

Competing at the Edge of Technology: Factors Creating Advantage of Knowledge-Based Companies in the Market

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Abstract

Given the growing role of knowledge-based companies in economic growth, job creation, and the development of new technologies, examining the factors influencing their competitiveness particularly in the field of information technology is of great significance in today's Iranian economic landscape. This study aims to investigate the competitiveness of knowledge-based companies operating in the information technology sector by employing Porter's diamond model. In terms of purpose, the research is applied in nature, and methodologically, it is qualitative and exploratory. The participants consisted of managers and experts from IT knowledge-based companies who were selected through purposive theoretical sampling. Data were collected through a review of relevant literature and in-depth semi-structured interviews with 28 participants and subsequently coded. The findings indicated that the extracted codes were classified into six main dimensions: related and supporting industries (energy imbalance, quality of technological infrastructure, support from large industries, ...), factor conditions (marketing and branding capabilities, intelligent management,

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inter-firm networking, ...), strategy–structure–rivalry (rebranding for entry into foreign markets, unfair competition from state-owned and semi-state companies, ...), demand conditions (expansion of emerging digital technologies, shortened product life cycles, saturation of the domestic market, ...), government (international interactions, access to governmental data, incentive policies, ...), and chance (sanctions, currency fluctuations, wars). Ultimately, this study presents a practical framework for analyzing and enhancing the competitiveness of IT knowledge-based companies in Iran and highlights that competitiveness results from the dynamic interplay between the environment and strategy.

Keywords: Knowledge based companies, Information technology, Porter’s diamond model, Competitive advantage.

Introduction

Knowledge-based companies, whose business models are basically rooted in the development and application of emerging technologies, are of significant importance due to their positive contribution to economic and social development, their capacity to create high-quality employment, and their role in revitalizing industries through transformative technologies (Alzate-Alvarado et al., 2025, p. 2). These companies are established with the aim of commercializing the results of research and development in advanced technology fields, and they play an important role in increasing production efficiency, turning knowledge into practical products, and strengthening national economic growth. Technology-based companies can create more added value by using more knowledge in their organizational structures. In fact, innovation, entrepreneurship, job creation and income generation show the key dimensions of the economic impact of knowledge-based companies (Maithami et al., 2023).). These companies can use their internal capabilities to respond more effectively to market challenges. They show a high degree of flexibility and strong adaptability in the development and management of high-tech products (Duan et al., 2020, p. 1). However, when introducing new technologies to the market, they face significant levels of risk and uncertainty (Rydehell et al., 2019). Competition in the information technology (IT) industry is intense and aggressive, often manifested through the emergence of new products and technologies that may replace existing companies. This volatility stems from the rapid pace of technological change, increasing customer diversity, and other environmental dynamics (Kim et al., 2016). In such a situation, the main concern of companies is to identify ways to achieve sustainable competitive advantage. Such an advantage enables companies to achieve profitability and growth beyond the industry average (Erboz, 2020, p. 267). According to Porter (1990), the strong development of industries largely depends on the increase of core competitiveness, and industries that lack competitiveness are inherently harmful in the development process. Whether in traditional manufacturing sectors or high-tech sectors, sustainable development can only be ensured through continuous improvement of core competitiveness (Wang et al., 2023, p. 5). Information technology can be applied to all value-added activities in a company, making it a key factor for competitive advantage. However, the technologies themselves are not inherently valuable. Their importance becomes apparent when they affect organizational competitiveness (Vargas-Hernandez and Sierra, 2018, p. 147). Several studies that have examined competitive advantage at the global level have pointed to Porter's diamond model and recognize it as a basic framework for analyzing national and industrial competition (Sagaian et al., 2025, p. 689; Huang et al., 2015; Bakan and Dugan, 2012). This model plays an essential role as a tool for systematic analysis of industry competitiveness (Zheng et al., 2020, p. 124).

Importantly, Porter's Diamond Model enables organizations to design effective strategies by understanding the structures and practices employed by competitors. It

assists firms in identifying regional advantages that can be leveraged to gain a competitive edge in broader markets and increase market share. Consequently, the model encourages firms not only to keep pace with industry trends but also to innovate and recognize key actors, suppliers, and buyers within their competitive environment, thereby avoiding decline or deterioration (Webster & Cain, 2025, p. 269). In addition to explaining the success of certain industries, the Diamond Model serves as a predictive tool for anticipating future industry trajectories. It can even indicate whether an industry has the potential to thrive and become more competitive when opportunities arise. The model is constructed based on four core determinants—factor conditions, demand conditions, related and supporting industries, and firm strategy, structure, and rivalry—alongside two exogenous variables: government and chance. These elements interact in a diamond-shaped system, from which the model derives its name (Zheng et al., 2020, p. 124). Accordingly, the present study employs Porter's Diamond Model as its theoretical framework to analyze the competitiveness of Knowledge based companies operating in the information technology sector in Iran. Given that Iran's economy is transitioning toward a knowledge-based paradigm, firms in the IT sector recognized as key drivers of innovation and value creation require a precise understanding of their competitive conditions and capabilities. Despite the growing importance of this domain, the lack of domestic studies that systematically incorporate and analyze these factors within Porter's theoretical framework represents a significant gap in the existing literature. The present study seeks to address this gap by adopting a qualitative methodology, drawing on data obtained from expert interviews and a comprehensive review of academic sources, to provide a realistic and in-depth understanding of the factors influencing the competitiveness of these firms. By doing so, the study aims not only to enrich the theoretical literature but also to contribute to the improvement of policymaking and strategic planning in support of this critical sector of the knowledge-based economy. From this perspective, the main research problem at the theoretical level can be articulated as follows: What factors influence the competitiveness of Knowledge based companies in the information technology sector in Iran, based on Porter's Diamond Model?

Literature review

Knowledge based companies

Amid the rapid expansion of the global economy and the increasingly complex and dynamic demands of markets, knowledge-based organizations play a vital role (Darmawan, 2025). Knowledge based companies are typically young and initially small enterprises that operate in fast-changing, high-technology, and research-and-development-intensive environments. These firms are often characterized by high growth potential, disruptive innovation, and greater uncertainty compared to traditional businesses (Passavanti et al., 2024). In essence, Knowledge based companies are distinguished by high growth, high risk, substantial investment requirements, intensive

R&D activities, and a strong emphasis on innovation, while actively leveraging new inventions and emerging technologies. Compared to other firms, knowledge-based organizations possess specialized and cumulative technical capabilities that evolve through diverse learning processes. These capabilities enable them to respond more effectively to market changes in order to ensure survival and achieve sustainable profitability (Duan et al., 2020, p. 1). Such organizations are highly dependent on their ability to manage knowledge effectively, develop human resource competencies, and foster an organizational culture that supports innovation and continuous learning (Darmawan, 2025). The competitiveness of knowledge-based organizations is also contingent upon employees' motivation to share knowledge, as well as mechanisms for protecting shared knowledge assets (Tongo, 2015).

These firms are expected to pursue the advantages of internationalization and achieve stronger market positioning through diversification, ultimately leading to higher profitability (Samadi et al., 2023, p. 1). However, a significant number of technology-based firms either fail along this path or do not attempt to expand beyond national borders. In emerging economies, three primary barriers to the internationalization of technology-based firms have been identified: (1) Institutional barriers, such as high capital costs for initiating international operations and insufficient governmental support (e.g., credit facilities, training programs, and tax incentives); (2) Organizational capability barriers, including challenges in delivering products or services that meet international customer demands, inadequate or inappropriate technical skills for competing in terms of cost and quality, and relatively high production costs compared to international competitors; and (3) Human resource barriers, such as language constraints and the lack of preparedness of human capital for international operations (Binnui, 2021, p. 186).

Information Technology

Industry 4.0 is characterized by the large-scale production of intelligent objects for everyday life and work, alongside advanced technologies such as artificial intelligence, the Internet of Things (IoT), big data analytics, and blockchain. These technologies have permeated virtually all sectors (e.g., food industries, healthcare, and services) as well as various stages of the value creation process, including procurement, production, logistics, and distribution (Cerchione et al., 2024).

Information technology (IT) plays a critical role in innovation processes, communication, and the efficient utilization of resources and dynamic capabilities within firms. Given the wide range of opportunities and functionalities enabled by IT, its adoption has been steadily increasing worldwide. Organizations have recognized that these technologies constitute key enablers for achieving competitive strategies at both local and international levels. IT is currently driving transformations in the operational approaches of competing firms, thereby influencing whether sustainable competitive advantages can be attained by those that effectively leverage such technologies.

Moreover, IT is instrumental in reshaping the various links within organizational value chains and has evolved into a fundamental component for industrial firms seeking market growth. It provides a stable infrastructure that underpins production, commerce, human resources, research and development, and other core organizational functions, ultimately facilitating the delivery of products that meet customer expectations (Vargas-Hernández & Sierra, 2018, pp. 142, 147). Information technology has long been recognized as a tool for reducing information asymmetry and uncertainty, while enhancing firms' information processing capabilities. It supports organizational activities, connects geographically dispersed components of supply chains, and strengthens linkages between firms and their customers (Chen, 2019). In essence, IT improves data collection and analysis, enabling firms to generate valuable insights into market conditions, customer needs, and emerging consumption trends. Furthermore, the application of IT allows firms to operate within a virtual environment unconstrained by geographical boundaries, thereby facilitating global expansion and growth (Sutrisno et al., 2023). On the other hand, the information technology industry is characterized by instability in market boundaries, as competitive positions shift frequently. Consequently, market leaders cannot rely solely on existing or legacy technologies for sustained success. In such dynamic environments, innovation and new product development are likely to be more critical than price competition or branding strategies (Kim et al., 2016).

Competitive Advantage and Competitiveness

Until the 1990s, competitiveness was a commonly used term often invoked as a solution, yet with limited understanding of how it could actually be achieved. Given its close association with the concept of competition, competitiveness is generally defined as the ability of individuals, firms, economies, or regions to compete at domestic and/or international levels. It reflects the intensity of rivalry among firms within an industry, which ultimately leads to the development of competitive advantage. Compared to competitive advantage, competitiveness is a broader and more comprehensive concept. Within a business environment, a firm's competitiveness extends beyond directly involved actors to include a wider network of individuals and organizations connected to it (Farhikhteh et al., 2020, pp. 316–317).

The term competitive advantage, however, gained prominence following the publication of *Competitive Advantage* by Michael E. Porter in 1985. According to Jay Barney (1991), a firm achieves competitive advantage when it implements a value-creating strategy that cannot be simultaneously pursued by current or potential competitors. Similarly, Day and Wensley (1988) argue that superior skills and resources form the foundation of competitive advantage. These resources act as structural determinants or drivers of cost leadership and differentiation advantages (Farhikhteh et al., 2020, p. 319). Furthermore, Yunas & Primiana (2016) emphasizes that competitive advantage consists of resources or capabilities that are difficult to imitate and are

essential for enabling organizations to outperform their competitors (Mukhsin & Suryanto, 2022). In addition to maintaining distinctiveness from competitors, firms must also consider other critical success factors, such as the ability to respond to environmental changes and resilience against competitors' strategic actions (Chen, 2019).

In 1990, Michael Porter introduced the well-known Diamond Model in his seminal book *The Competitive Advantage of Nations* to analyze industrial competitive advantage (Niu et al., 2020, p. 2). Porter's Diamond Model provides an analytical framework for identifying the determinants of national competitiveness at the macro level, grounded in the broader business environment of countries (Militaru et al., 2025). The forces identified by Porter determine the attractiveness and competitiveness of industries within competitive markets. According to this model, the factors influencing firm activities can be categorized into six main elements: (1) factor conditions; (2) demand conditions; (3) related and supporting industries; (4) firm strategy, structure, and rivalry; (5) government; and (6) chance (Saghaian et al., 2025). Factor conditions refer to inputs necessary for production, including human resources, natural resources, knowledge resources, capital, and infrastructure. Demand conditions relate to the nature of market demand for an industry's products, encompassing the structure, size, and growth of demand (Wang et al., 2023, p. 6). Porter particularly emphasized the size of the domestic market, the sophistication of demand, and the presence of demanding buyers—whether industrial customers or end consumers. A large domestic market encourages firms to invest in economies of scale, thereby fostering competitive advantage. Moreover, when domestic buyers are highly sophisticated and demanding, firms are compelled to meet higher standards and continuously upgrade their capabilities. Related and supporting industries refer to industries that facilitate value chain activities or provide intermediate goods and services (Kharub & Sharma, 2017, pp. 5–6). In essence, these industries represent upstream and downstream linkages within the industrial ecosystem, and their development contributes significantly to the sustainability and competitiveness of the focal industry. Firm strategy, structure, and rivalry pertain to how firms are organized, established, and managed, as well as the nature of competition and cooperative interactions within the industry (Wang et al., 2023, p. 6). The two external variables government and chance exert indirect yet significant influence on the four core determinants. Government policies and unforeseen events can substantially shape overall competitiveness and industrial development (Saghaian et al., 2025, p. 691). Governments influence the business environment and, consequently, firm strategy, structure, and rivalry. They also play a crucial role in shaping factor conditions through their impact on labor markets, technological advancement, infrastructure, and financial systems. Additionally, governments significantly influence demand through taxation, subsidies, regulatory frameworks, and other demand-shaping mechanisms (Webster & Cain, 2025, p. 270). Furthermore,

Carayannis & Wang (2012) emphasize the critical role of government in balancing supply and demand, providing support, resources, and incentives for innovation, and enhancing access to technology and knowledge (Militaru et al., 2025, p. 104).

In reviewing the literature, an effort has been made to identify selected studies that exhibit conceptual and thematic relevance to the present research. A summary of their key findings is presented in Table 1.

Table 1. Empirical Background of the Study

Researcher	Title	Summary of Research Findings
Lee et al. (2024)	Enhancing the Competitiveness of AI Technology-Based Startups in the Digital Era	A review of the research literature identified sixteen factors influencing the competitiveness of startups. These factors include, among others, the maturity of artificial intelligence technologies, strategic decision-making skills, government support, relevant regulations, financial investments, and the intensity of market competition. The identified factors were classified into four domains: human/entrepreneurial factors, environment, resources, and mechanisms. The findings indicate that the human-factor domain plays the most critical role in enhancing the competitiveness of AI startups. Among the factors within this domain, strategic mindset and thinking were identified as the most significant determinants of success for artificial intelligence startups.
Erboz (2020)	A Qualitative Study on Industry 4.0 Competitiveness in Turkey Using Porter Diamond Model	The results of this study indicate that the most critical factor in achieving competitive advantage is the condition of production factors, particularly access to specialized human resources and the substantial investments required. In addition, several challenges were identified as major barriers to enhancing competitiveness, including inefficiencies in employee training, dependence on imported technologies, an overemphasis on increasing sales rather than addressing the complex needs of customers, and weaknesses in the digitalization of relationships with suppliers.
Koprivnjak & Peterka (2020)	Business Model as a Base for Building Firms' Competitiveness	The findings revealed that although the firms' business models appeared different on the surface, they shared substantial similarities in their core components, such as key resources and cost structure. The importance of human

Researcher	Title	Summary of Research Findings
		capital, maintaining direct and long-term relationships with customers, and a strong focus on innovation in the value proposition were identified as critical success factors for these firms. The study underscores that, to maintain competitive sustainability, firms must leverage these shared elements while differentiating other components of their business models.
Kharub & Sharma (2017)	Comparative analyses of competitive advantage using Porter diamond model (the case of MSMEs in Himachal Pradesh)	The results of this study indicate that demand conditions, followed by strategy, structure, and rivalry, play the most significant roles in shaping competitiveness. Moreover, a statistically significant difference was observed across industries: the pharmaceutical sector achieved the highest level of competitive advantage, whereas the textile sector ranked lowest. The study emphasizes that achieving sustainable advantage requires a strategic focus on intangible resources and the strengthening of supporting industries.
Bhattacharjee & Chakrabarti (2015)	Investigating India's competitive edge in the IT-ITeS sector	The findings point to the influential role of advanced and specialized factors, the sophistication of domestic demand, product and process innovation, educational institutions as supporting industries, intense domestic rivalry, international expansion, and government support. In addition, chance-related factors were found to contribute to competitive advantage.
Tahmoore et al (2025)	Examining the Role of Governance in Supporting the Export of Knowledge-Based Products in the Downstream Oil Industry Based on Porter's Diamond Model	The findings revealed that governance, at both the transnational level (including political, structural, and international financial influences) and the domestic level (including structural, cultural, legal, and internal financial influences), plays a significant role within the framework of Porter's Diamond Model.
Razazzadeh Tousi et al (2021)	Identification of Components and Sub-Components of Development Driver Patterns at Knowledge-Based Companies: The Case of Knowledge-Based Companies in The Southeast of Iran	The results of this study led to the identification of eleven components including organizational culture, infrastructure, human resources, technical capability, marketing activities and knowledge management, societal culture, market conditions, supportive policies, technology, and legal frameworks along with forty-one subcomponents, forming the preliminary model of drivers for the development of knowledge-based companies.

Researcher	Title	Summary of Research Findings
Mohammadkazemi et al (2021)	Investigating the Impact of business model innovation on creation of competitive advantage with the mediating effects of entrepreneurial empowering (Case Study: ICT-Based Knowledge-Based Companies)	The results indicated that business model innovation has a positive and significant effect on entrepreneurial capability and competitive advantage. The findings further revealed that entrepreneurial capability directly enhances competitive advantage and functions as a mediating variable in the relationship between business model innovation and competitive advantage. By innovating their business models, firms can exploit previously unexplored market opportunities and thereby achieve competitive advantage.
Karimi & Hassanpour (2012)	A Study on Competitiveness Effect of Iran's Knowledge-Based Industries on Trade with South West Asia	The findings showed that the limited diversity of products and the weak competitiveness of these goods in regional trade exchanges pose a significant challenge to achieving the targets outlined in the Vision Document. Establishing dynamic and constructive linkages with industrialized countries, creating an enabling environment for attracting foreign investment, and adopting outward-looking trade policies can enhance product diversity and strengthen the competitiveness of Iran's knowledge-based export goods in regional markets.

The novelty of this study lies in its focus on identifying and analyzing the competitiveness of Knowledge based companies operating in the information technology sector an area that has received comparatively limited attention in prior research, where the dominant focus has largely been on manufacturing industries. This approach enables a clearer and more nuanced understanding of competitive dynamics within the context of Iran's knowledge-based economy. Furthermore, the integration of theoretical foundations with empirical data derived from in-depth interviews with managers of Knowledge based companies provides a realistic and context-sensitive depiction of the challenges and capacities related to competitiveness in Iran's actual business environment.

Methodology

This study is applied in terms of its objective and qualitative-exploratory in nature. Qualitative research is recognized for its unique capacity to capture the richness of social phenomena, including human experiences and perspectives, thereby preventing oversimplification and misinterpretation of social realities. It enables an in-depth exploration of the complexities of human behaviors and interactions (Lim, 2025). The research approach adopted in this study is inductive, and the methodological strategy

employed is qualitative content analysis. Qualitative content analysis is defined as a research method for the subjective interpretation of textual data through a systematic process of coding and the identification of themes or patterns (Hsieh & Shannon, 2005).

In the initial stage, relevant scholarly articles were purposefully reviewed to extract codes and identify preliminary themes. To this end, a literature review was conducted using both domestic and international databases, including SID, Noormags, Magiran, Google Scholar, and Scopus. In total, 28 articles comprising 18 Persian and 10 English publications were selected and utilized as complementary sources alongside the interview data.

The participants of this study consisted of managers and experts from Knowledge based companies operating in the information technology sector in Iran. Accordingly, purposive sampling, specifically theoretical sampling, was employed to select individuals with sufficient expertise and experience relevant to the research topic and who were best positioned to provide rich and insightful data. Data were collected through semi-structured interviews. The interview protocol included five main questions, each addressing a specific dimension of competitiveness:

1. What capabilities or characteristics enable IT-based knowledge firms to achieve superior performance?
2. What factors shape competition among IT-based knowledge firms?
3. What factors enable firms to better exploit existing opportunities?
4. How can firms differentiate their products or services and create value?
5. What are the main barriers and challenges that limit the competitiveness of IT-based knowledge firms?

The interview questions were designed to comprehensively capture the key dimensions of competitiveness in Knowledge based companies. To ensure accuracy and completeness, all interviews were audio-recorded with participants' consent and subsequently reviewed during the analysis process. Data collection continued until theoretical saturation was achieved. After conducting 28 interviews with managers and experts, the researcher concluded that no new insights were emerging and that the core categories had reached saturation. For data analysis, categorization, and coding of indicators and themes, MAXQDA 2020 software was utilized. To ensure the trustworthiness and rigor of the data, the framework proposed by Lincoln and Guba (1985) was applied, encompassing four key criteria:

- **Credibility:** To ensure the accuracy of the data, a portion of the findings and codes was shared with several interviewees to obtain their feedback regarding their validity (participant review/member checking). In addition, several fellow researchers were consulted to review the analyses. These measures helped ensure that the research findings closely reflected the actual experiences of the participants.
- **Transferability:** The researcher attempted to provide detailed and transparent descriptions of the participants' characteristics, the research context, and the data

collection process so that other researchers could apply the findings in similar contexts. Consequently, the results possess the potential for transferability to comparable situations.

- **Dependability:** All stages of the research, including data collection and analysis, were thoroughly documented so that the research process can be clearly traced if the study is replicated by other researchers. This ensured the consistency and stability of the research process.
- **Confirmability:** To ensure that the findings were grounded solely in the data rather than the researcher's personal perspectives, all interview transcripts, initial codes, and field notes were recorded and preserved. This procedure minimized the influence of researcher bias on the findings.

Findings

Demographic Characteristics of Participants

Table 2 presents the demographic characteristics of the participants in this study. The participants consisted of 28 experts and managers from knowledge-based companies operating in the information technology sector. Among them, 23 were male and 5 were female. In terms of educational level, the highest frequency belonged to individuals holding a master's degree (13 participants), followed by those with doctoral and bachelor's degrees. Examination of work experience indicated that the majority of participants had more than ten years of professional experience. Furthermore, regarding executive positions, the participants held various roles, including chief executive officer, deputy director, and department manager.

Table 2. Demographic Characteristics of the Research Participants

Row	Gender	Education	Executive Position	Years of Professional Experience
1	man	PhD	International Relations Officer, Science and Technology Park	15
2	man	PhD Student	CEO	19
3	man	bachelor	CEO	14
4	man	master of science	Deputy of ceo	22
5	Woman	bachelor	Business management	27
6	Woman	PhD	Executive Manager	15
7	man	bachelor	CEO	6
8	man	bachelor	CEO	10
9	Woman	master of science	CEO	4
10	man	master of science	CEO	11
11	man	PhD	CEO	5
12	man	master of science	CEO	15

Row	Gender	Education	Executive Position	Years of Professional Experience
13	man	master of science	Business Development Manager	10
14	man	master of science	CEO	12
15	man	bachelor	Business Manager	18
16	man	master of science	Business Development Manager	17
17	Woman	master of science	Informatics Project Manager	6
18	man	PhD	President, Science and Technology Park	20
19	man	PhD	Training and Research Officer	20
20	man	master of science	CEO	18
21	Woman	master of science	Product Manager	5
22	man	master of science	Head of Artificial Intelligence Operations	3
23	man	PhD	Vice President of Development	20
24	man	PhD	CEO	20
25	man	master of science	CEO	13
26	man	master of science	Monitoring and Data Analysis Department Manager	17
27	man	master of science	CEO	25
28	man	master of science	CEO	7

The specifications of the articles used in the qualitative analysis are presented in Table 3.

Table 3. Characteristics of articles used in coding

Names of the article's authors	Article abbreviation code	Names of the article's authors	Article abbreviation code
Yaghoubi et al. (2017)	A2	Amini et al. (2020)	A1
Razazzadeh Tousi (2021)	A4	Morovat & Nazarizadeh (2022)	A3
Akbarpoor & Tizroo (2022)	A6	Hajifathali et al (2022)	A5
Khayatian et al (2014)	A8	Shakuri & Bonyadi naeini (2016).	A7
Dana et al. (2022)	A10	Alizadeh & Soltanisehat (2020)	A9
Salamzadeh et al. (2022)	A13	Tavazoeifar et al (2019)	A12
Mansuri et al (2017)	A15	Ramazanpour Nargessi & Faghihipour (2018)	A14
Sadeghi & Sadabadi (2015)	A18	Tari et al (2016)	A16

Names of the article's authors	Article abbreviation code	Names of the article's authors	Article abbreviation code
Tayebi Abolhasani et al (2018)	A22	Meysami et al. (2023)	A19
Rouhanirad & Tayebi Abolhasani (2020)	A24	Keshavarz et al (2021)	A23
Mohammadabadi et al (2018)	A26	Fallah & Kazemi (2020)	A25
Lee et al. (2024)	A28	Rannikko (2012)	A27

Section Two: Data Analysis

In the first step of the study, relevant domestic and international articles and research were reviewed to identify the indicators and dimensions influencing the competitiveness of knowledge-based companies in the information technology sector. The analysis of existing scientific literature led to the extraction of several initial codes, each representing one of the factors affecting competitiveness. This stage provided the theoretical foundation for developing the preliminary conceptual framework of the study.

In the second step, semi-structured interviews were conducted with selected managers of knowledge-based companies. After full transcription, the interviews were examined and coded line by line. In this phase, 37 codes were identified, some of which overlapped with the findings of the literature review, while others contributed new concepts to the existing body of knowledge. After collecting data from both sources (the literature and field interviews), all codes were integrated and organized into main categories and subcategories based on similarities, overlaps, and shared concepts.

Ultimately, the resulting set of 47 codes was aligned with Porter's Diamond Model and classified under its six dimensions: "Factor Conditions," "Demand Conditions," "Related and Supporting Industries," "Firm Strategy, Structure, and Rivalry," "Government," and "Chance." The results of this analysis are presented in Table 4.

Table 4. Content Analysis Results

Main Category	Sub-Category	Statements	Source
Related and Supporting Industries	Energy Imbalance	Irregular power outages and voltage fluctuations damage our equipment.	I1, I2, I21
	Quality of IT Infrastructure	We need high-speed internet and strong IT infrastructure.	I1, I5, I9, I19, I23, I26
	Development Level of Energy Infrastructure	The level of development of energy infrastructures (water, electricity, gas).	A15, A14

Main Category	Sub-Category	Statements	Source
	Support from Large Industries for Knowledge based companies	Larger industries should support knowledge-based companies.	I5
	Support and Cooperation of Banks	The support and cooperation of banks with start-ups and Knowledge based companies.	A3
	Support from Incubators, Science and Technology Parks, and Universities	University policies affect the development of Knowledge based companies, particularly through providing facilities similar to those offered by science parks and incubators.	I5, I10, A8, A22, A2, A16, A23
	Collaboration with Universities and R&D Institutions	Creating synergy by fostering collaboration between industry, universities, and R&D institutions—for example, through industry-led training courses, joint projects, or recruiting skilled university graduates.	I24, A14, A22, A1, A18
Factor Conditions	Having marketing and branding skills	Market creation, marketing, and branding skills are highly important for Knowledge based companies.	I2, I9, I20, I24, I25, I26, I27, A24, A23, A22, A15, A5, A2, A19, A7
	Self-Learning Capability	In the IT sector, it is crucial for personnel to have strong self-learning abilities.	I7, I14
	Problem-Solving and Analytical Skills	The ability to analyze complex problems is essential. Overall, problem-solving skills are increasingly highlighted in the workforce of the Fourth Industrial Revolution.	I18, I13, I2
	Negotiation Skills	Negotiation skills are highly important.	I2, I18, A5
	Teamwork Skills	Possessing soft skills such as teamwork is vital.	I13, A4, A13
	Creative and Critical Thinking	Creative and critical thinking will be very important in the future.	I2, I14

Main Category	Sub-Category	Statements	Source
	Presence of Intelligent Managers in Knowledge based companies	It is essential to have intelligent, informed, strategic, and analytical managers capable of making correct decisions in turbulent and uncertain environments.	I19
	Strategic Thinking and Planning Skills	Knowledge based companies must develop accurate and reality-based strategic planning capabilities.	I14, I22, A28
	Co-location with science and technology parks/Incubators	Physical proximity to science and technology parks is beneficial for Knowledge based companies.	I1, A19, A8
	Uniqueness Level of a Firm's Technology	The degree of uniqueness and advancement of a firm's technology determines how deeply its technological offering goes compared to competitors.	I7
	Adequate Investment in IT	Insufficient investment in R&D and IT projects creates financial challenges for Knowledge based companies.	I5, I23, I26, A28
	Use of Mentors	We bring in highly capable mentors to diagnose and solve issues faced by knowledge-based companies.	I1, I5
	Having an internal locus of control	Presence of an internal locus of control among personnel.	A16, A23, A12
	Having a Platform and Network Thinking	Possessing a platform-oriented and network-based mindset.	I4
	The existence of business intelligence	Business intelligence is highly important.	A25
	Networking and strong relationships between firms	Strong networking and collaboration among small and large companies.	I27, A5, A15, A16, A22, A18, A26
Strategy–Structure–Rivalry	Lack of Foreign Competitors in the Domestic Market	Due to sanctions on foreign software providers, domestic software remains largely unrivaled and can dominate the internal market.	I20, I19, I10, I16, I25, I28
	Monopolistic Behavior in the IT Market	The IT sector in Iran suffers from monopolies that block competition and increase market entry costs for new firms.	I8, I22, A6

Main Category	Sub-Category	Statements	Source
	Rebranding for Entry into Foreign Markets	In countries that consider Iran hostile, working under an Iranian brand is difficult; firms often must rebrand or use the identity of another country.	I25
	Customer Orientation	Products should meet customer needs and ensure customer satisfaction. Effective communication and empathy with customers are fundamental.	I4, I7, I8, I9, I11, I12, I15, I16, A23, I27, A4, A12, A5, A7, A26, A2, A13
	Unfair Competition from State-Owned and Semi-State Companies	When state-affiliated firms enter the market, their vast resources severely disadvantage private companies.	I9, I14
	Growing competition in the domestic market	Competitive pressures in the domestic IT market are increasing.	A13, A27, A28
	Presence and cooperation in international markets	International presence and cooperation contribute significantly to brand development.	I26, A5
	Customer Relationship via Exhibitions and Social Media	One important opportunity is customer engagement through exhibitions, corporate holdings, intermediaries, social networks, and webinars.	I1, I14, I15, A5
	Market Leadership	Being a market leader.	A5, A14
Demand Conditions	Domestic market saturation	Many private IT companies have reached the ceiling of the domestic market and thus seek entry into foreign markets, regardless of governmental support.	I7, A5
	Implementation of demand-generation policies in domestic markets	Implementing policies that generate demand for products and services in the domestic market.	A2
	Expansion of Emerging Digital Technologies	The emergence and expansion of technologies such as AI, IoT, blockchain, and cloud computing will dramatically transform the market.	I1, I2, I3, I4, I6, I7, I10, I12, I13, I14, I15, I16, I18, I19, I20, I21, I22, I24, I25, I26, I27, I28, A7, A9, A10, A28

Main Category	Sub-Category	Statements	Source
	Shortened Product Life Cycles	Product and service life cycles have shortened.	A13
government	Weak Investment in Artificial Intelligence	Iran has weak capabilities—technical, financial, and managerial—in AI investment.	I19
	Access to Governmental Data	Government agencies should reduce data monopolization and make data publicly accessible.	I7, I22, I23
	Support for Domestic Knowledge-Based Products	Government should support domestic and indigenous products.	I6, I20, I25, A14, A15
	Supporting technology firms at exhibitions to sell products	Government-backed participation of technology firms in exhibitions helps them sell products.	A15
	Providing government incentive policies in taxes, insurance, and financial resources	Government institutions should provide greater financial support and offer tax and insurance relief until products reach commercialization.	I1, I5, I6, I8, I17, I28, A1, A14, A28
	Government's Conservative Approach to New Technologies	Public-sector managers are highly conservative and reluctant to adopt modern IT solutions, even when mandated.	I14
	Open international interactions	Limited engagement with global markets prevents firms from accessing modern technologies and participating in global competition.	I3, I5, I10, I13, I19
	Policies Supporting Venture Capital Funds	Policies that encourage the growth and participation of venture capital funds.	A2
chance	Sanctions	Due to political instability, foreign clients are inaccessible despite potential opportunities in Central Asia and Arab countries.	I2, I3, I4, I5, I6, I8, I9, I10, I12, I13, I14, I15, I16, I18, I19, I20, I21, I24, I25, I26, I28, A1, A2, A3, A4, A5, A6, A7, A8, A16
	Exchange Rate Volatility	Instability in currency markets prevents IT firms from securing the capital needed for foreign exchange-dependent infrastructure.	I15, I21, I23, I24, I28, A5, A8, A16

Main Category	Sub-Category	Statements	Source
	Wars	Internal and external conflicts, along with related news, disrupt public sentiment and negatively affect the market.	I28

Figure 1, illustrates the model of factors influencing the competitiveness of knowledge-based companies in the information technology sector. The tree diagram provides a graphical representation of the relationships, beginning from a main node or trunk. This type of diagram is used to organize categories and to reach more detailed levels of analysis. In this figure, thinner lines indicate lower frequencies, whereas thicker lines represent higher frequencies of the extracted codes.

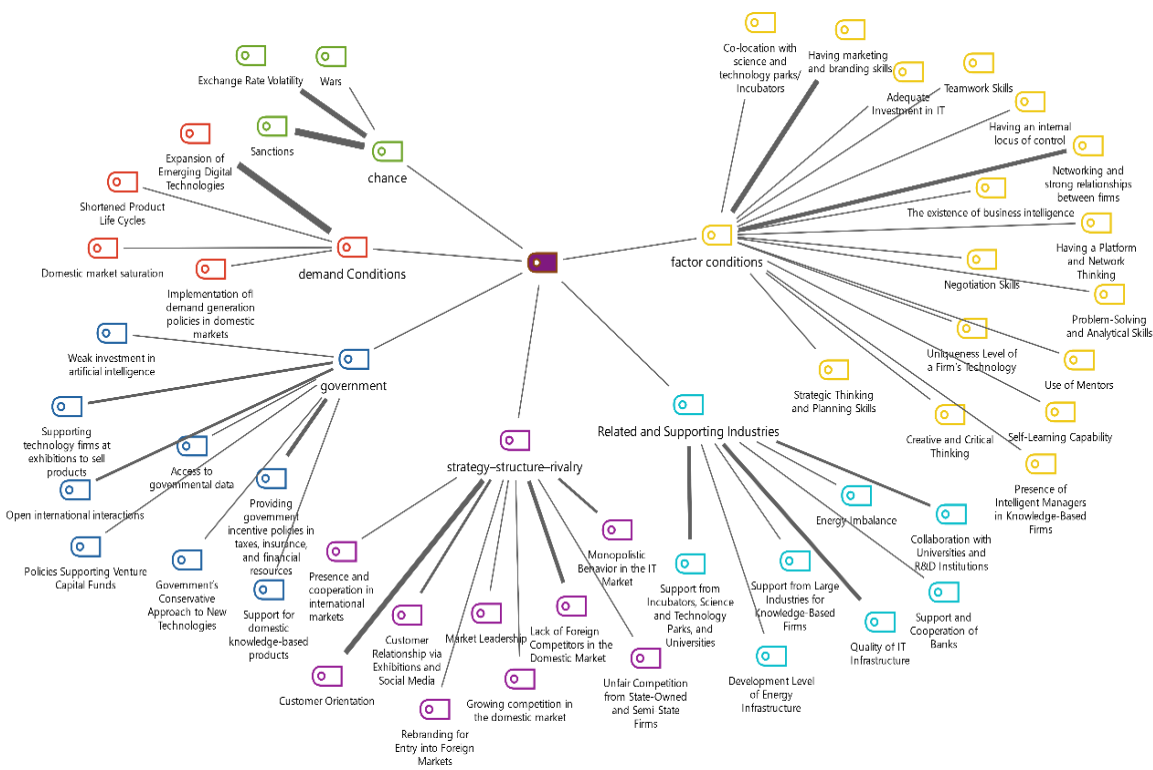


Figure 1. Pattern of Competitiveness Factors for Knowledge-Based Companies in the Information Technology Sector



Figure 2. Competitive Diamond Model for Knowledge-Based Companies in the Information Technology Sector

Discussion and Conclusion

Knowledge-based companies produce innovative goods and services based on high or medium technology, thereby contributing to the rapid growth of international trade. In developing countries such as Iran, the trade and export of high-technology products are

of even greater importance for the transition from a resource-based economy to a knowledge-based economy, for enhancing international competitiveness, and for achieving sustainable economic growth. These companies seek the best ways to operate and strengthen collaboration-based relationships by pursuing a superior position in the market (Samadi et al., 2023). Globalized markets and rapid technological change can affect the nature of the competitive advantages developed by knowledge-based companies. Therefore, it is critically important to understand how such firms in emerging economies can create competitive advantage in order to compete effectively in the marketplace (Rodríguez et al., 2015). Accordingly, the present study was conducted with the aim of identifying the factors affecting the competitiveness of knowledge-based companies operating in the information technology sector. Using a qualitative approach and semi-structured interviews, this study demonstrated that the competitiveness of knowledge-based companies in the information technology sector is influenced by multiple factors that can be categorized based on Porter's Diamond Model. Based on the qualitative analysis of the research data, six main dimensions were identified: factor conditions, supporting industries, strategy–structure–rivalry, demand, government, and chance, each of which comprised several related categories. More specifically, the dimension of supporting industries included 7 categories; factor conditions, 16 categories; strategy, structure, and rivalry, 9 categories; demand conditions, 4 categories; government, 8 categories; and chance, 3 categories.

Within the dimension of supporting industries, several categories were extracted, including the level of development of energy infrastructure (i.e., the provision of electricity, gas, and water) and the quality of information technology infrastructure (such as internet connectivity and fiber-optic networks). In this regard, Ramazanpour Nargessi and Faghihipour (2018) stated that one of the most important and fundamental measures for the development and institutionalization of knowledge-based companies is the development of their critical infrastructure. Establishing the necessary infrastructure to reduce the risks associated with the activities of knowledge-based companies and to facilitate their growth is therefore essential. A strong information technology infrastructure can reduce the structural barriers to knowledge flow and enhance organizational agility in competitive environments. Likewise, Mansuri et al. (2017) emphasized the quality of energy infrastructure as an influential component in the development of the competitiveness of Knowledge based companies.

In this study, among the categories related to the factor conditions of knowledge-based companies, items such as networking and effective inter-firm communication, marketing and branding capabilities, and the degree of technological uniqueness were identified. Research participants referred to the differentiation of their products and services from those of competitors, as well as the importance of creating internal and external communication networks to collaborate with other firms, institutions, and suppliers. Previous studies also confirm the significance of these factors.

Mohammadabadi et al. (2018) showed that networking at regional, national, and international levels, along with interaction with industry, enhances firms' ability to identify market opportunities and improve their performance. Tayebi Abolhasani et al. (2018) likewise emphasized that networking is particularly important in the development of advanced technologies and that the absence of networking and effective communication can create serious constraints for firms. They also noted that marketing and sales capabilities are essential conditions for the survival and continuity of knowledge-based companies, as they enable firms to pay closer attention to customer needs, manage distribution and sales effectively, and, more broadly, maintain sound customer relationship management. Although the managers of these companies generally possess high technical expertise, their primary focus tends to be on the product itself, with less attention paid to marketing activities. As a result, one of the major weaknesses of technology-based firms is inadequate marketing; given the small size of the market, mistakes in marketing innovative products may increase their failure rate.

Within the dimension of strategy, structure, and rivalry, several categories were identified as influential in shaping the competitiveness of knowledge-based companies in the information technology sector. Examples include monopolistic tendencies in the information technology market, active communication with customers through exhibitions and social media, and presence and collaboration in international markets. These findings are consistent with the results reported by Akbarpoor and Tizroo (2022) and Hajifathali et al. (2022). In particular, Asgharnia et al. (2023) emphasized that market monopolization gradually restricts the supply of goods and services and leaves only one or a few dominant providers in the market; such a situation reduces product diversity and service quality and prevents competitive dynamism. By contrast, the institutionalization of a healthy culture of competition and market actors' commitment to fair competitive principles are key factors in enhancing competitiveness and preventing monopolization. In addition, rebranding emerged as a category from the perspective of the participants in this study. Many companies, when faced with trade restrictions and sanctions, adopt rebranding as a strategy to reduce the direct effects of these constraints; in other words, by changing the brand or outward appearance of their products, they seek to make it possible to enter foreign markets without directly referring to the sanctioned country or company.

In the demand conditions dimension, the emergence and expansion of new technologies such as artificial intelligence, the Internet of Things, blockchain, and cloud computing are profoundly transforming the market and customer behavior. Knowledge-based companies that are able to integrate these technologies into their products and services will be better positioned to respond to emerging customer needs, increase their market share, and create competitive advantage. In addition, the shortening of product and service life cycles is another major challenge for these firms. Salamzadeh et al.

(2022) demonstrated that with the rapid introduction of new technologies, older products quickly become obsolete and their market demand declines. This increases environmental uncertainty and places greater pressure on firms' business decisions. Factors such as the implementation of policies aimed at creating domestic demand and the saturation of the domestic market also influence demand behavior and require companies to adjust their market and innovation strategies in accordance with environmental conditions in order to maintain competitiveness.

Within the government dimension, open international interactions play a crucial role in enhancing the competitiveness of knowledge-based companies in the information technology sector. Such interactions facilitate access to global markets, the transfer of knowledge and advanced technologies, and the utilization of successful experiences from firms and international innovation networks. In this regard, Idris et al. (2021) showed that both high-technology exports and imports contribute to raising a country's technological level. In particular, high-technology exports promote technological development and improve national competitiveness, whereas high-technology imports function as a mechanism for technology transfer and exert a positive effect on national competitiveness. With respect to government incentive policies in taxation, insurance, and financial resources, Salamazadeh et al. (2022) found that establishing guarantee funds to financially support technology-oriented knowledge-based businesses, or providing them with bank facilities for the purchase and modernization of equipment and for research and development activities, can be an effective strategy for strengthening and improving their performance indicators and competitiveness. These findings are consistent with the studies of Yaghoubi et al. (2017), Amini et al. (2020), and Ramazanpour Nargessi and Faghihipour (2018). Furthermore, participants in the present study stated that the government's conservative attitude toward the acceptance and adoption of emerging technologies prevents many innovative products and services of knowledge-based companies from entering the public sector market, thereby resulting in the loss of real revenue opportunities and the inability to consolidate market share.

The chance dimension in Porter's Diamond Model includes unpredictable events that may affect firms' competitiveness. Participants pointed out that sanctions, by creating barriers to access to equipment, software, and foreign investment, slow down the pace of innovation and product development in knowledge-based companies operating in the information technology sector and limit their ability to compete in both domestic and international markets. In addition, the companies' experiences indicated that the recent war and the disruption of internet access caused serious disturbances in operational activities, product development, and customer communication. Moreover, exchange rate fluctuations in Iran have had a considerable impact on productive and industrial sectors. Each sharp currency depreciation increases production costs and, consequently, the final price of products, which in turn reduces the purchasing power of

domestic consumers and leads to market recession (World of Economics, 2020). In recent years, this trend has particularly affected the vulnerability and competitiveness of information technology industries and has constrained firms' ability to maintain competitive advantage and develop innovative products.

Recommendations

The findings of the present study provide the basis for the following recommendations to enhance competitiveness:

In the area of supporting industries, it is recommended that the government and institutions associated with science and technology parks strengthen infrastructure in the fields of energy and information technology and ensure a stable energy supply. Such measures can create favorable conditions for the operation of knowledge-based companies and support their survival and movement toward greater competitiveness.

Given the identified categories of presence and collaboration in international markets, the expansion of emerging technologies, and the constraints imposed by sanctions, it is recommended that companies target the markets of neighboring and regional countries, where sanction-related limitations are less severe and market entry barriers are lower. These markets often face shortages of technological solutions; therefore, they provide valuable opportunities for Iranian companies to offer their technological products and services and establish a competitive position.

On the other hand, actively utilizing the capacities of science and technology parks and incubation centers, as well as engaging in collaboration with universities and research and development institutions, can facilitate companies' access to research infrastructure, financial resources, and knowledge networks. Such collaborations can provide a foundation for development and innovation within firms.

It is also recommended that the government move away from a conservative and traditional approach and instead play a facilitative role in innovation. This role can be realized through the broader use of knowledge-based products in government projects, the provision of tax and insurance incentives, and support for venture capital funds aimed at purchasing and modernizing equipment and financing research and development activities.

Based on the categories extracted in this study, such as networking, strong inter-firm relations, and a network-oriented perspective, it can be recommended that the formation of unions, technology clusters, or professional associations serve as a mechanism for sharing resources, experiences, and creative solutions to reduce the effects of sanctions and financial constraints. Likewise, collaboration with smaller domestic or regional firms through joint projects may help distribute risk among companies.

A strong focus on digital branding and the strategic use of social media and trade exhibitions can enable information technology companies to introduce their products and services to customers in a targeted and wide-reaching manner. In addition, creating

a creative and learning-oriented work environment, along with organizing specialized workshops and mentoring programs, can enhance the retention motivation of skilled professionals within companies.

Limitations

The present study was subject to several limitations, including limited access to and cooperation from some companies, which may have reduced the diversity of perspectives to some extent. The findings are also related to a specific time period, and future changes in the market, policies, or technologies may provide grounds for complementary studies. In addition, the study focused solely on knowledge-based companies operating in the information technology sector in Iran; therefore, the findings are mainly applicable to the in-depth analysis and understanding of this particular group.

Conflict of Interest

The authors declare that there is no conflict of interest.

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