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Evaluating technological intelligence dimensions in innovative startups: A confirmatory factor analysis approach

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A B S T R A C T

This article aims to study technological intelligence in innovative startups in Algeria using Kerr's model. Technological intelligence consists of four main dimensions: intelligent systems, competitive intelligence, market intelligence, and intelligent processes. To collect data, a questionnaire was distributed to a sample of 255 innovative startups in Algeria, and the data were analyzed using confirmatory factor analysis (CFA) with Smart PLS software. The results indicated that the two-dimensional model combining intelligent systems and competitive intelligence provided the best fit, with a relationship value of 0.605 between these two dimensions. On the other hand, the relationship between market intelligence and competitive intelligence was weak, with a value of 0.281, reflecting the limited use of analytical methods by startups to monitor competitors. Based on these findings, the study recommends that innovative startups in Algeria enhance their use of competitive intelligence and intelligent systems to improve decision-making processes. Additionally, these startups should make better use of available market technologies to develop their products and services, while focusing on continuous competitor analysis and identifying opportunities. In conclusion, technological intelligence is a strategic element for startups, helping them improve their performance and achieve a competitive edge in the changing business environment in Algeria.

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1. Introduction

In today's world, creating value within organizations based on knowledge generation has become increasingly important due to the need to adapt to environmental changes, particularly in the realm of technology. This is the reason why intelligence systems have become established, owing to their diversity, in order to identify internal capabilities and environmental changes by transforming data into strategic knowledge (Castellanos & Torres, 2010, p. 2). Furthermore, modern environmental developments impose on organizations the challenge of accessing relevant information before competitors and using it optimally as a tool for decision-making (Dayal et al., 2009). Among these developments is the concept of technological intelligence, which serves as a capability employed by enterprises to support decision-making processes by gathering and presenting information about new technologies (Mortara et al., 2009, p. 2). It involves the timely acquisition and transfer of technological information, which is part of the process through which organizations gain insights into technological threats and opportunities, ultimately enhancing decision-making in technological matters such as new business ventures and technology development (Hataminejad et al., 2020).

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Although technological intelligence operates as an independent tool for a specific set of goals and needs, it requires a deep understanding of business plans, market demands, and external environmental conditions. It also necessitates access to and review of patents and publications (Arman & Foden, 2010, p. 185). Technological intelligence involves various processes necessary for organizations to allocate resources and continuously implement them. The goal of technological intelligence is to exploit potential opportunities and defend against potential threats by providing timely and relevant information about technological trends in the business environment (Lichtenthaler, 2004, pp. 197-221). Additionally, it seeks to identify new products, processes, trends, and events that are critical to competitiveness, as well as to enhance and optimally utilize core technological competencies (Kobe, 2003, p. 2). Technological intelligence explores ever-evolving and complex technologies to assist in understanding the direct and indirect activities that support managerial technology in decision-making (Chukuigwe, 2022). It relies on a set of elements that are vital for strategic planning and execution, with a focus on the market (Dishman & Calof, 2008). It is a continuous and cyclical process designed to continuously generate knowledge from data and information (Mekimah et al., 2024, p. 2). Through this study, we aim to examine the elements of technological intelligence in emerging projects as outlined in Kerr's model, focusing on the following key question:

What are the elements of technological intelligence according to Kerr's model as achieved by innovative startups in Algeria?

2. Literature Review

Technological intelligence refers to a set of activities that support technological decision-making by leveraging the timely preparation of relevant information on facts and technological trends; opportunities and threats from the organization's environment through collection, analysis, and dissemination methods (Gonçalves & Carvalho de amelda, 2019, p. 107). It captures and delivers technological information as part of the process by which organizations become aware of technological threats and opportunities (Ying & Mortara, 2017, p. 4). It is a process that focuses precisely on science and technology and their impact on the organization's research and development activities (Colakodlu, 2011, p. 20). Technological intelligence is characterized by its focus on technological trends and scientific breakthroughs, which enable the development of information regarding opportunities and threats for the organization, and it facilitates social communication, efficiency, and productivity.

Technological intelligence is distinguished by several key features, the most important of which is its ability to allow organizations to respond to threats, identify, and exploit opportunities arising from technological and scientific changes. It supports innovation strategies, research, and development. Additionally, it provides easy access to information, enhances social communication, efficiency, and productivity, and improves decision-making, encouragement, and creativity (Asikhia et al., 2019, p. 26). Other characteristics include dynamism, flexibility, and methodical processes (Castellanos & Torres, 2010). Technological intelligence is a crucial element of strategic management for every organization, offering potential benefits such as identifying technologies that present opportunities or threats, generating ideas based on new technologies, solving problems related to the current development of projects, collecting information to support decision-making on project initiation, complementing core technological competencies, and optimally utilizing them, while also enabling the creation and application of new technologies (Kobe, 2003, p. 2).

Technological intelligence operates at different levels, the most notable being the national level. At this level, organizations use mechanisms such as international R&D units, technology ambassadors, participation in conferences, and international exhibitions to gain intelligence. At the sector or industry level, organizations carefully define the objectives of their technological intelligence systems based on the relevant industry to meet specific goals, such as decisions about entering technological fields, and so on. At the business level, organizations establish connections between users and intelligent tools to precisely identify information needs and strengthen spontaneous behaviors in identifying and applying technological trends in their business operations to improve their performance (Hataminejad et al., 2020, p. 6).

Technological intelligence involves activities related to analyzing and communicating relevant information on technological trends to support technological decisions within the organization. Its primary objective is to exploit potential opportunities and defend against threats by providing timely delivery of relevant technological trend information in the work environment. Technological intelligence activities can be summarized in four points: searching the environment for signals that may precede significant technological changes, identifying the potential consequences of these signals (assuming the signals are not false and that the trends they suggest remain valid), selecting the information, policies, events, and decisions that should be monitored to verify the actual speed and direction of the technology and its effects, and providing data from the previous steps in a timely and appropriate manner for management to make decisions regarding the organization's interactions. According to Kerr's model, technological intelligence consists of four elements: competitive intelligence, a critical tool for an organization's strategy, reflected in the formal planning, management, and exploration process of its marketing strategy model (Rahma & Mekimah, 2023). It is a behavior used by organizations and countries alike as a means to enhance competitiveness through the better use of information (Faruq & Tatnall, 2016). Market intelligence, expressed as a strategy that links an organization's activities with its resources and capabilities, aims to maximize current and future performance by transforming existing objectives into functional and operational ones (Johnson et al., 2008). It impacts both long-term and short-term planning and adds value to strategic decision-making (Lackman et al., 2000). Additionally, intelligent systems, defined as a set of technical or technological means that interact with individuals or groups, or function independently, are capable of making decisions

based on information, knowledge, and motivation to achieve a goal and find a rational way to achieve it (Pupkov, 2017, p. 1). Intelligent processes involve identifying intelligent information needs, collecting information, analyzing it, disseminating it, and decision-making (Ranjbar & Cho, 2016).

Startups are defined as technology-based companies that use scalable business models, relying on continuous improvements to the technology underpinning their project, enabling them to create new products or services. These companies aim to gain a competitive advantage and create value by committing to developing their intellectual capital. The primary strength of startups lies in their fresh thinking and small size, which provides more room for innovation (Thiel & Masters, 2014, p. 11). Startups are diverse and complex by nature, with distinct life cycle characteristics, and they have evolved significantly in recent years (Salamzadeh & Kawamorita, 2015, p. 1). They serve as powerful drivers of open innovation processes, aiming to find repeatable and scalable business models during the startup phase, where new ideas are introduced to the market and transformed into economically sustainable companies (Spender et al., 2017, p. 2). These companies are composed of individuals whose primary goal is to create a new product or service in uncertain conditions, representing a human endeavor, not merely one based on a product, technology, or innovative idea (Mikle, 2020).

3. Research methodology

To achieve the study results and identify the best model for measuring technological intelligence according to the Kerr model, innovative startups in Algeria were studied as a case study. This involved testing first-order confirmatory factor analysis using Smart PLS 4 software through the CB-SEM methodology.

3.1. Presentation and Analysis of the Study Tools

The study population was estimated at a total of 756 innovative startups in Algeria. A simple random sample was selected using this formula: (Steven & Thompson, 2012, pp. 53-56)

$$n = \frac{N \times p \times (1-p)}{\frac{d^2}{z^2} \times (N-1) + p \times (1-p)}, \tag{1}$$

N: Population size
z: Standard score corresponding to the significance level of 0.95, which equals 1.96
d: Margin of error, which equals 0.05
p: Proportion of the characteristic's presence and neutrality = 0.50

Applying Eq. (1) yields

$$n = \frac{756 \times 0.05 \times (1-0.05)}{\frac{0.5^2}{1.96^2} \times (1,300,000-1) + 0.05 \times (1-0.05)} \approx 255. \tag{2}$$

Out of these, 255 questionnaires were returned and deemed analyzable, resulting in a response rate of 100%. To test the relationships between the study variables and build a valid model, a questionnaire was designed comprising 16 questions divided into 4 sections.

Table 1
Questionnaire items

Construct	Item code	Item number	Statement
Competitive intelligence	CO1	1	Your organization incorporates the goal of obtaining information into its plans.
	CO2	2	Your organization encourages its employees to document the information they possess based on their experience and learning.
	CO3	3	Your organization employs systems and methods to analyze its competitors.
	CO4	4	Your organization conducts early detection of risks and available opportunities.
Market intelligence	MA1	5	Your organization uses the internet to connect its internal units and branches in the market.
	MA2	6	Your organization benefits from available technology in the market to develop its products and services.
	MA3	7	Your organization utilizes smart programs to search for information available in its job market.
	MA4	8	Your organization creates a map that includes all current and future trends regarding individuals' needs and preferences.
Intelligence systems	S1	9	Your organization employs the internet to meet customer demands as quickly as possible.
	S2	10	Your organization provides a safety and occupational health system to minimize risks and workplace accidents.
	S3	11	Your organization uses smart programs and systems to aid in decision-making.
	S4	12	Your organization employs data and information backups in case of loss.
Intelligence operational	O1	13	Your organization engages in storing large amounts of information.
	O2	14	Your organization sorts and selects stored information to achieve success.
	O3	15	Your organization invests time and money in research and development.
	O4	16	Your organization effectively uses its information technology to achieve cost-reduction goals.

The value of technological intelligence is measured by the interest of startups in it, using indicators that include: market intelligence, competitive intelligence, Intelligence systems, and intelligent processes. Based on this conceptual foundation, and as shown in the table above, 16 survey questions were produced as illustrated in Table 1. Each item has five possible responses according to the Likert scale: "Strongly Disagree, Disagree, Neutral, Agree, Strongly Agree."

3.2. Confirmatory Factor Analysis of the Technological Intelligence Dimensions in Innovative Startups According to Kerr's Model

Technological intelligence, according to Kerr's model, consists of four elements: competitive intelligence, market intelligence, intelligent systems, and intelligent processes. To validate this model, we employed confirmatory factor analysis (CFA) to confirm these dimensions. The following configurations were used: two dimensions of technological intelligence, three dimensions, and all four dimensions combined, as detailed below:

3.2.1. Confirmatory Factor Analysis for Two Dimensions of Technological Intelligence

Below is the free model concerning the two dimensions of technological intelligence in innovative startups according to Kerr's model. This is illustrated in the Table2.

Table 2
Fit Indices for the Two Dimensions of Technological Intelligence

Measurement Model	X2/ df	NFI	CFI	TLI	RMSEA	GFI	SRMR	Chi-square, X2	P value
Terminology	Chi-Square Value	Standardized Fit Index	Comparative Fit Index	Tucker-Lewis Index	Root Mean Square Error of Approximation (RMSEA)	Goodness of Fit Index (GFI)	Square Root of Mean Square Error (RMSE)	Chi-Square	Significance Level
Acceptance Criterion	From 1 to 5	NFI≥ 0,9	CFI≥ 0,9	TLI≥ 0,9	RMSEA≤0,08	GFI≥0.9	SRMR ≤0.08	The lower, the better	P≤0.05
Systems and Market Intelligence	3.042	0,946	0,963	0,946	0,089	0,951	0,035	57.805	0.000
Systems and Competitive Intelligence	1.944	0,969	0,985	0,978	0,061	0,966	0,029	36.931	0.000
Processes and Market Intelligence	3.012	0.947	0.964	0.946	0.089	0.950	0.038	57.227	0.000
processes and competitive intelligence	2.791	0.954	0.970	0.956	0.084	0.954	0.046	53.029	0.000
intelligent systems and processes	6.619	0.898	0.911	0.869	0.148	0.896	0.051	125.759	0.000
market and competitive intelligence	2.867	0.971	0.980	0.951	0.086	0.983	0.032	11.467	0.000

Based on Table 2, it becomes clear that technological intelligence can be represented through two dimensions, namely: systems and market intelligence, systems and competitive intelligence, processes and market intelligence, processes and competitive intelligence, intelligent systems and processes, and market and competitive intelligence. After subjecting the model to confirmatory factor analysis, it became evident that the proposed model for measuring technological intelligence did not exhibit an acceptable fit (lack of goodness-of-fit) for the following combinations: systems and market intelligence, processes and market intelligence, processes and competitive intelligence, intelligent systems and processes, and market and competitive intelligence, as most indicators did not meet the required threshold. The suitable model for measuring technological intelligence was found in the combination of intelligent systems and competitive intelligence, as all indicators met the criteria.

The Goodness-of-Fit Index (GFI) value reached 0.966, while the Standardized Root Mean Square Residual (SRMR) value was 0.029. The Comparative Fit Index (CFI) value was 0.963, and the Root Mean Square Error of Approximation (RMSEA) value was 0.061. The Tucker-Lewis Index (TLI) value reached 0.978, and the Chi-square (X^2) value was 36.931, while the Chi-square per degree of freedom ratio (Chisqr/df) was 3.042. This indicates that all the indicators demonstrated a good fit for the adjusted technological intelligence measurement model at a significance level of 0.000. Figure 1 illustrates these results.

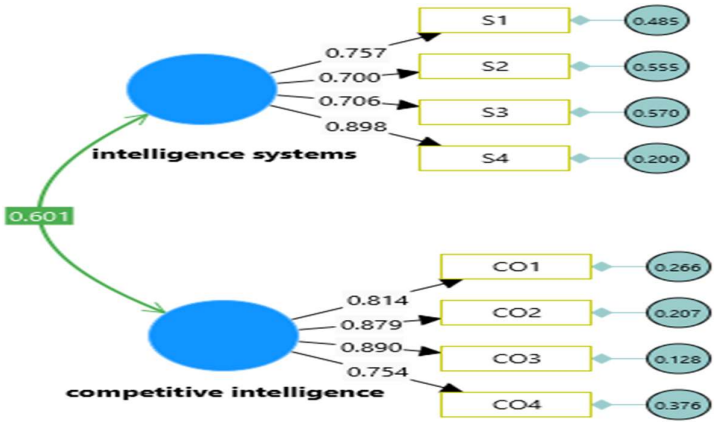

Fig. 1. Diagram of the Confirmatory Factor Model for Technological Intelligence

Based on Fig. 1, it is evident that all correlation coefficients (saturation values) between the items and latent variables were high. The relationship between the two dimensions, intelligent systems and competitive intelligence, was moderate, estimated at 0.601.

3.2.2. Confirmatory Factor Analysis for Three Dimensions of Technological Intelligence

Below is the free model concerning the three dimensions of technological intelligence in innovative startups according to Kerr's model. This is illustrated in the Table3.

Table 3
Fit Indices for the Three Dimensions of Technological Intelligence

Measurement Model	X2/ df	NFI	CFI	TLI	RMSEA	GFI	SRMR	Chi-square, X2	P value
Terminology	Chi-Square Value	Standardized Fit Index	Comparative Fit Index	Tucker-Lewis Index	Root Mean Square Error of Approximation (RMSEA)	Goodness of Fit Index (GFI)	Square Root of Mean Square Error (RMSE)	Chi-Square	Significance Level
Acceptance Criterion	From 1 to 5	NFI≥ 0,9	CFI≥ 0,9	TLI≥ 0,9	RMSEA≤0,08	GFI≥0.9	SRMR ≤0.08	The lower, the better	P≤0.05
Intelligent systems, competitive intelligence, and market intelligence	3.578	0.906	0.930	0.909	0.101	0.899	0.042	182.480	0.000
Intelligent systems, competitive intelligence, and intelligent processes	3.838	0.904	0.927	0.905	0.105	0.893	0.047	195.733	0.000

Based on Table 3, it is clear that technological intelligence can be represented through three dimensions: intelligent systems, competitive intelligence, and market intelligence, as well as intelligent systems, competitive intelligence, and intelligent processes. After subjecting the model to confirmatory factor analysis, it was evident that the proposed model for measuring technological intelligence did not exhibit an acceptable fit for the following combinations: intelligent systems, competitive intelligence, and market intelligence, and intelligent systems, competitive intelligence, and intelligent processes, as some indicators did not meet the required thresholds. The appropriate model for measuring technological intelligence was found in the combination of intelligent systems, competitive intelligence, and market intelligence, but adjustments were necessary to improve the model's fit. The table 4 illustrates the structure of the adjusted model for the three dimensions of technological intelligence.

Table 4 shows that the Goodness-of-Fit Index (GFI) value reached 0.972, while the Standardized Root Mean Square Residual (SRMR) value was 0.032. The Comparative Fit Index (CFI) value was 0.978, and the Root Mean Square Error of Approximation (RMSEA) value was 0.08. The Tucker-Lewis Index (TLI) value was 0.958, and the Chi-square (X^2) value was 61.420, compared to the previous value of 25.220. The Chi-square per degree of freedom ratio (Chisqr/df) was 2.293, indicating that all the indicators demonstrated a good fit for the adjusted technological intelligence measurement model. This confirms that all these indicators have achieved a satisfactory level of fit. This can be further illustrated in the Fig. 2.

Table 4
Fit Indices for the Three Confirmed Dimensions of Technological Intelligence

Measurement Model	X2/ df	NFI	CFI	TLI	RMSEA	GFI	SRMR	Chi-square. X2	P value
Acceptance Criterion	From 1 to 5	NFI≥ 0.9	CFI≥ 0.9	TLI≥ 0.9	RMSEA≤0.08	GFI≥0.9	SRMR ≤0.08	The lower. the better	P≤0.05
Intelligent Systems, Competitive Intelligence, and Market Intelligence	2.293	0.963	0.978	0.958	0.071	0.972	0.032	25.220	0.000
Decision	achieved	achieved	achieved	achieved	achieved	achieved	achieved	achieved	Achieved

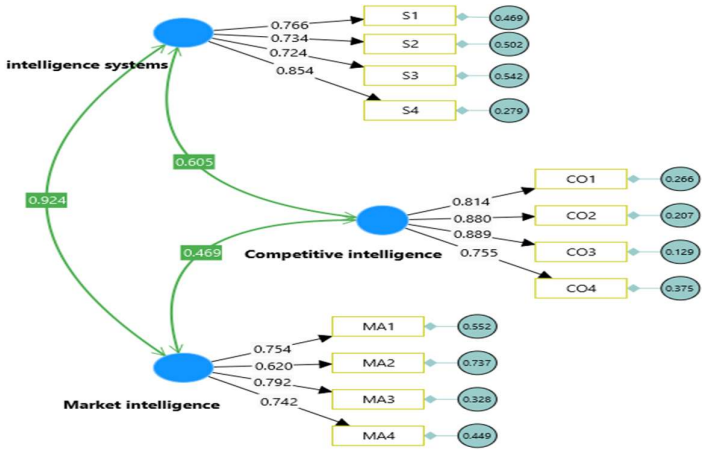

Fig. 2. Diagram of the Confirmatory Factor Model for the Three Dimensions of Technological Intelligence

Based on Fig. 2, it is evident that all correlation coefficients (saturation values) between the items and latent variables were high. The relationship between the dimensions intelligent systems and competitive intelligence** was moderate, estimated at 0.605. The relationship between competitive intelligence and market intelligence was also moderate, estimated at 0.469, while the relationship between intelligent systems and market intelligence was strong, with an estimate of 0.924.

3.2.3. Confirmatory Factor Analysis of Technological Intelligence Dimensions:

Below is the free model concerning the dimensions of technological intelligence in innovative startups according to Kerr's model, which can be illustrated in the following table:

Table 5
Fit Indices for the Four Dimensions of Technological Intelligence

Measurement Model	X2/ df	NFI	CFI	TLI	RMSEA	GFI	SRMR	Chi-square. X2	P value
Acceptance Criterion	From 1 to 5	NFI≥ 0.9	CFI≥ 0.9	TLI≥ 0.9	RMSEA≤0.08	GFI≥0.9	SRMR ≤0.08	The lower. the better	P≤0.05
Intelligent systems, competitive intelligence, market intelligence, and intelligent processes	4.067	0.862	0.891	0.867	0.110	0.852	0.050	398.583	0.000
Decision	achieved	Not achieved	Not achieved	Not achieved	Not achieved	Not achieved	achieved	achieved	Achieved

Based on Table 5, it is clear that technological intelligence is represented by four dimensions: intelligent systems, competitive intelligence, market intelligence, and intelligent processes. After subjecting the model to confirmatory factor analysis (CFA), it became evident that the proposed model for measuring technological intelligence (intelligent systems, competitive intelligence, market intelligence, and intelligent processes) did not show an acceptable fit, as most indicators did not meet the

required thresholds. However, adjustments are necessary to improve the model's goodness-of-fit. The 6 table illustrates the structure of the adjusted model for the four dimensions of technological intelligence:

Table 6
Fit Indices for the Four Confirmed Dimensions of Technological Intelligence

Measurement Model	X2/ df	NFI	CFI	TLI	RMSEA	GFI	SRMR	Chi-square, X2	P value
Acceptance Criterion	From 1 to 5	NFI≥ 0.9	CFI≥ 0.9	TLI≥ 0.9	RMSEA≤0.08	GFI≥0.9	SRMR ≤0.08	The lower, the better	P≤0.05
Intelligent systems, competitive intelligence, market intelligence, and intelligent processes	3.749	0.931	0.947	0.910	0.078	0.940	0.059	87.731	0.000
Decision	achieved	achieved	achieved	achieved	achieved	achieved	achieved	achieved	Achieved

The table shows that the Goodness-of-Fit Index (GFI) value reached 0.940, while the Standardized Root Mean Square Residual (SRMR) value was 0.059. The Comparative Fit Index (CFI) was 0.947, and the Root Mean Square Error of Approximation (RMSEA) value was 0.078. The Tucker-Lewis Index (TLI) value was 0.910, and the Chi-square (X^2) value was 78.731, while the Chi-square per degree of freedom ratio (Chisqr/df) was 3.749. This indicates that all the indicators demonstrated a good fit for the adjusted technological intelligence measurement model, confirming that all these indicators have achieved a satisfactory level of fit. This can be further illustrated in the following Fig. 3.

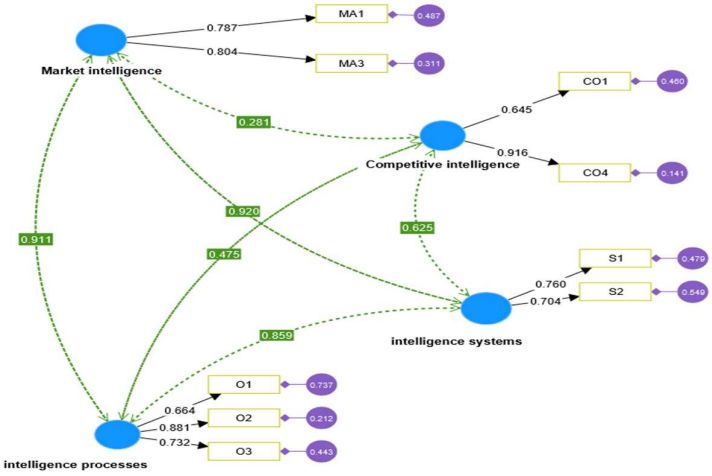

Fig. 3. Schematic Diagram of the Confirmatory Factor Model for the Four Dimensions of Technological Intelligence

Based on Fig. 3, all correlation coefficients (saturation values) between the items and latent variables were high. The relationship between market intelligence and competitive intelligence was 0.281, indicating a weak relationship. The relationship between market intelligence and intelligent systems was 0.920, showing a strong relationship, while the relationship between market intelligence and intelligent processes was 0.911, also indicating a strong relationship. The relationship between competitive intelligence and intelligent systems was 0.625, which is moderate, and the relationship between competitive intelligence and intelligent processes was 0.475, showing a moderate relationship. The relationship between intelligent systems and intelligent processes was 0.859, demonstrating a strong connection.

3.2.4. Confirmatory Factor Analysis for the Best Technological Intelligence Model According to Kerr's Model in Innovative Startups

Below is the free model concerning the best technological intelligence model in innovative startups according to Kerr's model, as illustrated in Table 7.

The table shows that all the values of the technological intelligence model indicators are satisfactory and well-achieved. However, the two-dimensional model, concerning intelligent systems and competitive intelligence, represents the best model with a good fit compared to the three-dimensional and four-dimensional models for the measurement of technological intelligence. This indicates that the two-dimensional model is more suitable for accurately measuring technological intelligence in the context of innovative startups in Algeria.

Table 7
Fit indices for the technological intelligence model before and after adjustment.

Measurement Model	X2/ df	NFI	CFI	TLI	RMSEA	GFI	SRMR	Chi-square, X2	P value
Acceptance Criterion	From 1 to 5	NFI≥ 0.9	CFI≥ 0.9	TLI≥ 0.9	RMSEA≤0.08	GFI≥0.9	SRMR ≤0.08	The lower. the better	P≤0.05
Intelligent Systems and Competitive Intelligence	1.944	0.969	0.985	0.978	0.061	0.966	0.029	36.931	0.000
Intelligent Systems, Competitive Intelligence, and Market	2.293	0.963	0.978	0.958	0.071	0.972	0.032	25.220	0.000
Intelligent Systems, Competitive Intelligence, Market Intelligence, and Smart Processes	3.749	0.931	0.947	0.910	0.078	0.940	0.059	87.731	0.008
Decision	achieved	achieved	achieved	achieved	achieved	achieved	achieved	achieved	achieved

4. Discussion

Through our study, we arrived at several key findings, which are summarized as follows:

- Technological intelligence is a process that focuses precisely on science, technology, and their impact on research and development activities in startups. This finding aligns with the study by (Colakodlu, 2011, p. 20).

- Startups can apply technological intelligence by considering competitive intelligence and early detection of risks and opportunities. This finding aligns with the study by Rodrigues (Gonçalves & Carvalho de amelda, 2019), though our study differs in that it focuses on startups in Algeria, while theirs focused on small and medium enterprises (SMEs) in Korea.

- Technological intelligence consists of four elements according to Kerr's model, as confirmed in our study, which aligns with Kerr et al. (2006).
- Competitive intelligence contributes to enhancing startup performance, consistent with the findings of (Hassani & Mosconi, 2021), though their study focused on SMEs.

- There is a weak relationship between market intelligence and competitive intelligence, likely because innovative startups do not employ systems or methods to analyze their competitors. This finding is consistent with but differs from (Hussein, 2020), who found a strong relationship and influence between competitive and market intelligence.

- There is a strong relationship between market intelligence and intelligent processes in innovative startups, likely due to the use of smart programs to gather available market information. This aligns with the study by Mandal (2022).

- There is a moderate relationship between competitive intelligence and intelligent processes, which can be attributed to innovative startups' limited capacity to conduct early risk and opportunity detection. This finding contrasts with the study by Madureira et al. (2023).

Our study differs from previous studies in several significant results, summarized as follows:

- The two-dimensional model (intelligent systems and competitive intelligence) represents the best fit compared to the three- and four-dimensional models for measuring technological intelligence in innovative startups in Algeria.

- There is a strong relationship between market intelligence and intelligent systems in innovative startups, as these startups employ the internet to meet customer demands promptly.

- There is a strong relationship between intelligent systems and intelligent processes, as innovative startups effectively use smart systems and programs to aid decision-making and optimize their use of information technology.

- Innovative startups do not heavily utilize market intelligence and intelligent processes, primarily due to their insufficient use of available technologies in the market to develop products and services, as well as their failure to effectively filter stored information to ensure success.

Based on the results, we recommend that innovative startups in Algeria prioritize technological intelligence as it plays a crucial role in improving performance. They should also focus on competitive intelligence, which is essential for making strategic decisions that enhance performance, as well as on early detection of risks and opportunities. Additionally, market intelligence should be given more attention, as it has a less significant impact on improving performance. Leveraging market technology to develop products and services and addressing the gap in understanding the needs and desires of potential customers is essential. Startups in Algeria should also prioritize intelligent systems since they enable faster human responses and aid in decision-making. Continuous development of intelligent processes is crucial to handling big data and achieving competitive advantages. Startups should actively seek out market opportunities and reduce their reliance on non-renewable resources to preserve the environment and energy. It is also vital to document workers' knowledge gained from experience and learning. Moreover, Algerian startups should set growth and expansion as strategic goals after the legally defined period of eight years, aspiring to evolve into larger enterprises.

5. Conclusion

Technological intelligence is a critical factor in enhancing performance and fostering innovation in startups, particularly in dynamic and ever-changing business environments. Through this study, we found that the two-dimensional model comprising intelligent systems and competitive intelligence is the most effective for measuring technological intelligence in innovative startups in Algeria. This highlights the importance of adopting smart strategies to navigate technological challenges and opportunities. The study also revealed strong relationships between certain dimensions of technological intelligence, such as the link between intelligent systems and market intelligence, underscoring the need to integrate these dimensions in developing innovative products and services that meet market demands.

While some other dimensions, such as market intelligence and competitive intelligence, exhibited weaker relationships, this presents an opportunity for startups to improve their methods of analysis and monitoring to fully capitalize on available opportunities. Based on these findings, the study recommends increasing the focus on technological and competitive intelligence to enhance competitiveness and strategic decision-making, as well as promoting the use of intelligent systems in daily operations.

In conclusion, technological intelligence represents a vital tool that Algerian startups can leverage to achieve growth and excel in a complex and fast-paced business environment. By adopting this model and continuously improving their tools and processes, these startups can boost their efficiency and competitive potential both locally and internationally.

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