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# Providing a Model for Discovering Technological Entrepreneurial Opportunities in the field of Nanotechnology

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***Abstract:*** *Nowadays, in order to benefit from discovering business opportunities and staying competitive, companies have to adopt adaptive and innovative strategies to respond to the rapidly changing customer demands and environmental uncertainties. Discovering entrepreneurship opportunities is very important in nanotechnology, and therefore in the present study, a model for discovering technological entrepreneurial opportunities is presented. The research is developmental in terms of purpose and descriptive in terms of method. Based on the studies, the dimensions and components of opportunity discovery and the interview protocol have been developed. Then, the opinions of the managers of 11 knowledge-based nanotechnology companies were examined by a semi-open interview. The analysis technique in this study was grounded theory and the data collected from the interviews were cast in three stages and the last model was finally presented. The results showed that the discovery of technological entrepreneurship is affected by three dimensions of effective, underlying and inhibiting factors. Examining factors can facilitate the conditions for discovering entrepreneurial opportunities. Then, to confirm the designed model and examine the relationships between the dimensions and their components of the, the opinions of 15 experts through a pairwise effect comparison questionnaire were used by ISM technique. The results showed that each component is related to the other components and how they are effective. The researcher's findings showed that for discovering technological entrepreneurial opportunities, what the effective, and underlying and deterrents factors are, so that appropriate measures can be taken to develop the discovery of technological entrepreneurial opportunities based on this model.*

***Keywords:*** *Nanotechnology, Entrepreneurship, Discovering Technological Entrepreneurship Opportunities.*

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## Introduction

In the present era, the nanotechnology industry and its place in defining the power of governments and societies has played a key role (Mitrano et al., 2015). Therefore, in the last two decades, advanced and technological countries have paid attention to nanotechnology as a fundamental axis of development, so that each country, in turn, has implemented special national and regional plans for the development of this technology. According to the government's attention and focus on this area, it can be said that our country is no exception to this rule (Rezaei et al., 2017). In order to benefit from discovering business opportunities and staying competitive, companies need to adopt adaptive and innovative strategies to respond to rapidly changing customer demands as well as environmental uncertainties (Peng zhang, 2008).). Nowadays, due to the rapid changes in technology, we are witnessing the discovery of many opportunities, among which they have been of the type of discovery that have created great value, for example, ebay $ 1.3 billion, Yahoo $ 3.18 billion, Facebook $ 33 billion, WhatsApp $ 22 billion. These statistics show the high importance of discovering opportunities by entrepreneurial actions. One of the most important features of today's world is wide-ranging change, increasing complexity and competition. Today's organizations operate in a complex yet dynamic environment (werington, 2006).

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Technological entrepreneurial capacities are inextricably linked to and influenced by the environment in which they develop. This environment consists of specific indigenous conditions and a combination of relational and institutional configurations that affect the development of technology and entrepreneurship. Therefore, there is an environmental component that must be taken into account, for example, the quality and availability of foreign institutions and resources that provide conditions for the discovery and exploitation of profitable technological opportunities (Jamali et al., 2018). The concept of technological entrepreneurship also consists of an entrepreneurial component that includes the capacity of companies to identify technologies and business opportunities, management components, or the capacity of companies to rapidly develop valuable proposals and built business models. To take advantage of technological opportunities, these two sets of capacities together create the capacities of technological entrepreneurship, which can be referred to the capacity to identify and take advantage of technological opportunities to create or improve new products for their successful commercialization. These capacities are known as "high-performance organizational processes" that bridge the gap between technology development and business creation (Patti and Zhang, 2011). The truth is that these opportunities do not appear by themselves or in creative and talented individuals or groups. Rather, the discovery of technological opportunities and their exploitation is often the result of a series of systematic activities that involve actors who provide resources and a set of appropriate conditions that lead to the development and dissemination of technological applications, which are collectively considered as a system.

That is, a system that requires interaction between talented individuals, government agencies, educational and research institutions, as well as institutions and investors, which significantly facilitates, stimulates and promotes technology exploration where needed. In summary, the concept of technological entrepreneurship in the system model consists of three components, which are: entrepreneurial components, managerial components and environmental components. In other words, the basis of technological entrepreneurship is reflected in a system in which actors engage in a range of activities related to technology identification and development, opportunity identification, product development, and the development and creation of technology-based businesses (Petty and Zhang, 2011). Iranian companies are entering domestic and international markets by designing and manufacturing products based on nanotechnology. With the discovery of nanotechnology in the last two decades, a very good ground has been created for the development of entrepreneurship, including technological entrepreneurship. Existence of very wide markets and intertwining of research, scientific and innovative fields, has caused this field to have many entrepreneurs. In the meantime, examining the factors affecting the discovery of technological entrepreneurship opportunities can be of great importance. Because by strengthening these factors, the field for entrepreneurship in the field of nanotechnology can be developed. A review of studies shows that such a model has not been studied in domestic and foreign research. Therefore, in this study, the main purpose is to present a model for discovering technological entrepreneurial opportunities in the field of nanotechnology. Because by strengthening these factors, the field for entrepreneurship in the field of nanotechnology can be developed.

Accordingly, the main issue of the research is how the discovery of technological entrepreneurship opportunities by Iranian entrepreneurs in the field of nanotechnology occurs? What are the dimensions of this model?

## Literature Review

### Entrepreneurship

"Entrepreneurship, like other concepts in the humanities, can be analyzed and examined when a clear definition or definitions are provided, but entrepreneurship is one of the words from which the same definition is not provided. Accordingly, various theories have been proposed about it by theorists of different sciences "(Niazi et al., 2010: 76). Historically, the word entrepreneurship came to the fore in the 16th century from the French Word Entrepreneur. In fact, the term "was first used for people who risked themselves in military missions" (Ahmadpour, 1379: 4).

He used economics and called it "creative destruction" (Fu, 2000). Hisrich and Peters (2002, quoted by Ahmadipour, 2009) Entrepreneurship is the process of creating something valuable and different, by allocating sufficient time and effort along with financial, psychological and social risk, as well as receiving financial rewards and satisfaction, and someone who knows the results. Liu and Dabinski (2000) also consider entrepreneurship as a multidimensional concept or a process of risk-taking, innovation and foresight in creating or controlling events. "Entrepreneurship can be called a dynamic process that includes ideals, transformation, and creativity. This process requires the use of energy and motivation of people to create and implement new ideas as well as practical solutions. Components of the main processes are:

- Desire to take risks calculated on a time basis
- Net worth or job opportunity
- The ability to form a team in connection with doing a risky job
- Creative skills in organizing the required resources
- Having the perspective to find opportunities that others cannot find in a chaotic situation "(Kuratko and Hodges, 2004, quoted by Ali Miri, 1387: 30).

Entrepreneurship is the engine of economic growth and development and job creation and community reform (Gurol & Astan, 2006). Entrepreneurs are individuals, groups or people who establish and manage a new business in a way that it creates employment for at least one person (Kirkwood, 2007). An entrepreneur sets up and runs a business according to the need for success and with the aim of improving his performance (growth, profit, etc.) under challenging and competitive conditions (Hansemark, 1998; Utsch & Rauch, 2000; Murray, 1938). It is this unique trait that motivates entrepreneurs to face challenges in order to succeed at work and excellence (Atkinson & Raynor, 1974; Grote & James, 1991). Entrepreneurship is associated with new business ideas that may change the nature of the market. Entrepreneurship is the search for opportunities and the ability to identify gaps in the market. An entrepreneur-centered approach is one that emphasizes market and product innovation, and venture capital, and seeks to outperform competitors by tending to innovate (Miller, 1983). Innovation as one of the components of entrepreneurship is considered an inevitable necessity of all organizations. Therefore, organizations must always seek to discover new opportunities in order to succeed in their performance and achieve sustainable competitive advantages through innovation (Tajeddini, 2006). Entrepreneurship is the driving force whose role is to find untapped opportunities in the market and seek to create a new balance in the market (Elenurm et al., 2007). Risk-taking is one of the most emphasized entrepreneurial traits (Cunningham & Lischeron, 1991; Morris & Trotter, 1990).

A person at risk is someone who has a strong tendency to work in uncertain decision-making situations (Ho & Koh, 1992). From an entrepreneurial perspective, entrepreneurs are always looking for risk (Agarwal & Prasad, 1998), and entrepreneurs are those who tend to use their resources in opportunities where they are more likely to fail. McClelland argues that entrepreneurs are characterized by self-confidence, the ability to accept calculated risk, the need to explore the environment, and the desire to have feedback on their performance (McClelland, 1965, 38). An entrepreneur's personal success can affect his perception of risk and how he manages it (Kliem & Ludin, 2000, 28).

**Entrepreneurial opportunities**

Opportunity is a new situation or need that can be turned into a business or a value. Opportunity is a positive external tendency or change that provides unique opportunities for innovation and value creation (Ocalan, 2016). Shin and Wakataraman (2000) consider the existence of opportunities in a specific market or from outside; therefore, they consider entrepreneurship in relation to the discovery, evaluation and exploitation of opportunities and the group of people who discover, evaluate and exploit opportunities (Bagheri, 2017). According to Kasan, entrepreneurial opportunities mean the difference between production costs and market prices. This value difference is called surplus value; thus, entrepreneurial opportunity is defined in relation to surplus value and benefits. In terms of surplus value, there are two possible scenarios: one is that certain market prices have fallen due to innovation and creativity. In this case, the value difference is due to innovation and change in production. The second

case is that with certain costs (existing technology), a new market or new information from the market can be found that has better prices or better conditions. In this case, intelligence in discovering the gap between supply and demand creates entrepreneurial opportunities. In fact, it can be concluded that entrepreneurial opportunities are the difference in value and surplus value in goods and services that is due to innovation (Schumpeter mode) or the discovery of new markets and new market studies (Curzner mode) (Rezaei, 2015). Dimo (2007) considers this process as moving in a path from the initial idea to a complete idea, He argues that not every idea is a good opportunity (meaning that what is interesting is different from what has the potential for commercial profitability), that every opportunity starts with an initial idea, but the existence of ideas that are necessary and not sufficient conditions for opportunities to appear. The condition of adequacy depends on gathering evidence about the potential for profitability, the existence of a potential market, the ability to be profitable, and the sustainability of profitability over time. Thus, the idea is an abstract representation of the idea of future reality while opportunity tends towards the realization. After an idea comes to mind, the entrepreneur modifies the idea by talking to friends, colleagues, potential customers, etc., and the new idea is more justifiable, at least theoretically.

This cycle repeats itself, and more formal actions may be taken to pursue the idea (such as talking to potential employees or checking the location of the business) or the idea may be convinced that the idea is unjustifiable, Whether the result is an opportunity or an abandonment of the idea, these actions are entrepreneurial actions that seek to solve problems related to uncertainty about the original idea. In the process of moving from the initial idea to the final idea, this idea is constantly reproduced and new information obtained from the media or from the opinions and judgments of others is used. The creative result of this process is to find new solutions to advance the idea, that is, to frame it using information available at any point in time. Thus, opportunity, as a creative product in entrepreneurship, is moving (idea + action) in a direction that starts from the initial vision and ends with a complete idea about starting and running a business (Demo, 2007). Given that the process of identifying and selecting opportunities is generally done by entrepreneurs intuitively. It is very important for entrepreneurs to enter into the discussion in this field with non-intuitive approaches and based on scientific approaches to select, identify or compare opportunities. (Miller et al. 2016).

**Discovering entrepreneurial opportunities**

Those who use exploratory perspectives to identify and explore opportunities, examine and analyze the market, and the unknown dimensions of supply and demand in the market for which goods are in demanand and Supply does not meet their needs. But the question is, how can hidden market's demand be discovered? Entrepreneurs examine market processes and discover unknown dimensions of supply or demand related to a phenomenon through activity in their networks, the use of new information and previous experiences. If none of the dimensions of supply and demand related to a particular good or service is known, supply, demand, or both must be created. Therefore, to create a new opportunity, basic economic initiatives in product design or product marketing must be performed (Jamali, 1396).

**Nano-technology**

Nanotechnology is a new technology that has spread all over the world, and to be more precise, "nanotechnology is not part of the future but all of the future." Nanoscience is the study and research of devices and structures that exist in the smallest dimension unit (200) nanometers or less. It follows from the above definitions that nanotechnology is not a discipline but a new approach in all disciplines. Applications for nanotechnology exists in various fields from food, medicine, medical diagnostics and biotechnology to electronics, computers, communications, transportation, energy, Environment, aerospace and national security that has been considered: the wide range of applications in this field and its socio-political and legal consequences that have made this technology a cross-disciplinary and cross-sectorial field.

**A review of previous researches**

- In a study examining the impact and causality in creating knowledge-based businesses, Villani, Linder, and Grimaldi (2018) examined two groups of small businesses that have been set up in a traditional and creative way, pointing to how decisions are made. Those in the first group use

linear decision-making and planning methods and reduce their business risk, and those in the second group use non-linear methods and have more risk to take. Also, these two groups have different educational needs because the first group focuses more on planning and needs knowledge for analysis, and the second group focuses on flexibility and needs knowledge to innovate and make decisions in ambiguous situations.

- Alsos, Klossen, Hitty, and Solol (2017) in their study examined how an entrepreneur's social identity influences his behavior when forming a new investment. Based on interviews with entrepreneurs in six previous launches in the tourism and literature sectors, three hypotheses were considered regarding entrepreneurial identity and entrepreneurial behavior causality, and impact that were tested. The results of this study show that entrepreneurial identity affects whether a person is mainly involved in influential or causal behavior. Hence, entrepreneurial identity helps to shape the behavior of entrepreneurs as an important factor. In addition, they point to the perception of entrepreneurs as a heterogeneous group. Entrepreneurs are different in terms of their identity, and these changes have consequences for their entrepreneurial behaviors.
- Sarrafzadeh Qazvini and Zare Dehabadi (2016) in a study on technological entrepreneurship in the field of environment, introduced the components of technological entrepreneurship including technology entrepreneur, universities, research and development centers, companies, capital, customers and market, government and consultants. Then they dealt with the characteristics of environmental technological entrepreneurship such as the need for high capital, the need to observe ethical laws in human and animal experiments, the need for extensive martyrdom and protection of intellectual property, and the most important component of environmental entrepreneurship is the entrepreneur himself and different components for Commercialization and market entry routes in biotechnology which were enumerated. (Sarrafzadeh Qazvini and Zare Dehabadi, 2016).
- A study was conducted by Mohammadi and Momayez (2014) under the title of identifying the key success factors in social technology entrepreneurship in the field of providing urban services to the disabled. In this research, the exploratory mixed method has been used. The research area has been the city of Tehran. The statistical population of the research was 10 people in the qualitative part and 120 companies and 52 entrepreneurs with disabilities in the quantitative part. The results of the research were achieving 6 groups of effective factors, counting 52 success factors and ranking these factors based on their factor loads in 46 ranks, which are related to education, standardization, monitoring and feedback systems, networking, technological innovation, management Technology, alliances with growth centers, team dynamics and marketing with the highest factor scores that were selected as key factors for success.

**Model arising from the literature**

Usually, basic research models are developed based on the raw ideas of researchers. Therefore, if the researcher is not allowed to review his or her original research model, the research process will not be very wise. The model derived from the literature is the result of studying theoretical foundations and helps to identify the frontiers of knowledge. At the same time, it facilitates the avoidance of repetition. In fact, this model is the result of combining the findings of previous research with the original mental model of the researcher, and in a sense, it can be said that the report is a summary of what the researcher has achieved in his literary tour. In other words, the model arising from literature is the researcher's initial travelogue in his scientific journey (Pourezat, 2014). The model for discovering technological entrepreneurial opportunities was identified in the form of the following components according to the literature review:

- ✓ Individual factors: Factors related to individual characteristics and capabilities. These factors are high risk-taking, acceptance of ambiguity, self-confidence, optimism, perseverance and uncompromising spirit (Jamali, 1396; McMullen and Shepherd, 2006; Davidson, 2005; Park and Eun, 2008; Maine et al., 2015; Plum et al., 2018; Jamali et al., 2018).

- ✓ Belief factors: Belief in God, belief in success, trust in God, fear of failure, belief, trust in God before starting work, personal belief of the entrepreneur, their intention to help people, trust in the system, motivation (Jamali, 1396; Mac Mullen and Shepherd, 2006; Davidson, 2005; Park and Eun, 2008; Plum et al., 2018; Jamali et al., 2018).
- ✓ Environmental factors: Attending conferences and scientific and technological circles and domestic and foreign exhibitions, infrastructure sanctions, being in the environment, technology change, new knowledge, the emergence of technology (Jamali, 1396; McMullen and Shepherd, 2006; Davidson, 2005; Park and Eun, 2008; Plum et al., 2018; Jamali et al., 2018).
- ✓ Social and communication factors: relationship with inventors and owners of domestic and foreign companies and businesses, social network, communication networks, support of family and friends, coach support (Jamali, 1396; McMullen and Shepherd, 2006; Davidson, 2005; Park and Eun, 2008; Maine et al., 2015; Song et al., 2017; Plum et al., 2018; Jamali et al., 2018).
- ✓ Economic Factors: Financial Support, Corruption, Financing, Research and Exploitation Loans, Financial Aid, Tax Protection Laws (Jamali, 1396; McMullen and Shepherd, 2006; Davidson, 2005; Park and Eun, 2008; Plum et al., 2018; Jamali et al., 2018).
- ✓ Cultural and educational factors: previous educational and research activities, articles and studies, journals, brochures and catalogs, educational system (Jamali, 1396; McMullen and Shepherd, 2006; Davidson, 2005; Park and Eun, 2008; Plum et al., 2018; Jamali et al., 2018).
- ✓ Legal and policy-making factors: policy-making, weakness of laws, legislative power in international institutions, registration and copyright laws, laws of inventor and company owner (Jamali, 1396; McMullen and Shepherd, 2006; Davidson, 2005; Park and Eun, 2008; Plum et al., 2018; Jamali et al., 2018).
- ✓ Political factors: government unplanned, inability to lobby government, global sanctions, political and scientific relations of countries (Jamali, 1396; McMullen and Shepherd, 2006; Davidson, 2005; Park and Eun, 2008; Plum et al., 2018; Jamali et al., 2018).

Based on the factors identified in previous researches and researches, the model arising from the literature is designed as follows:

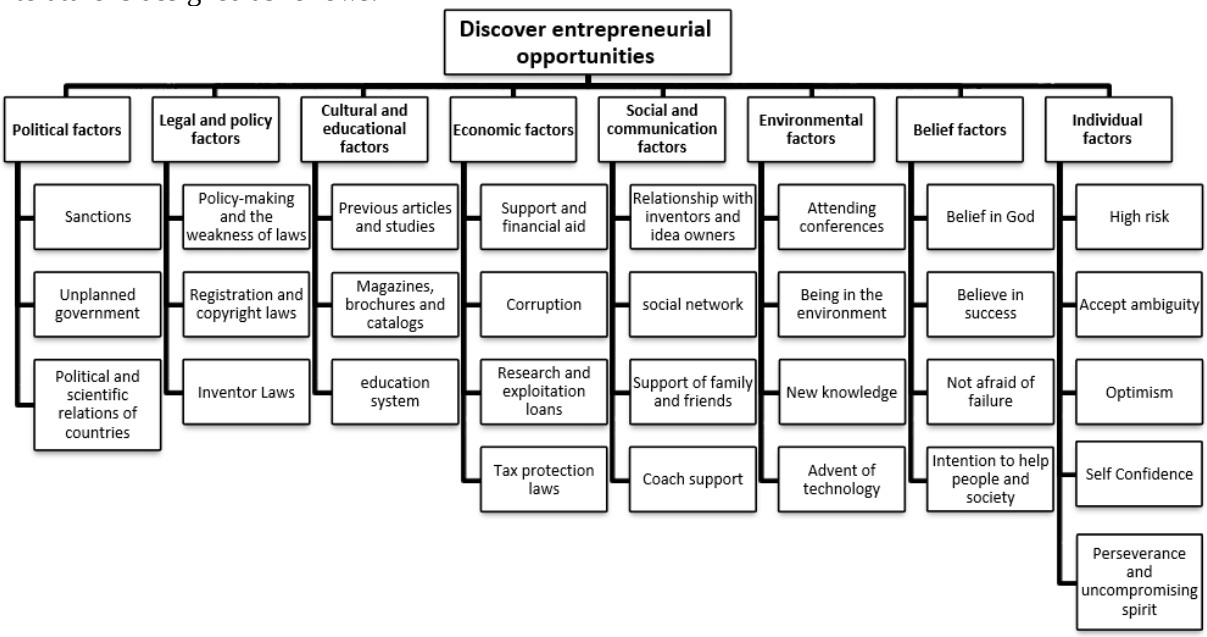


***Figure (1): Model of factors affecting the discovery of entrepreneurial opportunities arising from the literature***

## Research methodology

The dominant philosophical paradigm of research is the paradigm of interpretivism, because in this research, effective factors are identified. This means that through interviews with individuals, the factors affecting the discovery of technological entrepreneurial opportunities in the field of nanotechnology are addressed. Also, the present research is qualitative in terms of method. Because the required data is the

description that is obtained through interviews with people and the data is not small. The present study is considered inductive in terms of cognitive approach because the presentation of the research cognitive model is obtained from the total micro cognitions of the people interviewed, and after aggregating these views, a model is presented. Also, the present research is developmental and applied in terms of purpose. This means that in this study, a new model is presented based on interviews with entrepreneurs of nanotechnology companies and also the existing theories in the field of nanotechnology and the factors affecting the discovery of technological entrepreneurship opportunities that are discussed. Interviewees included nanotechnology entrepreneurs. About 25 companies were identified based on the discovery of entrepreneurial opportunities in science and technology parks located in Tehran. Then, based on the data saturation theory, interviews were conducted and finally, after 11 interviews, the researcher was faced with data saturation. Interviews were conducted in person at their office or outside the workplace by prior appointment. Interviews lasted between 1 and 3 hours. The library method was used to collect data and secondary information and the field method was used to collect the required data. For the library method, the study of documents and research was done and contained in domestic and foreign journals and scientific databases, and also for the field method, interviews were used. To calculate the reliability of the interview at this stage of conceptual coding, a researcher with a Ph.D. in Public Administration from the University of Tehran and a Ph.D. student in Public Administration at Allameh Tabatabai University, who were familiar with coding and content analysis, were asked to do so. In order to Re-do the process of extracting concepts and coding concepts, the researcher provided the first and ninth interviews to the first colleague researcher and the fourth and tenth interviews to the second colleague. The results obtained from coding based on internal agreement, and is also based on the following formula as follow:

$$\frac{\text{number of agreements}}{\text{number of all codes}} \times 100$$

***Table (1): Results of calculating reliability between co-coders***

| Row | Peer Coder | interview | Percentage of internal agreement |
|---|---|---|---|
| 1 | PhD in Public Administration | 1 and 9 | 81% |
| 2 | PhD student in Public Administration | 4 and 10 | 79% |

As can be seen in the table above, the internal agreement in the first coding is 81% and in the second coding is 79%, and Considering the acceptable limit of 60% for reliability (Siahkali Moradi, 2018), it can be concluded that the reliability of conceptual coding is acceptable.

The researcher analysis method was grounded theory in which three coding steps were performed and finally the model was designed based on the Charms (2014) technique.

## Research findings

### Results of initial coding and extraction of concepts

Based on the interviews, the foundation was coded in three steps using the data theory method, and the results of the axial coding are shown below:

***Table (2): Axial coding of individual factors***

| Basic codes | concepts | Category |
|---|---|---|
| High risk | Ambiguity and risk-taking | Individual factors |
| High ambiguity and decision making in ambiguous situations | | |
| Compromising and interactive | Interaction | |
| high self-confidence | Self Confidence | |
| Hardworking and with great perseverance | effort and Perseverance | |
| stubborn and persistent in goals | | |
| Internal control, self-reliance, not on others | | |
| Fight against convenience | | |
| Optimistic about the result | Consequentialism | |
| Logical and realistic | | |
| Analytical and analytical power of complex situations | Looking Ahead | |
| Futurist and looking to the future | | |
| Learner and thirsty for learning | | |
| ambitious | Achieve success | |

| | | |
|---|---|---|
| Successful | | |
| Independence | | |

**Axial coding of belief factors**

In the table below, the extracted codes are categorized and the main concepts were extracted.

***Table (3): Axial coding of the category of belief factors***

| Basic codes | concepts | Category |
|---|---|---|
| Believe in success | Belief and trust | Belief factors |
| Trust in God | | |
| Resist the fear of failure when making decisions | | |
| Having good intentions and intention to solve society's problems | Entrepreneur Intent | |
| Job creation in society | | |
| Intention to make a profit | | |

**Axial coding of environmental factors**

In the table below, the extracted codes are categorized and the main concepts were extracted.

***Table (4): Axial coding of environmental factors***

| Initial codes | concepts | Category |
|---|---|---|
| Up-to-date knowledge and reading new articles | Strengthening and monitoring knowledge | Environmental factors |
| Monitoring of emerging technologies and new technologies | | |
| Attending conferences and see international exhibitions | Benefiting from the experience and achievements of others | |
| Presence among entrepreneurs and entrepreneurial companies | | |
| Proper identification of needs | Sensitivity to symptoms | |

**Axial coding of social and communication factors**

In the table below, the extracted codes are categorized and the main concepts were extracted.

***Table (5): Axial coding of social and communication factors***

| Initial codes | concepts | Category |
|---|---|---|
| Relationship with idea owners and inventors | Communication with entrepreneurs and experts | Social and communication factors |
| Coach and Incentive | | |
| Social Networks | social relations | |
| Support family and friends | Family support | |

**Axial coding of economic factors**

In the table below, the extracted codes are categorized and the main concepts were extracted.

***Table (6): Axial coding of economic factors***

| Initial codes | concepts | Category |
|---|---|---|
| Weak protection laws | Financial support | Economic factors |
| Corruption in sponsoring organizations | | |
| Reduction of currency fluctuations | currency fluctuations | |
| Fairness between the investors and investee | investment | |
| Business culture | | |

**Axial coding of cultural factors**

In the table below, the extracted codes are categorized and the main concepts were extracted.

***Table (7): Axial coding of cultural-educational factors***

| Basic codes | concepts | Category |
|---|---|---|
| Strengthen the scientific foundation through related studies and articles | Scientific reinforcement | Cultural and educational factors |
| Studying related brochures and catalogs | | |
| Weakness of the country's education system and the need to reform it | education system | |

**Axial coding of legal factors**

In the table below, the extracted codes are categorized and the main concepts were extracted.

***Table (8): Axial coding of legal factors***

| Initial codes | concepts | Category |
|---|---|---|
| Amend patent and copy right laws | Amending the rules | Legal factors |
| Amending protectionist laws | | |
| Respect the rights of inventors and pay attention to the rights of the owners of ideas | | |
| Government employment laws | | |
| Reform of the administrative bureaucracy | enforcement | |
| Focus on enforcing laws and the need to implement enacted laws | | |
| Mature private sector | Strengthen the private sector | |
| Acknowledging government inefficiency | | |

**Axial coding of political factors**

In the table below, the extracted codes are categorized and the main concepts were extracted.

***Table (9): Axial coding of political factors***

| Initial codes | concepts | Category |
|---|---|---|
| Cooperation and scientific relations with other countries | Impact of sanctions | Political factors |
| Turn the threat of sanctions into an opportunity | | |
| Cost of imported equipment | | |
| Government planning | government role | |
| Smart government support | | |
| Reducing government ownership | | |
| Deductive modeling | Modeling successful patterns | |
| Communication with external accelerators and incubators | | |
| Following the example of successful countries | | |

**Extracting the main categories**

Once the central codes are identified, the main themes are created by putting the categories together.

***Table (10): Identified categories***

| concepts | Category |
|---|---|
| ▪ Ambiguity and risk-taking<br>▪ Sensitivity to symptoms | Discovering opportunities |
| ▪ Interaction<br>▪ Self Confidence<br>▪ effort and perseverance<br>▪ Consequentialism<br>▪ Looking Ahead<br>▪ Achieving success<br>▪ Trust<br>▪ Entrepreneur intent<br>▪ Scientific reinforcement | Effective factors |
| ▪ Strengthen and monitor knowledge<br>▪ Benefit from the experience and achievements of others<br>▪ Communication with entrepreneurs and experts<br>▪ social relations<br>▪ Support of relatives<br>▪ Financial support<br>▪ investment | Underlying factors |
| ▪ currency fluctuations<br>▪ Impact of sanctions<br>▪ government role<br>▪ education system<br>▪ Amending the rules<br>▪ Enforcement<br>▪ Strengthen the private sector<br>▪ Modeling successful patterns<br>▪ Business culture | Inhibitory factors |

Then, according to the identification of the main category that is the discovery of opportunity and the factors affecting it, as well as the identification of underlying factors and deterrents, in the following figure, the relationship between the main categories based on Strauss and Corben (2012) model was identified. In this model, opportunity discovery is at the center of the model. Also, effective factors have been identified as influential factors in the model and also underlying and inhibiting factors have been identified as positive and negative interfering factors. According to Strauss and Corben, a model should be able to lead to theorizing based on the relationships between categories, which has been done in this study.

**Design relationships between categories**

Based on the results, it was found that the discovery of technological entrepreneurship opportunities in the field of nanotechnology is created by identifying the needs and sensitivity to the symptoms in society, and the entrepreneur makes decisions based on it in a vague and uncertain situation. On the other hand, factors affect the entrepreneur's irritability and decision making, which include entrepreneur interaction, entrepreneur confidence in his decision, entrepreneur's effort and perseverance, consequentialism and optimistic entrepreneur, confidence and belief to achieve success, these cases are considered as effective individual factors. Entrepreneurs also boost positive energy by trusting and relying on good intentions and sociability, thus facilitating decision-making for them. Also, cultural and educational factors such as strengthening knowledge and scientific spirit are effective on this decision-making process and overcoming future complexities and ambiguities. Among these, there are factors that are effective as communication factors in discovering opportunities, which include the use of experience and achievements, communication with entrepreneurs and experts and social communication that can help the researcher to achieve success. On the other hand, participating in conferences and exhibitions and strengthening and monitoring knowledge is also effective as a platform in strengthening the formation of opportunity in discovery. Also, the support of relatives and government's financial aid can support the entrepreneur spiritually and materially, and facilitating access to the capital needed by the entrepreneur, who often used personal capital to provide it, is very effective.

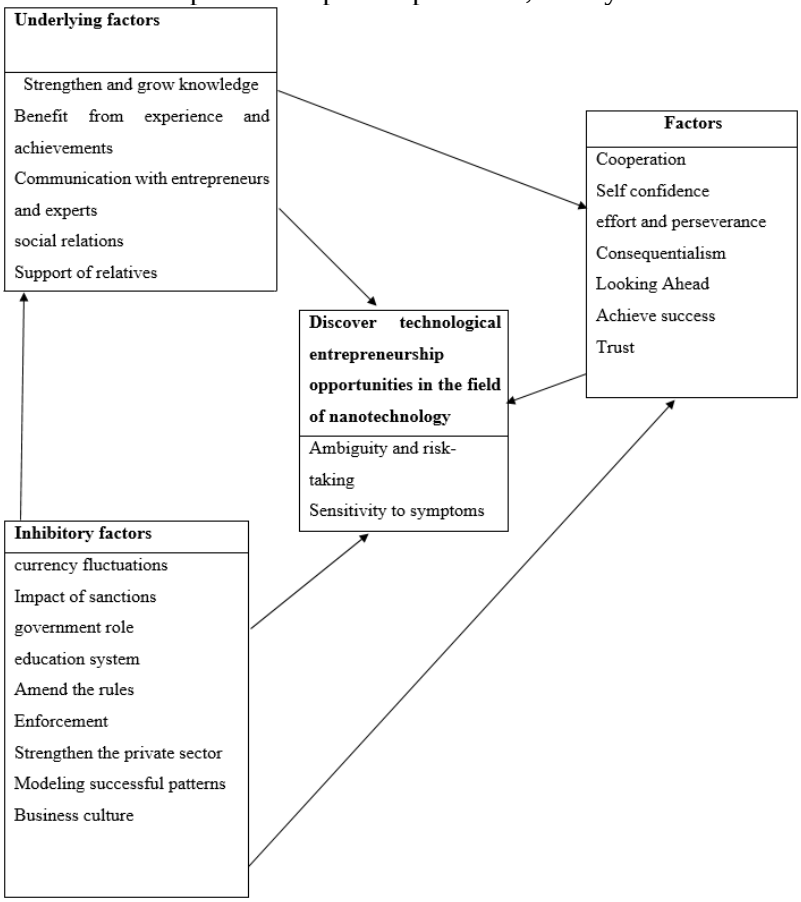


***Figure (2): Model for discovering technological entrepreneurial opportunities in the field of nanotechnology***

Some factors in the discovery process have the opportunity to intervene negatively and prevent its success. According to the owners of the companies, the existence of sanctions and unfavorable economic conditions have caused currency fluctuations. On the other hand, the government has a key role to play in modeling and improving the education system in which it has not been successful, and therefore laws must be amended in this regard. Because most of the interviewees believed that the laws protecting entrepreneurs in this area have problems. Of course, these problems are not limited to legislation, and there are fundamental problems in law enforcement. The government must strengthen the private sector and reduce its role in countless enterprises. On the other hand, to reform the entrepreneurial and business culture in the company, education and employment system must be reformed so that in the future, this culture will not hinder the success of entrepreneurs.

**Discussion and Conclusion**

In order to identify the stages of discovering technological entrepreneurial opportunities in the field of nanotechnology, first, previous and related researches of theoretical researchers in the field of opportunity discovery were studied and the processes mentioned in these articles were extracted. Then, the interview protocol was developed based on this initial process, and interviews were conducted with 11 companies in the field of nanotechnology. These companies were selected based on the fact that at least one of their products was invented and produced according to the definition of opportunity discovery. Then the interviews were coded using the data theory method in three stages and the results of axial coding were determined. The following are practical suggestions.

**Practical suggestions**

Based on the identified factors, it is recommended to entrepreneurs active in the field of nanotechnology to:

- Pay attention to environmental signs. Given that the origin of symptoms is in the environment, without considering the environment and environmental symptoms, one cannot expect the process of opportunity discovery to take shape. Accordingly, it is suggested that entrepreneurs monitor the trends of international and national changes in the field of nanotechnology, in the field of nanotechnology, equipment and achievements of researchers in other parts of the world so that they can be aware of these events and expose themselves to signs. It is also suggested that entrepreneurs be constantly informed of the research and field achievements that have taken place in the nanotechnology industry in order to understand the opportunities that lie at the heart of this research.
- Increasing prior knowledge is one of the effective factors in increasing the capacity to attract entrepreneurs. Absorption capacity is the ability of an entrepreneur to attract opportunities. Prior knowledge allows a person to have basic information in different cases, and this information may make a difference. Prior knowledge increases a person's sensitivity to the environment. It is suggested that entrepreneurs study specialized and general texts based on their expertise, which is the health and medical equipment industry. Increasing the relevant knowledge network can also create the ground for conceptual communication. For example, information about the field of mechanics, information about nanotechnology, information about various issues and other things that may, in addition to the individual's expertise, be able to increase their general knowledge.
- Strengthening the social network and the position of the person in this network helps the entrepreneur to be able to use the information and communication of people in the network when necessary. This network can be the beginning of a person's attention to symptoms. As mentioned in some interviews, the person has heard a topic from a group of friends or experts and has received signals during these conversations. Strengthening the network is created through effective communication and requires increased communication skills.
- One can develop some skills in order to strengthen skills and absorption capacity. These skills can be the effective use of the internet and social networks, communication skills and specialized skills, and so on.

- Participating in international and national exhibitions as well as attending international and national conferences can both increase attention to the environment and increase the areas of knowledge and skills of the individual. On the other hand, it can expand one's social network.
- Social networks are a new achievement in the world of communication, the skills of using which can facilitate connection to the world of information. Specialized telegram channels are a very dynamic and suitable environment for increasing knowledge, absorbing environmental signals and increasing one's social network.
- It is suggested that in order to overcome the fear of failure and make decisions in conditions of ambiguity, one should follow belief patterns such as trusting in God, trusting in the essence of oneness and making decisions based on "good in our situation" and aligning one's decision with divine policy greatly reduces the existing ambiguity. This heartfelt belief gives the person assurance that although the person is not aware of the process and the future, the essence of oneness is aware of all past and future events. Therefore, the entrepreneur makes his decision by relying on God's decision and reassuring his heart. This confidence, to a large extent, reduces stress in the person and increases his operational capacity. Also, the goodness of what is happening leads to optimism and confidence in the future.
- Some institutions are effective in the development of environmental factors. Protection laws must be targeted and optimized. Supportive approaches should be specialized, and a specialized NGO should take on the role of regulator to provide financial and advisory services in a specialized manner.
- The government should try as much as possible to increase the educational system towards the questioning spirit of students and their skills development during this period.
- Development of infrastructures such as laboratories, specialized libraries and communication networks of entrepreneurs with consultants, can develop and strengthen the fields of entrepreneurship and use specialized consultations to increase information resources, increasing knowledge and skills of individuals, reduce feasibility concerns and provides data search by the entrepreneur in the emergence process.
- Efforts to reduce the effects of sanctions and currency fluctuations on knowledge-based companies in various fields can help these companies to open a special account against the effects of sanctions on government aid. Of course, the right mechanism must be seen to support the establishment of knowledge-based companies as a means of exploiting individuals.

**Suggestions for future researchers**

The present study explains the process of discovering technological entrepreneurial opportunities in the field of nanotechnology in Iran. Based on the research achievements and results obtained, it is suggested that future researchers who are interested in research on topics close to the present research topic, use the following study and research axes:

- Investigating the process of discovering technological entrepreneurial opportunities in other fields such as medical equipment, oil, communications, software, agriculture and comparative study of the models explained with the current model
- Study of effective environmental and personal factors on each part of the process of discovering technological entrepreneurial opportunities using positivist methods
- Explain the process of discovering non-technological entrepreneurial opportunities and compare the explained model with the current research model
- Investigating the effective factors on strengthening the entrepreneur's decision in conditions of uncertainty
- Investigating the Impact of Iran's Economic Structure by Discovering Technological Entrepreneurship Opportunities in the Field of Nanotechnology and Comparative Study with Selected Countries

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