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The Evolution of Competitive Strategy: An Unsupervised Machine Learning Approach Using Topic Modeling and Keyword Clustering

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Abstract

The field of competitive strategy has attracted growing academic interest in recent years; however, the intellectual framework and thematic evolution of this research area remain fragmented. This study aims to systematically map the evolution of competitive strategy research using an unsupervised machine learning framework. Drawing on a dataset of approximately 3900 journal articles indexed in the Scopus database between 2015 and 2025, the study employs probabilistic topic modeling, specifically Latent Dirichlet Allocation (LDA), together with keyword co-occurrence network analysis, thematic mapping, and community detection techniques to identify the latent thematic structure of the field. The findings reveal a modular and interconnected conceptual landscape in which capability-based strategic perspectives, particularly dynamic capabilities and the resource-based view, continue to occupy central positions in the literature. At the same time, themes related to digital transformation, artificial intelligence, supply chain resilience, environmental, social, and governance (ESG)-oriented management, and sustainability-focused strategic capabilities demonstrate substantial growth and emerging prominence. Temporal analyses further indicate a gradual reconfiguration toward digitally integrated, sustainability-oriented, and capability-driven strategic frameworks. By integrating topic modeling with network-based bibliometric analysis, the study provides a comprehensive and data-driven mapping of the field's intellectual evolution. The study contributes to competitive strategy research by synthesizing the latent thematic structure of the field and by showing how complementary computational and bibliometric techniques can support large-scale literature mapping in a rapidly evolving research domain.

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1. Introduction

In recent years, competitive strategy research has undergone a substantial transformation due to rapid digitalization, platform-based competition, and the increasing strategic

importance of data-intensive business environments. Classical strategy perspectives have historically provided the conceptual foundations for explaining competitive advantage at the firm level. Porter's Competitive Strategy introduced the industry-based perspective and competitive positioning [?], while Competitive Advantage further elaborated the mechanisms through which firms achieve superior performance [?]. Porter later synthesized these ideas through the Five Forces framework [?]. In parallel, the resource-based view (RBV) emphasized firm-specific resources as the basis of sustained competitive advantage [?], whereas the dynamic capabilities framework extended this perspective by explaining how firms renew and reconfigure their capabilities in rapidly changing environments [?]. Porter's Five Forces framework remains one of the most influential analytical tools for comprehending competitive positioning within industries, while subsequent analyses of strategic evolution have emphasized the continued importance of positioning, trade-offs, and strategic coherence in modern competitive environments [?]. At the same time, the growing integration of digital technologies, artificial intelligence, Industry 4.0 systems, platform ecosystems, and supply chain analytics has introduced new layers of complexity that challenge purely static or firm-centric interpretations of strategy. As competitive advantage increasingly relies on agility, technological adaptation, ecosystem positioning, and digitally enabled value creation, the strategic management literature is expanding beyond its traditional theoretical boundaries.

Parallel to these developments, design-oriented and digitally integrated business models have become prominent in both academic and professional discourse. Digital transformation, platform ecosystems, user experience, sustainability, and supply chain resilience are increasingly interconnected with competitive positioning, resource orchestration, and capability development [? ? ?]. As a result, the competitive strategy literature has become more interdisciplinary, incorporating insights from strategic management, operations, innovation management, information systems, and design-oriented business research. While this expansion reflects the vitality of the field, it also makes the literature increasingly fragmented and difficult to interpret through conventional review methods.

Previous review studies have provided valuable theoretical syntheses of competitive strategy and its historical development. Nevertheless, the majority of previous studies rely on narrative reviews, conceptual discussions, or conventional bibliometric summaries, which are informative but limited in their ability to uncover extensive latent thematic structures and higher-order conceptual relationships in rapidly expanding research domains. In particular, prior work rarely captures how classical capability-based perspectives are being reconfigured within digitally enabled and design-related contexts, nor does it systematically examine how emerging themes such as digital transformation, supply chain resilience, sustainability, and analytics are reshaping the intellectual framework of the field. This limitation is becoming significant because competitive strategy research is no longer organized around a single dominant paradigm; instead, it is evolving into a multi-layered and interconnected knowledge domain.

Accordingly, a clear research gap emerges. Although individual studies have examined digital transformation, ecosystem competition, supply chain strategy, innovation, or sustainability from various perspectives, a comprehensive and data-driven analysis of how these domains collectively transform the competitive strategy literature remains largely missing. More specifically, the literature still lacks an integrated analytical framework that can identify latent themes, monitor their temporal progression, and reveal the conceptual relationships among them within a unified scalable design. Addressing this gap is crucial not only for clarifying the contemporary structure of competitive strategy research, but also for understanding whether traditional theories such as RBV and dynamic capabilities con-

tinue to dominate the field or are being reinterpreted under new digital and design-oriented paradigms.

To address these limitations, this study employs text mining and unsupervised machine learning techniques to thoroughly map the intellectual structure of competitive strategy research. Utilizing a large-scale Scopus dataset covering the period 2015–2025, the study integrates Latent Dirichlet Allocation (LDA), temporal trend analysis, keyword co-occurrence networks, and clustering techniques in a unified analytical pipeline. This multi-layered methodology facilitates the identification of dominant research themes, developing trajectories, and structural relationships within the literature, thereby moving beyond descriptive review approaches toward a more scalable and reproducible form of literature mapping.

By doing so, this study makes three specific contributions. First, it clarifies the recent thematic reconfiguration of competitive strategy research within digital and design-related contexts. Rather than claiming comprehensiveness solely on the basis of dataset size, the study defines comprehensiveness in terms of three analytical dimensions: temporal coverage of recent publications between 2015 and 2025, thematic coverage of capability-based, digital, sustainability-oriented, supply chain, and performance-related research streams, and methodological triangulation through topic modeling, keyword co-occurrence analysis, and thematic mapping. Second, the study contributes conceptually by showing how established strategy perspectives, particularly the resource-based view and dynamic capabilities framework, are being extended rather than replaced by digital transformation, sustainability, and operational resilience themes. Third, the study contributes to computational literature review practice by using topic modeling and bibliometric network analysis as complementary tools: topic modeling identifies latent semantic structures in abstracts, whereas keyword networks reveal explicit conceptual associations among author- and index-assigned terms. Therefore, the methodological value of the study lies not in introducing a new algorithm, but in demonstrating how these complementary techniques can be used together to interpret the changing intellectual structure of a complex strategy research domain.

Therefore, the aim of this study is not only to identify the intellectual structure, thematic composition, and temporal evolution of competitive strategy research, but also to synthesize these findings into an integrative research framework that explains how classical strategy perspectives are being connected with digital, sustainability-oriented, and operations-related strategic themes. In doing so, the study seeks to move beyond descriptive mapping and to identify theoretically meaningful research directions for future competitive strategy scholarship.

The remainder of the paper is organized as follows. Section ?? reviews the relevant literature. Section ?? describes the data and methodology. Section ?? presents the empirical findings. Section ?? discusses the implications of the results, and Section ?? concludes the study.

2. Literature Review

The foundations of competitive strategy research can be traced back to the early strategic management literature that developed during the 1950s and 1960s. In this initial phase, strategy was mostly associated with firm growth, organizational structure, and long-term planning rather than direct competition between firms. Ref. [?] defined the firm as a collection of productive resources and emphasized the role of managerial capabilities in shaping firm growth. Similarly, ref. [?] investigated the historical development of large industrial organizations and illustrated the relationship between strategy and organizational structure, arguing that organizational design evolves in response to strategic decisions.

Building on these early insights, ref. [?] established one of the first systematic approaches to corporate strategy, conceptualizing strategic decision-making as a rational analytical process concerned with growth, diversification, and product–market choices. During the 1970s, strategy began to be interpreted within a broader managerial and policy-focused perspective. Ref. [?] emphasized the necessity of corresponding a firm’s internal strengths and weaknesses with external opportunities and threats, highlighting the importance of strategic fit between the organization and its environment.

A significant turning point in the development of competitive strategy research occurred during the 1980s with the emergence of industry-based strategic analysis. Porter’s foundational research on competitive strategy introduced a systematic framework for examining industry structure and competitive forces [? ?]. Through the Five Forces model, Porter demonstrated that firm profitability is influenced by structural factors such as supplier power, buyer power, the threat of substitutes, the threat of new entrants, and rivalry among existing competitors. Within this concept, firms were argued to achieve competitive advantage by pursuing one of three generic strategies: cost leadership, differentiation, or focus. Empirical studies performed during this period also investigated the practical implications of these strategic decisions. For example, Ref. [?] examined the relationship between generic strategies and organizational performance, demonstrating that different strategic positions may lead to distinct performance outcomes. Porter’s subsequent research on competitive advantage further expanded this perspective by introducing the value chain framework, which highlights the role of firm-level activities in contributing to the competitive advantage [?]. Subsequent analyses, including [?], evaluated Porter’s contribution from historical and theoretical perspectives, emphasizing its permanent impact on the evolution of strategic management research. Later contributions pointed out the continuing significance of industry-based strategic analysis and emphasized that competitive positioning and structural analysis remain fundamental elements of strategy, irrespective of changing competitive environments [? ?].

While industry structure and positioning dominated strategic thinking during the 1980s, the focus of the literature gradually shifted toward firm-level resources and capabilities in the 1990s. The RBV has developed as a prominent theoretical framework explaining competitive advantage via firm heterogeneity. Ref. [?] introduced the idea that enterprises should be analyzed in terms of the resources they possess rather than only through their product markets. Establishing on this perspective, ref. [?] proposed that sustainable competitive advantage is derived from resources that are valuable, rare, imperfectly imitable, and organized. Refs. [? ?] further elaborated on the strategic implications of the resource-based view, emphasizing the role of internal capabilities in strategy formulation. Likewise, ref. [?] provided a systematic framework for understanding the conditions under which firm resources generate sustained competitive advantage. Comparative analyses of strategy frameworks also emerged during this period. For instance, [?] investigated the theoretical relationship between the resource-based view and industrial organization economics, while ref. [?] compared Porter’s industry-based perspective with the resource-based explanation of competitive advantage. More broadly, ref. [?] characterized the evolution of strategic management research as a “pendulum swing” between external and internal explanations of firm performance, demonstrating the continuing interaction between industry-based and resource-based perspectives.

At the same time, some experts questioned the assumption that competitive advantages are necessarily sustainable over long periods. Ref. [?] emphasized the significance of strategic commitments and the dynamic character of competition, while ref. [?] introduced the concept of hypercompetition, arguing that competitive advantages often become temporary in rapidly changing markets. Complementing this debate, ref. [?]

highlighted the role of distinctive capabilities, reputation, and relational assets as important sources of competitive advantage. The increasing importance of information technologies in competitive positioning was acknowledged during this period [?]. These advancements contributed to a wider shift toward dynamic and capability-based perspectives in the strategic management literature.

In the late 1990s and early 2000s, the dynamic capabilities framework further expanded the resource-based perspective by emphasizing firms' abilities to reconfigure and rejuvenate their resource base in reaction to environmental change [?]. Subsequent contributions continued to refine this perspective by associating dynamic capabilities with organizational agility and strategic renewal in unpredictable situations [? ?]. Throughout this period, numerous research aims to integrate industry-based and resource-based explanations of competitive advantage. For example, ref. [?] reexamined Porter's framework from a modern perspective, while ref. [?] evaluated the relevance of Porter's generic strategies in modern competitive environments. Similarly, ref. [?] conducted a historical examination of competitive strategy, emphasizing the importance of contextual and institutional factors in shaping strategic outcomes.

The 2000s also witnessed a growing interest in knowledge-based and institutional perspectives on strategy. Ref. [?] emphasized the importance of organizational learning and knowledge accumulation as a catalyst for competitive advantage. Ref. [?] further expanded the strategic management literature by analyzing the relationship between corporate social responsibility and competitive advantage, proposing that the development of social value can reinforce long-term strategic positioning. Additional studies explored the interaction between competitive strategy and several organizational domains. For example, ref. [?] examined the role of corporate real estate in supporting competitive strategies, while ref. [?] examined the contextual conditions under which firms adopt cost leadership or differentiation strategies. Similarly, ref. [?] showed that hybrid or combined competitive strategies may generate additional performance benefits under certain environmental conditions.

More recently, the competitive strategy literature has increasingly integrated ecosystem-based, technological, and relational perspectives. The emergence of digital platforms and associated value networks has fundamentally transformed the competitive landscape. Ref. [?] conceptualized business ecosystems as organized arrangements of interdependent entities that jointly generate value, while [?] emphasized the strategic importance of platforms and modular designs in modern industries. Building on these perspectives, ref. [?] argue that firms operating within digital platform ecosystems must continuously renew and orchestrate their capabilities across organizational boundaries. Their framework suggests that dynamic capabilities remain central in digital environments but are increasingly exercised through ecosystem participation, platform governance, and interorganizational resource integration rather than solely through internally controlled resources. In this changing environment, companies must therefore not only develop internal capabilities but also manage complex relationships with partners, suppliers, and complementors. This relational aspect is consistent with the principle of co-opetition, which emphasizes that cooperation and competition can coexist as complementary strategic mechanisms [?]. Complementary research has examined the alignment between competitive strategies, innovation, and market orientation [?], as well as the role of organizational learning in strengthening innovation performance under competitive intensity [?].

In the contemporary strategic management literature, competitive advantage is increasingly interpreted in relation to digital transformation, human capital, and organizational learning. Ref. [?] emphasizes the multidimensional character of strategic management by associating strategic decisions with operational and financial analysis. Recent studies

underline the value of learning capability in mediating the connection between competitive strategies and firm performance [?]. Similarly, ref. [?] show that human capital development plays a crucial role in strengthening the relationship between training and competitive strategy. Research also reveals that management qualities can affect strategic decisions, as illustrated by [?] in the context of tourism firms. The rapid advancement of digital technologies has broadened the scope of strategic research, focusing on digital service capabilities and strategic collaboration in technology-driven environments [?]. The operational strategy has also obtained renewed attention, especially in manufacturing and remanufacturing systems [?]. Recent empirical evidence further strengthens this contemporary perspective by demonstrating that dynamic capabilities continue to have a significant positive effect on product innovation and firm performance, particularly under conditions of technological uncertainty [?].

Therefore, the competitive strategy literature has progressed from initial planning-oriented methodologies to industry-based analysis, subsequently advancing to resource-based and capability-based explanations, and ultimately toward ecosystem-oriented and digitally integrated strategic frameworks. This historical evolution illustrates that competitive advantage cannot be explained through a single theoretical perspective but rather emerges from the interaction of industry conditions, firm resources, organizational capabilities, and relational networks. As a result, current strategy research increasingly employs multidisciplinary and data-driven approaches in order to better understand the complex dynamics influencing competitive advantage in modern business environments [? ?].

Previous Reviews of Competitive Strategy Research

The growing breadth and complexity of competitive strategy research have stimulated several review studies seeking to synthesize its theoretical foundations and emerging directions. For example, ref. [?] conducted a bibliometric review of competitive strategy and organizational performance and identified major themes, influential actors, and thematic trends within the field. Similarly, ref. [?] provided a large-scale bibliometric overview of strategic management research and demonstrated the evolution of strategic management from competitive strategy and resource-based perspectives toward themes associated with innovation, technological change, and strategic flexibility.

Recent reviews in adjacent strategy domains have also increasingly adopted integrative approaches to map fragmented knowledge structures and identify future research opportunities. For instance, ref. [?] employed bibliometric and thematic analyses to examine airline strategy research and proposed a conceptual framework that integrates sustainability, digital transformation, and decision-support analytics as emerging strategic priorities. Likewise, ref. [?] conducted a systematic review of small and medium-sized enterprise (SME) branding and developed a framework-based synthesis demonstrating how digital technologies are reshaping strategic branding processes and competitive positioning.

Beyond conventional bibliometric reviews, recent studies have increasingly adopted computational literature review approaches that integrate topic modeling with bibliometric techniques to uncover latent semantic structures within large scientific corpora. For example, ref. [?] combined bibliographic coupling with LDA to map the intellectual structure and emerging research themes in entrepreneurship education, while ref. [?] integrated bibliometric analysis and topic modeling to examine the conceptual relationship between sustainable entrepreneurship and sustainable consumption and to develop a future research framework. Similarly, ref. [?] employed a computational literature review combining bibliometric analysis with topic modeling to identify thematic evolution and emerging research trends in tourism sustainability. Collectively, these studies demonstrate the growing value of integrating machine learning-based text analysis with conventional bibliometric

techniques to reveal conceptual patterns that remain difficult to identify through citation- or keyword-based analyses alone.

Despite these valuable contributions, previous reviews predominantly rely on narrative syntheses, co-citation analyses, keyword co-occurrence techniques, or domain-specific thematic mappings. Recent methodological work on computational literature reviews further emphasizes the importance of transparent reporting, validation procedures, and theoretically informed interpretation when applying machine learning and natural language processing techniques to literature review contexts [?]. Consequently, previous studies provide limited evidence regarding latent semantic structures, their temporal re-configuration, and the higher-order conceptual relationships emerging across increasingly interconnected streams of competitive strategy research. Accordingly, the present study adopts a computational literature review perspective by integrating topic modeling with bibliometric network analysis to identify latent thematic structures, examine their temporal evolution, and provide an integrative conceptual understanding of contemporary competitive strategy research.

Overall, the reviewed literature demonstrates that competitive strategy research has evolved into an increasingly interdisciplinary and interconnected field encompassing classical strategic management theories alongside digital transformation, sustainability, innovation, and supply chain perspectives. This growing thematic complexity provides the theoretical and methodological motivation for the present study, which integrates topic modeling with bibliometric network analysis to uncover latent thematic structures, reveal higher-order conceptual relationships, and provide a more comprehensive understanding of the contemporary competitive strategy literature.

3. Data and Methodology

3.1. Data Collection

The empirical dataset employed in this study was obtained exclusively from the Scopus database, which was selected because of its broad coverage of peer-reviewed journals in business, management, economics, and related social sciences, as well as its standardized bibliographic metadata that facilitates large-scale computational text analysis. Although additional databases such as Web of Science index relevant strategy journals, the use of a single database ensured consistency in document retrieval, metadata structure, and text preprocessing throughout the analytical workflow. Nevertheless, this choice may have excluded some publications indexed exclusively in other databases, and the findings should therefore be interpreted within the scope of the Scopus collection.

The data collection process was designed to capture recent developments in competitive strategy research and its increasing interaction with digitally enabled and design-oriented strategic contexts. Accordingly, a structured search query was formulated by combining established strategy-related terminology (e.g., competitive strategy, generic strategy, resource-based view, and dynamic capabilities) with terms reflecting emerging digital and platform-based environments (e.g., digital platform, platform ecosystem, and user experience). Therefore, the resulting corpus should be interpreted as representing contemporary developments in competitive strategy research within digitally integrated and design-related contexts rather than the entire historical body of competitive strategy literature. This delimitation is consistent with the objective of the study, which seeks to examine how foundational strategy perspectives are being extended and reinterpreted within contemporary strategic environments.

The search was restricted to peer-reviewed journal articles published between 2015 and 2025 in the fields of Business, Economics, and Social Sciences. This temporal scope was intentionally selected to capture the most recent phase of competitive strategy research,

characterized by accelerated digital transformation, platform-based competition, sustainability transitions, and increasing concerns regarding ecosystem dynamics and supply chain resilience. Foundational perspectives, including industry-based competition, the resource-based view, and dynamic capabilities, had already been extensively established and consolidated prior to this period. Therefore, the present study focuses on how these established theories have been extended, reinterpreted, and integrated within contemporary strategic contexts during the last decade. Only journal articles were included to ensure conceptual coherence and academic integrity. After eliminating incomplete and irrelevant records, the final dataset consisted of approximately 3900 publications. For each document, bibliographic metadata including titles, abstracts, author keywords, index keywords, publication years, and source information were extracted. These textual fields provide a rich textual corpus suitable for computational literature review, large-scale text mining, and thematic mapping.

The search strategy intentionally combined competitive strategy concepts with digital- and design-related terms using a conjunctive search logic. Consequently, the resulting corpus does not represent the entire competitive strategy literature but rather the segment of the literature where competitive strategy intersects with digital transformation, platform ecosystems, innovation, and design-oriented perspectives. This focused sampling strategy was adopted to examine how classical strategic management theories have evolved within contemporary digital and innovation-driven business environments. Accordingly, the findings should be interpreted within this thematic scope rather than generalized to the broader competitive strategy literature.

To ensure transparency and replicability, the complete Scopus search query used to construct the dataset is provided in Appendix ???. Furthermore, the analytical procedures and the R packages employed throughout the data preprocessing, text mining, topic modeling, and network analysis stages are detailed in Appendix ???. All analyses were conducted using R (version 2026.06.0+242) within the RStudio environment (version 2026.06.0+242).

3.2. Analytical Framework

This study adopts a computational literature review framework that integrates unsupervised machine learning and bibliometric techniques to examine the contemporary competitive strategy literature. Although bibliometric methods are highly effective for identifying citation structures, collaboration patterns, and explicit keyword relationships, they primarily rely on reported metadata and therefore provide limited insight into latent semantic relationships embedded within textual corpora. In contrast, probabilistic topic modeling enables the identification of hidden thematic structures by analyzing patterns of word co-occurrence across document abstracts. Because the objective of the present study extends beyond mapping bibliometric relationships and seeks to uncover the underlying conceptual organization and thematic evolution of competitive strategy research, topic modeling and bibliometric analysis are employed as complementary rather than competing analytical approaches.

The analytical workflow consists of three main stages:

- Text preprocessing;
- Probabilistic topic modeling;
- Keyword co-occurrence network analysis.

In the first stage, textual data obtained mostly from article abstracts were cleaned using standard natural language processing procedures. These steps included lower-casing, punctuation elimination, stop-word filtering, and lemmatization. After preprocessing, a document-term matrix was created to transform the textual corpus into a structured format suitable for machine learning analysis.

Prior to topic modeling, the textual corpus was transformed into a document–term matrix (DTM) using unigram representations. The preprocessing workflow included lowercasing, removal of URLs, punctuation, numbers, and English stop words together with a custom stop-word list, followed by lemmatization and the exclusion of tokens containing fewer than three characters. Bigrams were generated for descriptive text-mining analyses but were not incorporated into the LDA model. No predefined maximum vocabulary size was imposed; instead, vocabulary dimensionality was controlled through sparse-term filtering. Empty documents were removed, and sparse terms were filtered using a sparsity threshold of 0.99 to reduce vocabulary dimensionality while preserving semantically informative terms. A detailed summary of the text preprocessing pipeline and LDA configuration is provided in Appendix ?? (Table ??) to facilitate methodological transparency and computational reproducibility.

In the second stage, LDA was employed to identify the latent thematic structure of the literature. LDA is a probabilistic topic modeling technique that assumes each document comprises a mixture of latent topics, with each topic represented by a probability distribution over words. Unlike keyword frequency analyses or citation-based techniques that focus on explicit relationships among publications, LDA facilitates the discovery of hidden semantic patterns distributed across the textual corpus. Consequently, this approach enables the automatic organization of extensive collections of abstracts into interpretable thematic configurations without requiring predetermined categories or manual coding procedures. The final LDA model was estimated using the standard implementation of the *topicmodels* package with a fixed random seed (123) to ensure reproducibility. Following common practice in computational literature reviews, the final topic solution was selected based on multiple complementary criteria, including statistical diagnostics, semantic coherence, thematic distinctiveness, and interpretability.

LDA was selected because it provides a transparent and well-established probabilistic framework for identifying latent thematic structures in large textual corpora while producing interpretable topic–term distributions that are particularly suitable for computational literature reviews [? ?]. Although alternative approaches such as Structural Topic Modeling (STM), Non-negative Matrix Factorization (NMF), and more recent embedding-based methods such as BERTopic offer additional capabilities, they are often designed to incorporate document-level metadata, exploit contextual language representations, or optimize semantic embeddings rather than providing directly comparable probabilistic topic structures. Given the objective of the present study—to identify broad thematic configurations and examine their conceptual relationships within a large bibliographic corpus—LDA provides an appropriate balance between interpretability, computational efficiency, and methodological transparency. Nevertheless, LDA also has recognized limitations, including its bag-of-words assumption, sensitivity to topic-number specification, and reliance on researcher interpretation when assigning semantic labels to extracted topics. To mitigate these limitations, topic selection was based on multiple complementary criteria, including statistical diagnostics, semantic coherence, thematic distinctiveness, and interpretability, while additional robustness and sensitivity analyses are reported in Appendix ??.

In the third stage, a keyword co-occurrence network was constructed utilizing author keywords and index keywords to enhance the topic-level analysis. Keywords co-occurring in the same documents were linked to create a weighted network that represents conceptual relationships in the literature. To improve network interpretability, only keywords appearing in at least 10 documents were retained (minimum document frequency = 10). Furthermore, keyword pairs were connected only when they co-occurred in at least five documents (minimum co-occurrence = 5), thereby reducing weak semantic associations and network noise. The Louvain community detection algorithm was subsequently applied

to identify clusters of closely related keywords, thus revealing the modular conceptual framework of the research field.

All analyses were performed using the R statistical computing environment, version 2026.04.0 + 526. Topic modeling and text processing techniques were executed using specific text-mining libraries, while network structures and visualizations were produced with dedicated packages for network analysis and visualization. To ensure transparency and reproducibility, the whole list of R packages utilized in this study is provided in Appendix ??.

4. Empirical Findings

4.1. Descriptive Context of Competitive Strategy Research

Although the primary objective of this study is to identify latent thematic structures and their evolution, an initial descriptive overview provides essential contextual information regarding the expansion and diversification of competitive strategy research. Publication patterns, as illustrated in Figure ??, establish the empirical context within which the subsequent topic modeling and network analyses should be interpreted, thereby linking the descriptive characteristics of the dataset with the study's analytical objectives.

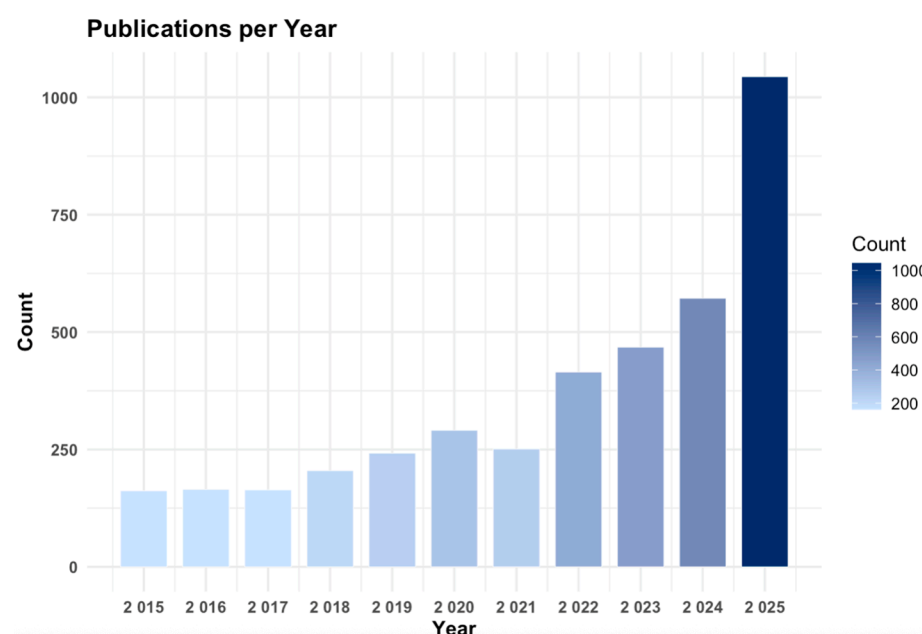


Figure 1. Yearly number of publications in competitive strategy research (2015–2025).

The publication trend shows a steady increase in academic output over the observed period. While the early years display relatively moderate publication levels, the number of studies grows progressively over time. In particular, the annual publication count increased from 251 studies in 2021 to 415 in 2022 and exceeded 1000 publications by 2025. The acceleration observed after 2021 suggests that issues related to digital transformation, platform-based competition, and design-oriented strategic thinking have gained substantial momentum in recent years. This pattern indicates the increasing scholarly attention devoted to competitive strategy research during the study period.

Additional insight into the conceptual framework of the literature can be obtained by analyzing the most frequently used author keywords. Figure ?? presents the distribution of the top 25 keywords in the dataset. The keyword landscape highlights the continued prominence of capability-based strategic perspectives. Specifically, terms such as dynamic capabilities and resource-based view emerge among the most dominant keywords, signifying that these theoretical perspectives remain among the most frequently occurring

conceptual foundations of the contemporary competitive strategy literature. Moreover, the keyword distribution also reflects the growing incorporation of technological and digital themes into strategic management discussions. Keywords such as digital transformation, artificial intelligence, Industry 4.0, and supply chain resilience also rank among the most frequently occurring keywords among the most frequent terms. Overall, the observed keyword distribution is consistent with the growing integration of technology-driven and digitally enabled perspectives into contemporary competitive strategy research.

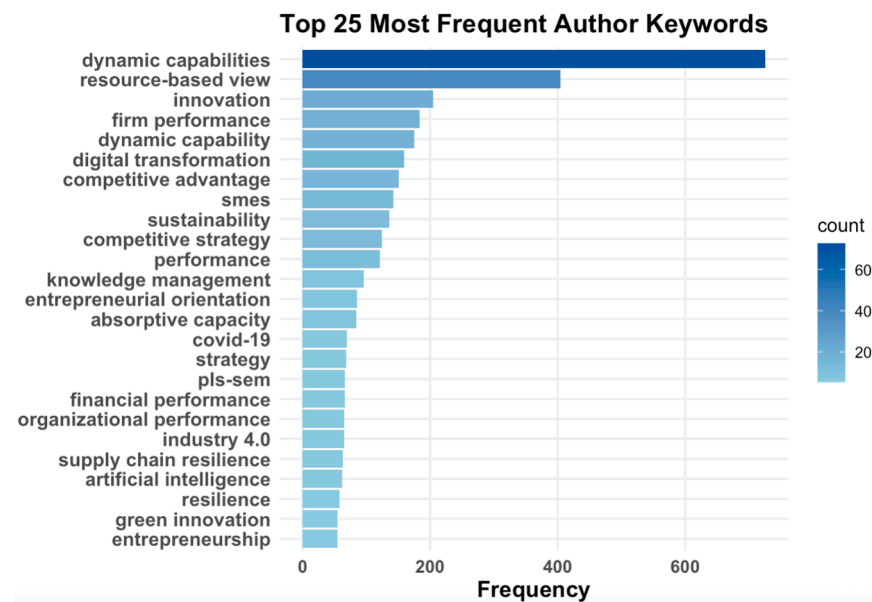


Figure 2. Top 25 most frequent author keywords in the competitive strategy literature.

4.2. Topic Modeling Results

To identify the latent thematic structure of the literature, LDA was applied to the corpus of article abstracts. This probabilistic topic modeling technique enables the organization of extensive textual datasets into interpretable thematic clusters without relying on predefined categories.

The analysis identified eight coherent topics representing dominant research streams in contemporary competitive strategy research. Table ?? presents the latent topics together with their representative keywords and interpretive labels. Although the representative terms were generated automatically by the LDA algorithm, topic labels were assigned through an iterative interpretive process based on three considerations: the highest-probability terms associated with each topic, the collective semantic relationships among these terms, and their correspondence with established streams of research in the strategic management and competitive strategy literature. Consequently, the labels should be interpreted as conceptual representations of broader thematic configurations rather than simple descriptions of individual keywords.

Figure ?? presents the statistical diagnostics used to determine the appropriate number of topics in the LDA model. Figure ??a reports the log-likelihood values, whereas Figure ??b presents the perplexity scores across different topic numbers (k). The results indicate substantial improvements in model fit between $k = 2$ and $k = 6$, as reflected by increasing log-likelihood values and decreasing perplexity scores. After this point, the diagnostic measures exhibited only limited additional improvement, suggesting diminishing returns from increasing the number of topics. Although the statistical diagnostics indicated improved model fit around $k = 6$, lower-topic solutions produced broader and partially overlapping thematic structures that obscured several conceptually meaningful research streams. In particular, sustainability-oriented strategies, supply chain capabilities, SME-

oriented innovation, and firm performance perspectives tended to be merged into broader capability-based themes under lower-topic solutions. The eight-topic solution provided greater thematic granularity and conceptual distinctiveness by allowing these emerging domains to be represented as independent but related research streams. Accordingly, the final topic number was determined through a combination of statistical diagnostics and interpretive evaluation of semantic coherence and theoretical meaningfulness, consistent with recommendations in computational literature review research.

Table 1. Latent topics identified by the LDA model and their representative keywords.

Topic	Topic Label	Representative Keywords
T1	Dynamic Capabilities, Innovation, and Strategic Design	innovation, dynamic, design, capability, business, resource, theory, view, social, technology, capital, firm
T2	Strategic Capability Development and Organizational Performance	design, performance, capability, management, dynamic, strategy, business, knowledge, view, market, industry, originality
T3	Competitive Strategy and Resource-Based Advantage	market, performance, theory, dynamic, capability, innovation, resource, business, development, project, strategic, publish
T4	Supply Chain Capabilities and Knowledge Integration	capability, chain, supply, performance, resource, theory, knowledge, innovation, management, business, manager, publish
T5	Organizational Performance and Strategic Resource Integration	performance, design, firm, resource, management, innovation, organizational, market, originality, dynamic, social, family
T6	Competitive Strategy and Sustainable Innovation	strategy, firm, performance, management, innovation, resource, competitive, strategic, environmental, originality, financial, practical
T7	Digital Transformation and Green Innovation Capabilities	capability, dynamic, innovation, digital, firm, market, performance, green, technology, smes, service, industry
T8	Manufacturing Competitiveness and Organizational Resources	resource, firm, design, dynamic, performance, business, manufacture, organizational, competitive, emerald, smes, technology

Note: Topic labels were assigned by the authors through an iterative semantic interpretation of the highest-probability terms and their correspondence with established themes in the competitive strategy literature.

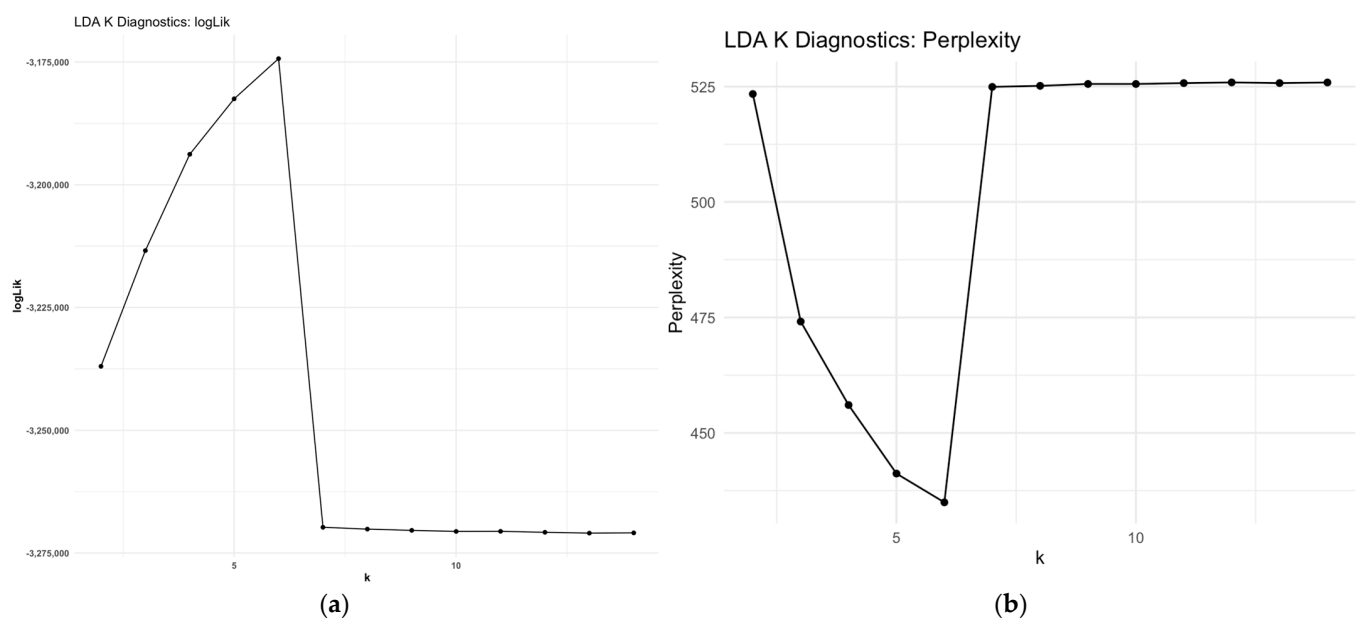


Figure 3. LDA topic number diagnostics based on statistical fit measures: (a) log-likelihood values across different topic numbers (k); (b) perplexity values across different topic numbers (k).

As an additional robustness check following the review process, we further compared the six- and eight-topic solutions using the UMass coherence metric. The eight-topic

solution achieved a higher mean UMass coherence value (-0.863) than the six-topic solution (-1.300), indicating stronger semantic coherence among the representative terms. A detailed comparison of the candidate topic solutions is provided in Appendix ?? (Table ??).

Therefore, the final selection of eight topics was based not only on statistical fit measures, but also on semantic coherence, thematic distinctiveness, and interpretability considerations, which is consistent with common practices in topic modeling research. The topic structure illustrates a multidimensional intellectual landscape in which capability-based perspectives remain highly influential. Topics T1 (Dynamic Capabilities, Innovation, and Strategic Design), T2 (Strategic Capability Development and Organizational Performance), and T3 (Competitive Strategy and Resource-Based Advantage) collectively emphasize dynamic capabilities, strategic capability development, innovation, and resource-based competitive advantage. Together, these topics indicate that capability-driven strategic thinking remains a central theoretical foundation for explaining competitive advantage while increasingly incorporating innovation- and market-oriented perspectives. The interpretive labels assigned to these topics therefore reflect theoretically meaningful configurations of related concepts rather than isolated keyword groupings, enabling a more substantive understanding of how contemporary competitive strategy research is organized.

In addition to these foundational perspectives, several topics demonstrate the expanding thematic scope of competitive strategy research. Topic T4 (Supply Chain Capabilities and Knowledge Integration) highlights the growing importance of supply chain capabilities, knowledge integration, and innovation in strengthening organizational resilience. Topic T5 (Organizational Performance and Strategic Resource Integration) emphasizes the interaction between organizational resources, strategic design, and firm performance. Topic T6 (Competitive Strategy and Sustainable Innovation) reflects the increasing prominence of sustainability-oriented competitive strategies and environmentally focused innovation. Topic T7 (Digital Transformation and Green Innovation Capabilities) illustrates the convergence of digital transformation, green innovation, technological development, and SME competitiveness, indicating the growing integration of digital and sustainability capabilities within strategic management research. Finally, Topic T8 (Manufacturing Competitiveness and Organizational Resources) captures a distinct stream focusing on manufacturing capabilities, organizational resources, and technological competitiveness as complementary sources of firm-level competitive advantage.

In this study, the term -design- is interpreted in relation to strategic design, business model design, and design-oriented managerial approaches rather than the discipline of design studies. Since design-related terms were included in the Scopus search query, the resulting topic labels should be interpreted within this intentionally delimited analytical scope.

The distribution of papers across the eight topics provides additional insight into the thematic composition of the literature. As illustrated in Figure ??, the topic distribution is relatively balanced, although Topics T1 and T6 emerge as the most prevalent thematic domains. This pattern indicates strong scholarly attention toward dynamic capabilities, innovation-oriented strategic design, competitive strategy, sustainable innovation, and performance-related strategic research. Topics T3, T2, T4, and T8 occupy intermediate positions within the distribution, reflecting the continuing relevance of resource-based advantage, strategic capability development, supply chain capabilities, knowledge integration, and manufacturing competitiveness. In contrast, Topics T7 and T5 account for comparatively smaller shares of the literature. Although these themes remain conceptually important, their lower proportions suggest that digital transformation and green innovation capabilities, as well as organizational performance and strategic resource integration, represent more specialized thematic streams within the broader corpus. Overall, the distribution

demonstrates that competitive strategy research is organized around a multidimensional thematic structure encompassing capability-based strategy, sustainable innovation, organizational performance, supply chain capabilities, manufacturing competitiveness, and digital transformation.

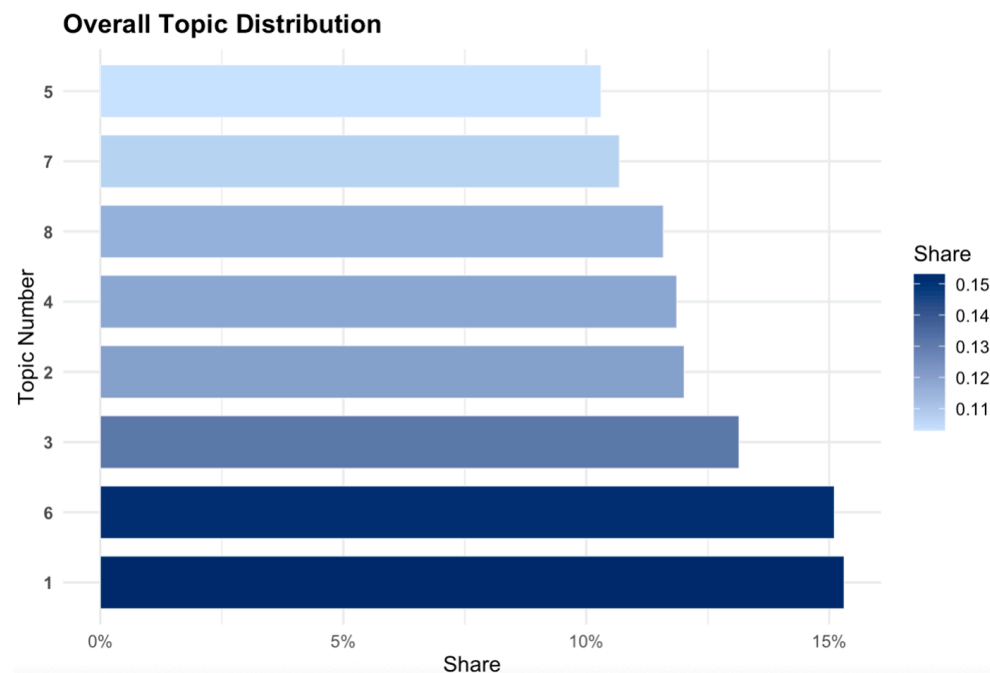


Figure 4. All topic distribution across the analyzed publications.

The semantic consistency of the extracted topics was subsequently evaluated using topic coherence scores. Figure ?? presents the coherence values associated with each topic in the eight-topic solution. It should be noted that absolute coherence values are influenced by corpus size, vocabulary diversity, preprocessing decisions, and the specific coherence metric employed. Consequently, relatively low absolute coherence values are not uncommon in large and heterogeneous bibliographic corpora and should be interpreted comparatively across candidate topic solutions rather than against universal threshold values. The coherence profile indicates noticeable variation in semantic consistency across the identified thematic structures. Topic T3 exhibits the highest coherence value, followed by T5 and T8, suggesting comparatively stronger semantic relatedness among the representative terms within these topics. In contrast, Topics T1, T2, T6, and T7 display relatively lower coherence values, reflecting broader thematic coverage and greater conceptual diversity. Topic T4 occupies an intermediate position within the coherence distribution.

Such variation is expected in large bibliographic corpora, where broader research themes often integrate concepts originating from multiple theoretical traditions and interdisciplinary domains. Consequently, topic coherence was not interpreted as an absolute measure of topic quality but rather as one of several complementary diagnostic criteria. In the present study, the final topic solution was selected through the joint consideration of statistical diagnostics, semantic coherence, thematic distinctiveness, and theoretical interpretability. Collectively, these criteria support the use of the eight-topic model as a coherent and analytically meaningful representation of the contemporary competitive strategy literature.

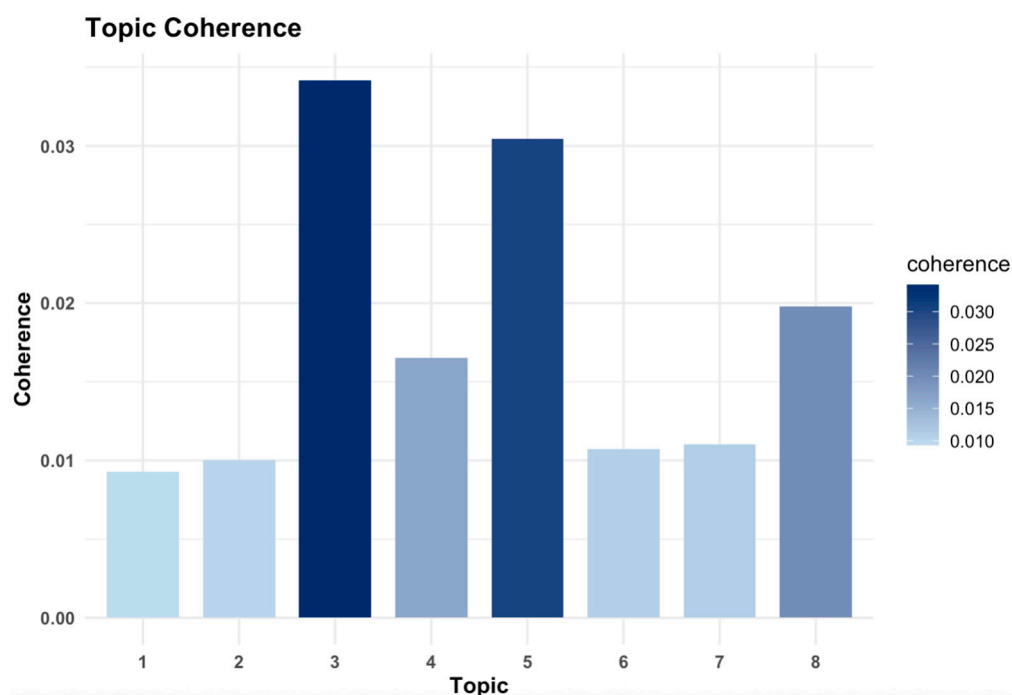


Figure 5. Topic coherence scores for the eight-topic LDA solution.

4.3. Topic Trends over Time

The chronological evolution of topic shares provides important insights into how thematic priorities in the competitive strategy literature have shifted over time. Figure ?? depicts the proportional distribution of each topic throughout the observation period.

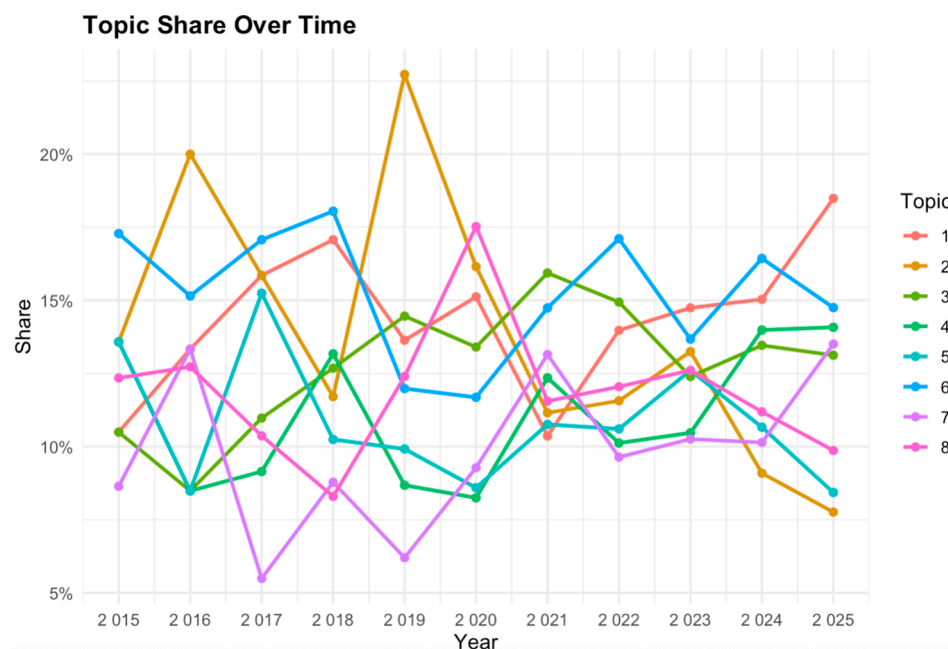


Figure 6. Temporal evolution of topic shares in competitive strategy research.

The temporal patterns suggest a gradual reconfiguration of research priorities rather than abrupt thematic discontinuities. Topic T2 accounts for a relatively large share of the literature during the early years of the observation period, reaching its highest levels between 2016 and 2019, but subsequently exhibits a steady decline after 2020. In contrast, Topic T1 demonstrates the clearest long-term upward trajectory, particularly after 2021, and becomes the most prominent topic by 2025. This pattern suggests increasing scholarly

attention to dynamic capabilities, innovation-oriented strategic design, and related strategic perspectives within the contemporary competitive strategy literature.

Topics T3 and T6 maintain comparatively stable shares throughout the study period, indicating the continued relevance of resource-based strategic perspectives and sustainable innovation within the field. The remaining topics exhibit moderate year-to-year fluctuations without pronounced long-term upward or downward trends, reflecting the coexistence of multiple complementary research streams rather than the replacement of established theoretical perspectives. Overall, the temporal evidence indicates that competitive strategy research has evolved through the gradual expansion of emerging themes while retaining strong foundations in established strategic management theories.

While Figure ?? highlights the longitudinal trajectories of individual topics, Figure ?? provides a complementary overview by displaying the relative intensity of each topic across the study period. The heatmap facilitates the identification of periods in which particular research themes became comparatively more or less prominent, thereby providing a more detailed perspective on temporal thematic dynamics.

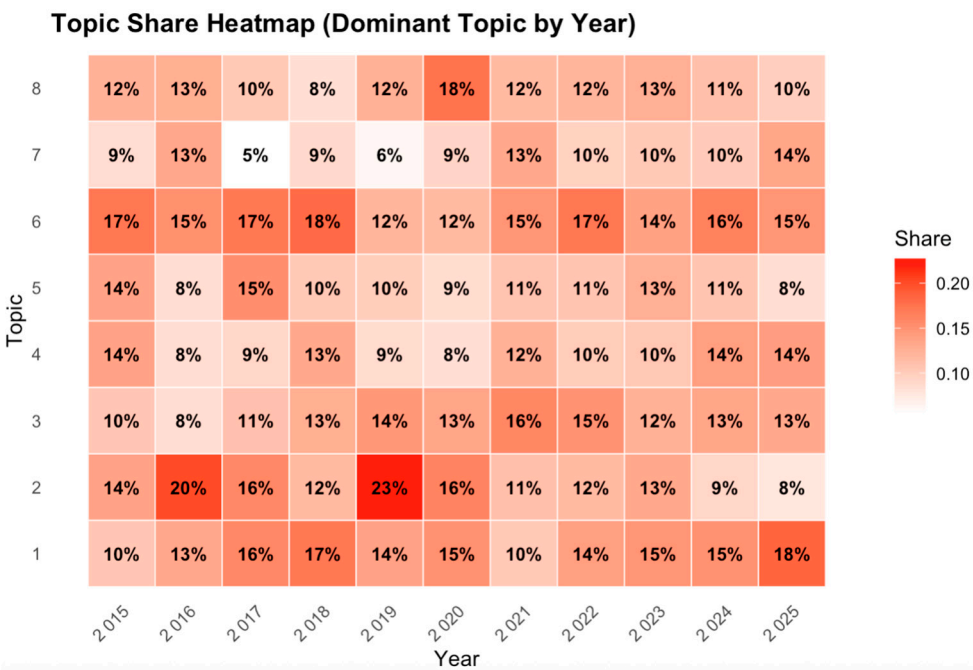


Figure 7. Heatmap of topic share by year showing the dominant thematic intensity across the study period.

The heatmap reveals substantial differences in thematic intensity across the observation period. Topic T2 exhibits the highest concentration during the earlier years, particularly in 2016 and 2019, but gradually declines in prominence after 2020. In contrast, Topic T1 becomes increasingly prominent during the later years of the study period and reaches its highest relative intensity in 2025. Topic T6 maintains comparatively high intensity throughout the entire period, indicating a consistently established position within the competitive strategy literature, whereas Topic T3 displays moderate but relatively stable prominence across most years.

Overall, the heatmap confirms that the evolution of competitive strategy research has occurred through gradual changes in thematic emphasis rather than abrupt shifts, reflecting the coexistence of established strategic perspectives and emerging research domains throughout the study period.

4.4. Keyword Co-Occurrence Network and Clustering

A keyword co-occurrence network was established utilizing both author keywords and index keywords to strengthen the topic-level analysis and provide a deeper understanding of the conceptual relationships within the literature. Keywords co-occurring in the same documents were connected to construct a weighted network representing semantic associations across the research domain.

The structural relationships among the extracted topics are illustrated in the cosine similarity network presented in Figure ???. The network reveals a connected thematic structure in which all eight topics remain linked through moderate to strong semantic similarities while forming two broad conceptual communities. One community comprises Topics T1, T5, T6, T7, and T8, reflecting a closely interconnected set of themes centered on innovation-oriented strategic design, competitive strategy, sustainability, digital transformation, and organizational resources. The second community includes Topics T2, T3, and T4, representing conceptually related themes associated with strategic capability development, resource-based advantage, and supply chain capabilities. Although these communities are visually distinguishable, multiple connections between them indicate that the identified research streams are not isolated but remain embedded within a common intellectual structure.

Topic Network (cosine similarity ≥ 0.62)

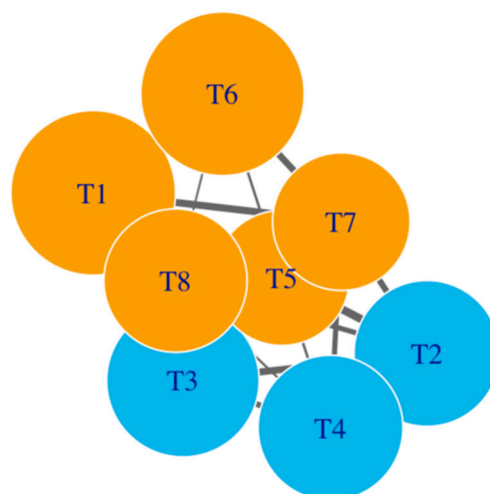


Figure 8. Topic similarity network based on cosine similarity (threshold = 0.62). Node colors indicate the two communities identified through community detection, while edge thickness is proportional to cosine similarity strength.

To evaluate the robustness of the topic similarity network, a sensitivity analysis was conducted using alternative cosine similarity thresholds ranging from 0.50 to 0.70. Lower thresholds (0.50–0.55) generated excessively dense networks in which nearly all topics were interconnected through numerous weak semantic associations, thereby reducing interpretability. Conversely, higher thresholds (0.70) produced fragmented structures characterized by multiple disconnected components and isolated topics. Threshold values between 0.60 and 0.65 yielded broadly comparable connected networks. The threshold of 0.62 was retained because it preserved a single connected network without isolated topics while substantially reducing network density, thereby providing a balanced and interpretable representation of conceptual relationships among topics. The sensitivity analysis results are summarized in Appendix ?? (Table ??).

Additional insights into the higher-order conceptual structure of the literature are provided by the hierarchical clustering analysis presented in Figure ???. The cosine similarity dendrogram reveals several interconnected thematic groupings rather than isolated topic structures. Among the closest thematic associations, Topics T5 and T8 form the nearest cluster, indicating a high degree of semantic similarity between organizational performance, strategic resource integration, and manufacturing competitiveness. Topic T1 subsequently joins this cluster, suggesting close conceptual relationships with dynamic capabilities, innovation-oriented strategic design, and related strategic perspectives.

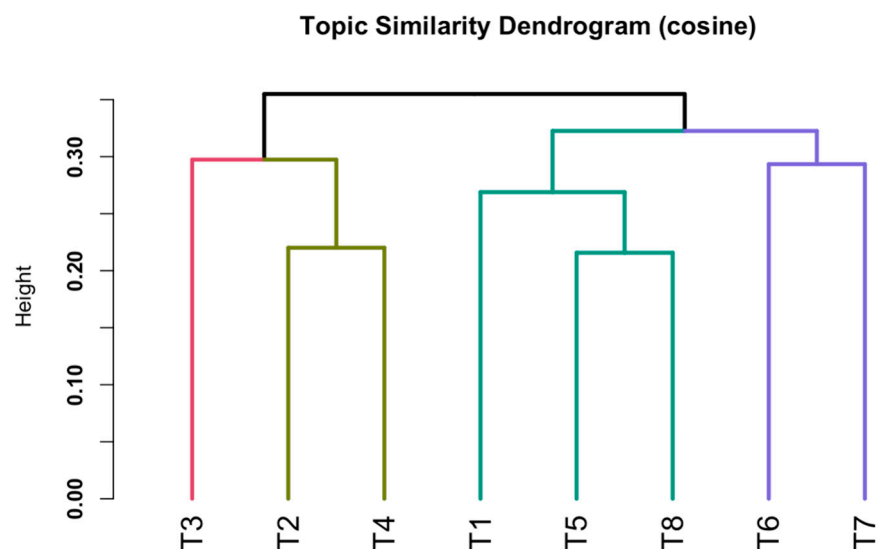


Figure 9. Hierarchical clustering of topics based on cosine similarity. Branch colors are used only for visual differentiation of the hierarchical clustering structure and do not represent additional analytical variables.

A second major grouping is formed by Topics T2 and T4, which are linked at a relatively low clustering distance and are subsequently joined by Topic T3. This pattern reflects the conceptual proximity among strategic capability development, supply chain capabilities, knowledge integration, and resource-based strategic perspectives. In parallel, Topics T6 and T7 constitute another closely related pair, indicating semantic connections between sustainable innovation, digital transformation, and green innovation capabilities.

At higher linkage distances, these thematic groupings merge into a single hierarchical structure, indicating that although individual research streams retain distinct conceptual identities, they remain embedded within a broader and interconnected intellectual framework. Overall, the dendrogram supports the view that contemporary competitive strategy research is characterized by multiple closely related thematic clusters rather than isolated domains.

To further examine the conceptual organization of the literature at the keyword level, a keyword co-occurrence network based on author keywords was constructed. The Louvain community detection algorithm identified five major keyword clusters representing the dominant thematic communities within the competitive strategy literature. The identified clusters and their representative keywords are summarized in Table ??.

Table ?? highlights several major research streams shaping contemporary competitive strategy scholarship. These clusters encompass traditional competitive strategy discussions centered on firm performance and competitive advantage, digitally oriented strategy research emphasizing artificial intelligence and big data analytics, supply chain and operations management perspectives, sustainability and environmental strategy, and innovation- and knowledge-based capability development. Together, these clusters demonstrate that

contemporary competitive strategy research extends beyond classical strategic management perspectives and increasingly integrates digital technologies, sustainability, operational resilience, and knowledge-based capabilities.

Table 2. Keyword clusters identified from the co-occurrence network.

Cluster	Thematic Interpretation	Representative Keywords
C1	Core Competitive Strategy Research	competitive strategy, firm performance, competitive advantage
C2	Digital Transformation and Analytics	digital transformation, artificial intelligence, big data
C3	Supply Chain and Operations Strategy	supply chain, logistics, resilience
C4	Sustainability and Green Strategy	sustainability, green innovation, environmental strategy
C5	Innovation and Knowledge-Based Strategy	innovation, knowledge management, dynamic capabilities

The conceptual relationships among these thematic communities are visualized in the keyword network presented in Figure ???. The network indicates that one of the largest and most densely connected communities is centered on capability-based strategic perspectives, particularly dynamic capabilities and related strategic management concepts. This finding supports the topic modeling results and confirms the ongoing importance of capability-oriented strategic thinking.

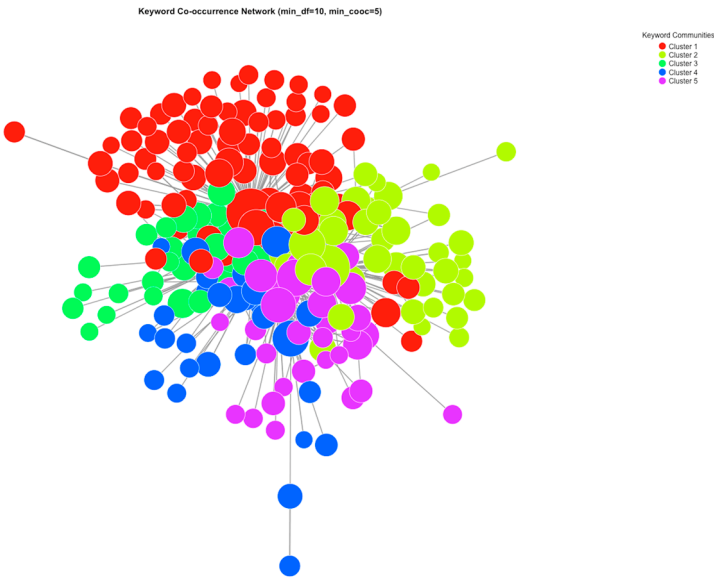


Figure 10. Keyword co-occurrence network showing the conceptual structure of competitive strategy research.

Another prominent thematic community encompasses research related to digital transformation, analytics, and capability-driven strategic management. This cluster highlights the increasing importance of data-driven capabilities, enterprise resource management, and digital integration in shaping contemporary strategic decision-making processes. Other communities emphasize themes related to supply chain management, sustainability-oriented strategy, innovation dynamics, and knowledge-based capability development, illustrating the multidimensional structure of contemporary competitive strategy research.

An additional perspective on the structural organization of research themes is provided by the thematic map presented in Figure ???. Following the science mapping framework originally proposed by [?] and subsequently operationalized by [?], the map classifies research themes according to two dimensions: centrality, representing the degree of interaction with other themes in the literature, and density, indicating the internal development and conceptual maturity of each theme. Based on these dimensions, the thematic map is

divided into four quadrants: motor themes, basic themes, niche themes, and emerging or declining themes.

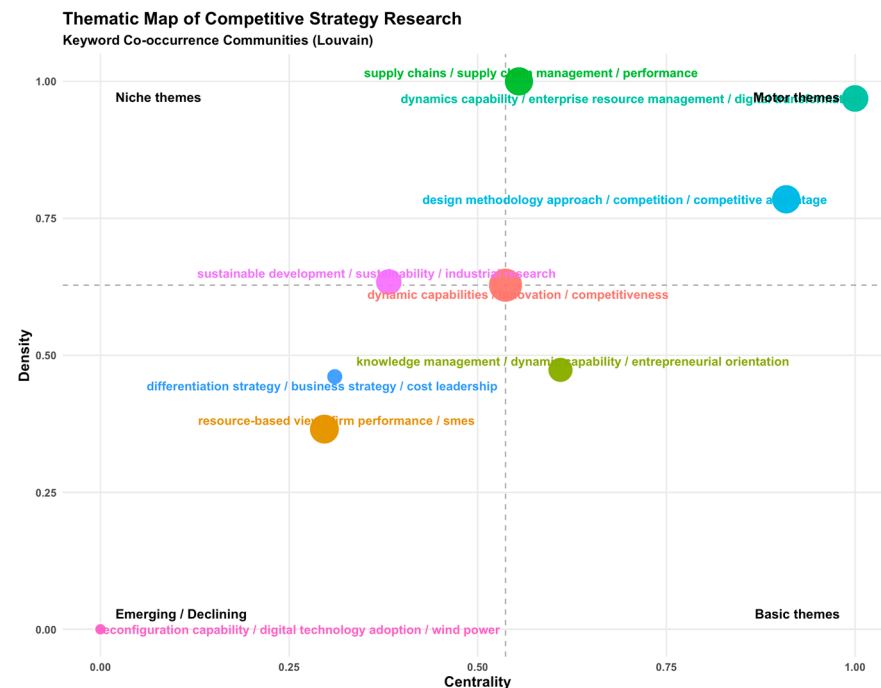


Figure 11. Thematic map of competitive strategy research based on keyword co-occurrence. Bubble size is proportional to the size of each keyword community, while connecting lines indicate the relationships among co-occurring keywords.

Themes located in the motor themes quadrant (upper-right) represent conceptually mature and highly central research domains that strongly influence the intellectual structure of the field. In this study, themes associated with supply chain management, performance, dynamic capabilities, enterprise resource management, and digital transformation are positioned within this quadrant. Their placement suggests that these themes possess both strong internal development and extensive conceptual connections with other strategic research streams.

The basic themes quadrant (lower-right) includes themes that are strongly connected to the broader literature but demonstrate relatively lower internal density. Themes related to dynamic capabilities, innovation, competitiveness, knowledge management, entrepreneurial orientation, and strategic capability development are located within this region. This finding indicates that these themes constitute foundational components of competitive strategy research while continuing to evolve conceptually.

Themes situated in the niche themes quadrant (upper-left) are characterized by strong internal development but comparatively limited interaction with the broader literature. In the present analysis, sustainability-oriented development and industry-focused strategic discussions appear within this quadrant, suggesting the existence of specialized but conceptually established research streams.

Finally, the emerging or declining themes quadrant (lower-left) contains themes with relatively low centrality and low density. Topics associated with reconfiguration capability, digital technology adoption, and wind power are positioned in this region, indicating either newly emerging research directions or thematic areas that remain only weakly integrated into the broader competitive strategy literature.

Although the keyword network analysis identifies five primary clusters, the thematic map provides a more detailed perspective of the research landscape by illustrating varia-

tions in the maturity and prominence of these themes in the broader literature. While the keyword co-occurrence network and thematic map describe the conceptual structure of the literature from complementary perspectives, Figure ?? adds a temporal dimension by illustrating the evolution of keyword-based themes across three consecutive time periods (2015–2018, 2019–2021, and 2022–2025).

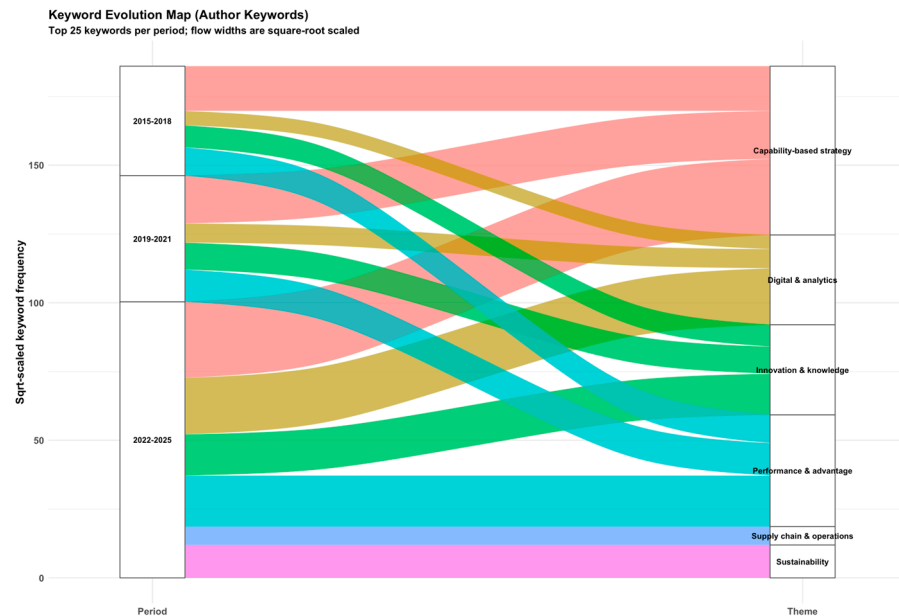


Figure 12. Keyword evolution map of competitive strategy research based on author keywords across three time periods.

Innovation and knowledge-based perspectives remain crucial in explaining competitive advantage, despite the emergence of sustainability- and supply chain-related themes as relatively new research areas in the literature. Overall, the evolution map depicts a gradual diversification of competitive strategy research toward digital technologies and sustainability-oriented strategic perspectives.

Further evidence of emerging research directions is provided by the analysis of rapidly growing keywords shown in Figure ?. The ranking is determined by the compound annual growth rate (CAGR) of each keyword's proportional share across the study period. To reduce the influence of rare or sporadically occurring terms, the analysis was restricted to keywords appearing in at least three publication years ($\text{min_years} = 3$) and in a minimum of 20 documents ($\text{min_total_docs} = 20$). These filtering criteria improve the robustness of the growth analysis by reducing the influence of artificially inflated CAGR values associated with very low-frequency keywords. Among all keywords, green innovation and sustainable performance exhibit the highest growth rates, indicating a rapidly increasing scholarly emphasis on sustainability-oriented strategic perspectives and environmentally focused competitive capabilities.

Technological and digitally oriented themes also demonstrate strong growth trajectories. In particular, Industry 4.0, digital transformation, artificial intelligence, and digitalization emerge among the fastest-growing keywords in the literature. These findings reflect the growing integration of digital technologies, data-driven strategic decision-making systems, and advanced analytical approaches into competitive strategy research.

In addition, methodological and organizational themes such as PLS-SEM, dynamic capabilities theory, firm performance, organizational agility, and supply chain resilience also display notable growth patterns. Collectively, these trends reflect the increasing inte-

gration of sustainability, digital transformation, organizational adaptability, and advanced analytical approaches into contemporary competitive strategy research.

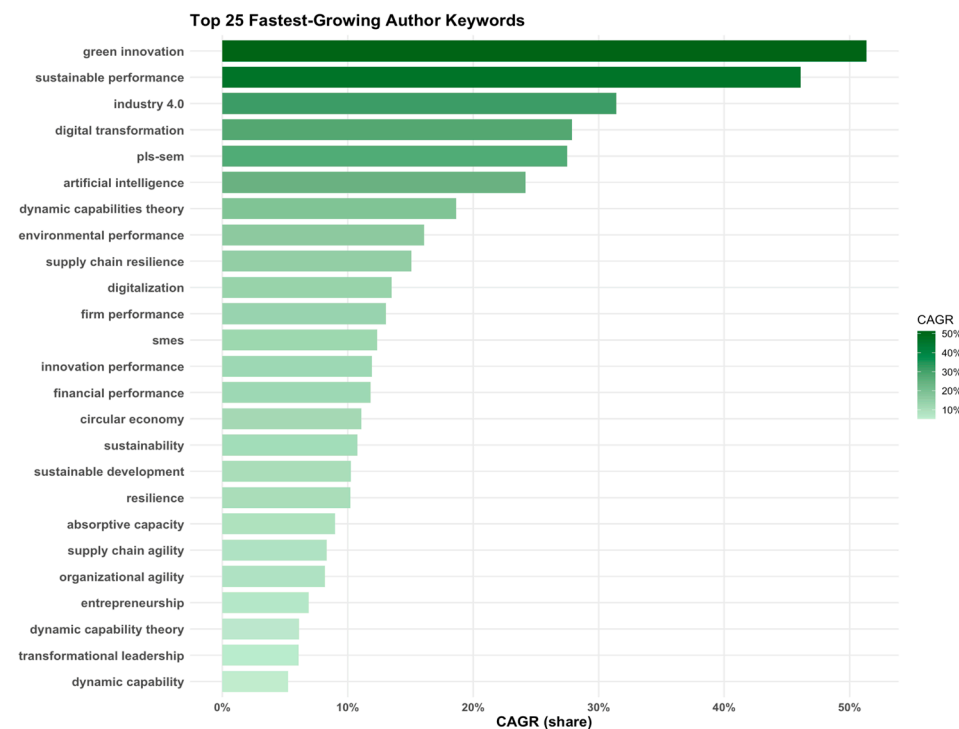


Figure 13. Top 25 fastest-growing author keywords in competitive strategy research based on CAGR of keyword share.

The keyword burst analysis presented in Figure ?? further emphasizes emerging research areas. Burst detection identifies keywords that experience sudden increases in research attention over time. The burst score measures the intensity of this surge in attention, indicating how rapidly a concept gains prominence within the literature during a defined period.

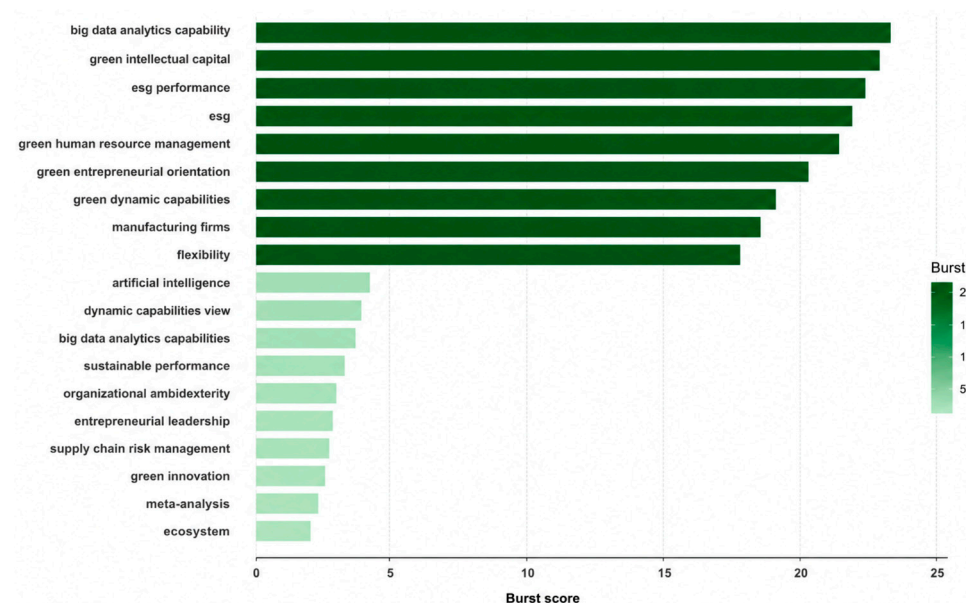


Figure 14. Keyword burst analysis identifying emerging author keywords in competitive strategy research.

The results reveal that big data analytics capability, green intellectual capital, environmental, social, and governance (ESG) performance, ESG, green human resource manage-

ment, and green entrepreneurial orientation demonstrate the strongest burst effects. These findings indicate rapidly increasing scholarly attention toward sustainability-oriented capabilities, ESG-related governance perspectives, and data-driven organizational competencies. In particular, the prominence of ESG-related concepts reflects the growing integration of environmental sustainability into competitive strategy research.

Several additional emerging themes are also evident in Figure ???. Concepts such as artificial intelligence, blockchain technology, big data analytics capability, digital capability, and supply chain risk management exhibit notable burst activity, suggesting that digitally enabled strategic systems and technology-oriented organizational capabilities are becoming increasingly influential within the literature. Furthermore, topics including organizational ambidexterity, entrepreneurial leadership, strategic alignment, and dynamic capability's view indicate expanding scholarly interest in organizational adaptability and capability-driven strategic management approaches. The analysis also demonstrates growing attention toward sustainability and performance-oriented themes, including sustainable performance, green innovation, green dynamic capabilities, and manufacturing firms.

Overall, the burst analysis identifies three dominant emerging trajectories within the literature: sustainability-oriented management, digitally enabled organizational capabilities, and resilience-focused strategic adaptation. Collectively, these findings indicate that recent competitive strategy research is increasingly characterized by sustainability-oriented management, digitally enabled organizational capabilities, and resilience-focused strategic adaptation.

Finally, the structural importance of individual keywords within the literature can be examined through betweenness centrality analysis. Figure ??? presents the most influential author keywords ranked according to their normalized betweenness centrality values. Betweenness centrality measures the extent to which a keyword functions as a bridge connecting different thematic communities within the network structure.

The results indicate that dynamic capabilities occupy the most central bridging position in the network by a substantial margin, highlighting their central role in connecting multiple conceptual domains across the competitive strategy literature. The resource-based view also demonstrates a notably high betweenness value, confirming the continuing theoretical importance of capability- and resource-oriented strategic perspectives within the field.

Several additional keywords, including innovation, digital transformation, firm performance, sustainable development, competitive strategy, and supply chains, also exhibit relatively strong centrality values. The prominence of these concepts suggests that contemporary competitive strategy research is increasingly organized around the interaction between capability development, digital transformation, sustainability, performance management, and competitive positioning.

Moreover, the appearance of themes such as artificial intelligence, Industry 4.0, circular economy, environmental performance, and enterprise resource management indicates that technologically enabled and sustainability-oriented strategic frameworks appear to be increasingly integrated into the broader intellectual structure of the literature. Overall, the centrality analysis further supports the prominent bridging role of dynamic capabilities within the conceptual structure of competitive strategy research.

Taken together, the findings from topic modeling, keyword co-occurrence analysis, thematic mapping, burst detection, and centrality analysis reveal a multidimensional and evolving intellectual structure within the competitive strategy literature. Collectively, these analyses highlight the growing prominence of digital transformation, sustainability, and capability-oriented strategic perspectives alongside well-established theoretical

foundations. Building upon these empirical findings, the following section discusses their theoretical implications within the broader strategic management literature.

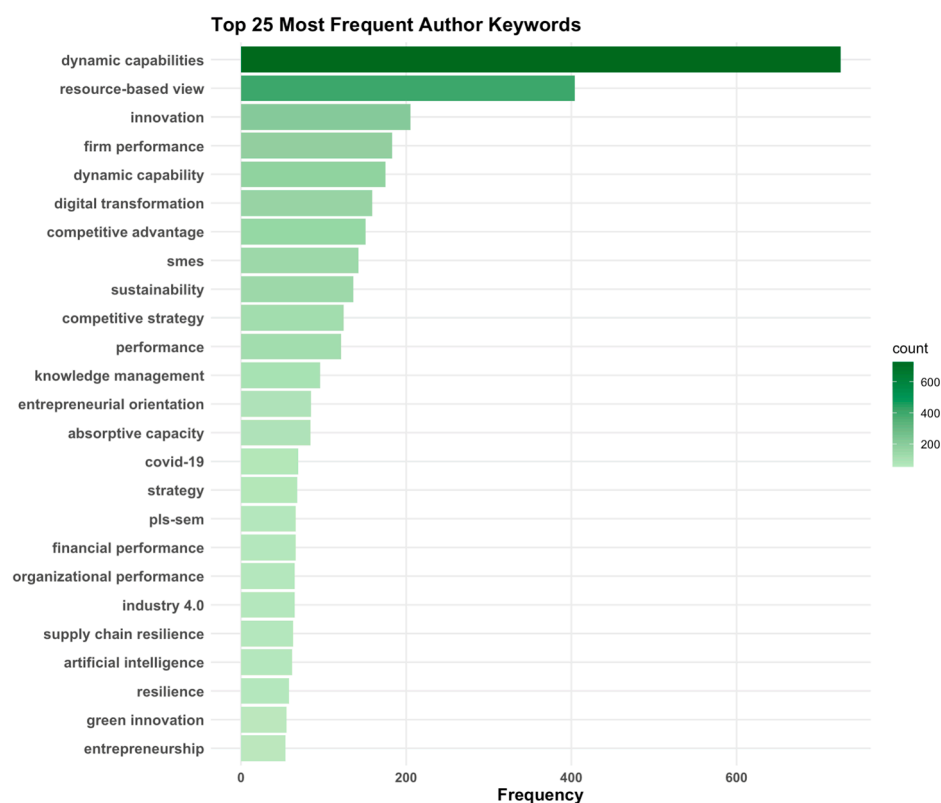


Figure 15. Top 25 author keywords ranked by betweenness centrality in the keyword co-occurrence network.

5. Discussions

This study examined the intellectual structure and thematic evolution of competitive strategy research by integrating topic modeling and bibliometric network analysis. The findings indicate that competitive strategy has evolved into a multidimensional and increasingly interconnected research domain shaped by technological transformation, sustainability concerns, operational resilience, and capability-based strategic perspectives.

One of the most prominent findings is the continuing centrality of capability-based perspectives within the literature. Both topic modeling and keyword network analyses indicate that dynamic capabilities and the resource-based view remain foundational components of contemporary competitive strategy research. In particular, the high centrality of dynamic capabilities suggests that capability-oriented frameworks continue to function as conceptual bridges connecting diverse research streams. This finding is consistent with classical strategic management studies emphasizing firm-specific resources and organizational capabilities as the primary sources of sustained competitive advantage [? ? ?].

At the same time, the findings demonstrate that competitive strategy research is no longer organized around a single dominant theoretical perspective but is increasingly characterized by a diversified and interconnected intellectual structure. The thematic map and clustering analyses reveal that digital transformation, supply chain management, organizational adaptability, performance-oriented strategic management, and sustainability have become closely integrated with capability-based strategic perspectives rather than developing as isolated research streams. Furthermore, the strong growth patterns associated with artificial intelligence, Industry 4.0, digital transformation, ESG, green innovation, and supply chain resilience suggest that competitive advantage is increasingly conceptualized

through broader strategic frameworks integrating technological capability, environmental adaptation, and operational resilience. These findings are consistent with recent strategic management research emphasizing that digital technologies fundamentally transform how firms establish, sustain, and renew competitive advantage while simultaneously fostering greater integration across previously distinct strategic domains [? ?].

From a methodological perspective, this study illustrates the potential of computational literature review approaches for systematically mapping complex intellectual domains. By integrating topic modeling and bibliometric network techniques, the analytical framework facilitates the identification of latent thematic structures, semantic relationships, and temporal transformations that may be difficult to detect through narrative reviews or conventional bibliometric techniques alone.

Toward an Integrative Framework and Future Research Agenda

Taken together, the findings suggest that competitive strategy research is evolving toward a multi-layered and integrative intellectual configuration. Rather than replacing classical perspectives such as the resource-based view and dynamic capabilities framework, emerging themes including digital transformation, sustainability, and supply chain resilience appear to extend and reconfigure these foundational theories.

Beyond confirming well-established developments such as the growing importance of digital transformation and sustainability, the present study demonstrates the additional analytical value of topic modeling for computational literature reviews. Unlike conventional review articles, citation analyses, or keyword co-occurrence techniques that primarily identify influential publications or frequently occurring concepts, LDA uncovers latent semantic structures by grouping terms according to their probabilistic co-occurrence across the entire corpus. This approach reveals how classical theoretical perspectives, including the resource-based view and dynamic capabilities, are increasingly integrated with digital transformation, sustainability, platform ecosystems, and organizational resilience within broader conceptual configurations. Consequently, the contribution of the present study lies not merely in identifying emerging themes, but in demonstrating how these themes are systematically interconnected and collectively reshape the intellectual structure of competitive strategy research.

This interpretation is also consistent with the digital business strategy perspective proposed by [?], who argue that digital technologies have evolved from operational support tools into core strategic resources shaping value creation, competitive positioning, and organizational transformation. The growing prominence of digital transformation themes identified in the present study can therefore be interpreted as reflecting technological change but also the increasing integration of digital capabilities into firms' overall competitive strategies.

Consequently, competitive advantage is increasingly conceptualized not as the outcome of isolated firm resources but as the product of interactions among organizational capabilities, digital infrastructures, ecosystem relationships, and sustainability-oriented strategic imperatives. This interpretation is further supported by [?], who argue that dynamic capabilities remain fundamental in digital platform ecosystems, although their deployment increasingly depends on ecosystem participation, platform governance, and the orchestration of complementary resources across organizational boundaries. Accordingly, the present findings suggest that capability-based theories continue to provide a robust theoretical foundation for competitive strategy research while simultaneously expanding to accommodate digitally connected and ecosystem-oriented competitive environments. Taken together, these findings suggest that contemporary competitive strategy increasingly emphasizes the interaction among organizational capabilities, digital infrastructures,

platform ecosystems, and sustainability-oriented strategic practices while retaining the explanatory relevance of capability-based theories.

6. Conclusions

This study examined the intellectual structure and thematic evolution of competitive strategy research by applying unsupervised machine learning and bibliometric analysis techniques to a large corpus of Scopus-indexed academic publications published between 2015 and 2025. By integrating topic modeling, keyword co-occurrence analysis, thematic mapping, burst detection, centrality analysis, and temporal trend evaluation, the study provides a comprehensive and data-driven overview of how the competitive strategy literature has evolved in recent years.

The findings indicate that capability-based strategic perspectives, particularly dynamic capabilities and the resource-based view, remain central to the intellectual structure of competitive strategy research. Their prominent positions within the keyword network suggest that these perspectives continue to provide a robust theoretical foundation despite the increasing thematic diversification of the field.

At the same time, the results reveal that competitive strategy research has progressively expanded beyond its traditional theoretical boundaries. Themes associated with digital transformation, artificial intelligence, big data analytics capability, Industry 4.0, supply chain resilience, sustainability-oriented management, and ESG-related strategic perspectives exhibit substantial growth and emerging prominence throughout the literature. These developments highlight the growing integration of technological, operational, environmental, and organizational perspectives within contemporary competitive strategy research.

Collectively, the empirical analyses indicate that competitive strategy research is evolving toward an increasingly multidimensional and interconnected intellectual structure in which digital transformation, sustainability, and organizational capabilities interact more closely than in earlier periods. These findings suggest that competitive advantage is progressively conceptualized through a combination of technological adaptability, organizational flexibility, sustainability integration, and data-driven strategic capabilities.

Beyond its substantive findings, the study also provides methodological contributions to the strategic management literature. By combining unsupervised machine learning techniques with bibliometric network analysis, the study demonstrates the potential of computational approaches for systematically mapping large-scale and conceptually complex academic fields. The analytical framework employed in this study enables the identification of latent thematic structures, conceptual relationships, and emerging research trajectories that may be difficult to detect through traditional narrative review methods alone.

Despite these contributions, several limitations should be acknowledged. First, the analysis relies exclusively on publications indexed in the Scopus database. Although Scopus provides extensive coverage of the business and strategic management literature and offers standardized bibliographic metadata suitable for computational text analysis, relevant studies indexed exclusively in other databases may not be represented in the analyzed corpus. Consequently, the findings should be interpreted within the scope of the selected dataset. Second, although machine learning-based text mining techniques provide valuable structural insights into large textual corpora, these methods primarily identify statistical and semantic patterns rather than detailed theoretical interpretations of individual studies. Accordingly, some contextual and theoretical nuances may not be fully captured through automated analytical procedures.

Future research may extend the present study by incorporating additional bibliographic databases, such as Web of Science and Dimensions, to broaden dataset coverage

and improve the representativeness of the analyzed literature. Future studies may also employ Dynamic Topic Modeling (DTM) to capture the continuous temporal evolution of research themes, thereby providing a more fine-grained understanding of how strategic concepts emerge, evolve, and converge over time. In addition, transformer-based approaches such as BERTopic may generate contextually richer topic representations by leveraging semantic language embeddings, enabling the identification of more nuanced conceptual relationships within competitive strategy research. Furthermore, integrating computational literature review methods with qualitative systematic review approaches may provide richer theoretical interpretations of emerging strategic themes and interdisciplinary developments.

Overall, this study demonstrates that competitive strategy research is characterized by an increasingly interconnected intellectual structure in which established capability-based theories continue to evolve alongside emerging themes related to digital transformation, sustainability, and ecosystem-oriented competition. These findings contribute to a more comprehensive understanding of how the strategic management literature is adapting to contemporary technological, environmental, and organizational challenges.

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Data Availability Statement: The data were obtained from the Scopus database. The search query and data retrieval process are provided in Appendix ?? to enable reproducibility.

Conflicts of Interest: The authors declare no conflicts of interest.

Abbreviations

The following abbreviations are used in this manuscript:

LDA	Latent Dirichlet Allocation
RBV	Resource-based view
CAGR	Compound annual growth rate
ESG	Environmental, social, and governance
DTM	Dynamic Topic Modeling
NMF	Non-negative Matrix Factorization
STM	Structural Topic Modeling

Appendix A. Scopus Search Query

The dataset used in this study was retrieved from the Scopus database using the search query presented below. The query was designed to capture publications related to competitive strategy and capability-based strategic perspectives while simultaneously incorporating design- and digital-related contexts. The search was limited to journal articles published between 2015 and 2025 within the subject areas of Business, Management and Accounting; Economics, Econometrics and Finance; and Social Sciences.

TITLE-ABS-KEY (("competitive strategy" OR "generic strategy" OR "cost leadership" OR "differentiation strategy" OR "resource based view" OR "dynamic capabilities") AND (design OR "digital platform" OR "platform ecosystem" OR "user experience")) AND

PUBYEAR > 2014 AND PUBYEAR < 2026 AND (LIMIT-TO (SUBJAREA, "BUSI") OR LIMIT-TO (SUBJAREA, "ECON") OR LIMIT-TO (SUBJAREA, "SOCI")) AND (LIMIT-TO (DOCTYPE, "ar")).

Appendix B. R Packages Used in the Analysis

All analyses in this study were conducted using the R statistical computing environment. The analytical pipeline included data preprocessing, text mining, topic modeling, keyword network construction, clustering analysis, and graphical visualization. To ensure transparency and reproducibility, the main R packages used throughout the analysis are listed below.

- Data manipulation and processing

The following packages were used for data cleaning, transformation, and manipulation of the bibliographic dataset: readr (v. 2.2.0), dplyr (v. 1.2.1), stringr (v. 1.6.0), tidyr (v. 1.3.2), purrr (v. 1.2.2), tibble (v. 3.3.1).

- Text mining and natural language processing

Text preprocessing, tokenization, stopword removal, lemmatization, and document-term matrix construction were performed using: tidytext (v. 0.4.3), textstem (v. 0.1.4), tm (v. 0.7-18), SnowballC (v. 0.7.1), slam (v. 0.1-55).

- Topic modeling

LDA modeling and topic probability estimation were implemented using: topicmodels (v. 0.2-17).

Topic coherence evaluation and additional topic quality diagnostics were conducted using: textmineR (v. 3.0.6).

- Network analysis and clustering

Keyword co-occurrence networks, cosine similarity matrices, and community detection analyses were performed using: igraph (v. 2.3.2), proxy (v. 0.4-29), cluster (v. 2.1.8.2).

The Louvain community detection algorithm was used to identify thematic clusters in the keyword network.

- Visualization

All figures and graphical outputs presented in the study were produced using: ggplot2 (v. 4.0.3), ggrepel (v. 0.9.8), ggalluvial (v. 0.12.6), scales (v. 1.4.0), forcats (v. 1.0.1).

These packages enabled the visualization of publication trends, keyword frequencies, topic evolution, keyword co-occurrence networks, thematic maps, and emerging keyword dynamics.

Appendix C. Robustness and Sensitivity Analyses

Table ?? reports network characteristics obtained under alternative cosine similarity thresholds. Lower thresholds generated highly dense networks containing numerous weak semantic connections, whereas higher thresholds produced increasingly fragmented structures. The threshold value of 0.62 preserved a fully connected network without isolated topics while substantially reducing network density, thereby providing a balanced and interpretable representation of conceptual relationships among topics.

Table A1. Sensitivity Analysis of Topic Similarity Networks Across Alternative Cosine Thresholds.

Threshold	Nodes	Edges	Density	Components	Large Components Size	Isolated Nodes
0.50	8	27	0.964	1	8	0
0.55	8	20	0.714	1	8	0
0.60	8	18	0.643	1	8	0
0.62	8	15	0.536	1	8	0
0.65	8	10	0.357	1	8	0
0.70	8	4	0.143	5	5	3

Table ?? summarizes the principal preprocessing decisions and model configuration adopted prior to topic modeling. The reported settings correspond to the workflow implemented in the R environment and are provided to enhance methodological transparency and facilitate the reproducibility of the computational literature review.

Table A2. Text preprocessing and LDA configuration.

Parameter	Setting
Text representation	Unigrams
Bigrams	Used only for descriptive analysis
Lowercasing	Yes
Stop-word removal	Yes
Custom stop-words	Yes
Lemmatization	Yes
Minimum token length	3
Sparse threshold	0.99
Empty documents removed	Yes
Random seed	123
Topic selection	Statistical diagnostics + semantic interpretability

Table A3. Comparison of candidate LDA topic solutions (k = 6 vs. k = 8).

Criterion	k = 6	k = 8
Log-likelihood	−317,432	−327,127
Perplexity	432	519
Mean UMass coherence	−1.300	−0.863
Thematic granularity	Moderate	High
Topic interpretability	Moderate	High
Final selection	X	✓

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