Synergizing Pathways in the Digital Economy: Empowering Network Competitiveness through Technological Convergence

Elio Shijaku
Universittat de Barcelona
Department of Business
Av. Diagonal 690
08034 Barcelona, Spain

Nathalie Marcela Cerón Hurtado
Universitat Autonoma de Barcelona
Department of Physics
Carretera de Bellaterra a l'Autònoma, Edifici C, 08193
Cerdanyola del Vallès, Barcelona, Spain

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Abstract

This study extends Competition Network Theory (CNT) by positioning technological convergence as an endogenous driver of network competitiveness in the digital economy. Whereas extant research has emphasized firm-level differentiation (divergence) or considered technology as exogenous, we focus on the comparatively understudied process of convergence in reshaping ties and competitive behavior. Our conceptual framework identifies node- and edge-based mechanisms, including periphery–core migration, multiplexity, collaborative synergies, and structural brokerage, that explain how convergence enhances market commonality, resource similarity, and perceived rivalry. From this, we develop a set of propositions linking convergence to network competitiveness through node–edge interactions and resource integration. The framework advances extant research by situating convergence-driven CNT within broader strategy debates and highlighting the relational value of technological assets in dynamic networks. It also provides managers with guidance on how to utilize brokerage positions, build shared platforms and standards, and strike a balance between cooperation and competition to succeed in technologically convergent ecosystems.

Keywords: technological convergence, network structure, network dynamics, network competitiveness, relational mechanisms, network mechanisms, competition network theory.

Introduction

The current digital economy has undergone rapid changes with the emergence of new technologies (e.g., AI, blockchain, IoT). This wave of digitization has created increasingly dynamic interorganizational networks (Dyer & Singh, 1998; Gulati et al., 2000), fostering growth, collaboration, sharing, and building competitive advantage between firms (Gawer & Cusumano, 2014; Ritala & Hurmelinna-Laukkanen, 2009). However, such digitalization has also presented challenges for firms in building and maintaining a competitive advantage in these networks, with technology playing a crucial role in this process.

These developments suggest that competitive advantage in the current digital economy cannot be explained solely by traditional firm-specific constructs; instead, it should adopt a broader, network-based view. Such a task is related to the central issue of how firms create and maintain a competitive advantage that is not just firm-focused, but also utilizes ecosystem and network logics. Although early theoretical lenses such as the resource-based view (Barney, 1991) and dynamic capabilities (Teece, 2007) describe firm-specific strengths, they do not fully explain how technology reshapes structures and relationships across networks.

Extant research further reinforces this theoretical shortcoming, focusing on technological divergence, defined as the use of proprietary innovation to block entry and keep differentiation (e.g., Christensen, 1997; Tripsas, 1997). This dominant view, focused on how firms protect their value, is central to analyzing specific firm-level competitive capabilities. However, it risks underestimating the growing network ties and blurred boundaries that characterize the digital economy across industries.

In contrast to this focus on divergence, technological convergence, defined as the process where different technologies come together into one market (Borés et al., 2003; Harianto & Pennings, 1994), requires particular attention, mainly because dynamic networks operate as key facilitators of partnerships like strategic alliances, buyer-supplier relationships, and coopetitive engagements (Baum et al., 2000; Hsieh & Vermeulen, 2014). This type of convergence alters how firms (nodes) and their ties (edges) interact with one another, continually reshaping networks within and across industries. (Hertz & Mattsson, 2004).

In the digital economy, firms must balance technological divergence with technological convergence, that is, maintaining unique capabilities to stand out while also joining broader platforms to grow (Tushman & O'Reilly, 1996; Gawer & Cusumano, 2014). This strategic duality is central to network competitiveness: divergence enables firms to capture unique value and maintain differentiation (Tripsas, 1997), while convergence enables the building of shared platforms, ecosystem integration, and scale advantages (Yoo et al., 2010). Most firms do both at the same time, using convergence to connect and grow, but keeping divergence to protect their own position and profits (Wareham et al., 2014). Understanding this balance is crucial to explaining how competitive networks are formed and utilized in digitally enabled markets.

However, although both processes are critical, we focus mainly on technological convergence because, while divergence has been widely theorized as a source of proprietary advantage and differentiation (Christensen, 1997; Tripsas, 1997), the network-level, relational, and dynamic effects of convergence are much less explored. Specifically, we lack sufficient understanding of how technological convergence directly shapes network structures at both the node and edge levels, leaving the technological processes within networks under-theorized (Rowley et al., 2000).

Building on this observation, it is understandable that, despite the growing importance of technological convergence in dynamic networks, much of the existing research on network competitiveness continues to focus on static structures or resource-based competition. Most of these studies treat technology as a background factor rather than as a relational and structural driver of network competitiveness, which is the central gap we address. For example, studies of innovation networks (e.g., Powell et al., 1996) and alliance portfolios (e.g., Lavie, 2007) emphasize firm capabilities and structural positioning, but do not explain how convergence-driven technological platforms alter the nature of these ties. Similarly, knowledge transfer models in networks (e.g., Hansen, 1999) view relationships as simple conduits, rather than as dynamic outcomes of evolving technologies. Thus, while various scholarly works have examined aspects of network competition or digital transformation, a clear theory of how technological convergence, as an internal network mechanism, reshapes firm relationships at the node and edge levels to improve network competitiveness is still missing.

These gaps raise the following question: How does technological convergence reshape the structure and dynamics of networks, and why does network competitiveness matter in the digital economy? To answer this question, we use Competition Network Theory (CNT; Lavie, 2021), which goes past firm- and industry-level views in other network theories and instead looks at structure and how firms (nodes) interact, with a clear focus on competition (Chen, 1996; Kilduff et al., 2010). However, Lavie's work on CNT primarily examines firm-level competitive outcomes and has not fully acknowledged how technological convergence, as a combined process, affects network competitiveness.

We argue that convergence has a significant impact on key aspects that lead to network competitiveness, including the utilization of technology-based capacities, information, and capabilities, and, by extension, competitive dynamics (i.e., market commonality, resource similarity, and perceived rivalry) among participating firms (Knudsen et al., 2021). Unlike traditional concepts of tie strength (Granovetter, 1973), structural holes (Burt, 1992), or information flows (Tsai, 2001), our model sees edges as active points of technological convergence, where platforms, modular interfaces, and shared standards work as conduits of system-wide advantage, rather than only channels of knowledge or access.

Our study contributes to strategic management by linking network and technology literatures, extending CNT's structural focus to include dynamic, technology-driven reconfiguration of ties, and offering a framework that clarifies how convergence-driven synergies build competitiveness at the network level (Lavie, 2021). Theoretically, we introduce several node- and edge-based mechanisms (e.g., brokerage and multiplexity) that achieve convergence-based network competitiveness. We develop a process model that connects technological convergence with proxies for network competitiveness, thereby advancing our understanding of how digitally enabled networks develop.

In practice, we guide managers on how firms can form alliances on shared technology platforms, agree on standards across firms, and utilize flexible governance to manage interdependencies arising from convergence. These steps help managers adjust their network positions and create value together in fast-changing digital markets.

The remaining parts of this study discuss the theoretical foundations of CNT, explain our conceptual framework by integrating technological convergence, and conclude with a discussion of our contributions, limitations, and future research directions.

Theoretical Foundations

Despite its strategic significance, extant research has thus far addressed technological contributions indirectly. Key concepts, such as structural holes (Burt, 1992), commonality and market and resource similarity (Chen, 1996), and social capital (Nahapiet & Ghoshal, 2009), focus on structural position and relational assets, but tend to handle technology as exogenous or context-based. Furthermore, traditional models such as the industry-based or resource-based view are less applicable to today's digital economy because they fail to reflect the revolutionary changes brought about by technological convergence.

A growing literature has begun to examine how technology organizes ecosystems, platforms, and network externalities (Gawer & Cusumano, 2014; Karhu et al., 2024). These explanations, however, concentrate primarily on actor positions, complementarities, or effects at the outcome level, rather than on the relational processes through which technological convergence reconfigures interfirm competition. Technological convergence, as understood here as the unification of previously distinct technological domains in shared platforms or infrastructures (Borés et al., 2003; Rindova & Yeow, 2024), is noticeably absent from theories of network competitiveness. Furthermore, one of the principal challenges of competitive networks today is navigating both technological convergence and divergence simultaneously (Gawer & Cusumano, 2014). Firms utilize divergence (such as unique innovations or specialized skills) to stand out, but they also strive for convergence (like shared platforms or common standards) to scale up, expand into more markets, and connect with digital ecosystems. Hence, the management of duality is not accidental but intentional, as firms must preserve differentiated competencies while accessing scale and ecosystem advantages predicated on convergence.

This sets a delicate balance: convergence provides a common platform for network integration and increased competitive space, while divergence allows the capture of unique value (Eisenhardt & Sull, 2001; Tushman & O'Reilly III, 1996). This dynamic coexistence has an immediate impact on edge structure and dynamics. For instance, strong convergent edges can facilitate new cooperative connections, while divergent edges can create competitive boundaries; firms must handle the two strategically to gain maximum competitive foothold within the network.

Based on these observations, a central theoretical gap is that while the phenomenon of technological convergence is increasingly recognized, prevailing research has generally overlooked its relational-level dynamic interaction. Despite the growing importance of technological convergence in dynamic networks, the existing literature on network competitiveness primarily focuses on either static network structures or resource competition. For example, past studies have examined competition and strategy through concepts such as structural holes (e.g., Burt, 1992; Skilton & Bernardes, 2015; Thatchenkery & Katila, 2021) or rival behaviors between pairs of firms (e.g., Chen, 1996; Hsieh & Vermeulen, 2014). However, in these works, technology is mainly treated as exogenous or not included at all when explaining how convergence shapes networks.

Most of these studies treat technology as a backdrop, rather than a relational and structural driver of network competitiveness, which is the central gap we address. Likewise, initial work on competitive dynamics and competitor analysis (e.g., Chen, 1996) established the foundation with constructs such as market commonality and resource similarity; however, it did not address how accelerated technological convergence reshapes these competitive arenas at a rapid pace. Studies on dyadic competition (e.g., Hsieh & Vermeulen, 2014) or structural hole outcomes (e.g., Burt, 1992; Skilton & Bernardes, 2015; Thatchenkery & Katila, 2021) have looked at network competitiveness, but they mostly start from static structures or outside classifications, not from convergence as a mechanism that creates new interactions or redraws boundaries.

It is here that Competition Network Theory (hereinafter referred to as CNT) offers the latest theoretical approach for understanding how competitors coexist within networks. CNT focuses on the structure and dynamics of networks, specifically how interorganizational ties are formed, which in turn drive innovation, adaptation, and competitiveness (Lavie, 2021). Unlike earlier network-based theories, such as Social Capital (Nahapiet & Ghoshal, 2009) or Social Networks (Parkhe et al., 2006), CNT takes a different view by prioritizing competition over cooperation and resource accumulation (Kilduff & Brass, 2010). It highlights that when networks strengthen, firms increasingly rely on the relational side of networks to establish their competitive advantage (Lavie, 2021).

Even CNT, however, primarily examines static structures and firm results, without fully illustrating how convergence alters ties at the edge or drives real-time redesign. Koch and Windsperger (2017) also discuss a "network-centric view," but focus on the broad digital environment rather than on how convergence works at the node and edge levels to reshape relations. Similarly, older ideas such as stable social ties (Granovetter, 1973; Uzzi, 1996) or one-way knowledge flows (Ahuja, 2000a) overlook the dynamic, technology-driven synergies that we emphasize, where multiplex ties and tech-enabled brokerage reconfigure relationships and drive competitive advantage.

Our framework departs from these prior constructs by theorizing how convergence-driven edges serve as emergent, co-created mechanisms that fuse technological domains, reshape rivalry, and produce competitive advantages unavailable through static ties or unidirectional knowledge flows. By explicitly theorizing convergence as an endogenous network mechanism, our model therefore fills this gap and expands CNT by exploring how technology operates as a relational capability, transforming both node and edge dynamics into sources of network-level competitive advantage.

Nodes are the basic building blocks of network growth, since their different technologies and skills create new flows of information (Bohlmann et al., 2010). Nodes that are active in broad, connected, and dynamic networks become central because they can accumulate social capital and resources from these networks (Baum & Korn, 1996; Hernandez & Menon, 2021; Wu et al., 2024). Nevertheless, market reconfiguration and competitive repositioning of nodes are consequences of technological convergence, especially in digital networks, accelerating their dynamics (Soda et al., 2019), an aspect that CNT fails to discuss. Thus, nodes must leverage their structural position in the network to integrate such technology into their value chain.

Edges are the ties between the nodes, inducing cohesion and enabling cooperation among network members (Borés et al., 2003; Gulati et al., 2011). Nevertheless, our understanding of edges, particularly technological convergence, diverges quite dramatically from and expands upon what has traditionally been understood as relational constructs. Traditional social network theory tends to theorize ties as stable social relations that facilitate information exchange or access to resources (e.g., Granovetter, 1973; Uzzi, 1996), whereas innovation networks tend to theorize knowledge flows as unidirectional flows between organizations (e.g., Ahuja, 2000a). In contrast, our edge synergies are emergent, dynamic, and often co-produced interactions that arise directly from the confluence of unique technologies between entities within a network. For example, edge properties such as multiplexity (maintaining more than one competitive and cooperative relationship simultaneously) or technology-based brokerage (spanning previously differentiated technological areas across the edge) are not merely conduits for static information or earlier knowledge.

Edges are helpful in highlighting the dynamic context of networks compared to the 'static (snapshot)' view traditionally served by network-based research. Consequently, the effectiveness of nodes in mastering technological convergence in digital networks depends on the quality, requirements, multiplexity, and dynamics of these edges (Chung et al., 2000; Kossinets & Watts, 2006), another aspect that CNT does not fully discuss.

In this vein, one question that existing research has yet to address is whether the paths through which network configurations, nodes, and edges enable technological convergence can be conceptually analyzed. We address this question by building on the foundational premises of CNT and proposing a conceptual model that brings technological convergence back into the competition discussion (see Table 1 for a detailed comparison). We posit that the node-edge tandem drives technological convergence, affecting network competitiveness (i.e., market commonality, resource similarity, perceived rivalry).

--- Insert Table 1 about here ---

Conceptual Framework

To further our understanding of how network competitiveness emerges from node-edge interactions, we first examine the role of network structure in driving technological convergence by linking it to node and edge properties. Consequently, we examine the role of network dynamics in driving network competitiveness through node- and edge-based interactions (see Figure 1 for an overview).

--- Insert Figure 1 about here ---

Node competitive properties and technological convergence

Nodes are responsible for technological convergence by providing heterogeneous technical expertise and experience (Nambisan & Sawhney, 2011; Pittaway et al., 2004). These skills are combined to enable them to form edges at a quicker pace and acquire technology from the network, hence establishing the foundation of technological convergence (Dyer & Singh, 1998; Gulati et al., 2000). Once edges between nodes have been formed, the network itself becomes a competitive ground where nodes compete to reap the maximum advantage from the adoption of technology and tap into digital potential (Iorio, 2022; Tanriverdi & Lee, 2008). In this paper, we treat firms as network nodes and their ties as edges; thus, for the remainder of the paper, when we refer to nodes and edges, we are explicitly referring to firms and their respective ties within the network.

When nodes connect and share information, they amplify technological convergence, resulting in increased potential for innovation (Ingram & Roberts, 2000). A network effect occurs when each node's innovation contributes, such that the whole network generates more value than the sum of any single node's contribution (Granovetter, 1973; Uzzi, 1996). When nodes share markets, resources, and even rivals, they are pushed to form new ties in the network. These ties help them learn about other nodes while strengthening and converging the network as a whole (Chen et al., 2007). To stay competitive, nodes must continually innovate, which strengthens their network position and enhances their ability to counter rival nodes (Kamalaldin et al., 2021)—at the same time, increased competition forces nodes to adapt and redefine themselves in dynamic networks. Paradoxically, while innovation is crucial, conformity can also be strategic: nodes develop shared technology platforms that allow them to expand across the network into other industries.

Advanced cryptography in blockchain, machine learning algorithms for AI, and data mining methods for advanced analytics are among the most recent technological advancements in the digital economy, showcasing how nodes leverage technological convergence not only for innovation but also for shaping competition and industry structures. (Cavusoglu et al., 2019; Lumineau et al., 2021; Simsek et al., 2019). Convergence occurs when nodes combine different technologies to create new solutions. To keep pace, nodes often rush to align these capabilities, resulting in a degree of resource similarity (Volberda et al., 2021). This process enables some nodes to assume leadership roles within the network.

Central players are especially influential: they establish industry standards and encourage others to adopt them in order to remain competitive, which in turn heightens the sense of rivalry (Hoberg & Phillips, 2016; Kilduff & Brass, 2010). Central players gain these positions by mastering key technologies that set standards and guide the pace of convergence. As nodes compare their technological progress, rivalry intensifies, driving networks toward greater convergence and increased innovation. This dominance emerges from the heterogeneous technological attributes distributed across nodes, which create the variation that gives rise to leadership positions.

Such leadership dynamics directly shape how nodes position themselves competitively, as technological rivalry becomes a central driver of convergence across networks. Nodes that possess advanced technology can position themselves in the network to set industry standards and shape new technological trends (Ahuja, 2000a; Zaheer & Bell, 2005). For nodes to stay ahead of the technological curve, they must persist in innovating and maintaining market dominance by fostering market commonality, resource similarity, and perceived rivalry as key drivers of their competitive network positioning. As convergence deepens, nodes increasingly measure themselves against rivals based on their technological trajectories. This technological rivalry, which is a competition over whose technologies become dominant, intensifies network-wide convergence pressures and accelerates cycles of innovation. Rivalry thus acts as a driver of convergence, as nodes are compelled to align with or respond to dominant technological trajectories.

For example, NVIDIA shows technological convergence in its progress with AI computing, deep learning, autonomous vehicles, and data center systems (Bresciani et al., 2021; Jeon et al., 2021). Convergence has helped NVIDIA strengthen its own advantage while also influencing the direction and behavior of competitors (McGahan & Porter, 1997). The convergence enhances NVIDIA's products (GPUs) through the convergence of technologies, pushing NVIDIA's buyer-supplier network towards digitalization and enhancing its perceived competitive advantage. With its superior technological position, NVIDIA forces other players in the industry to innovate or become irrelevant. This is an example of perceived rivalry, where nodes must continuously adapt their strategies to keep pace with dominant rivals. Here, competition matters, as nodes like NVIDIA compete for technological solutions within the network while simultaneously striving to achieve resource similarity and expand their market commonality (Gnyawali et al., 2006). Given the above arguments, we posit the following:

Proposition 1 (P1): *The degree of technological convergence increases with greater heterogeneity in node-based technological attributes (i.e., dominant technology and technological rivalry).*

Edge competitive properties and technological convergence

A node-level view, such as the heterogeneity of technological attributes, cannot, by itself, explain convergence at the network level. It is the ties and interactions between nodes that combine different technologies and innovations, forming the basis for edge-based synergies that raise innovation chances (Ahuja, 2000a; Hernandez & Shaver, 2019). These synergies deliver more than the sum of each node's efforts, driving convergence more widely and deeply by pooling diverse skills and knowledge (Baum et al., 2000; Gulati et al., 2011). They also strengthen the network's ability to create value and support co-innovation (Altman et al., 2022).

In this vein, the digital economy exemplifies a technological shift that requires collective innovation on a scale and complexity not previously seen (Volberda et al., 2021).

For example, blockchain technology was utilized when Pfizer and Moderna collaborated to facilitate the distribution of their COVID-19 vaccines. This strategic alliance benefited from multimarket contact, resulting in the creation of a robust supply chain management network that met the technical requirements for temperature-controlled vaccine distribution (Musamih et al., 2021). In this scenario, multimarket contact, or firm interaction across different markets, played a crucial role in promoting technological convergence, as both firms had an easier time accessing knowledge across various industries and thereby hastening technological convergence in multiple domains.

One of the primary strategic advantages of edge-based collaborative synergies is face-to-face communication on the dyadic level, in which any two nodes develop intense, long-lasting associations (Kilduff et al., 2010; Uzzi, 1996). The dyadic interplay requires nodes to balance rivalry and cooperation, especially in cases of perceived rivalry. We use the term 'collaborative synergies' here to signal the value created at the edges through cooperation, while emphasizing that these are distinct from traditional collaborative or transactional constructs, as convergence often blurs the lines between cooperation and rivalry.

The level of synergies achieved from such dyadic interaction depends on the balance of strength between the nodes involved, as well as the diverse multimarket perspectives they each contribute (Ferrier et al., 1999; Gimeno, 2004). These factors drive technological convergence, allowing nodes to share benefits and produce more innovation. In particular, strength equality, where connected nodes have a balanced level of influence, resources, and capabilities, is important, as balanced edges enable nodes to combine complementary strengths.

Edge-based collaborative synergies enable networks to project emerging technology trends and guide innovation within industries (Rothaermel, 2001; Sjödin et al., 2024). Given the rapid and dynamic nature of digital transformation, neither R&D nor acquiring new technology is sufficient for nodes to maintain or enhance their network competitiveness. In this vein, networks should be established that support the process of combining different technologies to develop unique resources and capabilities, leveraging strength equality and multimarket contact to maximize the impact of these collaborations (McEvily et al., 2004; Welch & Nayak, 1992).

The dynamic interaction between collaboration and technological convergence highlights the strategic value of edge-based properties in driving network competitiveness (Duysters et al., 2020). Specifically, the degree of technological convergence is the highest when edges are characterized by larger-scale collaborative synergies between the nodes, especially those with strength equality and multimarket contact. This leads to our following proposition:

Proposition 2 (P2): *The degree of technological convergence increases with greater edge-based collaborative synergies (i.e., strength equality, multimarket contact).*

Node-based dynamics and network competitiveness

The speed at which networks evolve is primarily the result of nodes changing their positions within the network. Technological convergence underpins the relocation of nodes from the periphery to the center, enabling them to enhance their position in the network and connect to competitive clusters. Technological convergence triggers these dynamics by shifting the functionality and ability of the network, thereby optimizing knowledge flows (Lipparini et al., 2014).

Peripheral nodes are quick to integrate and apply the latest technological competencies as technological convergence erodes the traditional barriers across industries and knowledge domains (Guan & Zhao, 2013). Through strategic positioning, these peripheral nodes increasingly become influential in the network, gaining greater access to essential resources and interconnections. By breaking established routines and introducing new technologies, they obtain a perceived competitive advantage. As their competitiveness increases, these nodes eventually find their way to the network core, supported by their unique knowledge bases and capabilities (Eder, 2019). Nodes that enhance their market commonality by overlapping technological domains with network competitors increase their chances for potential collaboration, aiding their migration from the periphery to the core of the network. This transition encompasses not only repositioning but also substantial transformations in the ways nodes and networks relate to one another (Dencker et al., 2023). Competitive embeddedness is a significant mechanism driving this process, as nodes consolidate their relationships within the network and engage in strategic alliances, leading them to drift towards the market core.

As nodes move closer to the core, they perform essential functions that benefit network competitiveness, stimulate innovation, facilitate information dissemination, and engage in collaborative initiatives (Dhanaraj & Parkhe, 2006). This migration enables new nodes to become leaders in the network, contributing to its flexibility and thereby increasing its innovation potential (Müller-Seitz, 2012). By positioning and embedding themselves strategically within competitive networks, migrating nodes leverage technological convergence to access new markets and opportunities (Collinson & Gregson, 2003). By reducing the distance to the core, migrating nodes enhance opportunities for cooperative interactions, resource sharing, and resource similarity, thereby gaining a shared presence in key markets while also mitigating perceived rivalry, which allows them to be among the leading nodes that drive industry changes (Madhavan et al., 2004).

These enhanced connections at the network's center intensify the integration and convergence of diverse technologies, making the network more innovative and responsive to market demands (Garud et al., 2013). Such associations between node migration and technological convergence enhance network competitiveness, as nodes improve their structural position, resulting in increased market footholds and a greater scope for innovative partnerships (Lu et al., 2017). Ultimately, nodes that achieve a strategic network position are better placed to leverage the benefits brought by technological convergence, thereby enhancing their long-term market positions. In this vein, network competitiveness becomes more visible as peripheral nodes move towards the core, gaining a competitive advantage and status within the network (Khanagha et al., 2022).

A good example of peripheral-to-core migration is Shopify, which, in its early years, had to look up to Amazon and eBay as the incumbents of the e-commerce network. Through technological convergence, which enhanced its network position, Shopify strategically placed itself in this ecosystem, making strategic alliances and leveraging new market opportunities.

With the synchronization of cloud computing infrastructure, mobile commerce systems, and social media integration, Shopify, originating as a business serving SMEs on the fringes, expanded globally. It became one of the dominant providers in the global online commerce market by developing its technological commonality with top technology firms (Dushnitsky & Stroube, 2021). This transformation illustrates how networks evolve, as nodes that utilize emerging technologies and possess a strong reputation are more likely to become central actors in the network, thereby increasing their resource similarity and perceived rivalry (Durugbo, 2016). The migration of nodes from the periphery to the core thus acts as a key mechanism linking technological convergence with network competitiveness. This leads us to the following proposition:

Proposition 3 (P3): *The degree of network competitiveness increases with greater node-based periphery-core migration enabled by technological convergence.*

Technological convergence strengthens network structure, especially node-based brokerage, and boosts competitiveness (Burt & Soda, 2021; Choi et al., 2022). Brokers link previously separate nodes, enabling information, resources, and innovation to flow freely. Convergence enables nodes to assume critical positions and close competitive gaps. As it grows, brokers can enhance market commonality by partnering with major players, thereby increasing their influence and connectivity within the network (Soda et al., 2021). Structural brokerage, driven by technological convergence, goes far beyond the typical advantages offered by this position (Stuart, 1998). In addition to acting as a dynamic capability (Burt & Soda, 2021), brokerage can link nodes with other parts of the network, enhancing market commonality through converging technologies, creating new access to resources, and fostering the potential for new tie formation and innovation.

Market leadership enables brokers to shape market patterns, industry practices, and even the pace of technological convergence across industries (Soda et al., 2021). Convergence also enhances resource similarity by assigning nodes stronger brokerage roles and providing them with technological features that facilitate the bridging of gaps between industries and knowledge fields (Kwon et al., 2020). Structural brokers further support resource similarity by driving technological standardization, aligning processes and capabilities across network members, and ensuring resources are used efficiently (Gulati, 1999).

A classic example is Google, whose function has evolved beyond its initial scope and transformed from a structural broker into a structural consolidator through its Android Auto platform. Google has expanded its market reach through strategic partnerships with app developers and car manufacturers. Google has successfully positioned itself as a central orchestrator in the automotive industry through strategic positioning, enabling the adoption of technology and fostering collaboration among stakeholders (Pushpananthan & Elmquist, 2022). Using Android Auto, car manufacturers can enhance the digital connection and improve the user experience in vehicles, while developers can create applications that are compatible with automotive technologies. The combination of different technologies, with the help of Android Auto, has accelerated automation by opening up new avenues for software functions.
This innovation has reshaped the automotive industry, introducing new models of programmability, modularity, connectivity, and data utilization (Hind et al., 2022). The case illustrates how nodes acting as brokers utilize technological convergence to enter new markets and shape industry standards.

Technological convergence enables network nodes to act as structural brokers, enhancing the innovative recycling of resources, whereas competitive bridging enables nodes to reach key stakeholders and tap into new sources of value. This strengthens their role as competitors and lets them influence important market trends (Zaheer & Bell, 2005). Networks that utilize technological convergence systematically can also accelerate resource sharing and shorten innovation cycles, which supports sustainability for both nodes and the network (Hacklin et al., 2009). Together, structural brokerage and convergence turn nodes from passive actors into central drivers of innovation, boosting overall network competitiveness. Based on this, we propose the following:

Proposition 4 (P4): *The degree of network competitiveness increases with greater node-based structural brokerage enabled by technological convergence.*

Edge-based competitive dynamics and network competitiveness

Technological convergence enhances the efficiency of networks by concentrating resources at the edge, allowing nodes to expand their reach into overlapping markets and thereby stimulate both cooperative and competitive behavior within the network (Shijaku & Ritala, 2023). The optimal allocation and utilization of capabilities are directly influenced by technological convergence, which enhances a firm's ability to integrate different technological resources through resource integration. This encourages new market entry and, consequently, the increment in their market commonality. Convergence in technology also leads to resource similarity by aligning corresponding technological abilities, enabling nodes to have similar technological capabilities and thus enhancing operating efficiency and accelerating the diffusion of innovation.

Edge-based resource integration stimulates more resilient and enduring edges among nodes, which in turn accelerates network centralization and resource integration—critical factors in increasing market commonality and resource similarity (Sirmon et al., 2010). By leveraging resource integration, nodes drive technological convergence, achieving resource similarity, which enhances their market positions and long-term competitiveness. Therefore, perceived competition increases because it enables them to participate and influence market dynamics via edge connectivity (Akerlof et al., 2024). Such nodes can rise as industry leaders through innovation and can adapt more easily to market shifts and new technologies.

For example, Microsoft Azure and GE's Predix worked together to integrate cloud computing with industrial IoT (Khanagha et al., 2022). Predix, GE's IoT platform, gathers and analyzes industrial data to improve reliability and efficiency. By integrating Predix with Azure cloud computing services, big data analytics, and AI technologies, GE has expanded its market reach while also strengthening its dominance through substantial real-time data exchanges, thereby enhancing performance data across relevant sectors (Steiber et al., 2021).

Furthermore, through competitive resourcing, nodes can leverage shared technological capabilities to address perceived rivalry, positioning themselves strategically to differentiate their offerings while simultaneously expanding their technological influence. Similarly, resourcing competition enables nodes to strategically position and deploy resources within interconnected fields, capitalizing on emerging technological potentials and maintaining their competitive advantage (Zahra & Nambisan, 2012). Convergence resulting from the combination of cloud, IoT, and AI resources enhances the competitiveness of actors within a network by facilitating both their strategic positioning and their capacity for long-term innovation (Tanriverdi & Lee, 2008).

The coordinated clustering of resources located in the peripheries enhances the competitiveness of the whole network. This enhances the network's capacity to adapt to changes in consumer preferences and technological advancements (Shipilov & Li, 2008). Furthermore, networks that effectively exploit technological convergence can accelerate the flow of critical resources and innovation cycles, ensuring competitiveness at both the network and node levels (Hacklin et al., 2009). Therefore, edge-based resource integration is a key driver of network competitiveness. Given the above, we propose the following:

Proposition 5 (P5): *The degree of network competitiveness increases with greater edge-based resource integration enabled by technological convergence.*

Multiplexity refers to the presence of multiple types of edges among network nodes (Ertug et al., 2023; Ferriani et al., 2013). Contractual ties between different nodes, such as strategic alliances, are the most common type of edges in interorganizational networks. They are, nevertheless, one among numerous ways by which the nodes interact with each other within the network (e.g., memorandum of understanding, board interlocks) (Novoselova, 2022). The convergence of technologies is one of the primary drivers of multiplex edges, enabling nodes to create diverse types of edges across industries and technological domains, thereby gaining increased access to high-quality network resources. In this sense, edges indicate both proximal and distal strategic multiplexity, through which nodes, directly and indirectly, search for resources and knowledge within and across the networks (Shipilov, 2012).

Technological convergence influences edge-based strategic multiplexity by broadening the scope and efficiency of resource sharing, and fostering market commonality, which, in turn, makes more resources available by establishing different technological platforms and standards (Rietveld & Schilling, 2021). When technological convergence facilitates diversification at the edge, it can also create a perceived sense of competition. This occurs as nodes form ties that enhance their competitive strength through new market opportunities and by achieving synergies across different industries. Furthermore, resource similarity facilitates edge multiplexity by aligning nodes' technological capabilities through standardized interfaces, standard operational practices, and interoperable digital infrastructures (Hurmelinna-Laukkanen et al., 2022).

Strategic multiplexity leads to improved resource mobilization and enhanced adaptability to rapidly changing market circumstances and, crucially, the emergence of collaborative innovation (Capaldo, 2014). Nodes enhance their market commonality until sustainability, rendering them powerful market influencers. They can even continue to progress in resource similarity and increase their exposure by capitalizing on their new technology procurement, as discussed by McIntyre et al. (2021).

One instance where technological convergence is successfully applied is in the transportation industry, specifically with the blockchain-based TradeLens platform developed jointly by IBM and Maersk (Ahmed & Rios, 2022). On this platform, IoT sensors are utilized to provide tracking information for the shipping process by collecting real-time data on goods, thereby expanding the market reach of IBM and Maersk while also reinforcing resource similarity by offering standardized data-sharing practices (Slot et al., 2020).

With this in mind, edge-based multiplexity through technological convergence is crucial for enhancing network competitiveness. Nodes can amplify their influence and accrue a strategic advantage over competitors by maximizing their competitive positioning in the network through the diversification of edges (Wang & Gao, 2021). Such an approach enables nodes to increase the overall competitiveness of the network, concentrate influence within the strategic structural sections of the network, and enhance their presence in those areas. In essence, the node's capacity to promote technological innovation and adoption within the broader network ecosystem is bolstered by the interaction between competitive positioning and edge diversification. Based on the aforementioned arguments, we put forth the following proposal:

Proposition 6 (P6): *The degree of network competitiveness increases with greater edge-based strategic multiplexity enabled by technological convergence.*

Discussion

Overall, our framework and propositions highlight the pivotal role of technological convergence in driving network competitiveness by integrating the structural aspects of network structure with dynamic node- and edge-based outcomes (see Table 2).

--- Insert Table 2 about here ---

Extant research on networks has deepened our understanding of how technology influences outcomes at the node level, including innovation, performance, and relationships. Past studies have examined node position, brokerage, and multiplexity in detail (Ferriani et al., 2013; Shipilov, 2012). However, the rapid proliferation of digital platforms has transformed traditional network architectures, with the consequence that nodes have to alter their strategic positions to compete. The rise of emerging technologies, along with the new features offered by the current digital economy, has led to a fundamental shift in the current dynamics and opened up new opportunities for nodes to gain competitive advantages from the evolving network structure (Anacka & Lechman, 2023).

In this regard, technological convergence is pivotal as it enables node migration in the network and thereby reshapes competition by influencing their competitive positioning and embeddedness (Vasudeva et al., 2013). Although firms should balance technological convergence and divergence to preserve differentiation, divergence has already been extensively theorized as a source of proprietary advantage. By contrast, the relational and network-level effects of convergence remain underexplored, which is why our model centers on convergence as the primary mechanism shaping network competitiveness.

At the node level, technological heterogeneity promotes mutual learning by filling the information asymmetry gap and providing a conducive environment for innovation (Phelps et al., 2012). Nodes that fully utilize technological convergence can enhance their network positioning by leveraging major technologies and gain a perceived competitive advantage as a result of strengthening their position within the network. This diversification is essential, as it enables the node to leverage emerging technologies. Existing literature stresses that even those nodes that achieve technological leadership must continue to develop their capabilities. Such continuous development is necessary for them to sustain their competitive advantage in the present ever-complex digital landscape (Ganco et al., 2020). Furthermore, the growing convergence of technological capabilities among nodes is a sign of innovation and growth in a network, which, in turn, promotes network competitiveness in the form of market commonality (i.e., the shared presence of various industries), resource similarity (i.e., the alignment of technological resources and competencies) and perceived rivalry (i.e., the awareness and recognition by a firm of another firm as a competitor, regardless of whether the rivalry is reciprocated) (Lavie, 2021; Shijaku & Ritala, 2023).

Networks should enable their nodes to quickly integrate external resources through technological convergence, thereby creating value (Ozdemir et al., 2016). Competitive resourcing and resource integration become the means of optimizing the utilization of technological resources, enabling nodes to unlock their full strategic potential and enhance competitiveness throughout the network. By combining their tech assets with those of their ecosystem partners, nodes can unlock new market opportunities and build sustainable competitive advantages. Such resource integration helps networks become more responsive and adaptive, as well as increases their capability for innovation and the intensity of network competitiveness.

Nodes in structural positions, or brokers, can exchange resources and build unique capabilities because they connect different parts of the network (Iorio, 2022). Competitive bridging and positioning enable these brokers to combine diverse technological experiences and gain influence across various industries. Evidence suggests that structural brokerage in rapidly evolving technological settings enables nodes to test new technologies more effectively and adapt to shifting market demands (Balachandran & Hernandez, 2018; Hargadon & Sutton, 1997). Convergence technologies enhance these brokerage benefits by allowing brokers to bridge more diverse knowledge bases and pools of assets, translating their positioning within the network into fluid capabilities to set standards, establish market trends, and capitalize on cross-industry complementarities, even as they confront perceived competition.

Within the dynamic digital space, edge-based synergies of collaboration are crucial in spearheading technological convergence through integrating a broad array of technological knowledge. This enhances the network's innovation performance, as well as its responsiveness to technological innovation (Volberda et al., 2021). Multimarket contact and equality of strength enable nodes to form closer relationships, leading to improved market positioning and broader opportunities across multiple industry sectors. Such nodes, which efficiently coordinate their alliances within virtual networks, are able to boost their innovation cycles and broaden their technological scope, thereby increasing market commonality and resource similarity as well as fueling strategic perceived rivalry (Hofer et al., 2022; Lee, 2007; Paquin & Howard-Grenville, 2013).

Edge-based strategic multiplexity, supported by technological convergence, boosts network competitiveness by creating more interactions that drive value (Ferriani et al., 2013). Diversifying edges and positioning strategically help nodes stay competitive by building new technological capabilities. Recent research indicates that multiplexity also enhances a firm's ability to identify and leverage new opportunities across various markets (Rietveld & Schilling, 2021). When nodes connect through multiplex edges, they not only expand their market reach and align resources but also enhance their ability to handle rivalry and maintain visibility in fast-changing industries.

Edges are used as mechanisms that expand the boundaries of what is technically possible, which makes the strategic importance of the partner-forming approach in maintaining pace with emerging technologies arise amidst the diffusion of new technologies. As technological convergence advances through stronger edge-based collaboration, it suggests that future progress will depend more on how global networks cooperate and integrate technologies than on single, major discoveries (Ye et al., 2020). This makes competitive positioning and edge diversification crucial for bringing resources together and helping nodes compete in dynamic industries (Kleinbaum & Stuart, 2014). Strategic alliances are now essential, as they let nodes pool technologies and create synergies that drive future innovation (Furr & Shipilov, 2019). Network competitiveness is energized by this dynamic engagement, which not only dictates industry trends but also encourages innovation in technology and business processes.

Theoretical insights

Our study highlights the significance of firm positioning in the digital economy, where technological convergence is shifting competition from traditional models to network-based strategies (Rietveld et al., 2020). Convergence is not only a tool for firm flexibility but also a way to reconfigure positions in the network to seize new market opportunities (Ahuja, 2000). It underlines how connectivity, collaboration, and especially convergence make network dynamics a key driver of competitive advantage (Verbeke & Hutzschenreuter, 2021). In this context, value creation relies on edge-based synergies, the diverse technological capabilities of nodes, and the strategic use of technological convergence to foster competitive advantages (Altman et al., 2022).

CNT views networks as sets of competitive ties and relationships. Our model builds on CNT's view of networks as competitive ties by adding technological convergence as a mediator that shapes network competitiveness. We argue that convergence improves not only market commonality but also resource similarity by aligning technologies across the network. Additionally, technological convergence amplifies perceived rivalry, driving firms to adopt competitive strategies that encourage innovation and strategic differentiation. This triadic closure effect enables nodes to strategically relocate within the network, shifting from peripheral to core positions as they develop technological competencies and solidify their linkages (Lipparini et al., 2014). Strategic multiplexity and resource combination across edges also fuel this process, meaning that network competitiveness has its genesis in the synergy between nodes that cooperate, rather than fragmented competitive action (Kilduff et al., 2010; Lavie, 2006).

While Competition Network Theory (CNT) is characterized by competitive firm-to-firm relationships, especially between those in direct competition for the same markets, our model pays less attention to competitive differentiation at the firm level and greater attention to the overall network. By considering how firms leverage technological convergence to fuel network competitiveness, our model presents a broader view of network-level competitiveness, where firms compete through coopetition (Gnyawali et al., 2006). As technological convergence enables firms to leverage these synergies, they can integrate technologies, bridge gaps between different industries and knowledge domains, and thereby gain a competitive advantage within the network.

Our framework alters the perspective on CNT. Instead of focusing solely on what a single firm does to compete or its market position, we emphasize the importance of network-wide collaboration. By combining ideas such as periphery-core migration and structural brokerage, we suggest that firms can continually shift their position within a network. This enables them to access strategic resources and expand their sphere of influence across various markets (Chen et al., 2007). It posits that in today's digital world, creating value and gaining a competitive advantage is not driven by individual node efforts, but rather by strategic network engagement, showing how technological convergence between nodes ultimately boosts the overall network's competitiveness (Chen, 1996; Kilduff, 2019).

Our framework also introduces the concept of edge-based resource integration, highlighting how technological convergence across edges strengthens the resilience and adaptability of networks. Through edge-based resource integration, nodes can plan for any external threats and simultaneously enhance their resource similarity, resulting in a greater competitive advantage in the long run (Dyer & Singh, 1998). This view shows that the resources and data shared between nodes through edge-based synergies enhance the network's ability to rejuvenate and respond to market shifts, thereby increasing network competitiveness (Hacklin et al., 2009; Soda et al., 2021).

Adding technological convergence to our framework not only reveals how networks evolve but also provides firms with a clearer view of their strategy. Firms that act as brokers can utilize convergence to create unique value by linking previously unconnected markets and knowledge areas (Burt, 2004). New technologies help firms keep up with change while also widening their ability to collaborate. This shift indicates a broader network-based strategy, where advantage stems from being part of a converging ecosystem of technology rather than from standard competitive moves (Baum & Korn, 1996; Gimeno & Woo, 2017).

Our study, which incorporates technological convergence into CNT, fills a crucial gap in earlier research. Previous work on network competition—whether examining static structures, structural holes, or competition at the firm level—has often treated technology as an external factor or something of minor importance. CNT views networks as sets of competitive ties and relationships, emphasizing structural positioning and firm-level outcomes. However, it does not explain how technological convergence actively reshapes connections or creates new synergies at the edge of networks. Our model extends CNT by integrating convergence as a relational mechanism that mediates network competitiveness.

Practical insights

Our study provides managers with insights into designing their network dynamism roadmap in the digital economy. First, it helps them understand how technological convergence is driving network dynamism (Chirkunova et al., 2021). Technological convergence is a key enabler of edge-based strategic multiplexity, enabling firms to leverage new technologies and resources to expand their market presence, share target markets, and align resources effectively. This alignment helps firms match their technological assets with industry standards and expectations. Furthermore, firms can utilize technological convergence to cope with perceived competition, placing themselves strategically within networks to counter competitive forces.

Second, we emphasize technological convergence as a vital approach for firms seeking to optimize their use of structural positions and venture network collaboration (Ganco et al., 2020). Seizing opportunities in brokerage positions in structures, firms are able to serve as a go-between to exchange resources, providing portals for cross-industry alliances and innovation creation (Burt & Soda, 2021). Structural brokerage positions enable firms to effectively seize advantages and acquire the necessary resources to match their rivals.

Third, the framework enables firms to develop network capabilities by understanding edge-related synergies and informing strategic decisions through technological advancements (Borges et al., 2021). The ability to manage and leverage collaborative synergies through multimarket contact further enables firms to mitigate market uncertainties and sustain competitive advantage in dynamic networks (Chen et al., 2007).

Conversely, firms should remain updated by creating edge-based synergies and continuously integrating new technologies into their processes. This approach will not only maintain but also improve their competitive position. Such continuous integration necessitates that firms establish dynamic capabilities, enabling them to remain flexible and responsive to evolving industry demands (Teece, 2007). Through this framework, firms can leverage value creation from strategic areas that improve their network positioning, ensuring they maintain a competitive advantage within their ecosystems.

In turn, these observations suggest that managers have four priority concerns in managing technologically convergent networks: finding common technological platforms and standards that expose them to larger markets; using brokerage positions to orchestrate cross-industry innovation and organize heterogeneous actors; leveraging edge-based synergies, i.e., multimarket contact and strength equality, to foster cooperation and govern rivalry at the same time; and building dynamic capabilities for continuous integration of novel technologies and relationships. By doing so, firms can move from reacting to technological convergence to leading it, positioning themselves at the center of their evolving ecosystems.

Limitations and future research

Despite its contributions, our study has some limitations that future studies may address. First, our framework may oversimplify technology as the primary driving mechanism of network dynamics. Although the convergence of technologies is most salient to network competitiveness, future research should consider how convergence operates in conjunction with other strategic drivers—institutional conditions, governance structures, and resource endowments—to shape or influence network competitiveness. Dynamic modeling or simulation methods (Sankar et al., 2020) can give a clearer view of how convergence grows over time. These tools can follow how technology, network structures, and competitive outcomes change together.

Second, our model does not fully account for the fact that industries vary considerably in their structural and institutional environments. This may require rethinking the model to accommodate cross-industry differences, especially between innovation-based, fast-moving industries and more mature, asset-intensive industries. Future research would have to consider the degree to which technological convergence has a differential effect on market commonality, resource similarity, and perceived rivalry across such settings. Additionally, the usefulness of our framework might be limited by the scarcity of resources, especially for smaller firms. While SMEs and born globals are often more agile, they face clear challenges in fully leveraging the synergies that convergence drives. Future research could investigate how these firms manage limited resources by leveraging multiplex ties and structural brokerage (Zhou et al., 2007).

Third, future research could investigate how convergence affects internal coordination, capability development, and innovation within firms. This would extend the model to include how internal networks contribute to making the supra-network more competitive. Such work would help us understand not only how convergence is reshaping firm boundaries, but also the minimal, fundamental elements—the micro-foundations—of competitive advantage.

Lastly, the framework should be empirically tested with actual data to achieve its highest level of practical and theoretical usefulness. Empirical testing using longitudinal or multilevel data, complemented by qualitative case studies, would be capable of testing the propositions developed here, refining the mechanisms, and detailing boundary conditions. Collaboration with industry experts and the application of field-based learning will also enable the framework to stay abreast of the pace of technological evolution and emerging market trends.

Conclusion

This study investigates how technological convergence (when different technologies merge) affects competition in business networks. Our framework offers a fresh perspective on network competition by illustrating how firms reposition themselves. We highlight mechanisms at the node level (changes in a company's position, such as moving from the edge to the center) and the edge level (changes in a company's connections, such as building a diverse range of relationships and acting as a bridge). We argue that technological convergence serves as a link between these movements and network changes, demonstrating how firms can utilize technological shifts to grow and innovate continuously.

From a theoretical perspective, our framework showcases that technological assets are valuable due to their relationships with other firms, rather than solely because of their intrinsic value. Our work also responds to research calls for integrating network processes into strategy (Cennamo, 2021) and adds to the concept of business ecosystems by demonstrating that assets gain value through the interdependencies created by convergence (Shipilov & Gawer, 2020). This places our model at the crossroads of strategy and network research.

In practice, firms should balance between cooperation and competition to support convergence, effectively manage their resources in relationships, and establish strong network positions. Dynamic capabilities are essential for coping with uncertainty, seizing new opportunities (e.g., creating new platforms), and mitigating threats (Teece et al., 2016; Rietveld & Schilling, 2021). Strategic multiplexity and brokerage enable firms to enter multiple markets and connect different technological areas, sustaining competitive advantage in integrated environments.

Our study also highlights the importance of competitive bridging through structural brokerage (Burt, 1992), which allows firms to span different technological areas and create new value together. Future research could investigate how convergence-driven competitiveness differs across industries, how small and new firms manage with limited resources, and how micro-level dynamics drive network outcomes (Nirmala et al., 2024; De Keyser et al., 2024). The framework could then be improved and tested using long-term data.

Overall, firms that actively manage technological convergence through clever positioning, collaboration, and innovation will not only survive but also thrive in the digital economy.

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Table 1. Comparison of CNT and Technological Convergence-driven CNT

Aspect	***Competition Network Theory (CNT)***	***Technological Convergence-driven CNT***
Market Commonality	Competitors are identified based on their simultaneous operations in shared market segments (Gimeno, 2004).	Expands market presence by integrating diverse technological capabilities, facilitating shared opportunities, and enhancing interdependencies, while balancing convergence-driven scale with divergence-based differentiation to sustain competitiveness.
Resource Similarity	Competitive behavior is influenced by firms with overlapping resource bases and shared third-party relations (Gulati et al., 2000).	Aligns and optimizes technological resources across edges through integration and cross-industry recombination, consistent with the logic of dynamic capabilities, thereby deepening collaborations and strengthening network competitiveness.
Perceived Rivalry	Firms assess competitors based on strategic intent and potential threats, which may not always be reciprocated (Chen, 1996).	Shapes competition by balancing coopetition and rivalry through competitive embeddedness and multimarket contact, altering threat perceptions, and reinforcing competitive positioning in convergent networks.
Multimarket Contact	Competition across multiple markets may lead to mutual forbearance or intensified rivalry (Baum & Korn, 1996).	Facilitates technological expansion across domains, enabling firms to enhance their influence and positioning through peripheral–core migration and cross-market engagement, thereby amplifying network competitiveness.
Network Positioning	A firm's centrality in the competitive network determines its exposure to competitive threats and opportunities (Burt, 1992).	Strengthens structural brokerage by enabling firms to bridge diverse technological and industry segments, recombining resources and capabilities to increase network influence and competitive advantage.
Tie Strength & Multiplexity	Competitive ties facilitate strategic positioning, with the strength of the tie influencing the flow of competitive actions (Granovetter, 1973).	Recasts edges as adaptive, convergence-driven mechanisms rather than static ties, fostering multiplexity across technological domains and creating opportunities for innovation, adaptability, and network competitiveness.

Figure 1. A visual representation of the conceptual framework linking technological convergence with network competitiveness

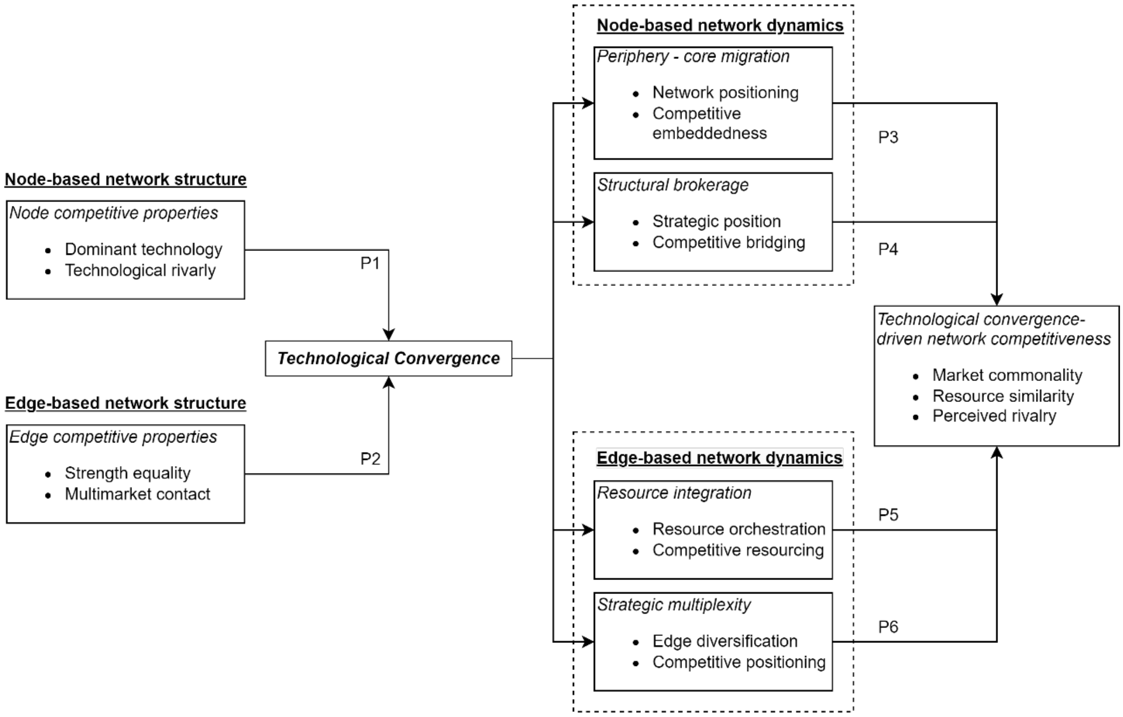

Table 2. Influence of Network Systems on Technological Convergence and Network Competitiveness

Network Systems	***Definition***	***Technological Convergence Influence on Network Competitiveness***	***Propositions***
Properties: Node-based Technological Attributes	Diversity in technological skills, expertise, and competitive capabilities among nodes.	Drives technological convergence by integrating diverse technological attributes, fostering innovation, and enhancing market positioning.	P1
Properties: Edge-based Collaborative Synergies	Interactions and partnerships between nodes that leverage complementary technological capabilities.	Enhances technological convergence by fostering collaborative synergies, strengthening network adaptability, and promoting mutual benefits.	P2
Dynamics: Node-based Periphery-Core Migration	The progression of nodes from peripheral positions to more central roles within the network.	Enhances network competitiveness by improving network positioning and fostering competitive embeddedness.	P3
Dynamics: Node-based Structural Brokerage	Nodes that act as intermediaries, bridging disconnected parts of the network and facilitating resource flow.	Strengthens network competitiveness by optimizing strategic position and enabling competitive bridging.	P4
Dynamics: Edge-based Resource Integration	Integration and utilization of diverse resources and technological capabilities across network nodes.	Enhances network competitiveness by driving resource integration and enabling competitive resourcing.	P5
Dynamics: Edge-based Strategic Multiplexity	The ability of network edges to support multiple types of strategic and technological interactions simultaneously.	Strengthens network competitiveness by fostering edge diversification and enhancing competitive positioning.	P6