



## Interpretive Structure Model Designer Risk management in the field of investing in start-up companies in the capital market

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### ABSTRACT

As drivers of innovation and economic growth, start-ups play a significant role in the dynamism of capital markets. However, investing in such companies entails a variety of complex, multidimensional, and interconnected risks; identifying, analyzing, and managing these risks requires a structured and systematic approach. This study aims to design a risk management model for start-up investments within the capital market, utilizing Interpretive Structural Modeling (ISM). The research is exploratory in nature and employs a qualitative approach. Data were collected through interviews with 17 experts, utilizing a snowball sampling method. Subsequently, thematic analysis was applied to categorize and analyze the data extracted from both the literature and the interviews. Semi-structured interviews and a literature review guided by a thematic analysis strategy served as the primary methods for data collection. Ultimately, the analysis yielded 72 initial themes, which were classified into 15 basic themes, 6 organizing themes and 1 global theme. The findings indicate that corporate governance and strategic management alongside macro-environmental and social risks function as foundational factors at the lowest level of the model. These factors set the stage for the emergence of technological and innovation-related risks, as well as legal, regulatory, and intellectual property risks, which are situated at the intermediate level of the model. This category of risks directly impacts operational, supply chain, and human resource-related risks. These, in turn, serve as precursors to financial, investment, market, competitive, and brand-related risks situated at the final level of the model. The final model developed in this research can assist capital market decision-makers, managers of start-ups and investors in better understanding the structure of risks, prioritizing threats, and formulating effective risk management strategies. By identifying the causal and dependent levels of risk, this study provides a scientific foundation for integrated risk management within the dynamic environment of the capital market.

**Keywords:** Risk management, start-ups, capital market, strategic management, interpretive structure.



## 1. Introduction

The economic uncertainty of the past few years has significantly impacted how companies operate today. Organizations that once relied on forecasts to guide their smooth operations are now increasingly turning to business judgment. To navigate this environment and address the challenges ahead, companies are employing a concept known as "risk management." Risk is the primary source of uncertainty within any organization (Bilialov, 2022). Consequently, firms are placing greater emphasis on identifying risks and managing them before they can affect the business. The ability to manage risk enables companies to make future business decisions with greater confidence. By being aware of the risks they face, organizations gain access to various options for addressing potential problems (Pokala et al., 2018).

Risk management encompasses the identification, analysis and response to risk factors that are inherent to business operations. Effective risk management involves attempting to control future outcomes to the extent possible through proactive rather than reactive measures. Thus, effective risk management offers the potential to reduce both the likelihood of a risk occurring and its potential impact (Kubokko et al., 2017). Risk management frameworks are designed to do more than simply point out existing risks; a robust framework should also account for uncertainties and forecast their impact on the business. Ultimately, the outcome is a choice between accepting or rejecting risks. This decision depends on the tolerance levels that a business has previously defined for itself. If a business establishes risk management as a systematic and continuous process for identifying and addressing risks, the resulting risk management structures can support other risk-mitigation systems such as planning, organizing, cost control, and budgeting. In such a scenario, a business is less likely to encounter major surprises, as the focus remains on proactive risk management (Nadali et al., 2018).

Risk management is a vital process; it equips a business with the necessary tools to effectively identify and address potential risks. Once a risk has been identified, it becomes easier to mitigate. Furthermore, risk management provides a foundation upon which a business can make sound decisions (Raty, 2019). For any business, assessing and managing risk is the best way to prepare for contingencies that may arise along the path of growth

and development. By evaluating plans to manage potential threats and establishing structures to address them, a business increases its chances of becoming a successful entity. Moreover, proactive risk management ensures that high-priority risks are addressed with the utmost rigor. Furthermore, management will possess the necessary information to make informed decisions and ensure the profitability of the business (Polishchuk et al., 2019). Given the intensifying pace of change, managers in order to maintain their organization's competitive advantage must foster internal flexibility. They should strive to implement appropriate adjustments to organizational strategies and internal factors, thereby aligning the organization with the shifting conditions and demands of the external environment. Strategic management serves as a key instrument in this endeavor. The development and implementation of strategic management within an organization are influenced by a variety of factors (Bentley & Kohe., 2020). Environmental shifts spanning areas such as technology, the competitive landscape, and government economic policies necessitate organizational adaptation to ensure survival and excellence; in dynamic environments, companies facing competition must evolve. The rapid pace of environmental change today has established strategic management as the primary source of competitive advantage, particularly in fast-changing markets. In essence, strategic management can be understood as fundamental shifts in an organization's structure, processes, and culture, designed to enhance the alignment between the organization and its environment in terms of resources and value creation (Adenji et al., 2018). Moreover, aligning human resource strategy with ethical decision-making practices can positively impact organizational performance. In management literature, three coordination models have been proposed: the rational model, the natural model, and the comprehensive model (or the "strategic reference points" framework). By assessing their current status relative to these strategic reference points, organizations can select an appropriate strategy (Hashemi et al., 2019).

Risks can originate from both internal and external sources. External risks are those not directly under management's control such as political issues, exchange rates, and interest rates. Internal risks, on the other hand, include factors like non-compliance or data

breaches, among others. Consequently, risk management is vital for an organization; without it, a company cannot effectively define its future objectives. If a company sets goals without accounting for potential risks, it risks losing its intended path the moment any of these risks materialize (Prach et al., 2016).

In recent years, many companies have integrated risk management departments into their organizational structure. The role of this team involves identifying risks, developing strategies to mitigate them, implementing these strategies, and fostering a culture where all employees collaborate to support these risk management efforts. Larger organizations typically face greater risks; consequently, their risk management strategies must be more sophisticated (Davis & Richard., 2018). Furthermore, the risk management team is responsible for assessing each risk and determining which ones are critical to the business. Significant risks are those capable of exerting an adverse impact on the enterprise; such risks must be duly addressed and prioritized. The overarching objective of risk management is to ensure that a company assumes only those risks that facilitate the achievement of its core goals, while keeping other risks under control (Buchner et al., 2017). While risks and the challenges they entail are significant for all firms, becoming a primary concern for managers and corporate policymakers, certain companies are disproportionately affected due to their specific circumstances. The concept of risk holds even greater importance for newly established firms often referred to as "startups" as they have recently entered the market and lack extensive experience in the field. Internal and external threats, therefore, impact these types of companies more severely than they do more established, long-standing organizations (Proença et al., 2015). As evidenced by the economic conditions and current events in Iran, the country's primary capital market the stock exchange holds great significance for the public. In recent years, the intensification of investment activity, coupled with the market's frequent and substantial fluctuations, has drawn considerable attention. In this context, emerging firms that have recently entered this challenging market must employ sound management strategies to mitigate internal and more importantly external risks. By doing so, they can not only preserve their share value but also compete effectively against rivals and

gain a competitive edge. Consequently, the concept of risk management has become a critical priority for such firms and serves as the central focus of this study.

Existing literature indicates that risk management in these types of companies has been largely overlooked; few studies have addressed the subject, a gap that has led to numerous challenges (Bowers & Khorakian, 2014). Therefore, developing a risk management model for emerging firms one that adopts a strategic approach to identify various risk dimensions and provides an operational framework would undoubtedly help resolve many of the problems and threats these companies face, ultimately yielding significant benefits. In a general sense, strategic management entails the continuous planning, monitoring, analysis, and evaluation of all requirements that organizations must fulfill to achieve their goals and objectives (Farhat et al., 2017). Changes in work and business environments compel organizations to constantly evaluate their strategies for success. The strategic management process enables organizations to assess their current situation, define and implement strategies and examine the effectiveness of the management strategies put into place. By maintaining a defined strategic management process, organizations can make rational decisions and rapidly develop new objectives to align with emerging technologies, business conditions, and market dynamics. Consequently, strategic management assists organizations in gaining a competitive advantage, increasing market share, and planning for the future. Focusing on the characteristics of strategic management particularly in the present era can enhance the effectiveness of risk management processes within companies, as it encompasses all facets of an organization. Strategic management is rooted in a clear understanding of an organization's mission, its future vision and the values that guide its actions. This process requires a commitment to strategic planning a subset of business management which involves an organization's capacity to establish both short-term and long-term objectives. Strategic planning encompasses the planning of strategic decisions, activities, and the allocation of resources required to achieve these objectives.

In light of the points discussed, this study aims to provide an appropriate answer to the following question: "What is the design of an interpretive structural model for risk management in the context of

investments in startups within the capital market, with an emphasis on the role of strategic management in the new era?"

## 2-Theoretical Foundations and Literature Review

In a study, Silva et al., (2023) examined the mapping of risks faced by startup investors, employing an approach based on the Apriori algorithm. This paper identifies and validates the interdependencies among the risks encountered by startup investors. A systematic review of 33 articles was conducted, followed by a meta-analysis utilizing the Apriori algorithm. We identified 14 investment risks faced by startup investors and categorized them into four dimensions: external, internal, human, and capital. Furthermore, the Apriori algorithm revealed interdependencies among 9 of these investment risks. This research addresses a gap in the literature specifically, the lack of a structured, comprehensive approach to the risks faced by startup investors. Moreover, by providing a thorough examination and discussion of the connections between these risks, the study establishes a theoretical foundation for startup investment, grounded in an analysis of the risks inherent to this activity.

In a study, Şerban et al., (2023) explored the decision-making process regarding whether or not to invest in a startup. The paper discusses five stages involved in the financing of a startup business. The first stage entails market analysis to assess potential growth including estimating the addressable market, analyzing the competitive landscape (using tools such as the Five Forces model) and identifying the ideal customer and/or consumer. The second section focuses on the business model, which entails determining whether the offering is a technology-based product or a service, describing the product, providing numerical estimates, and defining the technological dimension. The third section outlines a growth strategy, involving the identification of competitive advantages and the development of a roadmap that details the core commercial and technical specifications to be pursued in the future. The fourth stage involves determining the required investment amount and the intended allocation of funds. Valuing a startup is a critical step in this process; the article highlights two fundamental principles: first, that valuation methods are particularly

complex during the early stages of a startup and second, since startups are not publicly traded, valuation is inherently subjective and serves as an ongoing negotiation process. The final stage consists of an audit of the current situation to assess whether the company faces any legal or financial risks, and to determine the feasibility of securing financing.

Bilyalov., (2022) examined risk management in startups focused on innovative production. The study aims to modernize the process of introducing innovative products to the market via startups, taking into account the innovative development trends of the modern economy. The research employs situational and design-based approaches; simulation and functional-structural modeling methods to determine potential market demand for innovative products and to plan their market introduction; and the BPMN notation to formalize integration links between stakeholders involved in the market introduction process. Consequently, a framework was developed to evaluate the economic efficiency of managing the market introduction of innovative products. This framework organizes various indicators across each stage of the innovation process, thereby enhancing the clarity and comprehensiveness of the management process while simultaneously reducing costs. The risk management system for innovative products is illustrated through the case of "Hideez Technology Ltd" an innovative startup as it entered the European and US markets. This approach enabled the company to achieve an economic gain of \$20,000. Finally, a sequence of managerial actions was defined to guide decision-making during the implementation of the strategy for managing the market introduction of innovative products.

Heydarzadeh Aghdam et al., (2021) presented a risk management model for digital banking. Utilizing a grounded theory research methodology and a literature review, this study explicates and develops a conceptual model for risk management within the digital banking sector. In the first phase, a comprehensive review of risk management models in digital banking was conducted. Following the identification of several gaps among the components of the current research, the second phase commenced, in which the researcher interviewed experts in management and decision-making within the banking industry. After coding the interviews and synthesizing the derived concepts, a conceptual model for risk management in digital

banking was developed. This model which emphasizes the monitoring and evaluation components of risk management in the country's digital banking sector is designed with a view toward international, national, and regional development, aiming to serve as a benchmark and model for the country and the broader region. Utilizing a fuzzy-expert methodology and a three-stage questionnaire distribution process, the study examined expert opinions regarding the significance of risk management indicators in digital banking, established a consensus among experts, and prioritized the research indicators. The findings of this study present an evaluation of the risk management model for digital banking within the nation's banking industry.

Taghva et al., (2021) conducted a study titled "Designing a Model for Developing Strategies to Cultivate Senior Managers in Knowledge-Based Companies." In recent years, many knowledge-based companies in Iran have faced failure within the competitive market; a primary cause of this failure is managerial weakness. Given the pivotal role of senior managers in the success of such companies, no scientific or systematic model for cultivating these executives has been proposed to date. This research employs a hybrid "function-competency" approach to present a model for identifying strategies to develop senior managers in knowledge-based companies. To this end, the core components of the model managerial functions, managerial competencies and methods for developing each competency were first identified. Subsequently, the relationships between these components were examined by gathering and synthesizing the insights of experts in the knowledge-based sector, utilizing the Copeland method. The study's findings indicate that senior managers in knowledge-based companies must perform six key functions: planning and organizing; team building and empowerment; effective leadership of personnel; motivating employees; evaluating technological trends and engaging with the external environment; and monitoring and controlling employee performance. To enhance managerial performance, the proposed model identifies five essential competencies for each function, along with two development strategies for each of those competencies.

Souri et al., (2021) developed a model for environmental quality risk management within the supply chain, specifically examining its impact on the

financial and quality performance of the Iran Khodro Company. This study employed a mixed-methods approach, consisting of both qualitative and quantitative phases. Given that the primary objective is to design an environmental quality risk management model for the supply chain at Iran Khodro, the study falls under the category of applied research. Furthermore, as it utilizes both library research (literature review) and field research methods specifically questionnaires it is classified as descriptive-survey research. In the qualitative phase, a snowball sampling method was used; the statistical population comprised high-level documents, records, academic articles, and theses relevant to the field. Following the identification of initial factors associated with each variable derived through textual content analysis interviews were conducted with 15 organizational experts and university professors to refine these factors, which were then validated using the Delphi method. In the quantitative phase, a convenience sampling method was employed to select a sample of 207 individuals who completed the research questionnaires. The collected data were analyzed using SPSS and LISREL statistical software. The findings indicate that formal and social controls implemented through supplier development and product recalls exert a positive influence on both the quality and financial performance of the Iran Khodro Company.

Ghaderi and Tari Verdi., (2020) presented a model for corporate risk management and examined its implications for the effective control of earnings attributes. In the present study, a corporate risk model is estimated and its effectiveness regarding earnings attributes is investigated. The statistical population consists of companies listed on the Tehran Stock Exchange, and a sample of 129 companies was selected based on the study's specific criteria. Panel data regression analysis was employed to analyze the data and test the hypotheses. To measure earnings attributes, this study utilizes three metrics: earnings persistence, earnings timeliness and earnings conservatism. The findings indicate that enterprise risk management does not have a significant impact on earnings attributes.

According to the existing theories, used models, as well as the review of domestic and foreign research background, it can be seen that despite conducting some studies in the field of risk management, the issue

of risk management in the field of investment of start-up companies in the capital market still faces fundamental challenges. It is important to note that comprehensive researches have not been done so far in order to provide a functional and structured model in this field. Both in domestic studies and in international researches, the focus of most researchers has been on the general investigation of investment risks or the analysis of the performance of start-up companies; Without having dealt with the special risk management of this category of companies in the framework of the capital market in an integrated and systematic manner. In other words, there is a clear research gap in the research literature regarding the identification, classification and modeling of the specific risks of start-up companies in the process of entry, survival and growth in the capital market. In the few researches, limited and sometimes only quantitative or qualitative approaches have been used, while comprehensive methods such as structural-interpretive modeling (ISM), which has the ability to analyze the relationships between complex and layered components of risk, have been used less. Therefore, it can be said that the lack of comprehensive and operational models for managing the risk of investment of start-up companies in the capital market is the main research gap in this field. In this regard, the present study tries to cover this existing gap by using the ISM method and provide a conceptual model for effective risk management in the investment of start-up companies in the capital market.

### 3- Research Methodology

The present study is exploratory in nature, aiming to construct concepts, patterns, and frameworks. In terms of orientation, it is fundamental (basic) research; philosophically, it adopts an interpretive stance. Its primary strategy is methodological pluralism, employing a qualitative approach that integrates thematic analysis with Interpretive Structural Modeling (ISM). In the first phase, thematic analysis is used to extract key themes related to risk management within the context of investments in start-up companies (ventures) within the capital market. Subsequently, these extracted themes are organized into hierarchical levels following the process prescribed by the Interpretive Structural Modeling method to develop a model illustrating the relationships among them. Data for a research project

can be gathered through both library-based research (literature review) and field methods, such as questionnaires or interviews. For this study, expert interviews were conducted for the thematic analysis phase, while a researcher-designed questionnaire was utilized for the Interpretive Structural Modeling phase. Given the research objectives, the questionnaire was administered to experts and specialists in the field of financial management; thus, the study's statistical population consists of experts and professionals within this domain. In the thematic analysis phase, 17 experts were interviewed, with participants selected via the snowball sampling method until "theoretical saturation" was reached. Theoretical saturation occurs when interviewees no longer provide new information, meaning that any subsequent data would merely be repetitive. Furthermore, to implement the Interpretive Structural Modeling (ISM) methodology, a questionnaire was distributed among experts; ultimately, 17 completed questionnaires were collected and served as the basis for this research. To enhance research credibility, qualitative researchers should employ at least two strategies (Agheli et al., 2023).

In the present study, the following measures were taken to achieve this objective: Member checking feedback on the research process report and data was obtained from two professors and two doctoral students in the field of Financial Management, leading to the revision of several concept labels based on their suggestions. Prolonged engagement with the research topic due to the compelling nature of the subject and the researcher's in-depth exploration of the concepts under discussion, the literature review process was quite extensive. Pluralism to ensure diversity within the examined literature, an effort was made to analyze various types of textual data, including books, articles, project proposals, and analyses published across different databases; Additionally, following Creswell, (2003) two methods were employed to ensure research reliability: a) maintaining detailed and precise field notes and b) conducting blind coding with the assistance of an individual outside the research team. In thematic analysis, data analysis is centered on the coding process. A "theme" represents a pattern or concept found within the data that relates to the research questions. This method provides a framework for analyzing textual data (such as that derived from interviews), transforming scattered and diverse information into rich, detailed data (Agheli et al., 2023).

Thematic networks, following a specific procedure comprising the examination of the text, the derivation of meaning from seemingly unrelated information, the analysis of qualitative data and the systematic observation of individuals, interactions, groups, organizational settings or cultures systematize themes into the following categories: \*basic themes\* (codes and key points extracted from interviews), \*organizing themes\* (categories derived from the synthesis and summarization of basic themes) and \*global themes\* (overarching themes that encompass the principles governing the text as a whole). These themes are then mapped as web-like networks, illustrating the prominent themes at each of the three levels, along with the relationships between them. A thematic network is not merely a preparatory step or a means of presenting final analytical results; rather, it is a method for deconstructing a text to uncover its significant and meaningful insights. Interpretive Structural Modeling (ISM) is an interactive learning process in which a set of diverse, interrelated elements is structured into a comprehensive, systematic model. This approach draws upon fields such as mathematics, graph theory, social sciences, group decision-making, and computer science. ISM assists in imposing order upon the complex relationships among the elements of a system and identifying the internal connections between variables; it serves as an effective technique for analyzing the influence of one variable upon others. As an interpretive method, it seeks to provide a judgment based on group decision-making regarding the connections between variables. It is termed "interpretive" because it is the group's judgment that determines which elements are related and the nature of those relationships. Furthermore, it is a structural model, in the sense that an overall structure comprising a complex set of elements is derived based on the existing relationships. Finally, the relationships among the elements and the identified overall structure are visualized and presented in a graphical model.

#### 4- Data Analysis and Research Findings

In the first step, to become familiar with the data, all information obtained from interviews regarding risk management and the capital market was reviewed. Following repeated reviews, 55 initial codes were extracted in the second step. In the subsequent step,

basic themes emerged through the analysis and synthesis of the annotated statements. In the fourth step based on the formation of 72 initial themes 15 basic themes, 6 organizing themes and 1 global theme were identified. In the fifth step, considering the organizing themes and the researcher's evolving perspective throughout the study, seven global themes were determined. Themes and patterns within data are identified using either an inductive (bottom-up) approach or a theoretical-deductive (top-down) approach. In the inductive approach, the identified themes are closely linked to the data itself and are derived from the collected information; conversely, in the theoretical-deductive approach, the themes stem from the researcher's theoretical interest in the subject, emerging from the existing literature and the researcher's professional background. Typically, research is conducted on a topic when there is a scarcity of existing theory regarding that subject; in such cases, an inductive approach is preferable. Therefore, this study employs an inductive method to extract basic, organizing, and global themes, as illustrated in the figure below.

#### 4-1- Construction of the Structural Self-Interaction Matrix

The Structural Self-Interaction Matrix (SSIM) is the primary matrix used in Interpretive Structural Modeling (ISM). It is employed to identify the interrelationships among indicators based on the perspectives of experts. The matrix derived at this stage reveals which variables influence others and which variables are influenced by others. Typically, symbols such as those presented in Table 3 are used to define the pattern of relationships between the elements.

The structural self-interaction matrix is constructed by considering the dimensions and indicators of the study and comparing them using four types of conceptual relationships. Based on the Interpretive Structural Modeling (ISM) methodology, the gathered information is synthesized to form the final structural self-interaction matrix (Agheli et al., 2023). In accordance with the symbols presented in Table 1, the structural self-interaction matrix is structured as shown in Table 2.

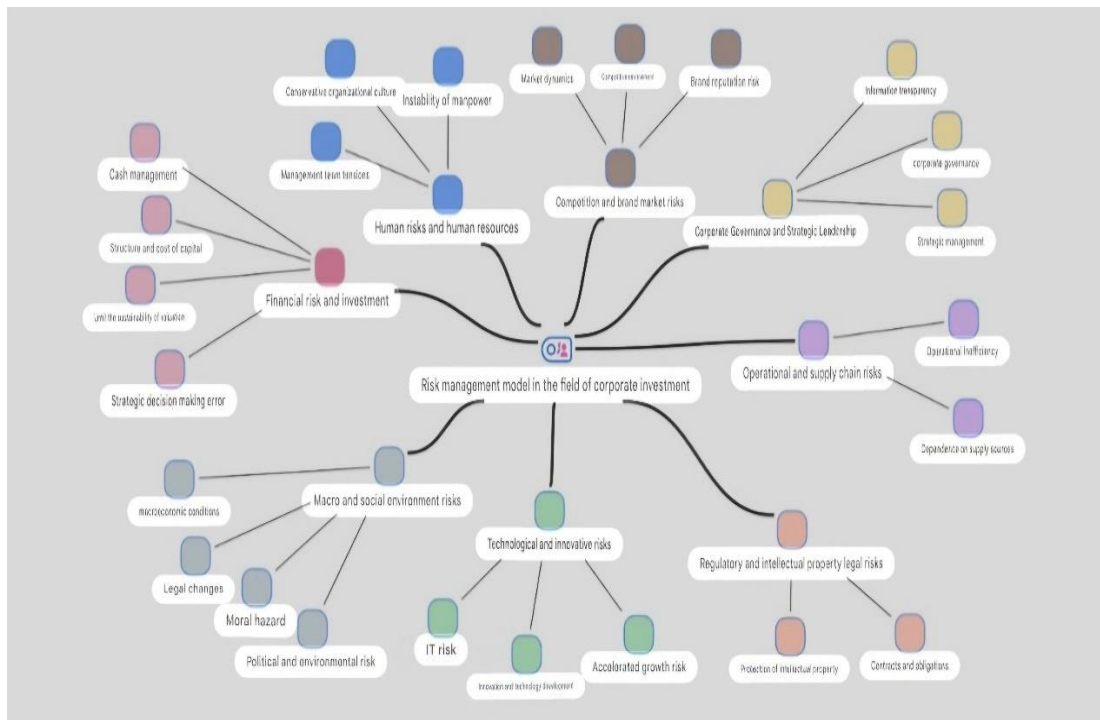


Figure (1): Initial Research Model

Table (1): States and Symbols Used to Describe Relationships Between Variables

| O                         | X                    | A                              | V                              | Symbol       |
|---------------------------|----------------------|--------------------------------|--------------------------------|--------------|
| Absence of a relationship | Two-way relationship | Variable j has an effect on i. | Variable i has an effect on j. | Relationship |

Table (2): Structural Self-Interaction Matrix

| C08 | C07 | C06 | C05 | C04 | C03 | C02 | C01 | SSIM |
|-----|-----|-----|-----|-----|-----|-----|-----|------|
| V   | V   | O   | X   | V   | V   | V   |     | C01  |
| A   | A   | A   | O   | A   | A   |     |     | C02  |
| O   | V   | X   | O   | A   |     |     |     | C03  |
| A   | V   | V   | O   |     |     |     |     | C04  |
| O   | O   | A   |     |     |     |     |     | C05  |
| A   | X   |     |     |     |     |     |     | C06  |
| A   |     |     |     |     |     |     |     | C07  |
|     |     |     |     |     |     |     |     | C08  |

#### 4-2- Construction of the Reachability Matrix

The reachability matrix is derived by transforming the structural self-interaction matrix into a binary matrix consisting of zeros and ones. In the reachability matrix, the diagonal elements are set to one. Furthermore, to ensure consistency, transitive relationships must be verified; that is, if A leads to B,

and B leads to C, then A must also lead to C. In other words, the reachability matrix must account for these transitive effects. If, in practice, this condition is not met, the table must be corrected to explicitly include the transitive relationship. Accordingly, the reachability matrix for the variables is presented in Table 3.

Table (3): Reachability Matrix of the Variables

| C08 | C07 | C06 | C05 | C04 | C03 | C02 | C01 | RM  |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 1   | 1   | 1   | *1  | 1   | 1   | 1   | 1   | C01 |
| 0   | 0   | 0   | *1  | 0   | 0   | 1   | 0   | C02 |
| 0   | 1   | 1   | 0   | 0   | 1   | 1   | 0   | C03 |
| 0   | 1   | 1   | *1  | 1   | 1   | 1   | 1   | C04 |
| 0   | 0   | 0   | 1   | 0   | *1  | 0   | 0   | C05 |
| 0   | 1   | 1   | 1   | 0   | 1   | 1   | *1  | C06 |
| 0   | 1   | 1   | *1  | *1  | 0   | 1   | 0   | C07 |
| 1   | 1   | 1   | *1  | 1   | 0   | 1   | 0   | C08 |

### 4-3- Constructing the Final Reachability Matrix

Once the initial reachability matrix has been obtained, the final reachability matrix is derived by incorporating transitivity into the relationships between the variables. This is a square matrix in which each entry is equal to 1 if an element is reachable from another (via a path of any length), and 0 otherwise. The method for obtaining the reachability matrix is based on Euler's theory, wherein the adjacency matrix is added to the identity matrix. This resulting matrix is then raised to the power of \*n\* until the entries no longer change. The following formula illustrates the method for determining reachability using the adjacency matrix:

### Relation 1: Determining the Final Reachability Matrix

$$A + I$$

$$M = (A + I)^n$$

### Relation 2: Boolean rules

$$1 \times 1 = 1; 1 + 1 = 1$$

Therefore, to ensure accuracy, secondary relationships must be accounted for. This means that if A leads to B, and B leads to C, then A must also lead to C. In other words, if direct effects should be present based on these secondary relationships but are not observed in practice, the table must be corrected to reflect the secondary relationship. The final reachability matrix for the model's variables is presented in Table 4.

Table (4): Final Reachability Matrix of Variables

| C08 | C07 | C06 | C05 | C04 | C03 | C02 | C01 | RM  |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 1   | 1   | 1   | 1*  | 1   | 1   | 1   | 1   | C01 |
| 0   | 0   | 0   | 1*  | 0   | 0   | 1   | 0   | C02 |
| 0   | 1   | 1   | 0   | 0   | 1   | 1   | 0   | C03 |
| 0   | 1   | 1   | 1*  | 1   | 1   | 1   | 1   | C04 |
| 0   | 0   | 0   | 1   | 0   | 1*  | 0   | 0   | C05 |
| 0   | 1   | 1   | 1   | 0   | 1   | 1   | 1*  | C06 |
| 0   | 1   | 1   | 1*  | 1*  | 0   | 1   | 0   | C07 |
| 1   | 1   | 1   | 1*  | 1   | 0   | 1   | 0   | C08 |

### 4-4- Determining Relationships and Hierarchical Leveling of Dimensions and Indicators

To determine the relationships and hierarchical levels of the criteria, the set of outputs and the set of inputs for each criterion must be extracted from the obtained matrix.

- Reachability Set (row elements, outputs, or influences): Variables that can be reached starting from a given variable.
- Antecedent Set (column elements, inputs, or dependencies): Variables from which a given variable can be reached.

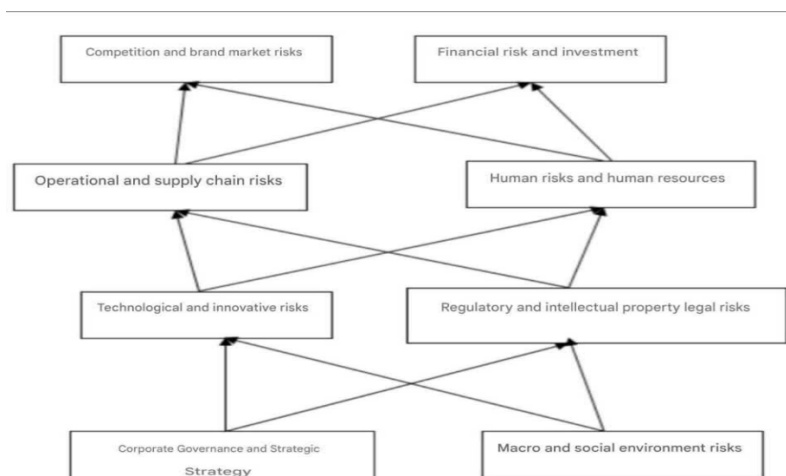
**Table (5): Set of inputs and outputs for level determination**

| Level | Subscription     | Input: Susceptibility (Columns) | Output: Impact (rows)        | Symbol | Variables                                         |
|-------|------------------|---------------------------------|------------------------------|--------|---------------------------------------------------|
| 1     | C01              | C01 ,C04                        | C01,C02,C07, C08             | C01    | Corporate Governance and Strategic Direction      |
| 1     | C02              | C01,C02,C03,C04                 | C02,C05,C08                  | C02    | Macro-environmental and Social Risks              |
| 2     | C05,C08          | C01,C02,C04 C05,C06,C08         | C03,C05,C08                  | C03    | Technological and Innovation Risks                |
| 2     | C01 ,C04         | C01,C04,C08                     | C01,C02 ,C04 C06,C07         | C04    | Legal, Regulatory and Intellectual Property Risks |
| 3     | C04,C05,C08      | C01,C04,C05,C08                 | C02,C04,C05,C06 ,C07,C08     | C05    | Operational and Supply Chain Risks                |
| 3     | C06,C07,C08      | C05,C06,C07,C08                 | C01,C02,C06, C07,C08         | C06    | Human Risks and Human Resources                   |
| 4     | C01,C03,C04, C05 | C01,C03,C04,C05, C08            | C01,C02,C03,C04 ,C05,C06,C07 | C07    | Market, Competition, and Brand Risks              |
| 4     | C04,C05,C06,C08  | C01,C04,C05,C06 ,C08            | C02,C04,C05, C06,C08         | C08    | Financial and Investment Risk                     |

The set of outputs for a given criterion includes the criterion itself as well as those criteria upon which it exerts an influence. The set of inputs includes the criterion itself and those criteria that influence it. Subsequently, the set of bidirectional relationships among the criteria is determined. For a variable  $C_i$ , the reachability set (outputs or influences) consists of variables that can be reached starting from  $C_i$ . The antecedent set (inputs or dependencies) consists of variables from which  $C_i$  can be reached. Once the reachability set and the antecedent set have been defined, their intersection is calculated. The first variable (s) for which the intersection of these two sets is identical to the reachability set (the output set) are assigned to the first level. Consequently, the elements at the first level are the most influenced (dependent)

variables within the model. After establishing this level, the identified criterion is removed from the entire set; the input and output sets are then reconstructed to determine the level of the next variable (Agheli et al., 2023).

The final hierarchical structure of the identified variables is illustrated in Figure 2. In this diagram, only significant relationships those between elements at one level and those at the level below, as well as significant internal relationships among elements within the same level are considered. Following the determination of the factors' levels, and to better understand the relationships between them, these connections can be represented graphically as a model Figure 2.

**Figure (2): Model design based on dimensions and components**

## 5- Conclusion and Recommendations

Interpretive Structural Modeling (ISM) was employed to develop the model. ISM is an exploratory modeling technique used in the field of management; the initial concept was proposed by Warfield (1974) and subsequently introduced by Sage (1977). The ISM approach enables experts to map complex relationships among a large number of elements within a multifaceted decision-making context. This method serves to organize and provide direction to the complexity of relationships between constructs. By analyzing the impact of one construct on others, the sequence and direction of the complex relationships within a system are examined, thereby overcoming the inherent complexity of these interrelationships. This method constitutes an interactive learning process in which various constructs are structured into a systematic and comprehensive model specifically, by analyzing how one construct influences others. Consequently, it becomes possible to identify the relationships between constructs, develop an interpretive structural model, and ultimately classify these constructs based on their driving power and dependence.

At the primary level, it can be stated that "corporate governance and strategic direction" and "macro-environmental and social risks" serve as the fundamental pillars influencing "technological and innovation-related risks" as well as "legal, regulatory, and intellectual property risks." In interpreting these findings, it can be noted that these two factors play a foundational role in the formation, intensification, or mitigation of other types of risks. Corporate governance and strategic management encompass an organization's decision-making systems, transparency, accountability and managerial structure; these elements play a pivotal role in determining a company's readiness to confront uncertainties and adopt appropriate strategies. Conversely, macro-environmental and societal risks such as economic volatility, political shifts, sanctions, socio-cultural pressures, and environmental changes—lie beyond a company's direct control yet exert a profound influence on the business and investment landscape. Through their interaction, these two sets of factors shape the context that influences the intensity and manifestation of technological and innovation-related risks (e.g., the pace of technological change or misalignment with market innovations), as well as

legal, regulatory, and intellectual property risks (including issues pertaining to patent laws and capital market regulatory requirements). In effect, weaknesses in corporate governance or instability within the macro-environment can exacerbate these complex, specialized risks or cause them to emerge more acutely. The results of this study align with the findings of Silva et al. (2023) and Șerban et al. (2023).

At the second level, "technological and innovation-related risks" and "legal, regulatory, and intellectual property risks" are identified as key factors that simultaneously influence "operational and supply chain risks" and "human-related and human resource risks." Regarding these results, it can be noted that technological and innovation-related risks encompass challenges such as technological instability, rapid technological shifts, an inability to adapt to innovations, and weak digital infrastructure; these factors can disrupt a company's operational processes and create serious difficulties for supply chain management. Furthermore, complexities concerning intellectual property rights, a lack of clear regulatory standards, or challenges in complying with emerging regulations within the capital market can in addition to creating legal risks impact human resource processes; for instance, by introducing ambiguity into contracts, diminishing employee motivation, or increasing the turnover of key personnel. In interpreting the results at this level of analysis, it can be stated that technological and legal risks not only affect the technical and regulatory dimensions of a company's performance but also through a ripple effect undermine the operational capacity and human resources of startups. This underscores the necessity of specifically identifying, assessing, and controlling these key factors during risk management planning; given their intermediary role in transmitting and exacerbating other risks, they exert long-term, systemic impacts on the sustainability of companies within the capital market. The findings of this research align with those of Bilalov., (2022) and Lu et al., (2021).

At the third level, "operational and supply chain risks" and "human and human resource risks" are identified as influential factors that simultaneously impact "financial and investment risks" as well as "market, competition, and brand risks." More specifically, disruptions in operational processes, inefficiencies in supply chain management, resource shortages, or delays in the procurement of raw

materials can lead to increased costs, reduced productivity, and lower investment returns. Similarly, weaknesses in human resource management such as an inability to attract, retain, and develop skilled personnel, a decline in employee motivation, or a lack of up-to-date training can result in diminished organizational performance, stifled innovation, and an inability to meet market demands. In explaining the results at this level, it can be emphasized that operational and human-related risks act as drivers and amplifiers of the company's ultimate external risks namely, financial risks and those associated with the market and brand. For instance, a decline in operational productivity or the departure of key personnel not only drives up costs and complicates the process of attracting investors but also weakens the brand's competitive position in the market. Consequently, these two categories of risk play a critical role in either preserving or eroding the economic value and market standing of startups, necessitating special attention within comprehensive risk management strategies. The results of this study align with the findings of Silva et al. (2023) and Heydarzadeh Aghdam et al. (2021).

At the final level of the framework, "financial and investment risks" and "market, competition, and brand risks" emerge as the core elements and the ultimate focal points for decision-making. In interpreting these results, it can be noted that within the structural analysis framework, these two categories of risk serve as the primary and concluding elements for decision-making. They represent the ultimate outcome and consequence of interactions with and influences from higher-level tiers, playing a decisive role in the success or failure of startups within the capital market. Financial and investment risks encompass issues such as liquidity fluctuations, difficulties in raising capital, unforeseen costs, and inadequate returns on investment all of which are heavily influenced by performance in other areas, including operations, human resources, and technology. Similarly, market, competition, and brand risks stem from challenges like declining market share, a weakened brand image, intense competition, and rapid shifts in customer preferences; these, in turn, are driven by supply chain inefficiencies, legal risks, and strategic instability. At this level, it can be concluded that financial and market-oriented risks acting as the ultimate indicators of organizational performance play a key role in managerial decision-

making and serve as a final reflection of the quality of risk management applied at lower levels. In essence, any disruptions or shortcomings arising in the preceding layers of the model manifest as financial and market-related consequences, potentially posing serious challenges to the future of startups within the capital market. Therefore, this level of the analytical framework is considered the level of strategic decision-making, which determines the organization's path toward survival or growth. The results obtained in this study align with the findings of Silva et al., (2023) and Heydarzadeh Aghdam et al., (2021).

It can be concluded that this research, utilizing the Interpretive Structural Modeling (ISM) approach, sought to identify and elucidate the hierarchy and causal relationships among various types of risks affecting investments in start-ups within the capital market. Structural analysis revealed that, at the first level, foundational factors such as corporate governance, strategic direction, and risks stemming from the macro-environment and social sphere act as driving forces and serve as the basis for the emergence of other risks. These factors create the context for the manifestation of technological and innovation-related risks, as well as legal, regulatory, and intellectual property risks; these were identified as key factors at the second level of the model. Subsequently, these intermediate risk categories directly impact operational and supply chain risks, as well as human resource-related risks, potentially disrupting daily operations and organizational resources. At the third level, these areas influence financial and investment risks, as well as risks related to the market, competition and brand. Finally, at the ultimate level of the framework, these latter risk categories emerge as direct consequences reflecting the overall quality of risk management within the organization and play a fundamental role in macro-level decision-making, capital acquisition and the maintenance of a start-up's competitive position in the capital market. This hierarchical analysis demonstrates that ultimate financial and market risks do not emerge independently; rather, they are shaped by a chain of infrastructural, legal, operational, and human factors. Consequently, for effective risk management in startups, it is of critical importance to focus on foundational levels and to design preventive policies at these primary layers.

**Since the findings showed, it is suggested that:**

- Start-up companies should create a transparent governance structure with a clear separation of roles and responsibilities between managers, boards of directors and shareholders. This action increases the confidence of investors and reduces the risks caused by tasteless or unprofessional decisions.
- Using environmental analysis tools (political, economic, social, technological, environmental and legal) on a periodic basis can help companies to identify environmental changes earlier and provide timely strategic responses.
- To deal with risks caused by environmental uncertainty, companies can predict possible futures by writing scenarios and design flexible plans for each scenario.
- Establishing an internal unit to monitor the organization's social responsibility and interact with government institutions, media and society can reduce social pressures and external risks and strengthen the brand.
- Establishing a clear process for identifying, evaluating, developing and implementing innovations, especially in emerging technologies, helps companies to benefit from the benefits of innovation and reduce the risks of not being prepared for technological changes.
- Startups should work with legal counsel to protect patents, trademarks, patents, and intellectual property from competitors or copying.
- Establishing direct and continuous communication with supervisory organizations such as the Stock Exchange Organization, the Center for Intellectual Property and the Ministry of Communications facilitates legal processes and reduces regulatory risks.
- Holding training workshops for employees about capital market regulations and technology trends increases the organization's awareness of potential risks.
- Dynamic budgeting and liquidity forecasting based on different market scenarios helps to increase the financial resilience of start-up companies.
- Using digital tools and content-oriented strategies to highlight the social and innovative mission of the brand, attracts customers and reduces competitive risk.

- Setting up a specialized team to manage communication with investors, update performance information, and improve financial transparency can be effective in attracting financial resources and increasing market confidence.

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