MANAGEMENT MECHANISMS AND THE PERFORMANCE OF UNIVERSITY-INDUSTRY COLLABORATION, WITH THE MEDIATION EFFECT OF UIC ACTIVITIES

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ABSTRACT

University-industry collaboration (UIC) has attracted the attention of academics and practitioners in innovation management, innovation systems, and regional development studies. This study aims to examine the relationship between UIC management mechanisms and UIC performance, with the mediating effect of UIC activities. This study was conducted in Qatar's academic institutions, which included colleges, faculties, schools, and research centres affiliated with universities in Qatar. Data for the study were collected via random sampling from 209 respondents. The respondents were academic professors and researchers affiliated with 33 academic institutes in Qatar. All data were analysed using the partial least squares (PLS) technique, based on structural equation modelling (SEM). The Smart PLS 3.0 software tool was applied to generate all the required tests for data analysis. The results confirm the positive and significant influence of UIC management mechanisms on UIC performance, and the partial mediating effect of UIC activities on the relationship between UIC management mechanisms and UIC performance. This study also offers a practical tool for assessing the performance of UIC in Qatar and draws key contextual conclusions to enhance UIC in Qatar.

Keywords: University-industry, collaboration, relations, linkages, performance, Qatar

INTRODUCTION

University-industry collaboration (UIC) has become a critical factor driving innovation ecosystems (Rodionov & Velichenkova, 2020). There is also increasing evidence of UIC's role in driving radical innovations (Arant et al., 2019). Innovation is the creation of wholly new products, services, or processes to provide new or improved value to customers. Innovation changes the competition mix, transforms markets, and sets new customer expectations (Crossan & Apaydin, 2010).

UIC is present in many phases of the innovation continuum. Hence, UIC bridges and streamlines resources across the continuum. The continuum runs from (1) invention and discovery, (2) technology demonstration, (3) technology development, and lastly (4) commercialization (Jackson, 2011). Governments, research and academic institutions are heavily involved in supporting invention and discovery. Industry and investors, however, are usually more engaged in supporting the commercialization of new products and services. As such, discoveries and inventions face a lack of resources for demonstrating and developing technology, thus being stuck in what Jackson (2011) called the "*Valley of Death*." Therefore, bridging the

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gap between the commercial and knowledge economies often relies on nurturing UIC, which enables inventions and discoveries to cross the "*Valley of Death*."

The above interaction between knowledge and commercial entities of the ecosystems is essential to their survival. Nevertheless, universities and industries have different missions, cultures, and motives to engage in bilateral relationships within the ecosystem. So, universities apply a range of management mechanisms to foster and improve the performance of UIC. These management mechanisms include a set of strategies, policies, and approaches that the university adopts to stimulate and govern collaboration with industry and business through the application of UIC activities and, consequently, improve UIC performance (Galan-Muros et al., 2017).

UIC activities are a set of activities that form the entire spectrum of how universities engage with industry and business (Galán-Muros et al., 2017). UIC performance is a set of matrices used to measure the achievement of university-industry collaboration's goals and objectives (Perkmann et al., 2013; Clauss & Kesting, 2017). Such matrices cover generated revenues, created patents, and research publications as results of university-industry collaboration.

The context of the study is unique. Qatar's economy is transforming from a hydrocarbon-based economy into a knowledge- and innovation-based one. According to Etzkowitz (2017), if natural resources, labour, and capital are the traditional sources of wealth, knowledge is the emerging alternative driver of economic growth. Therefore, Qatar is well focused on higher education as an essential tool to transform its economy from a hydro-based into a knowledge-based economy (Ahmed, 2018).

Qatar's national development strategy emphasizes the need for economic transformation towards a knowledge-based economy (MPDS, 2018). Qatar's national research strategy was established in 2012 and updated in 2014. It identified key national challenges which set priorities for research across the state (QNRF, 2014). In 2018, the Qatar Research, Development and Innovation Council (QRDI) was established in order to develop a research, development and innovation strategy that tackles national challenges and enables the provision of innovative solutions (QRDIC, 2019).

Knowledge-based economies call for an entrepreneurial status for universities and an active role in regional development (de Castro et al., 2019). Likewise, Muparadzi & Caesar (2020) debated that the commercialization of university-based knowledge requires (1) the entrepreneurial orientation of the university, (2) systematic processes for outward technology transfer, and (3) the university's capacity to sustain the implementation of these processes.

Therefore, the challenge is for all Qatari universities to become more entrepreneurial and contribute to the economic development of Qatar. Consideration of the use of feedback loops to measure the performance impact of implementing UIC initiatives has become imminent (Burns & Chopra, 2017). Such feedback is essential to improve university curricula and various forms of collaboration among universities, industry, and policymakers in Qatar. There is a lack of objective performance management processes for UIC. Such processes are crucial to assessing the validity, credibility and effectiveness of UIC partnerships in Qatar (Abduljawad, 2015).

THEORETICAL BACKGROUND

University-industry collaboration refers to all forms of interactions established between universities, industry and business to foster innovation, knowledge transfer and economic development (Bekkers & Freitas, 2008; Siegel et al., 2003).

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The university-industry collaboration started with the emerging role of the Massachusetts Institute of Technology (MIT) and Stanford University in the late 19th century and the early 20th century (Etzkowitz, 2017). The notable program driving UIC in the United States is the Bayh–Dole Act of 1980 (Hall, 2004). The comparable program in Europe is Horizon 2020 (Mascarenhas et al., 2018). In Qatar, the essential government programs driving UIC are delivered through the Qatar National Research Fund (QNRF) and the Qatar Science and Technology Park (QSTP), which were launched in 2006, and supported by the Qatar Foundation and Qatar University (MEHE, 2020).

The Triple Helix Model represents a dynamic relationship among the three actors (Etzkowitz, 2017). More often, one actor drives the relationship while the other two actors make a balanced contribution toward maintaining the relationship (Liu et al., 2018). Additionally, the lead actor continuously changes depending on the state of how the relationship is developing, the goals of each actor, the absorptive capacity of each actor and who has the most valuable resources to share with the other actors. Indeed, in optimal collaborative ecosystems, the roles and actor contributions overlap, and relationships become co-equal among all actors. Moreover, the greater the number of collaborative partners, the greater the synergic effect, and thus the greater the chances of knowledge transfer Sun et al. (2020), and business innovation (Hernández-Trasobares & Murillo-Luna, 2020). Therefore, recent studies have conceptualized the Quadruple or Quintuple Helix Model of multilateral relationships among universities, industry, the government and civil society (Baier-Fuentes et al., 2021).

In this regard, Lašáková et al. (2017) studied the barriers and drivers of innovation and sustainability in European universities. They argued that the main barriers to university innovation include administration and management systems, university policies and guidelines, resource availability, the associated technology and institutional culture.

Later, Ávila et al. (2017), in a worldwide study, revealed similar results in terms of barriers to university innovation. Indeed, when universities start to overcome these barriers, the appropriability of knowledge becomes more central in their agenda for knowledge creation and research. Similarly, this transition unlocks additional resources and investments in university teaching, research and technology infrastructure that, in turn, enhance further university innovation processes and the appropriability of the knowledge created.

Semantic and pragmatic boundaries are the two key organizational boundaries between partner organizations (Lotman, 2009). The key management mechanisms to cross semantic boundaries include the development of (1) joint structures and (2) mutually understood language. Key management mechanisms to cross pragmatic boundaries include sustaining a dialogue to anticipate, reframe and negotiate interests (Rau et al., 2012).

Likewise, Davey et al. (2011) debated institutional determinants that create better absorptive capacity for UIC, including a focus on technological disciplines and a bias toward applied science. They also suggested different management mechanisms to improve motivation towards UIC, including linking assessments of academic performance to cooperation with industry, provision of incentives for academics, provision of academic mobility policies, presence of businesspeople on university boards, and supportive policies and regulations.

UIC performance is defined as the set of matrices used to measure the achievement of the goals and objectives of UIC (Perkmann et al., 2013; Gulbrandsen & Thune, 2017; Albahari et al., 2017; Berbegal-Mirabent et al., 2015; Berbegal-Mirabent et al., 2020; Healy et al., 2014; Huang & Chen, 2017). In this research, the dependent variable is UIC Performance. Eight items were used to measure this variable, adopted from previous studies (Gulbrandsen & Thune, 2017;

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Albahari et al., 2017; Berbegal-Mirabent et al., 2015). These items cover three main UIC performance groups: (1) research performance, (2) patent performance and (3) UIC revenue performance.

Items related to research performance are adapted from the study of Gulbrandsen & Thune (2017), which was conducted to test the effects of non-academic work experience on external interaction and performance. They tested this instrument on 4,400 academics employed in Norwegian universities and colleges. Items related to the research performance group covered the quantity and quality of research publications. Thus, it is a measure of two items: research quality and research productivity, as described by Gulbrandsen & Thune (2017) and Aldieri et al. (2018). Research productivity refers to the number of scientific publications, whereas research quality refers to the number of citations (Aldieri et al., 2018). Publications, in this context, include peer-reviewed journal articles, books, book chapters, and conference papers or proceedings for which the academic professor or researcher was the sole author, the first author or one of the multiple authors (Lin & Bozeman, 2006).

The number of publications item as a measure of research performance was used by various scholars, including studies by Clauss & Kesting (2017), de Castro et al. (2019), Gulbrandsen & Thune (2017), Liu et al. (2018), Huang & Chen (2017), Aldieri et al. (2018), Albats et al. (2018), Al-Ashaab et al. (2011), Azagra-Caro et al. (2019), Chen, et al. (2019), Franco & Haase (2015), Li & Fang (2019), Perkmann, et al. (2011), Seppo & Lilles (2012), Van Looy et al. (2004), Zhang et al. (2019), Chen et al. (2020), Gibson et al. (2019), Tseng et al. (2020), Garcia et al. (2020), Tijssen et al. (2020), and Cheng et al. (2020). Indeed, this research made no distinction regarding publication methods, journal impact factor, or first or single authorship to avoid any subjectivity in the data collected on the number of publications.

On the other hand, local and global citations were distinguished from each other for the number of citations. This distinction was made due to remarks made by scholars of Qatar University, who gave higher consideration to global citations than to local ones. The citation index as a measure of research performance was used by various scholars, including studies of Gulbrandsen & Thune (2017), Aldieri et al. (2018), Perkmann et al. (2011), Van Looy et al. (2004), Tijssen et al. (2020) and Petruzzelli & Murgia (2020).

Items related to the patent performance group covered the disclosure and registration of patents generated by university research activities. This measures two items, namely patent disclosure and patent registration. These two measures have been widely used in previous studies to quantify UIC's performance. The number of patents registrations as a measure of patent performance was used by various scholars, including studies by Perkmann et al. (2013), de Castro et al. (2019), Davey et al. (2011), Sun et al. (2020), Huang & Chen (2017), Albats et al. (2018),
Chen et al. (2019), Seppo & Lilles (2012), Tseng et al. (2020), Tijssen et al. (2020), Cheng et al. (2020), D'este & Perkmann (2011), Fischer et al. (2018), Goel & Göktepe-Hultén (2018), Hue Kyung et al. (2016), Perkmann et al. (2011), Riviezzo et al. (2019), Rossi & Rosli (2013), Hu et al. (2019), Lyu et al. (2019), (Fischer et al. 2019), and (Teixeira et al. 2019).

Likewise, the number of patent disclosures as a measure of patent performance was used by various scholars, including studies by Perkmann et al. (2013), de Castro et al. (2019), Davey et al. (2011), Huang & Chen (2017), Chen et al. (2019), Perkmann et al. (2011), Seppo & Lilles (2012), Tijssen et al. (2020), D'este & Perkmann (2011), Fischer et al. (2018), Goel & Göktepe-Hultén (2018), Hue Kyung et al. (2016), Riviezzo et al. (2019), Rossi & Rosli (2013).

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National and university databases for patent registrations and disclosure were used in the previous studies of Hue Kyung et al. (2016) and Chen et al. (2017). Likewise, Albahari et al. (2017) used the number of patent applications to measure innovation performance based on a community innovation survey of 25 technology and science parks and 849 firms in Spain.

Items related to the UIC revenue performance group covered all types of income generated from UIC contracts in addition to research funding grants. Income generated by UIC contracts as a measure of UIC revenue performance was used by various scholars, including studies by Clauss & Kesting (2017), Albahari et al. (2017), Berbegal-Mirabent et al. (2015), Al-Ashaab et al. (2011), Seppo & Lilles (2012), Tseng et al. (2020), Tijssen et al. (2020), Cheng et al. (2020), Hue Kyung et al. (2016), Rossi & Rosli (2013), Rajalo & Vadi (2017), Son et al. (2019) and Von Raesfeld (2012). This item covers revenue generated from training contracts, consulting contracts (Hue Kyung et al., 2016), research contracts (Berbegal-Mirabent et al., 2015), licensing fees (Davey et al., 2011; Hue Kyung et al., 2016), trading of intellectual property assets (Galán-Muros et al., 2017).

Research funding grants as a measure of UIC revenue performance was used by various scholars, including studies by Clauss & Kesting (2017), de Castro et al. (2019), Albahari et al. (2017), Al-Ashaab et al. (2011), Franco & Haase (2015), K. Chen et al. (2020), Tseng et al. (2020), Hu et al. (2019), Hansen et al. (2018), Muscio et al. (2012), and Mosayebi et al. (2020).

In this study, research funding grants were treated in terms of quality and quantity (Davey et al., 2011). The value of research grants represented a qualitative measure, whereas the number of research grants represented a quantitative measure. As such, two items were used for research funding grants.

UIC management mechanisms are defined as the set of strategies, policies, and approaches that a university adopts in order to stimulate and govern collaboration with industry and business (Galán-Muros et al., 2017; Perkmann et al., 2013). This variable covers a wide range of items to enhance universities' academic motivation and absorptive capacities to engage in UIC. It also provides mechanisms to deal with external institutional and social pressure, overcome proximity barriers, and promote trust and commitment among UIC partners. In this research, the key dependent variable of this study is UIC performance, while a key predictor variable is UIC management mechanisms.

Similarly, Huang & Chen (2017) studied how to improve academic innovation performance in UIC. Their findings suggest a positive relationship between both management mechanisms and regulation implementation, and academic innovation performance. In their research, the management mechanisms for UIC are related to formal arrangements to stimulate and govern UIC by the subject university. Regulation implementation is related to the implementation of specific regulations to foster R&D as well as UIC by the subject university.

Indeed, UIC management mechanisms involve two types of UIC governance mechanisms; one is contractually based, and the other one is based on relations between people of the collaborative organizations. As such, relational governance mechanisms stimulate the performance of UIC. Academics and industry counter-partners are individuals whose culture, attitudes, behaviours and mutual experience influence the relationships. The influence can be on issues such as the relationship's form, sustainability and future expectations. In this case, ideas are openly shared, and knowledge is voluntarily combined and created by partners from both institutional logics.

Relational governance mechanisms were also reinforced by the study (Goel et al. 2017). Their findings suggest heavy reliance on professors' networks, capacity, reputation and

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motivation to initiate relationships with the industry. In addition, they argued that informal contracts facilitate trust, knowledge exchange and publication goals. Accordingly, they argued that professors are more successful at initiating industry collaboration with smaller firms, which often have less bureaucratic relations.

Similarly, Ruangpermpool et al. (2020) and Ismail et al. (2021) showed that a combination of formal and informal governance mechanisms positively influences UIC performance. Cao & Lumineau (2015) also debated the complementarity of contractual-relational governance mechanisms. They discussed the joint impact of both types of governance on UIC performance. They also argued that the institutional contexts of the collaborating partners mediate such a paired relationship. First, the relationship is positively mediated by a collectivist culture and the length of the relationship. Second, the relationship is negatively mediated by a power distance culture and the legal system's effectiveness.

Likewise, Tseng et al. (2020) found that UIC management mechanisms positively relate to UIC funding and universities' technology innovation performance. The university innovation performance in that study included the number of research publications, the number of patents issued, the number of licensing patents, the number of business incubations in the university and the amount of royalty income from technology licensing. UIC management mechanisms in the latter study focused on providing UIC resources and UIC reward systems.

UIC management mechanisms, as independent variables influencing at least one item of UIC performance, have been found in previous studies (Perkmann et al., 2013; Clauss & Kesting, 2017; Albahari et al., 2017; Galán-Muros et al., 2017; Huang & Chen, 2017; Tseng et al., 2020). In this research, the first independent variable is a UIC management mechanism which is hypothesized to influence UIC performance.

HYPOTHESIS

***H_1*:** *UIC management mechanisms influence UIC performance.*

UIC management mechanisms variable refers to the set of strategies, policies and approaches the university adopts to stimulate and govern collaboration with industry and business (Galán-Muros et al., 2017; Perkmann et al., 2013). The items used to measure this variable were adopted from previous studies (Galán-Muros et al., 2017; Perkmann et al., 2013; Davey et al., 2011). These items cover four main management mechanisms groups: (1) top management support, (2) UIC incentives, (3) UIC support structure, and (4) UIC promotion.

Galán-Muros et al. (2017) studied how European universities supported their collaboration with business, mainly based on studies of European university-business cooperation (Davey et al., 2011). The online survey conducted by Davey et al. (2011) included a matrix of questions on the extent to which the university cooperates with businesses. The extent of cooperation was measured using a 10-point Likert scale, from 1 ("*not at all*") to 10 ("*to a very large extent*"). Galán-Muros et al. (2017) tested this instrument on 2157 respondents from 33 European countries. The results showed that Cronbach's alpha reliability for the 10-point Likert scale ranged from 0.79 to 0.91. Davey et al. (2011) sent the original survey to managers and academics in 3,551 officially registered higher education institutes in 33 European countries and collected responses from 6,280 respondents.

As such, in the present study, items related to the top management support group included four items adapted from the studies of Galán-Muros et al. (2017), Davey et al. (2011)

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and Hansen et al. (2018). These items measure the degree of top management support for the practice of university-industry collaboration, including (1) the top-level management's commitment to UIC, (2) the presence of academics on business and industry boards, (3) the presence of business-people on the university boards, and (4) the presence of board member or dean-level positions for UIC.

Likewise, items related to the UIC incentives group included four items adapted from previous studies of Galán-Muros et al. (2017), Davey et al. (2011), Van Looy et al. (2004), Tseng et al. (2020), and Awasthy et al. (2020). These items measure the adoption of policies and procedures by the university management to encourage academics to engage in UIC, including (1) the provision of resources and funding to support UIC, (2) the dedication of incentives for academics to encourage UIC, and (3) the inclusion of UIC as part of academic performance appraisals.

Similarly, items related to the UIC support structures group included four items adapted from the studies of Galán-Muros et al. (2017), Van Looy et al. (2004), Riviezzo et al. (2019), Awasthy et al. (2020), Dalmarco (2018), van Stijn et al. (2018) and Nsanzumuhire & Groot (2020). These items measure the presence of dedicated organizations or structural arrangements within universities to support UIC, including the presence or access to (1) career development offices within the university, (2) internal agencies within the university dedicated to UIC, (3) incubators for the development of new businesses, and (4) actions of an alumni network

Moreover, items related to UIC promotion included three items adapted from the studies of Galán-Muros et al. (2017), Davey et al. (2011), Riviezzo et al. (2019), Tseng et al. (2020), and van Stijn et al. (2018). These items measure the adoption of consistent internal and external communications about embracing UIC among different stakeholders, including (1) a documented mission or vision statements embracing UIC, (2) the internal promotion of UIC, e.g., entrepreneurship education, competitions, and featured projects, and (3) the external promotion of UIC, e.g., networking sessions, printed, and online materials.

UIC activities are defined as a set of activities that form the entire spectrum of how universities engage with industry and business (Galán-Muros et al., 2017; Ishengoma & Vaaland, 2016; Gulbrandsen & Thune, 2017; Vaaland & Ishengoma, 2016).

There are different ways in which universities and industry can cooperate. These include, but are not limited to, research and development (R&D), mobility of academics, mobility of students, curriculum development, curriculum delivery, lifelong learning, and spinoff and startup formation. In fact, Davey et al. (2011) found that UIC activities that provide straight and measurable benefits tend to be the most developed types of cooperation, such as R&D, commercialization and student mobility.

As such, the collaboration between universities and industries can take several forms and involve various activities. Most commonly, such collaboration falls into one of three main groups of activities: (1) collaborative training and education, (2) collaborative consulting and services, and (3) collaborative research (Galán-Muros et al., 2017; Perkmann et al., 2013; Ishengoma & Vaaland, 2016; Gulbrandsen & Thune, 2017; Davey et al., 2011; Nsanzumuhire & Groot, 2020; Vaaland & Ishengoma, 2016; Kotiranta et al., 2020).

A study by Van Looy et al. (2004) indicated that academic engagement in entrepreneurial activities corresponds with increased publication quality and productivity. As such, Perkmann et al. (2013) investigated the role of academic engagement in sustaining UIC. Academic engagement refers to knowledge-related collaboration activities by researchers with industry and non-academic organizations. Perkmann et al. (2013) distinguished the determinants that lead to

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academic commercialization from the determinants of academic engagement. Commercialization refers to the use of knowledge created by the university through patenting, licensing of inventions and business entrepreneurship. Their findings suggest a positive relationship between some individual determinants and academic engagement. These determinants include gender (male), seniority, previous government grant experience, previous industry contract experience and scientific productivity. In the same sense, Davey et al. (2011) found that academic age (seniority), gender (male), previous business experience and technological orientation were among the key individual drivers for UIC.

In addition, Vaaland & Ishengoma (2016) investigated the impact of different forms of collaboration on UIC innovation performance as perceived by three different actors (i.e., industry professionals, faculty members and students). The three collaboration forms were (1) collaborative training and educational activities, (2) collaborative consulting activities, and (3) collaborative research activities. The industry perceives all forms of collaboration to be important to the enhancement of UIC innovation performance. The faculty members consider that only consultancy services and research are essential. Surprisingly, students thought all forms of collaboration to be ineffective in enhancing UIC innovation performance. Moreover, Ishengoma & Vaaland (2016) showed that UIC activities influence student employability after graduation.

Likewise, Huang & Chen (2017) showed the influence of three UIC activities on UIC innovation performance. These activities included forms of collaborative training and education and collaborative consulting and services, including (1) number of conducted UIC conferences and forums, (2) number of intellectual property (IP) courses offered by the university, and (3) number of held entrepreneurial contests and lectures. Similarly, Guerrero et al. (2016) indicated that the innovation climate reflects the university's support for entrepreneurial activities by faculty members, students and administration staff.

As such, the literature review indicated a positive relationship between UIC activities and UIC performance (Huang & Chen, 2017; Vaaland & Ishengoma, 2016). So, in this research, the second independent variable is UIC activities which is hypothesized to influence UIC performance.

***H_2*:** *UIC activities influence UIC performance.*

In addition, in a recent study conducted in Europe, Galán-Muros et al. (2017) found a positive relationship between four groups of UIC management mechanisms and seven key UIC activities. These UIC management mechanism groups were (1) top management support, (2) communication, (3) incentives, and (4) support structures. The key collaboration activities were (1) joint curriculum design and delivery, (2) lifelong learning, (3) student mobility, (4) professional mobility, (5) joint R&D, (5) entrepreneurship, and (6) commercialization of joint R&D results. In the present study, all the above four groups of UIC management mechanisms and the seven key UIC activities were adapted to measure the variables of UIC management mechanisms and UIC Activities.

Likewise, Davey et al. (2011) showed that eight UIC activities were influenced by organizational drivers and perceived measurable and promotable benefits of UIC. The eight UIC activities included collaboration in R&D, mobility of academics, mobility of students, commercialization of R&D results, curriculum development and delivery, lifelong learning, entrepreneurship and governance. The organizational drivers included the possibility of accessing funding, a focus on technological disciplines, a bias toward applied science, linking

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assessments of academic performance to cooperation with industry, provision of incentives for academics, academic mobility policies, presence of businesspeople on university boards, and supportive policies and regulations. The organizational drivers of the above study by Davey et al. (2011) were linked to the four groups of UIC management mechanisms as defined by Galán-Muros et al. (2017). So, in this research, the independent variable of UIC management mechanisms is hypothesized to influence UIC Activities.

H_3: *UIC management mechanisms influence UIC Activities.*

In addition, Clauss & Kesting (2017) studied the influence of two types of governance mechanisms (i.e., relational and transactional mechanisms) on the achievement of collaboration goals with three forms of knowledge sharing activities as a mediating factor. Governance refers to the different management mechanisms for organizing or controlling exchange relationships. Relational governance mechanisms refer to the informal mechanisms that partners use to interact and communicate with each other. On the other hand, transactional governance mechanisms refer to formal tools, including the use of legal provisions and economic incentives to organize the relationship (Bouncken et al. 2016).

Indeed, knowledge sharing activities come in three forms: learning, knowledge combination and co-poises. Learning refers to the direct attainment, use and internalization of the partner's knowledge. Knowledge combination refers to complementing one's knowledge with knowledge and expertise from the other partner without needing to internalize the external knowledge and expertise. Co-poises refer to the synergic creation of new knowledge through the combined efforts of all partners, which is aimed at innovation and achievement of mutual gains (Paavola & Hakkarainen, 2005).

However, Clauss & Kesting (2017) considered the control factors influencing the impact of knowledge sharing activities on achieving the goals of UIC. These control factors included the obligation to get external research funding (Goel et al., 2017), professors' attitude towards UIC Lam (2010), the degree of applied research Manual (2002), the number of employees under the professors' supervision, professors' years of experience, size of the partner organization and the type of partner organization (i.e., whether it is a private, public, or not-for-profit organization).

Moreover, the findings of Clauss & Kesting (2017) suggested the positive influence of relational governance mechanisms on all forms of knowledge sharing. However, their findings suggest the negative influence of transactional governance mechanisms on all forms of knowledge sharing. Furthermore, their findings suggest the positive impact of knowledge combination and co-poises on achieving UIC goals. However, learning showed a negative impact on the achievement of UIC goals.

Likewise, Albats et al. (2018) showed that UIC activities variable mediates the relationship between UIC inputs and UIC performance. In the latter study, UIC activities involved were under the collaborative research group, while UIC performance indicators were reflective indicators of research and patent performance. UIC inputs included hard and soft management mechanisms to boost UIC performance, including the provision of physical resources, human and financial resources. In this research, the second independent variable is UIC activities, hypothesized to mediate the relationship between UIC management mechanism and UIC performance.

H_4: *UIC Activities mediate the relationship between UIC management mechanisms and UIC performance.*

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So, in this research, the mediator variable is UIC activities. This variable refers to a set of activities covering the entire spectrum of how universities engage with industry and business (Galán-Muros et al., 2017; Ishengoma & Vaaland, 2016; Gulbrandsen & Thune, 2017; Vaaland & Ishengoma, 2016). Initially, the items were used to measure this variable, adopted from previous studies of Galán-Muros et al. (2017), Ishengoma & Vaaland (2016), Gulbrandsen & Thune (2017), Davey et al. (2011), Vaaland & Ishengoma (2016), and Kotiranta et al. (2020). These items cover three UIC activity groups: (1) collaborative training and education, (2) collaborative consulting and services, and (3) collaborative research.

Previously, Ishengoma & Vaaland (2016) developed a survey questionnaire and tested it in Tanzania on 404 respondents from universities and industry to examine the influence of university-industry linkages on both student employability and UIC innovation performance. This instrument consists of 30 questions that measure various UIC activities over a six-point Likert scale from 0 (‘‘*don't know*’’) to 5 (‘‘*strongly agree*’’).

In addition, studies of how European universities support their collaboration with business (Galán-Muros et al., 2017) were based on the study of the State of European University-Business Cooperation (Davey et al., 2011). The online survey of Davey et al. (2011) included matrix questions to measure to what extent the university cooperates with the business through UIC activities.

Items related to collaborative training and education activities included five items adapted from the previous studies of Rodionov & Velichenkova (2020), Galán-Muros et al. (2017), Ishengoma & Vaaland (2016), Vaaland et al. (2016), Gulbrandsen & Thune (2017), Davey et al. (2011), Nsanzumuhire & Groot (2020), Kotiranta et al. (2020), and Orazbayeva et al. (2020). These items measure the extent to which the university cooperates with industry with respect to various training and education activities, including (1) cooperative education by having students spend a substantial share of their academic program in the industry through internships, (2) industrial training through the provision of practical training on the application of new technologies and methods to students and faculty on industry premises, (3) small business training through the provision of programs and short courses targeting entrepreneurs and small businesses, (4) student assignments through the provision of access to information and stimulus for carrying out university assignments and research projects within the industry, and (5) visiting lectureships from the industry through official arrangements to support teaching activities by inviting part-time lecturers from the industry.

Items related to collaborative consulting and services activities included eight items adapted from the previous studies of Rodionov & Velichenkova (2020), Galán-Muros et al. (2017), Perkmann et al. (2013), Ishengoma & Vaaland (2016), Vaaland et al. (2016), Gulbrandsen & Thune (2017), Davey et al. (2011), van Stijn et al. (2018), Nsanzumuhire & Groot (2020), Kotiranta et al. (2020), and Orazbayeva et al. (2020). These items measure to what extent the university cooperates with industry in respect to various collaborative consulting activities including (1) transformation programs by supporting the university in developing and delivering academic programs and curricula according to industry needs, (2) technology transfer through licensing technologies and intellectual property assets to industry, (3) co-organizing seminars and conferences that enhance knowledge sharing with industry partners, (4) sabbaticals through the facilitation of academic leave for faculty members taken in the industry, (5) job search assistance through organizing job fairs and business presentations, (6) technical services through provision of testing, calibration and design services by the university to industry, (7) advisory services through provision of counselling from specialized faculty members,

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technology transfer offices, technology parks, or business incubators at the university, and (8) direct or indirect investments through provision of investments in university projects and initiatives.

Items related to collaborative research activities included four items adapted from the previous studies of Rodionov & Velichenkova (2020), Galán-Muros et al. (2017), Ishengoma & Vaaland (2016), Vaaland et al. (2016), Gulbrandsen & Thune (2017), Riviezzo et al. (2019), Davey et al. (2011), van Stijn et al. (2018), Nsanzumuhire & Groot (2020), and Kotiranta et al. (2020). These items measure to what extent the university cooperates with industry with respect to different collaborative research activities, including (1) contract research through establishing research agreements for the provision of specific research for industry partners, (2) joint research projects through forming common teams that conduct research of common interests at dedicated laboratories, research facilities, or industry facilities, (3) partnership research contracts through building research facilities based on a long-term arrangement between the university and industry, and (4) industrial fellowships and researchers interchange through long term agreements that sustain the interchange of researchers between the university and industry.

To develop the theoretical research model, we used four key relationships established or assumed on the basis of the literature review. The first relationship is between UIC management mechanisms and UIC performance (Galán-Muros et al., 2017; Perkmann et al., 2013; Clauss & Kesting, 2017; Albahari et al., 2017; Huang & Chen, 2017; Tseng et al., 2020). The second relationship is between UIC activities and UIC performance (Ishengoma & Vaaland, 2016; Berbegal-Mirabent et al., 2015; Vaaland & Ishengoma, 2016). The third relationship is between UIC management mechanisms and UIC activities (Galán-Muros et al., 2017; Perkmann et al., 2013; Gulbrandsen & Thune, 2017). The fourth relationship is the mediation effect of UIC activities on the relationship between UIC management mechanisms and UIC performance (Clauss & Kesting, 2017; Albats et al., 2018). Figure 1 summarizes the theoretical research model used in the present research.

The theoretical research model described below helps the researcher, on the one hand, to address the research objectives and research questions presented earlier. On the other hand, in the context of Qatar, it assists policymakers in overcoming the challenge for Qatari universities to become more entrepreneurial and contribute to the economic development of Qatar.

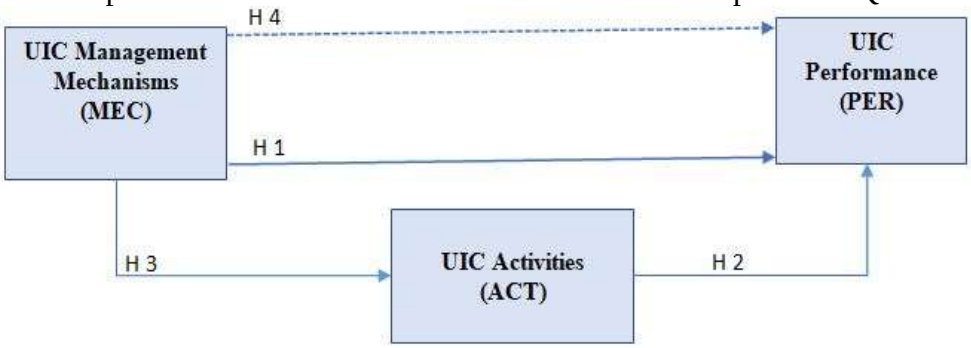

FIGURE 1
THEORETICAL RESEARCH MODEL

Research Purpose and Questions

UIC is significant in driving the value creation for knowledge-based economies. Many studies emphasize the role of UIC in economic development. Thus, boosting the performance of

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UIC in emerging economies, as in the case of Qatar, takes precedence in the national agenda (GSDP, 2008). The literature review revealed two key predictor variables for UIC performance; the first is UIC management mechanisms and the second is UIC activities.

Some researchers have studied the influence of UIC activities on UIC performance (Ishengoma & Vaaland, 2016; Vaaland et al., 2016), but they have ignored the UIC management mechanisms in this relationship. On the other hand, some scholars have investigated the relationship between UIC management mechanisms and UIC activities and overlooked the inputs of UIC performance (Galán-Muros et al., 2017). Some other researchers, e.g., (Gulbrandsen & Thune, 2017), have combined some UIC activities with UIC performance components as dependent variables in the relationship. Therefore, there has been no clear distinction between relationship performance as a goal and the means to achieve this goal. As such, the UIC activities variable is believed to partially explain the relationship between UIC management mechanisms and UIC performance. In other words, UIC activities variable is assumed to mediate the relationship between UIC management mechanisms and UIC performance. This proposition is a new contribution of this study.

Moreover, the context of the study is unique in terms of the emerging role of UIC in transforming the Qatar Economy from a hydrocarbon-based to a knowledge-based economy. The country devoted focused policies to promoting such transformation following the Qatar National Vision 2030 in 2008 (MPDS, 2017). However, some of the key challenges that face UIC in Qatar are the foreseen sustainability of the higher education system model in Qatar, that is dependent on government funding, and the need for transforming Qatari universities to become more entrepreneurial, self-dependent and contribute to the economic development of Qatar.

Based on the background of the study and research problem, this research answers the following questions:

RQ1: Do UIC management mechanisms influence UIC performance?

RQ2: Do UIC activities mediate the relationship between UIC management mechanisms and UIC performance?

The purpose of this study is to examine the relationships between UIC management mechanisms and UIC performance, with the mediating effect of UIC activities. For this purpose, the following research objectives were defined:

RQ1: To examine the relationship between UIC management mechanisms and UIC performance.

RQ2: To assess the mediating effect of UIC activities on the relationship between UIC management mechanisms and UIC performance.

This research makes theoretical, practical and methodological contributions to the literature. Primarily, this research contributes to the body of knowledge by examining the relationships between UIC management mechanisms and UIC performance.

UIC is an important field of research. Its significance has led Munster University to establish a standalone research centre to examine this emerging research field, namely the ‘Science-to-Business Marketing Research Centre’ (Davey et al., 2011).

An essential aspect of this research is that it develops its own new theoretical research model by introducing UIC activities as a mediator variable for the relationship between UIC management mechanisms and UIC performance. Therefore, this study contributes to the body of knowledge by assessing the mediating role of UIC activities on the relationship between UIC management mechanisms and UIC performance.

This research offers a new instrument to measure the relationships between UIC management mechanisms and UIC performance with the mediating variable of UIC activities. The reliability and validity of the research instruments are methodological contributions to the

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body of knowledge. The research instruments can be used carefully for comparative studies or the potential inclusion of other influencing factors in the research model.

As a practical contribution, this study proposes to study the relationship between UIC management mechanisms and UIC performance in Qatar. To the best of our knowledge, in this context, no previous studies have been conducted before. Thus, the findings of this research contribute to the emerging expertise and focus on UIC in Qatar. The research illuminates key contextual conclusions and gives recommendations to enhance performance gaps in UIC in Qatar, including (1) the need to grow the mix of UIC activities, and (2) the need to monitor and provide a baseline of the performance of UIC in academic institutions.

This study focuses on the academic institution in Qatar, including colleges, faculties, schools, and research centres, that provide or co-provide higher education or academic research (third level) from Bachelor to Ph.D. level in one of the five priority applied disciplines, which included (1) Business & Economics, (2) Engineering, (3) Health & Medicine, (4) Information Technology, (5) Natural & Other Applied Sciences. Including other academic institutions that are not oriented for teaching or research in one of the above five disciplines in the sample would increase the time and complexity of data collection without adding to the quality of the findings. With respect to the nature of UIC, this study focuses on three groups of UIC activities, including (1) collaborative training and education, (2) collaborative consulting and services, and (3) collaborative research.

METHODOLOGY

The research question is formulated to answer whether or not UIC activities mediates the relationship between UIC management mechanisms and the performance of UIC. The theoretical research model is created on the basis of the literature review, and the hypotheses were formulated accordingly (Ellis & Levy, 2008). Therefore, this research examines the relationship or linkage between two specific sets of variables. The first set includes management mechanisms and UIC activities. The second set includes the performance of UIC.

This research utilised a survey as the research strategy. Surveys involve a collection of structured data from a large population through either questionnaires, structured observations, or structured interviews (Saunders & Lewis, 2012). It is a common and widely accepted strategy in business and management research. Indeed, it is a cost-effective strategy and appropriate for descriptive research like the present study.

In terms of the time dimension, this research is a cross-sectional study, whereby data are collected at a particular time, giving a snapshot. Longitudinal studies that study the topics over an extended period are time-consuming, costly and not feasible for this research (Saunders & Lewis, 2012).

In this research, the unit of analysis is at the level of academic institutions in Qatar. However, the sampling unit is in two levels (1) at the level of academic institutions in Qatar and (2) at the level of university professors and researchers affiliated with academic institutions in Qatar. Realistically, the academic institutions themselves cannot respond to questionnaires on their own but only through university professors and researchers affiliated with them.

The definition of the sampling unit is the key to determine the required sample size. The sample size is defined with the assumption that the sample is drawn randomly or that all observations are independent (Dolma, 2010). The sample includes all academic institutions in Qatar. Random sampling is used in this research, whereby the research population included all

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university professors and researchers affiliated with selected academic institutions in Qatar. A random sample was selected from the research population, and the questionnaire was distributed to 900 university professors and researchers from 36 academic institutions in Qatar.

The population for this study was determined based on the literature review and the context of the study. This study focuses on UIC. Moreover, the context of the study is Qatari universities. The term "*universities*" refers to all kinds of academic institutions in Qatar that provide or co-provide higher education or academic research (third level) from Bachelor to PhD level (Ec-Oecd, 2012), including colleges, faculties, schools and research centres. The population included university professors and researchers (at the lower level of sampling) affiliated with academic institutions in Qatar (at the higher level of sampling) who carry out teaching and research in one of the selected priority disciplines for UIC.

The list of all Qatari universities was taken from the website of the Ministry of Education and Higher Education (MEHE, 2020). Considering all universities in Qatar, this research ensures no bias towards selected academic institutions in Qatar. However, since not all research fields are relevant to UIC, this research combines the target population base from relevant or selected applied disciplines (Perkmann et al., 2013). The criterion for choosing relevant research disciplines is the prime focus of the higher education priorities set according to the Qatar National Development Strategy 2018-2022 (MPDS, 2018). Therefore, the selected disciplines included (1) Business & Economics, (2) Engineering, (3) Health & Medicine, (4) Information Technology, and (5) Natural & Other Applied Sciences.

The website of each university in the list was reviewed in order to confirm that it provides teaching and research in one of the selected disciplines. Institutions and colleges related to defence and police studies were excluded from this study because of the sensitivity of data disclosure and their unique curriculum structure. In addition, community colleges that provide vocational or diploma qualifications were not considered in this research.

As such, the selection criteria for the population of the higher-level sampling unit (i.e., academic institutions in Qatar) include the (1) level of degree offered (i.e., BSc or higher), (2) teaching and research disciplines (i.e., five applied disciplines), and (3) irrelevance to defence and police studies. The selection criteria were applied to the list of all academic institutions in Qatar (MEHE, 2020). Hence 36 academic institutions in Qatar made up the population on the higher level for this research.

However, the lower level of the sampling unit consists of university professors and researchers affiliated with the 36 academic institutions in Qatar, which made up the study population. A random sample was drawn from the total population. As such, data were collected through a survey questionnaire distributed to university professors and researchers who were affiliated with the 36 selected academic institutions in Qatar. The reason for focusing on this group was because professors and researchers have been at the forefront of UIC if such collaborations are practised in that subject academic institution at all. Additionally, this group was considered a known population, which enabled the selection of a probability random sample to represent the whole population (Saunders & Lewis, 2012). To deal with the fact that some of the selected professors and researchers in the random sample may not have knowledge of the practice of UIC, all questions of the questionnaire included the answer choice of "*Do Not Know*." However, any response was deemed incomplete if the respondent selected the "*Do Not Know*" answer option. Incomplete responses were removed from the responses received and were not qualified for data analysis.

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To define the population size and contact details of professors and researchers, a manual search was conducted on each academic institution's website and social media accounts. The search was based on data published before 29 February 2020. Indeed, the population size at that point in time was estimated at 1700 individuals, forming the entire population for this research.

When the sample size is adequately selected from the population or sampling frame, the researcher can generalize results for the whole population (Creswell, 2009). The simple random sampling technique was used in this research. Firstly, the entire population of the study included professors and researchers from all academic institutions that fulfilled the criteria of this research. Secondly, all professors and researchers in the drawn sample had an equal chance of being selected. The choice of sample size is important to indicate confidence or level of certainty that the sample represents the whole population (Saunders & Lewis, 2012). According to Hair et al. (2016), the sample size depends strongly on three factors (significance level, statistical power level and effect size) and marginally on the maximum number of arrows pointing at a construct. Indeed, this research targeted a significance level of 5% and a statistical power of 80% since there was no assurance on the level of indicator loading to maximize the statistical power of the data analysis. Moreover, to be conservative, the effect size was projected to be small at the level of 0.05, considering the novelty of researching the performance of UIC. As such, the minimum acceptable sample size was 160, according to (Hair et al., 2016). To be more conservative, the target sample size was 200.

The sample was randomly selected from the entire population of professors and researchers from the selected 36 academic institutions in Qatar. However, Baruch & Holtom (2008) showed that the expected response rate in business and management research disciplines, in which data are collected from individuals, is around 52.7%. However, the survey questionnaire was distributed online via QSurvey. Fan & Yan (2010) found that the response rate to online surveys is 11% lower than other survey methods. Moreover, the data were collected during the Covid-19 pandemic, which was projected to reduce the response rate negatively. In light of this, the target sample size of 200 was amplified by a factor of 4.5 and a random sample of 900 was drawn from the entire population. The online questionnaire was distributed to 900 professors and researchers. Around 200 questionnaires were expected to be returned for data analysis. Indeed, to increase the response rate to the online survey questionnaire, the recommendations of Saleh & Bista (2017) were followed, including (1) designing the questionnaire to consist of short and concise question items, (2) not including open-ended questions, (3) distributing the survey questionnaire with a covering letter that has a sharp subject headline and (4) sending a reminder within one week of the original letter.

As such, the final achieved sample size was 209 responses from 33 academic institutions in Qatar. Descriptive statistics did not show a marginal contribution in the achieved sample for any of the academic institutions in Qatar. The percentage of responses from each academic insinuation ranged between 2.39% and 4.78%.

In this research, the research questionnaire was distributed online by sending an email accompanied by a cover letter. Distribution by post, by hand, or face to face was not feasible because of government restrictions during the Covid-19 pandemic. The cover letter was personalized and titled individually to each potential respondent. The letter clarified the purpose and importance of the research, the way the information would be analyzed, the confidentiality and anonymous nature of the responses, the voluntary nature of responses, the approximate time for completing the questionnaire, a hyperlink to the online questionnaire, a final word of appreciation for responding within the set timeframe and the contact details of the researcher.

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The survey questionnaire was designed to measure all the variables simultaneously from the same source, namely professors and researchers at academic institutions in Qatar. This may have introduced a common method bias (Clauss & Kesting, 2017) or a social desirability bias (Bstieler et al., 2015; Nederhof, 1985). This research, therefore, accounted for the influence of external pressures imposed by universities and policies aimed at boosting UIC. To mitigate this risk, the researcher ensured that responses to the survey were anonymous (Garcia-Perez-de-Lema et al., 2017). All questions were kept simple, concise and specific (Podsakoff, 2003).

The present research examined the relationships between (1) UIC management mechanisms and UIC performance and (2) UIC activities and UIC performance. All variables were measured through multiple items. This method of measurement allowed comprehensive measurement of the variable and contributed to reducing the measurement error (James et al., 1984). In this research, a five-point Likert scale was used. The five-point Likert scale was chosen in line with the study of Miller (1956) for the human capacity for processing information, which is in the range of seven discrete categories, plus or minus two. A higher number of alternatives produces higher measurement error, as Graybill et al. (1974) explained.

The independent variable is UIC management mechanisms, which comprised 11 items. Respondents were asked to rate these items using a five-point Likert scale. Two-scale ranges were used depending on the question type (Brown, 2010). The first scale is frequency driven and is scored as 1= never, 2=a little, 3=somewhat, 4=much and 5=a great deal. The second scale is value-driven and is scored as 1=none, 2=low, 3=moderate, 4=high and 5=very high.

UIC performance is the dependent variable, which had eight items. Respondents were asked to rate the items on a five-point Likert scale (1=none, 2=low, 3=moderate, 4=high, and 5=very high).

Moreover, the survey measured the mediating effect on the main relationship between UIC management mechanisms and UIC performance through UIC activities, which comprised 15 items. Respondents were asked to rate the items on a five-point Likert scale (1=never, 2=a little, 3=somewhat, 4=much, and 5=a great deal).

The questionnaire developed for this research consists of 49 questions distributed over four key sections. The first section comprises 11 questions to measure the UIC management mechanisms. The second section comprises eight questions to measure UIC performance. The third section comprises 15 questions to measure UIC activities. Finally, the fourth section comprises 15 questions asking information about the respondent's demographic profile and the characteristics of the academic institution. The respondents' demographic profile includes their gender, age, position, education, research discipline and working experience in that position (Ishengoma & Vaaland, 2016; Davey et al., 2011; Goel & Göktepe-Hultén, 2018). University characteristics include the name of the university and the academic institution. The online version of the questionnaire presented the questions in Section 3 in a matrix format to enhance readability and reduce the expected completion time.

Since the official language of education in all the selected academic institutions is English and/or Arabic, the questionnaire was made available with the option of responding to the questionnaire either in English or Arabic according to the respondent's preference. However, the single-use online hyperlink used for the distribution of the questionnaire blocked the possibility of receiving two responses, one in each language, from the same respondent.

The questionnaire was initially prepared in the English language, so when professionally translated into the Arabic language, we ensured the semantic, idiomatic, experiential and conceptual equivalence of both the Arabic and English versions of the questionnaire. For that

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purpose, four recognized steps were implemented for questionnaire design and translation, including (1) forward translation, (2) backward translation, (3) expert review and (4) translation pilot testing (Brislin, 1986). Subsequently, a final version of the bilingual questionnaire was produced.

The final version of the questionnaire was distributed online via the QSurvey tool. This tool has been developed by Qatar Leadership Development Center and made available for use by researchers in Qatari governmental organizations. A free online version of QSurvey is also available for anyone and allows researchers to export collected data in popular formats, including Excel and SPSS.

The Partial Least Squares (PLS) technique was selected as the analysis method for this research. This choice was guided by its lower sample size requirements, ability to deal with measurement error, handle potential multicollinearity between variables, and flexibility in dealing with moderating and mediating variables. In terms of software tool selection, several software tools can apply the PLS technique, including PLS-Graph, PLS-GUI, SPAD-PLS and SmartPLS (Temme et al., 2010). The latter was selected due to its ease-of-use, features, and performance quality.

The recommended empirical tests for the reflective measurement model, according to Coltman et al. (2008), include assessments of the construct reliability and internal consistency, factor loadings and average variance extracted. These tests show all constructs' composite reliability, convergent validity and discriminant validity. In this research, assessing the quality of the measurement model involved four key steps, as described by Hair et al. (2019) and Hair et al. (2020), in addition to testing for common method variance (Podsakoff, 2003). As such, assessing the measurement model involved the following steps:

1. Testing for common method variance,
2. Assessing the indicators' outer loadings,
3. Assessing construct reliability (CR),
4. Assessing convergent validity, and
5. Assessing discriminant validity.

The data collected from the pilot study, as well as the main study, were entered into SmartPLS to conduct these empirical tests and produce reliability and validity indicators.

Assessing the quality of the structural model involves primarily six key steps, as described by Hair et al. (2019) and Hair et al. (2020). As such, in this research, the assessment of the structural model involved seven steps as follows:

1. Evaluating the structural model's collinearity,
2. Assessing the coefficient of determination,
3. Assessing the effect size of each construct,
4. Assessing the predictive relevance of the model (primarily in-sample prediction),
5. Assessing the predictive power of the structural model via PLSpredict (primarily out-of-sample prediction), and
6. Examining the size and significance of path coefficients.

The pilot study was conducted on a limited sample representative of the target population (Bhattacherjee, 2012). The main purpose of the pilot test was to assess the reliability and validity of the research instrument prior to the data collection phase. Data collected from the pilot test were imported to the SmartPLS software package to analyze the validity and reliability of the measures. The analysis determined how reliable the measures were and their convergent and discriminant validities.

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The respondents selected for the pilot study came from the same research sample (Saunders & Lewis, 2012). The sample size of the pilot testing was selected in line with the guidelines Thabane et al. (2010) developed. As such, the sample was selected to be principally representative of the target population of the research. The sample included 69 respondents from 33 academic institutions in Qatar.

The online questionnaire was distributed along with a cover letter to 200 faculty members and researchers from 36 academic institutions in Qatar. The online questionnaire was sent in early April 2020, and data collection lasted for two weeks. A reminder was sent after one week in order to improve the response rate.

The responses were screened to ensure their completeness and quality. A questionnaire was deemed incomplete if the respondent, either accidentally or willingly, failed to answer one or more than one question or selected the "*Do Not Know*" answer option. Incomplete responses and straight-lining answers were removed from the responses received during the pilot testing. As such, 69 responses were qualified for pilot testing analysis. The descriptive statistics show the key characteristics of the pilot testing sample. Microsoft Excel was used to analyze the descriptive statistics. Indeed, the demographic characteristics of the respondents who participated in the pilot study showed a good representation of the target population.

In order to ensure that common method variance was not a problem in this study, Harman's single-factor test was used (Chang et al., 2010). The results of the tests indicate that common method variance was not evident in the collected data since the total variance extracted by one factor was 36.305 %, which is less than the proposed threshold of 50%. As such, the first step of the assessment was completed satisfactorily.

As shown in Table 1, all indicators exceeded the minimum outer loadings of 0.5, and the majority of indicators exceeded the most conservative outer loadings of 0.708. As such, all indicators were deemed reliable and retained in the measurement model. As such, the second step of the assessment was completed satisfactorily. Since the CR for all constructs is within the acceptable value range (0.7–0.95), all constructs were deemed reliable. As such, the third step of the assessment was completed satisfactorily. Since the Average Variance Extracted (AVE) for all constructs exceeded the minimum value of 0.5, all constructs were deemed to have convergent validity. As such, the fourth step of the assessment was completed satisfactorily.

Table 1
INDICATOR OUTER LOADINGS, COMPOSITE RELIABILITY AND AVERAGE VARIANCE EXTRACTED (AVE) FOR ALL CONSTRUCTS

Construct	Item/ Indicator Code	Outer Loading		Composite Reliability (CR)		Average Variance Extracted (AVE)	
		Pilot Study	Main Study	Pilot Study	Main Study	Pilot Study	Main Study
UIC management mechanisms	MEC01	0.6579	0.6412	0.9245	0.9172	0.5280	0.5036
	MEC02	0.6842	0.6540				
	MEC03	0.7927	0.8118				
	MEC04	0.7462	0.7886				
	MEC05	0.6848	0.6665				
	MEC06	0.6976	0.6312				
	MEC07	0.7343	0.7426				

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	MEC08	0.6902	0.6543				
	MEC09	0.7533	0.7388				
	MEC10	0.8332	0.7688				
	MEC11	0.6990	0.6790				
UIC activities	ACT01	0.7559	0.7186	0.9487	0.9491	0.5532	0.5550
	ACT02	0.7051	0.6759				
	ACT03	0.7437	0.6622				
	ACT04	0.7625	0.7663				
	ACT05	0.7846	0.7235				
	ACT06	0.6191	0.7044				
	ACT07	0.6639	0.6930				
	ACT08	0.7130	0.7474				
	ACT09	0.8007	0.7445				
	ACT10	0.749	0.7417				
	ACT11	0.7334	0.7594				
	ACT12	0.7418	0.7866				
	ACT13	0.8147	0.8355				
	ACT14	0.7427	0.7770				
	ACT15	0.8010	0.8162				
UIC performance	PER01	0.8195	0.8291	0.9145	0.9272	0.5743	0.6150
	PER02	0.8720	0.8536				
	PER03	0.6608	0.7293				
	PER04	0.7263	0.7512				
	PER05	0.6485	0.7445				
	PER06	0.7754	0.7394				
	PER07	0.7580	0.8152				
	PER08	0.7761	0.8015				

Discriminant validity was assessed through the monotrait ratio of correlations (HTMT) ratio (Henseler et al., 2015). Since the HTMT ratios for all pairs of constructs in the measurement model were lower than the cutoff value of 0.85, all constructs were deemed to have discriminant validity and to be statistically different from each other. As such, the fifth step of the assessment was completed satisfactorily.

Table 2
PILOT TESTING-HETEROTRAIT-MONOTRAIT RATIO OF CORRELATIONS (HTMT)

Constructs	HTMT Ratio	
	Pilot Study	Main Study
UIC Management Mechanisms -> UIC Activities	0.6957	0.6850
UIC Performance -> UIC	0.6493	0.7007

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Activities		
UIC Performance -> UIC Management Mechanisms	0.7321	0.6894

As such, the assessment of the quality of the measurement model showed that all the indicators used were reliable. All constructs were internally consistent and reliable and were deemed to have convergent and discriminant validity. As such, analysis of the pilot testing data was completed satisfactorily.

RESULTS AND DISCUSSION

Data were collected between May and July 2020. Since the duration of the data collection was relatively short (i.e., three months), a non-response bias test was not required (Armstrong & Overton, 1977). Overall, 900 questionnaires were distributed, and 283 questionnaires were received. As such, after removing the incomplete responses and responses with suspicious patterns, 209 questionnaire responses qualified for data analysis. The analysis of the respondents' demographic characteristics showed a good representation of the target population in the main study.

Similar to the pilot study, the assessment of the quality of the measurement model for the main study showed that all the indicators used were reliable. All constructs were internally consistent and reliable and were deemed to have convergent and discriminant validity.

Multicollinearity is measured through the variance inflation factor (VIF) analysis, which calculates the degree of correlation between one predictor and the other predictors in the structural model. Ideally, the value of VIF should be less than 3 (Hair et al., 2019; Hair et al., 2020). As shown in Table 3, the VIF scores for all pairs of constructs were below 3. So, all constructs were deemed to not have collinearity issues. As such, the first step of the assessment was completed satisfactorily.

Table 3
VARIANCE INFLATION FACTOR (VIF) SCORES

Constructs	VIF
UIC Activities->UIC Performance	1.7025
UIC Management Mechanisms->UIC Activities	1.0000
UIC Management Mechanisms->UIC Performance	1.7025

According to Table 4, the Coefficient of Determination (R^2) values of both UIC activities and UIC performance were greater than 0.333 and were considered to be moderate. Thus, for UIC activities, 41.26% of the variance can be explained by the independent variable, whereas for UIC performance, 54.29% of the variance can be explained by the predictor variables. As such, the second step of the assessment was completed satisfactorily.

Table 4
COEFFICIENT OF DETERMINATION (R^2) VALUES

Construct	R^2	Rating
UIC Activities	0.4126	Moderate
UIC Performance	0.5229	Moderate

Table 5 shows the effect size (f^2) test results and the corresponding ratings for the two predictor constructs in the structural model.

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Table 5 EFFECT SIZE (F^2) OF THE PREDICTOR CONSTRUCTS		
Predictor Construct	**Effect size (f^2)**	**Effect Size Rating**
UIC Activities -> UIC Performance	0.2214	Medium
UIC Management Mechanisms -> UIC Activities	0.7025	High
UIC Management Mechanisms -> UIC Performance	0.1718	Medium

As such, the predictive ability of UIC management mechanisms for UIC activities was high but was medium for UIC performance. Similarly, the predictive ability of UIC activities was medium for UIC performance. As such, the third step of the assessment was completed satisfactorily.

Table 6 shows the predictive relevance of the two dependent variables in the structural model.

Table 6 PREDICTIVE RELEVANCE (Q^2)	
Construct	**Q^2**
UIC Activities	0.2114
UIC Performance	0.2934

Indeed, Q^2 was greater than zero for the two dependent variables, UIC performance and UIC activities. The relative impact of Q^2 is reflected by the effect size, q^2, which is calculated for each predictor construct or path. Table 7 shows the predictive relevance test results and the corresponding ratings for each predictor construct or path in the structural model.

Table 7 PREDICTIVE RELEVANCE (Q^2) AND EFFECT SIZE (Q^2) OF THE PREDICTOR CONSTRUCTS				
Predictor Construct	**Q^2 Included**	**Q^2 Excluded**	**Effect size (q^2)**	**Effect Rating**
UIC Activities -> UIC Performance	0.2934	0.2387	0.0774	Small
UIC Management Mechanisms -> UIC Activities	0.2114	0	0.2681	Medium
UIC Management Mechanisms -> UIC Performance	0.2934	0.2527	0.0576	Small

The generated values of q^2 indicate the small effect of UIC activities on UIC performance, the medium effect of UIC management mechanisms on UIC activities and the small effect of UIC management mechanisms on UIC performance. Thus, the predictive power of the structural model was confirmed for all predictor constructs. As such, the fourth step of the assessment was completed satisfactorily.

Table 8 shows the results obtained from the PLSpredict test method for all indicators of the two dependent variables in the path model:

Table 8 PLSPREDICT TEST RESULTS								
	PLS-SEM Values			**Linear Regression Values (LM)**			**PLS-SEM<LM**	**PLS-SEM<LM**
Indicator	**Q^2_predict**	**RMSE**	**MAE**	**Q^2_predict**	**RMSE**	**MAE**	**(based on RMSE)**	**(based on MAE)**
ACT01	0.2034	0.8462	0.6683	0.1484	0.8749	0.6863	✓	✓
ACT02	0.2063	0.8577	0.683	0.1866	0.8682	0.6922	✓	✓

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ACT03	0.109	0.8178	0.6224	0.1464	0.8004	0.618		
ACT04	0.2818	0.7742	0.6167	0.2598	0.7859	0.6351	✓	✓
ACT05	0.181	0.7586	0.5945	0.1488	0.7734	0.5992	✓	✓
ACT06	0.1631	0.888	0.6936	0.0777	0.9322	0.74	✓	✓
ACT07	0.172	0.8382	0.6471	0.2408	0.8026	0.6291		
ACT08	0.198	0.8464	0.6422	0.149	0.8719	0.6627	✓	✓
ACT09	0.2271	0.7752	0.5896	0.2496	0.7638	0.578		
ACT10	0.1978	0.8552	0.6304	0.1501	0.8803	0.6547	✓	✓
ACT11	0.2516	0.7334	0.5837	0.2833	0.7177	0.5727		
ACT12	0.2651	0.7011	0.5426	0.254	0.7064	0.5437	✓	✓
ACT13	0.2834	0.7607	0.5922	0.2546	0.7759	0.6022	✓	✓
ACT14	0.2322	0.7897	0.627	0.2222	0.7949	0.6278	✓	✓
ACT15	0.2995	0.7115	0.5625	0.3031	0.7097	0.5604		
PER01	0.341	0.6364	0.4978	0.3188	0.6471	0.5028	✓	✓
PER02	0.3685	0.6449	0.51	0.359	0.6497	0.5031	✓	
PER03	0.2804	0.6071	0.4764	0.2711	0.611	0.4748	✓	
PER04	0.1885	0.652	0.5068	0.22	0.6392	0.4866		
PER05	0.1629	0.6608	0.5334	0.1773	0.6551	0.5186		
PER06	0.1628	0.6311	0.4945	0.209	0.6134	0.4639		
PER07	0.2559	0.691	0.5297	0.2711	0.6839	0.5314		✓
PER08	0.1836	0.7215	0.5498	0.2062	0.7115	0.5572		✓

From Table 8, it can be seen the Q^2_Predict value was greater than zero for all indicators. Moreover, the RMSE (or MAE) values obtained from the PLS path model were lower than the corresponding values of RMSE (or MAE) obtained from the naïve linear regression for the majority of the indicators (13 out of 23 indicators). As such, the path model was considered to have medium predictive power. As such, the fifth step of the assessment was completed satisfactorily.

The Path Coefficient β value is a measure used to test the hypothesized relationship between constructs in the structural model. The significance of β was assessed by running bootstrapping in SmartPLS 3.0 (Ringle et al., 2015).

Figure 2 shows the β and the corresponding *t*-values for the path in the structural model without the mediating variable. Indeed, the results demonstrated the significant and positive influence of UIC management mechanisms on UIC performance (path coefficient = 0.6549, *t*-value = 16.1464*** > 2.58, *P*-value < 0.01).

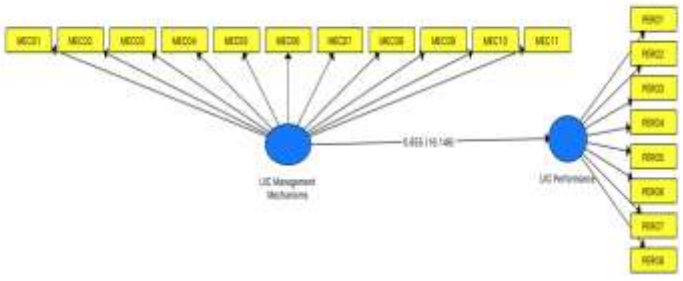

FIGURE 2
PATH COEFFICIENTS (B) AND THE CORRESPONDING T-VALUES, WITHOUT THE MEDIATOR VARIABLE

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Figure 3 shows the β and the corresponding *t*-values for each path in the structural model, after adding the mediator variable to the structural model. Indeed, after adding the UIC Activities to the structural model, the relationship between UIC management mechanisms and UIC performance was significantly reduced (i.e., β value was reduced from 0.6549 to 0.3735) and remained significant (*t*-value = 4.6276*** > 2.58, *P*-value < 0.01). Moreover, the direct effect of the UIC management mechanisms on UIC performance is less than the direct effect of the UIC activities on UIC performance. Therefore, H1 was accepted.

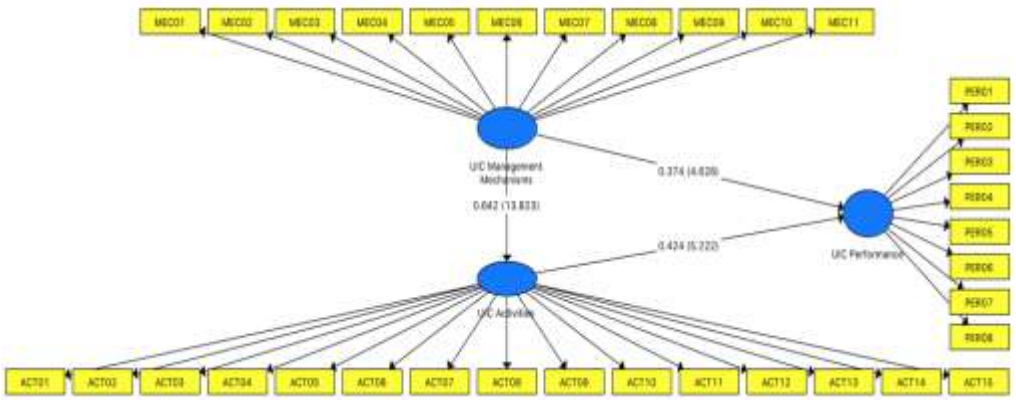

FIGURE 3
PATH COEFFICIENTS (B) AND THE CORRESPONDING *T*-VALUES, WITH THE MEDIATOR VARIABLE

As shown in Figure 3, the results demonstrated the significant and positive influence of UIC activities on UIC performance (path coefficient=0.4241, *t*-value=5.222 *** > 2.58, *P*-value < 0.01). Therefore, H2 was accepted. Also, the results demonstrated the significant and positive influence of UIC management mechanisms on UIC Activities (path coefficient = 0.6424, *t*-value = 13.8226*** > 2.58, *P*-value < 0.01). Therefore, H3 was accepted.

Table 9 summarizes the path coefficients significant test for total, direct and indirect effects of the UIC management mechanisms on UIC performance.

Table 9
SUMMARY OF MEDIATION ANALYSIS

	β	*t*-value	*P*-value
Total Effect (MEC -> PER)	0.6459	14.8336	0
Direct Effect (MEC -> PER)	0.3735	4.6276	0
Indirect Effect (MEC -> ACT -> PER)	0.2724	4.7402	0

Indeed, as shown in the above table with the inclusion of the mediating variable (i.e., UIC activities), the direct effect of UIC management mechanisms on UIC performance was significant (path coefficient = 0.3735, *t*-value = 4.6276 ***> 2.58, *P*-value < 0.01), and the indirect effect of UIC management mechanisms on UIC performance through UIC activities was also significant (path coefficient = 0.2724, *t*-value = 4.7402*** >2.58, *P*-value < 0.01). The VAF number for mediation effect = 55% (See Table 10). Since the VAF value is larger than 20% but less than 80%, this indicates a partial mediation effect (Hair et al., 2016). These results show that UIC activities partially mediate the relationship between UIC management mechanisms and UIC performance. Therefore, H4 was accepted.

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Table 10 CALCULATING THE VAF NUMBER FOR MEDIATION EFFECT	
Path	**Path coefficient (β)**
UIC Management Mechanisms -> UIC Performance (c ')	0.3735
UIC Management Mechanisms -> UIC Activities (a)	0.6424
UIC Activities -> UIC Performance (b)	0.4241
VAF Formula=a * b / (a * b + c ')	55%

c ': Direct Effect

On the basis of the assessment of the quality of the structural model and the empirical test results, the confirmed structural model of UIC performance is summarized in Figure 3.

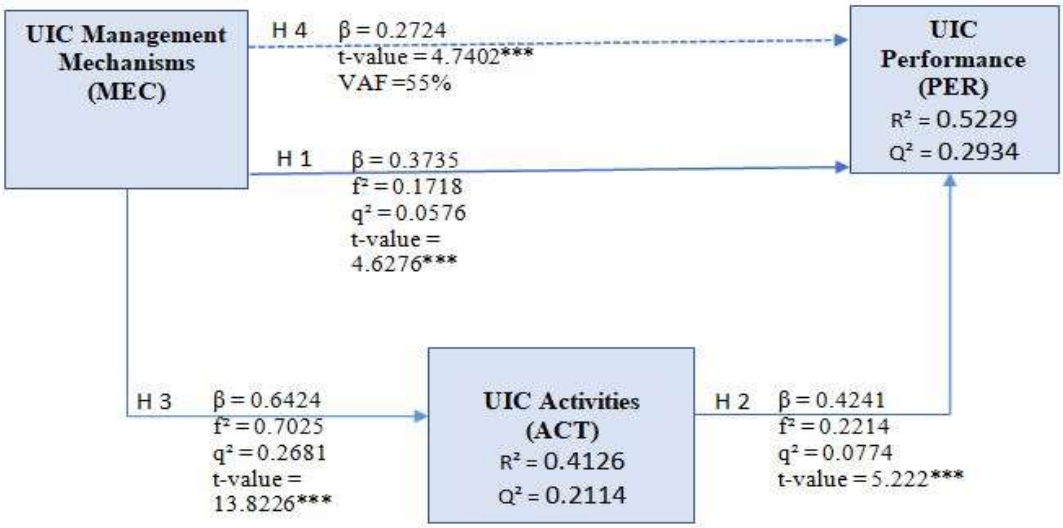

FIGURE 4
CONFIRMED STRUCTURAL MODEL FOR UIC PERFORMANCE

R^2=coefficient of determination; Q^2=predictive relevance; β=path coefficient; f^2=effect size on R^2; q^2=effect size on Q^2; t-value=t-test statistic; p-value=level of significance; VAF=variance accounted for mediation effect

As shown in Figure 4, the R^2 for UIC performance is moderate at a level of 0.5259, which indicates that the predictor variables, UIC management mechanisms and UIC activities, influenced 52.29% of the variance of UIC performance. The effect size (f^2) values are 0.1718 and 0.2214, respectively, showing that both predictor constructs have a medium effect on UIC performance. As such, the model fits well by combining the predictor constructs, UIC management mechanisms and UIC activities.

Similarly, the R^2 for UIC activities is moderate (R^2=0.4126), which means that UIC management mechanisms influence 41.26% of the variance in UIC activities. The f^2 value is 0.7025, which shows that UIC management mechanisms strongly affect UIC activities. VAF of the mediation effect of UIC activities is 55% which confirms the partial mediation effect of UIC activities on the relationship between UIC management mechanisms and UIC performance.

The Q^2 value for UIC performance is 0.2934. Since this value is above zero, this confirms the predictive relevance of the model for the construct. Moreover, the values of q^2 are 0.0774 and 0.0576, respectively, which show that UIC management mechanisms and UIC activities have small effects on the predictive relevance of UIC performance. As such, the predictive relevance

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of the two predictor constructs is collectively better than the predictive relevance of each construct separately.

After analysis of the results obtained from the respondents, for H1, UIC management mechanisms showed a significant positive influence on UIC performance (*t*-value=4.6276***). This finding is consistent with previous studies. According to Huang & Chen (2017), UIC management mechanisms positively influence universities' academic innovation performance. In the later study, innovation performance is reflected by the number of patents and the number of publications. The study of Huang and Chen (2017) has been linked to organizational control theory, which sees management mechanisms as organizational tools that influence UIC performance.

Similarly, Tseng et al. (2020) found that UIC management mechanisms positively influence UIC funding and universities' innovation performance. The university innovation performance in that study included the number of research publications, the number of patents issued, and the number of licensing patents, the number of business incubations in the university and the amount of royalty income from technology licensing.

On the contrary, Riviezzo et al. (2019) found that the entrepreneurial orientation of university departments, although it influenced the rate of spin-offs, did not influence the number of patents generated. Entrepreneurial orientation in that study included industry collaboration, which was measured by four items that relate to UIC management mechanisms in the present study, including UIC policies and promoting research mobilization, unconventionality and industry collaboration. The results of Riviezzo et al. (2019) were not in line with our findings nor the findings of other studies, which may be related to (1) external contextual variables (the study was conducted in Italy, Spain, the UK and Portugal), (2) internal contextual variables (the profile of the university departments that participated) and (3) methodological limitations relating to the items used in the measurement of latent variables.

According to Perkmann et al. (2013), the organizational determinants of UIC positively influence the commercialization of research, represented by patenting and academic entrepreneurship. These organizational determinants included the quality of the university or department, organizational support, incentive systems, organizational commercialization experience and peer effects. The last study was linked to the institutional theory that sees management mechanisms as part of a social structure that includes laws, norms, cultures and routines that become holistic guidelines for driving organizational behaviours, including UIC behaviour. This proposition is in line with another study Anatan (2015) conducted regarding the institutional pressure to improve the performance of the university's research activities.

Likewise, the findings of Hue Kyung et al. (2016) suggested the significant influence of university research capacity on driving UIC performance. Research capacity in that study included the size of the technology licensing office (TLO) and the research capacity of the full-time faculty. The UIC performance measures in that study are represented by the number of patents, the number of technology transfer contracts and technology licensing fees. The latter study was linked to resource-dependency theory, which sees management mechanisms as an organization's reactions to reduce interdependencies and performance uncertainties when managing relationships with different organizations and society. Similarly, a study by Berbegal-Mirabent et al. (2015) showed a positive relationship between Technology Transfer Offices (TTO's) size and UIC revenue performance represented income of R&D contracts.

As such, with respect to the first research question, with regard to the relationship between UIC management mechanisms and UIC performance, the answer is that the relationship

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is significant, and there is a positive influence of UIC management mechanisms on UIC performance.

After the results obtained from the respondents had been analyzed, for H2, UIC activities showed a significant positive influence on UIC performance (*t*-value=5.222***). This finding is consistent with previous studies. Van Looy et al. (2004) indicated that academic engagement in entrepreneurial activities corresponded with increased publication quality and productivity.

Indeed, Huang & Chen (2017) showed the influence of three UIC activities, i.e., innovation climate, on UIC innovation performance. Similarly, a previous study by Vaaland & Ishengoma (2016) showed that UIC activities enhance the innovation performance of universities and industry. UIC activities in that study included three activity groups: (1) collaborative training and educational activities, (2) collaborative consulting and services activities, and (3) collaborative research activities. Innovation performance included measures of technological innovations (e.g., patenting) and organizational or managerial innovation (e.g., process or marketing innovations). The study of Vaaland & Ishengoma (2016) has been linked to the institutional theory that sees UIC activities' role within the broader national innovation system.

However, the results of the present study are not entirely consistent with the findings of Berbegal-Mirabent et al. (2015). They suggested that greater faculty involvement in UIC knowledge transfer activities does not significantly affect income from R&D contracts. Faculty involvement was measured by the extent of involvement in UIC knowledge transfer activities as a percentage of total faculty work at the university. These dissimilar results were interpreted in the context of Spanish universities, which focus more on UIC knowledge transfer activities that have publication rather than commercialization focus (Berbegal-Mirabent et al., 2015).

For H3, UIC management mechanisms showed a significant positive influence on UIC activities (*t*-value=13.8226***). This finding is consistent with previous studies. According to Galán-Muros et al. (2017), seven UIC activities were influenced by four groups of UIC management mechanisms. These management mechanisms included top management support, UIC incentives, UIC offices and UIC promotion. The UIC activities in the previous study included joint curriculum design and delivery, lifelong learning, student mobility, professional mobility, joint R&D, entrepreneurship and commercialization of joint R&D results. All four groups of UIC management mechanisms and the seven key UIC activities were used to measure the variables of UIC management mechanisms and UIC activities in the present study. Likewise, Davey et al. 2(011) showed that eight UIC activities were influenced by a number of organizational drivers, including eight UIC management mechanisms in the present study.

For H4, the indirect effect of UIC management mechanisms on UIC performance through UIC activities was significant (*t*-value=4.7402***). The VAF number for mediation effect = 55%. When UIC Activities was added, the relationship between UIC management mechanisms and UIC performance was significantly reduced (i.e., β value was reduced from 0.6549 to 0.3735). As such, the relationship between UIC management mechanisms and UIC performance is partially mediated by UIC activities. This finding is consistent with previous studies by Clauss & Kesting (2017) and Albats et al. (2018).

Indeed, the study of Clauss & Kesting (2017) showed the mediation of three UIC knowledge sharing activities on the relationship between two forms of UIC governance mechanisms and the achievement of UIC goals. Similarly, Albats et al. (2018) showed that UIC activities mediate the relationship between UIC inputs and UIC performance. In the later study, UIC inputs included hard and soft management mechanisms to boost UIC performance,

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including provision of physical resources, human and financial resources. UIC performance involved indicators of research and patent performance.

Regarding the second research question regarding the mediating relationship of UIC activities, the answer is that UIC activities partially mediate the relationship between UIC management mechanisms and UIC performance.

CONCLUSION

This research contributes to the body of UIC knowledge through developing its own theoretical research model by introducing the mediating role of UIC activities to the main relationship between UIC management mechanisms and UIC performance. The empirical study confirmed the mediating role of UIC activities. Therefore, it contributes to affirming the mediating role of UIC activities on the relationship between UIC management mechanisms and UIC performance.

This research offers a new measurement instrument for measuring the relationships between UIC management mechanisms and UIC performance with UIC activities as a mediator. Indeed, the reliability and validity of the research instrument, confirmed by data analysis, is a methodological contribution of this study. This instrument could be used carefully for comparative studies and to explore, assess and evaluate the state of UIC in Qatar over time. To the best of our knowledge, no previous studies have been conducted in this context before. Thus, the findings of this study have contributed to the ongoing research in this area. As such, the research illuminates key contextual findings and makes contributions to bridge the performance gaps of UIC in Qatar, including the following:

1. The need to grow the mix of UIC activities to cover the three UIC activity groups: (1) collaborative training and education, (2) collaborative consulting and services, and (3) collaborative research;
2. The need to monitor the performance of UIC in academic institutions in terms of the three main performance groups: (1) research performance, (2) patent performance and (3) UIC revenue performance;

Despite the valuable contributions of the study to the body of knowledge, this study still has some limitations that need to be considered in similar studies. The study was conducted in the institutional context of academic institutions in Qatar. Countries and regions with different phases of economic development and innovation ecosystems may display diverse forms of UIC and dissimilar relationship significances.

The study did not account for the influence of the type of academic institution (Hou et al., 2019) (e.g., public or private funding, affiliated with a comprehensive or specialized university, having local and international presence, and size measures for academic institution). Too, the study did not distinguish between UIC from different industry sectors (e.g., manufacturing, service, construction, high or low technology industries), different sizes and presence of the industry partner (e.g., national or international). Considering such control factors is beyond the scope of this study and may yield different results for each category.

The research design for this study was cross-sectional (a single-time observation), which, on the one hand, limits the strength of causal inferences among the observed variables to more statistical associations. On the other hand, it hinders the study of the change and dynamics of the effects accompanied by different collaboration experiences and UIC maturity levels.

Moreover, data were collected from one side of UIC, constrained to professors and researchers from academic institutions in Qatar who fulfilled the research selection criteria. The

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study considered five distinct applied disciplines when selecting the target population for the sample. Thus, any generalization of the findings has to be cautious.

The study offers several recommendations for future studies, as described below:

1) Future studies may include conducting comparative studies on UIC of different types of academic institutions, profiles of industry partners, and industry sectors.
2) Future research should preferably adopt a longitudinal research design to (1) strengthen causal inferences among the observed variables and (2) study the change and dynamics of the effects accompanied by different collaboration experiences and UIC maturity levels.
3) In the context of Qatar, future research should investigate the industry perspective for the effect on UIC performance.
4) Academic and business research is increasingly becoming multidisciplinary because of the complexities of the research agenda. Future research should explore how the relationships among the variables differ when the research orientation of the population is multidisciplinary.
5) Future research should consider using actual values of UIC inputs and outcomes, available in documented information and published reports, for further objective evaluations of UIC performance.
6) Emerging trends in UIC activities, like educational crowdsourcing platforms and other emerging intermediary organizations (e.g., digital collaboration, open data and crowdsourcing platforms), provide an opportunity for further investigations in future studies.

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