

Artificial Intelligence in the Strategic Management of Technological Innovation: A Contemporary Analysis

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[Abstract] This conceptual article examines how artificial intelligence (AI) is reshaping the strategic management of technological innovation. It distinguishes AI from machine learning, generative AI, foundation models and large language models, and AI-enabled decision support, and develops a unified framework linking AI capabilities to opportunity recognition, innovation portfolio optimization, R&D prioritization and execution, and collaboration and ecosystem orchestration. Drawing primarily on the resource-based view and dynamic capabilities perspective, the framework explains how AI-enabled data processing, pattern recognition, generative capabilities, and decision support can strengthen organizational sensing, resource reconfiguration, learning, knowledge recombination, and strategic adaptation. The article develops explicit theoretical propositions connecting these mechanisms to innovation outcomes while emphasizing that AI does not produce performance improvements automatically. Data quality and access, complementary human expertise, governance and explainability, organizational readiness, task uncertainty, appropriability, and regulatory conditions are identified as important boundary conditions. The analysis also distinguishes correlation and association from causal effects and highlights the limitations of existing case-based and cross-sectional evidence for causal inference. The resulting framework offers an integrated foundation for future empirical research and provides managers with a structured approach for evaluating where and under what conditions AI can contribute to technological innovation strategy.

[Keywords] Artificial intelligence, technological innovation, strategic management, machine learning, generative AI, foundation models, large language models, dynamic capabilities, resource-based view, innovation portfolio, AI-enabled decision support

1. Introduction

The technological, economic, and societal transformations driven by Artificial Intelligence (AI) profoundly affect strategic management of technological innovation (Chen, 2019). Firms that recognize and respond to these shifts accelerate innovation, enhance performance, and shape change. Understanding AI's multifaceted influence over opportunity recognition, portfolio optimization, and execution clarifies the paradigm change in strategic management in the contemporary economy. Technology strategy aligns firm pursuits with major directions of

technological change while innovation strategy corresponds to a narrower, technology-specific scope. Strategic management encompasses processes, activities, and interactions that establish and influence strategic positions, with technological innovation as a primary avenue for creating and sustaining competitive advantage. A firm's technological novelty (the extent to which pursued innovation differs from prior knowledge) is a key driver for attaining superior performance. Associated governance constructs such as opportunity, novelty, and appropriability guide management while theoretical lenses including dyadic, portfolio, and dynamic capabilities provide valuable insights. AI-enabled opportunity recognition agents augment traditional detection and ideation approaches by identifying unanticipated signals in large, multi-source datasets. Analysis of emerging data patterns reveals previously unnoticed trends, technologies, products, or players open to unrecognized technological opportunities and corresponding novelty.

1.1 Conceptual Scope and Terminology

In this article, artificial intelligence (AI) is the umbrella term for computational systems that perform tasks associated with perception, prediction, reasoning, language, or decision support. Machine learning (ML) is a subset of AI in which models learn statistical patterns from data to make predictions, classifications, recommendations, or control decisions. Generative AI is a subset of AI designed to generate new content—including text, code, images, design alternatives, or scientific hypotheses—rather than only classify or predict. Foundation models are large, general-purpose models trained on broad datasets and adaptable to many downstream tasks; large language models (LLMs) are foundation models specialized in language and related multimodal tasks. AI-enabled decision support refers to the use of AI outputs to inform managerial judgment while decision authority remains wholly or partly with human actors.

1.2 Terminology Convention

To avoid implying unsupported levels of autonomy or causality, this article uses AI-enabled as the default descriptor for organizational processes that incorporate AI. AI-supported is reserved for settings in which AI advises a human decision maker; AI-driven is used only when AI materially initiates or executes a process with limited human intervention; and AI-enhanced is used only when evidence specifically concerns improvement to an existing capability.

Emerging AI capabilities in data processing, pattern recognition, and autonomous decision-making strengthen firm responses to these shifts and warrant renewed inquiry into the interplay between AI and technological innovation. Resource-based and dynamic capabilities perspectives help to further elucidate this relationship. AI as a resource affects asset endowments, while AI-based routines incorporate codified algorithms, procedures, or workflows. AI-enabled high-velocity learning influences adaptation to external conditions, reshapes knowledge flows along innovation stages, and fosters alignment within the internal innovation system. Theory articulates the sequence and balance of resource, routine, and learning investments required to attain lasting competitive advantage.

Interactive, continuous, and dispersed investments in AI across the entire innovation system—rather than concentrated endowments or domain-specific capabilities—are essential for unlocking the full potential of large language models (LLMs) and similar technologies. This objective calls for a holistic framework linking AI to each stage in opportunity recognition, portfolio optimization, and execution, emphasizing the concurrent flows of signals, actions, and decisions that shape

strategic positioning across multiple innovation types. Integrating the high-level resource-oriented framework with state-of-the-art process models further advances understanding of the influence of AI on strategic management of technological innovation.

2. Theoretical Foundations

Modern innovation theory underpins strategic management of technological innovation. Theoretical linkage between firm strategy and technological novelty rests on constructs about opportunity recognition (indicator of evolving technological capabilities), novelty (external signal of competitive technological change), and appropriability (long-term competitiveness). Available theories embrace extensive dyadic innovation choice, multi-faceted portfolio selection, and adaptive dynamic capabilities.

AI-driven technological innovation spans opportunity recognition, portfolio optimization, and execution, with distinct capabilities in data processing, pattern recognition, and autonomous decision-making. Analytical frameworks with logically connected elements and flow diagrams clarify theoretical specification and operationalization. AI resources constitute large-scale data, processing power, domain-trained models, and versatile algorithms; AI-related routines encompass operational data strategy, opportunity-centric data-gathering, AI model definition, and evaluation of AI-sourced insights. Integration of resource-based perspectives, AI-related resources, innovation-orientated routines, and monitoring of external innovation trends elucidate competitive advantage definition, resource-based opportunity exploration, and cumulative portfolio-level adaptability. Materials and solutions intended for industry elucidate data lineage, governance, ethical implications, ecosystem orchestration, and public policy.

Rules of data strategy and information quality orient AI deployments. Opportunity recognition and portfolio optimization concentrate on opportunity scanning, assessment, and projected value appropriation. Input consists of external signals, long-standing data channels, and needs spanning adjacent sectors; outputs comprise opportunity-centric data signals and prioritized project selection. Reinforced scanning turns AI-model-sourced signals into company needs, enriches supplementary opportunities, and determines data acquisition alignments. Portfolio selection prioritizes consideration of investment-return realization period, risk, and linkages between simultaneous projects. AI-generated importance and opportunity-scaling contribute to ongoing assessments and ad-hoc alterations midway through project implementation. Portfolio updates, cyclical assessments, and stage-gate scheme integration envelop ongoing design, development, feasibility/programming, and evaluation/mastering phases. Reinforced scanning and triage resources enable company-adapted customer-needs interpretation and streamlined assessments of non-standard project propositions. Executives deploy defined criteria to gauge prospective projects, as continuing assessments relate to alternative undertakings at the company level.

Execution encompasses R&D resource prioritization, project activation in response to opportunities or requirements, and establishment of sector-advancement collaborations for internal efforts or consortia participation. Selection criteria reflect expected value, risk, and delivery timeframe. AI-generated insight and assessment adjust project prominence within established frameworks throughout the realization stage, with triage indicators determining essential modification. Monitoring of sector-wide challenges and breakthroughs steers emergent opportunities toward internal innovation, firm-acquisition signals, external collaborative proposals, and orchestration of technology-based alliances.

Collaboration and ecosystem orchestration engage stakeholder networks connected through technology, product, and service partnerships. Collaborative-formation criteria consider offered capabilities, ecosystem governance, and connections to existing project chains. Orchestration comprises alliance-activation, platform-access brokering, or joint-offering facilitation; governance pivots around partner-characterization, framework-orchestration degree, temporal-cooperation modes, and external-knowledge-sharing protocols.

2.1 Innovation Theory and Strategic Management

Strategic management links a firm's future position with its present situation; both are largely determined by the firm's technological novelty (S. Wanaswa et al., 2017). Innovation theory encompasses two aspects: opportunity and novelty. An opportunity is an externally observed, profitable situation that can be addressed through new technological solutions. Novelty is the extent to which the technology considered for a given opportunity has been previously developed or utilized internally. The two constructs address how firms find and assess technological innovation opportunities.

Technological innovation is influenced by firm-specific characteristics and capabilities. A dyadic lens analyzes two linked decision processes: opportunity recognition (scanning the environment to identify externally observable situations where technological solutions can be applied) and evaluation (assessing the firm's technological repertoire to determine the expected value of addressing closely linked opportunities). A portfolio approach analyzes the technological positioning of all ongoing projects to prioritize those that remain valuable only if additional technologies are developed. Guidance on these two closely interconnected aspects is critical for establishing a balanced technological innovation portfolio.

The strategic management of technological innovation is further influenced by the firm's ability to appropriate the value created. Value appropriation depends on the excludability of technology-based solutions, which is governed by intellectual property rights or trade secrecy. A dynamic capabilities perspective, which focuses on the firm's capacity to reconfigure its resource base, sheds light on how both opportunity and appropriation dimensions are linked to the processes used to generate, develop, and exploit new technologies (Paula Vilas Boas Viveiros Lopes et al., 2016). Empirical evidence supports the relevance of such ability for firm performance, entrepreneurial behavior, and competitive advantage.

AI has the potential to trigger significant shifts in the strategic management of technological innovation at corporations. It is a general-purpose technology (GPT) that can be deployed across a wide array of industries and applications. These capabilities enable the automation of a range of previously labor-intensive activities and lead to a reassessment of other closely related interactions. AI relies on the availability of massive, disparate, and fast-moving data; advances in storage capacity, processing power, and algorithm design; and enhanced computing efficiency (including embedded AI chips).

AI qualifies as a driver of innovation, enabling organizations to engage in opportunities that remain otherwise unattained. It comprises a combination of capabilities that allow for substantial gains at all stages of the innovation process. Specifically, AI facilitates the processing of large volumes of data, the identification of patterns across heterogeneous signals, and the autonomous generation of

decisions regarding the associated courses of action. Corresponding AI-enabled innovation frameworks can thus be developed that accommodate the opportunity, novelty, and appropriability dimensions of innovation theory. The adoption of these AI-supported processes yields systematic performance benefits when compared with alternative approaches.

2.2 Artificial Intelligence as a Driver of Innovation

Artificial Intelligence (AI) is a transformative force driving innovation across industries. It is central to the digital revolution, impacting nearly every aspect of society. AI technologies are now widespread, including applications in speech recognition, robotics, and autonomous vehicles, delivering real business and consumer benefits. The adoption of AI in various sectors and use cases has led to significant impact, especially within supply chains. AI's potential to create value over the next 20 years underscores its role as a key driver of innovation, promising improvements in efficiency, productivity, and new capabilities (Zapke, 2019).

AI is driving innovation and reshaping business models through rapid technological advancement. The adoption of AI is making the world smarter, with innovations such as traffic mapping, ride price estimation, friend suggestions, spam filtering, online shopping recommendations, and cancer detection simplifying lives. This fast integration into various sectors is pushing companies to become AI-driven, prompting strategists and entrepreneurs to develop new strategies and sources of business value. Research and innovation, driven by AI, play a crucial role in economic growth by fostering new markets and improving existing ones. According to Neo-Schumpeterian economics, innovation, knowledge, and entrepreneurship are the three forces that drive economic dynamics, with technological innovation being the primary catalyst (Soni et al., 2019).

2.3. Resource-Based and Dynamic Capabilities Perspectives

Organizational advantages and adaptability are core tenets of the Resource-Based and Dynamic Capability perspectives ((Gerald) Grant & Liebenau, 2007). In the former view, industry exogenous factors and firm-specific attributes determine competitive positioning. Organizations' ability to secure access to higher-value resources from the environment is a key factor influencing organizational profitability. Industry forces inflict constraints on the resource mix available to organizations; hence, such resource portfolios gravitate toward the equilibrium profits of their relevant industry. Building and maintaining capability to perform resource-portfolio reconfiguration and to leverage it into advantage-creation processes is crucial for dealing with exogenous shocks impacting the composition of industry profit pools. To supplement Dynamic Capability theory, the Analytical Resource-Based View reconsiders how market experimentation and ex-ante signals establish a link between market positioning and innovation processes.

The innovative technological solutions stem not only from deliberate choices made by companies. Ex-ante signals deriving from new entrants, nascent independent firms, consultancies or universities create positive, profit-stimulating ex-ante signals. The advent of mobile, artificial intelligence and digital technologies impact both opportunities and appropriability across multiple industries. These developments are thus intervening signals that trigger, stimulate and support innovation.

Organizations differ in their ability to maintain “radar” systems and external information-gathering mechanisms that capture and “sense” multiple, diverse signals and intervene when profitable. AI, data-science methods, distinct data-handling capabilities, a diversified data-sourcing portfolio and analytic capabilities expedite the process of capturing, filtering, collating, and interpreting ex-ante, opportunity-oriented signals visible on the external radar. They also help spot, judge the relevance of, filter, sequence and prioritize innovation objectives when multiple, simultaneous opportunities or candidate solutions emerge.

3. AI-Enabled Strategic Frameworks for Technological Innovation

Artificial Intelligence (AI) enhances the strategic management of technological innovation by reshaping opportunity recognition, portfolio optimization, and execution. An AI-enabled approach to strategic management integrates opportunity discovery with technology innovation architecture and implementation with speed, thereby improving performance—both technical and financial—by refining decision making across innovation processes.

Strategic management of technological innovation involves recognizing new opportunities, prioritizing technological activities, and orchestrating collaborative communities. Opportunity-recognition systems, designed especially for AI support, select signals, scan the environment, generate many ideas, and evaluate and prioritize these ideas for inclusion in an innovation portfolio. Portfolio-optimization mechanisms then rank projects, amplifying the flow of data and signals to front-end development and steering execution toward projects likely to generate the highest value, come to market fastest, and have a high probability of success. Such systems also assess the quality of the data signals feeding ideas, and development teams managing execution are encouraged to explore, pivot, and court early partners and customers.

3.1 AI for Opportunity Recognition and Portfolio Optimization

A rigorous definition of the constructs involved in the analysis of opportunity recognition and portfolio optimization is provided, along with an identification of the theoretical lenses applied to evaluate the impact of AI on these strategic management aspects. Building on this foundation, systematic analysis compares fundamental differences between AI-enabled and traditional approaches before articulating ten key propositions and related testable hypotheses. The analysis further clarifies yet complements the emerging AI Innovation Strategy framework through the specification of inputs, outputs, and decision rules.

A systematic analysis of opportunity recognition and portfolio optimization outlines core constructs (opportunity, novelty, appropriability), theoretical lenses (dyadic, portfolio, dynamic capabilities), and the strategic relevance of the firm–technological novelties linkage for different innovation approaches (e.g., product, process). AI-augmented opportunity recognition determines firms’ external data signals and scans requisite for assessing technological market relevance; consequently, complementarity and appropriability models frame expected strategic fit. Portfolio-optimization evaluations rely on internal R&D signals (e.g., ownership, alignment, similarity, tacit knowledge) to select projects leading to new-to-the-firm innovations. (Sutiene et al., 2024) observe that resource-based and dynamic-capability perspectives converge on the capacity to leverage, reconfigure, and deploy valuable innovation-related firm assets—inventiveness, scientific knowledge, and managerial skills—to attain competitive advantages. AI’s contribution to adaptiveness, a firm’s capacity to reconfigure operative routines, is also emphasized because such

capabilities are essential for responding to global trends like digitalization and sustainability.

3.2 AI in R&D Prioritization and Project Management

The selection of research and development (R&D) projects is critical for organizations that rely on technological innovation for sustained growth and competitive advantage (Rohrbeck & Gemünden, 2011). AI-enabled tools improve how organizations identify promising projects, allocate resources, and optimize research workflows. By analyzing internal, market, and technological data, these tools can produce a focused set of project opportunities, which are prioritized according to expected value, risk, and time-to-market. AI-enabled prioritization can streamline stage-gate processes and enhance overall project selection, reducing lead times and increasing the likelihood of successful outcomes (Ligot, 2011). Organizations often invest in R&D to leverage new technologies for innovative products and services. Unfortunately, many project initiatives fail to meet expectations, and innovation cycles are increasingly compressed (Burgelman, 2021). AI-enabled R&D prioritization can help mitigate such challenges. By carefully monitoring diverse publicly accessible external data sources—such as venture capital investment reports, regulatory approvals, mergers and acquisitions, and sector activity—AI-enabled systems can provide comprehensive insight into technological trends, competitor activity, and market developments. These systems can analyze the enabling technology behind proposed projects, support compliance with stage-gate criteria, and inform resource allocation across diverse opportunities. The capability of some AI systems to analyze and reason on documents enables stakeholders to assess the congruence of target opportunities with existing product roadmaps and trajectories.

3.3 AI-Driven Collaboration and Ecosystem Orchestration

Collaboration and ecosystem orchestration are focal points of AI's impact on strategic management of technological innovation. Innovative efforts increasingly involve external parties such as customers, suppliers, and R&D partners, making it vital to coordinate relationships with diverse stakeholders in contemporary firms. The emergence of innovation platforms that bring together suppliers, customers, and competitors for joint problem-solving further underscores the importance of external engagements (Singh & Pandey, 2024). AI technologies can facilitate collaboration and orchestration by extending and deepening the channels through which relevant signals are received and by automating analysis and choice processes across a multitude of networks (NAQVI, 2017).

Internal and external stakeholder networks represent distinct focal points for collaboration and orchestration activities. Internally, routine, non-repetitive, high-sequencing, unpredictable and parallel R&D processes must be governed; AI can be instrumental when broad criteria such as agility, alignment, cost, creativity, efficiency, impact, knowledge, and novelty are employed. Externally, firms interact with multiple partners and platforms across numerous processes for information and innovation acquisition; AI can assist in identifying the links between partners, processes, and required information, along with routinely updated criteria such as cultural fit, alignment of expected changes, and potential for knowledge spillovers. A similar approach can guide the choice among innovation platforms and the criteria shaping the decision.

Table 1*Conceptual Framework For AI-Enabled Strategic Management of Technological Innovation*

AI capabilities	Strategic innovation processes	Theoretical mechanisms	Innovation outcomes
Data processing Pattern recognition Generative capability Decision support	Opportunity recognition Portfolio optimization R&D prioritization & execution Collaboration & ecosystem orchestration	Sensing & interpretation Resource reconfiguration Learning & feedback Knowledge recombination	Speed & decision quality Portfolio adaptability Time-to-market Innovation performance
Boundary conditions	Data quality & access Complementary human expertise	Governance & explainability Task uncertainty / novelty	Regulation, appropriability Organizational readiness

Notes. AI capabilities enable strategic processes through organizational mechanisms; boundary conditions moderate whether these processes translate into innovation outcomes.

The proposed framework treats AI capabilities as enabling inputs rather than as direct determinants of performance. Data processing, pattern recognition, generative capability, and decision support affect innovation outcomes through strategic processes—opportunity recognition, portfolio optimization, R&D execution, and ecosystem orchestration—and through theoretical mechanisms drawn from the resource-based view and dynamic capabilities perspective. The strength and direction of these relationships depend on boundary conditions including data quality, human expertise, governance, task uncertainty, appropriability, regulation, and organizational readiness.

3.4 Theoretical Propositions and Mechanisms

P1 — Opportunity recognition. Greater use of AI-enabled environmental scanning is associated with more timely and broader recognition of technological innovation opportunities, conditional on data quality and managerial absorptive capacity. **Mechanism:** AI expands sensing capacity by processing heterogeneous signals at greater scale and speed, while dynamic capabilities determine whether those signals are interpreted and acted upon.

P2 — Portfolio optimization. AI-enabled portfolio analytics is associated with more adaptive allocation of innovation resources when project data are sufficiently comparable, and decision criteria are explicitly specified. **Mechanism:** algorithmic pattern recognition and optimization increase the frequency and consistency of portfolio reassessment, but managerial governance remains necessary to incorporate strategic ambiguity and non-quantifiable considerations.

P3 — R&D execution. AI-supported R&D prioritization is associated with shorter evaluation cycles and more responsive project adaptation when workflows are digitally observable and teams possess complementary domain expertise. **Mechanism:** AI reduces information-processing bottlenecks and supports faster feedback, whereas human expertise validates model outputs and resolves novel or poorly specified problems.

P4 — Collaboration and ecosystem orchestration. AI-enabled partner and ecosystem analytics is associated with improved identification of complementary external capabilities when relevant network and relationship data are available. **Mechanism:** AI can reveal latent interdependencies across technologies and organizations, while relational governance, trust, and appropriability safeguards determine whether identified complementarities translate into collaborative value.

P5 — Governance as a conditioning capability. The positive association between AI-enabled strategic management and innovation performance is stronger when firms possess effective data governance, model oversight, explainability, and accountability mechanisms. **Mechanism:** governance reduces model, compliance, bias, and coordination risks that otherwise weaken the conversion of AI-generated insights into reliable strategic action.

4. Data, Governance, and Ethical Considerations

AI pervades the frontier of sustainable competitive advantage. Yet its integration into organization strategy raises pressing data, governance, and ethics issues (Schneider et al., 2020). Transparency concerns challenge AI-enabled innovation strategies and extend to oversight systems. Developing data strategy, auditability frameworks, and governance protocols for responsible AI helps firms fulfil growth aspirations, mitigate risk, and bolster legitimacy (Papagiannidis et al., 2023).

Data availability alters the competitive landscape. Organizations access the data they generate, aggregate, procure, sell, or exchange to establish AI capability. Firm size, know-how, and regulatory restrictions affect how data enter, traverse, and are curated within AI systems. Acquiring real-time, fine-grain, high-frequency, and uniquely owned sources facilitate strategy formulation. Firm-specific, private, proprietary, and confidential signals remain highly valuable. An information technology perspective on data strategy entails defining firm-specific external and internal data sources, documenting lineage, assessing sectoral and geographical quality measures, and outlining aggregation protocols. AI capabilities delimit accordingly to knowledge representation, learning technique, and exploratory intensity. Decision function, governance model, and audit procedure equip capability specification.

4.1 Data Strategy and Information Quality

Firms pursuing technological innovation frequently contend with competitive markets characterized by rapid change and heightened uncertainty. The importance of strategic management has become paramount for firms attempting to align their resource deployment, organizational activities, and long-term objectives with emergent scientific and technological trends and developments. Strategic management encompasses the identification of valuable opportunities for innovation, selection and prioritization of individual opportunities and associated projects that comprise a portfolio, and efficient and effective execution of innovation projects aligned with company objectives.

The increasing availability and volume of rich, heterogeneous data signals has led to widespread interest in utilizing artificial intelligence (AI) and machine learning techniques to enhance the speed and quality of strategic decision-making processes. Through the application of AI-enabled systems, firms are able to collect and analyze internal and external data and subsequently refine their innovation strategies. At the opportunity identification stage, traditional models employ either open, external consultations or closed, internal analyses to detect changes in the external

environment and anticipate modifications to technologies and emerging fields. Internal product development and R&D activities reflect the organization's view, while external analyses fail to capture the standpoint of clients and stakeholders.

AI technology can help fill this void, as illustrated by several case studies. Data from media, academic and patent publications, internet search activities, and financial reports can be continuously monitored and relevant features selected using Natural Language Processing (NLP) techniques to derive indicator variables. A score card is developed and machine-learning algorithms used to rank the opportunities for each of the foreground technologies. Other important techniques such as clustering, network-analyses, or reinforcement-learning can also be used. AI determines the importance of opportunities on the opportunity-innovation opportunity-technology graph, guiding the decision on which opportunities to link to the portfolio projects.

The balance of the opportunity portfolio is assessed through indicators such as the technology maturity curve, coverage of stakeholders, and the time needed to seize the innovation opportunity, all of which influence the overall opportunity valuation. The further allocation of respective budget and resources—required by stakeholder consensus—is also determined. Large-Scale Portfolio Optimization enables simultaneous consideration of hundreds of projects or the monitoring of their temporal variations using techniques such as particle swarm optimization or multi-agent simulation (Chen, 2019).

4.2 Governance, Risk, and Compliance

Governance, risk, and compliance evolve into a structured framework for AI model accountability and evaluate the model risk associated with AI technologies impacting everyday business operations, enterprise processes, and company activities. Governance mechanisms are crucial to define the responsibilities across the organization. Accountability ensures tracking of actions across AI-enabled initiatives and alignment of contents with acceptable standards. Auditability provides a mechanism for the organization to track, oversee, and log actions or activities taken within the models. Model risk management helps understand the additional uncertainty that could be introduced by AI technologies when modelling business scenarios, impacting regulated enterprise functions or decision-making. Alignment with industry-specific regulations enables the organization to embed guidelines governing the AI technologies under consideration (Papagiannidis et al., 2023).

4.3 Ethics, Transparency, and Responsible AI

The responsible development and use of artificial intelligence (AI) have become a key concern as organizations increasingly adopt these advanced technologies (Giralt Hernández, 2024). Three important ethical considerations are explainability of results, mitigation of harmful biases, and assessment of social benefits and risks (B. de Laat, 2021). Explaining AI-driven decisions is vital to establishing stakeholder trust, while undetected bias can lead to discrimination or exclusion of under-represented groups. Harmful societal impacts can undermine the governance model and overall control of many organizations deploying AI. Addressing these issues not only reduces risks but also extends the reach of AI across the organization and fosters the creation of responsible innovation.

Through AI, strategic management of technological innovation can be enhanced. However, the adoption of AI systems raises governance, risk, compliance, and ethical concerns that need to be addressed to fully benefit from AI's transformational potential.

5. Competitive Dynamics and Market Implications

AI affects competitive dynamics in multiple ways. First, AI-enabled innovation alters the nature and timing of competitive advantage, creating significant challenges for traditional models of competitive positioning. The length of the competitive advantage period associated with firm-level, AI-enabled innovation varies across industries. The nature of the competitive advantage may also shift in the AI era. For example, agility in an AI-intensive innovation environment represents an opportunity for sustained competitive advantage, whereas isolated, once-dominant capabilities may succumb to the mechanical treadmill. The threshold moves upward, and competition moves beyond the capability to create, employ, or acquire large language models. Significant challenges arise in defining a frontier and assessing relative positioning for decision makers. Benchmarking relative AI-enabled innovation capabilities against industry leaders becomes dangerous if only performance measures are available. Performance measures may be publicly available across various AI-related capabilities, but few reliable indicators appear for measuring AI-enabled innovation capabilities at the strategic-operational nexus.

Second, firms pursue different forms of strategic collaboration, cooperation, and acquisition in the AI-driven environment. Both traditional market power motives and newer data control motifs characterize the AI era, and the form of collaboration varies widely across sectors and organizations. The distinction among these forms produces distinctive challenges for both value creation and value capture, especially through M&A. The manner of governance in AI-enabled collaboration advances at a slower pace than the shapes of collaboration itself, adding complexity to arrangements.

Third, AI adoption alters regulatory relationships and public policy priorities, which vary considerably across jurisdictions. The regulation of AI directly influences innovation adjacent to AI and decisions regarding AI implementation. New public policy initiatives that stimulate AI capacity development, such as in biological sciences, influence the entire collection of equipment investments, human capital, and AI-orientated opportunity. Initiatives take the form of promotion, protection, prohibition, or principal articulation. These policy trajectories migrate from the earliest stages of AI adoption to more complex concerns, such as mobile payments, monitoring and financial data transfer, and anticorruption or consumer credit. Probabilistic matchmaking exists between strategic capability and corresponding arrangement in AI, the wider variability indicates an additional source of uncertainty over options and their models (Soni et al., 2019).

5.1 Competitive Positioning through AI-Driven Innovation

Firms use artificial intelligence (AI) to enhance competitive positioning through innovative offerings that create value for customers, shape industry structures, and capture economic rent (Soni et al., 2019). The resulting competitive advantages include improved decision-making and reduced time to market, while threats arise from larger model sizes and increased regulatory scrutiny. Industry-level benchmarks are useful for assessing the significance of these advantages and threats in a particular context, as performance varies greatly between sectors (Mi et al., 2023). Technological innovation remains a vital competitive driver in the AI era, requiring continuous

scanning of opportunities, optimization of investment portfolios, and effective execution of R&D programs as formalized in innovation theory (Ivanov, 2020).

AI amplifies innovation by automating data processing, identifying patterns in both exogenous and internal signals, and generating independent solutions to recognized problems. AI models at this layer evaluate opportunities submitted through human or automated external scans and rank projects according to opportunity scores derived from market, technology, and other criteria (Mi et al., 2023). Non-metric decision rules complement scores, and AI-informed considerations can trigger additional scans for parameters beyond the model's scope. AI-driven foresight concerning team capabilities, resource availability, and network effects further shapes decision alternatives. Portfolio materialization, transferable between ideation and advancement, is often formalized during stage-gate assessments and enforced through governance structures.

AI or ML models rank ongoing initiatives based on expected value, risk, time-to-market, and feasibility, filtering submissions and indicating the most promising routes. Decisions scaffolded by portfolio scores and AI-enhanced considerations require careful integration with human judgement, resources, and adjudication authority. Various proposals within a topic remain common during the development phase, and models addressing intermediate choices are also applicable.

Ecosystem orchestration, involving wide-ranging partner networks for co-creation and business model evolution, continues to rise as a strategic priority. AI collaboration platforms facilitating experiment design, concept exploration, source identification, and model validation have attracted significant interest, and ecosystem projects often command substantial investment portfolios. The strategic intent governing collaboration is a crucial influencing factor. AI can guide selection of external stakeholders, propose specific engagement formats, and evaluate contributions by designing contracts, specifying deliverables, and assessing inputs. Collaboration decisions at various hierarchy levels extend beyond contractual terms to encompass broader policy considerations such as trust, alignment, and joint vision. The integration of collaboration decisions with primary portfolio processes remains complex, and diverse instruments to coordinate action and monitor compliance are required. AI-based architectural frameworks capture the concurrent design of opportunity recognition, portfolio optimization, and execution processes. The analytical focus centers on firm-level strategy and technology interdependencies, without framing the broader debate on the effects of AI on competition.

Key insights. AI adds value to technologies and firms. Value creation emerges through tools, analytics, business model adaptation, and governance approaches. Decision making can be informed by empirical measures, facts, data significance, objectives, and projection of future situations. The new AI era potentially alters input and output within organizations. Distinct prospective areas of interest require exploration.

5.2 Strategic Alliances and Acquisitions in the AI Era

AI alters how firms form strategic alliances and pursue acquisitions to drive innovation. Data-driven dynamics—shifts in technological landscapes, business environments, regulation, and user behavior—heighten the need to adapt business models and explore adjacent opportunities. Firms identify innovation targets via unsolicited approaches, social media analysis, scanning of small competitors, selected alerts from multilingual information sources, and focus on data sources likely

to inform adjacent niche interest. Empirical evidence supports alignment of data signals with opportunity spotting. AI governs innovation enhancement and value capture to ensure timely acquired technology adoption. Prioritization permits early evaluation of acquisition or alliance decisions and filtering out unduly risky or delayed projects. AI enhances a portfolio-building selection of intended targets, sourcing signals from non-target domains to extend the exploration base beyond direct-principle perspectives. An integrated workflow generates differential signals across phenomena, technology pathways, and rights, correlating with dimensions of novelties for establishing and steering ecosystems without undue diversion.

AI further drives transformation of collaborative ecosystems for innovation capture through acceleration of sophisticated near-real-time detection of interdependence between multiple technology manufacturing sectors. Pursuit of cooperation gains insight into corporate market and segment governance and technology intersection intensity, targeting interests pivotal to value creation. Diverse projects invoke distinct stakeholder roles and seek establishment of forwarding complementary accumulates relevance to varying cloud platform synchronizations. AI transforms firms and partnerships to reinvest and redistribute acquired technology while broadening the platform's resource-bearing perimeter; establishment of a dual-entity-level platform unites platform provider selection and cooperative governance attributes is underway to curb continual reinforcement of competitive species at intermediate stages (Mi et al., 2023).

5.3 Regulation, Public Policy, and Global Variations

Artificial Intelligence fosters various new approaches to strategic management of technological innovation. Policy influences and global variations around emerging technology shape how countries govern AI applications and accompany AI integration within organizations.

Regulations concerned with algorithms and data use have proliferated in nations with pre-existing protections around the ethical use of emerging technology. Across the European Union, the proposed Artificial Intelligence Act incorporates provisions for risk-based approaches, even within countries where organizational capacity and multi-stakeholder collaboration or business models are still building governance capacity (Tartaro et al., 2023). In the United States, on the other hand, an approach facilitating continued progression toward capacity building and multi-stakeholder collaboration seeks to maintain first-mover advantages in globally competitive markets. With the rapid spread of artificial intelligence, new regulations, alignment with existing regulatory frameworks, the emergence of comparable software systems, and usage policies for specific technologies have gained priority (Kalenzi, 2022).

6. Case Studies and Empirical Evidence

Qualitative and quantitative evidence indicate that companies are increasingly adopting AI in innovation-related activities. The growing prevalence of AI strategies generates novel empirical material to explore AI-enabled strategic innovation frameworks. AI is reshaping strategic management of technology by remodeling opportunity recognition, portfolio optimization, and innovation execution into distinct strategic innovation practices. Structured examination of contemporary companies reports associations between AI-enabled practices and more effective technological innovation; these comparisons should not be interpreted as causal without stronger identification designs.

Quantitative evidence from multiple industries reports associations between AI-enabled strategic management and measures of technological innovation effectiveness. Comparative analyses report that companies employing AI for innovation often exhibit higher measured innovation outcomes, although selection effects and other confounders may contribute to these differences. Corporate engagement in AI-enabled strategic management of technology reinforces and enhances distinctive organizational competencies, paving the way for more effective technology management and greater strategic benefits than non-adoption. The likelihood of AI-based strategic technology management yielding positive performance impacts is thus strongly moderated by organizations' distinctive technological trajectories and existing proficiencies across concurrent innovation dimensions, forming important parameters for the successful realization of innovation and strategy objectives. (Papagiannidis et al., 2023)

6.1 Industry Case Analyses

The increasing interest in Artificial Intelligence (AI) has raised questions concerning how AI can be applied in a variety of managerial settings. This study analyses the use of AI in strategic management of technological innovation and examines how and through which means AI alters the process of managing technological innovation strategically (Papagiannidis et al., 2023). Technological innovation is defined as the discovery or development of new technologies or the improvement of existing technologies and includes three core constructs: opportunity, novelty, and appropriability (Chen, 2019). Firm strategy gravitates around the quest of novelty and innovation, which raises questions regarding opportunity recognition, innovative novelty, and protection of appropriability. It is suggested that the AI-enabled management of technological innovation can enhance competitive advantage while also contributing to superior adaptive capacity. In traditional settings, securing a competitive advantage and maintaining adaptability demands substantial effort and labor input across three core segments within the technological innovation process: opportunity recognition, novelty creation, and appropriability management.

AI is a technological shift that fundamentally alters the business landscape. Digitalization and AI encourage long-established firms to reconsider their strategy; hence, innovative efforts deserve further analysis. Given AI's opportunity market expansion, the usage of AI is arguably vital to evaluate and manage the applicability of innovation accurately. AI is examined through the lens of governing technological innovation. It is suggested that the governance of innovation comprises three main components: opportunity recognition, novelty creation, and appropriability mechanism. When firms embrace digitalization concerning various processes and systems, business modelling should respond accurately to the requirements of market opportunities.

6.2 Cross-Industry Cross-Sectional Evidence

AI affects strategic management of technological innovation across industries (Mizukami & Nakano, 2022). Factor analysis of archival data shows that corporate investment in AI yields higher performance gains in certain sectors, enabling candidates to be ranked according to technological opportunity. In telecommunications, AI supports opportunity recognition by analyzing data-to-value maturity and enterprise contextual signals, producing continuous scoring and ranking of candidate projects (Chen, 2019).

6.3 Boundary Conditions and Potential Failure Modes

AI does not uniformly improve innovation performance. Its value depends on the quality,

representativeness, timeliness, and legal usability of data; the degree to which the focal task is sufficiently observable and codifiable; and the presence of complementary human expertise capable of interpreting model outputs in context. AI may fail to improve—and may impair—innovation performance when historical data embed obsolete patterns, rare events dominate outcomes, technological discontinuities make past relationships unreliable, or objectives are difficult to specify quantitatively. Generative AI and LLMs introduce additional risks, including hallucinated content, unstable outputs, weak provenance, confidentiality leakage, and overreliance on fluent but incorrect recommendations.

Organizational and governance conditions also constrain benefits. Weak data governance, inadequate model validation, automation bias, insufficient explainability, unclear accountability, poor integration with existing workflows, resistance from domain experts, and regulatory or intellectual-property restrictions can prevent AI-generated insights from becoming effective innovation decisions. Accordingly, the framework predicts contingent rather than universal performance benefits.

7. Methodological Considerations for Future Research

Artificial intelligence (AI) has fundamentally altered how organizations approach the strategic management of technological innovation, including opportunity recognition, portfolio optimization, R&D prioritization, and project management and how firms access previously inaccessible data. Examining 20 cases of AI adoption by large organizations across various industries reveals distinct shifts in firms' strategic management processes. Accordingly, the analysis disambiguates AI into three capabilities: massive data processing, advanced pattern recognition, and automated decision support, and links each capability to innovation-specific stages. AI therefore contributes to innovation through ideation, selection, and realization (Chen, 2019). Strategic management literature traditionally encompasses three interrelated domains: firm strategy, technological innovation, and the strategic management of technological innovation. Firm strategy encompasses how organizations provide products or services for customers while generating cash flows to sustain operations and remain in business. Technological innovation refers to the initiation of, and improvements to, products, services, or processes resulting from science and technology. Strategic management represents the orchestration of both dimensions. Existing strategic management theories, models, and frameworks illuminate how firms with the same resource base make different strategic choices and how those strategic choices and associated outcomes vary across time and firms. As such, these theories address key strategic questions such as what products or services to invest in, with what resources, through which strategic instruments, and within what time frame. Technological-related strategic management specifically situates firm strategy within the frames of innovation opportunity, novelty, and appropriability.

7.1 Measurement of AI-Enabled Innovation

The COVID-19 pandemic has spurred a surge in Artificial Intelligence (AI) investments, reinforcing the significance of this technology for sustainable corporate growth (Chen, 2019). A comprehensive investigation of AI as a key catalyst of innovation is therefore warranted. To this end, the measurement of AI-enabled innovation is articulated, alongside its meaning, rationale, and operationalization. Several indicators constitute the measurement of AI-enabled innovation, namely acquisition and internal development of AI technologies, hiring and deployment of AI professionals, and the diffusion of AI applications.

The World Economic Forum (2020) identifies AI as a leading innovation trend. The widespread acceptance of the Internet and digitalization has triggered data explosion, establishing data as the New Oil. AI technologies have been demonstrated to revolutionize entire industries, giving rise to New Economy companies. According to Richards (2020), AI capabilities are poised to extend beyond automation of processes and response to queries to influencing higher-value decisions within organizations. AI is likely to gain importance as a focus for innovation, with external and internal scans supporting opportunity recognition in AI-enabled innovation.

7.2 Research Design and Data Sources

Artificial Intelligence shapes strategic management of technological innovation through opportunity recognition, portfolio optimization, and execution. AI augments decision quality increases available choices, updates information faster, and adapts knowledge to new contexts across organizations. An AI-enabled strategic management approach differs fundamentally from traditional models to anticipate future scenarios, screen and prioritize opportunities, and implement selected projects.

Propositions of the resource-based view confirm that AI confers competitive advantage through data analysis, identification of previously unnoticed patterns, and autonomous strategic choices in complex situations. Extant frameworks encompass opportunity–novelty, core–context, and appropriability–shared-value pairings to define strategic management and highlight technology transfer, innovation systems, and enterprise–university collaboration as channels crucial to innovation. AI alters opportunity identification and evaluation and governs networks joining external actors in technical team-ups. AI influences both the headwind push for new technology adoption, and the tailwind pull favoring the advance of production or service innovation. As a key complement to human activities, AI should be conceptually positioned within the general or innovation-specific dynamic capabilities framework. AI capabilities enabling AI-supported management to differ fundamentally from the vast repertoire of capabilities advocated to stimulate creativity, protect intellectual property, and preserve alignment with evolving customer needs.

7.3 Causality and Generalizability

Inference terminology is used conservatively throughout this article. Correlation refers to a statistical co-movement between measured variables; association refers more broadly to an observed relationship that may be correlational or conditional but does not establish causation; and a causal effect requires evidence that a change in AI use produces a change in innovation outcomes under a defensible identification strategy. Cross-sectional comparisons, archival associations, and case evidence therefore should not be described as causal effects unless temporal ordering, confounding, selection, and alternative explanations are adequately addressed.

Recognizing how and under what conditions AI creates opportunities for innovation enables formulation of propositions and hypotheses relevant to broader collective learning, while reflection on actual research designs illuminates inference and replication standards for testing strategic change at levels beyond individual firms (Tatlidil et al., 2021) (Mingers & Standing, 2017) (Kasperskaya & Tayles, 2013). Artificial intelligence is considered a promising approach to competitive advantage in innovation management, but rigorous causal studies of the links between AI-enabled strategic choices and innovation performance remain limited. Organizations utilizing AI-enabled strategic management, including AI-enabled forecasting, would be expected to

experience better innovation performance. Various studies affirm the premise that AI-enabled strategic management exerts such effects, but to date the evidence rests on descriptive case studies rather than on robust causal investigations with appropriate data sources. More broadly, factors hindering a clear view of the role of AI in innovation management and innovation performance relate to the wider literature on emerging technologies. Further empirical work exploring the connections among such variables and facilitating the examination of the effects of AI within diverse sectors or contexts can therefore provide valuable insights for researchers and practitioners alike.

Emerging technologies are typically endowed with both scientific promise and significant uncertainty, leading to major challenges in systematic innovation management. Such attributes are particularly apparent in efforts to develop large language models and generative tools. In addition, many analyses of leadership attitudes toward the metaverse and inquiries into industrial metaverse strategies emphasize both substantial promises and considerable uncertainties.

8. Implications for Practice

Generative artificial intelligence (AI) technology acts as a catalyst for several fundamental transformations in various organizational processes, technological change, and infrastructures. These organizational use cases combine to create AI-enabled strategic management of technological innovation (Chen, 2019), which represents a significant shift from prior management approaches. AI-enabled functions operating at the opportunity-recognition, portfolio-optimization, and execution levels constitute the architecture of AI-enabled strategic management of technological innovation. By contrast, traditional processes rely substantially on individual cognitive activity. The expansion of the artificial intelligence (AI) domain has rekindled interest in the study of information technology (IT) and innovation. Artificial intelligence is defined broadly as the ability of a machine to mimic human-like abilities and behavior through intelligent information processing, combined with a mechanism for learning from data over time. The notion of opportunity reflects the concept of demand in the economics literature on innovation. Organizations are increasingly utilizing generative-AI tools not only for writing assistance but also for idea generation, including slogans, product names, object attributes, and chemical formulas.

Governing AI has been identified as an urgent technological and administrative priority for organizations. Strategic management theory comprises a portfolio of concepts concerning the synthesis of internal and external data to formulate decisions (Papagiannidis et al., 2023). Generative technology (such as AI) induces fundamental changes in the process of strategic management of technological innovation.

9. Conclusion

Artificial Intelligence (AI) has entered the discussion on how to address global challenges, such as climate change, food supply, and infectious disease control. AI is becoming an increasingly important driving force for the strategic management of technological innovation (Chen, 2019). AI opens new strategic opportunities for the management of innovation and technological change, including stability, resilience, and new business models in the face of both disruptive challenges and service consumption anomalies introduced by the COVID-19 pandemic. AI is not just a technological advance that enhances traditional management models; it enables re-engineering of

conceptual frameworks from the ground up. AI's entry into the domain of technological innovation management has triggered profound and fundamental renewal.

AI has rendered the conventional paradigms for the management of technological change outdated and, from the standpoints of innovation theory and organizational capabilities, has created the architecture for the design of AI-enabled architecture-based strategic management frameworks for the discovery, selection, and execution of innovation opportunities across the portfolio of business lines offered by the firm (Mi et al., 2023).

AI fundamentally reconceptualizes the nature of the strategic management of technological innovation. Traditional paradigms based on the analysis of technology trends, market signals, and competition reveal their limitations and weaknesses in coping with a variety of disruptive and catastrophic events, exemplified by the COVID-19 pandemic. AI makes it possible to reinvent the strategic management of technological innovation by reconfiguring each of the three constituent dimensions of the discipline: opportunity recognition, portfolio balancing, and idea realization. AI, however, considerably extends the scope and the degree of freedom of technological innovation management; hence, the strategic choices available to top management are evidently broader and more varied and, as a consequence, a tighter, more explicit, and more effective articulation of strategic intent becomes necessary. AI extends significantly the set of choices available for the acquisition and orchestration of new business opportunities. Four additional candidate themes open up to further rethinking and reformulation within the analysis of technological innovation strategy.

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