

INNOVATION CAPABILITIES AS A STRATEGIC LEVER: PATHWAYS TO ACHIEVING SUSTAINABLE COMPETITIVE ADVANTAGE

CAPACIDADES DE INOVAÇÃO COMO ALAVANCA ESTRATÉGICA: CAMINHOS PARA ALCANÇAR UMA VANTAGEM COMPETITIVA SUSTENTÁVEL

Article received on: 1/2/2026

Article accepted on: 4/1/2026

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The authors declare that there is no conflict of interest

Abstract

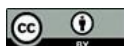
The study examines the role of innovation abilities as a strategic management factor in sustaining competitive advantages. The main research questions addressed include: What are the key features of innovation capabilities that influence organizational resilience and technological adaptability? How do companies leverage investments in innovation to improve sustainability? A systematic literature review was conducted following the PRISMA guidelines, analyzing empirical studies published between 2020 and 2025. Data were sourced from Scopus, Web of Science, Google Scholar, and ResearchGate, with an initial selection of 350 articles, from which 59 papers met the inclusion criteria for meta-analysis and quantitative synthesis. The findings identified various approaches for managing innovation challenges, including adaptation of R&D, open innovation, agile development, knowledge management, digitalization, and ecosystem integration. The suggestions highlight improvements in risk minimization, operational efficiency and decision-making processes. The findings suggest that strategic partnerships and technological integration in evolving business environments offer substantial benefits.

Keywords: Innovation Capabilities. Sustainable Competitive Advantage. Digital Transformation. Research and Development (R&D). Organizational Resilience. JEL CODES: O32, O31.

Resumo

O estudo examina o papel das capacidades de inovação como fator de gestão estratégica na manutenção de vantagens competitivas. As principais questões de pesquisa abordadas incluem: Quais são as principais características das capacidades de inovação que influenciam a resiliência organizacional e a adaptabilidade tecnológica? Como as empresas aproveitam os investimentos em inovação para melhorar a sustentabilidade? Foi realizada uma revisão sistemática da literatura seguindo as diretrizes PRISMA, analisando estudos empíricos publicados entre 2020 e 2025. Os dados foram obtidos do Scopus, Web of Science, Google Scholar e ResearchGate, com uma seleção inicial de 350 artigos, dos quais 59 atendiam aos critérios de inclusão para meta-análise e síntese quantitativa. Os resultados identificaram várias abordagens para gerenciar os desafios da inovação, incluindo adaptação de P&D, inovação aberta, desenvolvimento ágil, gestão do conhecimento, digitalização e integração de ecossistemas. As sugestões destacam melhorias na minimização de riscos, eficiência operacional e processos de tomada de decisão. Os resultados sugerem que parcerias estratégicas e integração tecnológica em ambientes de negócios em evolução oferecem benefícios substanciais.

Palavras-chave: Capacidades de Inovação. Vantagem Competitiva Sustentável. Transformação Digital. Pesquisa e Desenvolvimento (P&D). Resiliência Organizacional. CÓDIGOS JEL: O32, O31.



1 INTRODUCTION

The ability for innovation became the essential key to securing sustainable competitive positions. Within society, sustainability seems a buzzword as stated by Kara *et al.* (2022). Organizations focused on resources to improve research and development with enhanced collaboration networks and technology systems to preserve their long-term market position. The business environment advanced through fast technological changes with market transformations forcing organizations to build strategic approaches that enhanced their innovation capabilities (Do *et al.*, 2021). Organizations adapted to changing industry environments through the digital transformation of their operations by utilizing knowledge exchange tools and adjustable research and development protocols. This research confirmed a clear relationship exists between innovation capabilities and sustainable competitive advantage and their important contribution to organizational success. Through structured innovation management, businesses became capable of reducing operational hazards, attaining improved efficiency, and achieving sustainable growth. Companies adopted agile practices with open innovation techniques combined with integrated technological systems to achieve better competitive advantage. Research studies have provided essential mechanisms that help organizations develop their innovation capacities and thus emphasize the need for strategic frameworks (Fan *et al.*, 2021). The combination of emerging technology investments with strategic alliances enabled the firm to stay at the forefront of its market. This research paper is a systematic review of empirical evidence about optimal methods firms could use to develop innovative capabilities for enduring competitive positioning. The research gathered multiple studies to develop practical methods that enhanced competitive strength.

1.1 Background

Organizations depend on innovation capabilities to sustain their competitive positioning. Sustainable business tactics received support from both research and development expenditures along with collaborative partnerships and knowledge exchange programs. Organizations improve their operational performance by developing modern technological systems alongside framework adaptability. Digital transformation

tools allow organizations to enhance their decision-making procedures (Ferreira *et al.*, 2020). Ecosystem collaboration models helped businesses advance their innovation performance through cross-industry knowledge sharing. Previous research analyzed agility becomes essential for organizations to adopt trends that help maintain growth. The strategic planning of innovation programs helped businesses develop better resistance against market disturbances. Organizations achieve competitive advantage through proper resource distribution along with organizational adaptability capabilities. Business sustainability is affected by ethical considerations in AI decision-making as well as automation processes. The research analyzed past studies to identify important elements in innovation-led competitiveness (Gryshchenko *et al.*, 2021). The implementation of organized innovation management systems brought enduring advantages to organizations.

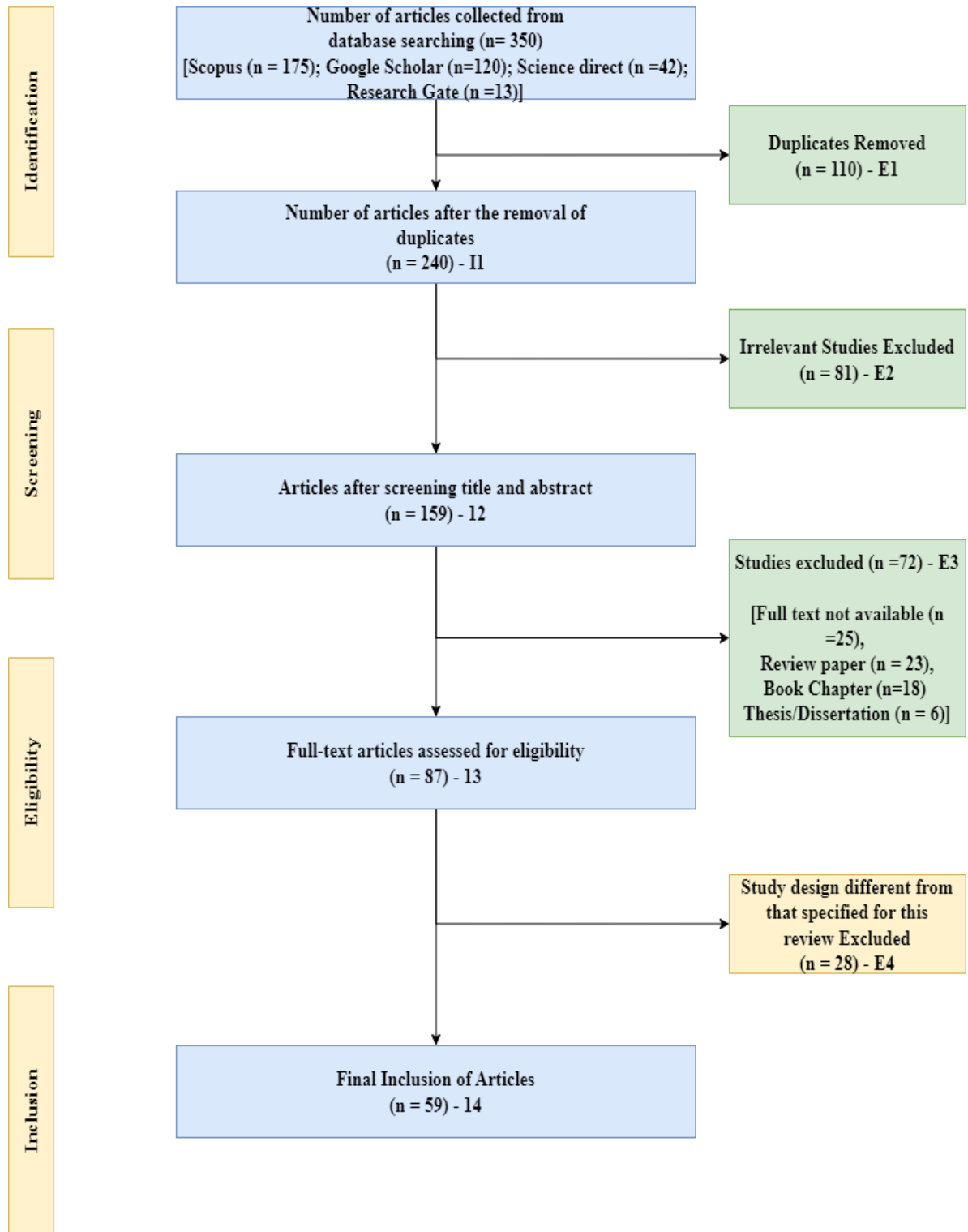
2 RESEARCH METHODOLOGY

The investigation utilized a systematic review methodology that condensed research about innovation capabilities serving as strategic tools for long-term competitive success. The review used the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework with a rigorous and transparent approach. Research papers from peer-reviewed journals between the years of 2020 to 2025 originated from Scopus, Web of Science and ScienceDirect. The research included only studies that specifically investigated innovation capabilities regarding their role in obtaining competitive advantage but omitted articles without empirical confirmation or theoretical value. The search relied on concepts regarding innovation capabilities with strategic management knowledge and sustainable competitive advantage. The search results required a two-step screening method that began with title and abstract evaluation before moving on to complete text evaluation.

2.1 Prisma model

Figure 1

PRISMA Model



The PRISMA evaluation assessing innovation capabilities as a strategic asset for sustaining competitive advantage commenced with the identification of 350 articles from four major databases: Scopus 175, Google Scholar 120, ScienceDirect 42, and ResearchGate 13. During the identification phase, a total of 110 duplicate records were removed, reducing the dataset to 240 articles for further analysis. In the screening phase, articles were assessed based on their titles and abstracts, leading to the exclusion of 81 studies deemed irrelevant. This filtering process refined the selection to 159 articles, which then proceeded to the eligibility phase for full-text evaluation. At this stage, 72 articles were excluded for various reasons, including unavailability of full text 25, classification as review papers 23, book chapter 18, or theses/dissertations 6. Further refinement led to the exclusion of 28 additional studies due to incompatibility with the specified study design, ultimately narrowing the selection to 59 articles for final inclusion in the systematic review. These selected studies formed the foundation for analyzing innovation capabilities as a strategic factor in sustaining long-term competitive advantage.

2.2 Inclusion and exclusion criteria

The literature selection used inclusion and exclusion criteria to make sure they were relevant and methodologically rigorous. Recent publications during the period of 2020 to 2025 were the sources to capture the latest technologies and their implementation to reach a competitive advantage. Only English journal articles that went through peer review were used so that the sources would be well-researched. Studies that implemented either qualitative, quantitative, or mixed methods were the prime in this empirical research. On the other hand, book chapters, conference proceedings, non-peer-reviewed articles, and publications in languages other than English were excluded. Studies that did not have enough empirical evidence or research objectives that diverged from the original proposals were also thrown away. Moreover, the study would exclude papers considered outdated or methodologically weak to protect the integrity of the systematic review. Such a process would secure the contribution of high-impact literature to the synthesis, allowing an understanding of innovation capability as a strategic lever for sustainable competitive advantage.

2.3 Identification

The identification stage required exhaustive database searches that resulted in 350 records from Scopus, Web of Science, ResearchGate and Google Scholar. The researcher gathered an academically diversified group of studies that studied innovation capabilities for securing sustainable competitive advantage. Research conducted across multiple databases resulted in superior literature collection by adding academic papers of high quality that enhanced the complete examination of the study field. The research scope led to the elimination of duplicate records and unnecessary sources potentially failed to match the study requirements during this phase.

2.4 Screening

Following the removal of 110 duplicate records, 240 unique studies remained for screening. During this phase, 81 articles were excluded due to irrelevance to the research topic, including book chapters, non-peer-reviewed papers, non-English publications, and conference proceedings. The screening process focused on identifying studies directly analyzing innovation capabilities and sustainable competitive advantage. Articles that lacked empirical evidence or were out of scope were also removed, reducing the total number of studies to 159 for further assessment.

2.5 Eligibility

The 159 remaining studies underwent a full-text evaluation to determine their relevance. A total of 72 studies were excluded due to unavailability, being review papers, book chapters, or dissertations. Additionally, 28 more studies were removed for not aligning with the specified study design. The final 59 articles were selected based on their empirical rigor, methodological validity, and direct contribution to understanding the relationship between innovation capabilities and sustainable competitive advantage.

2.6 Included

Finally, systematic review research established 59 high-quality studies that potentially served as the foundation of this analysis.

3 LITERATURE REVIEW

The recognition of innovation capabilities has risen as a fundamental strategic tool for building enduring business competition. The essential elements of innovation capabilities consist of research and development (R&D) investment along with collaboration and knowledge sharing with agility in adopting trends and technological infrastructure (Gryshchenko *et al.*, 2021). Research has demonstrated that these elements drive organization success through improved marketplace capabilities of adaptability and efficiency as well as differentiation (Williams *et al.*, 2021).

3.1 Investment and competitive advantage

Organizations maintain their competitive advantage with sustainability through investments made in research and development (R&D). Organizations that invested heavily in R&D functions demonstrated superior abilities for developing innovative products as well as bettering their current offerings together with their operational systems (Habib, 2023). Organizations that made research and development investments obtained distinctiveness from their competitors, especially in time of operating within rapidly evolving industry sectors. The research evidence shows that intensive R&D expenditures lead to lasting business achievements (Muisyo *et al.*, 2021). Organizations that made a strategic focus demonstrated better resilience against technological disruptions thus assuring their position at the front of their competitive industries.

Strong research and development capabilities helped organizations build proprietary technology platforms that function as barriers to market imitation hence improving their market dominance (Gutterman, 2023). The businesses demonstrated enhanced flexibility in market adaptation that allowed them to match their products with emerging customer demands (Obeidat *et al.*, 2021). Companies that invested little in

R&D thus fell far behind others in terms of technology and consequently saw their market share decline (Bergero *et al.*, 2023). The key tendency was that these firms never invested in robust R&D and thus they did not come up with novel products, that gradually limited their competitive opportunities and chances to maintain market significance in terms of the long term (Irziqat, 2026a).

3.2 Collaboration and knowledge sharing

According to Rehman *et al.*, (2021), Organizations have established knowledge sharing with collaboration as fundamental elements for achieving sustainable competitive advantage. Organizations that build cooperative relationships within their internal structure as well as beyond their operational boundaries use external expertise to develop best practices that in turn enhance their internal capabilities (Rehman *et al.*, 2021). Through collaborative networks, businesses developed innovative solutions that they would not have reached without mutual collaboration (Kattel, Lember and Tõnurist, 2020). The active practice of organizational knowledge-sharing initiatives produced growth beneficial to innovative development since organizations could merge multiple insights and skill sets (Singh *et al.*, 2021).

Organizations that merged collaboration systems with knowledge-sharing processes achieved rapid decision cycles with better market reaction capabilities. Organizations that developed cross-functional working environments with open information sharing achieved better results in detecting new trends and preventing them (Suchek *et al.*, 2021). Knowledge-sharing systems proved vital for improving technological resource utilization and led to increased innovation as well as operational gains. Firms that did not develop collaborative cultures faced performance issues and met resistance to trying to create innovation (Cho, Ryan and Buciuni, 2021). Poor communication systems and team fragmentation blocked vital information flow made the organization less effective at seizing available business opportunities. Research has shown that businesses having inadequate collaborative organization frameworks face delays in their innovation cycles and weaker market competition in dynamic business environments (Rehman *et al.*, 2021).

3.3 Agility in adopting trends

Research shows that organizations need to demonstrate fast adaptation to emerging trends because this ability creates a strong basis for staying competitive. Firms having high agility implemented a superior ability to detect market preferences technological changes and regulatory shifts (Tu and Wu, 2021). Organizations succeeded in modifying their business strategies quickly through this capability safeguarding their continued market importance in dynamic industries (Tsolakis *et al.*, 2022).

Agile companies achieved superior market position by applying innovative business models as well as adopting new technologies alongside launching innovative products (Ding, Ferras Hernandez and Agell Jane, 2023). Organizational units that fast-tracked their operational decisions and displayed flexible approaches delivered superior competitive advantages (Wang *et al.*, 2023). The implementation of continuous learning methods and experimental approaches within organizations strengthened their ability to make changes keeping their market operations aligned with market developments.

Organizations that failed to show adaptability experienced major problems dealing with disruptive market situations. The organization's rigid frameworks along with outdated systems and opposition to change blocked their effective detection and reaction toward developing market directions (Tu and Wu, 2021). Companies that took a long time to implement technological changes missed out on key opportunities resulting in decreased market performance. The research data proved that organizations that strategically supported agility achieved increased operational performance consolidating their decision systems and protecting enduring market positions (Ekins and Zenghelis, 2021).

3.4 Technological infrastructure and competitive positioning

Sustainable competitive advantage is recognized to depend on technological infrastructure. Investment in advanced technological systems enables organizations to deliver innovative solutions, optimize processes, and create better customer experiences (Yuan and Cao, 2022). Firms adopted digital tools, automation, and data analytics,

potentially enabling them to make strategic decisions based on information and opting to be more productive and less costly in terms of operating costs (Feng *et al.*, 2022).

Due to this, organizational scalability was made possible due to a strong technological foundation: firms could adjust their capacity to market fluctuations. These companies were efficient in meeting consumer demand as they integrated technological solutions into their supply chains and product development processes (Zhang *et al.*, 2023). In addition, digital collaboration tool deployment enabled the improvement of knowledge-sharing efforts and helped improve innovation and problem-solving capabilities.

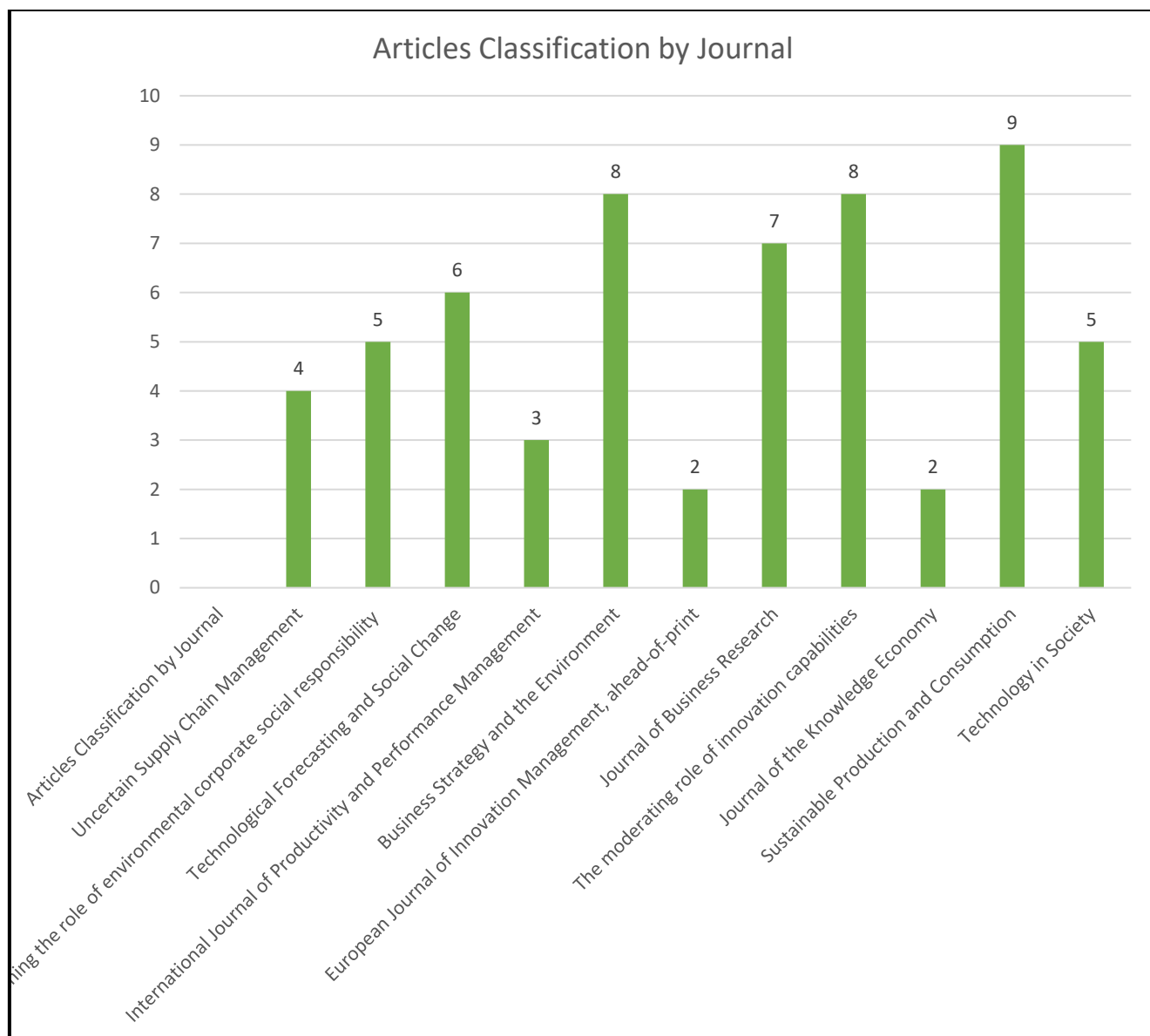
However, the lack of sufficient technological infrastructure often shaped a disadvantage to firms that desired to remain competitive. Mainly, organizations that were not able to modernize their systems experienced inefficiencies, delays in decision-making, and lowered adaptability to market changes (Zhang *et al.*, 2023). Since firms were not investing technologically, they lacked the means to utilize data-driven insights and overall became less competitive in the global marketplace. Some organizations have successfully invested in these innovation capabilities and have shown more agility to cope with technological disruptions offering better customer satisfaction and maintaining leadership in the respective industries (Ferlito and Faraci, 2022). On the other hand, firms that refused to understand these factors have stagnated, inefficient, and lost on the marketplace. In the context of rapidly advancing technology with accompanying global competition for competitive advantage, there continues to be a great interest in innovation capability to facilitate the ability to sustain competitive advantage (Jayashree *et al.*, 2021).

4 ARTICLES CLASSIFICATION

4.1 Articles classification by journal

Figure 2

Classification of Articles by journal



The classification process assigned the articles to specific journals based on their focus areas. Sustainable Production and Consumption included nine articles that demonstrated its importance within the fields of sustainability and innovation research.

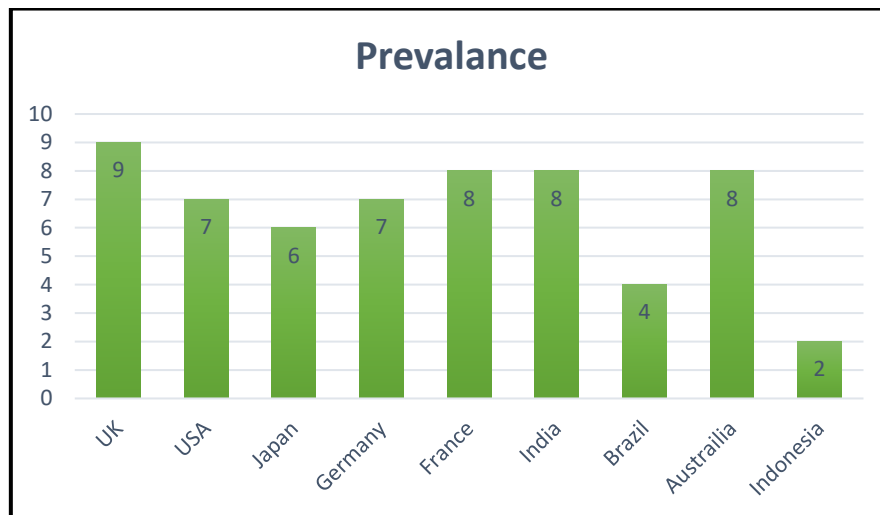
The journal *Business Strategy and the Environment* featured eight studies, in the *Journal of Business Research* published seven articles. Seven articles published in *The Journal of Business Research* highlighted its primary business innovation connection. Six articles appeared in *Technological Forecasting and Social Change* journal to discuss the progress of technological innovations. *Technology in Society* published five research papers that demonstrate its primary interest in studying technological effects on society. The collection of articles within *Examining the Role of Environmental Corporate Social Responsibility* were five thus showing academic interest in corporate social responsibility. The sector of *Uncertain Supply Chain Management* provided four articles to establish its main focus on supply chain uncertainty management. Productivity enhancement emerged as the key subject matter of the *International Journal of Productivity and Performance Management* due to its inclusion of three significant studies. The *European Journal of Innovation Management* provided readers with two research studies to show its dedication to innovation management. The *Journal of the Knowledge Economy* published two articles that emphasized knowledge-based economic strategies. The eight studies in *The Moderating Role of Innovation Capabilities* supported its central role in exploring innovation as a strategic business advantage.

The articles classification by journal highlights the distribution of research across various academic sources. The highest number of articles (9) are published in *Technology in Society*, indicating a strong focus on technological and societal impacts. Similarly, *Business Strategy and the Environment* and *The Moderating Role of Innovation Capabilities* (both with 8 articles) reflect a growing interest in sustainability and innovation strategies. The *Journal of Business Research* (7 articles) emphasizes the business and management perspective. Other journals, such as *Technological Forecasting and Social Change* (6) and *Uncertain Supply Chain Management* (5), contribute significantly to future-oriented and supply chain studies. However, journals like *Ahead-of-Print* and *Sustainable Production and Consumption* have the least representation (2 articles each), suggesting limited but emerging research in these areas. This classification reveals a multidisciplinary research trend, where sustainability, innovation, and business strategy dominate the discourse.

4.2 Articles classification by country

Figure 3

Classification of Articles by Country

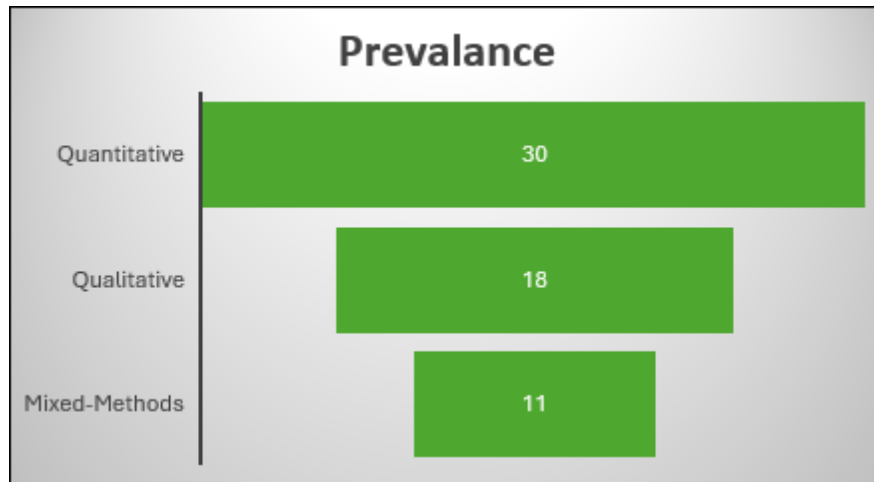


The classification of articles by country provides insights into the geographical distribution of research contributions. The UK leads with nine published studies, primarily focusing on innovation and competitive advantage, reflecting its strong academic engagement in these areas. The USA (7 articles) demonstrates active involvement in business strategy research, while Germany (7 articles) emphasizes industrial progress. France, India, and Australia each contribute 8 studies, showcasing their dedication to sustainability, market relevance, and strategic management, respectively. Japan (6 articles) highlights its expertise in technological advancements, whereas Brazil (4 articles) focuses on innovation within its developing market. Indonesia, with only 2 studies, has the lowest research representation, indicating limited academic contributions in this field. This distribution highlights the dominant role of developed nations in shaping research on innovation and strategic management, with emerging economies gradually increasing their participation.

4.3 Articles classification by methodology

Figure 4

Classification of Articles by Methodology



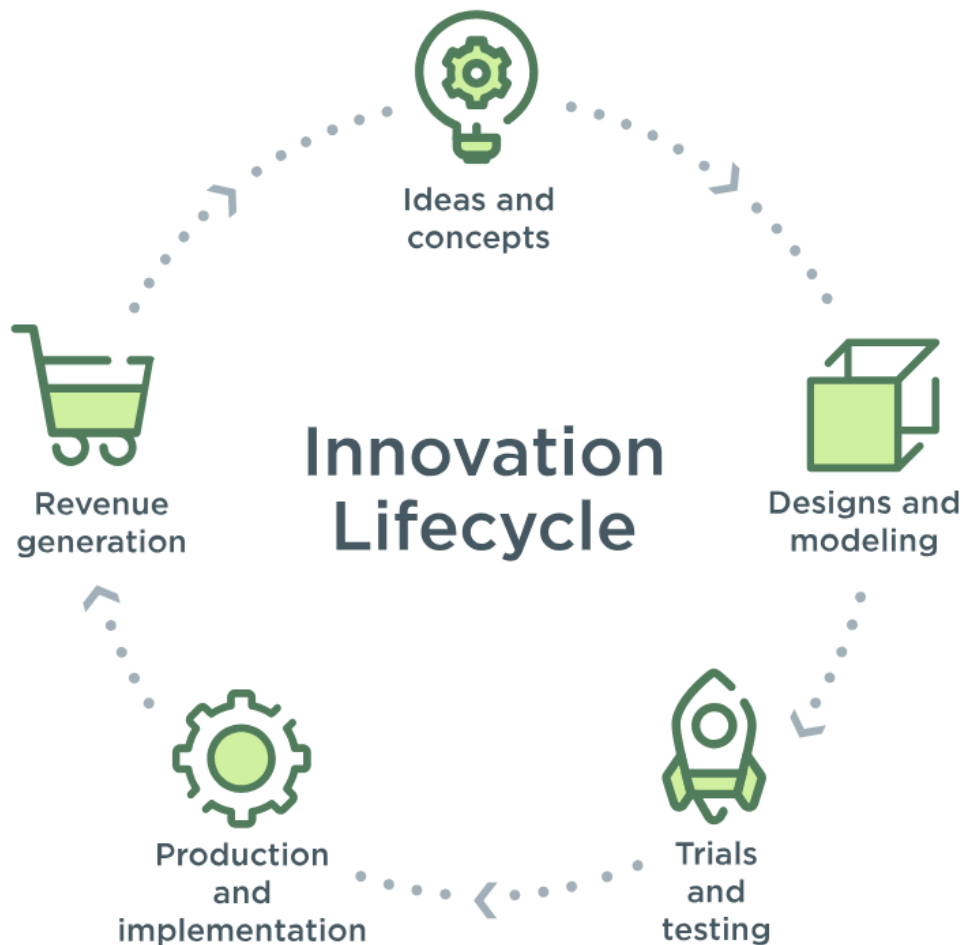
The classification of research articles by methodology reveals a predominant reliance on quantitative research methods, with 30 studies employing statistical analysis and numerical evaluation to assess innovation capabilities. Qualitative research approaches were utilized in 18 studies, focusing on in-depth exploratory analysis and comprehensive understanding of innovation dynamics. The mixed-methods category, comprising 11 studies, integrated both numerical data and qualitative insights, offering a balanced perspective on innovation and sustainable competitive advantage. This methodological distribution highlights the emphasis on empirical validation while also acknowledging the importance of interpretive analysis in examining business competitiveness and innovation trends. The diverse research approaches reinforce the significance of methodological rigor in evaluating industry advancements.

5 FINDINGS

5.1 Leveraging innovation capabilities as a strategic lever

5.1.1 Enhancing innovation through adaptive r&d strategies

Organizations dedicated their resources to developing adaptive R&D methods that enabled them to tackle technological changes. Organizations placed their investments into adaptable models that used real-time market information in their design. Organizations restaged their product development periods through changing industry market trends (Bhandari *et al.*, 2022). Through strategic partnerships, organizations achieved better knowledge acquisition and decreased their uncertainty. In an adaption of new strategies, Organizations tested newly emerging technologies to achieve improved innovation results (Borah *et al.*, 2021). Decision-making in constantly evolving environments received support from risk management frameworks. Companies improved their market positions because they started to adopt emerging disruptive technologies first. The continuous evaluation processes led to more efficient use of R&D funding. The organization maintained its long-term value by designing performance measures that followed industry evolution patterns. Improved learning processes led to enduring success for innovation-based business sectors (Ferraro *et al.*, 2024; Irziqat, 2026a).

Figure 5*R&D Cycle (GovGrant, 2022)*

This R&D cycle involves concepts or ideas generation, modelling and design, trials and testing, production and implementation, and finally the generation of revenue where innovations are incorporated into standard operations.

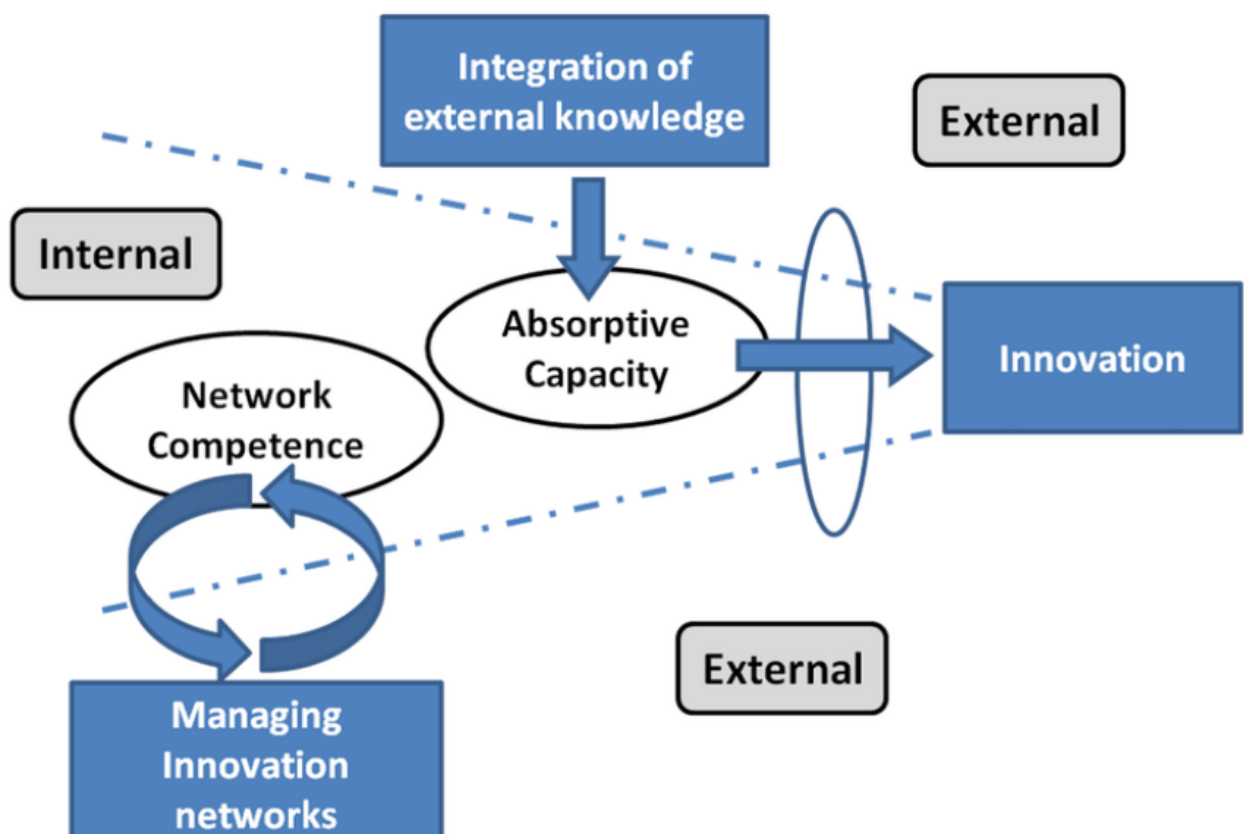
5.1.2 Advancing innovation via open innovation networks

The exchange of knowledge became possible through partnership work with outside stakeholders (Adhikari, Joshi and Basu, 2023). The organization strengthened its innovation process through strategic alliances between academic institutions and industry leadership groups. The sharing of intellectual resources expanded the limits of problem-

solving abilities for organizations (Boschma *et al.*, 2025). Information sharing occurred in real time using platforms that improved the speed and effectiveness of organizational decisions. Research efforts that operate without central oversight help organizations become independent of their internal talent base. Intellectual property management systems protect honest participation from all contributors. Crowdsourcing strategies improved idea generation and solution development (Elidjen *et al.*, 2022). Cross-industry partnerships brought up new perspectives into the innovation processes. Regulatory compliance frameworks guided open innovation strategies.

Figure 6

Open Innovation Framework (Kühne et al. 2011)



This framework indicates the way building network competence and managing innovation networks increases absorptive capacity. Additionally, this allows effective incorporation of external knowledge, promoting innovation. Apart from that, this model focuses on both external and internal collaboration, presenting the way knowledge flows

drive innovation through strategic network management and systematic capacity building.

5.1.3 Optimizing innovation using agile development processes

Companies embraced spiral lifecycles to enhance the speed of producing unique products. Such small adjustments helped to address the problem of wastage of resources and increase efficiency. Due to short development cycles, the competitors were able to respond quickly to the market changes (Florez-Jimenez *et al.*, 2024). Cross-functional teams streamlined the integration of the workflow. It is important herein to note that to update risk assessment, suitable changes are made based on the various milestones of the project. From a user point of view, the changes that occurred in the features implemented are real-time feedback from a user standpoint (Felipe, Cardoso and Teixeira, 2025). Most importantly the scalability of the frameworks that support their application in various industries (Gama and Magistretti, 2023). The use of communication improved collaboration in assembled teams. The automation of the process also helped to save time and minimize the issues caused by delays. This responsiveness to technological changes positively affected competitive positioning (Kalathingal and Ambrammal, 2025).

5.1.4 Strengthening innovation by enhancing knowledge sharing

Knowledge management systems created standardized systems for information distribution. Employee training programs build internal skills among employees through educational programs. The establishment of internal collaboration networks reduced the time needed for problem-solving (Lim *et al.*, 2024). Research groups combining multiple disciplines functioned to promote imaginative solutions through functional integration. Standard operating procedures were documented as best practices for process standardization (Abayomi Baiyere *et al.*, 2024). The establishment of intellectual property frameworks guaranteed the protection of business secrets. Performance assessment tools measured the success of implemented knowledge-sharing programs. The system enabled users throughout hierarchical structures to take part through interactive

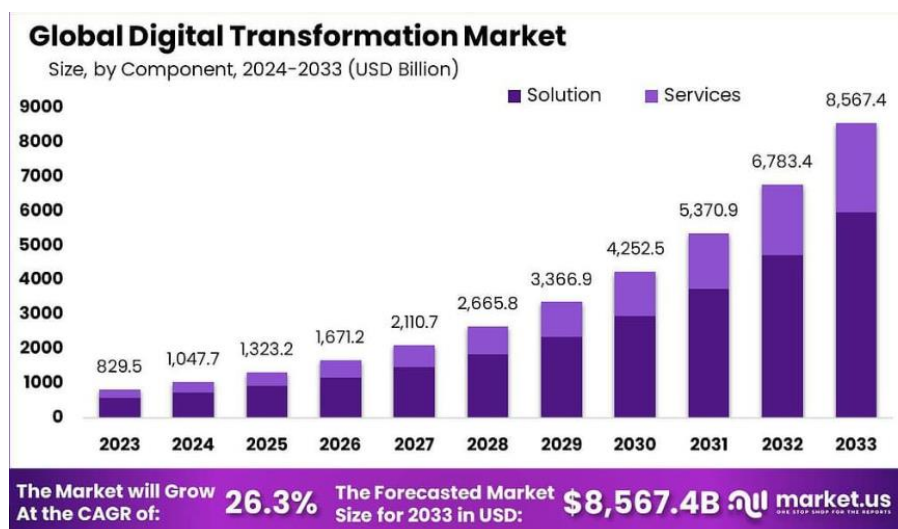
interfaces (Nima Heirati *et al.*, 2024). Organizational intelligence retention enables organizations to maintain their innovative capabilities long-term.

5.1.5 Driving innovation through digital transformation tools

Advanced digital technologies became integrated by organizations to simplify their innovation procedures. Artificial intelligence applications use computerized systems to execute data-based decisions automatically. Cloud computing services deliver better scalability and accessibility features to users (Allen *et al.*, 2025). The implementation of Blockchain technology strengthened research and development partnerships by improving their security measures with their transparency features. In the forecasted analyses, organizations developed more efficient predictions of market trends (Robb *et al.*, 2024). The use of virtual project platforms enabled the team to improve coordination through the use of information technology. Cybersecurity measures safeguarded intellectual property (Kalathingal and Ambrammal, 2025). The implementation of augmented reality technology enabled quicker development of new products. The implementation of Internet of Things technologies significantly improved business operational performance (Shaleen Khanal, Zhang and Araz Taeiagh, 2024). The adoption of strategic technologies enabled continuous innovation over extended periods.

Figure 7

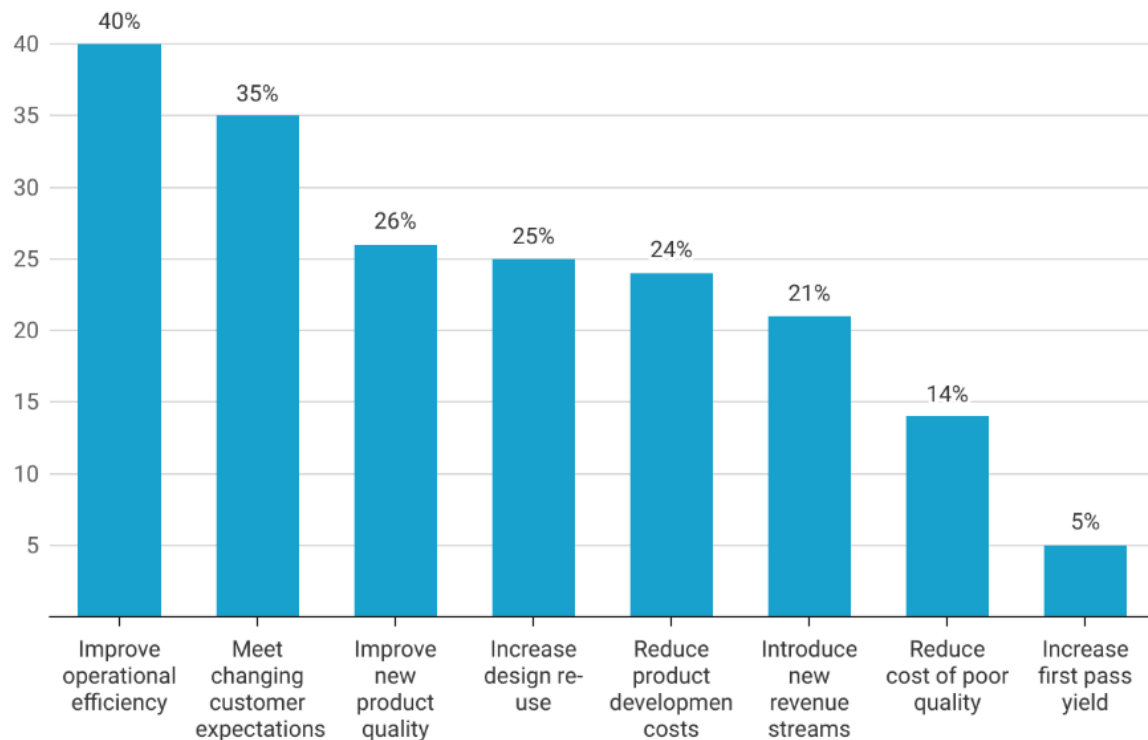
Global Digital Transformation Market (Pangarkar, 2024)



The digital transformation market worldwide is projected to develop at a 26.3% CAGR, reaching \$8,567.4 billion by 2033. Additionally, both solutions and services indicate strong upward trends. So, it suggests increasing demand for digital innovation across sectors over the next 10 years.

Figure 8

Benefits of Digital Model Adoption (Pangarkar, 2024)



This chart indicates that the adoption of the digital model primarily increases 40% operational efficiency and achieves 35% changing customer expectations. Moreover, other major benefits include new revenue opportunities, cost reduction, and improved product quality. Significantly, lesser impacts are observed in quality improvements and yield, suggesting changing value across operational dimensions.

5.1.6 Facilitating innovation via ecosystem collaboration models

Strategies used for engagement with multiple stakeholders improved the innovation capabilities (Kumar and Raj, 2024). Such activities were made possible by shared investments organized in industry consortia. Strategic partnering lowered the risks associated with expensive research and development initiatives (Wang, Sun and Li, 2025). It facilitated the co-evangelism drives within the open-sourced platforms. Public-private partnerships accelerated regulatory approvals. Social programs ensured availability and use of new systems and innovations were increased. Similar to current complex ecosystems, industry standardizations-maintained compatibility across systems (Bag, 2023). Distributed research centers enhanced the ability of regions to innovate. International alliances strengthened global competitiveness. The criteria for knowledge transfer agreements provided an effective means of achieving win-win partnerships for collaborative advantage (Zerihun Girma Aragaw, Haag and Massimo Baù, 2024).

5.2 Barriers to innovation capabilities in sustaining competitive advantage

5.2.1 Bias in decision-making processes

Organizational decision-making systems incorporated natural biases that altered their innovation strategies (Lee, Hussain and Abass, 2024). The innovative processes received influence from cognitive and algorithmic biases that led to decisions regarding resource management and technology acceptance together with business strategy selections. Organizations struggled to reduce these biases with limited success, so they struggled to deploy effective strategies. The developmental process became affected by preexisting assumptions together with subjective opinions thus restricting diversity within innovative approaches (Al-khawaldah *et al.*, 2022). AI-based decision-making systems generated discriminatory patterns since their training information fell short. Leadership roles lacking diversity caused additional biases in strategic decision-making. The market experienced lower competitiveness due to innovation strategies that relied on restricted

viewpoints that made adaptation challenging. Strategies to prevent bias would take time to consult with sources of data and various leaders.

5.2.2 Ensuring transparency in innovation strategies

There was poor revelation on innovation strategies hence creating a poor trust among the stakeholders (Nika Saputra *et al.*, 2025). Companies faced difficulties providing straightforward updates about their research work, developmental phases, and deployment activities. Inadequate openness in strategic planning created doubts about the technological choices that were made. Business collaborations were delayed because stakeholders could not understand intellectual property rights (Alam and Islam, 2021). The failure of organizations to disclose information about their AI-based innovations made stakeholders doubtful about ethical practices. To track the levels of transparency, the regulatory bodies demanded well-established reporting standards. Lack of clarity in strategic initiatives especially in organizational goals and objectives demoralized the investors and created an unstable market.

5.2.3 Managing hallucinations in AI systems

Outputs created through AI were known to contain some errors and this made innovations developed using the technology to be questionable in their credibility. Loops provided illusions of control over the decision-making process. This allowed organizations to face challenges that come with verifying AI recommendations (Rong *et al.*, 2024). The use of synthetic information in the processes decreased its adoption because of trust in artificial intelligence (AlNuaimi *et al.*, 2021). The preconditions to unverified outputs impacted negatively the efficiency of research and development. Using AI tools, errors that needed correction had to undergo many verification processes and hence were costly to the operation (Teguh Widhi Harsono *et al.*, 2024). AI governance frameworks were weak, thus posing a significant problem in the management of risk in innovation.

5.2.4 Preventing misuse of emerging technologies

New technologies had their challenges of being abused with ethical and legal issues. Decision-makers faced challenges in the establishment of control measures for top-notch innovations. The lack of policies was another factor that led to the development of unauthorized applications due to a lack of controls (Wang, Cui and Zhou, 2024). AI, blockchain, and IoT technologies are about security risks that call for a stringent approach. This is attributed to the fact that the enforcement of regulations to curb cyber threats was lacking in the emerging technology sectors (Arsawan *et al.*, 2020). Privacy issues were upgraded with the assistance of innovative solutions that demanded lots of information about users. In the future, preventive measures called for better regulation and policies across the food industry as well as strengthened compliance systems.

5.2.5 Societal impact of innovation practices

Innovative practices gave rise to social changes in workforce stability and ethicality. Technological advancements became a threat to conventional employment positions, hence raising unemployment prospects (Young, Wiley and Elizabeth, 2024). Thus, the gap between those people's access to new technologies and not only grown. Incidentally, there are social and ethical issues about automation supplanting human initiatives (Bag and Pretorius, 2020). Managers were accused of neglecting the social responsibility aspects of organizations in their administration in favor of efficacies. Various regulatory authorities put measures to check the overuse of technology in the interest of humanity (Asiaei *et al.*, 2022). These innovations' integration called for impact assessments to reduce negative effects.

6 DISCUSSION

6.1 Enhancing innovation capabilities as a strategic lever adaptive R&D strategies

Companies have devoted a great deal of effort towards developing new and optimal approaches and practices in managing R&D designed to deal with changing technologies. These investments allowed firms to include real-time market knowledge into their development models to develop innovations that fit rendering industry changes (Bhandari *et al.*, 2022). Thus, the planning of innovation cycles for product development was timely adjusted by organizations due to volatile markets. Successful partnerships were instrumental in the process of knowledge acquisition and management of risk by the firms with the help they were able to test the potential of these technologies (Borah *et al.*, 2021). Moreover, risk management frameworks offer the most help in dynamic decision-making and increase the chances for an organization to make appropriate decisions in the face of uncertainty. Disruptive technologies are a significant strategy for achieving competitive advantages, especially for companies that embrace new technologies in the market (Ferraro *et al.*, 2024; Irziqat, 2026b).

6.1.1 Open innovation networks

Engagement with outside organizations increased the transfer of knowledge, enhancing the capabilities of parties to improve their innovation. Alliances were made to enhance the organizational management of innovation activities between academic institutions and industry leaders (Boschma *et al.*, 2025). Through such an approach, the intellectual capital that firms used in solving problems increased and hence, the solutions formulated were more efficient. Real-time sharing of information enhanced the decision-making processes of firms, and this helped in responding to new events. In reducing dependence on internal knowledge, decentralized research offered the opportunity to capture multiple points of view on innovations (Elidjen *et al.*, 2022). Legal foundations of protection of intellectuals protected the contributions of people contributing to projects and thus made them more trusting of other users (Adhikari, Joshi and Basu, 2023). The crowdsourcing strategies were useful in idea sourcing and solutions since they

contributed to an expansion of the pool and innovation. This was the case as the idea called for representatives from different industries to come up with ideas that enriched the innovation ecosystem.

6.1.2 Agile development processes

Companies also implemented new development methodologies like the spiral lifecycles in their product development process to increase speed (Felipe, Cardoso and Teixeira, 2025). Efficiency was achieved by reducing resource wastage through slight modifications to increase a company's performance. Flexible short development cycles in the case of businesses proved accurate at adapting to changes within the market, helping to achieve a shortened time to market for new products (Florez-Jimenez *et al.*, 2024). Thus, the carry-over of functions was improved, and the interconnection of processes was achieved by cross-functional teams. Risk management plans were adjusted and revised at successive stages every time the accomplishment of a milestone was recorded ensuring active management of risk (Gama and Magistretti, 2023). Users also provided their feedback in real-time, thus, the product fit was enhanced. One of the significant factors of agility adopted in different industries was the scalability that agile frameworks offered (Kalathingal and Ambrammal, 2025). Communication promoted better relations with the team members and boosted staff performances within the teams.

6.1.3 Enhancing knowledge sharing

Sharing knowledge through the use of knowledge management systems made it easier to share information hence enhancing the learning process in the organizations (Abayomi Baiyere *et al.*, 2024). Organizations use employee training programs to contribute to strengthening the internal competencies and make sure that they are capable of managing new technologies. Intranet collaboration networks were effective in cutting down on time spent to solve problems within organizations hence improving innovation (Lim *et al.*, 2024). These cross-functional work teams encouraged idea generation based on knowledge of different disciplines. Policies and procedures were maintained, and innovation best practices were recorded in procedures to make them standard and

sufficient (Kalathingal and Ambrammal, 2025). There were contractual and legal barriers that gave legal backing to the protection of proprietary knowledge and encouraged a pro-innovation culture (Nima Heirati *et al.*, 2024).

6.1.4 Digital transformation tools

The establishment of sophisticated digital technologies integrated and improved the flow of innovation processes (Allen *et al.*, 2025). The employment of artificial intelligence makes it possible to minimize human interference in responding to decision-making based on data collected. Advances in cloud computing services provided the other means of increasing scalability and increasing the reachable performance thus enabling flexibility in collaboration (Robb *et al.*, 2024). Blockchain technology enhanced the security of data in research and development partnerships by increasing the levels of data transparency. Advanced analytical tools ensured better predictions of emerging markets hence aiding the firms in planning for innovation. Virtual project management also brought advantages in terms of integration through central project management platforms, making collaboration much easier across geographic locations (Shaleen Khanal, Zhang and Araz Taeihagh, 2024). Security was enhanced in the field of cybersecurity to safeguard its clients' intellectual property against risks that may emanate from cyber threats.

6.1.5 Ecosystem collaboration models

Active collaborations with other actors improved the innovation advantages. Collaborations within an industry cluster eased the distribution of costs for big-scale R and D projects. Alliances helped reduce the risks related to expensive R&D projects, thus making them more feasible (Wang, Sun and Li, 2025). They have empowered co-evangelism since they created better conditions for innovation across platforms (Bag, 2023). The synergistic PPP rules facilitated the issue of approvals for innovative products, speeding up the entry into the market. Civil Actions ensured equality in innovation as it tried to support innovations reaching as many people as possible (Zerihun Girma Aragaw,

Haag and Massimo Baù, 2024). It helped to standardize different industries thus increasing compatibility in the linkage of various systems.

6.2 Challenges for innovation capabilities in achieving sustainable advantage

6.2.1 Bias in decision-making processes

Limitation Cognitive and algorithmic biases affected the decision-making process of the organization and determined the innovation strategy. Such biases impacted decisions made on the distribution of resources, modes of technology mercantile management, and the way they devised their business strategies (Al-khawaldah *et al.*, 2022). Attempts to reduce the biases were only partially successful because numerous assumptions prevented other viewpoints in innovative practices (Lee, Hussain and Abass, 2024). Machine learning decision systems were particularly trained with biased data, meaning that had negative effects on innovation processes. The lack of diversity in leadership structures meant that bias was amplified, and therefore, strategies for innovation were not broad.

6.2.2 Ensuring transparency in innovation strategies

Lack of transparency in different firms' innovation strategies also led to a decline in stakeholder trust. Management and other stakeholders could not gain reliable information relating to further research and development on poor updates meaning that the investors and other partners could not be trusted in the organization. The nonexistence of revealing strategic planning led to the lack of clarity over some technological choices (Alam and Islam, 2021). This was mainly in cases of business collaborations over issues related to intellectual property rights proved to be questionable. Some of the problems that were aroused because of this secrecy included but were not limited to the following: This secrecy also reduced the level of stakeholder trust on the innovations created by the use of AI. Absence of strategic direction made investments suicidal and altered stakeholders' positions deceptively (Nika Saputra *et al.*, 2025). Adopting effective and

strong measures of transparency was very important in building trust and the place of being competitive.

6.2.3 Managing hallucinations in AI systems

In using AI-generated outputs obtained from relevant databases, researchers frequently encountered the problem of many inaccuracies and cast doubts on such AI-based developments (AlNuaimi *et al.*, 2021). AI systems prompt organizations to make bad decisions because of decision-making illusions. That means verifying the given recommendations became an issue because synthetic data was the only thing people could rely on in the company (Rong *et al.*, 2024). The extensive validation procedures that were necessary as a consequence of AI also led to operational costs going up and complicated AI adoption. AI governance frameworks were relatively fragile; the risks therefore increased resulting in enhanced regulatory efforts. To address these challenges, there was a need to strengthen AI training data, validation methods, and risk management systems (Teguh Widhi Harsono *et al.*, 2024).

6.2.4 Preventing the misuse of emerging technologies

The use of new and advanced technologies had issues regarding ethical and legal considerations. The major problems that decision-makers experienced were related to the development of control measures for implementing high-risk innovations (Arsawan *et al.*, 2020). Due to the lack of effective policies, there were numerous unauthorized applications, that resulted in the aggravation of the security threats (Wang, Cui and Zhou, 2024). AI, blockchain, and IoT brought about security threats within the cyber environment and called for more stringent regulations. This was mainly attributed to the lack of enforcement mechanisms that hampered the fight against threats from cybercrime. The notion of privacy became an issue of debate as novelties required people to provide much data thus eliciting ethical implications (Young, Wiley and Elizabeth, 2024).

6.2.5 Societal impact of innovation practices

In earlier times, technological innovations caused social disruption for workforce stability and ethical issues (Asiaei *et al.*, 2022). They have also contributed to changing the traditional employment standards and pose more unemployment threats (Bag and Pretorius, 2020). The major issue that was raised on the ethical side of things was the matter concerning job displacement by automation. It is interesting to note that organizations began being accused of being efficient but irresponsible (Young, Wiley, and Elizabeth, 2024). There were attempts made by regulatory bodies to address the negative impact of technology and the adoption of technology as was appropriate.

7 CONCLUSION

Innovation capabilities were established to play a definite strategic role in the attestation of sustainable competitive advantage. This research identified that investment in research and development, cooperation, knowledge exchange, the ability to respond to trends, and technology infrastructure were critical to sustaining competitiveness. Research evidence suggests that structured innovation helped in sustaining business success, particularly in the long run. Organizations that outsourced research on planned product growth and implemented knowledge organization systems successfully navigated volatile surroundings. The research also revealed that enhanced the decision-making process, operational efficiency, and sustenance of organizations' positions in the market by adopting digital transformation technologies.

Therefore, strategic cooperation was also another factor that contributed to stability in some business strategic environments. Some of them pertain to ethical issues in the applications of artificial intelligence and automation, that is job displacement, particularly in the workforce. Understandably, companies that adopted new technologies and value networks got competitive advantages over those that didn't face numerous problems and stagnated. This research highlighted the use of frameworks in innovation management by providing information about the useful approaches that support the sustenance of business. Based on this research, it was determined that those implying dynamic structural changes were able to enjoy sustainable growth. From the proposed

research, the literature secretions helped in giving history to the arguments about innovation strategies worked to foster business resilience. Managers strengthened practical insights into introducing and sustaining innovation-based competitive advantages and underlined the importance of adopting investment into development and cooperation with new technologies.

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