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The Role of Knowledge Management and Infrastructure in Developing Smart Universities in Saudi Arabia

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Abstract: *Moving toward a smart university has become a necessity to bridge the gaps between research and industry. Against this background, most of studies focused on the technical approach of a smart university in developed countries. The purpose of this study is to examine effect of knowledge management (KM) and infrastructure on the development of a smart university in Saudi Arabia. Academic staff from top five universities in the country were the population of this study. A stratified sampling was used to collect the data from 202 academic staff. The data was analysed using a smart partial least square 4.0. The findings showed that the effect of KM and its practices, knowledge creation, knowledge sharing, and knowledge utilization, and continuous learning and professional development affected positively the development of a smart university. In addition, the infrastructure and its dimension physical and digital infrastructure have a positive effect on the development of a smart university. Infrastructure also mediated the effect of KM on the development of a smart university. More investment in the digital and physical infrastructure can enhance the utilization of KM and foster the development of a smart university.*

Keywords: *Smart University, Knowledge Management, digital infrastructure, physical infrastructure, knowledge sharing, knowledge creation.*

1. INTRODUCTION

Smart University has become one of the important topics for businesses, academia, and practitioners[1]. The gap between industry and education is increasing and there is a need to establish and develop educational institutions that can bridge the gaps between research and practices[2]. Part of this development is the creation of a smart university that deals with the issues that face the community and support the economic sector of countries[3], [4]. Despite the notion that there are several research that has been conducted to establish a smart cities, the research into smart university is still limited and there is also limited research that examine the development of a smart university from behavioural approach rather than the technical approach[5]–[7]. Further, most of the studies in the literature are still a review or a conceptual paper to understand the characteristics of a smart university while empirical studies is still emerging [8]–[10]

The studies of smart university is dominated by developed countries[11], [12]. However, recently, emerging economies have made important steps in this field. One of the country that leads the digital transformation in the Middle East is the Kingdom of Saudi Arabia (KSA)[13], [14]. The kingdom has launched the vision of 2030 to reduce the dependence on oil and enhance the contribution of non-oil sector. Vision 2030 recognizes the need for digital transformation across all sectors, including education[13], [15]. Smart universities play a crucial role in this transformation by leveraging advanced technologies to enhance the learning experience, improve educational outcomes, and foster innovation.Vision 2030 envisions Saudi Arabia as a global knowledge hub and encourages international collaboration in various fields, including education[16], [17]. However, the studies that have linked the development of a smart university with other variables in the context of education is still limited.

Based on the knowledge based view, managing knowledge inside the organization is a critical step to support creativity, innovation and competitiveness[18], [19].Against this background, the practices of knowledge management and its role in developing the smart university has been examined by limited

studies in the literature[20]. This is because smart university is a new concept similar to the knowledge management. In addition, the role of having latest technology such as cloud computing, Internet of Things (IoT) is still an emerging topics especially in higher education[21].

Few studies examine the effect of KM on the development of a smart university. For instance, studies have examined the link between smart city and knowledge management while few examined the effect of knowledge management on the development of a smart university[21]–[23]. In addition, most of prior literature focused on the infrastructure from a technical perspective while examining the effect of physical and digital infrastructure on the development of smart university is still limited[24]. The mediating role of infrastructure is also examined by few studies[25].

Therefore, this study aims to examine the effect of knowledge management and infrastructure on the development of a smart university in Saudi Arabia. The study also aims to examine the mediating role of infrastructure between knowledge management and the development of a smart university. The remainder of this paper reviews the existing literature related to the smart university, knowledge management, and infrastructure. In addition, the methodology of this study is discussed as well as the findings and discussion. Implications for the theory and decision-makers are elaborated, and concluding remarks are provided.

2. Literature Review

This section discusses the theories that can explain the effect of knowledge management and infrastructure on the development of a smart university. The section also discusses the smart university, knowledge management, and infrastructure, as well as the development of the conceptual framework and the hypotheses of this study.

2.1. Theoretical Framework

Developing a smart university is linked to the ability of the university to manage its knowledge and to build infrastructure that facilitates this link and supports the development of a smart university. Among the theories that are known to explain the effect of knowledge management on several outcomes is the knowledge-based view by [18]. Grant [18]suggested that an organization can achieve superior performance by managing its internal knowledge and building on this knowledge to create new knowledge that can improve decision-making. Knowledge is the most important asset of any organization[18]. In addition, the resource-based view is also similar to the knowledge-based view on emphasizethe importance of internal resources[26]. One of the resources is the infrastructure. This infrastructure is divided into physical infrastructure such as classrooms and smart campuses, and digital infrastructure such as cloud computing and IoT. Both theories complement each other. The KBV was derived from RBV with focusing on knowledge.

KBV suggested that knowledge can consist of a cycle that includes the knowledge creation and sharing of this knowledge among organizational members as well as the implementation of knowledge along with the continuous development of knowledge and organizational member. On the other hand, the infrastructure includes the physical infrastructure and the digital infrastructure. The physical infrastructure includes the hardware and the technological tools that are required to facilitate the technological process. The digital infrastructure includes the application of cloud computing, high-speed internet, and IoT as well as augmented reality and virtual reality. The two theories are deployed in this study to explain the effect of knowledge management and infrastructure on the development of a smart university in Saudi Arabia.

2.2. Smart University

A smart university refers to a higher education institution that utilizes sophisticated technologies, data-driven methodologies, and innovative approaches to improve the overall educational experience, streamline administrative procedures, and foster collaboration and innovation. The integration of digital technologies, data analytics, and intelligent systems in educational practices surpass traditional methods, resulting in the development of a technologically advanced and forward-thinking educational environment. Smart educational institutions are characterized by the presence of high-speed internet, resilient networks, and cloud computing capabilities, as well as state-of-the-art equipment and software. Infrastructure encompasses the provision of instructional materials online

learning platforms, and administrative processes. Virtual reality (VR), augmented reality (AR), simulations, and gamification have the potential to enhance the intelligence of smart universities. These tools facilitate a highly engaging and participatory learning experience. The utilization of technology has the potential to enhance student engagement, foster active learning, and facilitate personalized learning experiences.

Academic institutions that prioritize data-driven decision-making employ analytics and predictive modelling techniques. The utilization of student performance, learning analytics, and administrative data has the potential to enhance instructional practices in intelligent educational institutions. Individuals possess the ability to observe patterns, predict future requirements, and exercise prudent decision-making. Intelligent educational institutions employ personalized learning strategies to cater to individual student needs. Adaptive learning, intelligent tutoring, and learning analytics are educational approaches that customize instruction by taking into account individual learning styles, progress, and goals. However, there are several issues that face the development of a smart university. These issues are related to the infrastructure and technology as building high-quality infrastructure requires continuous maintenance and upgrade. In addition, financial readiness, as well as technological readiness, and organizational readiness, are among the main challenge that faces the development of a smart university. These challenges exist in developed countries but they are more severe in developing countries.

2.2.1. Smart University in Saudi Arabia

The Smart University initiatives implemented in Saudi Arabia have garnered considerable attention and support, aligning with the country's Vision 2030 objectives. This comprehensive plan seeks to promote economic diversification and enhance multiple sectors, including education. The KSA acknowledges the significance of digital transformation within the context of higher education and perceives smart universities as pivotal drivers for fostering innovation, facilitating the dissemination of knowledge, and enhancing global competitiveness.

In the KSA, higher education institutions employ sophisticated technologies, data analysis, and novel methodologies to improve educational encounters, streamline administrative procedures, and enhance cooperation and scholarly inquiry. The primary objective of these initiatives is to revolutionize conventional educational methodologies and establish an environment that equips students with the necessary skills and knowledge to navigate the complexities and prospects of the digital era. The Saudi government has demonstrated substantial backing for smart universities initiatives by means of financial support, policy revisions, and collaborations with global institutions. However, the development of a smart university is still not up to the expectation. Therefore, this study examines the factors that affect the development of a smart university.

2.3. Knowledge Management

Knowledge Management has been emerging since the 1990s. The emergence of the knowledge-based view has supported the notion that knowledge is the most critical asset in any organization and the development and management of knowledge are key factors for competitive advantage and superior performance[18]. Researchers operationalized knowledge management to include three components, which is the technology, people, and organization[27]. Others view knowledge as a process in which the knowledge supply chain starts from creation to sharing and utilization[28]. In this study, both perspectives are combined by operationalizing knowledge management to includeknowledge creation and innovation, knowledge sharing, and knowledge utilization. The addition of continuous learning and professional development included the human element. In this study, the effect of knowledge management on the development of smart universities is examined.

2.4. Infrastructure

Infrastructure refers to the physical and technological components that support the implementation and functioning of smart educational initiatives. Smart universities need strong ICT infrastructure[29]. High-speed internet, campus-wide Wi-Fi, and stable networking infrastructure to provide smooth access to digital materials, online learning platforms, and collaboration tools[30]. Smart universities need cutting-edge software for instructional activities. This involves buying and maintaining computer

laboratories, interactive displays, digital projectors, VR and AR devices, instructional software, learning management systems (LMS), and data analytics platforms[31].Smart education requires both digital and physical infrastructure. Modern classrooms, collaborative learning spaces, labs, multimedia lecture halls, innovation hubs, and maker spaces for interactive and immersive learning are included. In this study, the infrastructure is operationalized to include physical and digital infrastructure[32]. A smart university can scale storage and processing using cloud computing. IoT is also important technology to be used by higher education. However, the usage of this technology within the higher education is still emerging.

2.5. Conceptual Framework

This study proposed based on the knowledge based view and resource based view that the knowledge management and its practices such as knowledge creation, knowledge sharing, knowledge utilization, and continuous learning and professional development will have a significant effect on the development of a smart university. In addition, the study proposes that infrastructure and its dimensions digital infrastructure and physical infrastructure will have a positive effect on the development of a smart university. The infrastructure is also proposed to mediate the effect of knowledge management on the development of a smart university. Figure 1 shows the conceptual framework of this study.

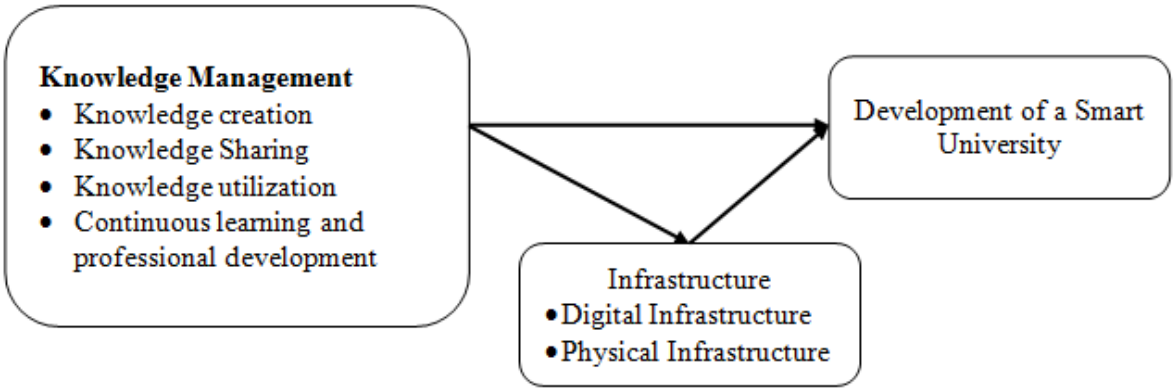

Figure1. *Conceptual Framework*

2.5.1. Knowledge Management and Smart University

Knowledge management plays a crucial role in the development of a smart university, as it involves the systematic collection, organization, sharing, and utilization of knowledge assets within the institution[19]. By effectively managing knowledge, a smart university can enhance its teaching and learning processes, foster innovation, and improve overall performance.Few studies examined the effect of knowledge management on the development of a smart university. For instance, research considered the knowledge management to be the key foundation for the development of a smart university [33]. Knowledge management also affected positively the development of a smart city which include also a smart university [34]. Researchers also found that knowledge management affected positively the development of a smart government [35]. Therefore, in this study, the following is proposed:

H1: Knowledge management affects positively the development of a smart university.

Knowledge Creation and Smart University

Knowledge creation is defined as the process of generating new knowledge or insights through various activities such as research, experimentation, analysis, and critical thinking[36], [37]. Knowledge creation is a critical process in which internal and external knowledge are combined to create a new knowledge that can help in fostering the decision making and the development of a smart university[38]. Few studies examined the effect of knowledge creation on the development of a smart university. Knowledge creation affected the development of a new instructional methods, pedagogical tactics, and educational resources[39]. It helps academics stay current on research, trends, and best practices. This boosts student success, education, and creativity[38].Therefore, this study proposes that the effect of knowledge creation on the development of a smart university is positive.

H1a: Knowledge creation has a positive effect on the development of a smart university.

Knowledge Sharing and Smart University

Knowledge sharing refers to the process of exchanging information, insights, experiences, and expertise among individuals or groups within an organization or community[19]. The knowledge sharing is effective in developing the smart university. Several studies indicated that knowledge sharing can play a role in the innovation and creativity of an organizations [40]. The effect of knowledge sharing on the development of smart university is positive and critical for facilitating smart choice and smart application [41]. In this study, knowledge sharing is expected to have a significant effect on the development of a smart university in Saudi Arabia. Therefore, the following is proposed:

H1b: Knowledge sharing affects positively the development of a smart university.

Knowledge Utilization and Smart University

Knowledge utilization is the process of employing knowledge and insights in real-world contexts to address issues, make well-informed choices, and foster innovation[40], [42]. In the context of a smart university, the utilization of knowledge assumes a pivotal role in harnessing the existing knowledge and transforming it into practical outcomes that actively contribute to the advancement and achievement of the organization[43]. In a literature review study, [44]found that utilization of learning analytics in higher education, encompassing the context of smart universities. The author concluded that implementing effective strategies for utilizing knowledge is critical to ensure that the insights obtained from learning analytics have a positive impact on teaching, learning, and decision-making processes. Other study referred to the importance of knowledge utilization in improving the learning and teaching capability of a smart university [8], [9], [45]. In this study, the knowledge utilization is expected to affect the development of a smart university.

H1c: Knowledge utilization has a positive effect on the development of a smart city.

Continuous Learning and Professional Development and Smart University

The implementation of CLPD initiatives significantly impacts the advancement of a smart university[46].CLPDinitiatives provide faculty members with the necessary support to remain up-to-date with the latest advancements, methodologies, and research within their specific disciplines. Faculty members can enhance their knowledge and expertise through continuous engagement in learning activities[47]. This, in turn, has a direct impact on the quality of their teaching, as well as their ability to employ innovative instructional approaches, ultimately leading to improved student outcomes[48]. CLPD has a positive effect on the development of a smart university [43], [49]. Few studies examined empirically the effect of CLPD on the development of a smart university. This study proposes that the relationship is positive and accordingly, the following is proposed:

H1d: CLPD has a positive effect on the development of a smart university

2.5.2. Infrastructure and Smart University

Infrastructure plays a crucial role in the development and functioning of a smart university. It forms the foundation for implementing advanced technologies, optimizing processes, and creating an environment conducive to innovative teaching and learning[24], [50]. Infrastructure is a foundational element in the development of a smart university[51]. A well-planned and integrated infrastructure enables the seamless integration of technology, fosters data-driven decision-making, supports innovative teaching and learning methodologies, enhances campus sustainability, and contributes to the overall success and effectiveness of the institution in preparing students for a digital and connected future[52]. Infrastructure is divided into physical and digital infrastructure and they are proposed to have a positive effect on the development of a smart university.

H2: Infrastructure affects positively the development of a smart university.

Digital Infrastructure

The development of a smart university is heavily reliant on the presence and functionality of thedigital infrastructure. The term "digitalinfrastructure" encompasses the various technological elements, systems, and platforms that facilitate the incorporation of digital technologies and data-driven

solutions in order to improve teaching, learning, research, and administrative procedures[53][32].The integration IoT devices and sensors across the campus forms a digital infrastructure. IoT devices are capable of acquiring data from diverse sources, including smart classrooms, laboratories, and campus facilities. The smart university benefits from digital infrastructure, which facilitates the establishment and growth of digital libraries and online resources[54]. Digital infrastructure affected positively the development of public service and the e-government implementation [55]–[57]. This study proposes the following:

H2a: Digital infrastructure affects positively the development of a smart university.

Physical Infrastructure

Physical infrastructurerefers to the collection of physical assets, facilities, and spaces that are utilized to facilitate the implementation of advanced technologies, promote innovation, and establish a conducive environment for the facilitation of effective teaching and learning[58]. The physical infrastructure of the smart university encompasses a range of learning spaces, such as libraries, laboratories, research centers, and innovation hubs. These spaces have been purposefully created to enhance the process of active learning, research, and experimentation. The institution possesses the requisite resources, equipment, and technology to facilitate various academic fields and foster practical, experiential education[59]. Physical infrastructure has a positive effect on economic growth [60], it also affected the choice of university by students [61]. Therefore, in this study, it is expected that the effect of physical infrastructure has a positive effect on the development of a smart university.

H2b: Physical infrastructure has a positive effect on the development of a smart university.

2.5.3. The Mediating Role of Infrastructure

The KM activities and practices can be facilitated by an effective infrastructure. The role of infrastructure as a mediator was examined by a few studies. Infrastructure mediated the effect of entrepreneurial orientation (EO)on business performance[62]. IT infrastructure mediated the effect of perceived behavioural control on use of interactive simulation in teaching [63]. The infrastructure also mediated the effect of university environment on entrepreneurial intention by teacher [64]. This study proposes that the effect of KM on the development of a smart university is mediated by infrastructure. Therefore, the following is proposed:

H3: Infrastructure mediates the effect of KM on the development of a smart university.

3. METHODOLOGY

This research deploys the research onion design. The paradigm of the research is positivism and it follows a deductive approach. Most of prior literature has used an inductive or experimental approach. In addition, the research is using a quantitative approach in which the data is collected from the top five universities in the kingdom. The academic staff in these five universities are using as proxies. The population of this study is 21,814 academic staff distributed in five universities. Based on [65], for a population of 21,814, the sample size is 378 respondents. The data is collected using a stratified random sampling. The data was collected using a questionnaire. The measurement of smart university development consists of five items and it was adopted from several sources [32][59], [66], for the knowledge creation, it consists of five items and it was adopted from [36], [37]. The knowledge sharing consists of 6 items and it was adopted from[20]. The knowledge utilization consists of five items and was adopted from[19]for Continuous Learning and Professional Development of human capital, it was self-developed. For the infrastructure, it consists of two dimension the digital infrastructure and the physical infrastructure. Both of which consists of six items and it was adopted from[24], [51], [52], [55]–[57], [67], [68].

Since the questionnaire includes some self-developed scale, a validation process was conducted. Three professors were asked to provide their opinions regarding the validity of the measurements. Several comments were emerged from the validation and they were addressed accordingly. A pilot study was conducted by assessing the Cronbach's Alpha (CA) of the measurement. One item in the scale of measuring the physical infrastructure was removed to enhance the Cronbach's Alpha. However, all the measurement showed a level of CA greater than 0.70 leading to a conclusion that the

measurement are reliable. An online questionnaire was distributed to 378 respondents based on their strata in the five universities. A low response rate was found where only 39 response were collected. A follow up was conducted and a paper based questionnaire were distributed. This has increased the response to 219 response. The responses were checked for missing values. A total of 11 responses were found to miss largenumber of answers and they were removed accordingly. In addition, six responses were having a serious outlier issues and they were removed as well. This has made a 202 are the valid responses.

4. FINDINGS

The findings of this study is presented in this section. The background information of the respondents as well as the measurement model and the structural model are shown in this section.

4.1. Demographic Information

The data of this study was collected from 202 respondents. The background information of the respondents is presented in Table 1 shows the background information of the variables. The respondents is divided into 63% male and 37% female. The age of the respondents ranged between 30 and 60 with the highest percentage between 41-50 years with percentage of 54.4. The respondents have varied experiences. A total of 53.4% have experience between 10-15 years. The majority of 91.1% of the respondents are holder of PhD degree while 8.9% are holder of a master degree.

Table1. *Demographic Information of Respondents*

Variable	Label	Frequency	Percentage
Gender	Male	127	63%
	Female	75	37%
Age	30 years or less	5	2.5
	31-40 years	77	38.1
	41-50 years	110	54.4
	51-60 years	10	5
Experience	Less than 5 years	3	1.5
	5-10 years	33	16.4
	10-15 years	108	53.4
	16-20 years	55	27.2
	21-25 years	3	1.5
Education	Master	18	8.9
	Ph.D.	184	91.1

4.2. Smart PLS

The analysis of the data of this study was conducted using Smart PLS 4. The analysis included the factor loading, reliabilities and validities. the structural model is assessed by checking the R-square, F-square, and path coefficient. All the analyses were conducted based on the suggestions of [69].

4.2.1. Measurement Model

The first step in assessing the measurement model is to check the factor loading (FL). The FL of the items showed an accepted level higher than 0.70 except for some items which had low factor loading (less than 0.70) and they were removed. Items that have been removed include KC3 from knowledge creation (KC), KS1 and KS4 from knowledge sharing (KS). From knowledge utilization (KU), item number 4 was removed. Item number 4 from the continuous learning and professional development (CLPD) was removed. From digital infrastructure (DI) and physical infrastructure (PI), item DI2 and PI5 were removed.

The Cronbach's Alpha showed that all the values above 0.70 as shown in Table 2. Similarly, the composite reliability (CR)were above 0.70 for all the variables. For the convergent validity, the value of average variance extracted (AVE) is above 0.50 for all the variables. This indicates that the convergent validity is achieved. The discriminant validity is checked using the Heterotrait-monotrait Ratio of Correlations (HTMT). The rule is to have a correlation among the variable less than 0.85 to conclude that there is no issue of discriminant validity.

Table2. *Assessment of First Order Measurement Model*

Variable	CA	CR	AVE	HTMT's Correlation						
CLPD	0.904	0.917	0.594	-						
DSU	0.914	0.915	0.818	0.774						
DI	0.915	0.925	0.882	0.65	0.645					
KC	0.903	0.905	0.675	0.718	0.696	0.568				
KU	0.824	0.827	0.815	0.603	0.57	0.513	0.628			
KS	0.832	0.833	0.83	0.415	0.614	0.55	0.669	0.491		
PI	0.825	0.827	0.817	0.502	0.553	0.629	0.462	0.426	0.412	-

Note: *CLPD: Continuous learning and Professional development, DSU: Development of Smart University, DI: Digital Infrastructure, INF: Infrastructure, KC: Knowledge Creation, KM: Knowledge Management, KU: Knowledge Utilization, KS: Knowledge sharing, PI: Physical Infrastructure*

For the second order, the factor loading is above 0.70. The CA and CR are above 0.70 as well as the AVE is greater than 0.50. HTMT's correlation among the variable is less than 0.85 which confirm the discriminant validity.

Table3. *Measurement Model of the Second Order*

Variable	CA	CR	AVE			
Development of Smart University	0.914	0.915	0.818	-		
Infrastructure	0.903	0.907	0.571	0.678		
Knowledge Management	0.899	0.901	0.539	0.746	0.66	-

4.2.2. Structural Model

The structural model of this study was assessed by examining three criteria. The first is the R-quare. As shown in Figure 2, the R-square of infrastructure is 0.387 and for development of a smart university (DSU) is 0.562. This indicates that 38.7% of the variation in infrastructure can be explained by knowledge management while 56.2% of the variation in DSU can be explained by the KM and infrastructure. For the F-square or the effect size, Table 4 shows that all the F-square were above 0.02 indicating that they are acceptable.

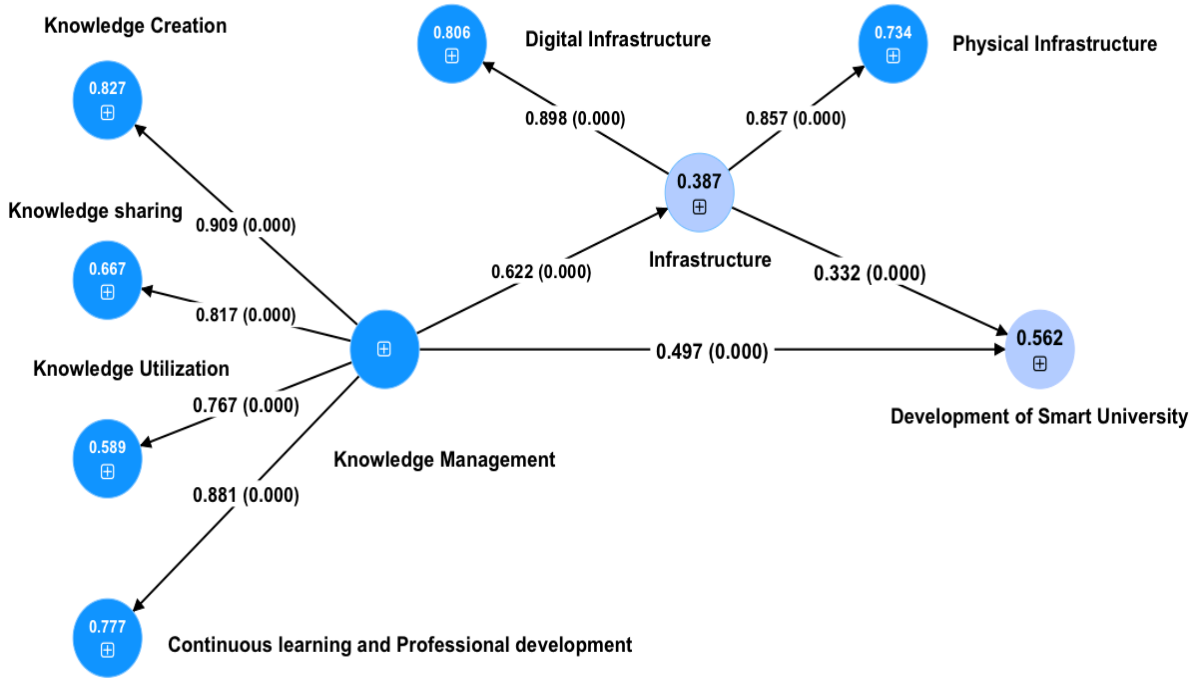

Figure2. *Structural Model of Second Order Variables*

For the path coefficient, all the path showed a level of significance less than 0.05. Table 4 shows the results of testing the path coefficient (hypotheses). It shows the path, path coefficient (B), standard deviation (Std), t-value (T), p-value, f-square, and concluding remark regarding the level of the hypothesis.

Table4. *Hypotheses Testing*

Hypothesis	Path	B	Std.	T	P-value	F-square	Conclusion
H1	KM ->DSU	0.497	0.048	10.352	0.000	0.355	Significant
H1a	KC ->DSU	0.186	0.051	3.651	0.000	0.039	Significant
H1b	KS ->DSU	0.123	0.049	2.51	0.012	0.023	Significant
H1c	KU ->DSU	0.091	0.041	2.218	0.027	0.021	Significant
H1d	CLPD ->DSU	0.296	0.045	6.507	0.000	0.117	Significant
H2	INF ->DSU	0.332	0.047	7.044	0.000	0.155	Significant
H2a	DI ->DSU	0.172	0.044	3.881	0.000	0.038	Significant
H2b	PI ->DSU	0.129	0.038	3.36	0.001	0.027	Significant
H3	KM ->INF -> DSU	0.207	0.033	6.296	0.000	-	Significant

4.2.3. Hypotheses Testing

The results of testing the hypotheses are shown in Table 4. It shows that the effect of KM on DSU is positive at path coefficient of 0.497 and p-value less than 0.05 supporting the effect of KM on DSU. Therefore, H1 is significant. For H1a, H1b, H1c, and H1d, all the hypotheses showed that they are supported. The effect of KC (B=0.186, P<0.05), KS (B=0.123, P<0.05), KU (B=0.091, P<0.05), and CLPD (B=0.296, P<0.05) are supported and significant. Therefore, KC, KS, KU, and CLPD are significant predictors of the DSU. For H2, the effect of infrastructure on DSU is positive and significant (B=0.332, P<0.05). The effect of DI and PI on DSU are also significant at B=0.172 and B=0.129 respectively and p-value less than 0.05. For the mediation role of infrastructure between KM and DSU, as shown in Table 4, the indirect effect (KM→INF→DSU) is significant (B=0.207, P<0.05). Therefore, it was concluded that the direct and indirect effect are significant indicating that the mediation has occurred and it is partial mediation.

5. DISCUSSION

This study was conducted to understand the effect of KM and Infrastructure on the DSU as well as the mediating role of infrastructure. This findingwas derived by collecting data from academic staff working in the top five universities in Saudi Arabia. The findings showed that knowledge management is critical for the DSU. The most important practice of KM is the CLPD. The increase in the KM activities and practices will lead to foster the development of a smart university in Saudi Arabia. In particular, the focus on the continuous learning and professional development is important for supporting the development of a smart university. This is followed by the knowledge creation. A smart university in Saudi Arabia should focus on extracting knowledge from internal sources and integrate this knowledge with external sources to come up with a new knowledge in term of research, learning and teaching. Knowledge sharing is a critical factor as well. Having the created knowledge shared among organizational members will lead to adding value and enlargement of the knowledge. This helps in creating a new knowledge and implementing the knowledge inside the university.

The findings are in line with the KBV which suggested that managing the knowledge effectively and capitalizing on the organizational knowledge will lead to a superior performance and competitive advantage. It also enhances the creativity and innovation at the individual level and the organizational level[18], [19]. Similarly, prior literature supported the positive effect of KM and its practices such as KC, KS, and KU as well as CLPD on DSU[34][35][38][39]. Prior literature found that in the process of developing a smart university, it is important to master the practices of KM such as the KC, KS, and KU as well as CLPD.

In term of the effect of infrastructure and its dimensions such as DI and PI, the effect is positive indicating that the increase in the investments in the digital and physical infrastructure will speed up the process of developing a smart university in Saudi Arabia. Digital infrastructure such as cloud computing, internet of things, and artificial intelligence are important for the development of a smart university. Similarly, investing in the physical infrastructure such as the smart campus, smart classroom and smart hardware is important to foster the development of a smart university. In line with these findings, the RBV suggested that using the internal resources is important to create a competitive advantage such as the development of a new learning method or teaching method in the context of a smart university[52][26]. Researchers also showed the importance of the infrastructure in supporting the KM process and enhancing the development of a smart university[55]–[57], [59]–[61].

In term of the mediating role of infrastructure between KM and DSU, the mediation is partial suggesting that part of the relationship between KM and DSU can be explained using the infrastructure. This finding indicates that the integration between KM and infrastructure is important to facilitate the knowledge creation, knowledge sharing, knowledge utilization, and the CLPD. Prior literature agreed with this findings and support the mediation role of infrastructure[62][63][64].

6. IMPLICATIONS

This study contributed to the literature and practices in the context of a smart university. The theoretical and practical implications are discussed in the following sections.

6.1. Theoretical Implication

The study contributed to the literature by examining the applicability of the RBV and KBV in the context of the development of a smart university in developing countries. KBV explained the effect of KM and its practices on the DSU and RBV explained the effect of infrastructure on DSU. Both theories complement each other and explained the relationship among the variables. Therefore, the theories are valid in the context of a smart university in developing countries. The study also contributed by operationalizing KM and including additional practices such as CLPD. The measurement of the variables were validated and pilot tested for reliabilities. In addition, the study contributed to the literature by operationalizing infrastructure into physical and digital infrastructure while prior literature focused only on the information technology (IT) infrastructure.

The study also contributed to the literature by examining the development of a smart university from the behavioural perspective by conducting a quantitative study using a questionnaire to confirm the effect of variables such as KM and its practices as well as infrastructure and its practices. The study contributed to the literature by examining the mediating role of infrastructure between KM and DSU. Overall, the study contributed to the literature by explain more than half of the variation in the development of a smart university in the context of developing counties such as Saudi Arabia.

6.2. Practical Implication

This study contributed to the development of a smart university in the context of Saudi Arabia. The study has found that KM and its practices are critical for the development of a smart university. Decision makers in Saudi Arabian higher education should focus on developing the professional skills of the academic staff and non-academic staff to support the development of a smart university. They are also recommended to enhance the knowledge creation by hosting workshops and seminars where staff with adequate expertise can provide their knowledge about the transformation toward a smart university. The study also contributed to the literature by highlighting the role of digital and physical infrastructure. Investing in digital infrastructure is highly recommended since the usage of technology such as cloud computing e-learning and IoT in higher education can foster the development of a smart university and can improve the performance of staff and students.

In term of the mediating role of infrastructure between KM and DSU, the findings supported a partial mediation. Decision makers are recommended to invest more in developing the physical and digital infrastructure because they play a crucial role in effectively translating the knowledge management efforts into concrete results. Hence, it is crucial to guarantee a robust congruence and fusion between knowledge management practices and the accompanying infrastructure. This may entail allocating funds towards the development of digital infrastructure, enhancing technological systems, and ensuring sufficient resources are available to support the processes of knowledge creation, sharing, and utilization.

Thus, decision makers are recommended to improve the capabilities of the infrastructure. It is essential to evaluate the specific aspects of the infrastructure that play a role in the advancement of a smart university, considering the partial mediation effect. This may entail assessing the efficacy of current digital platforms, network infrastructure, data storage systems, and communication tools. The identification of areas requiring improvement and subsequent investment in the necessary upgrades can significantly enhance the infrastructure's capacity to support knowledge management initiatives and effectively facilitate the development of a smart university. Accordingly, infrastructure alone does not solely determine the progress of a smart university. Partial mediation indicates that while

infrastructure does contribute to facilitating knowledge management, other factors also play a significant role in the university's development. Decision makers are recommended to promotes and advocatecontinuous learning and innovation for students, faculty, and staff. This study can contribute to the fulfilment of the vision of 2030 by developing a smart university in KSA.

7. CONCLUSION

This study was conducted to examine the effect of KM and its practices on the DSU in Saudi Arabia. The findings showed that KM and its practices such as knowledge creation, knowledge sharing, knowledge utilization, and continuous learning and professional development are critical predictors of the DSU. In addition, the infrastructure (digital and physical) are important for DSU and it mediates the effect of KM on DSU. The findings were derived from academic staff working in the top five university in Saudi Arabia. Thus, the findings are limited to the perception of the academic staff. It is also limited to the universities in Saudi Arabia. The finding also focused on the effect of KM and infrastructure on the DSU. To extend the findings of this study, future research are recommended to examine other factors. The government support toward the digital transformation is a critical factors and deserve further research. In addition, the development of a smart university in other countries such as the Gulf cooperation council (GCC) can be a direction for future work to allow comparison with the current findings. Future research can also include the perspective of non-academic staff. Future research can also examine other emerging technologies that can facilitate the development of a smart university such as the industry 4.0, cloud computing e-learning and IoT. Developing a smart university requires an effective integration between KM and the infrastructure and decision makers have to invest more in the infrastructure to foster the development of a smart university.

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