International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Integrating Digital Governance, Ethics, and Transformational Leadership for Digital Innovation Performance: A Multi-Theoretical Conceptual Framework for Public Sector Organizations

Raja Shaheen Alhammadi

University of Dubai, Dubai, United Arab Emirates

Abstract

Background: The high rate of development of Industry 4.0 technologies and artificial intelligence has posed the most significant challenges to the public sector organizations that are aiming at improving their performance in digital innovation. Although there has been an increase in scholarly interest, literature does not have an integrative conceptual framework, which can concurrently capture the role of digital governance, data ethics, digital transformation, technology adaptation, and transformational leadership in influencing the results of innovation within government organizations.

Objective: The present paper summarizes the available theoretical and empirical evidence to establish a multi-theoretical conceptual framework to explain the antecedents and the mechanisms that lead to digital innovation performance within the context of the public sector, specifically the case of the United Arab Emirates (UAE).

Methods: Drawing on four foundational theories Diffusion of Innovation (DOI) theory, Transformational Leadership theory, Institutional theory, and Teleological Ethical theory the study conducts a critical synthesis of the literature on digital governance, data ethics, technology adaptation, digital transformation, and their interrelationships with innovation performance.

Results: The framework suggested places data ethics, digital transformation, and technology adaptation as autonomous drivers of digital innovation performance, mediated by digital governance, and moderated by transformational leadership. It has nine testable hypotheses and explains the theoretical mechanisms that support each pathway. Conclusions: The integrative framework fills the key gaps in the existing literature by bridging the previously isolated areas of ethics, governance, leadership, and technology into a comprehensive explanatory framework of digital innovation in the public sector. Theoretical implications, empirical research implications, and implications to the management practice in the public sector are discussed.

Keywords: digital governance; data ethics; digital transformation; digital innovation performance; transformational leadership; public sector; Industry 4.0

1. Introduction

Industrial revolution four (Industry 4.0, hereafter IR 4.0) has radically changed the organizational landscape of organizations across the globe. As its original conceptualization, IR 4.0 refers to the integration of current technologies and the growing interconnectedness of the formerly closed entities/facets within the organization and its realms [1]. Similar efforts have been launched in the United States as the Industrial Internet Consortium and Smart Manufacturing Leadership Coalition, and in the Middle East, through bold governmental-led approaches to digitalization [1,2]. In this world-wide change, the problems of the public sector organizations are different: they must reconcile the needs of innovation and the demands of accountability, transparency, ethical data stewardship, and governance [3,4].

The United Arab Emirates has established itself as a digital leader in the region in terms of government. The government has since the beginning of the UAE Vision 2021 focused on enhancing the quality of the public service using technology in areas such as healthcare, education, and security [5]. This ambition is further forwarded by the UAE Centennial Plan 2071, and the UAE Strategy on Artificial Intelligence, published in 2017, is the first national strategy that states clearly that it would shift to an AI-driven government [6]. Klaus Schwab, the founder of the World Economic Forum, also found artificial intelligence to be the key driver of IR 4.0, which proves its contribution to spurring discontinuous changes in many industries [7]. In that regard, digitalization of the operations of the public sector is not just a technical endeavor but a strategic need that requires unified leadership, governance and ethical management.

Although the existing literature addresses the issue of digital transformation, governance, and innovation, various gaps are identified in it. To begin with, the concept of digital governance has hardly been examined as a direct mediating factor between technology-related antecedents and the digital innovation performance consequences [8,9]. Second, not many studies have investigated data ethics as an indicator of innovation performance in digitally transforming organizations [10]. Third, the moderating aspect of transformational leadership in the quickening of the influence of digital ethics, technology adjustment, and digital transformation on the results of innovation has not been completely examined [11,12]. Fourth, a substantial part of the previous study has focused on the private sector or the West, and there is a major gap concerning the public sector organizations in the Gulf Cooperation Council (GCC) region and the UAE itself [13].

The paper fills these gaps by formulating an integrative and multi-theoretical conceptual model which integrates the interrelationships between data ethics, digital transformation, technology adaptation, digital governance, transformational leadership, and digital innovation performance. Based on four theoretical frameworks, namely, Diffusion of Innovation (DOI) theory [14], Transformational Leadership theory [15], Institutional theory [16], as well as Teleological Ethical theory [17], the framework presents an overall theoretical framework of how public sector organization can deliver high-level digital innovation performance by the coordinated management of technology, governance, ethics, and leadership.

The value added by this paper is tripled. It presents a theoretically based synthesis of fragmented bodies of literature on governance, ethics, leadership, and digital innovation that existed previously. Second, it suggests a testable conceptual model which has well defined independent, mediating, moderating and dependent variables. Third, it places the framework in the context of the specific institutional and policy context of the UAE public sector and provides real-life applicability to the government leaders and policymakers in the face of digital transformation.

The rest of this paper is structured in the following way. Part 2 will provide a critical review of the available

literature on IR 4.0, digitalization, innovation, governance, ethics, leadership, and digital transformation. Section 3 indicates the theoretical basis of the proposed framework. Section 4 shows the conceptual model and the hypotheses. Section 5 explains how the framework is relevant to the current models and theories. Section 6 deals with implications for research and practice. Section 7 determines limitations and future directions, and Section 8 closes the paper.

2. Literature Review

2.1 Industry 4.0, Digitalization, and Innovation

The fourth industrial revolution is the term suggested by Rostow (1988) to define the shift of growing creations into the world of innovation of production groups [18]. Kagermann et al. (2013) then termed IR 4.0 to refer to the transformation of the strategy, organization, business model, value and supply chains, processes, products, skills, and stakeholder relations of firms [19]. According to Ruts, R., Ruessmann, et al., (2015), nine main technologies define IR 4.0: simulation, horizontal and vertical system integration, industrial Internet of Things (IoT), cyber security, cloud-based services, additive manufacturing, augmented reality, automated robots, and big data analysis [20]. Technology has brought about unprecedented opportunities that must be handled effectively by leaders and government to guarantee that they have positive impacts on business and society [21].

Its concept of innovation has intellectual roots. According to Schumpeter (1911), innovation was defined as a new or better product, a new method of production, the creation of new markets, the creation of new sources of supply and the creation of new industry structures [22]. He further elaborated this definition to mean doing new things or doing things which are already done in new way [23]. It is out of this that Yoo et al. (2010) defined digital innovation as the execution of new combinations of digital and physical elements to offer new products [24]. There are two key concepts, convergence and generativity [25], that define digital innovation and goes beyond simple digitization by redesigning current socio-technical structures and value propositions [24].

According to Organization of Economic Cooperation and Development (OECD) Oslo Manual (2005), innovation refers to the act of producing a new or much better item or service, marketing strategy, or a way of conducting business, organization or arrangements in the workplace, or PR [26]. Crossan and Apaydin (2010) pointed out three pivotal dimensions of innovation namely, form (type), referent (novelty), and magnitude (impact) [27]. Product, process, marketing, and organizational innovations are distinguished by the form dimension. The referent dimension deals with the level of novelty, which is new to the firm, the market, the industry or the world. Radical innovations and incremental ones differ in the dimension of magnitude. Digital innovations are often radical in nature, in that they often entail the reorganization of the current socio-technical systems and not just a digitalization of analog information [24,28].

In DOI theory, Rogers (1995) found five characteristics of innovation, compatibility, relative advantage, complexity, trialability and observability, but the first three attributes are always linked to the innovation adoption at the organizational level [29,30]. Using artificial intelligence has proven useful in facilitating the innovation process, such as customer service chatbots and speech and voice services, as well as automated network operations [31]. The role of managers in the adoption of AI is essential, and by prioritizing AI applications as a strategy, they become more inclined to spend resources on their implementation [32]. Combining digital and physical innovation is thus a fundamental concept to understand in the context of understanding how organizations acting in the public sector can utilize IR 4.0

technologies to improve their performance in digital innovation.

2.2 Governance, Ethics, and Leadership in the Digital Age

New technologies like artificial intelligence and robotics have posed regulatory problems, which are not limited to the traditional pacing problem of governance [33]. It has been suggested that soft law strategies can deal with the shortcomings of conventional regulation [34], and governance coordinating committees can be suggested to close the divide between technology creation and regulatory control [35]. To attain good governance in the public sector, there are six principles which are essential; they include: leadership, integrity, commitment, accountability, integration and transparency [36].

The moral aspects of digital technology have been addressed more intensively in scholarly literature. Floridi (1999) proposed a conceptual and methodological approach known as information ethics, which stated that old categories of ethical approaches were not sufficient in resolving the cyber technology-created issues [37]. A central issue that Martin and Freeman (2004) made is who must take the moral responsibility of technologies, and later studies have argued about whether this is the responsibility of the organizations that utilize the technology or algorithm creators [38,39]. Data ethics also involves a few imperative themes: privacy, accountability, safety and security, transparency and explainability, fairness and non-discrimination, human control of technology, professional responsibility, and the advancement of human values [40]. Yang et al. (2018) emphasized that the ability of the predictive and incessant pushing of the artificial intelligence must serve but not destroy human dignity and self-determination [41]. There are other governance and ethical issues brought forth by the notion of big data. Boyd and Crawford (2012) noted that people, things, and interactions are producing large amounts of information, and the term big data is not used to imply the amount of data but rather the computational capacity to make legal, economic, social, and technological claims [42]. The conflict between the principles of data minimization as per the General Data Protection Regulation (GDPR) and the broad tendencies of big data analytics leaves complex governance issues to organizations [43]. The Information Commissioner Office (ICO) has realized the same resistance and is urging institutions to consider using high quality governance procedures in data quality and management [43].

In the governance literature, there are two types of control mechanisms: internal and external. Operation procedures, organizational structure, budgets, and internal audits are internal controls [44]. Outside controls are based on legislation, regulations, and control roles [45]. The implementation of IT strategy is closely connected with IT governance, which plays a very important role in the general business-IT alignment [46]. Van Grembergen and De Haes (2010) defined an IT governance framework as structures, processes, and relational mechanisms [47]. Structures are associated with organization responsibility following the introduction of IT policies, processes with top management decision making processes, and relational mechanisms with leaders and people in an organization.

The issue of leadership has been cited to be one of the key determinants of organizational innovation and performance. According to Northouse (2004), leadership is a process through which an individual can influence a group to attain similar goals [48]. Burns (1978) explained that no leader can work without the goals and needs of followers [49], and Bass (1985) proved that the types of leadership are significant in the process of organizational changes [50]. The studies have continuously indicated that employee performance, innovation in the organization, and effectiveness of the public sector are influenced by leadership style [51,52,53]. In a study of 50 US states, Moynihan and Ingraham (2004) discovered that the kind of leadership exhibited in government agencies is a key factor in its performance [54]. Through comparative structural equation modeling in New Zealand, Parry and Proctor-Thomson (2003) proved

that the quality of team leadership was constant, and therefore, the quality of the work performed by the public sector may be as good as that of equivalent organizations in the private sector [55].

2.3 Digital Transformation and Technochange

Digital transformation is a radical change in the value creation and delivery model of organizations. It is possible to define the term as the process of organizational transformation which implies the usage and integration of digital technologies in novel combinations to radically change an organization [56]. Digital technologies will interrelate individuals, objects, and places to create and process very significant data, and digitization plus digitalization create digital transformation [57]. On the organizational level, researchers have posited that organizations should come up with strategies that can accommodate the consequences of digital transformation and lead to improved practical performance [58].

The principle of Techno-Change discussed by Brynjolfsson and Hitt (2000) is that properly designed and properly executed technology-based change can lead to a high output of organizational performance [59]. The technochange is entirely dependent on a completely different approach as compared to the traditional IT project management or organization change management. Song et al (2005) described technological change as the alteration of the technological environment of a firm and observed that technological change is not always predictable, thus necessitating managerial interpretation to the response of a firm [60]. Hausberg (2019) has outlined the possible adverse effects of the digital transformation, such as the loss of jobs, cyberattacks, and uncontrolled data or fake news [61].

Digital innovation performance is highly dependent on technology adaptation as an antecedent. Technology transition contrasts with technology transfer, which implies the collaborative work of the government and industry but is concerned with how useful technology is perceived by the target audience and the activities that are involved in the transfer of technology between the controlled IT conditions and operational use [62,63]. Technology adaptation should be regulated after the transition to technology as a significant aspect of the digital transformation and performance of innovations. According to Schlaepfer et al. (2015), some of the challenges that were encountered in the transition to IR 4.0 are the IT security, the necessity of reliability of machine-to-machine communication, and the necessity of huge investments in new technology and infrastructure [64].

2.4 Digitalization and Innovation in the UAE Context

The vision of the UAE government to establish itself as one of the most innovative governments in the world by 2021 has been implemented in several strategic activities. In the year 2015, after declaring that it was the Year of Innovation, the National Innovation Strategy (NIS) was introduced, addressing seven key areas, namely renewable energy, transport, education, health, technology, water, and space [65]. The Government Innovation Center Mohammed bin Rashid was created to promote innovation in the government, and a Chief Innovation Officer was introduced in the federal government organizations [65]. The NIS aims to ensure an innovative regulatory framework through creation of rules and regulations that would facilitate innovation, enhance an effective process of patent registration, and safeguard intellectual rights. Innovation in technology infrastructure is facilitated by such initiatives as The Smart Government and The Smart City that have provided the UAE with a leading role in the world in the field of digital governance [65].

Irrespective of such grandiose plans, the UAE state sector meets several management issues. The privacy of data, IT governance and adoption of new technologies have continued to be of concern [8]. It is estimated that the pace of technology adoption is low in most emirates except Abu Dhabi and Dubai and transformational leaders in speeding up the process of digital transformation of organizations are described

as a weak point that needs to be addressed [8,13]. These issues highlight the necessity of a unified conceptual framework that connects the various variables that affect the performance of the digital innovation in the UAE public sector setting.

3. Theoretical Foundations of the Proposed Framework

The proposed conceptual framework draws on four established theories, each of which illuminates distinct but complementary aspects of the digital innovation performance phenomenon. This section presents each theory and articulates its specific relevance to the framework's constructs and relationships.

3.1 Diffusion of Innovation (DOI) Theory

According to Rogers (1995), DOI theory explained the process of adoption, diffusion, or rejection of innovations, new ideas and new technologies by an individual, population or social system [14]. According to the theory the diffusion process exists within a time span and is available through some channels of communication within members of the social structure. The transition rates of emerging technologies are influenced by five considerations which include relative advantages, compatibility, complexity, trialability and observability [29]. The theory that is most widely applied in the organizational level, technology adaptation, is DOI [66,67].

In the suggested framework, the logic of DOI theory offers the basis of the theoretical understanding of the ways in which digital ethics, technology adaptation, and digital transformation are diffused in the context of the public sector organizations and affect the outcome of innovation. The focus on communication channels and social systems of the theory also agrees with the fact that the framework also includes governance structures as mediating mechanisms. In addition, the theory of DOI describes the impact of the mediation role of governance on the speed and course of innovation diffusion in organizations [14]. Companies utilizing and storing big data create new opportunities, and the use of big data has tremendously advanced the transformation of the traditional factor-based to innovation-based organizations [68]. This process of transformation as explained in the DOI theory needs the presence of governance structures that can mediate the relationship that exists between adoption of technologies and performance in innovation.

3.2 Transformational Leadership Theory

According to the writing of Bass and Riggio (2006), there are four elements of the leadership continuum that form the Transformational Leadership theory, namely idealized influence, inspirational motivation, intellectual stimulation, and individualized consideration [15]. Idealized influence is the type of influence where leaders act as role models and demonstrate high ethical and moral principles [69]. Inspirational motivation is a term used to refer to behaviors that motivate and inspire the followers by giving them meaning and challenge in their work. Intellectual stimulation promotes innovative and creative thinking among the followers and challenges believability, reframing problems and thinking of new ways to look at them. The individualized consideration guarantees that every follower will be treated individually with respect to his or her capabilities, needs, and motivations [15,70].

In the construct presented, the role of transformational leadership is the moderating variable that qualifies the nature and orientation of the relationships existing between the independent variables (digital ethics, technology adaptation and digital transformation) and the dependent variable (digital innovation performance). As Sheehan et al. (2020) proved, transformational leadership has a long-term impact on work innovation by spreading a targeted vision and offering inspirational motivation that improves innovation performance processes [12]. Chou (2014) determined that transformational leadership is an

influential and important method of successfully executing organizational change [71], and Jung et al (2003) established that transformational leadership is very favorable to organizational innovative climates, especially with empowerment of employees [72]. The theoretical process is that transformational leaders who demonstrate transformational behaviors provide the conditions, casting the vision, intellectually stimulating, and providing individualized support, which increase the effectiveness of technology, ethics, and governance in influencing the results of innovation.

3.3 Institutional Theory

The institutional theory gives a perspective of viewing organizations as social and cultural systems that are instilled in an institutional environment of social expectations and prescriptions of what constitutes the right behavior [16]. Contrary to pure rationalistic views, the institutional theory also highlights that organizations exist in organizational environments, in which key actors, such as regulators, professional associations, and media, form an institutional infrastructure that interprets, communicates and oversees adherence to socio-cultural rules [73]. Since the 1970s, organizations of the field of public administration have been analyzed within institutional lenses continuously, including the input of history, political science, and sociology [74].

The institutional theory has come up with a specific way of conceptualizing change and innovation in two ways [75]. First, it upholds the tension between stability and change where continuity and homogeneity are considered with change and heterogeneity among organizations. Second, it perceives change and stasis to be the result of field, organizational, and individual structures, activities, and actions. These methods provide a superior framework upon which to explore the area of innovation with regards to new products, services, and processes with a focus on the problems of digital transformation and radical change [76]. The institutional theory, in the proposed framework, informs the construct of governance by elucidating the role of regulatory frameworks, institutional norms and governance structures on the interaction between technology adoption and the outcome of innovation in the context of the public sector.

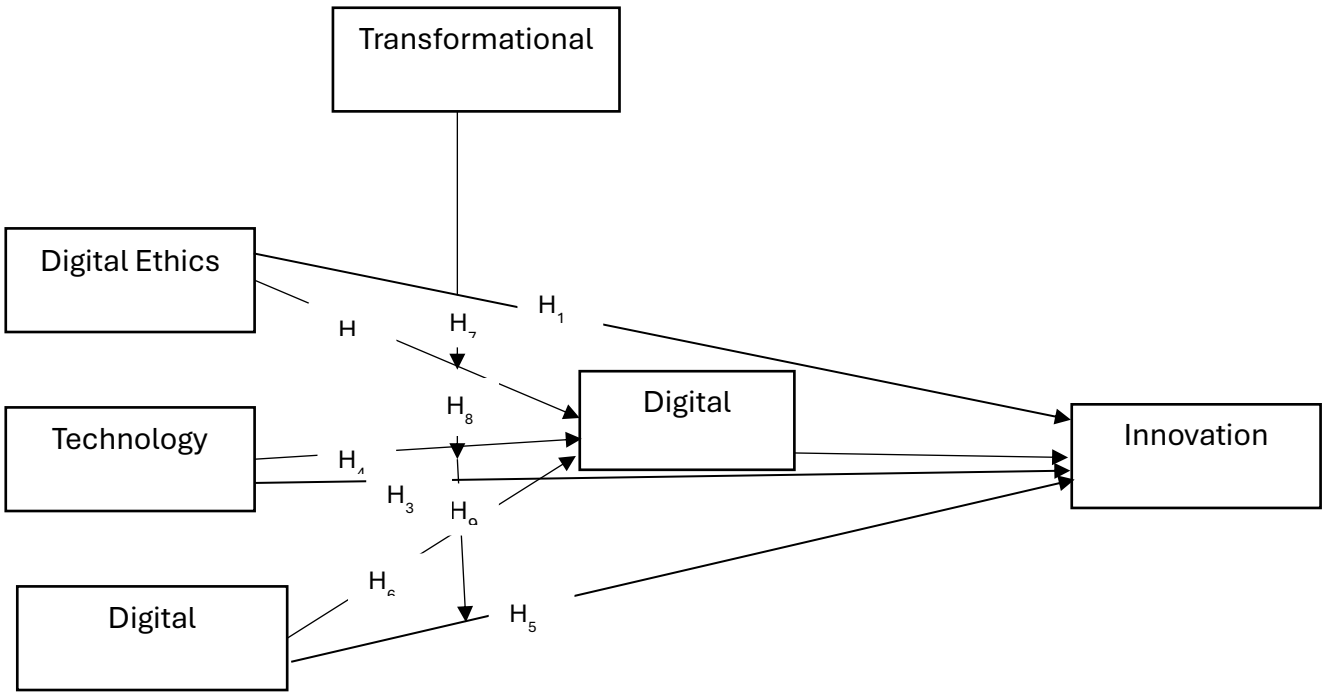
3.4 Teleological Ethical Theory

Teleological ethical theories, including consequentialism and utilitarianism, are concerned with whether an action leading to an outcome is good or bad for society [17]. These theories can simplify the resolution of ethical issues and determine whether an ethical concern is indeed ethical or unethical. Jones (1991) presented a comprehensive four-stage model of ethical decision-making: recognizing the moral issue, making a moral judgment, establishing moral intent, and engaging in moral behavior [77]. Many factors affect these stages, including individual characteristics, the nature of the issue, and contextual and organizational factors.

Within the proposed framework, teleological ethical theory provides the theoretical basis for the data ethics construct. In the digital context, AI-Ethics functions as self-reflection for computer and engineering sciences engaged in the research and development of AI and machine learning [78]. The data minimization principle, which requires personal data to be adequate, relevant, and limited to what is necessary for processing purposes, is a core ethical concern in organizations managing big data [43]. Teleological ethical theory explains why and how ethical considerations regarding data use, privacy, transparency, and accountability influence organizational decisions about digital innovation. When organizations adopt ethical frameworks that evaluate the consequences of their digital practices, they are better positioned to develop innovations that are sustainable, socially responsible, and aligned with governance requirements.

4. The Proposed Conceptual Framework

It is on this basis that this section gives the integrative conceptual framework and its constituent hypotheses based on the synthesis of the literature and theoretical underpinnings made above. The model places three independent variables (data ethics, digital transformation, and technology adaptation) as the antecedents of digital innovation performance (the dependent variable), and data governance as a mediating variable and transformational leadership as a moderating variable. It is based on the model suggested by Floridi (2018), who demonstrated the bi-directional dependence between data ethics and data governance [10] and expands it with the information provided by Lin et al. (2020) about governance and innovation via DOI theory [9] and Sheehan et al. (2020) about transformational leadership and innovation performance [12].



[FIGURE 1 Insert Research Conceptual Model from thesis (Figure 4). The model depicts three independent variables (Data Ethics, Digital Transformation, Technology Adaptation) connected to the dependent variable (Digital Innovation Performance) via direct paths and indirect paths through the mediator (Data Governance). Transformational Leadership is shown as a moderator on the paths from the independent variables to the dependent variable.]

4.1 Data Ethics and Digital Innovation Performance

The digital technologies have radically altered organizations and industries, and due to the process of digitalization, there are concerns regarding the ethical assumptions behind the management of innovation [79]. Floridi (1999) proposed an information ethics model sufficient to tackle the problems that are created by cyber technology [37], and later authors have noted that the ethical consequences of technologies need to be explicitly held responsible by organizations [38,39]. IT governance is linked directly to the implementation of IT strategy and is thus important in the overall business-IT alignment [46]. The model hypothesizes that organizations that practice data ethics will be in a better position to seek out digital innovation since when data is ethically governed, it will create the trust and transparency required to make innovation thrive.

Hypothesis 1: Data ethics has a significant impact on digital innovation performance.

Hypothesis 2: Digital governance mediates the relationship between data ethics and digital innovation performance.

4.2 Technology Adaptation and Digital Innovation Performance

IR 4.0 and related paradigms involve a set of characteristics, technologies, and enabling factors integrated into the industrial scenario to govern manufacturing operations and achieve higher levels of operational efficiency and productivity [80,81]. A common factor characterizing the main definitions of IR 4.0 is their techno-centric perspective, in which technological advancements are the primary trait [82]. However, introducing the IR 4.0 model beyond technological implementation represents challenges concerning the operational, organizational, and managerial levels [83]. Schlaepfer et al. (2015) identified several challenges during the IR 4.0 transformation, including IT security issues, reliability requirements, massive investments in new technology, and the need for new communication networks [64].

Hypothesis 3: Technology adaptation has a significant impact on digital innovation performance.

Hypothesis 4: Digital governance mediates the relationship between technology adaptation and digital innovation performance.

4.3 Digital Transformation and Digital Innovation Performance

Digital transformation has been defined as the combined effects of several digital innovations bringing about novel actors, structures, practices, values, and beliefs that change, threaten, replace, or complement existing rules within organizations, ecosystems, industries, or fields [84,85]. Ferreira et al. (2019) argued that managers should consider digital transformation as a value network issue rather than a value chain matter, as digital technologies are gradually transforming business-to-business companies [79]. Vial (2019) noted that technology is only part of the complex puzzle that must be solved for organizations to remain competitive in a digital world [86]. Digital governance maximizes the potential value of information by ensuring data quality and protecting information, and its mediating role between digital transformation and innovation performance is theoretically supported by the DOI framework [9,68].

Hypothesis 5: Digital transformation has a significant impact on digital innovation performance.

Hypothesis 6: Digital governance mediates the relationship between digital transformation and digital innovation performance.

4.4 The Moderating Role of Transformational Leadership

The limitations that should be determined in this paper are several. To start with, the proposed structure is not empirical research as it is a concept paper. The quantitative study should confirm the nine hypotheses by applying methodological strategies that are applicable to this problem through structural equation modeling with the use of data obtained within the public sector organizations. Second, the framework is, to a significant extent, contextualized in UAE public sector and how it can be generalized to other national settings, systems of governance and other institutional settings demand to be investigated. Third, the framework makes speculations based on a particular combination of independent, mediating, and moderating variables, however, other factors, including organizational culture, the digital literacy of the workers, financial resources, and external pressures of competition are not touched upon. Fourth, the transformational leadership is also considered as a single moderate variable in the framework when the other forms of leadership (e.g., transactional leadership, servant leadership, digital leadership, etc.) can also potentially affect the hypothesized relationships.

The following research would deal with them in a diverse number of ways. The hypotheses will be forced to be empirically tested with the help of a survey of the people who work in the public sector in different emirates of the United Arab Emirates and organizations. Longitudinal research would allow the researcher

to investigate the cause-and-effect relationships and dynamics that cannot be studied in the cross-sectional research. These comparative studies in other national settings (e.g., other GCC countries, OECD countries) would help the external validity of the framework. The results of the innovation could be more conveyed through qualitative research such as case studies and interviews with executives in the public sector in which nature and interdependence of governance, ethics, and leadership are likely to be provided. Further research can also add other moderating variables like digital HR practices, management by walking around, challenges of globalization and acceptance to the research so that the framework can be extended to examine the boundary conditions that are not evident in the current model.

Hypothesis 7: Transformational leadership positively moderates the relationship between digital ethics and digital innovation performance.

Hypothesis 8: Transformational leadership positively moderates the relationship between technology adaptation and digital innovation performance.

Hypothesis 9: Transformational leadership positively moderates the relationship between digital transformation and digital innovation performance.

4.5 Summary of Hypothesized Relationships

Table 1

Summary of Research Hypotheses

Hypothesis	Path	Statement	Type
H1	DE → DIP	Data ethics has a significant impact on digital innovation performance	Direct effect
H2	DE → DG → DIP	Digital governance mediates the relationship between data ethics and DIP	Mediation
H3	TA → DIP	Technology adaptation has a significant impact on digital innovation performance	Direct effect
H4	TA → DG → DIP	Digital governance mediates the relationship between technological adaptation and DIP	Mediation
H5	DT → DIP	Digital transformation has a significant impact on digital innovation performance	Direct effect
H6	DT → DG → DIP	Digital governance mediates the relationship between digital transformation and DIP	Mediation
H7	DE × TFL → DIP	TFL positively moderates the relationship between DE and DIP	Moderation
H8	TA × TFL → DIP	TFL positively moderates the relationship between TA and DIP	Moderation
H9	DT × TFL → DIP	TFL positively moderates the relationship between DT and DIP	Moderation

Note: DE = Data Ethics; DT = Digital Transformation; TA = Technology Adaptation; DG = Data Governance; TFL = Transformational Leadership; DIP = Digital Innovation Performance.

5. Discussion: Positioning the Framework Against Existing Models

The proposed conceptual framework advances the existing literature in several important ways and can be positioned against five key prior theoretical contributions.

5.1 Comparison with Floridi's (2018) Base Model

Floridi's (2018) base model established the foundational relationship between data ethics and data governance, demonstrating their bidirectional influence [10]. The proposed framework extends Floridi's model in three critical ways. First, it introduces digital transformation and technology adaptation as additional independent variables, recognizing that data ethics alone cannot account for the complexity of factors driving digital innovation performance. Second, it operationalizes digital governance as a mediating variable with testable pathways to innovation outcomes, whereas Floridi's original model treated governance primarily as a conceptual complement to ethics. Third, it incorporates transformational leadership as a boundary condition that modulates the ethics-innovation relationship, adding a human and organizational dimension absent from Floridi's predominantly technology-focused framework.

5.2 Comparison with Lin et al.'s (2020) Governance-Innovation Model

Lin et al. (2020) demonstrated how DOI theory could be applied to connect governance structures with innovation outcomes [9]. Their model showed that organizational storage of big data generates opportunities for innovation, strengthened by managerial power through internal governance mechanisms. The proposed framework builds on Lin et al's insights by (a) extending the governance construct to include both internal and external dimensions, (b) adding data ethics as a distinct antecedent variable rather than subsuming it within governance, and (c) explicitly modeling the moderating role of leadership, which Lin et al. acknowledged as important but did not formally incorporate.

5.3 Comparison with Sheehan et al.'s (2020) Leadership-Innovation Model

Sheehan et al. (2020) established the theoretical and empirical connection between transformational leadership and work innovation, showing that organizations whose leaders demonstrate transformational behaviors carry a focused vision and provide inspirational motivation that enhances innovation performance [12]. The proposed framework incorporates Sheehan et al.'s findings by positioning transformational leadership as a moderating variable rather than a direct predictor. This reconceptualization reflects the theoretical argument that leadership does not directly produce innovation but rather creates the conditions under which the relationships between technology, ethics, governance, and innovation are strengthened or attenuated. The moderating specification provides a more nuanced and testable account of how leadership interacts with other organizational factors to influence innovative outcomes.

5.4 Comparison with DOI Theory Applications

Traditional applications of DOI theory focus on the characteristics of innovations (relative advantage, compatibility, complexity, trialability, observability) as determinants of adoption rates [14,29]. The proposed framework extends DOI theory by incorporating governance as a mediating mechanism through which innovation diffusion translates into measurable performance outcomes. This extension addresses a recognized limitation of DOI theory: its relative silence on the institutional and governance conditions that shape whether innovation adoption leads to actual performance improvements. By integrating DOI with institutional theory, the framework provides a richer account of the organizational and environmental factors influencing digital innovation in public sectors.

5.5 Comparison with Institutional Theory Perspectives on Innovation

Institutional theory has traditionally emphasized how regulatory, normative, and cultural-cognitive press-

ures constrain organizational behavior [16,73]. While scholars such as Greenwood et al. (2017) and Scott (2014) have developed approaches to understanding change and innovation within institutional frameworks [75,76], relatively few studies have applied institutional theory specifically to digital innovation performance in public sector contexts. The proposed framework fills this gap by using institutional theory to explain how governance structures shaped by regulatory requirements, professional norms, and organizational culture mediate the relationship between technology-related antecedents and innovation outcomes. This application extends institutional theory into the digital domain and demonstrates its relevance for understanding public sector innovation in the context of IR 4.0.

6. Implications for Research and Practice

6.1 Implications for Theory

The proposed framework makes several contributions to theory development. First, it provides an integrative architecture that connects previously fragmented streams of literature on digital governance, data ethics, digital transformation, technology adaptation, transformational leadership, and digital innovation performance. By grounding this integration in four established theories, the framework offers a coherent and comprehensive theoretical account of the antecedents and mechanisms driving digital innovation in public sector organizations. Second, the framework specifies testable mediating and moderating relationships, moving beyond descriptive accounts to generate falsifiable predictions that can be evaluated through empirical research. Third, the multi-theoretical approach demonstrates how DOI theory, transformational leadership theory, institutional theory, and teleological ethical theory can be combined to explain complex organizational phenomena that no single theory can adequately address.

6.2 Implications for Practice

In this paper there are several limitations that should be found out. First, the proposed structure is not empirical research since it is a concept paper. The quantitative research must verify the nine hypotheses using the methodological strategies relevant to this issue, such as structural equation modeling using the data collected in the public sector organizations. Second, the framework is mostly contextualized in UAE public sector and how it can be generalized to other national settings, systems of governance and other institutional settings require to be explored. Third, the framework speculates on a specific set of independent, mediating, and moderating variables, other aspects, such as organizational culture, the digital literacy of the employees, financial resources, and external competitive pressures are not discussed. Fourth, transformational leadership is considered as a single moderating variable in the framework in the case where the other types of leadership (e.g., transactional leadership, servant leadership, digital leadership, etc.) also might influence the hypothesized relationships.

Future research would address these limitations in a variety of ways. The hypotheses will have to be empirically tested with the assistance of survey data of employees working in the public sector in various emirates of the United Arab Emirates and organizations. Longitudinal research studies would enable the researcher to examine the cause-and-effect relationships and the dynamics that cannot be analyzed in cross-sectional studies. The external validity of the framework would be achieved with the assistance of comparative studies in other national settings (e.g., other GCC countries, OECD countries). Qualitative research like case studies, interviews with leaders in the public sector could provide more information about the relationship and co-existence of governance, ethics, and leadership to determine the results of the innovation. Other moderating factors such as digital HR practices, management by walking around,

pressures of globalization and change acceptance could also be included in further research to extend the framework and study the boundary conditions that are not reflected in the current model.

7. Limitations and Future Research Directions

There are several limitations that need to be identified in this paper. To begin with, the proposed framework is not an empirical study because it is a conceptual paper. The nine hypotheses need to be confirmed by quantitative research based on the relevant methodological strategies, including the use of structural equation modeling with the data gathered in the public sector organizations. Second, the framework is largely contextualized in the UAE public sector and its generalizability to other national contexts, systems of governance and other institutional contexts need to be investigated. Third, the framework dwells on a particular collection of independent, mediating, and moderating variables, other factors, which may have been of significance, including organizational culture, employee digital literacy, financial resources, and external competitive pressures, are not covered. Fourth, the framework considers transformational leadership as a single moderating variable when other leadership styles (e.g., transactional leadership, servant leadership, digital leadership, etc.) also could have an impact on the hypothesized relationships.

These limitations would be overcome by future research in a few ways. The hypotheses must be empirically tested with the help of survey data of employees of the public sector in different emirates of the United Arab Emirates and organizations. Longitudinal research studies would allow researchers to study the cause-and-effect associations as well as the dynamics that cross-sectional studies are unable to assess. External validity of the framework would be established with the help of comparative studies in various national settings (e.g., other GCC countries, OECD countries). Qualitative research, such as case studies, interviews with leaders in the public sector, may shed more light on how governance, ethics, and leadership interrelate and co-exist to shape the outcomes of innovation. Further research may also include other moderating factors like digital HR practices, management by walking around, pressures of globalization and change acceptance to expand the framework and study the boundary conditions absent in the present model.

8. Conclusion

The conceptual framework presented in this paper has formulated the integrative and multi-theoretical understanding of antecedents and mechanisms that drive the digital innovation performance within the public sector organizations. Available as a synthesis of the literature on data ethics, digital governance, digital transformation, technology adaptation, and transformational leadership, and pegged on four mainstream theoretical perspectives, namely the DOI theory, transformational leadership theory, institutional theory, and the teleological ethical theory, the framework offers a well-rounded, unified framework through which theoretical formulation and empirical research can be viewed.

The framework contributes to making three main contributions. It incorporates streams of literature that have been previously divided into a single model with well-defined roles of variables (independent, mediating, moderating and dependent). It has nine hypotheses that can be tested and their statements indicate the specific mediating and moderating mechanisms. And it contextualizes these relationships within the institutional and policy context of the UAE public sector, and it is directly applicable to the government leaders who are going through the digital transformation.

With the world public sector still trying to figure out the opportunities and challenges brought about by IR 4.0, there has never been a time when theoretically grounded and empirically verifiable structures are required. The proposed model provides the basis of future research and a useful tool to the leaders of the public sector aiming to improve their digital innovation performance by integrating governance, ethics, technology, and leadership. The long-term goal is that the empirical validation of this framework will both add to academic knowledge and make strides in practical development of the digital innovation in government agencies across the globe.

References

1. Blanchet M, Rinn T. Industry 4.0: The new industrial revolution. How Europe will succeed. Munich: Roland Berger Strategy Consultants; 2016.
2. Deloitte. Transform Saudi Arabia. Deloitte Middle East; 2019.
3. Barrett P. Achieving better practice corporate governance in the public sector. AM Auditor General for Australia; 2002.
4. Stoker G. Governance as theory: Five propositions. International Social Science Journal. 1998;50(155):17–28.
5. UAE Vision 2021. National agenda. United Arab Emirates Government; 2018.
6. Government.ae. UAE strategy for artificial intelligence. United Arab Emirates Government; 2017.
7. Schwab K. The fourth industrial revolution. Geneva: World Economic Forum; 2016.
8. Mikalef P, Pappas IO, Krogstie J, Giannakos MN. Big data analytics capabilities: A systematic review and research agenda. Information Systems and e-Business Management. 2018;16(3):547–578.
9. Lin Y, Li J, Wang Y. Big data governance, innovation, and digital transformation: A multi-level analysis. Government Information Quarterly. 2020;37(1):101406.
10. Floridi L. Soft ethics and the governance of the digital. Philosophy & Technology. 2018;31(1):1–8.
11. Maura AW, Ndubuisi F, Olasunmbo O. Digital ethics and transformational leadership in public organizations. Public Management Review. 2020;22(5):1–20.
12. Sheehan M, Garavan TN, Morley MJ. Transformational leadership and work unit innovation: A dyadic two-wave investigation. Journal of Business Research. 2020; 109:399–412.
13. Runhui L, Qin M, Zhang Y. Digital governance, board structure, and innovation in public sector organizations. International Journal of Public Administration. 2020;43(12):1025–1038.
14. Rogers EM. Diffusion of innovations. 4th ed. New York: Free Press; 1995.
15. Bass BM, Riggio RE. Transformational leadership. 2nd ed. Mahwah, NJ: Lawrence Erlbaum Associates; 2006.
16. Scott WR. Institutional theory: Contributing to a theoretical research program. In: Smith KG, Hitt MA, editors. Great minds in management. Oxford: Oxford University Press; 2004. p. 460–484.
17. Nathan MJ. Teleological ethics and the foundations of technology assessment. Science and Engineering Ethics. 2015;21(3):735–753.
18. Rostow WW. The stages of economic growth: A non-communist manifesto. 3rd ed. Cambridge: Cambridge University Press; 1988.
19. Kagermann H, Wahlster W, Helbig J. Recommendations for implementing the strategic initiative INDUSTRIE 4.0. Frankfurt: Acatech; 2013.
20. Rüßmann M, Lorenz M, Gerbert P, Waldner M, Justus J, Engel P, et al. Industry 4.0: The future of productivity and growth in manufacturing industries. Boston: BCG; 2015.

21. Giacomo C, Ferraris A, Bresciani S. Digital transformation and innovation in Industry 4.0. Technological Forecasting and Social Change. 2020; 157:120091.
22. Schumpeter JA. Theorie der wirtschaftlichen Entwicklung. Leipzig: Duncker & Humblot; 1911.
23. Schumpeter JA. The creative response in economic history. Journal of Economic History. 1947;7(2):149–159.
24. Yoo Y, Henfridsson O, Lyytinen K. The new organizing logic of digital innovation: An agenda for information systems research. Information Systems Research. 2010;21(4):724–735.
25. Yoo Y, Boland RJ, Lyytinen K, Majchrzak A. Organizing for innovation in the digitized world. Organization Science. 2012;23(5):1398–1408.
26. OECD. Oslo Manual: Guidelines for collecting and interpreting innovative data. 3rd ed. Paris: OECD Publishing; 2005.
27. Crossan MM, Apaydin M. A multi-dimensional framework of organizational innovation: A systematic review of literature. Journal of Management Studies. 2010;47(6):1154–1191.
28. Porter ME, Heppelmann JE. How smart, connected products are transforming competition. Harvard Business Review. 2014;92(11):64–88.
29. Rogers EM. Diffusion of innovations. 5th ed. New York: Free Press; 2003.
30. Tornatzky LG, Fleischer M. The processes of technological innovation. Lexington, MA: Lexington Books; 1990.
31. El Khatib M, Al-Nakeeb A, Ahmed G. Integration of cloud computing with artificial intelligence and its impact on telecom sector: A case study. iBusiness. 2019;11(1):1–10.
32. Nah FFH, Lau JLS, Kuang J. Critical factors for successful implementation of enterprise systems. Business Process Management Journal. 2001;7(3):285–296.
33. Marchant GE, Wallach W. Coordinating technology governance. Issues in Science and Technology. 2016;31(4):43–50.
34. Marchant GE, Allenby BR. Soft law: New tools for governing emerging technologies. Bulletin of the Atomic Scientists. 2017;73(2):108–114.
35. Wallach W. A dangerous master: How to keep technology from slipping beyond our control. New York: Basic Books; 2015.
36. Barrett P. Achieving better practice corporate governance in the public sector. AM Auditor General for Australia; 2002.
37. Floridi L. Information ethics: On the philosophical foundation of computer ethics. Ethics and Information Technology. 1999;1(1):33–52.
38. Martin K, Freeman RE. Some problems with employee monitoring. Journal of Business Ethics. 2004;43(4):353–361.
39. Martin K. Ethical implications and accountability of algorithms. Journal of Business Ethics. 2018;160(4):835–850.
40. Jobin A, Ienca M, Vayena E. The global landscape of AI ethics guidelines. Nature Machine Intelligence. 2019;1(9):389–399.
41. Yang SJ, Ogata H, Matsui T, Chen NS. Human-centered artificial intelligence in education: Seeing the invisible through the visible. Computers and Education: Artificial Intelligence. 2018; 2:100008.
42. boyd d, Crawford K. Critical questions for big data. Information, Communication & Society. 2012;15(5):662–679.

43. Information Commissioner's Office. Big data, artificial intelligence, machine learning and data protection. Wilmslow: ICO; 2017.
44. Nguyen T. Internal governance mechanisms and corporate governance practices in the public sector. International Journal of Public Sector Management. 2008;21(6):601–615.
45. Weir C, Laing D, McKnight PJ. Internal and external governance mechanisms: Their impact on the performance of large UK public companies. Journal of Business Finance & Accounting. 2007;29(5–6):579–611.
46. De Haes S, Van Grembergen W, Debreceny RS. COBIT 5 and enterprise governance of information technology: Building blocks and research opportunities. Journal of Information Systems. 2013;27(1):307–324.
47. Van Grembergen W, De Haes S. A research journey into enterprise governance of IT, business/IT alignment and value creation. International Journal of IT/Business Alignment and Governance. 2010;1(1):1–13.
48. Northouse PG. Leadership: Theory and practice. 3rd ed. Thousand Oaks, CA: Sage; 2004.
49. Burns JM. Leadership. New York: Harper & Row; 1978.
50. Bass BM. Leadership and performance beyond expectations. New York: Free Press; 1985.
51. Shafie B, Baghersalimi S, Barghi V. The relationship between leadership style and employee performance. Singaporean Journal of Business Economics and Management Studies. 2013;2(5):21–29.
52. Asencio H. Leadership, trust and organizational performance in the public sector. Transylvanian Review of Administrative Sciences. 2016;12(SI):5–22.
53. Orazi DC, Turrini A, Valotti G. Public sector leadership: New perspectives for research and practice. International Review of Administrative Sciences. 2013;79(3):486–504.
54. Moynihan DP, Ingraham PW. Integrative leadership in the public sector: A model of performance information use. Administration & Society. 2004;36(4):427–453.
55. Parry KW, Proctor-Thomson SB. Leadership, culture and performance: The case of the New Zealand public sector. Journal of Change Management. 2003;3(4):376–399.
56. Goh E, Loosemore M, Zuo J. Digital transformation of the construction industry: A socio-technical analysis. Engineering, Construction and Architectural Management. 2011;28(5):1440–1462.
57. Legner C, Eymann T, Hess T, Matt C, Böhmann T, Drews P, et al. Digitalization: Opportunity and challenge for the business and information systems engineering community. Business & Information Systems Engineering. 2017;59(4):301–308.
58. Hess T, Matt C, Benlian A, Wiesbock F. Options for formulating a digital transformation strategy. MIS Quarterly Executive. 2016;15(2):123–139.
59. Brynjolfsson E, Hitt LM. Beyond computation: Information technology, organizational transformation and business performance. Journal of Economic Perspectives. 2000;14(4):23–48.
60. Song M, Droge C, Hanvanich S, Calantone R. Marketing and technology resource complementarity: An analysis of their interaction effect in two environmental contexts. Strategic Management Journal. 2005;26(3):259–276.
61. Hausberg JP, Liere-Netheler K, Packmohr S, Pakura S, Vogelsang K. Research streams on digital transformation from a holistic business perspective: A systematic literature review and citation network analysis. Journal of Business Economics. 2019;89(8–9):1011–1036.

62. Blood M. Technology transition: A challenge for technology users. Washington, DC: National Defense University Press; 2009.
63. Dobbins JH. Technology transition. In: National Academy of Sciences, editor. Technology transition. Washington, DC: National Academies Press; 2004.
64. Schlaepfer RC, Koch M, Merkle P. Industry 4.0: Challenges and solutions for the digital transformation and use of exponential technologies. Zurich: Deloitte AG; 2015.
65. Government.ae. National Innovation Strategy. United Arab Emirates Government; 2015.
66. Chong AYL, Ooi KB, Lin B, Raman M. Factors affecting the adoption level of commerce: An empirical study. Journal of Computer Information Systems. 2009;50(2):13–22.
67. Oliveira T, Martins MF. Literature review of information technology adoption models at firm level. Electronic Journal of Information Systems Evaluation. 2011;14(1):110–121.
68. Porter ME. Strategy and the Internet. Harvard Business Review. 2001;79(3):62–78.
69. Judge TA, Piccolo RF, Kosalka T. The bright and dark sides of leader traits: A review and theoretical extension of the leader trait paradigm. The Leadership Quarterly. 2009;20(6):855–875.
70. Hadden R. Leading culture change in global organizations. San Francisco: Jossey-Bass; 2003.
71. Chou P. Does transformational leadership matter during organizational change? European Journal of Sustainable Development. 2014;3(3):49–62.
72. Jung DI, Chow C, Wu A. The role of transformational leadership in enhancing organizational innovation: Hypotheses and some preliminary findings. The Leadership Quarterly. 2003;14(4–5):525–544.
73. Hinings CR, Logue D, Zietsma C. Fields, institutional infrastructure and governance. In: Greenwood R, Oliver C, Lawrence TB, Meyer RE, editors. The SAGE handbook of organizational institutionalism. 2nd ed. London: Sage; 2017. p. 163–189.
74. Hall PA, Taylor RCR. Political science and the three new institutionalisms. Political Studies. 1996;44(5):936–957.
75. Greenwood R, Oliver C, Lawrence TB, Meyer RE, editors. The SAGE handbook of organizational institutionalism. 2nd ed. London: Sage; 2017.
76. Greenwood R, Hinings CR. Radical organizational change. In: Clegg SR, Hardy C, Lawrence TB, Nord WR, editors. The SAGE handbook of organization studies. 2nd ed. London: Sage; 2006. p. 814–842.
77. Jones TM. Ethical decision making by individuals in organizations: An issue-contingent model. Academy of Management Review. 1991;16(2):366–395.
78. Rahwan I, Cebrian M, Obradovich N, Bongard J, Bonnefon JF, Breazeal C, et al. Machine behaviour. Nature. 2019;568(7753):477–486.
79. Ferreira JJM, Fernandes CI, Ferreira FAF. To be or not to be digital, that is the question: Firm innovation and performance. Journal of Business Research. 2019; 101:583–590.
80. Cimini C, Pinto R, Pezzotta G, Gaiardelli P. The transition toward Industry 4.0: business opportunities and expected impacts for suppliers and manufacturers. Advances in Production Management Systems. 2019; 566:119–127.
81. Lu Y. Industry 4.0: A survey on technologies, applications and open research issues. Journal of Industrial Information Integration. 2017; 6:1–10.
82. Kamble SS, Gunasekaran A, Gawankar SA. Sustainable Industry 4.0 framework: A systematic literature review identifying the current trends and future perspectives. Process Safety and Environm-

ental Protection. 2018; 117:408–425.
83. Oztemel E, Gursev S. Literature review of Industry 4.0 and related technologies. Journal of Intelligent Manufacturing. 2020;31(1):127–182.
84. Krimpmann D. IT-governance in scaling agile frameworks. Proceedings of the Multikonferenz Wirtschaftsinformatik. 2015; 1:1–12.
85. Loebbecke C, Picot A. Reflections on societal and business model transformation arising from digitization and big data analytics: A research agenda. The Journal of Strategic Information Systems. 2015;24(3):149–157.
86. Vial G. Understanding digital transformation: A review and a research agenda. The Journal of Strategic Information Systems. 2019;28(2):118–144.
87. Cai K, Wu Q, Zhang Y. Idealized influence and organizational innovation. Journal of Leadership & Organizational Studies. 2017;24(3):364–378.
88. Wu Q, Cai K, Zhang Y. Inspirational motivation and team outcomes: Evidence from Chinese organizations. Asia Pacific Journal of Management. 2010;27(3):505–525.
89. Wang D, Waldman DA, Zhang Z. A meta-analysis of shared leadership and team effectiveness. Journal of Applied Psychology. 2016;99(2):181–198.
90. Zhang H, Kwan HK, Everett AM, Jian Z. Servant leadership, organizational identification, and work-to-family enrichment: The moderating role of work climate for sharing family concerns. Human Resource Management. 2015;51(5):747–767.
91. Bass BM, Avolio BJ, Jung DI, Berson Y. Predicting unit performance by assessing transformational and transactional leadership. Journal of Applied Psychology. 2003;88(2):207–218.
92. Allison ST, Goethals GR. Heroic leadership: An influence taxonomy of 100 exceptional individuals. New York: Routledge; 2013.
93. Perkins CM. Inspirational leadership: Leading without being present. International Journal of Business and Management. 2010;5(8):184–188.