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RESEARCH PAPER

Introducing Strategic Drivers of Innovative Ideas in Active Small and Medium-Sized Enterprises of Different Technological Fields Using a Fuzzy Cognitive Map

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Abstract
Idea generators and investors are always interested in advancing innovative ideas and generating wealth from them. One of the gaps in previous research in this field is the failure to pay attention to different criteria and strategic paths in advancing innovative ideas from various fields. This research introduced a strategy for advancing innovative ideas and identifying the strategic drivers of small and medium-sized enterprises (SMEs) in various technological fields. The indicators were derived from the literature review and expert interviews, and they were chosen using a checklist and interviews to determine their relationships. The fuzzy cognitive map in question was then created using the FCMapper software. Strategic driver indicators related to the advancement of innovative ideas were identified. Thus, it is recommended that idea developers consider these indicators when presenting ideas and that experts and investors consider them when evaluating innovative ideas. According to the findings, the Persian Gulf Science and Technology Park and its ten active fields each have their own strategic paths for advancing innovative ideas.

Keywords: strategic drivers, SMEs, evaluation of innovative ideas, fuzzy cognitive map.

1. Introduction

Entrepreneurship, new business, and commercialization projects based on innovative ideas are critical to developing the global technological economy. Currently Iran faces significant economic challenges such as a low GDP, slowing economic growth, and a high unemployment rate; thus, it is critical to consider the potential of the country's talented, innovative, creative, and educated workforce, as well as the role of private investment and supporters of new ideas and business plans (Eslami Bidgoli & Ahmadi Aval, 2010).

One of the most critical industrial growth and development indicators in emerging economies is innovation (Dutz, 2007; Sehgal & Gupta, 2019). Hence, one of the top priorities for decision-makers and politicians is to create an environment conducive to entrepreneurship and innovation. There has been a focus on developing regional innovation systems (RIS) and learning more about how these innovative systems work (Cooke et al., 1997; Hasche et al., 2020).

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The development of new products is a critical factor in the success of businesses; thus, they frequently struggle to identify the best ideas from a plethora of options (Saaksjarvi & Hellen, 2019). Because venture capitalists' resources are limited when it comes to advancing and developing innovative ideas, the likelihood of compromising those limited resources is increased by the lack of a framework for the identification of appropriate criteria to support the ideas.

Because venture capitalists are experts at spotting profitable and successful businesses, their evaluation criteria can be used to determine the components of success for various businesses and new ideas (Franke et al., 2006). When many ideas and plans are presented to venture capitalists, the importance of investors' decision-making criteria becomes even more apparent, and considerations and decisions about "which ideas and designs to pursue" significantly impact venture capitalists' performance (Rooswall & Larsson, 2001). In this regard, the current study aims to identify decision-making criteria, investigate their relationships, and, in general, develop a fuzzy cognitive map based on the extracted criteria to progress innovative ideas in the Persian Gulf Science and Technology Park.

Diverse fields have different paths to improvement, advancement, and success. Misguidance can waste material and human resources from a variety of fields. Different paths to which different fields are exposed in advancing new ideas were plotted in strategic graphs in this study, which then helped identify the indicators linked to the advancement of innovative ideas. Finally, the drivers for various fields were introduced to address the following main research questions:

- What is the best way to create a framework for identifying the drivers of innovative ideas in SMEs?
- Are the criteria and priorities for advancing innovative ideas in various fields the same?
- In evaluating ideas and designs in each field, which criteria are most important to venture capitalists?
- In previous research on evaluating ideas and designs, what criteria were overlooked? How effective are those criteria at promoting new ideas?
- What strategic pathways have been considered by experts in each field to choose between and push forward ideas?

2. Literature Review and Theoretical Foundations

2.1. Literature Review

Innovation: Innovation is a strategic source of competitive advantage to outperform competitors in export markets (Blcakcloglu-Peynirci et al., 2020). While process innovation provides the means for undertaking production or service operations, safeguarding, saving costs, and improving quality (Tajeddini, 2016), product innovation refers to a company's ability to recognize and respond to new customer needs by developing entirely new or significantly improved products (Mabenge et al., 2020; Njeri, 2017). This could regard significant issues, involving the products' technical specifications, materials, compatible components, and user-friendliness (Kahn, 2018; Mabenge et al., 2020). The direct positive effect of financial support on innovation process suggests that SMEs are more likely apt to adopt process innovation (Tajeddini, 2016).

Financial Knowledge: Innovative SMEs have different financing patterns than their non-innovative counterparts. To improve innovation performance, innovative corporate management must reduce its reliance on short-term financing and profits and increase the use of long-term tools (Ayalew et al., 2020). Most owners and managers lack the necessary

knowledge about credit resources, investment terms, and financial management. Profitable companies have more domestic funding to grow and, consequently, can maintain this growth for a long time (Hossain et al., 2020).

In a study with the purpose to extend innovation management theory by exploring how financial triggers might influence innovation management in small and mediums firms, Tajeddini (2016) addresses the impact of financial orientation on performance as key antecedent to product innovation. According to his findings, since it seems more likely that financial budget facilitates different phases of product conceptualization, design, development, operationalization, distribution, and selling, financial assets must be managed as any other intangible assets, with portfolio orientation that accounts for sustained innovation performance (Tajeddini, 2016).

Management Control: Management control is management's systematic effort to compare performance to predetermined standards, programs, and goals, and to assess compliance with performance standards." This is the most effective and efficient way for businesses to achieve their objectives (Bollinger et al., 2020). Managers should be aware of their innovative skills' strategic potential, as this can help the company's innovation improve business performance (Omri, 2015).

2.2. Theoretical Foundations

The majority of the research indicates that entrepreneurship requires innovation (Ireland et al., 2009; Kuratko, 2009; Risker, 1998; Turner & Hendry, 2017). Furthermore, entrepreneurs accept innovation as their primary competitive advantage. According to Baumol (2002), many small businesses and entrepreneurs use innovation as their primary competitive tool (Clark, 2010; Eggers & Kraus, 2011; Jones & Rowley, 2011; Turner & Hendry, 2017).

Intensified competitive pressure, increased global competition, technology fusion, technological change in global environments, shortening product life cycles at an immense rate, continuous customer demand for quality products, and price reduction indicate innovations as essential activities for the long-term survival of organizations (Tajeddini & Trueman, 2012). Therefore, many researchers are focusing on innovation. This section includes a summary of the contents of a few of them.

As Moradi et al., (2002) assert, an idea must be scientifically justifiable and significant for customers and the market. Another important factor influencing an idea's success is the availability of experts to support the idea and its application in the humanities and social sciences. Furthermore, the proposed new concept should not necessitate large investments or sophisticated technology, and it should be commercialized quickly. Moreover, Islami Bidgoli and Bigdelou (2005) maintain that acceptance in the market, personality traits, growth potentials, diversity, product differentiation, market growth, and new market creation are all factors that influence the development of innovative ideas. Derakhshan and Mohammadi (2014) conducted a more thorough investigation of factors effective in evaluating innovative ideas, entrepreneurial personality traits, entrepreneurial abilities, technology complexity, product or service specifications, product-market characteristics, and financial and geographic considerations.

It is recommended to evaluate the originality of projects (level and scale of originality), project innovation, project compilation (level of detail and complexity), future project efficiency, project resource provision (level of need for specialized preparation and resource supply), and commercialization of companies' projects when selecting startups with high investment attractiveness (Morkovina et al., 2015). Ramsinnghani (2014) suggest invisible characteristics such as business management skills and teamwork skills as indicators for

evaluating the entrepreneur or idea owner; however, evaluating these indicators requires direct observation and time. Because investors make investment decisions before having worked with the entrepreneur and observing their characteristics in relation to these indicators, the decision's uncertainty increases significantly, posing a significant risk to investors.

Zacharakis and Meyer (2000) pointed out that due to the meticulous nature of the evaluation phase, venture capital firms typically spend less time on initial screening, increasing the risk of accepting unprofitable projects or passing up golden opportunities. They used four major components to make venture capital decisions: the team or entrepreneur's capabilities, product and service attractiveness, competitiveness, and potential returns. Franke et al. (2006) note that investors with specific experience in startups or large corporations are open to the idea of teams with a similar track record.

Opportunity identification, innovation, venture capital, market, job creation, regional development, support, small business, strategy, ability, collaboration, growth, economic development, strategic planning, human capital, social entrepreneurship, social capital, relationships, startups, entrepreneurial success, micro capital, motivation, self-employment, entrepreneurial passion, international entrepreneurship, higher education, entrepreneur personality, decision-making, entrepreneurial ability, marketing, scale development are among indicators cited by Akpan (2021) in a research on entrepreneurship, small businesses, and innovation.

Kim et al. (2018) asserted that the most important factor affecting the success of a design startup is commercialization. On the other hand, continuous investment is the most important aspect of technology startups, followed by idea commercialization. The ability to commercialize unique and appealing products determines the courage to start a business and the factors that lead to business success. A startup should make every effort to stay on top of market demands and environmental changes, and respond quickly to competitor actions by improving its products and services.

Weilinghoff (2018) suggests that in the venture capital literature, product, market, startup team, and financial returns are all taken into account. Investors agree that the following factors play a significant role in a startup's success: long-term unmet needs, a complementary team with relevant experience, a customized market strategy, product acceptance, technology uniqueness, market growth, and technology protection.

In addition, 49 of the 56 indicators listed in Table 4 are deemed as part of the theoretical background of this study. Many researchers, including Van Den Heuvel et al. (2020), have identified the drivers of innovation as well as the barriers of innovation in SMEs. Other researchers, such as Yin and Luo (2018) and Afful-Dadzie and Afful-Dadzie (2016), have looked into startup selection criteria to help them accelerate. However, we found no research that outlines a strategic plan for advancing and developing innovative ideas.

In this study, the five dimensions of advancing innovative ideas are referred to as the conceptual model dimensions. The indicators linked to these dimensions in the research background include the indicators that drove this study and the topics discussed in interviews, as well as a useful tool for creating a matrix of pairwise comparisons.

We cannot expect a similar path for advancing innovative ideas in all fields because different facilities, policies, strategies, and tactics are used in different fields. Disregarding differences among the criteria, sub-criteria, and strategic paths of advancing innovative ideas in different fields highlights the necessity of conducting the current study to introduce strategic drivers of innovative ideas in the SMEs of ten target fields.

3. Methodology

In terms of the data collection method, this study was a descriptive survey, and the nature of the collected data was mixed (i.e., both quantitative and qualitative data types were collected). This research aimed to reveal the complex and intertwined structure of various indicators to which entrepreneurs are subjected when advancing their ideas. The network nodes determine the position of each indicator in this complex structure, which can be useful in advancing innovative ideas, and the network branches explain how each indicator works.

Using a fuzzy cognitive map, the current study was undertaken in 2021 to identify the strategic drivers of innovative ideas in active SMEs in ten different disciplines of the Persian Gulf Science and Technology Park. The researchers used the snowball sampling technique, a checklist of indicators, a semi-adjusted questionnaire, and interviews with 43 experts in various domains due to the great complexity of the topic, the existence of numerous technological fields, and the small number of specialists in this study. From the 56 indicators retrieved in this study, ten strategic indicators in each discipline were selected after building a pairwise comparison matrix and studying the links among the indicators pushing innovation ideas at the Persian Gulf Science and Technology Park. The expert's demographic data are presented in Table 1.

Table 1. Demographic Information of Specialists

Post			**Education**		**Age**			**Experience**		
Chief	R&D management	Assessor	PHD	MA	34 - 44	44 - 54	54 - 64	6 -12	12 -24	24 -36
13	16	14	13	30	21	18	4	11	30	2

Unlike other quantitative methods that require precise approximation to increase productivity, fuzzy logic accepts ambiguity as a natural part of science. The fuzzy method is primarily used to supplement traditional methods for designing and modeling systems, in which the need for advanced and relatively complex mathematics is met by using linguistic values to simplify and improve system design efficiency. The fuzzy method mathematically expresses many erroneous and ambiguous concepts, variables, and systems, laying the ground for reasoning, inference, control, and decision-making in uncertain situations. It solves problems and leads to more accurate responses because it is based on approximate reasoning that avoids generalization and absolutism (Mousavi & Sadeghian, 2017).

Decision-making will be more difficult than ever due to the growing variety of demands and the multiplicity of interactive options. Thus, many researchers have concentrated their efforts on developing a valid and reliable decision-making model to deal with such complications. The main challenge in developing a decision model, aside from choosing or creating a robust model, is determining the appropriate relationships among indicators and their effects on one another.

A cognitive map is a useful tool for reflecting general or specialized beliefs and knowledge about a situation or context, as well as detecting causes, effects, and relationships between them (Baykasoglu & Durmusoglu, 2014). FCM stands for fuzzy computational cognitive mapping, a more realistic modeling method generated by the fuzzy logic method. The map principles, including the diagram nodes and cause-and-effect interactions, are represented as visual arches in a weighted and directional diagram. As indicated in Table 2, the map creator specifies membership functions for the linguistic variables that describe causal links (Stula et al., 2011).

Table 2. Linguistic Variables Associated with the Effectiveness of Indicators

Language variable	Very low	Low	Medium	High	Very high
Fuzzy numbers	(0,0,0.25)	(0,0.25,0.5)	(0.25,0.5,0.75)	(0.5,0.75,1)	(0.75,1,1)

The researcher usually performs the fuzzy and de-fuzzy processes directly to convert the system's actual values into map concepts and causal relationship values (Stula et al., 2011). The following formulas were used to de-fuzzy relationships in this study:

$$A = (a_l^{(1)}, a_m^{(1)}, a_u^{(1)}) \quad i = 1, 2, \ldots, n$$

$$A_{avf} = \frac{\sum_{i=1}^{n} (a_l^{(i)}, a_m^{(i)}, a_u^{(i)})}{n}$$

$$x_{max} = \frac{m_l + 2m_m + m_u}{4}$$

This map combines fuzzy logic, neural networks, and graph theory to store the representation of conceptual nodes and their relationships while simulating the reasoning knowledge and logic process through causation (Yang & Peng, 2009).

Nodes represent problem concepts, and arrows represent causal connections in fuzzy cognitive maps, which are graph structures. A model with n concepts links nodes (Cj) to arrows representing an n × n matrix (Poczeta et al., 2019). The definitions in this matrix are A, B, C, D, E, F, G, H, I, J. Cn are significant factors that can serve as either a stimulus or a constraint for the subject under investigation.

The direct arrows Ci→ Cj referred to the relationships between conceptual nodes and are indicated by an arrow in the diagram.

Adjacency Matrix: Wij. E = (Wij)= The weight of direct arrows according to Ci*Cj, ranging from -1 to +1, and the cumulative relation matrix represents all relationships among all concepts (Son et al., 2020). The proximity matrix corresponding to Figure *I* is shown in Table *3*.

Table 3. The Relation Matrix of the Cognitive Map Related to Figure I

	C_1	**C_2**	**C_3**	**C_4**	**C_5**	**C_6**	**C_7**
C_1		W_{12}		W_{14}	W_{15}		W_{17}
C_2	W_{21}				W_{25}	W_{26}	
C_3				W_{34}			
C_4					W_{45}	W_{46}	
C5							
C_6				W_{64}			W_{67}
C_7							

4. Case Study and Research Findings

A science and technology park an organization managed by professionals to increase wealth in the community and promotes the flow of knowledge and technology among universities, R&D institutes, private companies, and the market .The Persian Gulf Science and Technology Park spare efforts to develop technological knowledge, knowledge-based products, knowledge commercialization, and economic growth of the province by supporting technology centers and innovative ideas (Majidi, 2007). To that end, in addition to supporting 89 companies in the ten fields investigated in this study, this park also supports companies in the fields of shipbuilding and marine industries, fisheries and aquaculture, food industry, and date palms.

Eighty indicators associated with advancing innovative ideas were extracted after reviewing articles on the research background and interviewing 43 experts from 89 companies

active in the Persian Gulf Science and Technology Park. Because of their low and sometimes indirect effects, 24 indicators were removed after expert review and approval. Finally, the final 56 indicators were grouped. Table 4 presents indicators, codes, and their operational definitions by the group.

Table 4. Operational Definition of Indicators

Group	Code	Indicator	reference	Operational definition
Components related to idea owners	C1	Specialty	Camp (2002)	The level of skill and expertise that the idea owner has in relation to her design or idea.
	C2	Motivation for the idea	Rooswall & Larsson (2001)	The degree of the attractiveness of the stimulus that gave rise to the idea or business plan.
	C3	Credit	Kollmann & Kuckertz (2010)	The level of prestige that the idea owner possesses in the technological field of her idea.
	C4	Passion and attractiveness	Eslami bidgoli & Ahmadi Aval (2010)	The level of interest and effort that the idea owner has and takes to advance her innovative idea.
	C5	Background and experience	Camp (2002)	The background and relevant experience that the idea owner has in the field of her innovative idea.
	C6	Flexibility	Derakhshan & Mohammadi (2014)	The level of flexibility that the idea owner has in changing or modifying her design.
	C7	Ability to participate in teamwork	Mabenge et al. (2020)	The degree of the mastery of the idea owner in doing teamwork.
	C8	Realism	Derakhshan & Mohammadi (2014)	The amount of truth-seeking of the idea owner in presenting her innovative idea.
	C9	Self-confidence	Derakhshan & Mohammadi (2014)	The level of the self-confidence of the idea owner when presenting the idea.
	C10	Participating in investment	Adu-Danso & Abbey (2022)	The financial capacity and willingness to participate in the idea owner's investment in her proposal and idea.
	C11	The number of influential sponsors in the industry	Derakhshan & Mohammadi (2014)	The number of supporters of idea owners in the technological field related to her idea.
	C12	Investor interest in the idea owner	Eslami bidgoli & Ahmadi Aval (2010)	The investor's willingness to support the idea owner due to previous interactions with her or due to introducers' recommendations.
Product components resulting from the idea	C13	Product acceptance	Deventer & Mlambo (2009)	The level of the market acceptance of the product resulting from the innovative idea.
	C14	Potential to increase the share	Rajapathirana & Hui (2018)	The product capacity of the idea to increase market share.
	C15	product, service, and process differentiation	Block & Devrives (2014)	The degree of difference in goods, services, and processes resulting from the idea compared to the products available in the market.
	C16	Simplicity of use	Block & Devrives (2014)	The ease of use of the product resulting from the idea.
	C17	Market entry time	Rajapathirana & Hui (2018)	The time required for the goods to enter the market.
	C18	Sales potential	Rajapathirana & Hui (2018)	The product capacity of the idea to sell in the market.

Group	Code	Indicator	reference	Operational definition
	C19	The attractiveness of the product	Crawford & Ibrahim (1985)	The degree of the attractiveness of the product resulting from the idea for target market customers.
	C20	idea-induced product variety	Eslami bidgoli & Bigdelo (2005)	The amount of the variety of the product of the idea.
	C21	Availability of required raw materials	Derakhshan & Mohammadi (2014)	The ease of obtaining the required raw materials to manufacture the product resulting from the idea.
	C22	Period of life	Derakhshan & Mohammadi (2014)	The demand for the product in a certain period of time.
	C23	Level of technology and complexity	Derakhshan & Mohammadi (2014)	The difficulty in adopting the manufacturing technology of the product resulting from the idea.
	C24	Competitive advantage	Rajapathirana & Hui (2018)	The set of the capabilities of the product that lead to better performance than similar items.
	C25	Possibility of commercialization	Mac Millan et al. (1985)	The ability and opportunity to create a business based on the production and sale of the product resulting from the idea.
	C26	Product resistance to environmental threats	Deventer & Mlambo (2009)	The durability of the product resulting from the idea in the face of environmental challenges.
	C27	B2B possibility	Research Findings	The opportunity to sell products to another business.
	C28	B2G possibility	Research Findings	The opportunity to sell products to government agencies.
	C29	Compliance with scientific principles and obtaining product quality standards	Adu-Danso & Abbey (2022)	The degree of the compliance of the product resulting from the idea with global standards.
Market components	C30	Market growth potential	Mabenge et al. (2020)	The existing capacity to expand the product market.
	C31	Size	Rajapathirana & Hui (2018)	The target market size of the product resulting from the idea.
	C32	Attractions	Deventer & Mlambo (2009)	The attractiveness of the product market for customers.
	C33	The amount of market demand for the product	Deventer & Mlambo (2009)	The market demand for the product resulting from the idea.
	C34	The multiplicity of competitors in the market	Franke et al. (2006)	The number of competitors in the target product market.
	C35	The power of competitors	Franke et al. (2006)	The strength of competitors in the target product market.
	C36	Barriers to entry into the market	Deventer & Mlambo (2009)	Refers to the number and strength of inhibitors to introduce the product to market.
Financial components	C37	Possibility of export and amount of currency	Eslami bidgoli & Bigdelo (2005)	The ability to sell a product outside its borders and the opportunity to attract foreign exchange resources therefrom.
	C38	Capital return rate	Mabenge et al. (2020)	The proportion of the profit after deduction of depreciation refers to the average amount of capital consumed.
	C39	Return of capital	Rajapathirana & Hui (2018)	The payback period is the investor's initial capital through the product's sale resulting from the idea.
	C40	Capital required	Akpan (2021)	The financial resources needed to turn an innovative idea into a business.
	C41	Liquidity	Zacharakis & Shepherd (2001)	The conversion speed of a product resulting from an idea or business resulting from that product into cash.

Group	Code	Indicator	reference	Operational definition
	C42	Assessing available risks	Derakhshan & Mohammadi (2014).	The accuracy of estimating the risks that investors will face when turning an idea into a product.
	C43	Cost of production	Rajapathirana & Hui (2018)	The amounts of financial resources spent on manufacturing the product resulting from the idea.
	C44	The ratio of required capital to financial resources	Muzyka et al. (1996)	The degree of the consistency of the financial resources required by the plan with the investor's financial resources.
	C45	Variety of investment portfolio	Research Findings	The variety of fields supported by the investor and the number of ideas supported in each field.
	C46	Expected profit	Mabenge et al. (2020)	The desired profit from the sale of the product resulting from the idea.
Components of managerial	C47	Required technical and human resources	Akpan (2021)	The quality of the specialized and necessary human resources in creating the business resulting from the idea and the extent of access to them.
	C48	Ability to create employment	Akpan (2021)	The amount of entrepreneurship created by turning an idea into a business.
	C49	Executive team composition	Kollmann & Kuckertz (2010)	The efficiency of the arrangement of experts needed to advance the innovative idea.
	C50	The amount of compensation of the investor's loss	Research Findings	The amount of compensation for investor's losses through executive guarantees included in the partnership agreement.
	C51	Ownership ratio	Vaznyte & Andries (2019)	The percentage of investor ownership in the business resulting from the idea.
	C52	Alignment of the goals of the idea owner with the investor	Research Findings	Subscriptions determine the intention of the idea owner and the investor.
	C53	Support by senior industry management	Research Findings	The amount of help that top industry executives make in the process of promoting an innovative idea.
	C54	The role of the investor in the management structure	Research Findings	The investor's degree of authority and influence in the business management structure resulting from the idea.
	C55	The degree of attention to environmental indicators	Afful-Dadzie & Afful-Dadzie (2016)	The degree of environmental considerations of the idea or business plan resulting from the idea.
Goal	C56	Advancing innovative ideas	Eggers & Kraus (2011)	The component is dependent on the 55 components mentioned above that indicate the success rate of the product or service resulting from the idea.

Interviews with a sample of the target community experts were conducted to ensure that there was no difficulty understanding phrases and words, the items were connected optimally, there was no ambiguity, and there were no incorrect perceptions of phrases or inadequacies in word definitions. The developed instrument was relevant to the research objective after formal validity was confirmed and an objective judgment about the instrument's structure was made.

It was also confirmed that the experts who responded to the research tool in ten different fields completely agreed with the tool's terms and wording, as well as its components and totality.

By creating a matrix of pairwise comparisons and interviewing experts from the Persian Gulf Science and Technology Park, the effectiveness of the indicators and their operational definitions were determined as very high, high, medium, low, and very low. By gathering fuzzy data from experts and de-fuzzing the relevant information, a group proximity matrix was created. This matrix contains 56 rows and 56 columns that represent the relationships between the variables in question. A portion of this matrix is shown in Table 5.

Table 5. The Proximity Matrix Utilized in This Research

	C1	**C2**	**C3**	**C4**	**C5**	**. . .**	**C55**	**C56**
C1	0.00	0.43	0.75	0.00	0.73	. . .	0.00	0.75
C2	0.00	0.00	0.00	0.75	0.00	. . .	0.17	0.74
C3	0.01	0.00	0.00	0.05	0.62	. . .	0.01	0.23
C4	0.58	0.01	0.48	0.00	0.55	. . .	0.01	0.68
C5	0.50	0.50	0.62	0.50	0.00	. . .	0.00	0.16
⋮	⋮	⋮	⋮	⋮	⋮	⋱	⋮	⋮
C55	0.00	0.00	0.00	0.00	0.00	. . .	0.00	0.06
C56	0.00	0.00	0.00	0.00	0.00	. . .	0.00	0.00

The relevant cognitive map was then created using Gephi software. The size of the nodes in the cognitive map of Figure 1 was determined by their effect. The nodes' color is determined by their classification in Table 4. The nodes for the indicators are colored as follows: white (nodes associated with owners of ideas and designs); green (nodes associated with product/service indicators; blue (nodes associated with market feature indicators); purple (nodes associated with financial considerations); gray (nodes associated with management support and control indicators); and red (a node associated with advancing innovative ideas).

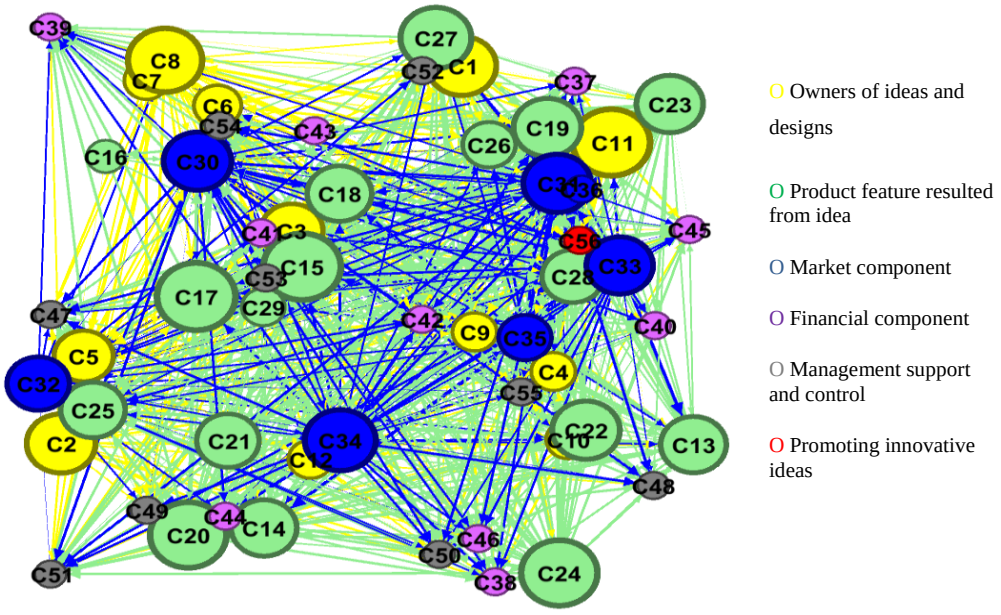

Figure 1. Cognitive Map of Advancing Innovative Ideas

In the next step, the obtained proximity matrix (Table 5) was imported into FCMapper software as primary data. The relevant matrix was investigated and analyzed using graph theory in this software. Table 6 displays each indicator's out-degree, in-degree, and centrality. It is worth noting that the indicators in this table are organized by their out-degree.

Table 6. Prioritization of Research Indicators by Their Out-Degree

Code	Indicator	Out degree	In degree	Centrality
C17	Market entry time	31.41	21.06	52.48
C15	Product, service, and process differentiation	28.43	10.7	39.14
C20	Idea-induced product variety	27.81	2.58	30.38
C11	The number of influential sponsors in the industry	27.03	14.29	41.33
C42	Assessing available risks	26.97	15.52	42.5
C24	Competitive advantage	26.77	3.4	30.17
C35	The power of competitors	24.05	13.53	37.59
C47	Required technical and human resources	23.05	17.5	40.55
C49	Executive team composition	22.49	15.65	38.14
C34	The multiplicity of competitors in the market	22.39	16.73	39.11
C27	B2B possibility	21.76	16.61	38.37
C8	Realism	21.48	4.89	26.37
C33	The amount of market demand for the product	21.15	5.15	26.29
C36	Barriers to entry into the market	20.4	10.93	31.33
C53	Support by senior industry management	20.2	14.05	34.25
C13	Product acceptance	20.02	11.71	31.73
C19	The attractiveness of the product	19.71	26.24	45.95
C18	Sales potential	19.63	16.29	35.93
C30	Market growth potential	19.56	13.01	32.57
C2	Motivation for the idea	19.16	2.3	21.45
C14	Potential to increase share	18.51	12.42	30.93
C23	Level of technology and complexity	18.23	5.7	23.93
C25	Possibility of commercialization	18	20.55	38.54
C31	Size	17.68	15.63	33.31
C37	Possibility of export and amount of currency	16.8	14.26	31.06
C1	Specialty	15.9	2.84	18.74
C22	Period of life	14.32	4.86	19.18
C28	B2G possibility	14.1	15.8	29.9
C43	Cost of production	11.82	6.59	18.41
C5	Background and experience	11.48	4.7	16.18
C32	Attractions	11.12	10.66	21.79
C3	Credit	11.08	9.18	20.26
C21	Availability of required raw materials	10.89	2.92	13.82
C50	The amount of compensation of the investor's loss	10.29	26.95	37.24
C55	The degree of attention to environmental indicators	10.13	15.93	26.06
C54	The role of the investor in the management structure	9.66	24.13	33.79
C52	Alignment of the goals of the idea owner with the investor	9.3	8.23	17.53
C40	Capital required	9.21	11.73	20.94
C38	Capital return rate	8.66	27.76	36.42
C51	Ownership ratio	7.91	33.56	41.47
C39	Return of capital	7.7	23.13	30.83
C10	Participating in investment	7.26	23.48	30.73
C6	Flexibility	6.92	21.19	28.1
C46	Expected profit	6.62	22.82	29.45
C44	The ratio of required capital to financial resources	5.49	24.92	30.4
C12	Investor interest in the idea owner	5.4	11.55	16.95
C26	Product resistance to environmental threats	5.22	8.59	13.81
C41	Liquidity	5.16	15.89	21.06
C7	Ability to participate in teamwork	4.38	2.06	6.44
C48	Ability to create employment	4.26	18.08	22.33
C45	Variety of investment portfolio	3.53	22.04	25.57
C9	Self-confidence	3.51	18.87	22.38
C29	Compliance with scientific principles and obtaining product quality standards	3.33	3.46	6.79
C4	Passion and attractiveness	2.95	16.56	19.51
C16	Simplicity of use	2.72	2.88	5.6
C56	Advancing innovative ideas	0	30.97	30.97

The out-degree of indicators represents the set of effects of that indicator on other indicators in the relevant cognitive map, as mentioned in the research methodology. Hence, each indicator with a larger impact will act as a separate cause and variable in this map. This means that if the concerned indicator changes slightly, the other system indicators or fuzzy cognitive maps will also change slightly. Market entry time (C17), product, service, and process differentiation (C15), and product variety as a result of the idea are the three effective indicators or main drivers of this research (C20).

The in-degree of the indicators shows how much each one is influenced by the other study map indicators. Therefore, any index with higher in-degree will be introduced as a variable dependent on independent variables. Consequently, because they result from several other indicators, such indicators are unsuitable for inclusion in management policy.

The centrality of the indicators is a third indicator studied in the fuzzy cognitive map. The greater the centrality of an indicator, the more likely it is to be influenced and influenced by the problem indicators. The fuzzy cognitive map was found to have the greatest centrality in advancing innovative ideas in the Persian Gulf Science and Technology Park for the three indicators of market entry time (C17), product attractiveness (C19), and risk assessment (C42) in this study.

The strategic path for advancing innovative ideas was determined, as shown in Figure 2, after examining the fuzzy cognitive map and having experts from ten different fields confirm the research findings in the Persian Gulf Science and Technology Park.

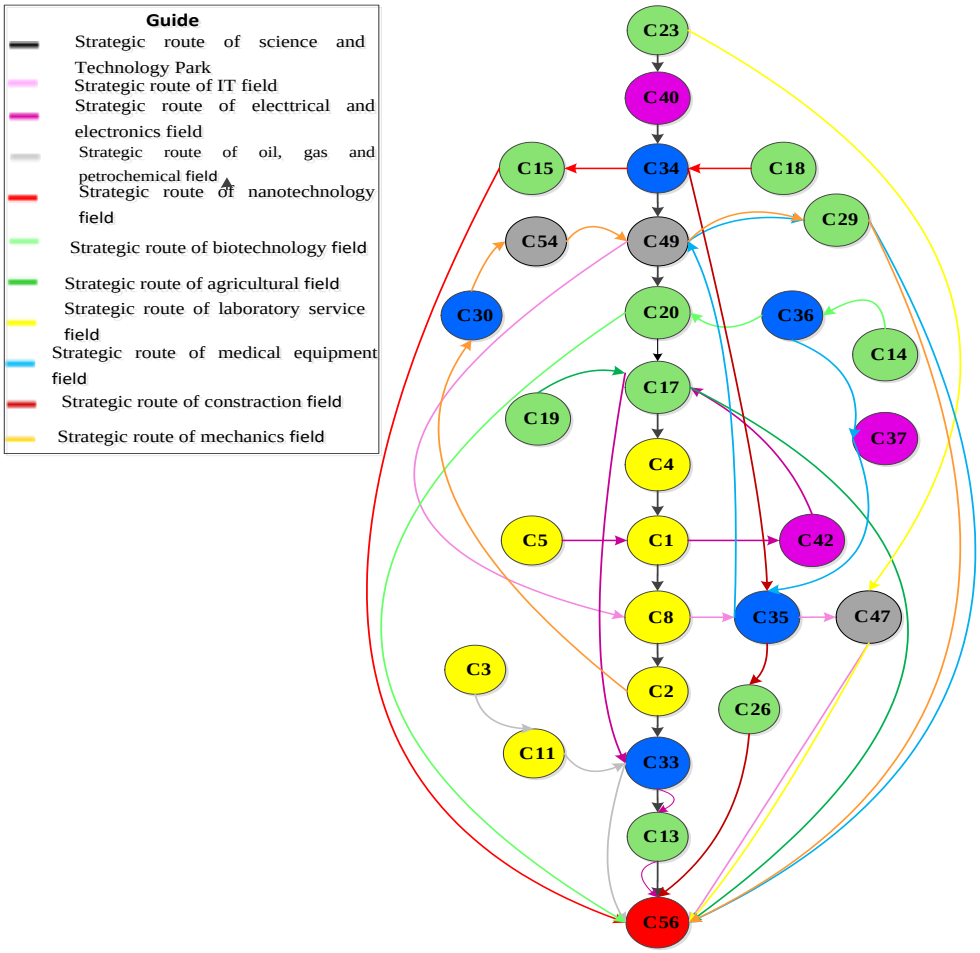

Figure 2. Strategic Directions for Advancing Innovative Ideas

The driving indicators of Science and Technology Park and its ten active fields: Black lines indicate the main highway or route (the lines marked by nodes from top to bottom in the middle of Figure 2). This is the path through which an idea is accepted. To begin, the developer and investor must have sufficient knowledge of the technology and the level of the complexity of the product that will result from the idea (C23). The level of complexity and the technology of the product are the drivers of the ideas in this park. The higher the complexity of the product of an idea, the greater the need to invest (C40) in that product. The level of technology and complexity of the idea-induced product and the capital needed to advance the idea product have a unique relationship.

There will be fewer competitors (C34) for a product with more sophisticated technology and higher investment requirements. In addition, the investor and the idea developer must put together a good executive team (C49) to assess the status and position of the idea-induced product. This issue would have a huge impact on the idea's product variety (C20). Various factors, including product diversity, affect the market entry time (C17) for each idea and the idea-induced product. Once these factors are specified, the owner of the idea and the executive team (C4) get motivated and determined. A product should be produced which is accepted by the market (C13) and leads to the advancement of innovative ideas(C56), based on expertise (C1) and realism (C8), the idea developer's motivation (C2), and market needs (C33). Each of the ten fields studied in this study has its own set of unique paths, as described below.

Strategic path of information technology: The composition of the executive team (C49), according to experts from six out of 16 companies in this field, is the driving force in advancing innovative ideas in this sector. This factor influences the realism (C8) of competitors' power (C35), the required technical and human resources (C47), and thus the advancement of innovative ideas in the field. To put it another way, the executive team can play a critical role in promoting innovative ideas in this field, so creators and investors must be extremely cautious when forming such groups.

Strategic path of electrical-electronics technology: Because of the high sensitivity of the products, the experts from eight of 21 companies in this sector believe that the ideator's (C5) background and experience is the main driver. This is because experience improves an individual's skills and expertise (C1), allowing the ideator to accurately assess the risks that lie ahead (C42). The amount of risk that a product faces has a big impact on how quickly it gets to market (C17). Reducing the time it takes for a product to reach the market allows market needs (C33) to be met more quickly, which increases the likelihood of product acceptance (C13) by customers and advances the ideas (C56). This path demonstrates that having a diverse background and experience not only increases skills and expertise but also lowers risk. Furthermore, the ideator's experience provides the idea owner with a good understanding of the market, which leads to the presentation of the idea, after which the resulting product takes into account more market needs and is thus more successful.

Strategic path of oil, gas, and petrochemical technology: The credibility of an ideator (C3) in the oil, gas, and petrochemical sector, as well as the number of influential sponsors (C11) and market demand for the product (33), all contribute to the idea's successful advancement (56). The ideator's credibility allows access to more powerful sponsors and allows for detecting market needs in this industry. According to experts from four out of nine companies in this industry, the above-mentioned items are essential drivers for advancing innovative ideas.

Strategic path of nanotechnology: According to experts, the potential for selling an idea-induced product (C18) leads to a multiplicity of competitors (C34) in the market in four out of eight companies in this sector. We can advance the idea (C56) in this field by differentiating

the product from the idea (C15). Competitors want to produce the product that sells the most. In this case, for the product to survive in the market, the ideator must have a well-thought-out strategy for distinguishing the product from the idea while also addressing the threats posed by competitors' products.

Strategic path of biotechnology: Experts from four out of nine companies in this sector believe that if the product has the potential to increase market share (C14), it can overcome marketing barriers (C36). Thus, the idea can be advanced (C56) by developing a cohesive program to diversify the product (C20).

Strategic path of agriculture: According to experts from three out of four agricultural companies, the attractiveness of the product (C19) and then the entry time requirement of product (C17) have an impact on the idea's advancement (C56). Hence, market attractiveness is a key driver of innovative advances in this field, and ideators should pay close attention to this indicator.

Strategic path of laboratory services: The level of technology and product complexity (C23) has a significant impact on the required technical and human resources (C47) and the advancement of innovative ideas (C56), according to experts from three out of four laboratory services companies.

Strategic path of medical equipment: Barriers to entry into the domestic market (C36), according to experts from three out of four medical equipment companies, force us to consider the likelihood of export and amount of currency of the product resulting from the idea (C37). Developing a plan to compete against strong foreign competitors (C35), utilizing the executive team's composition (C49), and producing high-quality products in accordance with industry standards (C29) are all important factors in determining the idea's success (C56).

Strategic path of construction technology: experts of construction companies believe that the multiplicity of market competitors (C34), their strength (C35), and Product resistance to environmental threats (C26) are important to advance the idea (C56). This path indicates that the market in this sector is extremely competitive. The idea creator must have unique plans to succeed in this competitive market so that the experts of this field can approve the idea.

Strategic path of mechanical technology: According to experts from six of eleven companies in the field of mechanics, appropriate motivation for the ideator to come up with an idea (C2) causes him/her to propose an idea so that the resulting product has the potential for growth (C30). The product will be presented according to the standards and with the desired quality, paving the way for the success and advancement of the idea (C56) by taking into account the investor effect in determining the management structure (C54) and the composition of the efficient executive team (C49). In other words, the trajectory of this sector suggests that the ideator's motivation for the emergence of an idea has a significant impact on the idea's advancement.

Aside from the differences in indicators for advancing innovative ideas in different sectors, as shown in Figure 2, there are some similarities in analyzing the strategic path for advancing innovative ideas in different sectors: market entry time index (C17) in electronics and agriculture; compliance with scientific principles and standards (C29) in medical equipment and oil, gas, petrochemical sectors; market demand for the product (C33) in electronics and oil, gas, petrochemicals; the multiplicity of competitors in the market (C34) in nanotechnology and construction; competitors' power (C35) in information technology, medical equipment, and construction sectors; barriers to entry into the market (C36) in biotechnology and medical equipment sectors; required technical and human resources (C47)

in information technology and laboratory services; and executive team composition (C49) in information technology, medical equipment, and mechanics.

5. Discussion and Conclusion

The fuzzy cognitive map in the current study revealed the following three indicators as critical drivers in the advancement of innovative ideas: market entry time (C17), product, service, and process differentiation (C15), and idea-induced product variety (C20). In this case, even a small change in these indicators would greatly impact the system. Therefore, the owners of the ideas that will be presented to this park should pay close attention to these indicators in their justification plan, studying and evaluating them thoroughly.

The importance of product, service, process (C15), and product diversity (C20) differentiation in advancing innovative ideas are similar to the findings of Eslami Bidgoli and Bigdelo (2005) who examined effective criteria in evaluating entrepreneurial venture capital businesses. They did not, however, look into the market entry time. Furthermore, a general strategic path (black path in Figure 2) was drawn to advance the innovative idea, indicating the shorter and clearer path in this complex and general map to the idea makers and experts. This path introduces the experts' strategic criteria for approving a project in the Persian Gulf Science and Technology Park for the first time. The level of the complexity and technology of the product resulting from the idea as one of the drivers of progress and development, as depicted on the black path, is critical. Derakhshan and Mohammadi (2014) and Weilinghoff (2018) have reported similar findings.

When discussing the differences between the findings of this study and previous research, it is worth noting that the role of investors in the management structure (C54) is one of the strategic indicators in mechanic field. This index was not considered by researchers in previous studies, but it is one of the indicators used by experts in this study.

Since each idea has a distinct path of development depending on the field to which it belongs, a distinct path was identified for each field by examining indicators and interviewing experts in the field. Consequently, those who develop ideas for SMEs under the auspices of the Persian Gulf Science and Technology Park should be aware of the dual nature of the road ahead. They should be aware that the strategic path of the Persian Gulf Science and Technology Park is the first and most important step to take and that they should then consider the path determined for advancing innovative ideas in the desired field.

SMEs require a logical and scientific roadmap, and the findings of this study provide them with one, allowing them to spend more time reviewing key indicators. The cognitive map created as a result of this study assists the Persian Gulf Science and Technology Park experts and investors who want to invest in these fields by introducing different indicators and paths of advancement, allowing them to select only the strong ideas in these indicators. The indicators used in this study as influential and pivotal nodes can be thought of as drivers of innovative business ideas. The results and validity of ten fields' findings were approved by experts.

The following are some of the novelties in this study. Developing a framework to recognize appropriate criteria in advancing and developing innovative ideas in the ten fields of the target community, using a fuzzy cognitive map to find strategic paths regarding the complexity and effectiveness of indicators in advancing and developing innovative ideas, addressing criteria overlooked by previous researchers in evaluating ideas and plans of various fields, and detecting infrastructure indicators as factors to control the complexities of cognitive map.

One of the research's limitations is the difficult access to experts in various fields of study. A large number of indicators and, consequently, the time-consuming nature of examining the relationship between the indicators from the experts' perspective were other limitations of this study.

6. Suggestions for Future Research

This study was a strategic pilot project to introduce the strategic drivers of innovative ideas in the Persian Gulf Science and Technology Park's fields of activity. Future researchers can use the proposed cognitive map to analyze the sensitivity of influential groups by floating the weights and significance of the mentioned indicators and sub-indicators, in addition to localizing the findings of this research to other science and technology parks. They can also investigate subsidiary and partial indicators in each of the ten fields introduced in this study, both hierarchically and separately, to create and analyze the fuzzy cognitive map in each field.

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