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Providing a Model for Identifying Digital Entrepreneurship Opportunities in Iran's ICT Industry

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ARTICLE INFO	ABSTRACT
	The aim of this research is to provide a model for identifying digital entrepreneurship opportunities in Iran's ICT industry. This study is qualitative and exploratory in nature, utilizing a combination of research methods focused on in-depth and semi-structured interviews as well as questionnaires to design a model for identifying digital entrepreneurship opportunities in Iran's ICT industry. Several stages were undertaken to achieve this goal. In the first stage, concepts were extracted using theoretical foundations, literature review, thematic analysis, in-depth and semi-structured interviews, and expert consultations. In the qualitative phase, 20 experts in the field of digital entrepreneurship, including individuals with relevant experience or active involvement in this domain, participated. The decision-making team comprised university professors, industry experts, key informants, digital entrepreneurs, and professionals from organizations such as the Ministry of Information and Communications Technology and other relevant institutions. The selection of participants was conducted using a purposive sampling method. As a result of this stage, the main and sub-components of digital entrepreneurship opportunities in Iran's ICT industry were identified, leading to the extraction of 139 codes. Subsequently, a fuzzy Delphi method was applied to filter the identified codes, and ultimately, 45 indicators were recognized as the key factors for the proposed model. The Delphi analysis was based on the opinions of 20 experts and was conducted in three rounds of expert surveys. At the end of this stage, 45 indicators were finalized as the critical elements of the model for identifying digital entrepreneurship opportunities in Iran's ICT industry. In the next stage, the Interpretive Structural Modeling (ISM) method was employed to design the final model. The constructs examined for developing this model included twelve key elements: innovative value creation, generation and processing of digital entrepreneurial ideas, personal characteristics of digital entrepreneurs, monitoring technological, political, legal, and demographic changes, digital infrastructure and internet-based platforms, digital business environment monitoring, entrepreneurial alertness, foresight, entrepreneurial networking, market and commercialization of digital technology, intellectual capital and digital knowledge, and entrepreneurial leadership in the digital industry. Ultimately, the model for identifying digital entrepreneurship opportunities in Iran's ICT industry was successfully developed.

Keywords: Digital Entrepreneurship, Opportunity Recognition, Innovative Value Creation, ICT Industry. |

INTRODUCTION

Entrepreneurship is a phenomenon that has been examined through various influencing factors. One of these factors is information technology (Ferreira et al., 2019). In the past century, Information and Communication Technology (ICT) has become a key driver of economic and social development, playing a crucial role in addressing challenges such as inflation, unemployment, limited financial resources, and negative trade balances in countries. The increase in communication speed and the global production of goods and services have impacted all markets. This technology can influence employment, entrepreneurship, and all related issues. Therefore, it can be argued that the development of employment and entrepreneurship is largely influenced by the advancement of information and communication technology (Store et al., 2018). One of the dimensions of entrepreneurship development is digital entrepreneurship. Digital entrepreneurship broadly refers to the creation of new investments and the transformation of existing businesses through the development of new digital technologies and/or the innovative use of such technologies (Shen

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et al., 2018). Digital entrepreneurship offers numerous opportunities for entrepreneurial activities as technology development accelerates the exchange of information and strengthens knowledge sharing. It enhances online stores and the capacity to conduct business through the internet (Chakraborty et al., 2020). A digital entrepreneur is someone who uses these tools to create business opportunities and generate revenue. With technological advancements, digital entrepreneurship seems more practical than entrepreneurship in other fields, providing an opportunity to leverage creative forces at lower costs and acting as a driver of value-added and productivity improvements in the market. This form of entrepreneurship is more than just about technology—it is essentially the interaction between technology, strategy, and business processes, where the role of information and communication technology in creating value across the entire business process chain, from acquisition to sustainability and competitive advantage, comes into play (Mahmud & Yu, 2015). In developed societies, technological advancements expand a wide range of entrepreneurial opportunities while also posing challenges for business owners and their companies, such as those associated with digitization (Bliva et al., 2020). In the process of digital entrepreneurship and the establishment of businesses in this domain, there are numerous opportunities that individuals and businesses exploit according to their needs and opportunity-seeking strategies. According to Kirzner (1973), entrepreneurial opportunity is the core of the entrepreneurship process, and in fact, entrepreneurship has no meaning without the recognition of opportunities (Septorno et al., 2020). Therefore, timing and correctly identifying technological opportunities are the most critical aspects of business strategies. The importance of recognizing entrepreneurial opportunities as one of the key elements of entrepreneurial behavior, as well as one of the central concepts defining entrepreneurship, has been discussed in numerous entrepreneurship studies. It can be said that identifying and selecting the right opportunities in businesses is the most important ability of a successful entrepreneur and serves as the foundation for a successful entrepreneurial process (Forouharfar et al., 2018). Digital entrepreneurs must possess certain characteristics, such as the ability to recognize digital entrepreneurial opportunities, the ability to innovate in this domain, the level of use of information technology, skills in utilizing information technology, and the innovative capabilities of digital entrepreneurs (Bali, 2020). Thus, the aim of this research is to provide a model for identifying digital entrepreneurship opportunities in Iran's ICT industry. The innovation of this study lies in both its subject matter and methodology. A review of the research literature reveals that, despite studies on entrepreneurial opportunities, digital entrepreneurial opportunities have received less attention. Furthermore, entrepreneurial opportunities in the digital domain, due to the novelty of digital entrepreneurship applications, will bring about new concepts. Additionally, most studies in the field of entrepreneurial opportunities have focused on the paradigms of discovery, creation, or recognition of entrepreneurial opportunities, and fewer studies have explored the exploitation of these opportunities. Therefore, this research can fill the gap in this area. This study also introduces a methodological innovation by utilizing an exploratory mixed-methods approach. The use of a mixed-methods approach, combining qualitative and quantitative research methods, will reveal new dimensions and pave the way for theorizing and modeling in the exploitation of digital entrepreneurial opportunities. Finally, in this study, the process of exploiting digital entrepreneurial opportunities is viewed as a set of factors, referred to as the **digital entrepreneurship ecosystem** (Frasso & Belyva, 2020).

ENTREPRENEURIAL OPPORTUNITIES AND DIGITAL ENTREPRENEURSHIP

Opportunity is a fundamental concept in entrepreneurship (Shert et al., 2010). Numerous definitions of entrepreneurial opportunities have been proposed, each addressing the topic from a different perspective. Opportunity is defined as a desirable moment or favorable situation with a set of conditions for taking action (Ozgen & Baron, 2007). Entrepreneurial opportunities are favorable conditions for actions that lead to the creation of economic value. An entrepreneurial opportunity includes a set of ideas, beliefs, and actions that enable the production of goods and services in the future for which there is currently no market. The uniqueness of this concept lies in how, during this process, the entrepreneur drives a set of immeasurable variables to achieve their goal and vision (Sepp-Turno et al., 2020).

From Kirzner's (1973) perspective, entrepreneurial opportunities exist in conditions of economic disequilibrium, and exploiting them shifts the economy from a state of disequilibrium to equilibrium. To exploit digital entrepreneurial opportunities, a set of factors is needed, which is referred to as the **digital entrepreneurship ecosystem**. Specifically, this ecosystem plays a role in understanding how entrepreneurial opportunities are identified and applied in the digital world, as well as how companies adapt to absorb value from external actors through network

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partners within the innovation ecosystem and how they exploit opportunities by leveraging internal resources and relevant external strategic relationships (Frasso & Belyva, 2020).

Timely recognition and accurate identification of technological opportunities is the most critical part of a business strategy. In this context, how technological opportunities are exploited, considering the right timing for exploitation, is highly significant. The characteristics of technological opportunities, such as the short duration of the "window of opportunity" and the differences in opportunity perception among firms, play an essential role (Shin, 2016). Some entrepreneurs are better at identifying opportunities, and these opportunities bring benefits that others fail to exploit. The existence of heterogeneity among entrepreneurs in recognizing opportunities, the nature, and quality of the identified opportunities could explain this phenomenon (Rindova et al., 2009).

According to Fletcher (2006), an opportunity is the presence of a combination of favorable conditions that makes a particular solution possible. Opportunity represents the gap between the current state and the potential future state, and this gap is reduced by entrepreneurs. Therefore, opportunity recognition is a key feature of entrepreneurs, and without it, entrepreneurial activity lacks meaning. In this process, however, not all individuals are able to recognize opportunities (Wang et al., 2016). As such, not everyone can engage in entrepreneurial activities. Entrepreneurial opportunities provide individuals or groups with a chance to offer innovative value to society (Li & Venkataraman, 2006).

Digital entrepreneurship is widely defined as the creation of new investments and transformation of existing businesses through the development of new digital technologies and/or novel uses of such technologies (European Union, 2015). Digital entrepreneurship is regarded by many countries as a cornerstone of economic growth, job creation, and innovation. The capacity for digital entrepreneurship in a nation largely depends on the behavior, culture, and strategies of digital entrepreneurs, as well as the supportive innovation ecosystem in which governments, industries, businesses, educational institutions, and non-governmental organizations work together (Srinivasan & Venkataraman, 2018).

The term "digital entrepreneurship" has been used by some researchers and policymakers, but its conceptualization and definitions remain ambiguous. Is digital entrepreneurship a subset of entrepreneurship that involves digital technologies? Or is it a subset of the digital economy combined with entrepreneurship? Or is it important and distinct enough to be recognized as a separate field? It can be said that there is limited conceptual development in the field of digital entrepreneurship because most previous research on the use of digital technologies in entrepreneurship has only examined scattered phenomena related to it. Some fundamental questions remain largely unanswered in the current literature. For example, how do digital technologies change entrepreneurship? How does digital entrepreneurship differ from traditional entrepreneurship? How does digital entrepreneurship predict performance outcomes? Such questions highlight further gaps in understanding the use of digital technologies by entrepreneurs (Nambisan et al., 2017). Digital entrepreneurship is a type of entrepreneurship that involves creating innovative products and services that are accessible to many people in society, with the sale of these emerging products and services across various platforms, leveraging advances enabled by technological progress (Bali, 2020).

The Role of Technology in Creating Entrepreneurial Opportunities and Digital Businesses

Technology is the key resource for businesses that significantly impacts the competitiveness of firms (Razavi & Samadi Ansari, 2020). It has become clear today that information and communication technologies (ICT) create numerous opportunities for businesses and society. A prime example of this is the success of businesses that have effectively leveraged digital entrepreneurship opportunities and experienced rapid and unprecedented growth. One of the most significant advantages of information technology is the ability to quickly access knowledge and information. A person who is aware of the prices of goods in various markets or has information about the past and future trends of a market will make better decisions to achieve higher profits, which not only holds intrinsic value but also impacts decision-making processes and their execution. Several studies in the field of entrepreneurship have explored the impact of digital technologies on entrepreneurs' decision-making, emphasizing the growing importance of digital entrepreneurship in this context (Fichter & Roper, 2014).

Communication, like information, is valuable and adds value proportional to the size and type of connections individuals have. Information and communication are fundamental tools for any entrepreneurial activity.

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Entrepreneurship requires discovering a social need, and identifying these needs depends on an understanding of the social, cultural, and economic context. In identifying the needs for any entrepreneurial activity, the entrepreneur must have insight into the environment and be aware of what solutions have been offered elsewhere in the world. Thus, both information and communication are essential for any entrepreneurial activity. Information technology, particularly the internet, has created new conditions in which producers, suppliers, vendors, customers, and almost all participants in an economic cycle are interconnected in a shared virtual space, exchanging information, services, products, and money (Jalali, 2017).

Most of today's startups use the digital economy and the virtual space it creates to develop and improve their performance (Keshavarz et al., 2019). Information and communication technologies, alongside globalization, have created unparalleled opportunities and threats in various business sectors. Many modern startups leverage the digital economy and the virtual space to enhance their growth and performance. Indeed, the opportunities arising from technological changes have led to the emergence of a new entrepreneurial approach known as digital entrepreneurship. Recent developments in entrepreneurship research have given more attention to the novel uses of digital technologies in entrepreneurship. For example, how entrepreneurs utilize social networks to develop social capital and identify opportunities has been a key focus. Digital platforms can act as a marketplace for knowledge and innovations or as intermediaries between problem solvers and those seeking solutions (Egers et al., 2012).

Digital Entrepreneurship and Its Impact on Creating Business Opportunities

Digital companies rapidly leverage new digital technologies (especially social solutions, big data, mobile, and cloud computing) to enhance their business activities, invent new business models, engage in business intelligence, and interact with customers and stakeholders, thereby creating future business opportunities and growth. It is likely that digital entrepreneurship represents the most significant manifestation of the concept of entrepreneurship in the modern age, with profound impacts on the structure of businesses themselves. In this regard, it appears that digital entrepreneurship will have a deep effect on all advanced economies. The entrepreneurial values are mainly aimed at job creation and commercialization of new inventions. New opportunities, along with the adoption of new methods and technologies, lead to the creation and shaping of competition, and it is reasonable to conclude that digital entrepreneurs will profoundly influence the development of the internet and the digital economy. Davidson et al. (2018) view digital entrepreneurship as productive job creation directly based on information and communication technology (ICT) components. This means that an entrepreneur can directly use ICT tools to create various job opportunities based on technology.

Digital entrepreneurship involves examining digital technologies and their unique characteristics in shaping entrepreneurial activities. Today, there is a growing emphasis on digital entrepreneurship due to the role of new digital technologies in online businesses. Given the knowledge-based economy, organizations adopt digitalization processes in their businesses to organize and gain a competitive edge at the global level (Dai et al., 2018). Digital entrepreneurship is important and essential not only for technology companies and the IT sector but for all industries (Nambisan, 2017). Thus, digital entrepreneurship leads to technological advancements and the creation of various opportunities for entrepreneurs (Kuster et al., 2018).

Many opportunities in the field of digital entrepreneurship have been identified, which generally include the development, marketing, and sales of products and services accessible through the internet. Services such as mobile software, networks and social platforms, informational and entertainment websites, computer software, training, and consulting can all be considered examples of digital entrepreneurship (Bali, 2020).

The concept of opportunity can be divided into various categories, with one of the most influential being technological opportunities. These opportunities can lead to innovation at different levels depending on their nature (Nekoeizadeh & Amini, 2019). Digital entrepreneurship involves identifying and utilizing opportunities, transforming these opportunities into sellable goods and services, risk-taking, and profit-making, and it can take place in various environments, including old and new businesses, or non-profit and governmental institutions. In summary, the creation of new value is a key characteristic of digital entrepreneurship (Siegel & Renko, 2016). Two of the most important drivers of digital entrepreneurship are digitalization and entrepreneurship. This concept utilizes network actor theory, which focuses on the interactions between human and machine actors (Tan, 2016). This type of entrepreneurship requires culture, strategy, and a supportive ecosystem. Digital companies differ from traditional

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investments in that they heavily rely on new digital technologies to enhance business operations, innovate business models, and connect with customers (Zhao et al., 2016).

RESEARCH BACKGROUND

Research in digital entrepreneurship is still in its early stages. The number of articles addressing this topic is not very large, with only one article published before 2010, and most research has been conducted from 2014 onwards. Additionally, the theoretical approaches and research methods in this area are still limited. As with any emerging scientific concept, most of the research focuses on developing the theory behind it, and both qualitative and quantitative research methods have been applied in digital entrepreneurship studies, albeit to a limited extent.

Negasong (2018) explored the factors influencing the development of digital entrepreneurship, identifying these factors as including policies, the development of information and communication technology infrastructure, local transportation infrastructure, and entrepreneurial education opportunities. According to Lijonberg's (2018) research, the key factors influencing the development of opportunities in digital entrepreneurship include four main elements: the nature of opportunities, the personal characteristics of the entrepreneur, risk and uncertainty, and serial or innovative entrepreneurship. Furthermore, Leong et al. (2017) examined the topic of digital entrepreneurship, digital companies, and products. The results of this research revealed that the effectiveness of digital entrepreneurial activities is an ambiguous concept in evaluating digital entrepreneurship, and through it, a better understanding of the digital entrepreneurship process in businesses can be gained.

According to Zhao et al. (2016), digital entrepreneurship refers to new investments and transformations in existing businesses with the development of new digital technologies and the new use of such technologies. Digital entrepreneurship has been recognized by many countries as the basis for economic growth, job creation, and innovation. The capacity for digital entrepreneurship in a nation largely depends on the behavior, culture, and strategies of digital entrepreneurship and the supportive innovation ecosystem, where governments, industries, businesses, educational institutions, and NGOs collaborate.

Leosaleh and Stark (2016) conducted research titled *The Relationship of Entrepreneurship in the New Digital World*, concluding that the internet has transitioned from a facilitative tool to an inseparable main factor. As a result, numerous opportunities have emerged to create new markets and offer virtual products through digital entrepreneurship. In this context, providing information about consumers and identifying their preferences and behaviors are crucial for the future of businesses. Sabora (2015) examined the key success factors of digital entrepreneurship among internet entrepreneurs in Thailand. According to his research, the success factors for entrepreneurs can be categorized into three groups: founder-related factors, electronic services, and external factors. The results indicated that internet entrepreneurs' success had a significant relationship with two traits: a desire for success and an internal locus of control, while there was no significant relationship with two other traits: risk-taking and networking.

Davidson (2015), in his study titled *Exploring the Components of Digital Entrepreneurship*, identified three interconnected types of opportunities within digital entrepreneurship: commercial entrepreneurship, knowledge entrepreneurship, and organizational entrepreneurship. Each of these categories is constrained or reinforced by the capabilities and limitations of information and communication technologies, through which economic and institutional structures interact.

In the final analysis, according to Davidson (2010), entrepreneurship in the digital economy requires three distinct yet interconnected types of opportunities: commercial, knowledge, and organizational. In this context, the nature of information technology compels entrepreneurs to engage in each form of entrepreneurship to make sustainable investments. Additionally, entrepreneurship practices in the digital economy are inherently social, which implies that examining this form of entrepreneurship provides a deeper understanding of the nature and dynamics of discovering and exploiting new investment opportunities.

Within the country, there have also been limited studies on the development of digital entrepreneurship and the exploitation of entrepreneurial opportunities. For example, Kashavarz et al. (2019) identified the drivers of successful digital entrepreneurship through an integrative approach. The results of this study indicated that the way marketing and customer communication is handled in the virtual space, the information and communication technology

infrastructure, and the culture of adopting digital entrepreneurship in organizations are the most important factors influencing the success of digital entrepreneurship. Also, Akhly and colleagues (2018) designed a conceptual model for recognizing opportunities for entrepreneurial technology start-ups in universities. The results showed that the most important features of recognizing entrepreneurial opportunities in this study include opportunity recognition, opportunity evaluation, capabilities related to recognizing and exploiting opportunities, determinants of recognizing and exploiting opportunities, and learning mechanisms.

Mir Parsa (2013) prioritized the factors affecting the development of digital entrepreneurship. The results indicated that variables such as opportunity recognition, managerial processes, technology, structure, and strategy have an impact on the development of digital entrepreneurship. Sakhta and Karimi (2018) identified the factors affecting open innovation in digital entrepreneurship. The influencing factors include environment, individual characteristics, business capabilities, and strategic activities. Imani and colleagues (2017) investigated the impact of social networks on digital entrepreneurship in knowledge-based companies. The results revealed that social networks and their dimensions (content of social relationships, information transmission methods, social information resources) have a significant and positive impact on the development of digital entrepreneurship. Allah Dadi (2016) conducted research aimed at designing a digital entrepreneurial marketing ecosystem for online retailers. The final model included new concepts such as product development through interactive investment, integrated channels, use of big data, sustainable service centers, shared economy, consumer-driven production, and the presence of different actors.

Yaqoubi Farani (2015) examined the role of knowledge and skills in the development of the digital entrepreneurial intent of students in public universities. The results showed that the developed model of planned behavior theory had an acceptable predictive power, and factors such as promoting an entrepreneurial culture, improving attitudes, and creating and strengthening entrepreneurial knowledge and skills were influential in this area. Roshandel Erbatani and colleagues (2015) identified the factors influencing the commercialization of digital innovations in media entrepreneurial companies. These factors included elements related to resources, companies, products, and strategies as controllable factors for entrepreneurs, and factors related to infrastructure as uncontrollable elements in the commercialization of digital innovations in media entrepreneurial companies.

Research Method

This study is applied in nature and, in terms of its objective, is descriptive-survey-based. An exploratory mixed-method approach was used for data collection and analysis, incorporating both qualitative and quantitative data. In this research, the data were initially collected qualitatively and then evaluated and assessed using quantitative methods.

Qualitative Research Sample

The qualitative research sample consisted of experts and key informants in the field of digital entrepreneurship. A purposive sampling method was employed, where individuals were selected based on the research objective and their expertise and experience. The criteria for selecting experts included their experience in the fields of activity, management, education, and research in digital entrepreneurship. The final number of selected participants was 20 individuals.

Data Collection and Interviews

To collect data for the qualitative part of the study, semi-structured interviews were conducted, each lasting between 45 and 60 minutes. The interviews continued until data saturation was reached, and after 20 interviews, the researcher determined that the collected data were sufficiently comprehensive and had reached saturation.

Data Analysis and Thematic Analysis Method

For data analysis, the thematic analysis method was used. With this method, the researcher identified the factors and pattern of identifying digital entrepreneurship opportunities in the Iranian ICT industry.

Ensuring Validity and Reliability

To ensure the validity of the qualitative part of the research, methods such as member checking, peer review, and participatory research were employed. To determine reliability, the results were evaluated by 8 specialists in the fields

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of digital economy and technological entrepreneurship. After making necessary revisions, the dimensions and components were further reviewed and assessed. Additionally, an executive plan was implemented in the research process, which helped reduce the issues caused by the lack of reliability in the qualitative findings.

Using the Fuzzy Delphi Method

After identifying and analyzing the qualitative data, the fuzzy Delphi method was used to evaluate and screen the indicators. In this phase, the indicators were provided to the experts in the form of a questionnaire, and after three rounds (or stages) of analysis, the final indicators were determined. This method, particularly due to its fuzzy characteristics, allowed for a better consideration of the uncertain and complex perspectives of the experts.

Reason for Using Fuzzy Logic

The use of fuzzy sets in this research is due to the fact that the quantitative representation of expert opinions cannot fully capture all the subjective and human competencies involved. The use of fuzzy numbers, particularly in real-world decision-making and long-term forecasting, provides a more accurate method for evaluating and analyzing data. In this study, a fuzzy table was used to process the experts' opinions (Karaman et al., 2009).

Table 1. Fuzzy Scale (Seven Degrees) for Index Evaluation

Fuzzy Triangular Equivalent	Fuzzy Value	Linguistic Variable
(0, 0, 0.1)	$\tilde{1}$	Completely insignificant
(0, 0.1, 0.3)	$\tilde{2}$	Very insignificant to insignificant
(0.1, 0.3, 0.5)	$\tilde{3}$	Insignificant
(0.3, 0.5, 0.75)	$\tilde{4}$	Insignificant to moderately important
(0.5, 0.75, 0.9)	$\tilde{5}$	Moderate
(0.75, 0.9, 1)	$\tilde{6}$	Moderate to important
(0.9, 1, 1)	$\tilde{7}$	Completely important

Then, for categorizing and determining the relationships between the categories, the Structural-Interpretive Modeling (ISM) method was used based on the following process. Ultimately, the analysis of influence power and dependency was conducted using the MICMAC technique, and the model for identifying digital entrepreneurship opportunities in Iran's ICT industry was designed.
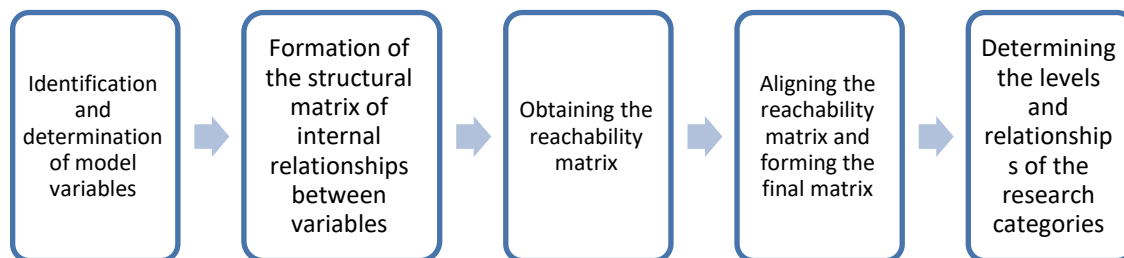

Figure 1. Phases of the Structural-Interpretive Modeling (ISM) Method Implementation

Analysis of Findings

In the first step, in order to identify the factors of the digital entrepreneurship opportunity identification model in Iran's ICT industry, interviews were conducted with experts in this field. Using thematic analysis, the main concepts

of this field were identified. The primary themes identified in this step were 139 items. These identified themes were then reviewed by the research team and two experts in the field of digital entrepreneurship, and an initial screening was conducted. This was necessary because some of the codes appeared to be similar either in terms of appearance or in conceptual and content terms, or there were relationships between the whole and the parts. As a result, 63 themes from the qualitative section of the research, which were agreed upon by the research team, were extracted, and examples of these items are provided below.

Table 2 - Sample of Extracted Themes

Proposition	Theme No.
Digital infrastructure architecture	1
Electronic marketing strategy	2
Implementation and development of e-commerce	3
Targeted digital innovation	4
Technology-related networks	5
Digital business environment	6
Access to financial resources	7
Digital skills and electronic leadership	8

In the first step of the Delphi method, experts' views on each of the indicators for identifying digital entrepreneurship opportunity patterns in the ICT industry of Iran were reviewed and evaluated. Out of the 63 initial indicators, 18 indicators were removed, and 45 indicators were determined as final indicators by the experts. In the second step of the Delphi method, the indicators were re-evaluated and screened by the experts, and the results confirmed all of the remaining indicators. Finally, the experts' views were consolidated in the third step of the Delphi method, and the results are presented in Table 3.

Table 3: Fuzzy Mean and Fuzzy Screening of Research Indicators (Round Three)

Round 3 Result	Definite Value	Fuzzy Mean	Third round
Accept	0/892	(0.783,0.917, 0.977)	Economic value creation
Accept	0/792	(0.623,0.817, 0.937)	Conditions and context of entrepreneurship
Accept	0/878	(0.75,0.903,0 .98)	Timing of entry into the technological market
Accept	0/844	(0.703,0.877, 0.953)	Providing innovative value to society
Accept	0/842	(0.703,0.867, 0.957)	Regular search for opportunities
Accept	0/844	(0.7,0.873,0. 96)	Idea generation in the field of digital entrepreneurship
Accept	0/840	(0.71,0.863,0 .947)	Idea development (analysis, modification, exploitation and commercialization)
Accept	0/826	(0.677,0.85,0 .95)	Understanding and feasibility of a profitable product or business

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Round 3 Result	Definite Value	Fuzzy Mean	Third round
Accept	0/814	(0.66,0.84,0.943)	Entrepreneurial spirit
Accept	0/853	(0.72,0.877,0.963)	Entrepreneurial attitude
Accept	0/837	(0.693,0.86, 0.957)	Mental norms
Accept	0/807	(0.653,0.827, 0.94)	Entrepreneurial intention
Accept	0/842	(0.7,0.863,0.963)	Creative thinking
Accept	0/853	(0.72,0.877,0.963)	Entrepreneurial mindset in acquiring and interpreting existing and new market information
Accept	0/889	(0.77,0.917,0.98)	Openness of the window of opportunity
Accept	0/776	(0.6,0.803,0.923)	Technological changes
Accept	0/842	(0.703,0.867, 0.957)	Political-legal changes
Accept	0/784	(0.62,0.807, 0.927)	Demographic changes
Accept	0/872	(0.743,0.9,0.973)	Information flows
Accept	0/837	(0.697,0.863, 0.95)	Monitoring the business environment (scanning, monitoring, forecasting and environmental assessment)
Accept	0/833	(0.683,0.863, 0.953)	Digital knowledge
Accept	0/822	(0.663,0.85,0.953)	Information and communication technology market
Accept	0/781	(0.607,0.807, 0.93)	Business and financial intelligence
Accept	0/814	(0.66,0.84,0.943)	Previous experience in the industry
Accept	0/828	(0.673,0.857, 0.953)	Entrepreneurial intelligence
Accept	0/831	(0.687,0.857, 0.95)	Intellectual capital
Accept	0/814	(0.66,0.84,0.943)	Entrepreneurial motivation
Accept	0/861	(0.723,0.887, 0.973)	Sense of self-efficacy
Accept	0/842	(0.707,0.87,0.95)	Driving forces (government, financial support, facilities, etc.)
Accept	0/796	(0.637,0.817, 0.933)	Networking Entrepreneurial
Accept	0/883	(0.76,0.91,0.98)	Social Network
Accept	0/818	(0.67,0.837,0.947)	Foresight

Round 3 Result	Definite Value	Fuzzy Mean	**Third round**
Accept	0/848	(0.713,0.873, 0.957)	Vision Development
Accept	0/906	(0.797,0.933, 0.987)	Digital Skills
Accept	0/839	(0.69,0.867,0 .96)	Targeted Digital Innovation
Accept	0/842	(0.703,0.867, 0.957)	Implementation and Development of E-Commerce
Accept	0/844	(0.703,0.877, 0.953)	Digital Business Environment
Accept	0/867	(0.733,0.893, 0.973)	Digital Infrastructure
Accept	0/809	(0.653,0.837, 0.937)	Internet Technology Platform
Accept	0/842	(0.7,0.863,0. 963)	Culture of Acceptance of Digital Entrepreneurship
Accept	0/853	(0.72,0.877,0 .963)	Access to Resources
Accept	0/883	(0.76,0.91,0. 98)	Access to Technical, Financial, Legal, Political and Legal Infrastructure
Accept	0/818	(0.67,0.837,0 .947)	Entrepreneurial Leadership
Accept	0/831	(0.687,0.857, 0.95)	Opportunistic Management
Accept	0/814	(0.66,0.84,0. 943)	Digital Entrepreneurship Education

No indicators were removed in the second and third rounds. The lack of removal of any indicators indicates the end of the Delphi rounds. To conclude the Delphi process, the average ratings of two consecutive rounds are compared, and if the difference between these two rounds is below a very small threshold (0.2), the survey process can be stopped (Cheng & Lin, 2002).

Table 4. Definite Value Distance Between Round Two and Round Three of Delphi Survey

Result	Disagreement	Round 3 Result	Round 2 Result	**Third round**
Agreement	0/044	0/892	0/848	Economic value creation
Agreement	0/072	0/792	0/864	Entrepreneurship conditions and context
Agreement	0/025	0/878	0/903	Timing of entry into the technological market
Agreement	0/016	0/844	0/828	Providing innovative value to society
Agreement	0/005	0/842	0/837	Regular search for opportunities
Agreement	0/031	0/844	0/803	Idea generation in the field of digital entrepreneurship

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Result	Disagreement	Round 3 Result	Round 2 Result	Third round
Agreement	0/009	0/840	0/831	Idea development (analysis, refinement, exploitation and commercialization)
Agreement	0/014	0/826	0/812	Understanding and feasibility of a profitable product or business
Agreement	0/006	0/814	0/820	Entrepreneurial spirit
Agreement	0/050	0/853	0/803	Entrepreneurial attitude
Agreement	0/028	0/837	0/809	Mental norms
Agreement	0/041	0/807	0/848	Entrepreneurial intention
Agreement	0/002	0/842	0/844	Creative thinking
Agreement	0/061	0/853	0/792	Entrepreneurial mindset in acquiring and interpreting existing and new market information
Agreement	0/029	0/889	0/760	Opening of the window of opportunity
Agreement	0/020	0/776	0/856	Technological changes
Agreement	0/055	0/842	0/787	Political-Legal Changes
Agreement	0/053	0/784	0/831	Political-Legal Changes
Agreement	0/072	0/872	0/800	Information flows
Agreement	0/020	0/837	0/817	Business environment monitoring (scanning, monitoring, forecasting and environmental assessment)
Agreement	0/037	0/833	0/796	Digital knowledge
Agreement	0/045	0/822	0/867	Information and Communication Technology Market
Agreement	0/076	0/781	0/857	Business and financial intelligence
Agreement	0/023	0/814	0/837	Previous experience in the industry
Agreement	0/002	0/828	0/826	Entrepreneurial awareness
Agreement	0/008	0/831	0/839	Intellectual capital
Agreement	0/032	0/814	0/846	Entrepreneurial motivation
Agreement	0/011	0/861	0/850	Feeling of self-efficacy
Agreement	0/0034	0/842	0/878	Driving forces (government support, finance, facilities, etc.)
Agreement	0/065	0/796	0/861	Entrepreneurial Networking

Result	Disagree ment	Round 3 Result	Round 2 Result	**Third round**
Agree ment	0/030	0/883	0/853	Social Network
Agree ment	0/060	0/818	0/878	Foresight
Agree ment	0/035	0/848	0/883	Vision Development
Agree ment	0/045	0/906	0/861	Digital skills
Agree ment	0/069	0/839	0/770	Targeted digital innovation
Agree ment	0/008	0/842	0/834	Implementation and development of e-commerce
Agree ment	0/033	0/844	0/811	Digital Business Environment
Agree ment	0/041	0/867	0/826	Digital Infrastructure
Agree ment	0/005	0/809	0/814	Internet technology platform
Agree ment	0/020	0/837	0/817	Culture of embracing digital entrepreneurship
Agree ment	0/045	0/906	0/861	Access to resources
Agree ment	0/008	0/842	0/834	Access to technical, financial, legal, political and legal infrastructure
Agree ment	0/030	0/883	0/853	Entrepreneurial Leadership
Agree ment	0/055	0/842	0/787	Opportunistic Management
Agree ment	0/053	0/784	0/831	Digital entrepreneurship education

The results of Table 4 show that the differences for all indicators are smaller than 0.2, and the Delphi steps can be concluded. Following this, the Structural-Interpretive Modeling method was used to design the model for identifying digital entrepreneurship opportunities in the ICT industry of Iran. Structural-Interpretive Modeling is an exploratory method for model design. This method can be used to map the complex relationships between multiple elements in a decision-making situation. It helps organize and direct relationships between factors and, by analyzing the impact of one factor on others, the order and direction of relationships between the factors of a system are examined. This method helps overcome the relationships between constructs (Azar et al., 2019).

This method is an interactive learning process in which a set of different constructs is structured into a systematic model, and the impact of one construct on the others is examined. Thus, the relationships between constructs can be identified, and a structural-interpretive model can be presented. Finally, the constructs are classified based on their power of influence and degree of dependency. The constructs related to the model for identifying digital entrepreneurship opportunities in the ICT industry of Iran are presented in Table 5.

Table 5. Comprehensive List of Constructs and Combined Indicators Extracted from Previous Steps of the Research

Main Factors	**Sub-Factors**
Economic value creation	

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Providing innovative value to society	Economic Value Creation
Targeted digital innovation	
Idea generation in the field of digital entrepreneurship	Idea Generation in Digital Entrepreneurship
Idea development (analysis, refinement, exploitation and commercialization of the idea)	
Understanding and feasibility of a profitable product, service or business	
Entrepreneurial spirit	Personal Characteristics of Digital Entrepreneurs
Entrepreneurial attitude	
Mental norms	
Entrepreneurial intention	
Entrepreneurial intention	
Entrepreneurial mindset in acquiring and interpreting existing and new market information	
Entrepreneurial motivation	
Sense of self-efficacy	
Technological changes	Monitoring Technological, Political, Legal, and Demographic Changes
Political-Legal Changes	
Demographic changes	
Digital infrastructure	Digital Infrastructure and Internet Technology Platform
Internet technology platform	
Internet technology platform	
Access to technical, financial, legal, political and legal infrastructure	
Entrepreneurship conditions and context	Digital Business Environment Monitoring
Environmental monitoring (environmental scanning, monitoring, forecasting and assessment)	
Digital Business Environment	
Driving forces (government support, finance, transportation facilities)	
Driving forces (government support, finance, transportation facilities)	
Digital Entrepreneurship Adoption Culture	Entrepreneurial Alertness
Digital Entrepreneurship Adoption Culture	
Technological market entry timing	
Technological market entry timing	
Foresight	Foresight
Vision development	
Entrepreneurial Networking	Entrepreneurial Networking
Social Communication Network	
Social Communication Network	
Information flows	Market and Digital Technology Commercialization
E-commerce Implementation and Development	
Intellectual Capital	Intellectual Capital and Digital Knowledge
Digital Knowledge	

Digital Skills	
Prior Industry Experience	
Digital Entrepreneurship Education	
Entrepreneurial Leadership	Entrepreneurial Leadership in the Digital Industry
Opportunistic Management	
Regularly Seeking Opportunities	

In the process of Structural-Interpretive Modeling (ISM), the Structural Self-Interaction Matrix (SSIM) is used in the first step to identify the internal relationships between factors based on the experts' views. This matrix shows which factors influence others and which factors are influenced by others. To identify the pattern of relationships between elements, the symbols in the following table are used.

Table 6. Symbols Used to Express the Relationship Between Factors

O	X	A	V	Symbol
Lack of relationship	Two-way relationship	Variable j affects i	Variable i affects j	Relationship

Based on the symbols in Table 6, the structural self-interaction matrix is as follows:

Table 7. Structural Self-Interaction Matrix (SSIM)

D12	D11	D10	D09	D08	D07	D06	D05	D04	D03	D02	D01	SSIM
A	V	V	V	V	O	V	V	A	A	A		D01
V	X	O	V	V	V	V	V	V	V			D02
X	A	V	O	V	V	V	V	X				D03
V	A	V	V	V	V	V	V					D04
V	A	V	X	O	V	V						D05
V	V	V	A	V	X							D06
V	V	V	A	V								D07
V	V	A	A									D08
O	V	V										D09
V	A											D10
X												D11
												D12

Then the received matrix is formed. This matrix is obtained by converting the self-interaction structural matrix into a matrix with two values: 0 and 1. In this matrix, the diagonal elements are equal to one, and to ensure accuracy, secondary relationships must be checked. This means that if A leads to B and B leads to C, A must lead to C. In such cases, direct effects should be considered based on secondary relationships. However, if this does not occur in practice, the table must be corrected, and the secondary relationship should be shown (Table 8).

Table 8. Received Matrix of Research Variables

D10	D09	D08	D07	D06	D05	D04	D03	D02	D01	RM
1	1	1	0	1	1	0	0	0	1	D01
0	1	1	1	1	1	1	1	1	1	D02
1	0	1	1	1	1	1	1	0	1	D03
1	1	1	1	1	1	1	1	0	1	D04
1	1	0	1	1	1	0	0	0	0	D05
1	0	1	1	1	0	0	0	0	0	D06
1	0	1	1	1	0	0	0	0	0	D07
0	0	1	0	0	0	0	0	0	0	D08

1	1	1	1	1	1	0	0	0	0	**D09**
1	0	1	0	0	0	0	0	0	0	**D10**
1	1	1	1	1	1	1	1	0	1	**D11**
1	1	0	1	1	1	0	0	0	0	**D12**

Table 9. Final Accessibility Matrix of the Research Variables

D10	D09	D08	D07	D06	D05	D04	D03	D02	D01	TM
1	1	1	1*	1	1	0	0	0	1	**D01**
1*	1	1	1	1	1	1	1	1	1	**D02**
1	1*	1	1	1	1	1	1	0	1	**D03**
1	1	1	1	1	1	1	1	0	1	**D04**
1	1	1*	1	1	1	0	0	0	0	**D05**
1	0	1	1	1	0	0	0	0	0	**D06**
1	0	1	1	1	0	0	0	0	0	**D07**
0	0	1	0	0	0	0	0	0	0	**D08**
1	1	1	1	1	1	0	0	0	0	**D09**
1	0	1	0	0	0	0	0	0	0	**D10**
1	0	1	1	1	0	0	0	0	0	**D11**
1	1	1	1	1	1	1	1	0	1	**D12**

In the next step, to determine the relationships and level classification of the factors, the output factors (factors that can be reached through this factor) and input factors (factors that can be reached through these factors) for each criterion are extracted from the received matrix (Table 10).

Table 10. Input and output sets for level determination

Subscription	Input: Effectiveness	Output: Impact	Variables
D01	D01,D02,D03,D04	D01,D05,D06,D07,D08,D09,D10	**D01**
D02	D02	D01,D02,D03,D04,D05,D06,D07,D08,D09,D10	**D02**
D03,D04	D02,D03,D04	D01,D03,D04,D05,D06,D07,D08,D09,D10	**D03**
D03,D04	D02,D03,D04	D01,D03,D04,D05,D06,D07,D08,D09,D10	**D04**
D05,D09	D01,D02,D03,D04,D05,D09	D05,D06,D07,D08,D09,D10	**D05**
D06,D07	D01,D02,D03,D04,D05,D06,D07,D09	D06,D07,D08,D10	**D06**
D06,D07	D01,D02,D03,D04,D05,D06,D07,D09	D06,D07,D08,D10	**D07**
D08	D01,D02,D03,D04,D05,D06,D07,D08,D09,D10	D08	**D08**
D05,D09	D01,D02,D03,D04,D05,D09	D05,D06,D07,D08,D09,D10	**D09**
D10	D01,D02,D03,D04,D05,D06,D07,D09,D10	D08,D10	**D10**
D02	D04	D01,D02,D03,D05,D06,D07,D08,D09,D10	**D11**
D02	D02,D03,D04	D01,D03,D05,D06,D07,D08,D09,D10	**D12**

The output factors include the factor itself and other factors that are influenced by it, while the input factors include the factor itself and those factors that influence it. After that, the set of bidirectional relationships between factors is determined. Based on the results from Table 10, the factor of innovative value creation (D12) is at the first level or dependent. After identifying the first-level variables, these variables are removed, and the input and output sets are recalculated without considering the first-level variables. The common set of identification and variables whose intersection is equal to the input set are selected as the second-level variables. Based on the calculation output, the variable of digital technology commercialization (D11) is at the second level. To determine the third-level elements, the second-level variables are removed, and once again, the input and output sets are recalculated without considering the second-level variables. Based on the common set of identification and variables whose intersection is equal to the input set, the third-level variables are selected. Accordingly, the variable of digital entrepreneurial idea generation and processing (D10) is at the third level. Additionally, the calculations show that the variables of monitoring technological, political, legal, and demographic changes (D09) and digital business environment monitoring (D08) are at the fourth level, and the variables of entrepreneurial alertness (D07) and foresight (D06) are at the fifth level. The variable of entrepreneurial leadership in the digital industry (D05) is at the sixth level; the variables of digital infrastructure and internet technology foundation (D04), intellectual capital and digital knowledge (D03), and entrepreneurial networking (D02) are at the seventh level, and finally, the personal characteristics of digital entrepreneurs (D01) are the most fundamental element of the model, at the eighth level, having the most influence on capacity building. Similarly, the level of influence decreases in subsequent levels, and variables at the same level have mutual interaction with each other.
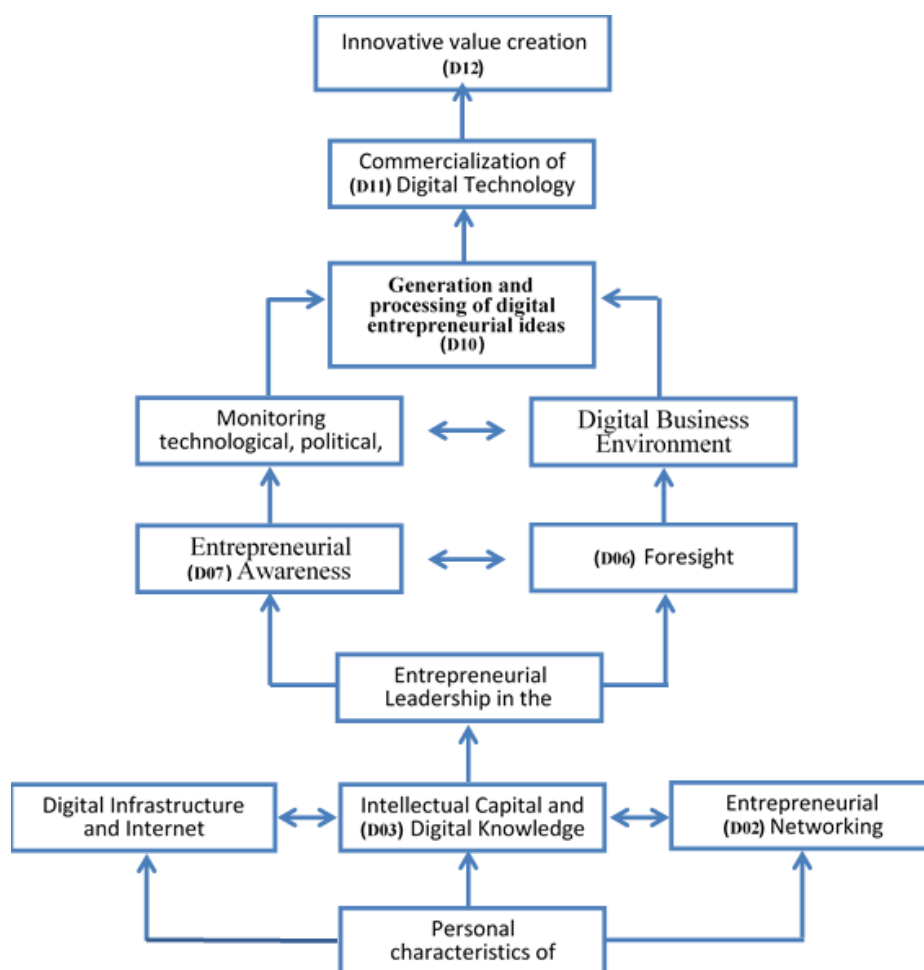

Figure 4. Conceptual Framework of Jihadi Entrepreneurship

In the following, the key criteria for the degree of influence and the degree of dependence of the criteria are determined using the MICMAC analysis method (Table 10).

Table 10. Influence and degree of dependence of research variables

Influence power	Dependency rate	Research variables
7	4	Personal characteristics of digital entrepreneurs) D01(
10	1	Entrepreneurial Networking) D02(
9	3	Intellectual Capital and Digital Knowledge) D03(
8	3	Digital Infrastructure and Internet Technology Platform) D04(
6	6	Entrepreneurial leadership in the digital industry) D05(
4	8	Foresight) D06(
5	8	Entrepreneurial Awareness) D07(
1	10	Digital Business Environment Monitoring) D08(
7	6	Monitoring the digital business environment) D09(
2	9	Generation and processing of digital entrepreneurial ideas) D10(
8	2	Digital Technology Market and Commercialization)D11(
10	3	Innovative value creation) D12(

Based on the relationships of power-dependency and influence of the factors, the coordinate system is divided into four equal sections called **autonomous factors**, **dependent factors**, **independent factors**, and **linking factors**. **Autonomous factors** have low guidance power and dependency, typically separated from the system, and changes in them do not cause significant changes in the system. **Dependent factors** have weak guidance and strong dependency, generally having high susceptibility and low influence on the system. **Independent factors** have high guidance and low dependency, characterized by high influence and low susceptibility. **Linking factors** have both high guidance and high dependency, with very high influence and susceptibility, and even small changes in these variables can lead to fundamental changes in the system. The power-dependency diagram for the factors is shown in **Figure 5**.
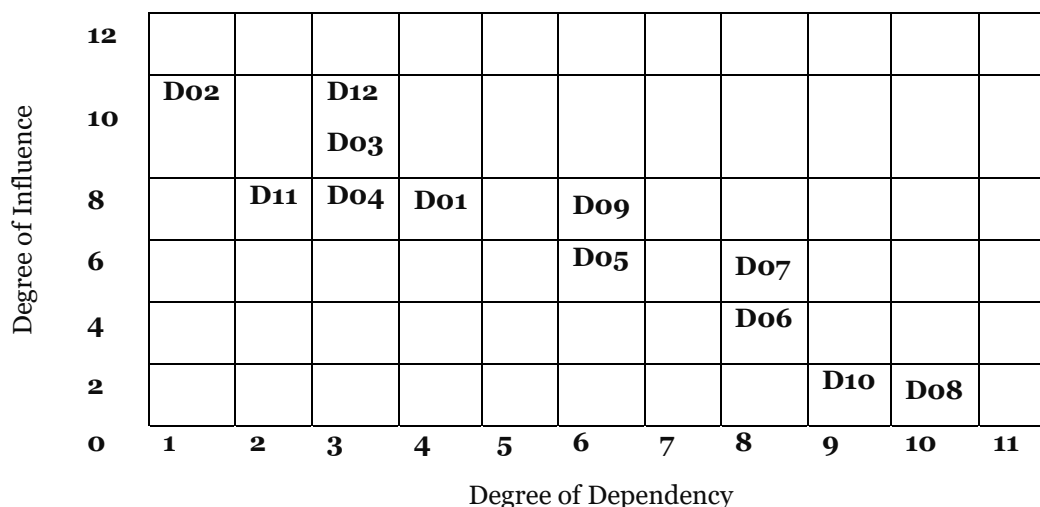

Figure 5. Power-Influence and Dependency Diagram (MICMAC Output)

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According to the influence-dependency diagram, the variables of **sincerity and entrepreneurial jihad spirit** (D02), **risk-taking and achievement motivation** (D03), **entrepreneurial jihad attitude** (D04), and **idealism** (D01) have high influence and low dependency, thus falling into the category of **independent variables**. The variables of **conscious activism** (D06), **entrepreneurial jihad motivation** (D07), **entrepreneurial jihad value creation** (D08), and **social entrepreneurship** (D10) have high dependency but lower influence, hence they are considered **dependent variables**. The variables of **jihad work culture** (D09) and **entrepreneurial jihad skills and abilities** (D05) have similar levels of influence and dependency, so they are classified as **linking variables**. Moreover, no variable falls into the first quadrant, i.e., the **autonomous region**.

CONCLUSION AND SUGGESTIONS

One of the dimensions for the development of entrepreneurship in the current economic conditions is digital entrepreneurship, which arises from the digital economy space. In digital entrepreneurship, new technological tools such as the internet and information and communication technology are used to develop businesses. Therefore, there are numerous opportunities in this field that can be exploited. The aim of this study was to identify and rank the factors affecting the exploitation of digital entrepreneurship opportunities in small and medium-sized enterprises, conducted using a descriptive-survey method based on an exploratory mixed approach in both qualitative and quantitative steps.

This research is of a qualitative and exploratory type, where a combination of research methods was used, focusing on in-depth and semi-structured interviews and questionnaires, to design a model for identifying digital entrepreneurship opportunities in Iran's ICT industry. For this purpose, several steps were undertaken.

In the first phase, using theoretical foundations, research background, and also by using thematic analysis, in-depth and semi-structured interviews, and expert consultations, concepts were extracted. In the qualitative step of this research, 20 experts in the field of digital entrepreneurship or individuals with experience or activities in this area participated.

It is worth mentioning that theoretical saturation was achieved with 16 interviews, and no new data was added to the existing data. However, the interview process continued until 20 interviews were conducted, and since no new data was obtained, the interviews were concluded with 20 experts. In the qualitative section, the decision-making team included professors, experts, key informants, digital entrepreneurs, and specialists from organizations such as the Ministry of Communications and Information Technology and other related organizations. The identification of individuals was done through purposive sampling. The outcome of this step was the identification of the main and sub-dimensions of digital entrepreneurship opportunities in Iran's ICT industry, which resulted in the identification of 139 codes. Then, for screening the identified codes, the fuzzy Delphi method was used. The Delphi analysis was based on the views of 20 experts, and after three rounds of surveys, 45 indicators were finally identified and evaluated as the final factors according to the experts' views. In the next step, for model design, structural-interpretive modeling was used, and the structures for presenting the model of digital entrepreneurship opportunities in Iran's ICT industry included twelve structures, which are: innovative value creation, digital entrepreneurial idea generation and processing, personal characteristics of digital entrepreneurs, monitoring technological, political, legal, and demographic changes, digital infrastructure and internet technology foundation, digital business environment monitoring, entrepreneurial alertness, foresight, entrepreneurial networking, digital technology commercialization, intellectual capital and digital knowledge, and entrepreneurial leadership in the digital industry.

The results of this study align with those of other researchers and complement the theoretical view of digital entrepreneurship. For example, in this study, the characteristics of digital entrepreneurs such as entrepreneurial alertness, foresight, and entrepreneurial networking were discussed, which were also addressed in the studies of Bali (2020), Zhao and Collier (2016), Septorno et al. (2020), etc.

Additionally, regarding the attention to the business environment and technological, political, legal, and demographic factors, similar discussions were held in the research of Farasso and Bliva (2020), Fukuda and Watanabe (2011), Russell et al. (2011), and others.

Based on the results obtained from the proposed model, the following suggestions are provided:

- Establish a digital entrepreneurship idea bank aimed at collecting innovative ideas and identifying digital entrepreneurs.

- Design programs to manage human capital in the field of digital entrepreneurship and encourage entrepreneurs and innovators in this field.

- Identify and develop entrepreneurial skills and characteristics among students, pupils, and other target communities.

- Pay attention to the business environment in the field of digital entrepreneurship and provide a foundation for the flourishing of this type of entrepreneurship.

- Monitor, track, and evaluate the digital business environment and strengthen and support this sector.

- Support markets related to this field and plan and implement programs for the domestic and international development of these markets.

- Establish entrepreneurial leadership strategies in the digital industry at national and regional levels.

- Create, maintain, and develop the digital entrepreneurship ecosystem in the country.

Additionally, some of the research areas that can be explored based on the results of this study include conducting research to complete and refine the model, analyzing the development of entrepreneurship while considering the identity and classes of digital entrepreneurs, assessing the effectiveness of digital entrepreneurs and its impact on the micro and macro economy of the country, converting concepts and categories into structural models and examining their mediating and moderating roles, identifying and prioritizing the barriers to digital entrepreneurship development, providing solutions for the development of digital entrepreneurship culture in the country, elucidating the role of leading institutions in digital entrepreneurship development, and examining the role of digital entrepreneurs in various entrepreneurial fields such as local businesses, rural entrepreneurship, home businesses, etc.

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