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Original Article

Study of innovation capacity of fisheries companies in the covid-19 pandemic crisis

Estudo da capacidade de inovação das empresas de pesca na crise da pandemia de covid-19

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Abstract

Many countries have encountered coronavirus pandemic crisis around the world. Through the outbreak of this disease in Iran, preventive plans have been implemented to break the chain of the disease infection. These measures in the economic sector have affected supply, production and demand, and to some extent have led to the partial or complete closure of some businesses and occupations. In the context, it seems that innovative an "innovation capacity" infrastructure measures and turning to innovation in this crisis can be a strategy to moderate and optimize the situation. This study tries to design concepts of the fisheries firms' innovation capacity model in the context of the COVID-19 pandemic crisis. After collecting data, they were analyzed using SPSS and PLS SMART software, which were performed in two parts: descriptive statistics and analytical or inferential statistics. A novel research model is presented to examine the impact of factors such as innovation management, social, cultural, human and organizational capital, crisis strategies, government actions in crisis situations, and marketing strategies in crisis situations, as well as, recognition and application of marketing advantages in crisis situations, which offers a re-analysis of innovation capacity. According to the results, among the variables played a significant role on the level of innovation capacity in epidemic conditions, innovation management ($p > 0.000$; $\beta = 0.593$), and recognition and application of marketing advantages ($p > 0.049$; $\beta = 0.209$) were the most significant, independent variables affecting the innovation capacity, which explained its variations.

Keywords: covid19 pandemic, fisheries firms, innovation capacities, smart PLS model.

Resumo

Muitos países enfrentaram crises na pandemia de coronavírus em todo o mundo. Por meio do surto dessa doença no Irã, planos preventivos foram implementados para quebrar a cadeia de infecção da doença. Essas medidas no setor econômico afetaram a oferta, a produção e a demanda e, em certa medida, levaram ao fechamento parcial ou total de alguns negócios e serviços. Nesse contexto, parece que medidas de infraestrutura inovadoras e com "capacidade de inovação" podem ser uma estratégia para moderar e otimizar a situação nesta crise. Este estudo tenta desenhar conceitos do modelo de capacidade de inovação das empresas de pesca no contexto da crise da pandemia de COVID-19. Após a coleta dos dados, eles foram analisados por meio dos softwares SPSS e PLS SMART e realizados em duas partes: estatística descritiva e estatística analítica ou inferencial. Um novo modelo de pesquisa é apresentado para examinar o impacto de fatores como gestão da inovação, capital social, cultural, humano e organizacional, estratégias de crise, ações governamentais em situações de crise e estratégias de marketing em situações de crise, bem como reconhecimento e aplicação de vantagens de marketing em situações de crise, que oferece uma reanálise da capacidade de inovação. De acordo com os resultados, entre as variáveis que desempenharam um papel significativo no nível de capacidade de inovação em condições epidêmicas, a gestão da inovação ($p > 0{,}000$; $\beta = 0{,}593$) e o reconhecimento e aplicação de vantagens de marketing ($p > 0{,}049$; $\beta = 0{,}209$) foram as variáveis independentes mais significativas que afetaram a capacidade de inovação, o que explicou suas variações.

Palavras-chave: pandemia de covid-19, empresas de pesca, capacidades de inovação, modelo PLS inteligente.

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1. Introduction

Achieving sustainable development goals (SDGs) requires innovative and ingenious replies to complex challenges such as eradicating starvation, improving peasant livings, and supporting the environment (Franco et al., 2020). However, no actor can offer solutions that address a wide range of issues facing agriculture today (FAO, 2014). Innovation, whether technological, institutional, or social, arises from collective thinking and action (Katila et al., 2019). Research, development, manufacturing, agricultural trade, and other actors, as well as policies, attitudes, and behaviors influencing them act as catalysts for innovation (Kok et al., 2019; World Bank, 2012; Borsellino et al., 2020; EU, 2015; Bukhari et al., 2022). They play a key role in forming food systems by producing, documenting, mixing, sharing, and using native and scientific knowledge and stimulating learning. Innovation capacities, however, predict how the system will perform at different levels. A wide range of skills is required for effective communication, collaboration, and learning of diverse actors in a system (FAO, 2014; Katila et al., 2019). Innovation capacities must be enhanced to increase the outcomes of collective efforts (UNCTAD, 2019). The relationship between innovation driver and innovation capacity as well as among innovation capacity and innovation performance is significant and strong. Innovative capacity creating is required to provide more effective innovation results and performance. Innovation and innovation capacity also plays a role in the export performance of small businesses (Oura et al., 2016). Several studies also provide evidence of a non-linear relationship among environmental, social and governance (ESG) implementation strategies and corporate innovation capacity. In other words, the findings are consistent with the "indirect value creation" process, according to which corporate social responsibility (CSR) and ESG policies increase their ability to pursue innovation capacity (Ramezani Farani et al., 2022; Forsman, 2011). Furthermore, it is required to identify the fundamental limitations in the four aspects of knowledge creation, knowledge acquisition, corporate innovation and innovation environment to identify regional innovation capacity. The three components of intellectual and emotional assets – knowledge and competence; digital technology; and reputation – and their effects on the ability to manage the marketing that leads to the business performance of the organization are also worth considering (Izadi et al., 2020). Considering the characteristics of innovation capacity, the achievement of the success of the innovation performance evaluation index system and the use of the traditional innovation performance evaluation model go through six dimensions of main source input, self-technology, process management, product performance, social value, and business value (Abudureheman et al., 2020; Alves et al., 2020). The study of regional compaction and regional innovation capacity (RIC) based on the Metropolitan Compaction Index (MCI) shows that sparse regions can hinder innovation capacity, while dense regions can overcome physical barriers to innovation production by providing quality locations and access to urban facilities. This can facilitate social interactions and increase social capital while reducing poverty and segregation. Therefore, investing in dense urban forms deserves more attention (Hamidi et al., 2019). Assessing innovation capacity and variations in it is not a simple exercise. The literature assisting to understand the role of innovation in agriculture and related businesses is constantly evolving. Further research relies on qualitative analysis (Hall and Clark, 1995; Klerkx et al., 2010). However, more structured approaches have recently been considered to evaluate innovation processes and capacities in agriculture (Schut et al., 2015; Sartas et al., 2017).

On the other hand, according to the report of the Islamic Parliament Research Center published on May 29, 2020, the Iranian economy has been in a state of recession with uncertainty since the end of 2019 due to the outbreak of Coronavirus and its continuation in 2020. In fact, the Iranian economy will be affected by the economic consequences of this virus until the end of 2020 either with the control of the disease or if it is not controlled and continued. The decrease in exports of Iranian products leads to a decrease in the country's income. In the domestic sector, total demand has also been affected by declining demand for some goods and services due to declining household incomes. On the other hand, supply has been encountered with supply shock due to disruption in the raw material supply network and limited activity of some trade unions. In this section, the risk factors facing businesses due to the coronavirus crisis are classified into three levels: international, national and business. The likelihood of businesses going bankrupt has increased in such circumstances. Accordingly, conditions for access to capabilities that can reduce these risks, such as turning to innovations in crisis situations, can pave the way for overcoming the recession and decline of productivity and efficiency (Heidary et al., 2017). In this regard, solutions can be provided to strengthen the strategic and entrepreneurial thinking of senior company managers in the fight against coronavirus. Continuous monitoring and analysis of business environment and macroeconomics and government policies, drawing new perspectives of the company, formulating plans based on the advantages and tailored to the situation, developing and applying leadership style tailored to the crisis situation, authoritarian or participatory style, attempting to provide the proposed value of the business model in accordance with current customer expectations, considering the business trends in crisis and post-corona period, applying new entrepreneurial approaches and methods, and paying attention to business social responsibility are among these strategies (PwC, 2020; Hamel and Välikangas, 2003). One of these strategies is to assess the presence and strengthen innovation capacities in these small businesses (Guest et al., 2020; Rafiquzzaman, 2020; Can et al., 2020).

According to the importance of fisheries in Iran, we can compare the advantages of the fishery sector and its effect on Iran's economic development with the aim of evaluating the added value of the comparative advantage of the fishery sector and its effect on economic development of different provinces. The analysis reveals that the provinces of Hormozgan, Sistan and Baluchestan, Tehran, Gilan, Golestan and Mazandaran have always had a comparative advantage of production in the fisheries and fishing

sector, but with increasing the comparative advantage of this sector, economic development has decreased by 0.033%, which indicates the value added has a comparative advantage for fisheries and fishing and a negative impact on Iran's economic development, which can be due to the significant role of other economic sectors compared to the fishing sector in the economic development of the provinces and lack of comparative advantage expertise in the fishing sector (Amirnejad et al., 2020; Gomes et al., 2019; Bennett et al., 2020; Pustokhina et al., 2021; Khorsandi et al., 2021). A study of the socio-economic effects of the coronavirus outbreak in the shrimp aquaculture globally shows that in Iran, approximately 121,000 tons of Iranian seafood worth more than $ 390 million were exported to world markets last year; these products were mainly exported to the European Union, the countries bordering the Persian Gulf, Iraq, Afghanistan, Russia, Vietnam, Malaysia, and Thailand. However, after the crisis, this amount has decreased significantly. Furthermore, due to the effect of COVID-19, the supply in places of reception, especially restaurants and hotels, has decreased due to ambiguities about health status, which is a factor in reducing the price of shrimp and the reluctance of shrimp farming among entrepreneurs (Shamsipur et al., 2012; Kumar et al., 2020). Regarding the understanding of the effects of approximate and contextual factors determining the impact of international seafood trade on small-scale local fisheries, research has shown that local empowerment, integrated fisheries management and increased stakeholder participation in fisheries and fishermen participation in decision-making can reduce barriers such as lack of sustainable aquatic stocks, lack of economic development, lack of marketing knowledge, and the process of reducing fishermen's income (Crona et al., 2015; Beraha and Đuričin, 2020; Webber et al., 2021). A study published by FAO (2020) in Asian countries on how COVID-19 affects food systems for fishing and aquaculture.

Another study on COVID-19 and its global impact on food and agriculture has been conducted by Poudel et al. (2020) which shows the decline in international trade, turmoil in the supply chain food and food production. The COVID-19 epidemic also provides opportunities for the sustainable production of food and agricultural products and the acceleration of green innovation. Reasonable yet ambitious economic recovery programs are essential when countries are reopening to growth and development. COVID-19 may create destructive technologies that divide food, ICT, health and the environment. Convergent innovation centers with several agencies can accelerate socio-economic improvement (Rowan and Galanakis, 2020; Ahmad et al., 2021; Waiho et al., 2020). Prajogo and Ahmed (2006, p. 504) defined innovation capacity as "the organizational capacity of innovation, which is determined by the skills and strengths in R&D, basic technology, and innovation management." As well as, company-specific values such as non-recurring resources, patents, brands, main production methods, technology and experienced engineers are important sources for innovation capacity. Rajapathirana and Hui (2018, p. 46) described innovation management as a "combination of assets and resources". Rajapathirana and Hui (2018) found a significant relationship among innovation capability and innovation management. Büyükbeşe and Yildiz (2019) conducted a research on 160 different companies located in the Gaziantep Organized Industrial Zone, and their research results showed that there is a significant and positive effect among firms' innovation capacity and their innovation performance.

The question now is how the innovation capacity index is assessed in these critical situations among small businesses, especially in agricultural products and, in particular, the fisheries industry and related processing. While assessing the status of innovation capacity in small businesses in the fisheries sector, we discuss the effectiveness of other indicators based on the results of research to identify and determine innovation and, consequently, the business situation in critical situations in order to find the missing link in improving the state of innovation in pandemic situations.

2. Materials and Methods

The present study is a practical study purposefully and a non-experimental or non-empirical study in terms of data collection because it is not possible to manipulate and control research variables. It is a descriptive-correlational and analytical study methodologically and it is of survey or field research type. This study was conducted to perform the stage of theoretical studies and qualitative research in the documentary method and to the quantitative stage in the field method. A questionnaire was used in the field method. The questionnaire as a researcher-made questionnaire was prepared by studying the indicators introduced in Kok et al. (2019) research in the field of measuring innovation in 17 separate sections, while examining the occupational and demographic characteristics of the research community and examining indicators of innovative capacity – including mobilization, equalization, coordination, institutionalization, and experimentation – measured in the 5-point Likert scale. Also by using studies of Calik et al. (2017), innovation management indicators, including strategies, processes, connections, reminiscence, and organization, capitals determining the social culture of innovation, innovation problems, marketing and sales strategies, were also questioned in the same range. The value of the total standardized alpha is equal to 0.89. This value indicates that the research items have an acceptable level of reliability, in other words, reasonable internal alignment to measure the subject of the research. As after obtaining the step-by-step model, the validity and reliability of the embedded structures were evaluated through CR (0.85). The statistical population of this study were entrepreneurs in the field of small businesses in the field of fish farming in Tehran province. In this project, there was no sampling and a census was conducted on 50 entrepreneurs due to the small and limited statistical population. After collecting data, they were analyzed using SPSS and PLS SMART software, which were performed in two parts: descriptive statistics and analytical or inferential statistics.

In this article, the proposed strategies for policymakers and entrepreneurs in the field of production include the following:

1. The government should support future production policies by providing a production system and sufficient incentives.
2. Current production facilities should be changed to digital production, robots and cyber physical systems for production and supply of goods.
3. The status of COVID-19 creates a great variety in consumption, so industry managers must plan to produce all the essential items during the epidemic, and online systems must be strengthened to deliver these materials online.
4. The success of production chains and local productions must be strengthened and supported.

The following hypothesis for testing is whether there is a significant relationship among innovation capacity and government measures:

The following hypothesis is to test whether there is a relationship among innovation capacity and innovation management:

H_1. There is a significant and positive effect between innovation capacity and innovation management.

H_2. There is a significant and positive impact between innovation capacity and government measures.

H_3. There is a significant and positive impact among innovation capacities, human, social and organizational capital and networking.

H_4. There is a significant and positive effect between innovation capacity and innovation strategies.

H_5. There is a significant and positive impact between innovation capacity, business growth strategies, and recognition of marketing advantages.

2.1. Descriptive analysis

The survey of respondents' shows that 52.5% of them were directly involved in commercial activities in the field of fish farming and the rest were involved in ancillary activities in the field of fisheries, including the preparation of fish food, fish egg production, marketing of products, etc. 90% of the respondents (38 people) had 1 to 4 full-time employees.

In order to identify the impact of business activity on the corona virus pandemic from the perspective of respondents, the highest frequency was related to the moderate impact with 13 people (32.5%). In response to the question of whether there is a risk of permanent closure of their business due to this crisis, if so, when this closure may occur, 19 people (47.5%) did not give this possibility. Furthermore, 70% of respondents attributed the presence of the Corona virus (COVID-19) pandemic to lower purchasing power among consumers.

In response to the question of how the pandemic affected respondents' businesses, they had the highest response to the temporary closure of their business (n = 17 people; 34%).

In response to the question of what strategies they have adopted to deal with the crisis of business managers, the respondents have highly considered the temporary reduction of employment with 38%.

Moreover, the ease of access to information and the advantages of government programs in terms of helping small businesses, which were asked across a range of 5 from very easy to very difficult, it was difficult for respondents (n = 19 people; 38%).

Furthermore, the best and most useful measures of the government to cope with the COVID-19 crisis according to the respondents included the introduction of employment programs with the highest frequency of 24 people (48%).

In order to evaluate the level of innovation management in the context of COVID-19 epidemic among fishery entrepreneurs, 5 general indicators of innovation management, including strategy, process, organization, links and learning, with their sub-indicators were presented in the questionnaire and the participants were asked to express their responses about each item in a range of 5 options (very low, low, medium, high, and very high). The results show that in the statistical population under study, the terms "communication with universities and other research centers to help develop knowledge" and "cooperation with other firms to develop new products/processes" due to having a lower coefficient of variation, from the perspective of respondents are more important in innovation management practices, they are ranked higher.

Five general innovation capacity indicators, including mobilization, testing, institutionalization, balancing and coordination, with their sub-indicators were given in the questionnaire in order to assess the innovation capacity in the context of COVID-19 pandemic among fisheries entrepreneurs. The participants were asked to express their responses about each item in a range of 5 options (very low, low, medium, high, and very high). Table 1 shows the frequency and percentage of responses of all subjects for each item.

The results indicate that in the study statistical population, the items "in case of conflict, skills in mediating conflicts over data-driven innovation" and "discussion of ethical aspects of data-driven innovation" due to having a lower coefficient of variation, are more important from the respondents' perspective in entrepreneurial innovation capacity and are ranked higher.

3. Results

3.1. Inferential findings

3.1.1. Correlation analysis

Correlation tests were used to assess the significant relationship between business innovation capacity in the context of COVID-19 pandemic and independent variables such as innovation management, available capital, business problems in the pandemic, advantages of marketing methods, government actions, strategies in crisis situations, adopted methods to improve the business situation and the level of firm innovation. The results of the research according to Table 2 showed that the value of correlation coefficient had a significant correlation between innovation

Table 1. Innovation capacity indicators in covid-19 pandemic.

No.	Items	Mean	Standard deviation	Coefficient of variation	Priority
1	Ideas of employees for data-based novation find the sound people to jointly implement these ideas.	2.38	1.469	0.617227	25
2	People who are responsible for data-based novation can engage firms, researchists, and citizenry to develop new ideas.	2.34	1.062	0.453846	11
3	They have a robust structural network of firms, researchists, and citizenry connected to data-based novation.	2.06	1.096	0.532039	21
4	People who are in charge of data-based novation can stimulate the development of new ideas among their colleagues.	2.4	1.107	0.46125	14
5	They have a robust network of employees with an interest in data-based novation.	2.56	1.236	0.482813	17
6	A company, researches, or citizenry with good ideas for data-based novation finds the right people to further develop these ideas.	2.54	1.147	0.451575	10
7	They are successful in setting up experiments.	2.52	1.147	0.455159	12
8	They have social support (from the citizenry, NGOs, firms, etc.) to test on data-based novation.	2.72	1.325	0.487132	16
9	Political institutions support data-based novation experiments.	1.94	1.114	0.574227	23
10	Office managers support data-driven innovation testing.	2.24	1.222	0.545536	22
11	They provide sufficient funding for testing.	2.06	0.978	0.474757	15
12	If necessary, they engage further governments, firms, and social organizations in trials on data-based novation.	1.94	1.058	0.545361	19
13	They are successful in scaling experiments.	1.88	0.866	0.460638	13
14	They adopt data-based novation that has been proven to be successful on a small scale in the systematic process.	2.6	0.948	0.364615	3
15	They evaluate experiments well with data-driven innovation.	2.34	1.206	0.515385	20
16	They succeed in piloting cooperation with governments, firms, and social organizations into structural forms of cooperation.	2.44	1.163	0.476639	16
17	They succeed in knowing ventures, detriments, and tensions around data-based novation.	2.74	1.209	0.441241	9
18	They initiate a general discussion of the dangers, disadvantages, and stresses of data-based novation and how to deal with them.	2.82	1.155	0.409574	5
19	If there are contradictions, he/she is skilled in mediating conflicts over data-based novation.	3.18	1.119	0.351887	2
20	The ethical aspects of data-based novation are well discussed.	3.52	1.129	0.320739	1
21	They make financial instruments structurally available for data-based novation.	3.02	1.317	0.436093	7
22	There is a good interchange of information about data-based novation among all actors.	2.9	1.096	0.377931	4

Table 1. Continued...

No.	Items	Mean	Standard deviation	Coefficient of variation	Priority
23	They have a culture that fosters data-based novation.	2.85	1.229	0.431228	6
24	They create the proper conditions for data-based novation (teaching, information exchange, tools, etc.).	2.63	1.299	0.493916	18
25	They have an explicit sight for data-based novation.	2.94	1.295	0.440476	8

Table 2. Correlation test of dimensions proposed in precision agriculture and understanding of precise agricultural concepts.

No.	First variable	Second variable	Correlation coefficient	Significant level
1	Innovation capacity	Innovation management	0.402**	0.004
2		Capitals	0.519**	0.000
3		Government measures	-0.286*	0.044
4		Crisis strategies	0.285*	0.045
5		Recognition and use of the advantages of marketing	0.335*	0.023

**Significance at level 99%. *Significance at level 95%.

management, capital, government measures, strategies in crisis and awareness situations and the use of marketing advantages. The results of correlation showed a positive effect of variables other than the variable of government measures. This means that government measures have had a negative impact on innovation capacity building and vice versa.

3.1.2. Multiple regression analysis

When there is a significant relationship between two or more independent variables and a dependent variable, multiple regression is used to predict the variations of the dependent variable and to assess the role of each of the independent variables on the dependent variable. Therefore, stepwise multiple regression method was used in order to analyze the role of independent research variables, which have a significant relationship with the dependent variable of the level of innovation capacity in small businesses in the field of fisheries. According to the results, it can be said that among the independent variables that have played a significant role on the dependent variable of innovation capacity, two variables of innovation management and awareness and recognition of marketing advantages are the most important independent variables affecting the research dependent variable, which interactively explain 32.2% of the variations in the research dependent variable.

At this stage, the first variable that entered the equation was innovation management. The results of calculations (Table 3) showed that this variable has the most role in the innovation capacity of entrepreneurs. Therefore, it can be stated that the mentioned variable alone has caused 21.2% of variations in the dependent variable by observing the coefficient of determination. In the second step of regression, the variable that entered the equation is knowledge of marketing advantages, which means that variable has the most impact on the dependent variable of innovation capacity after the innovation management variable. Therefore, it can be stated that the two variables of policy-making factor and the named factor have caused 32.2% of the variations in the dependent variable by observing the coefficient of determination.

According to the regression coefficients and the fixed value obtained from the stepwise multiple regression analysis tests (Table 4), the research regression equation was obtained (Equation 1).

$$Y = -7.741 + 0.560(Innovation\ Management) + 1.248(Knowledge\ and\ awareness\ of\ marketing\ advantages) \quad (1)$$

In this case, the equation means that if we graphed the equation - 7.741 + 0.560X1 + 1.248X2, the line would be a rough approximation for our data. The Regression equation shows that figure out research data is fit to the equation. This makes predictions from data– either future predictions or indications of past behavior. In this case, we know what Knowledge and awareness of marketing advantages and innovation management are going to be helpful in the innovation capacity future.

3.1.3. Modeling a small business innovation capacity in covid-19 pandemic

As respondents were asked about dependent and independent variables using a questionnaire, the presence of common method biases (CMB) was possible. By using the results of the research of Podsakoff et al. (2003), the

Table 3. Summary of the various stages of the introduction of independent variables for research on the innovation capacity of fisheries businesses in the covid-19 pandemic.

Steps	Independent variable	R	R^2	R^2Adj	F	Sig.
First step	Innovation management	0.479	0.230	0.212	13.126	0.001
Second step	Knowledge of marketing advantages	0.593	0.352	0.322	11.669	0.000

R indicates the multiple correlation coefficient; R2 coefficient of explanation of the model; R2dj adjusted determination coefficient (calculates degree of freedom); F confirmation the model; Sig Significance at 99% and 95% level.

Table 4. Coefficients of variables entered into the multiple regression equation.

Steps	Independent variable	B	SEB	Beta	T	Sig.
First step	Intercept	10.913	14.691	-	0.743	0.462
	Innovation Management	0.548	0.151	0.479	3.623	0.000
Second step	Intercept	-7.741	15.127	-	-0.512	0.611
	Innovation Management	0.560	0.140	0.490	3.989	0.000
	Knowledge and awareness of marketing advantages	1.248	0.439	0.350	2.845	0.007

B: The rate of increase of the dependent variable for each unit of increase in the independent variable; SEB: the standard error of the computed value of B; Beta: positive direction and direct relationship without two variables; T-test: the significance of the regression coefficient of each of the independent variables with the dependent variable; Sig: Significance at 99% and 95% level.

anonymity of the respondents was ensured to reduce the risks of CMB and the questions of strategically dependent and independent variables were distributed in the questionnaire. In addition, various statistical methods were used to control the effect of CMB. In this regard, Harman's one-factor analysis was used, which showed that the factor only explains 19.6% of the variance in the present study (KMO = 0.901, Barrett test = 413/11422, Sig. = 0.000). Moreover, Chin et al. (2013) used the measured latent marker variable (MLMV) method to evaluate CMB. To perform this method, 15 unrelated variables including 7 variables related to innovation in epidemic conditions were entered into modeling to affect each PLS model variable. After that, the path coefficients were calculated (Table 5). Minor variations have been created in the path coefficients. In addition, there were insignificant variations in the t-values of the model structures. As a result, CMB was not an issue in our article.

As shown in Table 5, convergence validity and combined reliability are satisfactory for each variable. Then, a partial least squares model was used using Smart PLS. Initially, confirmatory factor analyses (CFA) was used to consider the suitability of the model. The results showed that the model was defined correctly (SRMR = 0.053; NFI = 0.938; RMS_Theta = 0.155). Finally, the structural model was evaluated. The bootstrapping method was used to test the path coefficient estimation. Figure 1 show the relationship between variables.

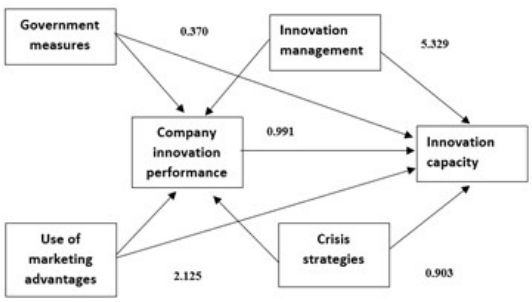

Figure 1. Research model.

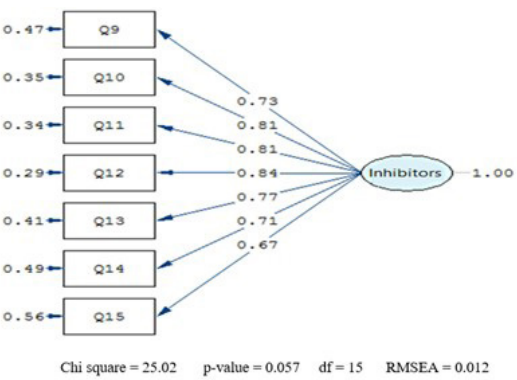

Figure 2. The measurement model of deterrents based on standard factor loads.

3.2. CFA of deterrents in knowledge management

The causal relationships between the observed variables (questionnaire items) and the deterrent construct is investigated using the CFA. Figure 2 shows the reliability and validity of the measurement model of deterrents using the CFA.

According to Figure 2, the factor loads of all items of the deterrent structure are more than 0.3, suggesting that all the designed items are capable of measuring the deterrent structure. Figure 3 shows the relationships between the

items and the deterrent structure based on t values. In this diagram, the calculated values of t are > 1.96 for each factor load of each item with the deterrent structure, demonstrating the valid alignment of the questionnaire items for measuring the deterrent structure at this stage.

The relationship between the items (explicit variables of the research) with their corresponding structure (hidden variables) in relation to the facilitators based on the factor load the value of t (Table 6) represents that all variables have a good significant correlation with the deterrent structure.

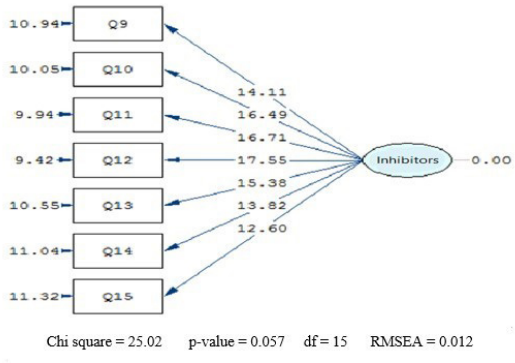

Figure 3. The measurement model of deterrents based on t values.

The model should be fitted after confirming the measurement model of deterrents in knowledge management by the CFA. The GoF indicators in Table 7 shows that the data of this research have a good fit with the factor structure and the research theoretical basis, indicating the alignment of the questions with the theoretical structures. It can, therefore, be concluded that the measurement model of deterrents is fitting and acceptable.

3.3. CFA of innovation in knowledge management (measurement model)

The causal relationships between the observed variables (questionnaire items) and the innovation construct is examined using the CFA. Figure 4 shows the reliability and validity of the measurement model of innovation factors using the CFA.

According to Figure 4, the factor loads of all items of the innovation factors are more than 0.3, suggesting that all the

Table 5. Comparison of path coefficient by structural level correction (CLC) approach and PLS model.

Relationships	Path coefficient	t-value	PLS estimate	P-value
CLC estimate	PLS estimate	CLC estimate		
Innovation management Innovation capacity	0.593	0.601	5.239**	0.000
Government measures Innovation capacity	-0.047	-0.049	0.370	0.712
Crisis strategies Innovation Capacity	0.105	0.110	0.903	0.367
Use of marketing advantages Innovation capacity	0.209	0.211	2.125*	0.049
Company innovation Innovation capacity	-0.19	-0.199	0.991	0.322

*Significance level of 5%; **Significance level of 1%.

Table 6. Specifications of the deterrent structure items in the measurement model.

Items	Sign in the model	Standard factor load	t	T factor load	Result
Inappropriate organizational culture	Q9	73.0	11.14	94.10	Confirmed
Unawareness and non-support of managers	Q10	81.0	49.16	05.10	Confirmed
No relations between the manager and the organization employees	Q11	81.0	71.16	94.9	Confirmed
Hierarchical structure	Q12	84.0	55.17	42.9	Confirmed
Lack of resource allocation to employee ability measurement	Q13	77.0	38.15	55.10	Confirmed
Inconsistence of staff needs with existing technology systems	Q14	71.0	82.13	04.11	Confirmed
No identification of experts on any field in the organization	Q15	67.0	60.12	32.11	Confirmed

Table 7. Fitness indicators of the measurement model of deterrents.

Indicator	Acceptable value	Reported value
χ^2	05.0≤	02.25
p-value	05.0≤	057.0
df	-	15
χ^2/df	3≥	668.1
RMSEA	05.0≥	012.0

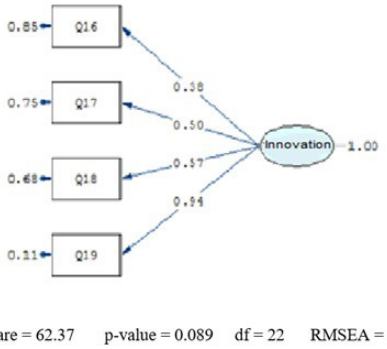

Figure 4. Measurement model of innovation factors based on standard factor loads.

designed items are capable of measuring the innovation structure. Figure 5 shows the relationships between the items and the innovation structure based on t values. The calculated values of t are > 1.96 for each factor load of each item with the innovation structure, representing the valid alignment of the questionnaire items for measuring the innovation structure at this stage. In fact, the results show that what the researcher intended to evaluate with the questionnaire questions has been achieved by this scale.

The relationship between items (explicit research variables) and their corresponding structure (hidden variable) in relation to innovation factors based on factor load and values of t is shown in Table 8, all variables have a good significant correlation with the innovation structure.

The model should be fitted after confirming the measurement model of innovation factors by the CFA. The Goodness of fit statistics (GoF) indicators in Table 9 shows that the data of this research have a good fit with the factor structure and the research theoretical basis, indicating the alignment of the questions with the theoretical structures. It can, therefore, be concluded that the measurement model of deterrents is fitting and acceptable.

3.4. CFA of knowledge management structure (application, creation, sharing, and storage)

The CFA of knowledge management variable is presented in Figure 6. Standard factor loads of CFA were obtained to measure the power of the relationship between the hidden variable of knowledge creation and explicit

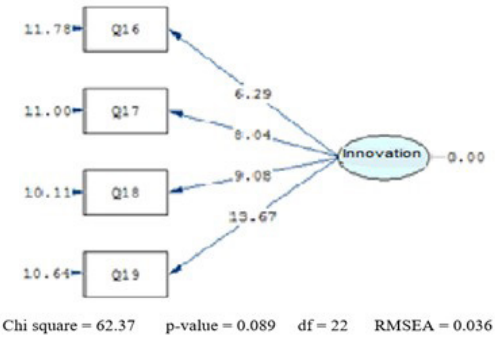

Figure 5. Measurement model of innovation factors based on t values.

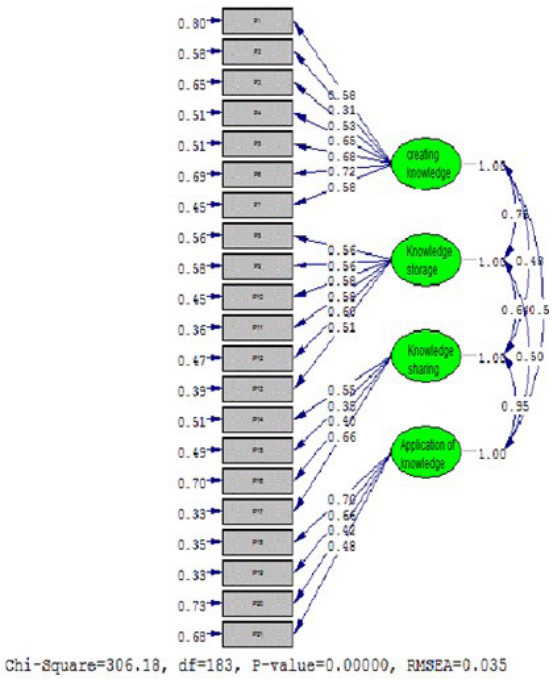

Figure 6. Standard factor loads of knowledge management structure.

variables. These include employees' familiarity with specialized and advanced Internet search methods (0.58), employees' familiarity with techniques and methods of creativity and innovation (0.31), process development and documentation procedures of employees' organizational knowledge (0.53), related knowledge produced outside the company by employees (0.65), continuous development of knowledge by employees (0.68), company information about the specialties and capabilities of employees (0.72), employees' knowledge in the internal journal (0.58), and the hidden factor load of knowledge storage with explicit variables of knowledge record and maintenance outside the company in the company's databases (0.56), storage and maintenance of information about employees' capabilities and expertise in the company's databases (0.56), preventing the loss of valuable knowledge by proper storage (0.58),

Table 8. Specifications of innovation structure items in the measurement model.

Items	Sign in the model	Standard factor load	t	T factor load	Result
Development of systemic learning	Q16	38.0	29.6	78.11	Confirmed
Development of innovative methods in the organization	Q17	50.0	04.8	0.11	Confirmed
Creation of a creative and dynamic atmosphere	Q18	57.0	08.9	11.10	Confirmed
Development of teamwork and engagement based on creative ideas	Q19	94.0	67.13	64.10	Confirmed

Table 9. Fitness indicators of the measurement model of innovation factors.

Indicator	Acceptable value	Reported value
χ^2	05.0≤	37.62
p-value	05.0≤	089.0
df	-	22
χ^2/df	3≥	835.2
RMSEA	05.0≥	036.0

transfer of knowledge and experience of retired or leaving employees (0.58), access and retrieval of acquired and stored knowledge (0.60), organizational memory storage (0.51), the hidden variable factor load of knowledge sharing with explicit variables of sharing knowledge and experiences of employees through meetings and seminars (0.55), quick access of employees to knowledge and information (0.35), ease of access to necessary information and knowledge to employees (0.40), eagerness to share knowledge and experiences with others (0.66), the factor load of the hidden variable of knowledge application with explicit variables of user-friendly design of information resources in the company (0.70), user-friendly design of documents (0.66), changing work processes in the company according to new knowledge (0.42), and employees' use of their knowledge in favor of the company (0.48, p18-p21). The standard factor load of CFA to measure the strength of the relationship between each factor (hidden variable) and its explicit variables (questionnaire items) has been obtained > 0.3 in all cases, which confirms the factor structure of knowledge management variable.

A significant test should be performed after calculating the standard factor load. Based on the results observed in Figure 7, the factor load of t-statistic for indices of each studied dimension is greater than 1.96 at 5% confidence level.

3.4.1. GoF of the model

The structural model of the main research model was fitted using a number of GoF (Equation 2).

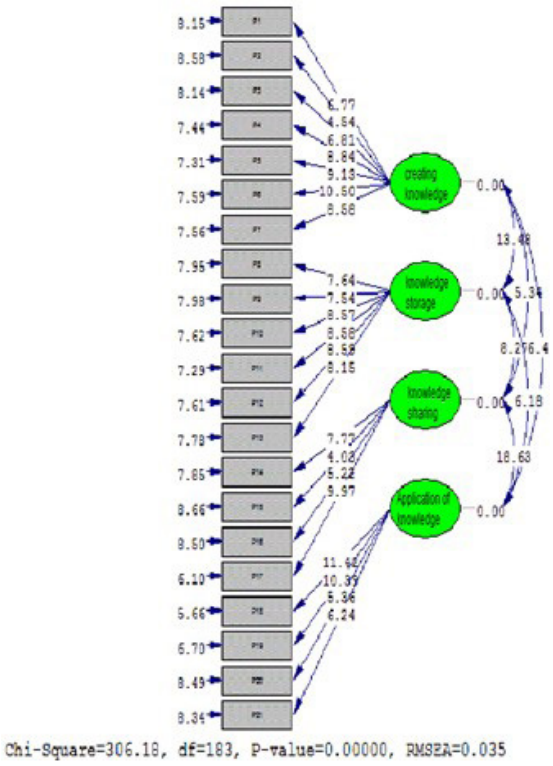

Figure 7. The significance statistic (t-value) of CFA for knowledge management variable.

$$\frac{\chi^2}{df} = \frac{309.18}{183} = 1.689 \quad (2)$$

The model has a good fit since the root mean square error of approximation (RMSEA) is equal to 0.035. Other GoF indicators in the acceptable range are listed in Table 10.

Hypothesis 1: There is a significant relationship between the application of knowledge management and innovation factors, which was examined by Pearson correlation coefficient test (Table 9). A Pearson correlation coefficient of 0.624 indicates a significant relationship between the application of knowledge management and innovation factors. The positive calculated correlation coefficients ($p < 0.05$) show

a direct relationship between these two variables. In Table 11, the value of the standardized beta coefficient (0.345) between the variables of knowledge management application and innovation factors shows an acceptable correlation between these two variables (Table 12). This test is performed at 95% confidence level at an error level of 0.05, i.e. the error level is $\alpha = 5$.

The test statistic calculated by dividing the non-standardized beta coefficient by the standard error is 3.250, which is greater than the critical value of 1.96, indicating the significance of the observed beta coefficient. This is also confirmed by the smaller value of normal significance than the error level. Thus, knowledge management and innovation factors have a significant relationship at the 95% confidence level.

Hypothesis 2: There is a significant relationship between knowledge management application and deterrents. The result of Pearson correlation coefficient test is equal to 0.627 (Table 13), which indicates a significant relationship between knowledge management application and deterrents ($p < 0.05$). The calculated positive correlation coefficients indicate a direct relationship between these two variables. The value of the correlation (0.337) observed in the SPSS software output between the variables of knowledge management application and deterrents (Table 14) shows an acceptable correlation between these two variables.

The test statistic calculated by dividing the non-standardized beta coefficient by the standard error is 3.250, which is greater than the critical value of 1.96, indicating the significance of the observed beta coefficient. This is also confirmed by the smaller value of normal significance than the error level. Therefore, knowledge management application and innovation factors have a significant relationship at the 95% confidence level.

Hypothesis 3: There is a significant relationship between knowledge management application and facilitators, which was examined by Pearson correlation coefficient test with a value of 0.578 (Table 15), suggesting a significant relationship between knowledge management application and facilitators ($p < 0.05$). The calculated positive correlation coefficients indicate a

Table 10. GoFs for the CFA of knowledge management questionnaire.

GoF indicator	RMSEA	GFI	AGFI	NFI	NNFI	IFI
Acceptable values	<0.1	>0.9	>0.9	>0.9	>0.9	0 - 1
Calculated values	0.035	0.94	0.91	0.98	0.93	0.94

Table 11. Pearson correlation coefficient between knowledge management application and innovation factors.

Correlation statistic	Correlation coefficient	Sig.	N	Relationship	Type of relationship
Pearson	0.624	**0.000<	158	Yes	Direct

*Significant at 0.05 level; **Significant at 0.01 level.

Table 12. Knowledge management application and innovation factors.

Variable	Non-standardized beta coefficient	SE	Standardized beta coefficient	t	Normal Sig.
Knowledge management application and innovation factors	0.345	0.106	0.262	3.250	0.001

SE: Standard error.

Table 13. Pearson correlation coefficient between knowledge management application and deterrents.

Correlation statistic	Correlation coefficient	Sig.	N	Relationship	Type of relationship
Pearson	0.627	**0.000<	158	Yes	Direct

*Significant at 0.05 level; **Significant at 0.01 level.

Table 14. Knowledge management application and deterrents.

Variable	Non-standardized beta coefficient	SE	Standardized beta coefficient	t	Normal Sig.
Knowledge management application and deterrents	0.337	0.098	0.275	3.456	0.001

direct relationship between these two variables. On the other hand, this hypothesis examines the relationship between knowledge management application factors and facilitators. The value of the correlation (0.342) observed in the SPSS software output between the variables of knowledge management application and facilitators (Table 16) shows an acceptable correlation between these two variables. This test is performed at 95% confidence level at an error level of 0.05, i.e. the error level is $\alpha = 5$.

The test statistic calculated through dividing the non-standardized beta coefficient by the standard error is 3.250, which is greater than the critical value of 1.96, indicating the significance of the observed beta coefficient. This is also confirmed by the smaller value of normal significance than the error level. Therefore, knowledge management application and facilitators have a significant relationship at the 95% confidence level.

Results show that innovation management has the highest impact on innovation capacity in the context of COVID-19 in small businesses in the field of fisheries (t-value = 5.239). This means that innovation management has a significant impact on creating innovation capacity. Significantly, this is a confirmation of previous works (Zhu et al., 2020; Zhang et al., 2019; Sawaean and Ali, 2020; Khosravi et al., 2019). The results also showed that recognizing marketing advantages has a significant effect on innovation capacity among the comprehensive target and in critical epidemic conditions (t-value = 1.2). The significant impact of marketing advantages on innovation capacity is consistent with the findings of Broadstock et al. (2020). This means that the increase in innovation capacity among the firms surveyed during the epidemic is mainly influenced by their knowledge of the market environment and marketing advantages, so that finding this cognition leads to improving their innovation capacity. Therefore, it is required to mobilize information, test items, institutionalize them, and ultimately balance and coordinate selected innovations with sufficient knowledge and awareness of the marketing advantages of manufactured products in order to improve innovation capacity, especially during the COVID-19 pandemic, when the market is less interested in using livestock and aquatic products.

Table 5 shows the SEM findings on innovation capacity in the context of COVID-19 pandemic. The results showed that innovation management has the greatest impact on innovation capacity ($p> 0.000$; $\beta = 0.053$) and awareness and use of marketing advantages ($p>0.049$; $\beta = 0.209$) also has some effect on innovation capacity among respondents. However, we did not find any effect between government measures and innovation capacity ($p> 0.712$; $\beta = -0.047$) and hypotheses related to government measures' assistance in building innovation capacity among respondents were not confirmed. As well as, other variables in question include capital ($p> 0.926$; $\beta = 0.041$), strategies in crisis situations ($p> 0.367$; $\beta = 0.105$), and company innovation ($p> 0.322$; $\beta = 0.190$) had no effect on the innovation capacity of firms.

This model explains 32% of the variance of innovation capacity. Also, the results confirm the predictive relationship (Q2) of the innovation management structure (Q2 = 0.328). According to the classification of Singh et al. (2020) innovation management as an exogenous structure has great predictive power.

These results show that innovation management capabilities including process innovation, organizational innovation, learning innovation and small business communication innovation as well as knowledge and use of marketing advantages have a positive effect on different levels of innovation capacity and have strengthened it. In addition, government measures, crisis strategies, (social, cultural, human and organizational) capital are each significantly associated with the innovation capacity, which have a positive and significant impact on the level of innovation capacity apart from government measures. The negative effect of government measures in creating and strengthening the innovation capacity indicates the inability or inefficiency of crisis management in general government policies to deal with crisis situations. This result suggests that having a higher level of innovation management can change the innovation capacity and give them the power to use the level of business advantages more effectively.

Table 15. Pearson correlation coefficient between knowledge management application and facilitators.

Correlation statistic	Correlation coefficient	Sig.	N	Relationship	Type of relationship
Pearson	0.578	**0.000<	158	Yes	Direct

*Significant at 0.05 level; **Significant at 0.01 level.

Table 16. Knowledge management application and facilitators.

Variable	Non-standardized beta coefficient	SE	Standardized beta coefficient	t	Normal Sig.
Knowledge management application and facilitators	0.342	0.090	0.047	3.780	0.001

4. Conclusion

Theoretically, this research has a significant contribution in promoting innovation capacity in Iran as one of the developed and developing countries. Our research is beyond the existing literature, especially in the field of innovation by incorporating different structures from different theoretical contexts and by proposing new exploratory relationships in the discussion of critical situations. Accordingly, this study enriches the effort to use innovation management in crisis situations and reveals the main elements affecting innovation capacity in developed and developing countries. Hence, our research is one of the most important analyzes for modelling by integrating structures related to another business area and analyzing two areas (e.g., businesses processing agricultural products specifically with a focus on industry). The integration of these structures into the research background is unique to date. No such combination has been conducted in developed countries.

There are certain limitations to our study. First, this study was conducted in the context of the COVID-19 crisis, and future studies could provide a better understanding of the variations that the disease has brought to innovative business circumstances. Second, in the face of this crisis, one of the riskiest tasks is to engage in businesses that are related to animals (hypothetical causes of disease). Third, this study may be more varied than in the previous case for other industries and services and may not be generalizable to other groups in society. It is recommended that innovation capacity will be studied in other groups in future research. Fourth, the effects of demographic factors have not been considered in this study. Other researchers can gain a better understanding of the state of innovative capacity among small businesses in the fisheries or other areas of activity by addressing some demographic variables, i.e., age, gender, number of employees, geographic location of the business, managerial specialization.

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