

Investigating the Impact of Threat-Oriented Interpretation in Climate Changes on Innovation: the Mediator Role of Innovation Capacity in Focus

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Article Type:

Research Article

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Spring & Summer (2025) 2(1): 99-120

Received: 9 April 2025

Revised: 12 April 2025

Accepted: 17 April 2025

Available Online: 4 May 2025

ABSTRACT

One of the dire consequences of innovation is rapid reaction to developments and changes in the environment, and this depends on the managers' ability to reflect on the changes in the environment and various aspects of business. The aim of this study is to investigate the effect of threat-oriented interpretation in climate changes on innovation and its dimensions (behavioral innovation, product innovation, process innovation, market innovation, and strategic innovation). Statistical population of this research consists of executives who belong to chemical and petroleum industries listed on the stock exchange. The data was collected using questionnaires from 79 companies. Structured Equation Modeling (SEM) and Partial Least Squares (PLS) methods were employed to analyze the data. The results showed that the threat-oriented interpretation in climate change has no direct effect on innovation. However, it indirectly and negatively affects innovation. The innovation capacity generally mediates this relationship.

KEYWORDS

Climate Changes, Innovation and Innovation Capacity, Threat Oriented Interpretation.

Cite this article: Hafezniya, H., Feizi, A., & Feizi, O. (2025). Investigating the Impact of Threat-Oriented Interpretation in Climate Changes on Innovation: the Mediator Role of Innovation Capacity in Focus. *Journal of Knowledge Economy Studies (JKES)*, 2(1), 99-120.

DOI: <http://doi.org/10.22034/kes.2025.2057456.1056>

Publisher: Hazrat-e Masoumeh University

Introduction

Climate change presents one of the most significant environmental challenges that organizations face today, requiring innovative responses to ensure adaptation and sustainability. How managers interpret these environmental challenges—as either threats or opportunities—can significantly influence their strategic decisions and innovation outcomes (Cristofaro, 2020; Pitelis & Wagner, 2019). The cognitive processes through which managers interpret climate change challenges represent a critical dimension of their dynamic capabilities, with direct implications for organizational innovation and adaptation (Greve & Teh, 2022; Shepherd et al., 2019).

Research has established that threat-oriented interpretations of environmental changes can trigger specific cognitive and behavioral responses in managers. When perceiving threats, managers often experience heightened anxiety and psychological stress that can constrain their decision-making processes, leading them to rely on familiar information-seeking patterns rather than exploring innovative approaches (Ocasio et al., 2018). This cognitive constraint becomes particularly significant in the context of climate change, where novel perspectives and innovative solutions are essential. Recent studies by Talafidaryani and Asarian (2023) emphasize how managerial interpretations shape organizational responses to environmental disruptions across industries. Similarly, Hafezniya and Ansari (2024), in their systematic literature review, highlight that specific cognitive capabilities are crucial for effective decision-making in turbulent environmental contexts. These perspectives directly inform our study's examination of how managers' interpretations of climate change challenges influence their innovation capacity and innovation outcomes.

Despite these advances in understanding managerial cognition in environmental contexts, a critical gap remains in understanding how threat-oriented interpretations specifically mediate innovation outcomes through organizational capabilities—a gap our study addresses by examining the mediating role of innovation capacity.

Research indicates that, alongside factors like R&D intensity (Cui et al., 2018), organizational size, institutional capacity, and learning (Chege et al., 2020), absorptive capacity and combined capabilities (Yazdani et al., 2021), managers' cognitive processes are critical for innovation (Lee & Trimi, 2021). Managers' dynamic capabilities—identifying external challenges—enable organizational flexibility in building and reconfiguring capabilities (Schoemaker et al., 2018). These capabilities can be assessed at the managerial level (Akkaya & Tabak, 2020; Gölgeci et al., 2019). Perception and attention, as key cognitive traits, link to sensing opportunities and threats, with managerial interpretation shaping strategic change and innovation (Chang et al., 2021). Innovation capacity is essential for product, service, or process innovation (Yun et al., 2020) and drives creativity, entrepreneurship, and competition (Maier et al., 2020).

Climate change impacts businesses (Daddi et al., 2019), and the chemical industry must adhere to environmental regulations. It needs adaptive processes and innovative capabilities in products, processes, and strategies to thrive. This study explores how

managers' perceptions of climate change influence innovative behavior in the chemical industry, focusing on the mediating role of innovation capacity.

Literature Review

Theoretical Foundations of Research

Interpretation of Managers

Interpretation refers to those cognitive activities and processes through which managers translate environmental data and stimuli into meaningful information that guides strategic action (Cristofaro, 2020). In the context of climate change, managerial interpretation plays a crucial role in determining organizational responses to environmental challenges. This interpretation process is grounded in categorization theory (Osiyevskyy et al., 2020; Shepherd et al., 2019), wherein managers classify environmental developments—such as climate change impacts—to reduce inherent complexity and guide decision-making (Joseph & Gaba, 2020). Recent experimental studies have shown that managers typically interpret climate-related developments through the lens of threats or opportunities (Kłopotek, 2020; Greve & Teh, 2022). These interpretations represent senior executives' beliefs about the potential impacts of climate change on their organizations (Pitelis & Wagner, 2019) and significantly influence strategic responses, including innovation initiatives (Daddi et al., 2019; Ocasio et al., 2018).

Innovation

Innovation is conceptualized as the capacity to respond to changes in the external environment and to impact and shape it (Lee & Trimi, 2021; Schoemaker et al., 2018). Innovation can manifest in various forms, such as product innovation, process innovation, radical or incremental innovation, and administrative or technological innovation (Cui et al., 2018; Yazdani et al., 2021). Scholars suggest a range of innovative options such as the development of new products or services, development of new methods of production, identification of new markets, exploration of new supply sources, and development of new organizational dimensions (Daddi et al., 2019). Recent research focuses on multiple dimensions: new product or service innovation, production methods or services, key executives' risk-taking, and search for unusual and innovative solutions (Chege et al., 2020). Table 1 briefly presents various aspects of innovation emphasized in different research studies.

Table 1.

Different Innovation Dimensions in Past Research Studies (Wang & Ahmed, 2004)

Author	Product innovation	Innovation in the market	Innovation in Process	Behavioral Innovation	Strategic Innovation
Lee & Trimi (2021)	✓	✓	✓		✓
Akkaya & Tabak (2020)	✓		✓	✓	
Chege et al. (2020)	✓	✓			✓
Yazdani et al. (2021)	✓		✓		

Author	Product innovation	Innovation in the market	Innovation in Process	Behavioral Innovation	Strategic Innovation
Cui et al. (2018)	✓	✓			
Daddi et al. (2019)		✓	✓		
Maier et al. (2020)	✓			✓	✓
Chang et al. (2021)	✓	✓	✓		
Yun et al. (2020)	✓	✓	✓	✓	✓

(Source: Researcher's Findings)

In line with these perspectives, innovation is defined as "the innovative ability of organizations to introduce new products to market or explore new markets through combining strategic orientation with behavior and innovative processes". According to [Gölgeci et al. \(2019\)](#), innovation can be identified in five dimensions: behavioral innovation, product innovation, process innovation, market innovation, and strategic innovation.

Innovation Capacity

Innovation capacity is defined as the continuous improvement in organizational features and capabilities that enable a company to discover and take advantage of opportunities to develop new products meeting market needs ([Yun et al., 2020](#)). Three different approaches are provided by researchers for measuring organizational innovation capacity ([Maier et al., 2020](#)).

In the first approach, the number of patents serves as a benchmark to measure innovation output ([Piening & Salge, 2022](#)), though this is considered an inadequate indicator in evaluating innovative performance, as patents are not the only way to protect knowledge and technology, and many firms are reluctant to patent ([Prajogo, 2020](#)).

In the second approach, researchers use resources allocated to innovation as the basis for measurement ([Nylund et al., 2019](#)). These resources include human resources (number of researchers and designers working on innovation projects), financial resources (funds dedicated to investments in new products and R&D), and physical assets (laboratory equipment and computer design systems) ([Kahn et al., 2022](#)).

Finally, the third approach examines innovation ability in physical facilities, skills, knowledge, and both tangible and intangible assets available to organizations in processes related to innovation and innovation management. This approach focuses on the process itself ([Iddris, 2019](#)). Moreover, the integration of Industry 4.0 technologies, such as IoT and big data analytics, can enhance innovation capacity by enabling sustainable processes and efficient resource utilization ([Zarei & Naderi, 2024](#)).

Development of Research Hypotheses and Conceptual Model

Interpretation of Managers and Innovation

Research in the management cognitive field argues that the manager's interpretation of situations or specific requirements significantly impacts the actions taken and is associated with changes in environmental strategies ([Hahn et al., 2014](#)). Negative assessment of issues can lead to psychological stress and anxiety among managers,

affecting their decision-making capabilities (Chengyuan et al., 2016). The effects of negative evaluations on decision-making processes are well documented, indicating that when decision-makers encounter problems they perceive as threatening, they tend to seek less information or only information that is familiar (Mitchell et al., 2021). Under these conditions, senior managers are likely to rely on traditional search mechanisms established within their current organizational structures. Consequently, new and innovative information fails to emerge, as the interpretative frameworks of managers do not align with these innovations (Chengyuan et al., 2016). Henny Brophy, in evaluating the impacts of managers' interpretations of environmental changes on innovation in products and services concluded that as a manager's interpretation of environmental changes becomes threat-based, innovative responses significantly decrease (Wen & Zhu, 2019). Similarly, research has highlighted that a threat-based interpretation regarding environmental changes adversely affects innovation in both product and process dimensions (Todd et al., 2016). Additionally, investigations conducted by Vos et al. indicated that negative evaluations of events have a detrimental impact on the innovative behavior of companies (Liu et al., 2019). Thus, it can be posited that the managers' threat-based interpretations regarding environmental changes negatively impact innovation across multiple dimensions, including behavioral innovation, product innovation, process innovation, market innovation, and strategic innovation (Hahn et al., 2014).

Interpretation of Managers and Innovation Capacity

The capacity for innovation is defined as the continuous improvement of an organization's capabilities to create opportunities for product innovation and manufacturing processes. The foundational work by Lawrence and Lorsch (1967) on organizational responses to the environment, along with the opportunity framework introduced by Learned et al. (1965), spurred research on organizational capabilities and cognitive management features (Grewatsch & Kleindienst, 2018). The resource-based view addresses varying performance outcomes among organizations within the same environment, highlighting that differences arise from the varying capabilities in leveraging similar resources, irrespective of managers' interpretations of their activities' results (Khosravi et al., 2023; Santoso et al., 2022). Conversely, cognitive management scholars argue that managers' interpretations of their environments substantially influence the quality of organizational responses (Dabić et al., 2020; Martins et al., 2015). In this context, Eggers and Kaplan (2009) reconcile these perspectives by illustrating that a misalignment between capabilities and market conditions occurs when managers' beliefs about opportunities diverge from reality (Kurniati et al., 2019). Furthermore, capabilities related to resource allocation have significant implications for innovation capacity (Helfat & Peteraf, 2014). Kaplan and Henderson (2005) assert that these capabilities stem from the concepts and interpretations managers hold regarding their operational processes (Riana et al., 2023). Danneels (2011) highlights that managerial interpretations shape the nature and efficacy of procedures and capabilities over time (Pryor et al., 2015). Managers often resort to traditional search mechanisms when interpreting events as threats, which can inhibit the

pursuit of complex and nuanced information (Li et al., 2018). Consequently, threat-based interpretations can impede the effective utilization of organizational capabilities, particularly affecting innovation capacity (Bingham & Haleblan, 2012).

The Impact of Innovation Capacity on Innovation

Innovation relies on an infrastructure that can be broadly divided into two categories: potential and actual. The potential dimension, known as "innovation capacity," reflects on an organization's latent ability to innovate, while the actual dimension, termed "innovation capability," represents its realized outcomes (Morais et al., 2022). Li and Xing (2017) define innovation capacity as a firm's potential to undertake innovation activities, such as developing new products, services, processes, and ideas. This capacity hinges on an organization's inherent resources and capabilities, which are critical drivers of innovation (Dias et al., 2021). Piening and Salge (2015) argue that these capabilities are a key competitive advantage in dynamic industries, encompassing efforts like advancing internal and external research, acquiring external knowledge, and enhancing staff training—factors that bolster innovation in manufacturing processes (Sugar, 2024). Similarly, Senoubar et al. (2011) highlight that innovation stimulants, including knowledge management, innovation management, and IT management, significantly strengthen innovation capacity (Tang et al., 2020). Prajogo (2016) further posits that innovation capacity serves as a mediator, transforming these stimulants into tangible outcomes like product and process innovations (Shang & Hai-bing, 2024). In a similar vein, Asarian et al. (2025) demonstrate that strategic flexibility and proactive IT strategies enhance business performance, suggesting that such IT practices can amplify innovation capacity in dynamic environments.

Conceptual Model Research

Finally, in connection with what has been discussed in the previous section, the following research hypotheses were proposed. Conceptual model of research is shown in Figure 1.

First hypothesis (H1): The threat-based interpretation of managers from climate changes has a negative and significant effect on innovation.

This main hypothesis is further broken down into the following sub-hypotheses addressing each dimension of innovation:

H1-1: The threat-based interpretation of managers from climate changes has a negative and significant effect on behavioral innovation.

H1-2: The threat-based interpretation of managers from climate changes has a negative and significant effect on product innovation.

H1-3: The threat-based interpretation of managers from climate changes has a negative and significant effect on process innovation.

H1-4: The threat-based interpretation of managers from climate changes has a negative and significant effect on market innovation.

H1-5: The threat-based interpretation of managers from climate changes has a negative and significant effect on strategic innovation.

The second hypothesis: threat-based interpretation of managers from climate changes has a significant negative impact on innovation capacity.

Third hypothesis (H3): Innovation capacity has a positive and significant effect on innovation.

This main hypothesis is further broken down into the following sub-hypotheses addressing each dimension of innovation:

H3-1: Innovation capacity has a positive and significant effect on behavioral innovation.

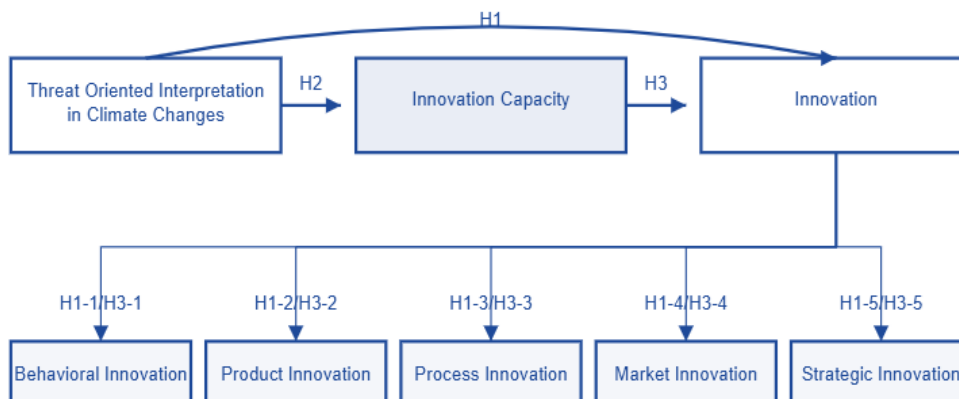
H3-2: Innovation capacity has a positive and significant effect on product innovation.

H3-3: Innovation capacity has a positive and significant effect on process innovation.

H3-4: Innovation capacity has a positive and significant effect on market innovation.

H3-5: Innovation capacity has a positive and significant effect on strategic innovation.

Figure 1.
Conceptual Model of Research



(Source: Researcher's Findings)

Methodology

Sample Selection and Access

This study employs an applied research approach, as it examines relationships between variables that can provide practical insights for organizational decision-makers. Our research design follows a descriptive-survey methodology, employing inferential statistical methods and structural equation modeling to test our hypotheses.

The research population consisted of companies in the chemical and petrochemical industries listed on the Tehran Stock Exchange. Based on official information from the Tehran Stock Exchange website, this population comprised 110 companies. Given that our research variables are quantitative and multi-valued with an ordinal scale, and the population size is limited, we calculated a sample size of 86 companies using the Cochran formula. This sampling approach ensured adequate statistical power while maintaining representativeness of the target population.

Data Collection Process

We collected data through questionnaires distributed to senior executives at the selected companies. The questionnaires were structured using a five-point Likert scale (1=complete disagreement to 5=complete agreement) for all measurement items. After distribution and follow-up, we received 79 completed questionnaires (representing a 91.9% response rate) that were used in the analysis stage. These respondents were senior managers with decision-making authority in their respective organizations, making them appropriate informants for assessing the variables under study.

The respondents in our study primarily held senior executive positions including CEOs (23%), operations directors (31%), and sustainability managers (46%). The mean industry experience of respondents was 12.7 years (SD = 4.3), with an average of 6.5 years (SD = 2.8) in their current role. All participants had direct involvement in strategic decision-making related to environmental initiatives and innovation processes within their organizations, making them appropriate informants for our research questions.

Questionnaire Validity and Reliability

We employed a rigorous process to ensure the validity and reliability of our measurement instrument. As detailed in our results section, we assessed construct validity through confirmatory factor analysis using SmartPLS software. As shown in Table 2, all measurement items except one (the fourth index of strategic innovation) achieved factor loadings above the recommended threshold of 0.4 (Hulland, 1999), leading us to remove that item from further analysis.

For reliability assessment, we utilized Cronbach's alpha coefficient. We initially distributed 30 questionnaires as a pretest and analyzed the resulting data to calculate alpha coefficients for each variable. As reported in the manuscript, all constructs demonstrated alpha values exceeding 0.7, confirming high reliability. In addition to Cronbach's alpha, we employed composite reliability as a complementary measure, which accounts for the relationship between constructs and their relative importance, rather than treating them as absolute values.

Data Analysis Techniques

Our data analysis employed structural equation modeling (SEM) with partial least squares (PLS) using SmartPLS software. The PLS-SEM approach was selected for its suitability for predictive research models and effectiveness with our sample size. Our analysis followed a systematic two-stage approach:

1. Assessment of the measurement model:
 - Evaluation of factorial loads (Table 2)
 - Analysis of reliability using Cronbach's alpha and composite reliability (Table 3)
 - Assessment of convergent validity using Average Variance Extracted (AVE) (Table 3)
 - Examination of discriminant validity using Fornell and Larcker criteria (Table 4)
2. Evaluation of the structural model:

- Analysis of path coefficients and t-statistics for hypothesis testing (Tables 6 and 7)
- Calculation of the coefficient of determination (R^2), with values categorized as weak (0.19), medium (0.33), or strong (0.67) following [Chin \(1998\)](#)
- Assessment of prediction power using the Q^2 coefficient, with values categorized as weak (0.02), medium (0.15), or strong (0.35) as suggested by [Geisser \(1975\)](#)
- Overall model fit evaluation using goodness-of-fit criteria, with our value of 0.468 exceeding the threshold for strong fit (0.36) as proposed by [Wetzels et al. \(2009\)](#)

This comprehensive analytical approach enabled us to rigorously test our hypotheses and evaluate the proposed relationships between threat-oriented interpretation, innovation capacity, and various dimensions of innovation.

Findings

In the data analysis, structural equation modeling with partial least squares method approach and SmartPLS software to evaluate research conceptual model were used. Following the findings of the study is investigated.

The Measurement Mode Assessment

Assessment of Factorial Loads of Measures

Factorial loads were calculated by calculating the correlation value of a structure indexes with that structure. Equal factorial loads or more than 0.4 indicates that variance between structure and its indexes is more than measurement error variance of that structure, and observable variable is reliable scale for hidden variable calculation ([hulland, 1999](#)). Obtained factorial loads from components of the model (shown in table 2) indicates that all measures except the fourth index of strategic innovation is more than 0.4, so this index is deleted for the rest of analysis.

Table 2.
Factorial Load Coefficient

Variable	Row	Questions	Load factor
Behavioral Innovation (BIN)	1	We encourage people to think and behave in the new and novel ways.	553.0
	2	We compromise in participate with people who do things in a different way.	902.0
	3	We tend to try new ways of doing things and are looking for unusual and innovative solutions.	772.0
	4	We receive many support from the company to testing new new methods of doing things.	875.0
Innovation (PIN)	1	Our company compared to competitors, highly innovative products has introduced during the past 5 years.	842.0
	2	Our company to introduce new products and services to the market, is often the first.	788.0
	3	Our new products and services, is often perceived as innovative products and services by customers.	876.0
	4	Our company compared to competitors has a low success rate in delivering new products and services.	404.0
Innovation in process (PRIN)	1	We constantly improve upon their business processes.	804.0
	2	During the past five years, our company has developed new approaches to management.	597.0

Variable	Row	Questions	Load factor
	3	When we are unable to solve problems we devise new methods using traditional methods.	784.0
	4	Our company changes production of goods and services with great speed compared to competitors.	861.0
Innovation in the market (MIN)	1	A recent marketing program of our products compared to competitors in the market are very different.	850.0
	2	Our new products and services has minor changes compared to existing products and services on the market.	694.0
	3	Our company to introduce new products and services has often distinctive features in technology.	651.0
	4	New products and services of company, puts us in front of new competitors.	798.0
Strategic Innovation (SIN)	1	Our R & D department is responsible for the development of new products and services.	857.0
	2	Our company's key executives are willing to take risks to explore growth opportunities.	897.0
	3	Senior managers constantly are looking for unusual and innovative ways to solve problems.	723.0
	4	When we see the new ways doing things we adopt ourselves strictly with those methods.	288.0
Interpretation of managers from climate changes (MI)	1	Climate changes are negative consequences on our company's activities.	942.0
	2	Climate changes will lead to the loss of our company.	927.0
	3	Climate changes is causing the loss of new investment opportunities.	792.0
Knowledge Management (KNM)	1	The organization uses a variety of tools for acquiring knowledge.	955.0
	2	Members' knowledge of the organization is exchanged and transfer between each other.	856.0
	3	Organization in the creation and production of knowledge as well as is able to stabilize and protect it in organization.	947.0
	4	Organization assesses state of knowledge and their knowledge assets.	854.0
Creative Management (CM)	1	Organization collects the new ideas of suppliers systematically.	797.0
	2	Organization collects the new ideas of suppliers systematically.	927.0
	3	Organization collects the new ideas of suppliers systematically.	892.0
	4	Organization uses of the comments of suppliers and consumers during the designing process of new products.	868.0
Information Technology Management (ITM)	1	Organization uses the information technology (the market analysis tools) for the detection of market conditions.	873.0
	2	Organization uses information technology to create new processes and methods.	763.0
	3	Organization uses information technology to identify customers' needs.	953.0
	4	Organization uses the information technology to meet customer needs and servicing.	916.0
Human Resource Management (HRM)	1	Organization pays attention to develop and promote and product innovation in educational programs.	902.0
	2	Organization pays attention to ability to create ideas during recruiting.	772.0
	3	The organization pays attention to staff's commitment to product innovations in the design of incentive systems.	875.0
	4	The organization uses human resources specialized in the design of new products.	842.0
Communications (COM)	1	Senior managers use the systems, control methods and project Management.	788.0
	2	Technological, methodological and economic changes is tracking and following in the Organization.	876.0
	3	Organization cooperates with other firms to create participating networks.	404.0
	4	Organization allocates the necessary funds to design new products.	804.0

(Source: Researcher's Findings)

It should be noted that the reverse questions the value were gotten in calculating of their reversed value (for example, if answer of managers was 5, has been entered in the accounts 1, etc.)

Combining Reliability and Convergent Validity

Besides Cronbach's alpha, another criterion known as combining reliability offers distinct advantages to this method. The primary benefit of combining reliability over alpha is that it assesses the reliability of structures not only in an absolute sense but also by considering the interrelatedness of the structures themselves (Zhang & Duan, 2010). Convergent validity is another standard procedure for fitting the measurement models in structural equation modeling method. Fornell and Larcker (1981) suggested using from extracted variance average as a criterion for convergent validity and believed that convergent validity is established when the value of the extracted variance average for each construct is bigger than 0.5 (Davari & Rezazadeh, 2014). According to data from Table 3, the combining reliability of all research variables is higher than 0.7 and their extracted variance average all the variables of 7/0 is larger than 0.5. So the structures have sufficient reliability.

Table 3.
Report of Alpha Criteria, Combining Reliability and Convergent Validity

Latent variables	Title in model	(Alpha≥0.7)	(CR≥0.7)	(AVE≥0.5)
Behavioral Innovation	BIN	0.816	0.864	0.621
Product innovation	PIN	0.822	0.830	0.565
Innovation in Process	PRIN	0.850	0.864	0.589
Innovation in the market	MIN	0.839	0.838	0.566
Strategic Innovation	SIN	0.802	0.867	0.687
Interpretation managers	MI	0.865	0.919	0.792
knowledge management	KNM	0.925	0.947	0.818
Creative Management	CM	0.894	0.927	0.671
IT management	ITM	0.899	0.931	0.772
Human resources management	HRM	0.851	0.899	0.692
Process management and communication	COM	0.850	0.846	0.586

(Source: Researcher's Findings)

Divergent Validity

The criteria established by Fornell and Larcker are employed to evaluate the validity of the measurement model. According to this framework, the correlation of a construct with its respective indicators must exceed the correlation of that construct with other constructs. As indicated by the results presented in Table 4, the average squared value of the extracted variance for all constructs is greater than their correlation with other constructs in the model. Therefore, this study demonstrates that all constructs (latent variables) exhibit a stronger relationship with their own indicators than with other constructs, thereby establishing that the divergent validity of the model is satisfactory.

Table 4.
Correlation between Latent Variables and Values of AVE

Components	1	2	3	4	5	6	7	8	9	10	11
1. MI	0.89										
2. BIN	0.61	0.78									
3. PIN	0.27	0.12	0.75								
4. PRIN	-0.2	0.29	0.40	0.76							
5. MIN	0.46	0.71	0.27	0.44	0.75						
6. SIN	0.14	0.06	0.61	0.26	0.29	0.82					
7. KNM	0.29	0.31	0.75	0.58	0.44	0.58	0.90				
8. CM	0.48	0.59	0.75	0.56	0.51	0.37	0.74	0.87			
9. ITM	0.67	0.58	0.59	0.25	0.47	0.24	0.78	0.79	0.88		
10. HRM	0.55	0.52	0.66	0.39	0.54	0.69	0.82	0.74	0.74	0.83	
11. COM	0.66	0.74	0.48	0.40	0.75	0.41	0.70	0.76	0.73	0.68	0.76

(Source: Researcher's Findings)

The Structural Model assessment

Following the evaluation of the validity and reliability of the measurement, the structural model was assessed through the relationships among latent variables using three significant criteria: the t-value, the coefficient of determination (R²), and the prediction power factor (Q²).

The Coefficient of Determination and Prediction Power Coefficient

In order to evaluate the structural model through the criteria of the coefficient of determination as delineated by Chin (1998), values of 0.19, 0.33, and 0.67 have been established as benchmarks for weak, medium, and strong correlations, respectively. The results presented in Table 5 indicate that the latent variables exhibit a high level of correlation, implying a robust relationship among them. To assess the model's predictive capabilities, the predictive power coefficient, as introduced by Geisser (1975), was utilized. For endogenous structures demonstrating strong predictive power, the thresholds of 0.02, 0.15, and 0.35 were identified as indicators of weak, medium, and strong predictive values, respectively. The findings suggest that the model possesses a high degree of predictability.

Table 5.
Results of the Structural Fitting Model

Criterion	Innovation					Innovation capacity				
	BIN	PIN	PRIN	MIN	SIN	KNM	CM	ITM	HRM	COM
Coefficient of determination (R ²)										
Power prediction Coefficient (Q ²)	0.49	0.63	0.70	0.41	0.35	0.82	0.81	0.81	0.83	0.76
Criterion	0.29	0.35	0.40	0.22	0.16	0.67	0.61	0.61	0.55	0.42

(Source: Researcher's Findings)

Hypotheses tests

After evaluating of measurement fitting model and the structural model and fitting proper models, research hypotheses was studied and examined. Moreover, the results of

meaningful coefficients for each of the hypotheses, the standard coefficients of related routes for each of the hypotheses in Tables (6) and (7) are provided.

Table 6.
Path Coefficients and Significant Values for Direct Effects

Hypotheses	Direction	Path coefficient	T statistic	Results
H ₁	Threat oriented Interpretation →innovation	-0.184	-1.128	Hypothesis rejection
H ₁₋₁	Threat oriented Interpretation →behaviorial innovation	-0.470	-6.381	Confirmation of hypotheses
H ₁₋₂	Threat oriented Interpretation → innovation in product	-0.279	-3.056	Confirmation of hypotheses
H ₁₋₃	Threat oriented Interpretation → innovation in process	-0.789	-11.10	Confirmation of hypotheses
H ₁₋₄	Threat oriented Interpretation → innovation in market	-0.281	-3.012	Confirmation of hypotheses
H ₁₋₅	Threat oriented Interpretation → Strategic innovation	-0.247	-1.878	Hypothesis rejection
H ₂	Threat oriented Interpretation → innovation capacity	-0.582	-6.616	Confirmation of hypotheses
H ₃	innovation capacity→innovation	0.964	10.675	Confirmation of hypotheses
H ₃₋₁	innovation capacity→ behaviorial innovation	0.314	3.864	Confirmation of hypotheses
H ₃₋₂	innovation capacity→ innovation in product	0.914	13.02	Confirmation of hypotheses
H ₃₋₃	innovation capacity→ innovation in process	0.965	9.068	Confirmation of hypotheses
H ₃₋₄	innovation capacity→ innovation in market	0.438	4.944	Confirmation of hypotheses
H ₃₋₅	innovation capacity→ Strategic innovation	0.697	8.338	Confirmation of hypotheses

(Source: Researcher's Findings)

Table 7.
Path coefficients and significant values for direct effects

Direction	Path coefficient	T statistic	Results
Threat oriented Interpretation→ Innovation capacity→ Innovation	-0.560	-5.103	Confirmation of hypotheses
Threat oriented Interpretation→ Innovation capacity→ behaviorial Innovation	-0.177	-2.657	Confirmation of hypotheses
Threat oriented Interpretation→ Innovation capacity→ Innovation in product	-0.515	-4.640	Confirmation of hypotheses
Threat oriented Interpretation→ Innovation capacity→ Innovation in process	-0.544	-3.625	Confirmation of hypotheses
Threat oriented Interpretation→ Innovation capacity→ Innovation in market	-0.248	-2.920	Confirmation of hypotheses
Threat oriented Interpretation→ Innovation capacity→ Strategic Innovation	-0.515	-3.847	Confirmation of hypotheses

(Source: Researcher's Findings)

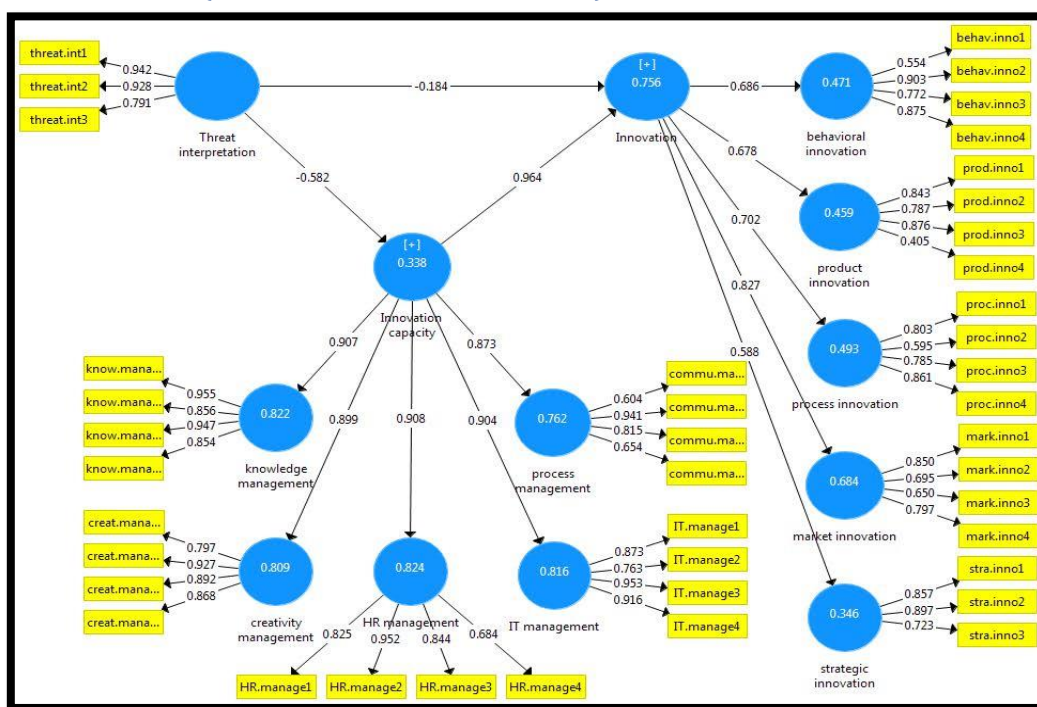
The results provide clear evidence regarding each of our hypotheses. For our first main hypothesis (H1), the path coefficient (-0.184) and t-statistic (-1.128) indicate that threat-oriented interpretation does not have a significant direct effect on overall innovation, leading to the rejection of H1. However, when examining the sub-hypotheses, we found significant negative effects on behavioral innovation (H1-1: path coefficient = -0.470, t = -6.381), product innovation (H1-2: path coefficient = -0.279, t = -3.056), process innovation (H1-3: path coefficient = -0.789, t = -11.10), and market innovation (H1-4: path coefficient = -0.281, t = -3.012). The effect on strategic innovation was not significant (H1-5: path coefficient = -0.247, t = -1.878), leading to the rejection of this sub-hypothesis.

For the second hypothesis (H2), our results strongly support that threat-oriented interpretation negatively affects innovation capacity (path coefficient = -0.582, t = -6.616).

For the third hypothesis (H3), we found strong support for the positive effect of innovation capacity on overall innovation (path coefficient = 0.964, t = 10.675). Each sub-hypothesis was also supported, with innovation capacity positively influencing behavioral innovation (H3-1: path coefficient = 0.314, t = 3.864), product innovation (H3-2: path coefficient = 0.914, t = 13.02), process innovation (H3-3: path coefficient = 0.965, t = 9.068), market innovation (H3-4: path coefficient = 0.438, t = 4.944), and strategic innovation (H3-5: path coefficient = 0.697, t = 8.338).

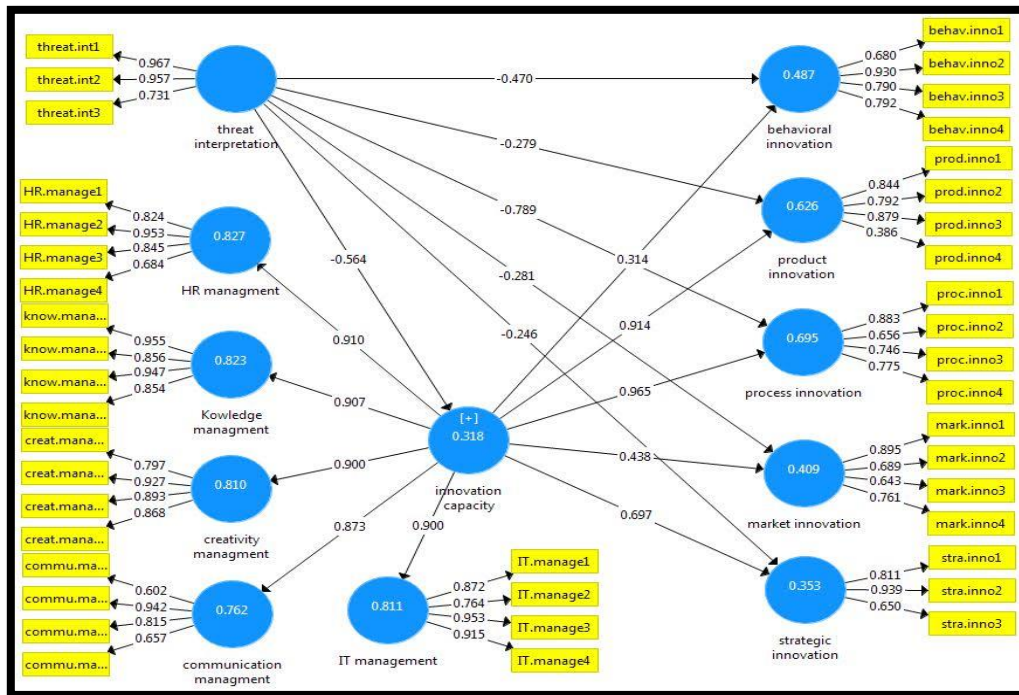
Furthermore, our mediation analysis (Table 7) confirms that innovation capacity mediates the relationship between threat-oriented interpretation and innovation dimensions, with significant indirect effects across all innovation components. Figure (2) and (3) are provided.

Figure 2.
Tested Model of Research (Path Coefficients and Factorial Loads)



(Source: Researcher's Findings)

Figure 3.
Tested Model of Research (Path Coefficient and Factorial Loads of Secondary Hypotheses)



(Source: Researcher's Findings)

The Overall Fit of the Model

Fitting goodness criteria is relegated to overall sector of structural equation modeling. This criterion allows for the regulation of the overall fitting sector subsequent to the measurement and structural fitting components. Wetzels et al (2009) have introduced three values 0.01, 0.25 and 0.36 values as weak, medium and strong values to this criteria (Wetzels et al., 2009). Considering that the mentioned value is 0.468, so overall fitting of model is confirmed as "strong".

Conclusion and Discussion

Discussion

This study examined the relationship between managers' threat-oriented interpretation of climate changes, innovation capacity, and innovation dimensions in chemical and petroleum industries. The findings reveal several important implications.

Our results show that threat-oriented interpretation of climate changes does not have a direct negative effect on overall innovation, contradicting the threat rigidity theory (Staw et al., 1981) and aligning with prospect theory (Kahneman & Tversky, 1979). However, our detailed analysis revealed that threat-oriented interpretation negatively affects behavioral innovation, product innovation, process innovation, and market innovation, while strategic innovation remains unaffected. This suggests that the relationship between threat perception and innovation is more complex than previously thought.

The confirmed negative relationship between threat-oriented interpretation and innovation capacity indicates that when managers view climate changes as threats, they tend to rely on traditional information search mechanisms rather than seeking novel information (Staw et al., 1981). This limits the organization's ability to effectively utilize its innovation capacity, supporting previous work by Eggers and Kaplan (2013) and Danneels (2011).

Our most significant finding is the mediating role of innovation capacity in the relationship between threat-oriented interpretation and innovation. This mediation effect reveals that managers' negative interpretations of climate changes impair innovation capacity, which in turn reduces innovative capabilities. This connects cognitive managerial processes to organizational outcomes through organizational capabilities.

For practitioners, these findings highlight the importance of developing cognitive capabilities that help overcome negative bias in interpreting environmental changes. Organizations may benefit from training programs that enhance managers' ability to see opportunities within threats, particularly regarding climate change.

Practical and Managerial Implications

Our findings offer important practical implications for organizations in industries affected by climate change. First, organizations should develop training programs to help managers recognize and overcome cognitive biases in environmental interpretation. These programs could include scenario planning exercises that challenge threat-based assumptions and encourage exploration of opportunities within environmental constraints.

Second, organizations should focus on strengthening innovation capacity components—knowledge management, innovation processes, IT capabilities, and cross-functional communication—as these can buffer against negative interpretations of climate change. Even when facing environmental threats, robust innovation capacity can maintain innovation momentum.

Third, companies should implement structured information-gathering systems that deliberately introduce diverse environmental perspectives, counteracting the tendency of managers under threat to seek only confirmed information. This could include establishing regular environmental scanning processes that consider both risks and opportunities.

By implementing these recommendations, organizations can create conditions that support innovation even when facing environmental challenges perceived as threatening, maintaining innovative momentum despite environmental pressures.

Conclusion

This study investigated the role of managers' cognitive variables in forming innovative acts, specifically examining how threat-based interpretation of climate changes affects innovation through innovation capacity. While previous research established that

interpretation processes shape organizational responses (Ginsberg & Venkatraman, 1995), the mediating role of innovation capacity remained unexplored.

Our results show that threat-based interpretation does not directly affect overall innovation (t: -1.128), contradicting threat rigidity theory (Staw et al., 1981) but aligning with prospect theory (Kahneman & Tversky, 1979). However, detailed analysis revealed that threat-based interpretation negatively impacts behavioral innovation (t: -6.381), product innovation (t: -3.056), process innovation (t: -11.10), and market innovation (t: -3.012), while its effect on strategic innovation was not significant (t: -1.878).

Furthermore, threat-based interpretation negatively affects innovation capacity (t: -6.616), as managers facing threats rely on traditional information search mechanisms, limiting their ability to process new information (Staw et al., 1981). Innovation capacity positively influences all innovation dimensions (t: 10.675), consistent with findings from Senoubar et al. (2011) and Prajogo (2016).

Importantly, our study confirms the indirect negative effect of threat-based interpretation on innovation through innovation capacity (t: -5.103). This novel finding suggests that when managers interpret climate changes as threats, they restrict their organization's innovation capacity, which subsequently impairs innovation performance.

To overcome these challenges, organizations should enhance managers' decision-making skills and establish supportive decision-making structures. Future research should examine organizational factors such as information processing structure (Thomas & McDaniel, 1990), perceived control (Denison et al., 1996), and organizational climate (Hornsby et al., 2002) that influence managers' cognitive processes and entrepreneurial actions.

Limitations and Future Research Direction

This study has several limitations that provide opportunities for future research:

1. Cross-sectional Design: Our research employed a cross-sectional data collection approach, which limits our ability to establish definitive causal relationships between the variables.

Future Research: Longitudinal studies tracking how managers' interpretations of climate change evolve over time and their long-term effects on innovation capacity and outcomes would provide stronger causal evidence.

2. Industry Specificity: Our sample was drawn specifically from chemical and petroleum industries in the Iranian stock market, which may limit generalizability to other industries or contexts.

Future Research: Comparative studies across multiple industries and different national contexts would help establish the boundary conditions of our findings and enhance external validity.

3. Cognitive Biases: Our findings suggest that managers experiencing anxiety and psychological pressure from negative interpretations tend to gather information that only confirms their existing beliefs, falling into a confirmation bias trap.

Future Research: Studies incorporating experimental designs to investigate specific cognitive biases in environmental interpretation would deepen understanding of these psychological mechanisms.

4. Organizational Factors: This study focused primarily on managerial interpretations without extensively examining organizational moderators.

Future Research: Researchers should incorporate organizational factors such as information processing structure (Thomas & McDaniel, 1990), perceived control (Denison et al., 1996), and organizational climate (Hornsby et al., 2002) that might influence the relationship between managerial interpretation and innovation.

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