performance (FP) and Resource Utilization (RU) is 0.432, and Resource Integration (RI) and Resource Utilization (RU) is 0.524. All HTMT values fall below the commonly accepted threshold of 0.85 [48], confirming adequate discriminant validity and indicating that each construct measures a distinct underlying concept without excessive correlation with the others.

These findings align with prior studies emphasizing HTMT as a superior method for evaluating discriminant validity due to its stricter construct separation criteria compared to the Fornell-Larcker criterion. Previous research has consistently shown that HTMT values below 0.85 provide empirical confirmation that constructs are distinct and conceptually independent, ensuring measurement accuracy in SEM models [48]. Within business and management research, the use of HTMT analysis has become increasingly essential in validating measurement models, as it helps to minimize multicollinearity risks and construct overlap, thereby improving model robustness and statistical reliability.

The confirmation of discriminant validity through HTMT in this study strengthens the credibility of the measurement model, ensuring that the relationships examined remain empirically valid and theoretically justified. Furthermore, it reinforces the theoretical contribution of this research by demonstrating that resource utilization and integration are distinct yet interconnected dimensions that influence firm performance. This validation is critical for ensuring alignment with resource-based theory, further solidifying the study's impact on strategic management and business performance research. With discriminant validity confirmed through both HTMT and Fornell-Larcker analyses, this study establishes a robust foundation for subsequent hypothesis testing and path analysis, guaranteeing precision in structural relationships within the research framework.

4.4. Structural Model

Table 6 presents the predictive accuracy and relevance of the structural model by analyzing Firm Performance (FP) and Resource Integration (RI) using R^2 (coefficient of determination), adjusted R^2, and Q^2 (predictive relevance).

Table 6. Predictive Accuracy and Relevance

Variable	Predictive Accuracy		Predictive Relevance
	R2	Adjusted R2	Q2
Firm Performances	0.240	0.233	0.148
Resource Integration	0.193	0.190	0.101

The R^2 value for Firm Performance (0.240) indicates that the model explains 24.0% of the variance, suggesting moderate explanatory power. The adjusted R^2 of 0.233 accounts for the number of predictors in the model and remains close to the R^2 value, indicating that the model maintains stability after adjusting for predictors [48]. The Q^2 value of 0.148 suggests that the model has moderate predictive relevance, meaning that while it has some ability to predict Firm Performance, there is still room for improvement. For Resource Integration, the R^2 value of 0.193 suggests that the model accounts for 19.3% of the variance, indicating modest explanatory power. The adjusted R^2 of 0.190 remains close to the R^2 value, showing that the model is relatively stable in its predictions. However, the Q^2 value of 0.101 indicates lower predictive relevance, suggesting that the model has weaker predictive capability for Resource Integration compared to Firm Performance.

Table 7. Effect Size

Variable	f^2 (Effect Size)	
	FP	RI
FP	-	-
RI	0.132	-
RU	0.050	0.239

The effect size (Cohen's f^2) measures the strength of predictor variables in explaining variance in the dependent variables within the model. Table 7 presents the effect size values for Resource Integration (RI) and Firm Performance (FP). The effect size (f^2) for the link between Resource Integration (RI) and Firm Performance (FP) is 0.132, indicating a small-to-medium effect size based on [48] classification, where 0.02

represents a small effect, 0.15 a medium effect, and 0.35 a large effect. Similarly, the effect size of 0.050 for Resource Utilization (RU) on Firm Performance (FP) suggests a small explanatory impact, meaning that Resource Utilization has only a limited direct effect on Firm Performance. However, the effect size of 0.239 for Resource Utilization (RU) on Resource Integration (RI) represents a medium effect, signifying that Resource Utilization plays a more substantial role in influencing Resource Integration than it does directly on Firm Performance.

The small effect size of Resource Utilization (RU) on Firm Performance (FP) is consistent with research indicating that the benefits of resource utilization are often realized through integration mechanisms, such as knowledge sharing and process alignment, rather than directly improving performance. The moderate effect size (0.239) of RU on RI supports findings that resource utilization facilitates resource integration, which, in turn, enhances firm capabilities and strategic agility. These results suggest that while resource utilization may not directly enhance firm performance, it significantly contributes to resource integration, which is a crucial intermediary for leveraging organizational resources effectively.

Table 8. Discriminant Validity Using Fornell-Larcker Criterion

Direct effect	β	Sample Mean	Standard Deviation	t-statistics	p-values
RI $\rightarrow$ FP	0.353	0.360	0.068	5.202	0.000
RU $\rightarrow$FP	0.218	0.222	0.069	3.155	0.002
RU $\rightarrow$RI	0.439	0.447	0.054	8.114	0.000

Table 8 presents the direct effects of Resource Utilization (RU), Resource Integration (RI), and Firm Performance (FP) within the structural model. The results indicate that Resource Integration has a significant direct effect on Firm Performance (RI $\rightarrow$ FP), with a path coefficient (β) of 0.353, a t-statistic of 5.202, and a p-value of 0.000. This suggests that effective integration of resources enhances firm performance. Furthermore, the relationship between Resource Utilization and Resource Integration (RU $\rightarrow$ RI) is also significant, with a β value of 0.439, a t-statistic of 8.114, and a p-value of 0.000. This strong effect highlights that organizations that effectively utilize their resources are more likely to achieve higher levels of resource integration. Additionally, the direct relationship between Resource Utilization and Firm Performance (RU $\rightarrow$ FP) is found to be statistically significant, with a β value of 0.218, a t-statistic of 3.155, and a p-value of 0.002. This suggests that firms that optimize their resource utilization tend to experience better performance outcomes.

Table 9. Indirect effect

Indirect effect	β	Sample Mean	Standard Deviation	t-statistics	p-values
RU $\rightarrow$ RI $\rightarrow$ FP	0.155	0.161	0.036	4.325	0.000

Table 9 presents the results of the indirect effect analysis, highlighting the mediation path from Resource Utilization (RU) to Firm Performance (FP) through Resource Integration (RI). The indirect effect (RU $\rightarrow$ RI $\rightarrow$ FP) demonstrates a statistically significant path, with a beta value (β) of 0.155, a t-statistic of 4.325, and a p-value of 0.000. This suggests that for every unit increase in Resource Utilization, Firm Performance increases by 0.155 units through the mediating role of Resource Integration. The statistical significance of this relationship indicates that resource utilization does not solely drive firm performance directly but operates through resource integration mechanisms.

Table 10. VAF estimates

Path	β	Sample Mean	S.D	Lower bound	Upper bound	t-values	p-values	VAF	Type of mediation
RI $\rightarrow$ FP	0.353	0.360	0.068	0.312	0.527	5.202	0.000	-	-
RU $\rightarrow$FP	0.218	0.222	0.069	0.212	0.472	3.155	0.002	-	-
RU $\rightarrow$RI	0.439	0.447	0.054	0.083	0.355	8.114	0.000	-	-
RU $\rightarrow$ RI $\rightarrow$ FP	0.155	0.161	0.036	0.097	0.236	4.325	0.000	41.555	Partial

Table 10 presents the mediation analysis results using the Variance Accounted For (VAF) technique to determine the extent to which Resource Integration (RI) mediates the relationship between Resource Utilization (RU) and Firm Performance (FP). The VAF value of 41.555% falls within the acceptable range of 20% to 80%

[48], indicating partial mediation. This suggests that while Resource Utilization has a direct impact on Firm Performance, a substantial portion of its effect is channeled through Resource Integration. Specifically, the direct path from RU $\rightarrow$ FP has a β value of 0.218 and a t-value of 3.155 (p = 0.002), confirming its significance. Meanwhile, the indirect path RU $\rightarrow$ RI $\rightarrow$ FP exhibits a β value of 0.155 with a t-value of 4.325 (p = 0.000), further supporting the mediating role of Resource Integration. These results imply that firms leveraging their resources effectively must also integrate them strategically to maximize performance outcomes.

The partial mediation effect of Resource Integration underscores the necessity for firms to develop robust integration mechanisms to fully capitalize on their available resources. While Resource Utilization contributes to Firm Performance, firms that emphasize internal coordination, process standardization, and knowledge-sharing mechanisms can further enhance their resource investments' impact. The moderate VAF percentage (41.555%) suggests that other mediating or moderating factors may also play a role in shaping the relationship between Resource Utilization and Firm Performance.

4.5. Discussion

The findings of this study reinforce the significance of technology-driven resource utilization and resource integration in enhancing firm performance. The results indicate that technology-driven resource utilization has a direct and significant impact on firm performance (β = 0.218, p = 0.002), confirming prior studies that emphasize the role of digital adoption in driving business success [18, 52]. However, unlike earlier research that primarily focused on resource possession, our findings highlight that firms must actively integrate and adapt their digital resources to achieve sustained performance gains. This supports the argument that technology alone is not a sufficient condition for business success rather, the strategic alignment and utilization of digital assets drive superior performance [20].

The strong positive relationship between technology-driven resource utilization and resource integration (β = 0.439, p $<$ 0.001) suggests that businesses leveraging digital platforms experience higher coordination efficiencies, improved knowledge-sharing, and stronger inter-organizational collaborations. This result aligns with prior studies that stress the necessity of structured integration mechanisms in resource deployment [47]. Additionally, this study contributes to the understanding of digital transformation in SMEs operating in emerging economies, where firms often face resource limitations and must strategically integrate digital tools to optimize their operations [53]. These findings suggest that the digitalization of business processes must be complemented by strong internal integration frameworks to fully leverage technological benefits.

Furthermore, the results confirm that resource integration significantly enhances firm performance (β = 0.353, p $<$ 0.001), reinforcing the argument that firms with robust integration capabilities can better adapt to market changes, foster innovation, and improve knowledge transfer. This is consistent with previous literature that identified resource integration as a key enabler of organizational innovation and competitive advantage [34, 39]. However, while previous studies predominantly examined integration within large multinational firms, our findings highlight its critical importance for SMEs, which often lack the extensive infrastructure needed for standalone digital transformation initiatives. This suggests that resource integration is not merely a process-oriented activity but a strategic enabler that dictates long-term business sustainability.

The mediation analysis confirms that resource integration serves as a key intermediary between technology-driven resource utilization and firm performance (β = 0.155, p $<$ 0.001). This finding underscores the notion that firms must not only invest in technology but also develop the internal capabilities necessary to integrate and align digital resources with broader strategic goals. Prior research has established the direct benefits of digital adoption [54], but this study demonstrates that the effectiveness of digital tools depends on how well they are integrated into the organization's existing workflows, decision-making processes, and external partnerships. In the absence of effective integration, the mere adoption of digital platforms may yield suboptimal outcomes [45].

To distinguish our study from previous research, we compare our findings with prior empirical studies on technology-driven resource utilization, resource integration, and firm performance. Table 11 provides a summary of our findings with prior research.

Table 11. Comparison of This Study's Findings with Prior Research

Study	Theoretical Framework	Methodology	Key Findings
[55]	Resource-Based View (RBV) & Market Orientation	Quantitative survey analysis	Marketing resources and capabilities influence firm performance, but the study does not fully address technology-driven resource utilization and digital transformation.
[56]	Dynamic Capabilities View (DCV) & Business Model Change	Multiple Case Study Analysis	Firms need strong dynamic capabilities to facilitate business model transformation, but lacks focus on technology integration in SMEs.
[5]	Dynamic Capabilities Theory & Relational View	Empirical Survey-Based Study	Supplier involvement and buyer trust enhance Tacit Knowledge Integration Capability (TKIC), but the role of technology in enabling TKIC remains underexplored.
[45]	Digital Servitization & AI Capabilities	Multiple Case Study Analysis	AI capabilities enable business model innovation through co-evolutionary processes and feedback loops, but the scalability of AI adoption remains a challenge.
This Study	RBV & Technology-Driven Resource Utilization	PLS-SEM with SME sample	Digital resource integration is a crucial mediator between technology-driven resource utilization and firm performance, particularly for SMEs.

The novelty of this study makes a significant contribution to the literature by integrating technology-driven resource utilization and resource integration into the RBV framework. Unlike prior research that primarily focused on resource possession or business model transformation, this study empirically demonstrates how the interplay between digital resource utilization and integration enhances firm performance, particularly in SMEs.

A key theoretical contribution of this study is the identification of resource integration as a critical mediator between digital adoption and firm performance. Previous studies have primarily examined direct effects; however, this research highlights that structured integration mechanisms are essential for realizing the full benefits of digital transformation. This provides a more holistic understanding of how SMEs can leverage technology for competitive advantage.

Furthermore, this study extends prior work by validating these relationships using PLS-SEM in an SME context, addressing the lack of empirical evidence in digital transformation literature concerning smaller enterprises. SMEs often operate with constrained resources, making the role of strategic integration even more vital, a perspective that has been largely overlooked in prior research.

This research also contributes to the ongoing discourse on Industry 4.0 and digital business strategies, demonstrating how SMEs can align digital technology with internal business processes to enhance innovation and adaptability. By bridging the gap between RBV theory and digitalization, this study offers insights into the mechanisms through which digital resources translate into firm performance.

5. MANAGERIAL IMPLICATIONS

This study provides valuable implications for both theoretical and managerial implications. Theoretically, this study expands the RBV by demonstrating how digital resources must be integrated strategically to drive superior firm performance. This research shifts the traditional RBV perspective by emphasizing dynamic digital resource deployment rather than static resource possession.

From a managerial perspective, the findings highlight the need for businesses, particularly SMEs in emerging economies, to adopt cost-effective digital solutions to enhance their resource utilization and integration processes. SMEs should strategically implement e-commerce platforms (e.g., Tokopedia, Shopee, Bukalapak) to expand market reach and reduce operational costs. Social media platforms such as Instagram, TikTok, and Facebook Marketplace provide cost-effective avenues for customer engagement, branding, and

sales. Additionally, digital tools such as Google Workspace, Trello, and project management software facilitate seamless collaboration and workflow automation, which is essential for business scalability. AI-powered chatbots in WhatsApp Business and Messenger can enhance customer support, reduce response times, and improve user experience, while businesses should integrate QRIS, GoPay, and OVO to facilitate secure and convenient financial transactions.

From a policy standpoint, these findings indicate that governments and policymakers should facilitate digital adoption among SMEs by providing financial incentives and grants to encourage the use of digital tools. Investing in digital literacy programs is crucial to ensure that businesses can effectively utilize new technologies, and expanding internet accessibility is necessary to support digital transformation initiatives in rural and underserved areas.

6. CONCLUSION

This study demonstrates that technology-driven resource utilization alone is insufficient to enhance firm performance unless supported by effective resource integration mechanisms. Drawing on the RBV, the findings confirm that technology-driven resource utilization positively influences firm performance both directly and indirectly through resource integration. Resource integration emerges as a critical organizational capability that enables firms to align digital technologies with internal processes and strategic objectives, thereby improving operational efficiency, innovation, and market adaptability. The results further highlight that SMEs, particularly in emerging economies, can achieve superior performance by strategically integrating digital resources rather than merely adopting them. These findings reinforce the importance of integration capability as a key determinant in translating digital investments into sustainable performance outcomes.

Despite its contributions, this study has several limitations that offer directions for future research. First, the cross-sectional design limits the ability to capture dynamic changes in technology utilization and resource integration over time. Future studies should employ longitudinal designs to examine how integration capabilities evolve as firms progress through different stages of digital transformation. Second, this research focuses primarily on SMEs in emerging economies, which may limit generalizability across industries and institutional contexts. Future research could extend the model to large enterprises or conduct cross-country comparisons to explore contextual differences. Additionally, incorporating moderating variables such as digital maturity, organizational culture, or government policy support may provide deeper insights into the conditions under which resource integration most strongly influences firm performance.

This study makes a novel contribution by extending the RBV through the explicit integration of technology-driven resource utilization and resource integration within an SME context. Unlike prior studies that emphasize resource possession or direct technology performance relationships, this research empirically demonstrates the mediating role of resource integration as a strategic mechanism that converts digital resource utilization into performance gains. By focusing on SMEs in emerging economies, the study addresses an underexplored context in digital transformation literature and provides evidence that integration capability constitutes a strategic asset rather than a supporting function. These insights advance theoretical understanding while offering practical guidance for firms seeking to achieve sustainable competitive advantage through digital transformation.

7. DECLARATIONS

7.1. About Authors

Muhammad Dharma Tuah Putra Nasution (MD) https://orcid.org/0000-0002-4671-0230

Yossie Rossanty (YR) https://orcid.org/0000-0001-9556-8958

Ramadhan Harahap (RH) https://orcid.org/0009-0009-9045-7699

Aulia Ramadhan Tanjung (AR) -

Thorique Akbar Maulana Nasution (TA) https://orcid.org/0000-0003-4138-0567

7.2. Author Contributions

Conceptualization: MD; Methodology: MD; Software: TA; Validation: MD and YR; Formal Analysis: RH and TA; Investigation: MD; Resources: YR; Data Curation: YR; Writing Original Draft Preparation:

TA; Writing Review and Editing: YR and R.H; Visualization: TA; All authors, MD, YR, RH, AR, and TA, have read and agreed to the published version of the manuscript.

7.3. Data Availability Statement

The data presented in this study are available on request from the corresponding author.

7.4. Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

7.5. Declaration of Conflicting Interest

The authors declare that they have no conflicts of interest, known competing financial interests, or personal relationships that could have influenced the work reported in this paper.

REFERENCES

[1] S. Bresciani, K. H. Huarng, A. Malhotra, and A. Ferraris, "Digital transformation as a springboard for product, process and business model innovation," 2021.

[2] S. Kosasi, U. Rahardja, I. D. A. E. Yuliani, R. Laipaka, B. Susilo, and H. Kikin, "It governance: Performance assessment of maturity levels of rural banking industry," in *2022 4th International Conference on Cybernetics and Intelligent System (ICORIS)*. IEEE, 2022, pp. 1–6.

[3] E. Eriksson and A. Hellström, "Multi-actor resource integration: A service approach in public management," *British Journal of Management*, vol. 32, 2021.

[4] A. P. Tower, K. Hewett, and A. Saboo, "Reexamining the tradeoff between value creation and value appropriation: The role of internal organizational resources vs. external strategic international alliances," *Journal of Business Research*, vol. 123, 2021.

[5] R. Parente, J. Y. Murray, Y. Zhao, M. Kotabe, and R. Dias, "Relational resources, tacit knowledge integration capability, and business performance," *Journal of Knowledge Management*, vol. 26, 2022.

[6] M. S. Karim, S. Nahar, and M. Demirbag, "Resource-based perspective on ict use and firm performance: A meta-analysis investigating the moderating role of cross-country ict development status," *Technological Forecasting and Social Change*, vol. 179, 2022.

[7] K. Kusnadi, M. Hatta, G. Brotosaputro, A. Amri, and S. Harris, "Information technology and its impact on modern classroom dynamics: A computer science perspective," *Aptisi Transactions on Technopreneurship (ATT)*, vol. 7, no. 1, pp. 282–293, 2025.

[8] R. G. Munthe, Q. Aini, N. Lutfiani, I. Van Persie, and A. Ramadhan, "Transforming scientific publication management in the era of disruption: Smartpls approach in innovation and efficiency analysis," *APTISI Transactions on Management*, vol. 8, no. 2, pp. 123–130, 2024.

[9] M. F. Nur and A. Siregar, "Exploring the use of cluster analysis in market segmentation for targeted advertising," *IAIC Transactions on Sustainable Digital Innovation (ITSDI)*, vol. 5, no. 2, pp. 158–168, 2024.

[10] B. Agyei-Owusu, D. Asamoah, D. Nuertey, and I. N. Acquah, "Examining the relationship between dimensions of supply chain integration, operational performance and firm performance: evidence from ghana," *Management Research Review*, vol. 45, 2022.

[11] S. Margita, E. Sediyono, S. Y. J. Prasetyo, A. Iriani, K. D. Hartomo, I. Sembiring, and H. D. Purnomo, "Valuation of software cost and time estimation methods: Asystematic review of the literature," in *AIP Conference Proceedings*, vol. 3234, no. 1. AIP Publishing LLC, 2025, p. 050010.

[12] The Global Goals. (2025) Goal 8: Decent work and economic growth. The Global Goals. Accessed: 2025-05-05. [Online]. Available: https://globalgoals.org/goals/8-decent-work-and-economic-growth/

[13] Global Society. (2025) Industry innovation and infrastructure (global goal 9). Global Society. Accessed: 2025-05-05. [Online]. Available: https://www.globalsociety.earth/global-goal-9-industry-innovation-and-infrastructure

[14] N. N. Rafiana, "Technopreneurship strategy to grow entrepreneurship career options for students in higher education," *ADI Journal on Recent Innovation*, vol. 5, no. 2, pp. 110–126, 2024.

[15] M. Z. Yaqub and A. Alsabban, "Industry-4.0-enabled digital transformation: Prospects, instruments, challenges, and implications for business strategies," *Sustainability (Switzerland)*, vol. 15, 2023.

[16] D. M. Wielgos, C. Homburg, and C. Kuehnl, "Digital business capability: its impact on firm and customer performance," *Journal of the Academy of Marketing Science*, vol. 49, 2021.
[17] S. A. Zahra, "The resource-based view, resourcefulness, and resource management in startup firms: A proposed research agenda," *Journal of Management*, vol. 47, 2021.
[18] N. R. Furr and K. M. Eisenhardt, "Strategy and uncertainty: Resource-based view, strategy-creation view, and the hybrid between them," *Journal of Management*, vol. 47, 2021.
[19] A. Khattak, M. I. Tabash, Z. Yousaf, M. Radulescu, A. A. Nassani, and M. Haffar, "Towards innovation performance of smes: investigating the role of digital platforms, innovation culture and frugal innovation in emerging economies," *Journal of Entrepreneurship in Emerging Economies*, vol. 14, 2022.
[20] J. Yao, A. Crupi, A. D. Minin, and X. Zhang, "Knowledge sharing and technological innovation capabilities of chinese software smes," *Journal of Knowledge Management*, vol. 24, 2020.
[21] A. Delhi and A. Sijabat, "The role of technology adoption in scaling startupreneur business models in the digital economy," *Startupreneur Business Digital (SABDA Journal)*, vol. 3, no. 2, pp. 141–147, 2024.
[22] M. Santiago, H. Febiansyah, and D. Dinarwati, "Integrating machine learning with web intelligence for predictive search and recommendations," *International Transactions on Artificial Intelligence*, vol. 3, no. 1, pp. 44–53, 2024.
[23] L. Meria, C. S. Bangun, and J. Edwards, "Exploring sustainable strategies for education through the adoption of digital circular economy principles," *International Transactions on Education Technology (ITEE)*, vol. 3, no. 1, pp. 62–71, 2024.
[24] M. Budiarto, A. Asmawati, and M. Kurniawan, "Digital transformation of local government: Design and development of the pakuhaji district community service information system website," *International Journal of Cyber and IT Service Management*, vol. 4, no. 1, pp. 11–18, 2024.
[25] H. Hamsinah, U. Rusilowati, and D. Sunarsi, "Analysis of lecturer competency and knowledge in technopreneurship development of student msmes in pts," *Aptisi Transactions on Technopreneurship (ATT)*, vol. 6, no. 3, pp. 623–638, 2024.
[26] S. L. Wamba-Taguimdje, S. F. Wamba, J. R. K. Kamdjoug, and C. E. T. Wanko, "Influence of artificial intelligence (ai) on firm performance: the business value of ai-based transformation projects," *Business Process Management Journal*, vol. 26, 2020.
[27] L. K. Choi, N. Iftitah, and P. Angela, "Developing technopreneur skills to face future challenges," *IAIC Transactions on Sustainable Digital Innovation (ITSDI)*, vol. 5, no. 2, pp. 127–135, 2024.
[28] A. S. Dervis Ozay, Mohammad Jahanbakht and S. Wang, "Artificial intelligence (ai)-based customer relationship management (crm): a comprehensive bibliometric and systematic literature review with outlook on future research," *Enterprise Information Systems*, vol. 18, no. 7, p. 2351869, 2024.
[29] A. Zebec and M. Stemberger, "Creating ai business value through bpm capabilities," *Business Process Management Journal*, vol. 30, 04 2024.
[30] R. Eller, P. Alford, A. Kallmünzer, and M. Peters, "Antecedents, consequences, and challenges of small and medium-sized enterprise digitalization," *Journal of Business Research*, vol. 112, 2020.
[31] G. H. Thomas and E. J. Douglas, "Resource reconfiguration by surviving smes in a disrupted industry," *Journal of Small Business Management*, vol. 62, 2024.
[32] S. S. Sondhi, P. Salwan, A. Behl, S. Niranjan, and T. Hawkins, "Evaluation of strategic orientation-led competitive advantage: the role of knowledge integration and service innovation," *Journal of Knowledge Management*, vol. 28, 2024.
[33] H. Haris, N. Priliasari *et al.*, "The design of web-based training management information systems at pt. sintech berkah abadi," *ADI Journal on Recent Innovation*, vol. 2, no. 2, pp. 216–222, 2021.
[34] A. Urbinati, P. Landoni, F. Cococcioni, and L. D. Giudici, "Stakeholder management in open innovation projects: a multiple case study analysis," *European Journal of Innovation Management*, 2020.
[35] C. Lu, Y. Qi, and B. Yu, "Effects of domestic and international external collaboration on new product development performance in smes: Evidence from china," *Sustainability (Switzerland)*, vol. 16, 2024.
[36] F. Chirico, L. Naldi, M. A. Hitt, P. Sieger, D. G. Sirmon, and K. Xu, "Orchestrating resources with suppliers for product innovation," *Journal of Product Innovation Management*, vol. 41, 2024.
[37] U. Rusilowati, H. R. Ngemba, R. W. Anugrah, A. Fitriani, and E. D. Astuti, "Leveraging ai for superior efficiency in energy use and development of renewable resources such as solar energy, wind, and bioenergy," *International Transactions on Artificial Intelligence*, vol. 2, no. 2, pp. 114–120, 2024.
[38] C. Giachino, M. Cepel, E. Truant, and A. Bargoni, "Artificial intelligence-driven decision making and

firm performance: a quantitative approach," *Management Decision*, vol. ahead-of-print, 1 2024. [Online]. Available: https://doi.org/10.1108/MD-10-2023-1966

[39] T. Hautala-Kankaanpää, "The impact of digitalization on firm performance: examining the role of digital culture and the effect of supply chain capability," *Business Process Management Journal*, vol. 28, 2022.

[40] E. M. Vătămănescu, J. G. Cegarra-Navarro, A. G. Andrei, V. M. Dincă, and V. A. Alexandru, "Smes strategic networks and innovative performance: a relational design and methodology for knowledge sharing," *Journal of Knowledge Management*, vol. 24, 2020.

[41] L. D'Oria, T. R. Crook, D. J. Ketchen, D. G. Sirmon, and M. Wright, "The evolution of resource-based inquiry: A review and meta-analytic integration of the strategic resources–actions–performance pathway," 2021.

[42] A. Sutarman, J. Williams, D. Wilson, and F. B. Ismail, "A model-driven approach to developing scalable educational software for adaptive learning environments," *International Transactions on Education Technology (ITEE)*, vol. 3, no. 1, pp. 9–16, 2024.

[43] W. Setyowati, R. Widayanti, and D. Supriyanti, "Implementation of e-business information system in indonesia: Prospects and challenges," *International Journal of Cyber and IT Service Management*, vol. 1, no. 2, pp. 180–188, 2021.

[44] J. Yin, Y. Li, Z. Ma, Z. Chen, and G. Guo, "Impact of entrepreneurship on technological innovation in the digital age: a knowledge management perspective," *Journal of Knowledge Management*, vol. 28, pp. 2750–2772, 1 2024. [Online]. Available: https://doi.org/10.1108/JKM-07-2023-0602

[45] D. Sjödin, V. Parida, M. Palmié, and J. Wincent, "How ai capabilities enable business model innovation: Scaling ai through co-evolutionary processes and feedback loops," *Journal of Business Research*, vol. 134, 2021.

[46] X. Sun and Q. Zhang, "How can dynamic capabilities make sense in avoiding value co-creation traps?" *Management Decision*, vol. 60, 2022.

[47] G. Nicoletti, C. von Rueden, and D. Andrews, "Digital technology diffusion: A matter of capabilities, incentives or both?" *European Economic Review*, vol. 128, 2020.

[48] J. Hair, G. T. M. Hult, C. Ringle, and M. Sarstedt, *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)*, 2022.

[49] C. Lukita, M. Hardini, S. Pranata, D. Julianingsih, and N. P. L. Santoso, "Transformation of entrepreneurship and digital technology students in the era of revolution 4.0," *Aptisi Transactions on Technopreneurship (ATT)*, vol. 5, no. 3, pp. 291–304, 2023.

[50] M. Sarstedt, C. Ringle, and J. Hair, *Partial Least Squares Structural Equation Modeling*. springer, 2021, ch. 25.

[51] D. Suhartini, B. Tjahjadi, and Y. Fayanni, "Impact of sustainability reporting and governance on firm value: insights from the indonesian manufacturing sector," *Cogent Business & Management*, vol. 11, no. 1, p. 2381087, 2024.

[52] A. Vafaei-Zadeh, J. Madhuri, H. Hanifah, and R. Thurasamy, "The interactive effects of capabilities and data-driven culture on sustained competitive advantage," *IEEE Transactions on Engineering Management*, vol. 71, 2024.

[53] S. Chatterjee and A. K. Kar, "Why do small and medium enterprises use social media marketing and what is the impact: Empirical insights from india," *International Journal of Information Management*, vol. 53, 2020.

[54] S. Chen and J. Zheng, "Influence of organizational learning and dynamic capability on organizational performance of human resource service enterprises: Moderation effect of technology environment and market environment," *Frontiers in Psychology*, vol. 13, 2022.

[55] A. O'Cass, L. V. Ngo, and V. Siahtiri, "Marketing resource-capability complementarity and firm performance in b2b firms," *Journal of Business and Industrial Marketing*, vol. 30, 2015.

[56] D. Witschel, A. Döhla, M. Kaiser, K. I. Voigt, and T. Pfletschinger, "Riding on the wave of digitization: insights how and under what settings dynamic capabilities facilitate digital-driven business model change," *Journal of Business Economics*, vol. 89, 2019.