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RESEARCH ARTICLE **Open Access**

Evaluation of Innovation Components in IT Startups with a Focus on Industry 4.0

Shahram Shakouri [1], Abbas Khamseh* [2], Reza Radfar[3]

Abstract
This research has evaluated the innovation components in information technology startups with a focus on Industry 4.0. The approach of the current research is of a qualitative type and was implemented based on the meta-composite approach. On this basis, all articles published in ISI magazines, books and internal and external theses related to the topic of innovation in the field of startups and in the period of 2015 to 2021 were examined. According to the SIP model, the researchers identified 17 concepts and 96 codes for each of the 4 categories of substrate (background), input (input), the main category of process and output (output), which were paid attention to in internal and external studies. The results of this research will help researchers and practitioners in the field of innovation in information technology startups to know what variables and components should be included in the four sectors of the platform for a comprehensive understanding of the innovation development of startups based on the 0.4 industry. Pay attention to the main category of process and output. The present study contributes to the literature on startup technology innovation in information technology and its practices and outlines desirable practices for future researchers.
Keywords: *Innovation; Startups; Information-Technology; Industry 0.4*

Introduction

With respect to the dazzling pace and expansiveness of changes in technology, it seems that the technology-resultant transformations due to the fourth industrial revolution are much more diverse and extended than the past three periods and can bring about serious and irreparable problems to businesses if they do not adapt themselves with these evolutions. Businesses need continuous and constant innovations for their survival. During the past decades, we have witnessed the shift of innovation models from the closed and intrinsic spaces of businesses to open innovation models with maximum productivity and cooperation and various external environments. Since companies present, develop, and commercialize their ideas in an internalized form, they should commercialize them according to the innovations of other

1.Ph.D Candidate in Technology Management , Department of Management, Science and Research Branch, Islamic Azad University, Tehran, Iran
2*. Associate Professor, Department of Industrial Management, Karaj Branch, Islamic Azad University, Karaj, Iran (Corresponding Author: Abbas.khamseh@kiau.ac.ir)
3. Professor, Department of Industrial Management and Accounting, Science and Research Branch, Islamic Azad University, Tehran, Iran

companies. They seek ways through which they can offer their internal competence by developing trajectories that are even beyond their current activation area (Taheri et al., 2023). Although startup companies more probably enjoy further innovative capacities than other firms, they face many difficulties when innovating or commercializing their inventions. Due to being small, startups are often deprived of the necessary physical, human, and financial resources to offer new technologies or products. In addition, owing to their novelty, these companies are less privileged in terms of reliability, creditability, and quality (Neyens et al., 2021).

Boer (2001) defined innovation as 'the creation of a new product, market, technology, and organization combination'. Tseng and Goo (2005) defined innovation as the capacity to develop the present knowledge and reinforce the new one, which encompasses the company's ability in developing new products or any innovative idea (Faria et al., 2021). Innovation can also be described as the creation of a new or existing thing that can potentially attract customers' attention (Ungerman et al., 2018). Based on advanced technologies, IT companies become more sensitive to the changes in their surrounding while paving the way for the technological advancement of other organizations and should manifest more serious reactions in order to survive. Researchers have unveiled some evidence that, in one aspect, innovation, similar to value proposition, changes other factors of business models as well. Hence, it can be concluded that innovation can incur complete changes in a single element of a business model (Bhatti et al., 2021). In this regard, due to their distinctive nature, like mutual dependence and value creation, innovation ecosystems have emerged as a more appropriate configuration for technology development and preparation in IT startups instead of the linear approach .Furthermore, startup projects, as driving forces, have typically increased contributions to creating a national competitive economy (Korohodova et al., 2020). The growing resources and expectations concerning the role of startups in innovation have paved the way for extended scientific and political debates about innovation (Winden & Carvalho, 2019). On the other hand, industry 0.4 engenders technological challenges and organizational consequences. This integration of physical and virtual domains via physical-cyber systems is a primary principle in industry 0.4 and thus shifts into a paradigmatic change. Globalization has made companies and countries cooperate to achieve new opportunities, survive in the completive market, and control their situations (Rocha et al., 2019). However, businesses faced fast changes during globalization concerning both customer needs and market nature. To enjoy a competitive advantage and improve their performance, companies should offer new products and strategies to attract new customers while satisfying the present ones. For this reason, the company-forwarding innovation concept has been extensively significant in IT startups (Ahadi Serkani et al., 2023).

Hence, technology-oriented companies, such as startups, that are severely centered on research and development should take steps toward reinforcing their R & D units and promoting their capacities. The promotion of innovation R & D capacities in technology-oriented enterprises not only prevents the irregular transfer of technologies, which makes enterprises depend on the technologies of other countries, but also develops the current technologies and, above all, incurs the achievement of new technologies (Asghari et al., 2020).

Concerning what was explained and according to the review of the past studies on innovation in startups, many experts and researchers worldwide, with various

perspectives and in different periods, have presented separate models and discrete frameworks for innovation in IT startups, wavering the inclusiveness of the respective findings. Thus, since innovation application in IT startups is a new category, a bulk of the associated research is case studies, leading to the high dispersion of surveys conducted in this area. Hence, no comprehensive and transparent perspective has been so far presented in integrated and consolidated forms concerning the different applications of innovation in IT startups. With regard to the uptrend of studies in this domain, the present study aimed to systematically and scientifically review and synthesize the previous studies in order to identify innovation components in IT startups and present a comprehensive categorization in this domain following the meta-synthesis approach.

Literature Review

Innovation in Information and Technology Startups

Due to their distinctive nature, e.g., mutual dependence and value creation, the innovation ecosystems of industry 0.4 have emerged as a more fine-tuned configuration for technology development and preparation instead of the linear approach .Furthermore, startup projects as driving forces contribute to the national competitive economy generally and incrementally (Namaayande & Zarei, 2021). Innovation in business models has been increasingly considered by scientists for the past several years. However, there is a dearth of extensive empirical studies pertaining to innovation in business models, and few efforts have been made for the examination of the different factors that can influence innovation in these models. Besides, various surveys have addressed strategy compilation models in startups, e.g., designing an innovation strategy compilation model for internet businesses or the consequences of innovation in the business model of the IT industry (Wang et al., 2020). However, no study has presented a model considering the genesis of the fourth industrial revolution, while the results show that innovation in business models remarkably relies on knowledge absorption capacity, agility, and top management, all calling for the recognition of future uncertainties in industry 0.4. In addition, innovation in business models mediates the relationship between these factors and commercial performance. From a managerial perspective, organizations should apply some changes to their business models in order to create a competitive advantage and enhance their performance. A study has selected and completely analyzed 41 papers about startups and open innovation and introduced seven subheads for this topic, wherein open innovation has been evaluated as the foremost phenomenon of startups. This finding helps us gain a thorough perception of startups' roles in open innovation processes. Startup companies are innately open organizations necessarily involved with R & D processes (Kiyomarsi et al., 2021).

Although companies are not to centralize all their efforts around R & D units for innovation development, they have to adequately activate their mechanisms and opportunities at the international level and employ various innovation portfolios (Radfar & Khamseh, 2009). In the startup domain, there are outnumbering models which reveal the logic behind innovation in IT startups and its effect on the development of businesses, especially electronic commerce (Molaei & Taheri, 2018). In their initial development phases, digital startups often enjoy value architecture and idiosyncratic business models. Recently, a set of practical approaches benefiting from pure and agile principles has been presented toward supporting digital entrepreneurs who tackle innovation in their business models. In this regard, the research by Korohodova et al. (2020), entitled 'the interaction of

transnational companies with startups in industry 0.4', discloses that startups' development accompanies considerable resources and a network of customers, and economic and state of art production ideas will be realized in the form of projects. For this reason, the fourth industrial revolution platform improves these startups as a repetitious process to decrease the uncertainty, attract shareholders, and promote collective learning with less expenditure.

-Ogiemwonyi et al., (2023) conducted a study entitled 'Green innovation behaviour: Impact of industry 4.0 and open innovation. The results of this research revealed that the impact of green innovation performance is found to be stronger when compared to Industry 4.0 and open innovation. Likewise, green innovation performance exhibits a substantial mediating impact between the exogenous variables and green innovation behaviour. The policy implication and conclusions are further discussed in the last section of the study.

-Grabowska and Saniuk (2022) conducted a study entitled 'Development of Business Models in the Fourth Industrial Revolution: Conditions in the Context of Empirical Research on Worldwide Scope Companies Located in Poland. The results of this research revealed that conducting a survey using the CAWI method, among 70 purposefully selected companies; the research was carried out in Poland. The impact of Industry 4.0 technology on business models, barriers to the implementation of these technologies, and changes in business models that occurred as a result of this implementation were identified. The article is dedicated to researchers working on business models and business practitioners.

-Jiang et al. (2020) studied the competition of technology standards in industry 0.4 from an innovation ecosystem perspective. In the industry 0.4 age, innovating in complex technology systems and developing smart technologies depend on technology standards. Thus, the competition of technology standards is vital for companies aiming to achieve a competitive advantage. To assist economic enterprises to acquire a competitive advantage by adopting proper strategies in the technology standards competition, this research has integrated the innovation ecosystem concept with technology standards competition and developed a mechanism based on Lotka Volterra's model. Specifically, five possible results of technology standards competition have been predicted, and the respective strategic alternatives of companies have been discussed.

-Mohajerani et al. (2019) identified open innovation components and presented a model for implementing open innovation at universities. According to the theme analysis results and the extracted open innovation components, a model for implementing open innovation at universities was presented. This model categorized the effective components in open innovation implementation at universities into three groups, including factors related to the organization and organizational structure of universities, factors related to university customers, and factors related to internal and external relationships of universities.

An investigation of the previous review studies reveals that systematic reviews have been so far carried out while being confined to case studies applying innovation in IT startups. Hence, no consolidated conceptual classification has been documented concerning the applications of this approach in the face of industry 0.4. The present study is reckoned as the first compiled and strategic research that sought to identify and comprehensively perceive innovation platforms in IT startups by focusing on industry 0.4 and applying the meta-synthesis approach.

Methodology

The present qualitative study has applied the meta-synthesis approach to systematically review the previous models and frameworks associated with innovation in information and technology startups. Since the adoption of the meta-synthesis approach to investigating innovation concept in IT startups is still in its infancy in developing countries, and, on the other hand, the bulk of papers in this field is qualitative and thus lack quantitative data, the present study has pursued the meta-synthesis approach as an appropriate method for inclusively synthesizing and integrating innovation concepts in IT startups according to the translation and interpretation of finite qualitative studies. Hence, the past research and review studies on innovation in IT startups in the world were examined by the meta-synthesis approach within the seven-step framework of Sandlowski and Barroso (2007).

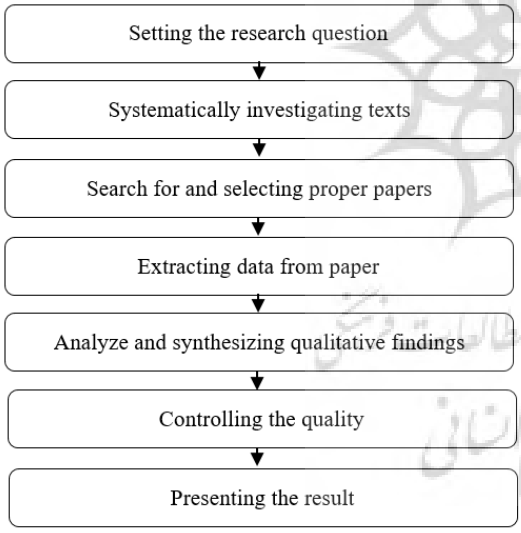

Fig 1. *Meta-synthesis steps; Source: Sandlowski and Barroso (2007) (Thorne, 2022)*

As shown in Figure (1), the seven-step framework of Sandlowski and Barroso (2007) has been employed in this study for implementing the meta-synthesis approach. Every step of this framework is described in the following:

Step 1: Setting the Research Questions

Different factors, such as the essence, time, and circumstance of the methodology of the examined population, were used for setting and formulating the research questions.

The research questions were raised according to the CIPP model as below:

What are the contexts and fundamentals of innovation in IT startups with the meta-synthesis approach?

What are the inputs of innovation in IT startups with the meta-synthesis approach?

What are the processes of innovation in IT startups with the meta-synthesis approach?

What are the outputs of innovation in IT startups with the meta-synthesis approach?

Step 2: Systematically Investigating Texts

The purpose of this step is to search the literature and collect data by the library method. The statistical population of this research comprised all articles published in ISI journals, books, and domestic and foreign theses associated with the innovation subject in startups in the 2015-2021 period.

The keywords pertaining to the strategic process development, innovation in IT startups, and related models in their topics, abstracts, and keywords were searched in domestic databases, such as Noormags, Civilica, Magiran, Elmnet, as well as foreign databases, including ScienceDirect, Emerald, Scopus, Proquest, Springer, Wiley, InterScience, and Taylor & Francis, and the specialized Google Scholar database. Over 145 papers were found by the use of the considered keywords and web search engine.

Step 3: Evaluating Studies Meticulously and Selecting Proper Texts

The fit of the discovered papers with the research questions was examined in the third step. Hence, the selected studies were reviewed several times. Some papers were excluded from the meta-synthesis process per revision in this step. The methodological quality of the

studies was inspected after the screening of their fitness with the considered factors.

The Critical Appraisal Skills Program (CASP) is a tool for evaluating the quality of initial studies in qualitative research. This tool consists of ten questions that assist with figuring out the concept of qualitative studies and determining their accuracy, credibility, and significance. Finally, 77 papers and a limited number of books and domestic and foreign theses were selected for data analysis. Figure (2) illustrates the reviewing process of selecting suitable papers for the topic of the present research.

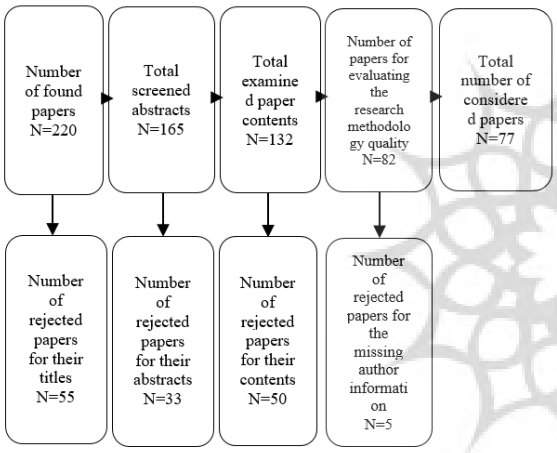

Fig 2. *Paper revision and selection process*

Step 4: Extracting Textual Information

In this phase of the meta-synthesis process, the selected papers were reviewed and studied several times for the acquisition of the innovation components in IT startups. The data associated with every one of the 77 papers, including innovation development components in IT startups, authors, and publication years, were extracted and included in tables.

Step 5: Analyzing and Synthesizing the Qualitative Data

The present research first identified all components of innovation development in IT startups and then extracted 17 concepts and 96 codes for every context, input, process (main category), and output category to answer the research questions. The results are presented in Tables 1-4.

The coding results in Table (1) show that organizational structure, organizational readiness, innovation orientation/tendency to innovations, and channels/network relationships influence innovation in IT startups. Innovation in IT startups is tied to the organization size, domestic, local, and global scales, organizational structure, organizational nature, up-to-dateness of technological structure, organizational patterns, self-regulation capacities, support of top managers, budget allocation, further integration and coordination of internal systems, changes in the innovation process, desirable training actions, removal of deficits in innovation infrastructures, exploitation of creative capacities, determining priorities and evaluating ideas, employee partnerships, reward system, beneficial relationships with commercial partners, universities and research centers, and relationships with stakeholders, all playing contextual roles in the consequences of innovation development in IT startups according to industry 0.4.

Table 1.
Innovation contexts in IT startups

Concept	Codes	References
Organizational structure	Organization size; domestic, local, and global scales	Strakova Varaya (2017) Kim et al. (2017) Marullo et al. (2018)
	Organizational framework Organizational nature	Alice et al. (2018); Liu et al. 2019); Winden & Carvalho (2019); Rocha et al. (2019)

Concept	Codes	References
	Up-to-dateness of technological structure	Kim et al. (2020); Seo et al. (2018)
	Organizational patterns	Iskandar et al. (2017)
Organizational readiness	Self-regulation capacity	Jiang, Gao, Zhoa, & Chen (2020)
	Support of top managers	Alhashmi et al. (2020)
	Budget allocation	Neolia & Roslia (2020); Bhatti et al. (2021); Neyens et al. (2021)
	Further integration and coordination of internal systems	Kim et al. (2020); Jasemann et al. (2021); Wang et al. (2021)
	Changes in the innovation process	Neolia & Roslia (2020); Jiang, Gao, Zhoa, & Chen (2020)
Innovation orientation/ten-dency to new innovations	Desirable training actions	Fakhr et al. (2018)
	Removing the deficits of innovation infrastructures	Seo et al. (2018)
	Exploiting creative capacities	Seidani, Meshkin Ghalam, & Ehsani (2021)
	Determining priorities and evaluating ideas	Strakova Veraya (2017); Doblinger et al. (2019); Ghezzi & Cavallo (2018)
	Employee partnership	Strakoa Veraya (2017)
	Reward system	Oliva & Kotabe (2019); Seo et al. (2018)
Channels/ network relationships	Beneficial relationships with commercial partners	Lang (2014); Kardas et al. (2019)
	Universities and research centers	Mehrani & Abdzadeh Kanafi (2019); Iskandar et al. (2017)
	Relationships with stakeholders	Sinha & Park (2017); Doblinger et al. (2019); Ghezzi & Cavallo (2018)

Table (2) represents innovation inputs in IT startups. These inputs encompass four cultural, managerial, financial, and employee factors. Sympathizing and strengthening motivations due to group work, the interaction between fresh and experienced employees, improving group works through participatory approaches, and a trust-based organizational atmosphere for interaction fall into the cultural factors sub-category. The presence of flexible managers to ensure internal commitment to startup innovations, supportive structures of innovation development in startups, the innovative mentality of managers, and management's trust and support from innovation constitute the managerial factors. These factors underscore the presence of managers who believe in new technologies and help with new perceptions of startup innovations in industry 0.4. Organizing and allocating adequate financial resources to support new technologies and innovations are grouped into the financial factors sub-category. Finally, employee creativity, employee learnability, reduced resistance to new changes, employee empowerment, committed employees, and human capital have been considered as the employee factors.

In this research, the processes' category has been considered as the main category of innovation in IT startups. The processes include five concepts of idea commercialization, absorption capacity, and value creation, startup positioning, and strategically evaluating innovative activities. Other categories, i.e., contexts, inputs, and outputs, are the sub-categories of innovation in IT startups based on 0.4 industry.

Table 2.
Innovation inputs in IT startups

Concept	Codes	References
Cultural factors	Sympathizing and strengthening motivations due to group work	Lin, Shyu, & Ding (2017); Ghezzi & Cavallo (2018), Muller (2019); Mohajerani, Karimi, and Nadi (2019)
	Interaction between fresh and experienced employees	Seo et al. (2018); Tobisen et al. (2018)
	Improving group works through participatory approaches	Kim et al. (2020); Alhashmi et al. (2020)
	A trust-based organizational atmosphere for interaction	Jiang, Gao, Zhao, & Chen (2020)
Managerial factors	Presence of flexible managers to ensure internal commitment to startup innovations	Dalmarco et al. (2017); Neolia & Roslia (2020); Wang, Luob, Saric, & Xue (2021)
	Supportive structures of innovation development in startups	Kim et al. (2020); Marullo et al. (2018); Wang, Luob, Saric, & Xue (2021)
	The innovative mentality of managers	Resberto et al. (2017)
	Management's trust and support from innovation	Kim et al. (2020); Alhashmi et al. (2020); Stephan et al. (2019)
Financial factors	Organizing and allocating adequate financial resources to support new technologies	Bakhsham, Karimi, & Hosseinpour (2021); Mohammafi, Tabatabaeian, Elyasi, & Roshani (2016)
	Organizing and allocating adequate financial resources to support new technologies	Fakhr et al. (2021); Mohammafi, Tabatabaeian, Elyasi, & Roshani (2016); Stephan et al. (2019)
Employee factors	Employee creativity	Seo et al. (2018); Lux et al. (2017)
	Employee learnability	Jiang, Gao, Zhao, & Chen (2020)
	Reduced resistance to new changes	Kim et al. (2020); Stephan et al. (2019)
	Employee empowerment	Fakhr et al. (2018); Arcese et al. (2015); Wang, Luob, Saric, & Xue (2021)
	Committed employees	Rocha, Mamedio, & Quandt (2019)
	Human capital	Wang, Luob, Saric, & Xue (2021)

Table 3.
Innovation process in IT startups

Concept	Codes	References
Idea commercialization	Identifying opportunities	Stenrad et al. (2016)
	Evaluating market demands	Seo et al. (2018)
	Selecting advanced technologies	Sharp et al. (2017); Parvan et al. (2015); Stephan et al. (2019)
	Evaluating market demands	Stenrad et al. (2016); Sharp et al. (2017); Parvan et al. (2015)
	Evaluating advanced technologies	Arcese et al. (2015); Wang, Luob, Saric, & Xue (2021)
Absorption capacity	Access to unique foreign knowledge	Pourmozirji, Esmaeili, & Hosseinzadeh (2020)
	Foreign research and development, a factor for startup prosperity	Kim et al. (2020); Seo et al. (2018), Jasemann, Constantisenko, & Roger (2021)
	Converting knowledge to exploitable knowledge	Alhashmi et al. (2020); Liu, Gao, Ma. & Chen (2019)
	Accelerating access to new innovations	Alhashmi et al. (2020); Liu, Gao, Ma. & Chen (2019); Seidani, Meshkin Ghalam, & Ehsani (2021)
	Knowledge transfer	Fakhr et al. (2018); Seo et al. (2018)

Startup positioning	Owning a unique positioning concept	Protila (2016); Morrar et al. (2017); Lin et al. (2017)
	Applying systematic processes to understand customers properly	Parvan et al. (2015); Resberto et al. (2017)
	Optimizing systems	Akbari (2020); Jasemann, Constantisenko, & Roger (2021)
	Integrated customer interactions	Muller (2020); Sharp et al. (2017); Parvan et al. (2015); Mohajerani, Karimi, & Nadi (2019)
	Offering generous rewards	Marullo et al. (2018)
	Implementing ideas	Molaei, Shirazi, & Soltanzadeh (2016); Mobini Dehkordi & Keshtkar Haranki (2016)
Strategically evaluating innovative activities	Long-term activities in knowledge and technology	Alhashmi et al. (2020); Jasemann, Constantisenko, & Roger (2021)
	Discovering potential uses of achievements	Seo et al. (2018); Winden & Carvalho (2019)
	Increasing the competitive power of startups	Ungerman, Dedakova, & Gurinova (2018); Martin et al. (2019); Liu et al. (2019)
	Developing R & D units	Phangestu, Kountur, & Prameswari (2020); Spender et al. (2017)
	Organizational pathology with the innovation development approach	Jasemann, Constantisenko, & Roger (2021); tokestani, Ghazinoori, & Jahedi (2017)
	Structuring resources	Kim et al. (2020); Sharp et al. (2017); Parvan et al. (2015); Alhashmi et al. (2020)
	Classifying resources	Beniz, Ayala, & Frank (2020)
	Employing new and existing capacities	Fakhr, Khastar, & Mousavi (2018)
	Startups' open innovation practices	Rocha, Mamedio, & Quandt (2019); Marrullo et al. (2018); Spender et al. (2017); Molaei & Taheri (2018)
	Developing startup culture to new domains	Kim et al. (2020); Beniz, Ayala, & Frank (2020)
	Innovative leaderships	Kim et al. (2020)
	Operating system-based ecosystem	Beniz, Ayala, & Frank (2020); Neolia & Roslia (2020); Sharp et al. (2017); Parvan et al. (2015); Jiang, Gao, Zhao, & Chen (2020)

As Table 3 shows, reaching innovation outputs (consequences) in IT startups is the desired objective of the research model. The desirable outputs of innovation in IT startups have been categorized into six factors, including environmental intelligence, competitive intelligence, organizational agility, business model improvement, competitive advantage, and digital evolution.

Table 4.
Innovation outputs in IT startups

Concept	**Codes**	**References**
Environmental intelligence	Detecting signs of technological changes	Beniz, Ayala, & Frank (2020); Muller (2020); Lee, Dai, & Koi (2020)
	Searching for the signs of technological changes	Alhashmi et al. (2020); Liu et al. (2019)

Concept	Codes	References
Competitive intelligence	Coordinating startups' competencies with environmental changes	Alhashmi et al. (2020); Sharp et al. (2017); Parvan et al. (2015); Resberto et al. (2017)
	Proper adaptation of products with the fast changes in customer demands	Alhashmi et al. (2020); Liu, Gao, Ma, & Chen (2019)
	Attention to technological changes and customer demands	Liu, Gao, Ma, & Chen (2019); Jasemann, Constantisenko, & Roger (2021)
	Attention to environmental dynamism and fast changes in the technological environment	Lee, Dai, & Koi (2020); Martin et al. (2019); Liu et al. (2019); Winden & Carvalho (2019)
	Directing innovative and technological research	Liu, Gao, Ma, & Chen (2019)
	Collecting and analyzing competitor information	Liu, Gao, Ma, & Chen (2019); Ungerman et al. (2018)
	Employing different information sources to raise competitiveness	Hamed et al. (2017); Marrullo et al. (2018); Reischauer (2018)
	Perceiving innovation pressures on the commercial environment	Liu, Gao, Ma, & Chen (2019); Shimohammadi, Nikmanesh, & Hassanzadeh (2020)
	Developing the quality of strategic programs	Neyens, Faems, & Sels (2021); Sharp et al. (2017)
	Creating opportunities in required sectors	Fakhr et al. (2018)
	Being informed of competitors' conditions	Sharp et al. (2017); Parvan et al. (2015); Stephan et al. (2019)
Organizational agility	Centralizing decisions on participatory innovation development in startups	Winden & Carvalho (2019); Alhashmi et al. (2020); Resberto et al. (2017)
	Adaptability in accepting new changes	Beniz, Ayala, & Frank (2020)
	Agility in accepting new innovations	Reischauer (2018); Marullo et al. (2018); Ungerman et al. (2018)
	Involving customers in innovative product development	Bhatti, Santoro, Khan, & Rizzato (2021); Reischauer (2018)
	Exploiting new market opportunities through cooperation	Stephen et al. (2019); Rahim Monfared (2020)
	Developing technologies based on artificial intelligence	Alhashmi et al. (2020)
	Developing technologies based on the Internet of Objects (IoO)	Jasemann, Constantisenko, & Roger (2021)
	Developing digital entrepreneurship	Phangestu, Kountur, & Prameswari (2020)
Business model improvement	Creating values for customers through business models	Benits, Ayala, & Frank (2020); Morrar et al. (2017); Spender et al. (2017)
	Business models: factors of innovation commercialization	Alhashmi et al. (2020); Resberto et al. (2017)
	Enhancing productivity as an approach to performance promotion	Faria, Santos, & Zaidan (2021); Parvan et al. (2015)
Competitive advantage	Institutionalizing innovation systems	Reischauer (2018); Jasemann, Constantisenko, & Roger (2021)
	Developing profitability	Jasemann, Constantisenko, & Roger (2021)

Concept	Codes	References
	Promoting business situations	Phangestu, Kountur, & Prameswari (2020); Marullo et al., (2018)
	Revealing stable behaviors in the face of new technologies	Resberto et al. (2017); Ungerman et al. (2018)
	Attaining smart commercial solutions	Beniz, Ayala, & Frank (2020); Neolia & Ruslia (2020)
Digital evolution	Employing the blockchain network	Beniz, Ayala, & Frank (2020); Wang et al. (2021); Jesemann (2021)
	Utilizing digital tools	Jasemann, Constantisenko, & Roger (2021)
	Digital value chains	Liu, Gao, Ma, & Chen (2019); Muller (2020); Lee, Dai, & Koi (2020)
	Consolidating intelligent sale technologies	Jasemann, Constantisenko, & Roger (2021); Marullo et al. (2018); Reischauer (2018)

Step 6: Controlling the Quality

To examine validity, this study employed the vital Glynn assessment tool, by which all selected papers were assessed and chosen via ten criteria. Furthermore, to obtain the research reliability, the researcher applied the inter-coder agreement method, i.e., samples of the selected papers were delivered to another expert, and the obtained results were calculated by the Kappa index in the SPSS software. The reliability of the research was approved considering the Kappa coefficient of 0.635 and the significance level of 0.001.

Step 7: Presenting the Results

A meta-synthesis approach to the investigation of the previous studies and categorization of the extracted codes (Tables 1-4) gave rise to innovation components in IT startups as follows: the contexts with four concepts and 18 codes, inputs with four concepts and 15 codes, main processes with five concepts and 29 codes, and outputs (consequences) with six concepts and 34 codes Figure (3).

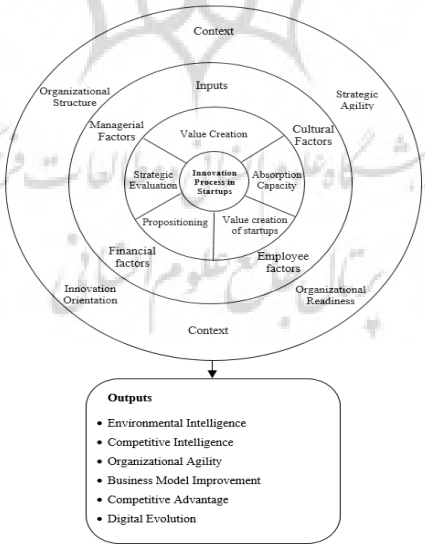

Fig 3. *Innovation framework in IT startups*

Finally, the proposed framework with 96 codes, 19 concepts, and 4 categories was designed. In the meantime, outputs with 34 codes comprised the most extended category, and the processes, contexts, and inputs with 29, 18, and 15 codes were ranked the second, third, and fourth categories. It is worth mentioning that to demonstrate the general framework, the study sufficed with presenting the main categories and concepts of the innovation framework in IT startups based on industry 0.4, illustrated in Figure 3.

Conclusion and Suggestions

This study adopted a meta-synthesis approach to identifying innovation components in IT startups. According to the findings, the meta-synthesis-derived framework based on the CIPP model reflects that innovation development in IT startups falls into four categories of contexts, inputs, processes, and outputs. Out of 96 examined codes, the outputs (consequences) category with 34 codes was of high significance. The desirable consequences of the strategic process development have been presented through six factors reflecting environmental intelligence, competitive intelligence, organizational agility, business model improvement, competitive advantage, and digital evolution, all catering to the privilege and distinction of IT startups in the face of industry 0.4. The attainment of these consequences from innovation development in IT startups was the intended objective of the research's framework. The results of this study are in line with the findings of the research by Neyens et al. (2021), Bhatti et al. (2021), and Reischauer (2018); however, these researchers have referred to dispersed and uncategorized consequences in their studies.

The second category, i.e., processes, includes 29 important codes. It means that it is highly significant to attend to this infrastructural factor, which includes idea commercialization, absorption capacity, value creation, startup positioning, and the strategic evaluation of innovation activities, during the innovation process development in IT startups. In fact, the conversion of the innovation process in IT startups into desirable consequences in the face of industry 0.4 takes place in a milieu of processes, solutions, approaches, developments, and executive actions. These results correspond with the findings of the studies by Muller (2020), however, neither of these surveys have presented compiled strategies, programs, and executive actions necessary for innovation in IT startups.

The third category (contexts) includes 18 significant codes. Innovation in IT startups calls for the consideration of the organizational structure, organizational readiness, innovation orientation/tendency to new innovations and channels, and network relationships. The results of the contexts' category correspond to the findings of the research carried out by Doblinger et al. (2019) and Ghezzi and Cavallo (2018). However, the current study had a comprehensive and compiled look at all contextual factors in order to enrich the presented framework.

Eventually, the fourth significant category comprised inputs with cultural, managerial, financial, and employee factors and 15 codes. These factors are extensively capable of meeting the needs and facilitating innovation in IT startups. The results of the inputs' category partially coincide with the findings of studies by Faria et al. (2021), though these researchers have entertained finite dimensions as the requisite inputs for innovation in IT startups.

The 4th industrial revolution is the most robust driver of innovation in the current and future IT startups that initiate new waves of innovation. Thus, the main characteristics associated with the 4th industrial revolution, e.g., orientation to new innovations and the environmental intelligence and organizational agility of innovative systems through

improvements in business models, are responses to the current challenges companies face due to intensified competition in globalization conditions, fluctuations in the market demands and lifecycle of products, and the raised complexity of products and processes. Hence, the fast digitalization of the IT startups' world collapses the conventional barriers of industry, and many researchers highlight the need for revising the present innovation models in the ecosystem of IT startups. However, recent studies have mainly focused on technology development and rarely tackled new business models emerging due to innovation integration in the 0.4 industry platform. Nevertheless, this state of art paradigm in the industry 0.4 platform transforms the current approaches to value creation since it includes technical and production evolutions, which, in turn, give rise to extended organizational consequences, improve customer relationships, or offer new services. Therefore, there are is a need for new business innovation models in IT startups, pushing researchers to discuss and take steps toward promoting the digital evolution of IT startups. Startup managers are suggested to create a competitive advantage for themselves, examine their strengths and weaknesses, and concentrate on the most crucial value dimensions if they lack the necessary power and capital for realizing all expected values. In other words, they should target a small segment of the market by focusing on industry 0.4.

This research selected the meta-synthesis method, while future studies can investigate its results in the form of case studies and prioritize and rank the components in addition to confirming them. Furthermore, multiple-criteria decision-making methods can be used for determining the priority and weight of the identified components in this research. This study analyzed the IT startup industry; however, information technology, especially in the artificial intelligence domain, advances at a fast pace. Thus, it is recommended that the classic behavior prediction and analysis methods be integrated with the new approaches of data sciences, such as machine learning and deep learning, and the potential capacities of the macro data analysis be exploited in market studies and other management-related disciplines.

Limitations

Among the limitations of this research, we can refer to evaluating and analyzing Persian and English papers and studies. Furthermore, a long time was spent extensively studying the literature and extracting, summing up, synthesizing, and interpreting the codes. The finite gamut of the model application constitutes another limitation of the study.

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Declaration of Interests:

Authors declare that they have no conflict of interests.

References

Ahadi Serkani, S. Y., atarasadi, M., & Amini khouzani, M. (2023). Comprehensive Systematic Model of Fraud and Decisions in Financial Management: A Structural Equation Modeling Approach. *Journal of System Management*, 9(1), 119-132. https://doi:10.30495/jsm.2022.1968673.1693

Alhashmi, F., Alshurideh, M., Al Kurdi, B., Salloum, A., Alhashmi, S., Alshurideh, M., & Salloum, A. (2020). A Systematic Review of the Factors Affecting the Artificial Intelligence Implementation in the Health Care Sector. *AICV*, 12(7), 37-49. https://doi.org/10.1007/978-3-030-44289-7_4

Arcese, G., Flammini, S., Caludia-Lucchetti, M., & Martucci, O. (2015). Evidence and Experience of Open Sustainability Innovation Practices in

the Food Sector. *Sustainability*, 7(2), 8067-8090. https://doi.org/10.3390/su7078067

Asghari, M., Khamseh, A., & Pilevari, N. (2020). A Model for Upgrading R & D Capabilities with a Qualitative Approach in the Power Plant Equipment Manufacturing and Energy Supply Industries. *Innovation Management in Defense Organizations*, 3(4), 125-150. https://doi.org/10.1016/j.jmsy.2019.04.008

Bhatti, H., Santoro, G., Khan, J., & Rizzato, F. (2021). Antecedents and Consequences of Business Model Innovation in the IT Industry. *Journal of Business Research*, 123(12), 389-400. https://doi.org/10.1016/j.jbusres.2020.10.003

Dalmarco, G., Maehler, E., Trevisan, M., & Schiavini, M. (2017). The Use of Knowledge Management Practices by Brazilian Startup Companies. *RAI Revista de Administracao e Inovacao*, 14(3), 226–234. https://doi.org/10.1016/j.rai.2017.05.005

Dehkordi, M., & Haranaki, M., (2016). A Meta-synthesis of Social Innovation Models. *Social Development & Welfare Planning*, 7(26), 101-138. https://doi.org/10.22054/qjsd.2016.4888

Doblinger, C., Surana, K., & Anadon, L. (2019). Governments as Partners: The Role of Alliances in U.S. Clean-tech Startup Innovation. *Research Policy*, 48 (6), 1458-1475. https://doi.org/10.1016/j.respol.2019.02.006

Fakhr, H., Khastar, V., & Mousavi, S. (2018). The Antecedents and Consequences of Open Innovation and Innovation Atmosphere in Entrepreneurial Ecosystem of Startups with an Emphasis on Organizational Antecedents. *An unpublished M.A. Thesis in Business Management*, Kharazmi University.

Faria, D., Santos, P., & Zaidan, H. (2021). The Business Model Innovation and Lean Startup Process Supporting Startup Sustainability. *Procedia Computer Science*, 7(3), 93-101. https://doi.org/10.1016/j.procs.2021.01.106

Ghezzi, A., & Cavallo, A. (2018). Agile Business Model Innovation in Digital Entrepreneurship: Lean Startup Approaches. *Forthcoming in Journal of Business Research*, 4 (6): 1-20. https://doi.org/10.1016/j.jbusres.2018.06.013

Grabowska, S., & Saniuk, S. (2022). Development of Business Models in the Fourth Industrial Revolution: Conditions in the Context of Empirical Research on Worldwide Scope Companies Located in Poland. *Journal of Open Innovation: Technology, Market, and Complexity*, 8(2), 513-529. https://doi.org/10.3390/joitmc8020086

Iskandar, K., Jambak, I., Kosala, R., & Prabowo, H. (2017). Current Issue on Knowledge Management System for Future Research: A Systematic Literature Review. *Procedia Computer Science*, 116(8), 68-80. https://doi.org/10.1016/j.procs.2017.10.011

Jesemann, I. Beichter, T., & Marc, R. (2021). Investigation of the 'Lean Startup' Approach in Large Manufacturing Companies towards Customer-Driven Product Innovation in SMEs. *Procedia CIRP*, 99 (21), 711-716. https://doi.org/10.1016/j.procir.2021.03.095

Jiang, H., Gano, S., Zhao, S., & Chen, H. (2020). Competition of Technology Standards in Industry 4.0. *An Innovation Ecosystem Perspective*, 37(7), 12-23. https://doi.org/10.1002/sres.2718

Kim, J., San Kim, T., & Sohn, Y. (2020). Recommendation of Startups as Technology Cooperation Candidates from the Perspectives of Similarity and Potential: A deep Learning Approach. *Decision Support Systems*, 130(12), 113-129. https://doi.org/10.1016/j.dss.2019.113229

Kiyomarsi, E., Saeednia, H. R., & Alipour Darvishi, Z. (2021). The Effect of Advertising on Expectations and Perception of the Brand with Emphasis on the Mediating Role of Customer Experience Management in the Insurance Industry. *Journal of System Management*, 7(4), 183-204. doi: https://doi.org/10.30495/jsm.2021.1943472.1562

Korohodova, O., Onopriienko, K., & Kuzhel, V. (2020). The Interaction of Transnational Corporations with Startups in Industry 4.0. Journal of Finance Management, 11(2), 101-122. https://doi.org/10.20535/2307-5651.17.2020.216393

Lin, C., Shyu, Z., & Ding, K. (2017). A Cross-Strait Comparison of Innovation Policy under Industry 4.0 and Sustainability Development Transition. *Sustainability*, 9(7), 17-28. https://doi.org/10.3390/su9050786

Liu, C., Gamo, X., Ma, W., & Chen, X. (2019). Research on Regional Differences and Influencing Factors of Green Technology

Innovation Efficiency of China's High-tech Industry. *Journal of Computational and Applied Mathematics*, 369(2), 112-139. https://doi.org/10.1016/j.cam.2019.112597

Martin, N., Matt, C., Niebel, C., & Blind, K. (2019). How Data Protection Regulation Affects Startup Innovation. *Information Systems Frontiers*, 21(18), 1307-1324. https://doi.org/10.1007/s10796-019-09974-2

Marullo, C., Casprini, E., Minin, D., & Piccaluga, A. (2018). Ready for Take-off: How Open Innovation influences startup success. *Wiley*, 27(4), 476-488. https://doi.org/10.1111/caim.12272

Mehrani, S., & Kanafi, A. (2019). Presenting a Model for Diffusion of Accounting Innovations in the Public Sector. *Governmental Accounting*, 5(16), 9-24. https://doi.org/10.30473/gaa.2019.41556.1222

Mohajerani, M., Karimi, F., & Nadi, M. A. (2019). Identifying Open Innovation Components and Presenting a Model for Implementing Open Innovation at Universities. *Scientific Journal of Innovation & Creativity in Humanities*, 9(2), 199-226. https://journal.bpj.ir/article_668770.html?lang=en

Molaei, N., & Taheri, S. (2018). E-business Development with Model of Data Innovation, Open Government Data, and Open Innovation. *Rahyaft*. 28(69), 41-52. https://rahyaft.nrisp.ac.ir/article_13641.html

Morrar, R., Arman, H., & Mousa, S. (2017). The Fourth Industrial Revolution (Industry 4.0): A Social Innovation Perspective. *Technology Innovation Management Review*, 7(11), 9-15. https://doi.org/10.1080/09537287.2023.2217414

Namaayande, P., & Zarei, B. (2021). Modeling the Communication Technology Industry's Innovation Ecosystem using an Adaptive Neuro Fuzzy Inference System. *Journal of System Management*, 7(4), 69-92. https://doi:10.30495/jsm.2021.1942235.1534

Neyens, I., Faems, D., & Sels, L. (2021). The Impact of Continuous and Discontinuous Alliance Strategies on Start-Up Innovation Performance. *International Journal of Technology*, 30(8), 1127-1142. https://10.1504/IJTM.2010.035982

Ogiemwonyi, O., Nurul Alam, M., Azizan, N., & Hossain, S. (2023). Green innovation behaviour: Impact of industry 4.0 and open innovation. *Journal of Heliyon*, 9(6), 201-217. https://doi.org/10.1016/j.heliyon.2023.e16524

Oliva, F. & Kotabe, M. (2019). Barriers, Practices, Methods and Knowledge Management Tools in Startups. *Journal of Knowledge Management*, 23(9), 1838-1856. https://doi.org/10.1108/JKM-06-2018-0361

Radfar, R., & Khamseh, A. (2009). Technology Commercialization: An Effective Factor in Technology Development and Economy. *Specialized Journal of Technology Development*, 5(20), 33-40. https://doi.org/10.3390/joitmc5030065

Reischauer, G. (2018). Industry 4.0 as Policy-Driven Discourse to Institutionalize Innovation Systems in Manufacturing. *Technological Forecasting & Social Change*, 132(8): 26-33. https://doi.org/10.1016/j.techfore.2018.02.012

Rocha, F., Mamédio, F., & Quandt, O. (2019). Startups and the Innovation Ecosystem in Industry 4.0. *Technology Analysis & Strategic Management*, 15(3), 22-34. https://10.1080/09537325.2019.1628938

Seo, Y., Kim, D., & Lee, S. (2018). The Effects of Knowledge Assets on the Performances of Startup Firms: Moderating Effects of Promotion Focus. *Journal of Asian Finance, Economics, & Business*, 5(4), 187-199. https://doi.org/10.13106/jafeb.2018.vol5.no4.187

Spender, C., Corvello, V., Grimaldi, M., & Rippa, P. (2017). Startups and Open Innovation: A Review of the Literature. *European Journal of Innovation Management*, 20(1), 29-45. https://doi.org/10.1108/ejim-12-2015-0131

Stephan, A., Bening, R., Schmidt, S., Schwarz, M., Hoffmann, H. (2019). The Role of Inter-Sectoral Knowledge Spillovers in Technological Innovations: The case of Lithium-ion Batteries. *Journal of Technological Forecasting and Social Change*, 148(10): 119-137.https://doi.org/10.1016/j.techfore.2019.119718

Taheri, S., Abdolbaghi Ataabadi, A., Arman, M. H., & Vaziri Sarashk, M. (2023). The Mechanism of Volatility Spillover and Noise Trading Among Financial Markets and the Oil Market: Evidence from Iran. *Journal of System*

Management, 9(1), 1-13. https://doi:10.30495/jsm.2022.1960629.1656

Thorne, S. (2022). *Qualitative meta-synthesis*. London: SAGE.

Ungerman, O., Dedkova, J., & Gurinova, K. (2018). The Impact of Marketing Innovation on the Competitiveness of Enterprises in the Context of Industry 0.4. *Journal of Competitiveness*, 10(2), 132-148. https://10.7441/joc.2018.02.09

Wang, L., Gong-li Luob, A., & Saric, Xue-F. (2020). What Nurtures Fourth Industrial Revolution? An Investigation of Economic and Social Determinants of Technological Innovation in Advanced Economies. *Technological Forecasting & Social Change*, 161(7), 120-135. https://doi.org/10.1016/j.techfore.2020.120305

Winden, V., & Carvalho, L. (2019). Intermediation in Public Procurement of Innovation: How Amsterdam's Startup-in-Residence Programme Connects Startups to Urban Challenges. *Research Policy*, 4(1), 48-69. https://doi.org/10.1016/j.respol.2019.04.013