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THE INFLUENCE OF CRISIS MANAGEMENT, RISK- TAKING, AND INNOVATION IN SUSTAINABILITY PRACTICES: EMPIRICAL EVIDENCE FROM IRAQ

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ABSTRACT

Aim/Purpose	This study examines the impact of decision-making, crisis management, and decision-making on sustainability through the mediation of open innovation in the energy sector.
Background	Public companies study high-performance practices, requiring overcoming basic obstacles such as financial crises that prevent the adoption and development of sustainability programs.
Methodology	Due to the COVID-19 pandemic, which has led to the closure of businesses in Iraq, a survey was distributed. To facilitate responses, free consultations were offered to help complete the questionnaire quickly. Of the 435 questionnaires answered, 397 were used for further analysis.
Contribution	The impact of crises that impede the energy sector from adopting sustainable environmental regulations is investigated in this study. Its identification of specific constraints to open innovation leads to the effectiveness of adopting environmentally friendly policies and reaching high levels of sustainable performance.
Findings	The impacts of risk-taking, crisis management, and decision-making on sustainability have been explored. Results show that open innovation fully

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	mediates the relationship between the factors of risk-taking, crisis management, decision-making, and sustainability.
Recommendations for Practitioners	The proposed model can be used by practitioners to develop and improve sustainable innovation practices and achieve superior performance.
Recommendations for Researchers	Researchers are recommended to conduct in-depth studies of the phenomenon based on theoretical and empirical foundations, especially in light of the relationship between crisis management, decision-making, and risk-taking and their impact on sustainability based on linear and non-compensatory relationships.
Impact on Society	This study provides a reference for organizations with similar cultural backgrounds in adopting sustainable practices to minimize pollution in the Iraqi context.
Future Research	A more in-depth study can be performed using a larger sample, which not only includes the energy industry but also other industries.
Keywords	crisis management, innovation, decision-making environment, sustainable performance

INTRODUCTION

Today's economies have critical characteristics, including continual change and quick technical progress of global competition (Hansen & Coenen, 2017). This quickly changing environment has introduced challenges for businesses to continuously adjust to external opportunities and dangers (Andrić et al., 2019). Open innovation refers to any innovation processes that rely on cooperation and sharing. Thus, the concept of open innovation indicates that the research and development (R&D) process is no longer closed to itself but rather open to the external environment. Open innovation is crucial to an organization's prosperity, ensuring its long-term survival and global competitiveness (Edgeman et al., 2015). Open innovation in businesses is contingent upon the human, financial, and natural resources they possess because of their involvement in producing value for the organization through the generation of new and beneficial ideas (Almeida et al., 2021). The capacity to generate new ideas also acts as a resilience element, enhancing the capacity of working individuals to deal with the demands of tasks and job duties (Bengtsson et al., 2015). Owing to the threat and fear of losing vital resources, the work environment in Iraq's energy sector generates conflict and resistance to the development of unique and innovative ideas in the electricity field (Karachiwalla & Pinkow, 2021). The corporate environment in this context is one of those situations in which opposition to open innovation and sustainability engenders new ideas (Zanjirchi et al., 2019).

The literature on innovation includes three perspectives. The first is concerned with an invention's final energy output. Specifically, manufacturing processes, manufacturing tools, electrical transmission and distribution, technology, and crisis management all evolve (Del Vecchio et al., 2018). The second perspective is based on the resource-based view (RBV) theory and physical capital resources such as financial resources, plants, equipment, human capital, capability, intellect, structure, culture, and strategy (Yun et al., 2020). The third perspective investigates open innovation at the company level (Stanislowski, 2020). The public companies in the Ministry of Electricity are considered essential to stability and continued economic growth. Thus, the sustainable growth and performance of these public companies require adequate resources (Zanjirchi et al., 2019). Corporate sustainability improves the ability of companies to enhance financial performance (Edgeman et al., 2015), but one of the main reasons for poor financial performance is the lack of sustainability activities (Alshehhi et al., 2018; Annunziata et al., 2018). A recent study indicates that more than 50% of newly established companies have collapsed due to limited skills and a lack of resources, efficiencies, sustainability, and

innovation activities (Anwar & Ali Shah, 2020). Corporate growth in emerging markets and developing countries is considerably hindered by limited corporate sustainability. Companies have also struggled to overcome many constraints that impede growth, survival, and sustainability (Almeida et al., 2021). Such constraints include risk-taking and decision-making, which may increase the financial performance of public companies in the Ministry of Electricity (Anwar & Ali Shah, 2020). The Ministry confirmed in its 2020 report that public companies cannot perform according to expectations due to limitations related to open innovation and government actions (Azar & Ciabuschi, 2017). One of the most important longstanding issues that have led to the decline in the overall financial performance of companies is the weakness of embracing open innovation (Minutolo et al., 2019). As indicated by a series of studies (Nadhum & Erzajj, 2020; Rashid et al., 2012), the most important issues that affect the performance of companies in Iraq include the lack of crisis management programs, lack of knowledge of the crisis, poor decision-making, excessive risk-taking, and failure to adopt open innovation. Many recent studies have dealt with the issues of low production, increased demand for energy, and low quality, as well as the performance, sustainability, and innovation of public companies in the Ministry of Electricity. Owing to the war and the economic blockade, the entry of coalition forces into Iraq from 2003 to 2014 led to the collapse of the infrastructure of most companies and electrical stations, especially these public companies (Al-Khafaji, 2018; Krishnan & Olivieri, 2016). The factors that affect the financial performance of public companies have had a narrow theoretical perception. In previous studies, more emphasis was placed on financial factors, whereas risk management factors (i.e., decision-making, risk-taking, crisis proneness) have been rarely investigated in terms of their role in enhancing financial performance (Israeli et al., 2011). Therefore, the Ministry of Electricity suffers from a lack of open innovation.

The paucity of previous studies on sustainability and innovation in the energy industry sector is addressed by this paper. It complements the literature by examining crisis management, decision-making, and innovation risk to enhance the role of sustainability in Iraq. We use innovation to examine the identification of this component within the institutions of the Ministry of Electricity (production, transmission, distribution). Iraqi energy companies consist of 16 public companies nationwide, indicating that they have diversified their operations to be more innovative by innovating new economic concepts. Electricity companies suffer from not supporting innovation and sustainability programs in their production activities, leading to a large loss of production that negatively affects performance (Bano & Kamal, 2016). Previous research highlighted the importance of crisis management variables (crisis management, decision-making, and risk-taking) for environmental innovation (Chesbrough, 2006). The acceptance of new technology by electric companies, therefore, leads to sustainable economic and environmental decisions (Saebi & Foss, 2015). Sustainability is also essential to fostering innovation. Sustainability promotes sustainability in environmental innovation in the development of production, processes, services, and new technologies that contribute to the growth and increase of energy, thereby increasing the welfare of society (Capaldo & Petruzzelli, 2011). Sustainability focused on environmental innovation modifies a company's ideology, beliefs, products, processes, and practices to generate and deliver social and environmental value at the lowest cost and highest quality (Greco et al., 2016; Hung & Chou, 2013).

In this context, sustainability has been discussed as a dependent factor in innovation (Agarwal et al., 2017). Therefore, sustainability is currently one of the largest obstacles. Similarly, the importance of sustainability at the corporate level has grown considerably, especially since the majority of industrialized and developing nations embraced sustainable development goals (Du et al., 2022; Zahid et al., 2021). Several studies have identified the impact of sustainability on open innovation (Minutolo et al., 2019; Searcy, 2011; Zhang et al., 2019), with Utami et al. (2020) showing that low sustainability negatively affects open innovation. However, these studies did not provide a full understanding by integrating crisis management factors (crisis management, decision-making, risk-taking), sustainability, and open innovation. Their findings cannot be generalized due to their conceptual challenges in framework, country, sample size, and study design. Furthermore, Calabrese et al. (2019) investigated the effects of sustainability on innovation using a large sample size.

Accordingly, this study overcomes the research gap by examining the effect of sustainability and circular economy on the factors of crisis management through the mediating role of innovation in Iraqi electricity companies. Thus, the contribution of this study is to guide new benchmarks compared with previous studies. In summary, this study aims to explain the impact of crisis management, decision-making, and risk-taking on sustainability. As regards the impact of open innovation on sustainability being vital in the firms, previous literature will be reviewed and discussed to find out the concepts and relationships between constructs. The population, sample size, and measurement are described in the methodology section. The data are analyzed and discussed, and theoretical and practical implications are suggested.

HYPOTHESIS AND CONCEPTUAL MODEL DEVELOPMENT

OPEN INNOVATION

Innovation refers to any innovation process that relies on cooperation and sharing. Thus, the concept of open innovation indicates that the R&D process is no longer closed to itself but is open to the external environment (Aziz & Mustapha, 2020). The introduction of a new or significantly improved product (good or service) to the market or the establishment of a new or significantly improved process within an organization are also considered part of open innovation. Firms can and should take advantage of internal and external concepts to promote the open innovation model to keep pace with the development taking place in the external environment (Westergren, 2011). The term “open innovation” refers to organizations’ readiness to grow or limit their collaboration with external business partners in innovation processes, respectively, and to address change rather than remain static (Granstrand & Holgersson, 2014). The strategy of innovation is a process for accelerating the pace, productivity, and sustainability of development. Involvement in the innovation process is no longer totally controlled by the focus firm but instead shared with other interested parties to improve open innovation (Chesbrough & Brunswicker, 2014). It also refers to an innovation model that emphasizes purposeful knowledge inflows and outflows across a firm’s boundary to leverage external sources of knowledge and commercialization paths (Chistov et al., 2021). The open innovation process is predicated on the idea that knowledge is widely distributed and that firms seeking external knowledge for their innovative purposes engage in open innovation techniques. This new paradigm necessitates reorganizing internal processes, resulting in the establishment of a more open and collaborative form of innovation, in which collaboration between businesses, individuals, and public agencies is encouraged when developing new products and services (Espada-Chavarria et al., 2021).

DECISION-MAKING

Decision-making is a critical component of managerial activities (Ferasso & Bergamaschi, 2020). Decision-making is a significant area of research in organizational studies and strategic management, having developed into a well-known and developed discipline of corporate management. Decision-making is also seen as a critical component of the crisis management process (Sulich et al., 2021). The classification of a decision is a set of alternatives to a problem (Boehmer-Christiansen, 2002). Decision-making can be described as a mental and responsive process of human activity in which humans generate possibilities or choose an option from a pool of choices depending on specific criteria (Y. Wang & Ruhe, 2007). The decision-making process results in a decision, or the willingness to pursue a certain course of action to resolve a problem (Alnoor et al., 2020; Vriens & Achterbergh, 2015). According to Worthington (2013), this process is a mental activity that involves weighing pros and cons and deciding between various options or courses of action. Decisions are made based on criteria or techniques that have been selected. In a broader sense, the capacity to manage an organization entail formulating the organization’s goals and tactics for achieving them. During the management decision-making process, conscious and reasoned decisions, rather than arbitrary ones, are made (Ikram et al., 2020). Hence, decision-making is characterized by achieving a compromise rather than pursuing an ideal solution (Farsäter & Olander, 2019). Decision-making is generally one of the

main critical aspects of the management role (Nooraie, 2008). The subject has a strong desire to increase the efficiency of its development resources by improving its concept decision-making process. Consequently, decision-making is a constant phenomenon in idea initiatives that are marked by doubt and confusion (Kihlander & Ritzén, 2012). Organization structure implies that the decision-making process should be designed in such a way that executives are capable of performing the following: being mindful of relevant moral ideals, considering these values and evaluating their applicability and relative importance, and making decisions based on these values (Hannah et al., 2011).

CRISIS MANAGEMENT

Crisis management is described as a collection of variables that are utilized to combat crises and mitigate the actual harm caused by them (Christensen et al., 2016). Three distinct sets of actions comprise crisis management: prevention and preparation, response, and learning and revision (Coombs, 2015). Crisis management is also described as the collection of pre- and post-crisis operations aimed at mitigating the risk and its implications (Ansell & Boin, 2019). Crisis management is a critical and challenging responsibility at all levels of government and the private sector (Boin & Smith, 2006) and refers to a concerted effort and collaboration aimed at avoiding or resolving a crisis. The fundamental purpose of crisis management is to prevent and prepare for crises, manage crises efficiently to limit actual damage, and deal with the post-crisis scenario (Coombs, 2015). Crisis management is a dynamic and ongoing process that comprises proactive and reactive efforts to anticipate and prepare for a crisis and confront and resolve it (Öcal et al., 2006). As a corporate activity, crisis management requires preparation and coordination to prepare for and respond to threats to operational activities. Many dangers have low probability but severe repercussions, in part because they are ambiguous (managers may not know the source, type, or magnitude of a threat) and managers have limited time to respond (Herbane, 2012). The majority of scholars in the economic literature, define anti-crisis management for enterprises as a collection of strategies targeted at resolving or preventing the crisis state manifested by the economic entity's insolvency, bankruptcy, or unprofitability. It comprises forecasting crisis events and establishing crisis preventive and fast response tactics, as well as eradicating or mitigating the repercussions of crises as they happen crisis (Tokakis et al., 2019).

RISK-TAKING

Investigating organizations' risk-taking behavior is critical. A worldwide crisis phenomenon has been observed and it includes the 2008 financial crisis in which several large investment corporations failed. They failed because they took risks in developing new financial products that lost their value due to the financial market catastrophe (Madugba et al., 2016). Through risk-taking, an individual is purposely exposed to the possibility of loss or danger. Risk is an unavoidable idea in uncertain times (Panno et al., 2021). Risk-taking represents a firm's predisposition for riskier ventures and its risk-management methodology. Intuition drives risk-taking; acts are made without regard for thinking or investigation (Alarape, 2013). Risk-taking proclivity refers to the unpleasant processes that underpin a behavioral proclivity to take risks in response to signals of possible reward, which also carries a chance of adverse consequences (Moreno-Padilla et al., 2018). A venture's strategic decisions in this context relate to risk-taking on uncertain results (Alsalem et al., 2022; R. Wang & Sui., 2019). An organization considering risk-taking indicates a willingness to stray from tried-and-true paths and embark on uncertain endeavors (Dai et al., 2014). The aspect of risk-taking demonstrates top leaders' willingness to seek questionable prospects (Eshima & Anderson, 2017). Risk is a quantitative indicator of the likelihood and severity of unfavorable events. Although risk-taking is widely accepted as an inherent part of business, what motivates a firm's risk-taking activity remains a complicated subject (Tsai & Luan, 2016). Risk-taking is a critical component of enterprise attitude that encompasses the procedures, methods, and decision-making tasks that result in a new entrance (Lumpkin & Dess, 1996). Investment decisions in innovation reflect businesses' risk-taking to pursue projects with indeterminate potential returns. A reasonable manager should select an investment with a positive net present value to maximize a company's benefits (Yu et al., 2013).

SUSTAINABILITY

Corporate involvement in sustainable development is unavoidable and necessary (Agarwal et al., 2017). As organizations face pressures to address environmental and social issues in recent years, corporate sustainability has become increasingly important (Ionescu, 2021c; Linnenluecke et al., 2009). It can be defined as a shift in company strategies and operations toward meeting the demands of businesses and stakeholders while also sustaining, maintaining, and improving human and natural resources that will be required in the future (Searcy, 2011). Corporate sustainability is a corporate strategy that focuses on the ethical, social, environmental, cultural, and economic components of doing business (Utami et al., 2020). Corporate sustainability has been described as an organization's strategic and profit-driven response to environmental and social challenges (Calabrese et al., 2019). The term also refers to voluntary company initiatives that demonstrate the incorporation of social and environmental issues into business operations and relationships with stakeholders (Alnoor et al., 2018; Van Marrewijk, 2003). Thus, corporate sustainability, defined broadly as the incorporation of social and environmental concerns into company activities and interactions with stakeholders, has started to emerge as not only a new but also quite appealing organizational practice and objective capable of producing long-term win-win solutions for enterprises and society at large (Epstein & Buhovac, 2014; Gianni et al., 2017). Corporate sustainability can be further defined as achieving long-term profitability in an organization's operations and creating value for all stakeholders while utilizing only necessary resources (Grabowska & Strzelczyk, 2015; Pflugmann & De Blasio, 2020). Corporate sustainability management encompasses all systematic activities aimed at measuring, analyzing, and improving a company's economic, social, and environmental performance (Schaltegger et al., 2013). In traditional strategy and management literature, corporate sustainability has historically been used to refer to an organization's economic performance, growth, and long-term profitability (Fowler et al., 2007).

Businesses are developing custom-made security frameworks to boost their resilience and ensure their competitiveness, crisis management, and innovation. Businesses must provide a report summarizing their safety concerns, failures, and losses. A direct correlation is found here, demonstrating that increased security and risk resilience as a means of avoiding crises is a crucial condition for increasing a business's competitiveness and innovation (Calvo-Porrá & Lévy-Mangin, 2020; Elattar et al., 2020). The financial crisis had a beneficial effect on business innovation. However, corporations have been unable to rapidly modify their corporate sustainability levels to the new optimal level (Lopatta & Kaspereit, 2014). Thus, firms whose management was more positive about the benefits of corporate innovation before the crisis should now have a comparative advantage over organizations that were hesitant to adopt corporate innovation measures (Lundgren, 2011). Typically, the terms 'crisis management' and 'resilience' are mentioned in discussions about energy and innovation. Practitioners and researchers have been exploring how sustainable development and commercialization strategies should incorporate preparations for preparing, protecting, and rebuilding a destination following a crisis (Becken & Hughey, 2013).

H1: Crisis management has a positive impact on open innovation.

Decision-making facilitates knowledge sharing within companies, allowing managers and staff to collect critical information necessary to adopt open innovations (Shahin et al., 2021). Open innovation and strategy converge when designing products and services. Open innovation and management are made to be more adaptable and flexible, that is, they are adapted to meet the general demands from the management of time trade-offs between economy, society, and the environment, related to speed with decisions made about those products and services. According to this perspective, management, decision-making, and open innovation enable insights to be reconstructed, decision-making processes to be understood across time scales, and multiple dimensions of open innovation to be integrated with the decision-making (Tian & Zhai, 2019). Managers may take on new projects and become capable agents of creativity by capturing and understanding the dominant story logic surrounding open innovation. Companies with a sustainable business model receive higher returns than the

stock market on average by making superior decisions. A relationship exists between firms' plans and decision-making (Holsapple & Sena, 2005).

H2: Decision-making has a positive impact on open innovation.

Risk-taking has a beneficial effect on open innovation. A strong correlation exists between taking calculated risks and outbound open innovation. Owing to the heterogeneity of risk-taking and reactivity values, certain interactions can be asserted as significant (Brunswick and Chesbrough, 2018). A strong association has been found between taking risks and external networking in the context of open innovation (Atshan et al., 2022; Schroll & Mild 2011). However, the risks linked with established technology corporations' adoption of open innovation are significantly less well understood. In inbound open innovation, excessive reliance on extramural research and development activities via alliances and acquisitions may risk incumbent enterprises' crucial internal knowledge and competence, as well as their potential for breakthrough discoveries (Brunswick and Chesbrough, 2018). Thus, bridging links foster the necessary structure for innovators and promote risk-taking in creative activities (West, 2020). Researchers have argued for a negative relationship between risk-taking and open innovation (Hannen et al., 2019). Nonetheless, equivalent concerns have also been identified regarding potentially misaligned interests and incentives among various stakeholders associated with open innovation processes, which have been generally overlooked by previous research (Henkel et al., 2014). Open innovation research has also revealed risk-averse technology managers' aversion to open innovation in its entirety. When left unchecked, these attitudes tend to increase administrative and managerial expenses and dangers (Abbas et al., 2021; Hadi et al., 2018; West, 2020).

H3: Risk-taking has a positive impact on open innovation.

Innovation enhances firms' performance, which encompasses social, ecological, and economic performance (Kruke & Morsut, 2015). Sustainability in innovation also aids in the development of new products, processes, services, and technologies that contribute to the development and well-being of human needs and organizations while remaining mindful of natural resources and regeneration capabilities (Evans et al., 2017). Sustainability-oriented eco-innovation is the intentional altering of an organization's philosophy and beliefs, as well as its products, processes, and practices, with the specific goal of generating and achieving social and environmental value (Tello et al., 2008). Adopting techniques such as sustainability and innovation will almost certainly result in cost savings for firms through resource conservation, energy conservation, trash reduction, and water recycling (Bărbuță-Mișu et al., 2019). Adopting environmental and sustainability advances in the energy sector also helps companies avoid fines for non-compliance with regulatory requirements. Owing to the perceived benefits of innovation adoption and sustainability, the pace of adoption of innovations in the energy industry is expected to rise (Ionescu, 2021b; Seilsepoor & Ahmadi, 2016). The perceived benefits of sustainability innovation will drive the adoption of innovations in the energy industry (Ali et al., 2019). The adoption of environmental sustainability advances in the energy industry is significantly affected by the nature and strategy of innovation. Furthermore, the rate at which professional facilities embrace innovations is influenced by their own demands, attitudes, rules, and beliefs, as well as by government laws (Corral de Zubielqui et al., 2019). The rate of adoption of environmental sustainability innovations in the energy sector is affected by the innovations' compatibility with organizational capabilities, facilities, expertise, values, and processes (Kulkarni et al., 2006). Open innovation can be considered the primary factor in the development of new sustainable business practices because it is directly associated with sustainability issues such as climate change, resource efficiency, and energy scarcity (Abdullah et al., 2021; Alnoor, Khaw, et al., 2022; Giampaoli et al., 2017; Wah et al., 2022).

H4: Open innovation has a positive impact on sustainability.

MEDIATING ROLE OF OPEN INNOVATION

Sustainability encourages innovation, sustainability, and corporate operations linked to payback. Considering what needs to be delivered following the crisis is a critical insight for crisis management. A significant crisis frequently affects the behavior of customers, employees, and partners. The organization can then benefit from the flexibility it needs. Open innovation has the potential to broaden the area of value creation: it enables value to be created in a variety of ways, whether through new partners with complementary talents or by releasing buried potential in long-term connections. Open innovation can help organizations identify new solutions to pressing challenges and crises while creating a positive reputation when those crises are managed (Alnoor, Abdullah, et al., 2022; Dahlander & Wallin, 2020).

Competition has been cited as a means of assisting managers in making decisions, and open innovation is one type of competition (Chiu et al., 2014). Although innovation is critical to the international economy, businesses must choose the appropriate innovation approach at the appropriate moment given their limited resources. Making decisions, such as choosing innovative strategies, is a primary managerial responsibility that is complicated when managers lack the essential information and preliminary preparation, as well as knowledge and work experience. Decision-making based on criteria improves the quality of results (Pop et al., 2022; Shahin et al., 2021). The open innovation and decision-making processes encompass decision-makers' efforts to gather and process information to remove doubt about the benefits and drawbacks of an innovation's adoption. The processes consist of five stages: knowledge, persuasion, decision, implementation, and confirmation (Rogers, 2004).

Innovation also is a critical component of a company's competitiveness and advancement. Open innovation management decision-making supports significant transitions in modern firms, and corporate awareness of the importance of a well-defined innovation strategy is growing (Pisano, 2015). Throughout the decision-making process, organizations will determine a particular technological breakthrough based on the various alternatives between decision-making (Bromiley & Rau, 2011; Powell et al., 2011; Takemura, 2014). The company will decide whether to adopt open innovation during the decision-making stage. The process of adopting innovation and implementing open innovation leads to the advanced and final stages of the process of integrating the organizational and strategic goals of the institution (Rogers, 2004; Sahin, 2006). Acceptance of technology is also an important factor in open innovation, particularly when as regards ease of use and usefulness of technological innovation (Avcı-Yücel & Gulbahar, 2013; Marangunic & Granic, 2015). In other words, the perceived simplicity of use and utility of new open innovation will influence the subjective cost-benefit analysis connected with end-adoption users of new technology (Davis, 1989; Venkatesh et al., 2012).

Open innovation is facilitated by a willingness to take risks. Risk-taking is highly correlated with international open innovation. Since risk-taking and reactivity tend to fall on a spectrum, there are specific correlations that stand out as particularly important (Albahri et al., 2022; Oliva et al., 2022). When discussing open innovation, a significant correlation has been shown between risk-taking and establishing external networks (Carvalho & Sugano, 2016). The dangers associated with open innovation adoption by large, well-established technological companies, however, are considerably less well acknowledged. When it comes to inbound open innovation, incumbent businesses may put their vital internal expertise and competence as well as their potential for groundbreaking discoveries at risk if they rely too much on extramural research and development operations via alliances and acquisitions (Manzini et al., 2017). Connecting dots, then, provides the framework that innovators need and encourage creative risk-taking (Uzzi & Spiro, 2005). There may be a negative correlation between risk-taking and open innovation, but this has not been proven (Ionescu, 2021a; Schroll & Mild 2011). Previous studies have ignored similar worries about the possibility of misaligned interests and incentives among the numerous stakeholders involved in open innovation processes (Alharbi & Alnoor, 2022; Brunswicker & Chesbrough, 2018).

H5: The relationship between decision-making and sustainability is positively mediated by open innovation.

H6: The relationship between crisis management and sustainability is positively mediated by open innovation.

H7: The relationship between risk-taking and sustainability is positively mediated by open innovation.

METHODOLOGY

The challenges faced by the energy sector in developing countries (especially Iraq) have increased in recent years, and we believe that focusing on the economic, social, and political situation in Iraq, in particular, is important. This research was conducted in the Iraqi electricity sector. We used data from various companies in the Ministry of Electricity, which comprises 16 public companies. Previous studies did not focus on these companies (Israeli et al., 2011). Data collection from these companies was considered acceptable due to the large number of managers and heads of departments. We also considered the control of disparities between companies in politics, infrastructure, and variables in social support systems that may contribute to the disparity in the work of those companies.

Ease of access and access to data and scientific and regulatory convergence also motivated us to choose the Ministry as a sample for the study. The questionnaires were in English and were translated into Arabic by specialists in Arabic translation, and the participants were asked to complete the questionnaire online. The study population was selected from managers and heads of departments from different companies (from cities such as Baghdad, Basra, Babil, and Mosul). The managers and heads of these departments have the same experience, educational attainment, and common characteristics. The electronic questionnaire was sent to 549 managers and heads of departments using different social networks (Google Forms). From 549 questionnaires, 384 completed ones were collected. Therefore, the sample size is suitable and acceptable for data analysis, especially with partial least squares structural equation modeling (PLS-SEM) (Bell & Waters, 2018; Hair et al., 2014). The validity of the questionnaire was also tested. It consisted of 49 items covering the variables and respondents answered using a five-point Likert scale. The problem of method bias is common in human resource research, especially when asking questions according to self-report. To address this issue, some preventive measures were taken, such as ensuring the confidentiality of information for respondents, drafting some inverse clauses, and separating information sources from independent and dependent variables. A single-factor Harman test (Podsakoff et al., 2003) was also performed. The test indicates that the bias problem appears when the variance of the first factor exceeds 50%, but in this study, the percentage was 30%, satisfactory mitigating bias. The final sample consisted of 384 managers and heads of departments representing 55% men and 45% women. Diploma holders constituted the majority at 51%, while the percentage of those holding a bachelor's degree was 39% of the sample and the percentage of those with master's and doctoral degrees was 10%.

This section includes a description of the different scales used to define the variables for this study. The state of the managers and heads of the departments was calculated using a dichotomous variable. The managers and heads of departments who contributed to the questionnaire were coded. Institutional support, according to Tasleem et al. (2018), a one-dimensional variable consisting of a 24-item scale, was developed by only two of the four representations adopted. To suit the purposes of the current study, support for sustainability and support for open innovation in companies, which received the highest reliability, were combined into a single concept of sustainability. Crisis management was measured with a three-item scale. Decision-making was measured using the four-item scale developed by Han and Kim (2010). Risk-taking was measured using the three-item scale developed by Sheaffer et al. (2011). The study operationalizes performance as a one-dimensional construct using 15 items to measure open innovation as the mediating variable adapted from Hojnik et al. (2018), based on the use of a five-point Likert scale (1 = strongly disagree; 2 = disagree; 3 = neutral; 4 = agree; 5 = strongly agree).

A sampling methodology is a strategy for selecting a representative sample from a target population (Bell & Waters, 2018). The sampling technique is divided into probability and non-probability, and the latter was used in this study.

The questionnaire for this study was created to be appealing to respondents by not being overly lengthy or difficult, with the goal of increasing response rates (Rowley, 2014). The intercept technique was applied using the following question: “Before you begin, please answer the following question: Do you have the title of Senior Manager or Head of Department?” The filter question was created to specifically target managers. If they were a head of a department or manager, they were asked to continue answering; otherwise, they were requested to stop. The questionnaire was divided into many sections and portions to guarantee that the research questions were addressed adequately. The objective of Part A Section 1 was to ascertain the respondents’ demographic characteristics and the study’s overall context. The responders were required to provide a numerical response indicating their age, position in the firm, educational level, job experience, the age of the firm, and their status. Part B (Sections 1-4) gathered data on the independent variables (crisis management, decision-making, and risk-taking). Part C gathered data on the dependent variable (corporate sustainability). The final part was Section D, which gathered data on the mediating factor of open innovation.

The demographic profiles of the sampled respondents are presented in Table 1. The total number of respondents presented is 397 from the public companies of the Ministry of Electricity, with several of them distributed over four main cities in Iraq, namely, Baghdad, Basra, Mosul, and Babil. A total of 307 (77.330%) of the respondents are men, whereas women comprised a little less than one-quarter (22.670%) at 90. This disparity is expected in a country in which men dominate business like Iraq. Previous studies have also confirmed a similar distribution regarding the gender of employees in the public companies of the Ministry of Electricity.

More than half of the respondents (225) fall within the age group of 51–60 years, representing 51.134% of the respondents. Second is 120 in the age group of 41–50 years, representing 36.020%. Third is 40 in the age group of 31–40 years, representing 10.075%. Last is 12 in the age group of 21–30 years, representing (3.024%).

A total of 203 (51.14%) of respondents have work experience of more than 31–40 years, followed by 143 (36.020%) with 21–30 years, 42 (10.579%) with 11–20 years, and 9 (2.267%) with less than 10 years. This is a positive development and indicates that the majority of respondents have sufficient work experience. The results were acceptable for this research.

The respondents showed a high level of educational qualifications. About 238 (59.950%) have bachelor’s degrees, followed by secondary school leavers at 64 (16.121%), those with diploma degrees at 55 (13.854%), those with master’s degrees at 28 (representing 7.052%), and those with doctorates at 12 (3.023%). These demographics will positively reflect on the outcome of the result because the respondents have acquired the basic education to be able to answer the questionnaire correctly.

The majority of the sample in public companies of the Ministry of Electricity comprises managers at 146 (36.776%), and about 128 (32.242%) of the respondents have dual roles as heads of departments in the public companies of the Ministry. Finally, 123 (30.982%) of the respondents are senior managers. Thus, more than half of the public companies of the Iraqi Ministry of Electricity are managed by the managers.

Table 1: Demographic profile

Demographics	Options	Frequency	Percent
Gender	Male	307	77.330
	Female	90	22.670
Age	20–30 years	12	3.024
	31–40 years	40	10.075
	41–50 years	120	30.226
	51–60 years	225	56.675
Work Experience	<10 years	9	2.267
	11–20 years	42	10.579
	21–30 years	143	36.020
	31–40 years	203	51.134
Education Qualification	Secondary school	64	16.121
	Diploma	55	13.854
	Bachelor	238	59.950
	Master	28	7.052
	Doctoral	12	3.023
Job position	Senior manager	123	30.982
	Manager	146	36.776
	Head of department	128	32.242

RESULTS

To test the proposed hypotheses, structural equation modeling (SEM) was performed using the Smart PLS 3.3.3 technique (Hair et al., 2011). Before testing, the validity of the convergent and discriminant tests was determined. For convergent feasibility testing, factor loading (which must be greater than 0.7), mean extracted variance (AVE) (which must be greater than 0.5), composite reliability (CR), and Cronbach's alpha (which must be greater than 0.7) were used (Chen et al., 2010). As shown in Table 2, the variables (dm2, eco10, eco15, eco5, eco9, sus10, sus15, sus16, sus20, sus21, sus4, sus5, sus6, sus6, sus7, and sus8) with values less than 0.7 were eliminated. However, the remaining items were more than 0.7. For CR, Cronbach's alpha was more than 0.7. AVE was greater than 0.5. Therefore, there is no cause for concern about convergent validity values.

Table 2. Convergent tests

Variables	Items	Loading factor	CA	CR	AVE
Crisis management	Recurrent successes induce me to be complacent.	0.783	0.738	0.800	0.571
	Crises have only negative impacts on the organization.	0.741			
	Preparing for crises is impossible because they are unexpected.	0.741			
Decision-making	The organization has a say in selection and training decisions.	0.711	0.764	0.815	0.596
	The organization can participate in strategy-making of organizational administration.	0.771			
	The organization can participate in the measurement of organizational performance and compensation.	0.829			
Open innovation	Among the external innovation activities performed by our company, the association is an important source of information.	0.766	0.921	0.933	0.558
	Among our company's external innovation activities, the private research institution is an important source of information.	0.728			
	Among the external innovation activities performed by our company, the university is an important source of information.	0.754			
	Among our company's external innovation activities, government-funded research institutes are an important source of information.	0.758			
	Among our company's external innovation activities, conferences, fairs, and exhibitions are important information sources.	0.734			
	Among the external innovation activities performed by our company, professional journals and books are a source of important information.	0.750			
	The manufacturing process of the company effectively reduces the emission of hazardous substances or waste.	0.762			
	Our firm management often uses novel systems to manage eco-innovation.	0.752			
	Our firm management often collects information on eco-innovation trends.	0.734			
	Our firm management often invests a high ratio of R&D in eco-innovation.	0.762			
	Our firm management often communicates experiences among various departments involved in eco-innovation.	0.714			

Variables	Items	Loading factor	CA	CR	AVE
Risk-taking	The organization tends to opt for high-risk projects.	0.832	0.739	0.852	0.657
	The organization constantly renews organizational technology.	0.803			
	The organization considers daring actions to gain high rewards.	0.797			
Sustainability	The organization tends to improve product quality and reliability.	0.750	0.940	0.948	0.564
	Product performance organizations compare or better with competitors' performance, as well as the performance of similar products offered by other organizations.	0.701			
	The organization tends to improve product features, technology, and usage that are advanced and easy to use.	0.764			
	The organization tends to use a product and dispose of it in an environmentally friendly way, and there are slight losses to the environment.	0.749			
	The organization seeks to improve measures and key results related to process efficiency, effectiveness, capacity, or productivity.	0.704			
	The organization has improved its financial performance and results since the implementation of crisis tool practices.	0.775			
	The organization has adopted sustainability programs and innovation practices, which have improved the market's performance, position.	0.760			
	The organization strives to be the best in its class and has received many international, national, or other awards due to excellent performance in its business practices.	0.805			
	The organizational status is more stable, competitive, and sustainable as a result.	0.724			
	The organization benefits from improved workforce capacities and skills due to enhanced workforce engagement, satisfaction, morale, and loyalty.	0.785			
	The organization seeks to reduce risks and crises while increasing awareness and vigilance on this issue among stakeholders.	0.726			
	The organization seeks to improve the results of key measures related to crises and financial performance objectives.	0.777			

Variables	Items	Loading factor	CA	CR	AVE
	The organization has improved its customer relationship building and likely will get more strengthened.	0.783			
	Better coordination has occurred among all stakeholders, including employees, customers, suppliers, partners, collaborators, shareholders, government or regulators, and members of society associated with them.	0.703			

The discriminant validity test ensures that a certain concept scale is unique from another inside the same model. Fornell and Larcker were used to ensure that all ratio values were above the median and below correlation. As shown in Table 3, the data exhibited no discriminatory validity issues.

Table 3: Discriminant validity

Variables	1	2	3	4	5
1. Crisis management	0.756				
2. Decision-making	0.701	0.772			
3. Open innovation	0.673	0.650	0.747		
4. Risk-taking	0.660	0.668	0.734	0.811	
5. Sustainability	0.685	0.614	0.683	0.731	0.751

The second part of partial least squares (PLS) analysis is model evaluation and hypothesis testing. Here, the direct and indirect relationships between the mediator variables, as well as the mediator variable’s effect on the two dependent variables, are examined. We evaluate the value of R2, which indicates the amount of the exogenous variable’s influence on the endogenous variable. Table 4 and Figure 1 present a summary of the results.

Table 4. Assessment of structural model

Direct effect						
Path	(O)	(M)	(STDEV)	(O/STDEV)	P Values	Result
Crisis management -> Innovation	0.255	0.259	0.071	3.583	0.000	Supported
Decision-making -> Innovation	0.141	0.143	0.064	2.201	0.028	Supported
Innovation -> Sustainability	0.883	0.884	0.016	54.469	0.000	Supported
Risk-taking -> Innovation	0.472	0.471	0.059	7.964	0.000	Supported
Indirect effect						
Path	(O)	(M)	(STDEV)	(O/STDEV)	P Values	Result
Crisis management -> Innovation -> Sustainability	0.225	0.229	0.063	3.595	0.000	Supported
Decision-making -> Innovation -> Sustainability	0.124	0.126	0.057	2.199	0.028	Supported
Risk-taking -> Innovation -> Sustainability	0.417	0.417	0.056	7.494	0.000	Supported

The results in Table 4 suggest a direct effect, but there was a strong indication that all statistical assumptions on direct effects were valid. Regarding the indirect influence hypotheses, the results revealed that the mediator, namely, three independent elements (crisis management, risk-taking, and decision-making), plays a full mediating role in the interaction between the mediator and the independent.

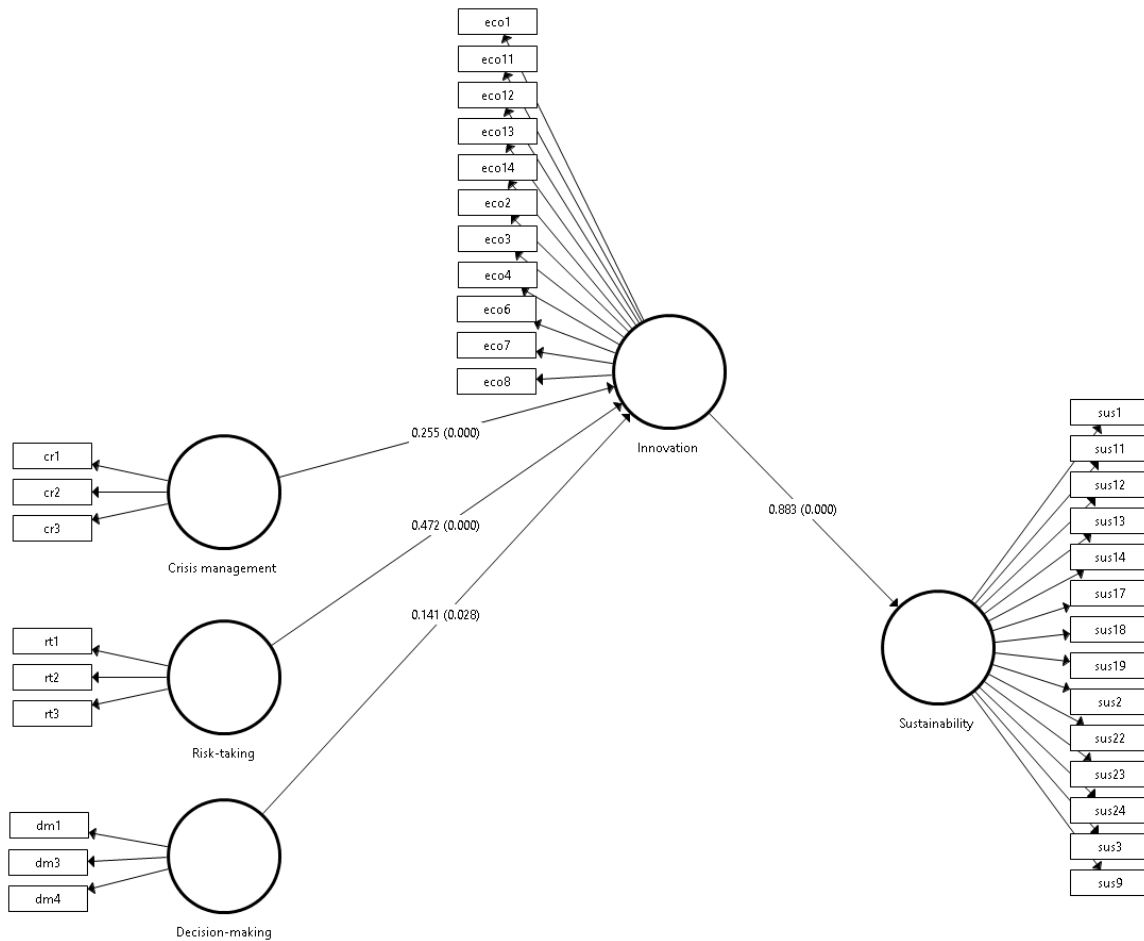


Figure 1. Hypotheses test

In addition, as shown in Table 4 and Figure 1, an important role was identified for innovation in increasing the positive impact among the three independent variables and sustainability. Standard PLS-SEM studies provide information about the relative importance of certain constructs in explaining the impact of exogenous constructs on another endogenous construct of interest. Information about the significance of constructs is necessary for conclusion-making. The importance-performance map analysis complements the PLS-SEM results by determining the importance-performance of each construct. As a result, conclusions can be drawn on many dimensions (i.e., importance and performance), which is critical when prioritizing managerial measures. Accordingly, improving the performance of those constructs that have a high degree of significance for explaining a particular target construct, but also have a relatively poor performance, should be prioritized. The importance-performance map indicates the size of the effect of each variable on the dependent variable. Figure 2 shows the map, in which the most influential variables are innovation, risk-taking, and crisis management.

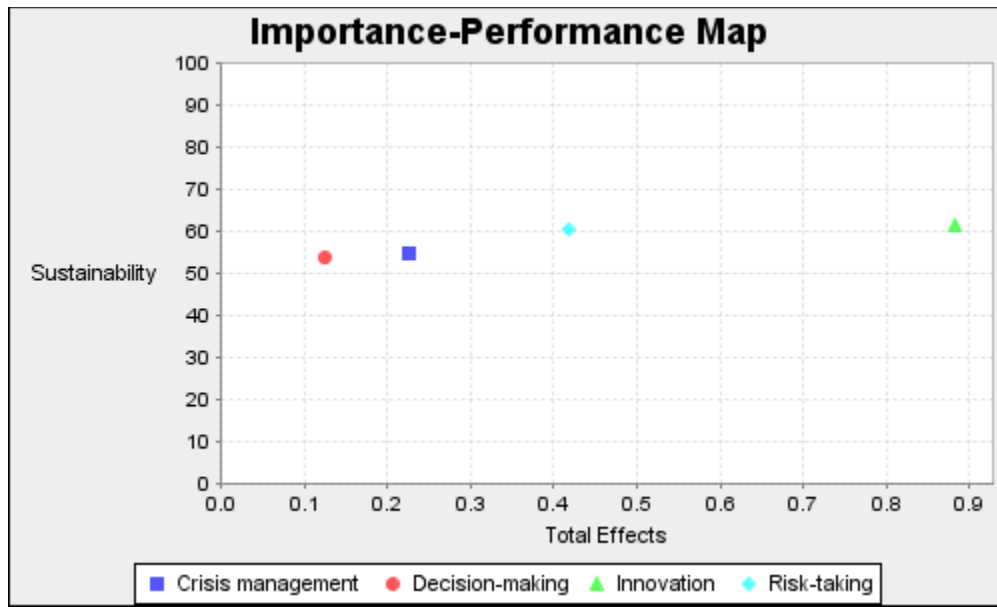


Figure 2. Importance-performance matrix analysis

Figure 2 shows the importance of the influence of an exogenous construct (i.e., innovation, risk-taking, crisis management, and decision-making) on sustainability. Innovation achieved the highest importance of impact at 0.883, followed by risk-taking, crisis management, and decision-making at 0.417, 0.225, and 0.124, respectively.

DISCUSSION

Open innovation, as a factor, greatly affects sustainability. In this study, the results of the energy sector suggest positively opening up innovation and linking it to sustainability. Respondents believe that managers and department heads are important to the organization because leadership influences employees' perceptions of the importance of work, inculcates positive enthusiasm, and fosters mutual trust and cooperation between employees and management, thereby enhancing the innovation process and supporting sustainability programs (Alnoor, 2020; Khaw, Alnoor, Al-Abrow, Tiberius, et al., 2022; Tsui et al., 2006). Through sustainability, open innovation helps the company build an impactful culture and a positive organizational climate. Crisis management factors, as a factor, greatly influence sustainability and were found in this study to relate to sustainability positively. Crisis management factors integrate ideas, values, processes, and procedures into business processes and maximize organizational profitability and mitigate the crisis. Sustainability is a characteristic that determines the performance of open innovation. This study shows that sustainability can affect open innovation, indicating a direct connection between sustainability and open innovation performance.

This research aimed to offer light on how corporate sustainability and crisis management factors (crisis management, decision-making, and risk-taking) influence open innovation success. Based on empirical evidence, this study concludes that the contribution of corporate sustainability to open innovation is mediated by the dynamic interaction of crisis management factors characteristics. To achieve the high success of open innovation, innovation-project leaders must pay close attention to the internal environment of the sustainability idea within the business to support a specific objective. Such objectives include the execution of an innovation project involving external partners (e.g., foreign firms in the energy sectors, governmental institutions, and universities). At marketing levels, managers and their staff should operationalize market-oriented values and ensure that innovative ideas, products, and services can provide pinpoint solutions, in particular by being tailored to the

changing needs of customers as firms carry out their innovation projects, thereby sustaining organizations. The results of open innovation studies show the significant impact of this factor on crisis management factors. These results are consistent with previous literature indicating interactions between crisis management factors and open innovation to benefit from the advantage of addressing crises in scientific ways (Bryksina et al., 2018; Fernández-Mesa & Alegre 2015). According to Ramkumar et al. (2022), open innovation plays a significant role in achieving sustainable competitive advantage. In this context, the companies of the Ministry of Electricity in Iraq must pay attention to crisis management to move toward open innovation.

CONCLUSION

A clear overview of various perspectives on the relationship between open innovation and sustainability is presented in this study. Value-creating theory believes in the significant positive influence of sustainability on open innovation, while value-support theory believes in improving financial performance by focusing on social, economic, and environmental practices. To examine this model, we employed SEM in PLS-SEM analyses of the empirical evidence collected from 384 heads of department and managers in the Iraqi Ministry of Electricity. The results indicate that crisis management, decision-making, and risk-taking significantly positively contribute to sustainability, open innovation, and performance. Open innovation plays a partial mediating role between crisis management, decision-making, risk-taking, and sustainability. This research confirms a significant positive influence of open innovation on sustainability, thereby supporting value-creating theory while opposing value-destroying theory. Considering the substantial role of crisis management, decision-making, and risk-taking, our research favors RBV theory and recommends that firms should emphasize their internal capabilities (hereby deemed innovation) to gain superior performance. Our findings showed that open innovation is more critical for firm sustainability and high performance than risk-taking in the emerging economy of Iraq. Organizational top management needs to allocate sufficient attention to configure open innovation in various departments because it significantly spurs performance and sustainability. To summarize, we recommend that heads of departments and managers give due attention to the adoption of crisis management and decision-making to survive in the long run. Finally, open innovation has a complete mediation in the relationship between crisis management factors (crisis management, decision-making, and risk-taking) on sustainability. This is a basic indication of the importance of crisis management factors in activating sustainability to achieve greatly competitive open innovation.

Despite the energy industry having a wider environmental impact than other industries, we demonstrate that open innovation has a significant and positive effect on corporate sustainability and risk management variables, thereby decreasing this impact. Previous research has reached comparable results as a result of their examinations of innovation and the application of a sustainability scale to other sectors (Donais et al., 2022). Therefore, open innovation has a good impact on sustainability and is one of the main factors that bring about competition between companies (Al-Abrow et al., 2022; Kropp et al., 2006; Roxas et al., 2017). Despite the rich literature on the theoretical correlations between firm capacities and open innovation, the empirical execution of these relationships in specific types of public enterprises in the Iraqi Ministry of Electricity requires further study (Martin & Javalgi, 2016). Our research reveals that crisis management, risk-taking, and decision-making have considerable positive benefits on open innovation. These factors enhance the development of renewable energy products and operations modified to customer needs, including their sustainability demands, thereby enhancing innovativeness, facilitating early entry into sustainability programs, and encouraging greater risk-taking (José Ruiz-Ortega et al., 2013). Although the effect of risk-taking on open innovation is greater than the effect of crisis management and decision-making (José Ruiz-Ortega et al., 2013; Khaw et al., 2021; Khaw, Alnoor, Al-Abrow, Chew, et al., 2022), we report that risk-taking constitutes a core capability that positively affects open innovation not only in high-industry and technology sectors (José Ruiz-Ortega et al., 2013; Liu et al., 2020) but also in energy. Our findings also indicated a positive relationship between crisis management and corporate sustainability in

public companies of the Ministry. Thus, high crisis management leads to more corporate sustainability programs. The findings agree with the literature in an important way. For example, De Sausmarez, (2007) found a significant positive relationship between crisis management and corporate sustainability, and the present study's findings are positively significant. The findings of this study also agree with the literature stating that crisis management is vital in explaining sustainability growth. Therefore, decision-making has a positive and significant relationship with corporate sustainability, flexibility, and innovation, consistent with previous studies (e.g., Iakovidis et al., 2022). The effective management of the public companies of the Iraqi Ministry of Electricity makes decisions related to the products and services, reduces risks, and enhances sustainability programs. This is in line with prior studies such as Donais et al. (2022), who found that decision-making has supported and has a significant positive relationship with corporate sustainability and improves innovation programs. Our results also show that risk-taking is positively related to corporate sustainability in the public companies of the Ministry of Electricity. Risk-taking is classified as environmental, social, organizational, or political concerns, which separately and collectively have a cumulative effect on business sustainability (e.g., Alhamdi et al., 2019; Iakovidis et al., 2022). This implies that the more corporate sustainability engages in risk-taking, the better the company's performance innovation.

THEORETICAL CONTRIBUTIONS

The present study provides significant contributions to the literature on open innovation and business sustainability as regards risk management variables (crisis management, decision-making, and risk-taking). First, by responding to the invitation for more research on open innovation in general (Lilien, 2016) and antecedents of risk management factors specifically (Bstieler et al., 2018), this research expands the current understanding of key organizational antecedents or drivers that facilitate open innovation-focused corporate sustainability in public companies of the Iraqi Ministry of Electricity. Second, sustainable development is currently a key concern, making corporate sustainability a top strategic priority for many companies. Despite growing evidence of the positive financial consequences of sustainability, additional guidance on how to make businesses more sustainable is urgently required (Varadarajan, 2017). Our research contributes to the literature by identifying various risk management factor antecedents (crisis management, decision-making, and risk-taking) that could help organizations increase their focus on sustainability in their innovation. It also provides a preliminary organizational framework for future research in this field (Al-Abrow et al., 2021; Hamid et al., 2021).

Third, our study contributes to the literature on energy sustainability and open innovation by evaluating the mediating effect of open innovation, a concept that has been often employed in innovation studies but rarely in open innovation or the global perspective. Our findings indicate that risk management elements can improve the efficiency of open innovation efforts. Public companies of the Iraqi Ministry of Electricity with active innovation approaches appear to be better able to assess their environments and identify opportunities that arise outside the company's borders. When possibilities are identified, these companies are better able to reorganize their risk management factors (crisis management, decision-making, and risk-taking) and competencies to elevate the significance of open innovation centered on corporate sustainability (Abdulaali et al., 2019; Eneizan et al., 2019; Fadhil et al., 2021).

MANAGERIAL IMPLICATIONS

To create shared value, firms are compelled to recognize the social, ethical, and environmental impacts of their management processes considering the substantial challenge of sustainable development and the increased expectations of external stakeholders such as regulatory bodies and governments. Corporate sustainability based on open innovation is a strategic competence and methodology that enables energy companies to increase their competitive advantage (Gabler et al., 2015). This

study proposes ways for managers to foster innovation with an emphasis on sustainability. First, organizations in the energy industry benefit from a worldwide perspective and the ability to recognize, integrate, and use sustainable knowledge gained from it. Second, managers need to manage open innovation wisely to benefit the sustainability-focused innovation of their firms. Open innovation in the shape of external collaborative efforts and co-development appears to be a valuable means of fostering open innovation because it can provide access to novel knowledge and skills from external sources to manage the crisis-stricken public companies of the Iraqi Ministry of Electricity. However, managers should be aware of the drawbacks of crises. An overreliance on corporate sustainability could be detrimental to a firm's innovation focus while neglecting decision-making and risk-taking might not easily provide the complementary resources or skills needed to enable sustainability-focused innovation to manage their crises.

Third, managers must implement a proactive innovation strategy that monitors, evaluates, and responds rapidly to early signs of crisis management. Proactive open innovation not only correlates positively with sustainability-focused innovation but also increases the beneficial impact of open innovation on sustainability-focused innovation, suggesting a synergistic relationship between open innovation and corporate sustainability. Public enterprises in the forward-thinking Iraqi power and electricity sector are likely to reap the benefits of open innovation by assimilating external knowledge more efficiently and incorporating this input into their efforts to manage their financial problems through sustainable innovation.

LIMITATIONS OF THE STUDY

This study has various limitations that affect the generalizability of the results. First, this study utilized cross-sectional data. Although various ways, such as the longitudinal method, improve the generalizability of the results, the transversal character of the data-gathering method inhibits the assessment of crisis management. Future studies should adopt the longitudinal method to address the problems of the cross-sectional method; sustainability within industrial and service companies on an ongoing basis should also be studied. The longitudinal study design also facilitates the investigation of crisis management across time and the evaluation of the strength of causal linkages.

Second, in accordance with the study's objectives, the present study was implemented in the public companies of the Iraqi Ministry of Electricity. As a result of the differences in findings dependent on the target sector, the sample size did not allow for the generalization of the results. The target sector is regarded as one of the most influential sectors that impede the process of generalizing the results, so the adoption of other sectors can affect this process. Generalizing the findings to all industrial firms is therefore a limitation of our study. Moreover, the future use of this study provides practitioners and academics with insight into the most significant obstacles to implementing crisis management in various sectors. For instance, future research is recommended to adapt the proposed model to private sectors because public and private sectors differ in many aspects, including supply and legislation.

Third, cultural variations between countries were not considered. Focusing on a single nation like Iraq makes generalizing results to other nations more difficult. Future researchers are recommended to focus on investigating different nations to assess the impact of cultural differences on the adoption of crisis management.

Fourth, we utilized the PLS-SEM approach for investigating causal linkages and comparisons. The non-linear and non-compensatory interactions that can be investigated utilizing an artificial neural network (ANN) method were not included. Future research should apply PLSE-SEM, ANN, and MCDM methods to analyze the hurdles to adopting a sustainability business model in public companies of the Iraqi Ministry of Electricity. These methods might predict significant variables and validate PLS-SEM results.

RECOMMENDATIONS

First, corporate sustainability faces challenges in understanding energy crises and risks. Therefore, the use of sustainability by managers can reduce the impact of such challenges on sustainability performance. Managers must also maintain products that have a low price and high innovation. Second, managers must overcome competitive disadvantages to achieve high sustainability. Sustainability enables companies to face risk management factors and exploit resources. Third, prospects for real and visible benefits should be evaluated by adopting sustainability to boost activity innovation and improve the business. Fourth, managers and staff should learn about sustainability issues and practices by taking basic sustainability education online training.

Fifth, managers should provide support in developing and disseminating a clear strategic imperative for the company by setting a budget dedicated to sustainability programs to encourage employees to adopt innovation and sustainability programs. Sixth, organizational frameworks should be put in place to support the increasing active engagement of managers and employees in enhancing the sustainability of enterprises and communities. Seventh, the production of sustainable feedstocks (gas and oil) should be encouraged if renewable energy sources are unavailable. Eighth, citizens should be advised to use energy more sustainably and effectively by using energy-saving electrical appliances. Ninth, employees who support sustainability programs in their work should be rewarded by sending them to and involving them in development courses organized by universities and educational institutions.

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