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The impact of knowledge management on the research capacity of university lecturers in Hanoi

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ABSTRACT

This study was conducted with the objective of evaluating the influence of knowledge management on the research capacity of university lecturers in Hanoi. First, the decision system analysis method was used for the decision-making process of the knowledge management model through three rounds of interviews with 15 experts from universities, research institutes, and scientific journals. Five factors, namely knowledge creation, knowledge collection, knowledge sharing, knowledge application, and knowledge management with big data, were then identified. A survey was conducted with 388 participants, and the collected data were analyzed through partial least squares structural equation modeling. Accordingly, the knowledge management model with five factors that affect the motivation of research and the research capacity of lecturers at universities in Hanoi was evaluated, and the significant values of the reliability and suitability of the model were accepted, showing that the proposed model is suitable. The test results showed that knowledge creation, knowledge collection, knowledge sharing, and knowledge management with big data had a significant relationship with the faculty's research capacity. The analysis revealed that knowledge creation, knowledge application, and knowledge management with big data had a significant impact on the motivation of lecturers for research. The results also showed the direct impact of research motivation on lecturers' research capacity. Furthermore, the indirect relationships between knowledge creation, knowledge sharing, knowledge collection, and knowledge management with big data and research capacity through research motivation is a noteworthy finding of this study.

Contribution/Originality: This study contributes to the existing literature of knowledge management and the knowledge management model by using a new estimation methodology to study the impact of knowledge management on the research capacity of university lecturers in Hanoi.

1. INTRODUCTION

Nowadays, educational institutes or universities not only act as training institutions but also play a chief driving role in a student's research activities. In addition to training functions, universities are also centers for knowledge creation, technology transfer, and innovation (Ngoc-Tan & Gregar, 2019). In recent years, numerous

studies on knowledge management have been conducted (Ferraresi, Quandt, Santos, & Frega, 2012; Gunjal, 2005; Putra & Febriani, 2017; Sudibjo, Aulia, & Harsanti, 2022). However, studies on knowledge management models mainly focus on the issues of acquiring, creating, storing, sharing, developing, diffusing, and deploying knowledge (Abu-Naser, Al Shobaki, & Abu Amuna, 2016; Rivera & Rivera, 2016; Sonmez Cakir & Adiguzel, 2020), but there is a dearth of studies on knowledge management with community practice and big data (Pham et al., 2021). This study was conducted with the objective of performing a comprehensive literature review in the field of knowledge management and the knowledge management model in universities and its impact on the research capacity at universities in Hanoi, Vietnam. The authors then identified the major challenges in the field of knowledge management in universities. Finally, several implications for managers and practitioners were identified and are proposed herein.

2. LITERATURE REVIEW

2.1. Model of Knowledge Management

According to Smith (2001), knowledge management is a process that includes collecting and accumulating knowledge for organizations; organizing, allocating and applying knowledge to an organization's activities; practice-sharing and protecting the rights of knowledge creators; and taking motivating employees to maintain valuable knowledge for the organization. For educational institutions, knowledge management is the key to effective and efficient school managers. In addition to information management, knowledge management is more broadly understood as trust management and the opinions and experiences of people in an organization (Samad, Rahmad Sukor, Syah, & Muslihah, 2014; Ugwu & Okore, 2020).

Knowledge management (KM) in education is an activity within the management model and creative guidance of educational institutions (Koch, 2003). A systematic review by Miltiadis and Athanasia (2003) shows that prior studies classify knowledge management into different groups that are not exactly the same but, in general, have five basic components, namely collection, transfer, application, protection, and preservation. Rivera and Rivera (2016) studied the model of knowledge management in the context of higher education in Mexico and proposed a KM model with six factors (leadership, culture, structure, human resources, information technology, and measurement) that facilitates the processes of creation, storage, transfer, and utilization of research. A study conducted by Kiran, Agarwal, and Verma (2013) of 30 higher technical education institutions in India proposed a model that includes knowledge technologies, knowledge acquisition, knowledge storage, knowledge dissemination, and a KM-based framework.

By conducting a literature review of 160 papers on knowledge management, published between 2010 and 2020, Pham et al. (2021) used the fuzzy-analytical hierarchy process method to develop a model for knowledge management at universities. This model consists of eight factors, namely knowledge sharing, knowledge management with big data systems, knowledge creation, knowledge use, knowledge collection, knowledge assessment, leadership, and knowledge storage. Based on the authors' analysis, it can be seen that the big data system is related to the use of information technology and the achievements of the fourth industrial revolution. The study showed a correlation with previous studies in the evaluation of knowledge management models at universities (e.g., Rivera & Rivera (2016) and Secundo, Schiuma, & Jones (2019)). Therefore, this study employed the knowledge management model proposed by Pham et al. (2021) to evaluate its effects on the research capacity of lecturers at universities in Hanoi.

2.2. The Relationship Between Knowledge Management and Lecturers' Research Capacity

Prior studies have shown that a faculty's research capacity is reflected in the quantity and quality of the works published by the lecturers in scholarly journals and presented at conferences (Wills, Ridley, & Mitev, 2013). According to Hedjazi and Behravan (2011), research competence is related to creative ideas; these ideas are then

published as works in journals, newspapers, or registered patents, and academic documents. Aydin (2017) reviewed and then listed the indicators that measure research capacity according to the approach based on the number of articles published in scientific journals, index of journals, number of published books, number of edited books, number of book chapters edited in monographs, number of citations, patent registration, research grants received, participation in research projects research, number of scientific awards, number of scientific conference papers, number of invitations to present scientific conference reports, number of dissertations/guidelines, participation in the editorial board of scientific journals, the position in professional associations, and the professional relationship with foreign colleagues.

In accordance with the aforementioned definitions and evaluation criteria of faculties' research competence, a knowledge management model is required to promote these competencies. Procedures, leaders, managers, colleagues, and knowledge management results have been demonstrated to influence the performance of research. Arntzen, Worasinchai, and Ribiere (2009) showed that, in addition to the basic factors including creating, collecting, storing, and using knowledge, the factor of sharing also has an important effect on the research capacity of lecturers at universities. Salo (2011) showed that the factors of the knowledge management model, such as knowledge creation, knowledge collection, and the use of knowledge, have a strong influence on the research capacity of students and lecturers. Bader, Haneen, Ala'aldin, Ali, and Ibrahim (2016) also showed that factors related to knowledge management methods provide lecturers with the opportunity to connect with other scientific groups in their communities through social networks, coding, personalization from impact measurement to research motivation, and the research capacity of lecturers (Ferraris, Mazzoleni, Devalle, & Couturier, 2019). Moreover, a number of studies have also confirmed the influence of knowledge management on faculties' research capacity (Al-Abbadi, Alshawabkeh, & Rumman, 2020; Gyemang & Emeagwali, 2020; Huie, Cassaberry, & Rivera, 2020). In line with the above-mentioned discussion, the following hypotheses were developed in this study:

H1: Factors in the knowledge management research model have a direct influence on the research capacity.

H1a: Knowledge creation has a direct influence on the research capacity.

H1b: Knowledge acquisition has a direct influence on the research capacity.

H1c: Knowledge sharing has a direct influence on the research capacity.

H1d: Knowledge application has a direct influence on the research capacity.

H1e: Knowledge management with big data has a direct influence on the research capacity.

2.3. The Relationship Between Knowledge Management and Faculties' Motivation for Research

Motivation is regarded as an important factor that drives individuals to achieve their goals. It reflects the human tendency to learn and is an inherent tendency to achieve goals, seek novelty and challenge to extend a capacity, and discover and learn (Ryan & Deci, 2000). Studies by Lee, Chang, Liu, and Yang (2007); Singh and Sharma (2011); Kianto, Vanhala, and Heilmann (2016) have demonstrated a positive relationship between knowledge management and job motivation. In addition to affecting the results of professional activities, the motivation for research is affected by the activities of knowledge management. In the field of knowledge management, promotion activities can develop teachers' motivation for research (Rasheed, Aslam, & Sarwar, 2010; Triyanto, 2019). The findings of the study by Nili, Isfahani, and Tanhaei (2013) suggest that knowledge management affects the motivation of lecturers for research. However, only a few studies have investigated the impact of knowledge management on the research motivation of university lecturers. Therefore, in line with the previous studies, the following hypotheses were developed in this study:

H2: The factors of the knowledge management model have a direct influence on research motivation.

H2a: Knowledge creation has a direct influence on research motivation.

H2b: Knowledge acquisition has a direct influence on research motivation.

H2c: Knowledge sharing has a direct influence on research motivation.

H2d: Knowledge application has a direct influence on research motivation.

H2e: Knowledge management with big data has a direct influence on research motivation.

2.4. The Relationship Between the Research Motivation and Research Capacity of Lecturers

Research motivation can be regarded as a factor affecting research capacity (Bland, Center, Finstad, Risbey, & Staples, 2005). Meanwhile, research capacity is assessed on the basis of the research productivity (Arsyad, Purwo, Sukamto, & Adnan, 2019; Brancolini & Kennedy, 2017) and research capacity (Nasser-Abu Alhija & Majdob, 2017) of each individual. Internal personal factors include intelligence, understanding, creativity, curiosity, self-efficacy, motivation, recognition and respect in the field, and the ambition and need to collaborate with other influences on research capacity (Chen, Gupta, & Hoshower, 2006; Chen, Nixon, Gupta, & Hoshower, 2010). External factors including promotions, financial rewards, staffing, teaching load, and research networks have been demonstrated to have a significant impact on faculty research capacity and research engagement. For example, staffing and promotion are potential drivers of research performance. In line with these arguments, the following research hypothesis was developed in this study:

H3: Research motivation directly influences research capacity.

A number of previous studies have tested the factors affecting the motivation of lecturers for research (Cadez, Dimovski, & Zaman Groff, 2017), or determine the score associated with the relationship between motivation and a faculty's research capacity (Dilger, Lütkenhöner, & Müller, 2015; Vernon, Balas, & Momani, 2018).

Runi, Ramli, Nujum, and Kalla (2017) showed that motivation has a positive and significant impact on research capacity. Waheed, Khan, Khan, and Khalil (2012) demonstrated that increasing the implementation of effective knowledge management activities would increase motivation and capacity for research, thereby increasing the effectiveness of the organization. Vernon et al. (2018) reported that university rankings affect the choice of lecturers to work as well as motivate lecturers to carry out scientific research. However, the authors did not account for the role of the knowledge management system of universities. Hall and Martin (2019) remarked that research must first come from passion; they further noted that management institutions should create an environment that stimulates such passion. Thus, although there have been studies examining the relationship between knowledge management, research motivation, and faculties' research capacity, no previous study has demonstrated the mediating role of research motivation in the relationship between science and technology and the knowledge management and research capacity of lecturers at higher education institutions. The following hypothesis was developed in this study:

H4: The factors of the knowledge management model have an indirect impact on research capacity through research motivation.

3. METHODOLOGY

The data were collected through a research-specific questionnaire, and the study was conducted in four steps. Step 1 is the initial qualitative research using a decision system analysis (DSA) method; Step 2 involves quantitative research through Cronbach's alpha analysis; Step 3 is the quantitative research using the partial least squares structural equation modeling (PLS-SEM) method; and Step 4 comprises additional qualitative research.

3.1. Research Design

This DSA method was used in this study to formalize the process of interviewing managers involved in different stages of the decision-making process. Previous studies (Howard and Morgenroth, 1968; Kaynak and Ghauri, 1994; and Ronkainen, 1985) have emphasized that the purpose of DSA is to describe the flowchart of the decision-making process. The steps of the decision-making process provide an opportunity to consider and evaluate changing needs, conditions, and alternatives. DSA diagrams can be adapted according to the input of the

interviewees when developing the decision-making flowchart while also taking into account the opinions of different groups and individuals (Ronkainen, 1985). The semi-structured interview process (Lehmann & Hulbert, 1972) is especially useful for creating a series of detailed diagrams depicting decisions made through the decision-making process.

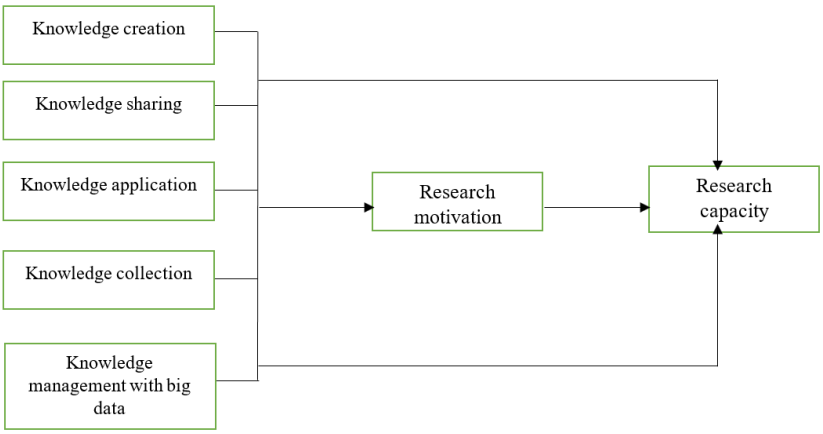

Figure 1. The proposed research framework.

The DSA method constructs flowcharts of the decision-making stages that involve managers' interactions. In this study, a three-round interview process was implemented (see Figure 2).

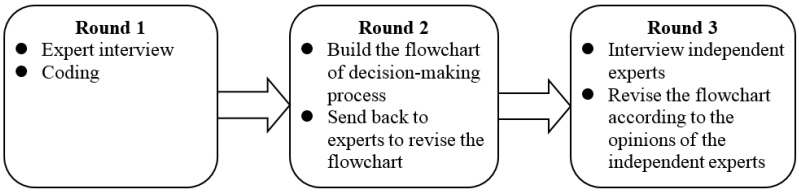

Figure 2. Three-round interview process.

In each round, the experts were asked to complete a qualitative interview questionnaire related to factors affecting the faculty's research capacity. During the interviews, the preliminary diagram was shown to the experts to provide additional details on the criteria and corrected if necessary. The diagram was then adjusted for completeness and accuracy. The schematic revision was sent to the experts in the third round of interviews and to other experts who had followed the decision-making process but did not participate directly in the previous interviews. The final version of the flowchart was completed after the third round of interviews to build a research model of the factors affecting the research capacity of lecturers.

Table 1. Experts' background information (rounds 1 and 2).

No.	Working position	Experience (Years)	Types of higher education institutions
1	Vice rector	10	Public
2	Rector	15	Public
3	Editor in chief	12	Public
4	Vice rector	15	Private
5	President	20	Public
6	President	20	Private
7	Rector	15	Public
8	Head of department of science management and international affairs	10	Public
9	Vice rector	20	Public
10	Dean	20	Private

In order to conduct the interviews, experts were selected from universities, research institutes and certified scientific journals who are directly involved in, or who have a direct influence on, knowledge management. The background information of the experts for the first and second rounds of interviews is summarized in Table 1.

The experts who participated in the interviews were carefully selected based on their qualifications, experience, and field of activity. Na, Marshall, and Woodside (2009) argued that "after a series of structured and unstructured discussions with managers, each decision-making participant demonstrated the behavior and thought processes of them in a variety of protocols." The background information of the experts in the third round of interviews is summarized in Table 2.

Table 2. Experts' background information in the third round of interviews.

No	Organization	Working position	Experience (In years)
1	University	Rector	12
2	University	Head of department of science management and international affairs	11
3	University	Dean	15
4	University	Head of department	12
5	Research institute	Director of institute	16

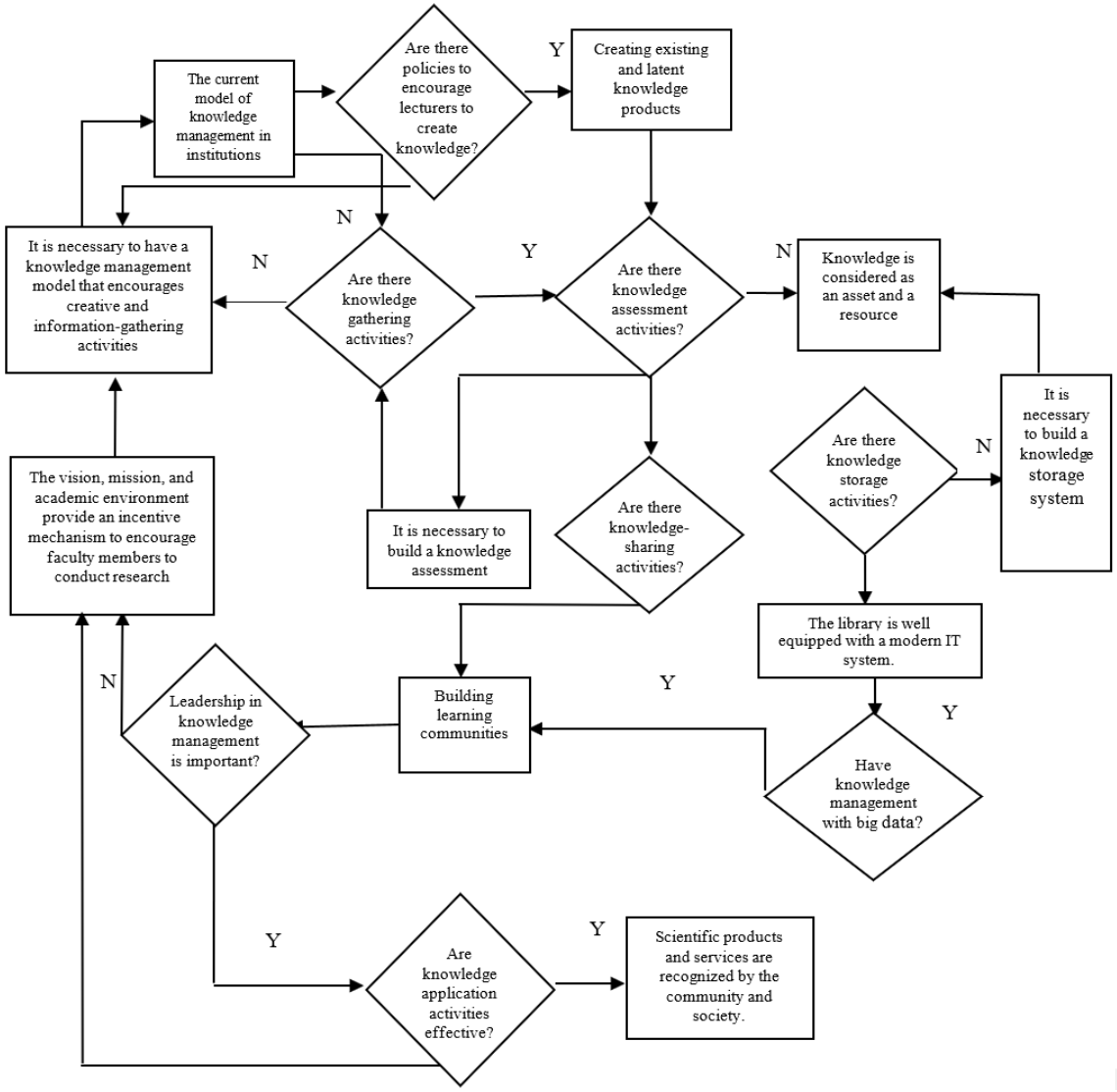

Figure 3. DSA flowchart for the knowledge management model.

According to Figure 3, in order to build a suitable and reliable research model, a specific set of questions were developed for the interviews. After conducting the third-round interviews, qualitative analysis techniques were used to encode the information collected. After forming the code systems, coding was carried out in which one or more suitable codes were assigned to the variables. Table 3 presents the qualitative analysis results. A total of 15 experts participated in the interviews, and items with agreement from 13–15 experts, 8–12 experts and 4–7 experts were labeled as "Majority," "Medium," and "Minority," respectively. If any item was agreed upon by fewer than four people, it was not accepted.

Table 3. Qualitative analysis results.

Variable	Definition	Result
Knowledge sharing	Knowledge sharing is defined as the exchange of knowledge, skills, experience, and understanding among individuals in an organization.	Majority (15/15)
Knowledge collection	Acquiring knowledge is not only a simple matter of acquiring knowledge; instead, things that are assumed to be natural categories, such as "body of knowledge," "learner," and "cultural transmission," require a re-conceptualization as products of cultural and social activities. These activities are based on knowledge organization and the knowledge of teachers in accordance with the action plans.	Majority (15/15)
Knowledge assessment	Knowledge assessment is an essential element of the knowledge management model and should be placed in the first stage of knowledge management. It is important to demonstrate and confirm whether the acquired knowledge is qualified and whether that knowledge can be used, shared, or stored within the organization.	Minority (4/15)
Knowledge application	Knowledge application is the process of explicitly representing and applying the acquired and validated knowledge to influence decisions, design policy, problem solving, or create new solutions to problems. It takes advantage of new opportunities and it creates new knowledge. Knowledge is always in the process of being built, transformed, and maintained.	Majority (13/15)
Knowledge creation	Knowledge creation can be defined as the ability of an organization to generate new and useful ideas and solutions related to various aspects of organizational activities, from technological products and processes to practice management.	Majority (11/15)
Knowledge storage	Knowledge storage is the use of technology that provides a means of storing and retrieving knowledge through computerization. It is important to make it accessible to others or the next generation.	Minority (4/15)
Leadership	Leadership factors in knowledge management are related to mission vision, academic environment, empowerment, governance system, openness to change, and policies that motivate research activities.	Minority (4/15)
Knowledge management with big data	The knowledge management generated from big data analysis and the integration and combination with solid knowledge systems ensures that data can be analyzed and classified and converted into knowledge.	Majority (10/15)

After consulting the experts, five factors of the knowledge management model were used as independent variables, namely knowledge creation, knowledge sharing, knowledge application, knowledge collection, and knowledge management with big data. The motivation for this research is to determine a variable connecting knowledge management with the research capacity of lecturers. The observed variables and their sources used in this study are presented in Table 4.

Table 4. Scales to measure the research variables.

Factor	Question	Code	Source
Knowledge creation (KNC)	There is a mechanism and policy to promote knowledge creation activities.	KNC1	Shannak, Maqableh, and Tarhini (2017)
	Lecturers are encouraged to exchange their knowledge and ideas.	KNC2	
	Rewards are given for new ideas and knowledge.	KNC3	
	Mechanisms exist to create new knowledge from the existing knowledge.	KNC4	
	A culture of creativity in research is nurtured.	KNC5	Developed by the authors

Factor	Question	Code	Source
Knowledge collection (KC)	Mechanisms exist to collect useful knowledge from a variety of sources.	KC1	Shannak et al. (2017)
	I receive support when I have a need for new knowledge.	KC2	
	I am provided with scientific information that is relevant to my research interest.	KC3	
	There is a budget for purchasing scientific databases.	KC4	Developed by the authors
	Conditions allow individuals to exchange their ideas and needs to explore new knowledge.	KC5	Shannak et al. (2017)
	Highly qualified lecturers and researchers are invited to increase the scientific capacity.	KC6	Shannak et al. (2017)
Knowledge sharing (KS)	There are knowledge sharing models that are accessible.	KS1	Shannak et al. (2017)
	Seminars and training workshops are organized to exchange knowledge and ideas.	KS2	
	Venues and opportunities are provided for a faculty to have informal discussions.	KS3	
	There is a community in which to share knowledge.	KS4	Developed by the authors
	Reports with relevant information are sent to the lecturers when necessary.	KS5	Shannak et al. (2017)
	There are libraries, resource centers and other forums for storing and exchanging knowledge.	KS6	Shannak et al. (2017)
	Working spaces and opportunities are provided to the faculty.	KS7	Shannak et al. (2017)
	There are scientific journals for lecturers to publish their studies.	KS8	Developed by the authors
Knowledge applied (KA)	There is a mechanism for lecturers to apply their knowledge.	KA1	Ngoc-Tan and Gregar (2019)
	There is a regime to protect copyright.	KA2	Shannak et al. (2017)
	New knowledge is used to make decisions related to school matters.	KA3	
	There are methods of analyzing and evaluating knowledge to create new knowledge for future use.	KA4	Ngoc-Tan and Gregar (2019)
	New and useful ideas are initialized and applied in daily life.	KA5	
Knowledge management with big data (KB)	There is a filtering and integrating mechanism for different sources and types of knowledge.	KB1	Ngoc-Tan and Gregar (2019)
	There is a big data encoding system.	KB2	Ardito, Ferraris, Petruzzelli, Bresciani, and Del Giudice (2019)
	There is an intelligent electronic library that can provide easy access to scientific databases.	KB3	
	There is an effective IT infrastructure to support research activities.	KB4	Developed by the authors
	There is an integration method with a solid knowledge system ensuring that data can be analyzed and classified.	KB5	Developed by the authors
	The connections among scientific activities are facilitated.	KB6	Developed by the authors
Research motivation (RMO)	I like conducting research because it plays a vital role in lecturers' professional lives.	RMO1	Developed by the authors
	I am proud to be recognized by the school and society for my scientific achievements.	RMO2	
	I am optimistic about my future scientific success.	RMO3	
	I will continue with my passion for research at my university.	RMO4	
	I have made a significant contribution to the development of my university.	RMO5	
	My studies have made a significant contribution to transferring knowledge to students.	RMO6	
	Besides teaching activities, I usually spend a lot of time conducting research.	RMO7	

Factor	Question	Code	Source
Research capacity (RCA)	The number of my published papers and scientific indexes has increased.	RCA1	Kotsemir (2012)
	I have a number of ISI- and SCOPUS-indexed papers.	RCA2	
	The university's scientific reputation regarding scientific activities has increased.	RCA3	Developed by the authors
	The total number of citations from my published papers has increased.	RCA4	
	The total number of citations of each paper has increased.	RCA5	Zhang (2014)
	Regarding the applicability, my research is highly appreciated.	RCA6	Developed by the authors
	My studies have a high reference value and a valid contribution to the research area.	RCA7	Developed by the authors

The questionnaire was divided into two parts: the first part contained questions regarding the survey participants, and the second consisted of the participants' evaluations of the research questions. A five-point Likert scale, from 1 *strongly disagree* to 5 *strongly agree*, was used in this study.

3.2. Data Sample

The convenient sampling method was used, and questionnaires were sent to 450 lecturers from universities in Hanoi, Vietnam, from March 2021–October 2021 via email and Google Forms. A total of 410 questionnaires (91%) were filled in and sent back. After removing any incomplete forms, 388 samples (86.2%) were used.

Regarding gender, 113 respondents were male (29.1%) and 275 were female (70.9%). The number of lecturers under the age of 25 years accounted for 14.9%, those aged 25–35 years accounted for 34.3%, those aged 36–45 years accounted for 38.9%, and those over 45 years old accounted for 11.9%.

Regarding academic qualifications and designations, lecturers with master's degrees accounted for 55.9%, PhD degrees accounted for 32.2%, and associate professors and professors accounted for 8.2% and 3.6%, respectively. Those with fewer than five years of work experience accounted for 22.9%, those with 5–10 years accounted for 25.3%, those with 11–15 years accounted for 29.4%, and over 15 years accounted for 22.4%.

Table 5. Demographic information of participants.

Characteristic		Frequency	Percentage
Gender	Male	113	29.1
	Female	275	70.9
Age (Years)	Under 25	58	14.9
	25–35	133	34.3
	36–45	151	38.9
	Above 45	46	11.9
Academic qualifications and designations	Master	217	55.9
	Doctor	125	32.2
	Associate professor	32	8.2
	Professor	14	3.6
Working time	Under 5 years	89	22.9
	5–10	98	25.3
	11–15	114	29.4
	Above 15 years	87	22.4
Working position	Lecturer	317	81.7
	Manager	71	18.3
Major	Social science and humanities	265	68.3
	Engineering	65	16.8
	Others	58	14.9
		388	100.0

With regard to working positions in universities, out of 388 respondents, 317 people were working as lecturers, accounting for 81.7%. The number of respondents who were in leadership and management positions was 71 (18.3%). There were 265 lecturers teaching in the majors of social science and humanities, accounting for 68.3%, 65 lecturers were in engineering, accounting for 16.8%, and 58 lecturers in other fields, accounting for 14.9%. Table 5 summarizes the respondents' demographic information.

3.3. Data Analysis

PLS-SEM is an analytical technique for detecting or building predictive models. For the analysis of causal models between latent variables, this method is considered to be better than the general linear structural relation model, which is more suitable for exploratory research (Ringle, Sarstedt, & Straub, 2012). In comparison with covariance-based structural equation modeling, which is evaluated by the covariance matrix, PLS-SEM is suitable for analyzing small samples. Chin (1998) suggested that the sample size of the PLS should be 10 times the latent variables included in the model. There are seven latent variables in the study, so according to the principle of statistical preservation, the minimum sample size for the study should be at least 70. The sample size of this study is 388, which exceeds the minimum sample size requirement. PLS-SEM is mainly designed to detect whether a causal relationship has a statistically significant linear relationship. Therefore, it is suitable for use with the theoretical model. In this study, the PLS-SEM was used to explore the relationship between the research variables. The PLS algorithm and bootstrapping were used to perform repeated sampling 5000 times to obtain the coefficients and statistical significance of the items (Henseler & Chin, 2010). This technique also shows the correlation and multi-dimensional influence between the variables.

4. RESULTS

4.1. Model Reliability and Validity

Reliability refers to the consistency of the observed variables. Metrics include the reliability of each scale and the internal consistency between the scales (Hair, Anderson, Tatham, & Black, 1998). The reliability of each scale was checked by the load factor indexes. Internal consistency was tested using the reliability of the latent variable (CR) component and Cronbach's alpha. The recommended value needed to be greater than 0.7.

After the data were collected, the reliability of the scale was tested using SPSS software. The results of the Cronbach's alpha analysis showed that some observed variables had similar coefficients. Correlation values less than 0.3 were excluded from the model. The knowledge creation variable had two excluded variables: KNC3 and KNC4. Knowledge collection had one observed variable excluded, KC6. The knowledge sharing variable had four excluded variables: KS4, KS5, KS7, and KS8. The knowledge management with big data variable had two excluded variables: KB4 and KB6. Research motivation had two observed variables excluded: RMO6 and RMO7. Lastly, the research capacity variable had three observed variables excluded from the model: RCA3, RCA6, and RCA7.

Validity refers to the correctness of the scale and the measurement indicators, including convergent and discriminant validity. The convergent values mainly measure the correlation between the scales in a factor and detect the average variance extracted (AVE). The recommended value should be greater than 0.5 (Bagozzi, Yi, & Nassen, 1998). Discriminant validity measures the correlation between scales with different characteristics using the square root value of the AVE. If the square root of the diagonal AVE is greater than the correlation coefficient of the horizontal or vertical columns, it is discriminant (Hair, Risher, Sarstedt, & Ringle, 2019).

The results of the load factor analysis showed that five of the observed variables had a loading factor value less than 0.7 and were removed from the model. Knowledge collection had one excluded variable (KC5), knowledge application (KA) had two excluded variables (KA3 and KA4), research dynamics had one excluded variable (RMO5), and research capacity had one excluded variable (RCA5).

Table 6. Convergent validity and reliability.

Factor	Item	Factor loading	Cronbach's alpha	CR	AVE
Knowledge creation	KNC1	0.899	0.868	0.919	0.791
	KNC2	0.893			
	KNC5	0.876			
Knowledge collection	KC1	0.841	0.891	0.925	0.754
	KC2	0.902			
	KC3	0.864			
	KC4	0.866			
Knowledge sharing	KS1	0.877	0.865	0.908	0.713
	KS2	0.881			
	KS3	0.857			
	KS6	0.757			
Knowledge application	KA1	0.811	0.741	0.850	0.654
	KA3	0.791			
	KA5	0.824			
Knowledge management with big data	KB1	0.813	0.848	0.897	0.686
	KB2	0.816			
	KB3	0.845			
	KB5	0.839			
Research motivation	RMO1	0.861	0.849	0.900	0.693
	RMO2	0.876			
	RMO3	0.864			
	RMO4	0.718			
Research capacity	RCA1	0.758	0.770	0.868	0.688
	RCA2	0.877			
	RCA3	0.848			
	RCA4	0.758			

After removing unsuitable observed variables, Table 6 shows that the load coefficients of all scales are greater than 0.7, and the Cronbach's alpha and CR values of all factors are also greater than 0.7, ensuring internal reliability and consistency. The AVE value of each factor is greater than 0.5, meeting the requirements for the convergence value of the factors. Table 7 shows that the other analytical parameters of the model also meet the statistical requirements, and the discriminant validity of the model is guaranteed because all values on the diagonal are larger than the values in the respective columns (Fornell & Larcker, 1981).

Table 7. Discriminant validity.

Factor	Knowledge management with big data	Knowledge sharing	Knowledge application	Knowledge collection	Knowledge creation	Research capacity	Research motivation
Knowledge management with big data	0.828						
Knowledge sharing	0.630	0.845					
Knowledge application	0.478	0.668	0.809				
Knowledge collection	0.554	0.609	0.554	0.868			
Knowledge creation	0.610	0.638	0.538	0.629	0.890		
Research capacity	0.637	0.648	0.557	0.693	0.694	0.829	
Research motivation	0.625	0.594	0.535	0.588	0.670	0.723	0.832

Table 8. Heterotrait-Monotrait ratio (HTMT).

Factor	Knowledge management with big data	Knowledge sharing	Knowledge application	Knowledge collection	Knowledge creation	Research capacity	Research motivation
Knowledge management with big data							
Knowledge sharing	0.735						
Knowledge application	0.582	0.825					
Knowledge collection	0.634	0.691	0.668				
Knowledge creation	0.711	0.735	0.662	0.713			
Research capacity	0.789	0.796	0.714	0.832	0.850		
Research motivation	0.733	0.689	0.655	0.668	0.769	0.890	

Table 8 shows that all heterotrait-monotrait ratio values are less than 0.9, confirming that the discriminant value ensures the model's fit (Henseler, Hubona, & Ray, 2016).

4.2. Structural Equation Modeling Analysis

When evaluating structural equation models, the problem of multiple additions should be carefully considered. When the variance inflation factor (VIF) is greater than 5, it means that multicollinearity can occur between the factors (Hair, Black, Babin, Anderson, & Tatham, 2006). The VIF values of the structural equation model in this study are less than 5, ranging from 1 to 2.379, showing that there is no homogeneity between the scales in the research study, that is, there is no polymorphism.

The standardized root mean square residual (SRMR) and root mean square residual covariance matrix of the outer model residual (RMS_theta) indexes are commonly used indexes for PLS-SEM to assess the fit of the overall model. The range of the SRMR value is from 0 to 1. When the SRMR is less than 0.08, the model is considered to have a good fit (Hair, Ringle, & Sarstedt, 2011). The RMS_theta value is only suitable for evaluating reflectance measurement models. RMS_theta values less than 0.12 indicate that the model fits well. The SRMR value in this study is 0.057, showing the appropriateness of the model. The RMS_theta value is 0.147, and although it is greater than 0.12, it is acceptable according to the recommendations of Henseler et al. (2016). Therefore, the model in this study is suitable to test the structural equation model. The multicollinearity analysis and model fit results are shown in Table 9.

Table 9. Collinearity analysis and model fit.

Factor	Research motivation (VIF)	Research capacity (VIF)	Model fit
Knowledge creation	1.937	2.042	SRMR: 0.071
Knowledge collection	2.602	2.644	RMS_theta: 0.167
Knowledge sharing	1.950	1.963	
Knowledge application	2.004	2.257	
Knowledge management with big data	2.177	2.379	
Research motivation		2.771	
Research capacity			

The R^2 values are used to evaluate the explanatory power of the model and range from 0 to 1. A higher R^2 value indicates a high explanatory power of the model. In Table 10, the adjusted R^2 is 0.602 (60.2%) for research motivation and 0.634 (63.4%) for research capacity, showing that the explanatory level of the latent variables is high. The function value f^2 represents the influence of the structure (factor) when removed from the model. Models with a small f^2 value (less than 0.02) show a low degree of association. In this model, we see that there are five links that have a low level of influence on the research motivation and research capacity of lecturers. The remaining links all show high influence $f^2 > 0.02$ (see Table 10).

Table 10. R^2 and f^2 values.

Factor	R^2		Adjusted R^2		f^2	
	Research motivation	Research capacity	Research motivation	Research capacity	Research motivation	Research capacity
Knowledge creation	0.608	0.639	0.602	0.634	0.093	0.054
Knowledge collection					0.126	0.001
Knowledge sharing					0.016	0.000
Knowledge application					0.007	0.012
Knowledge management with big data					0.054	0.042
Research motivation						0.125

In order to test the hypotheses posed in the study, after the reliability, fit, and explanatory values of the model were ensured, a bootstrapping test was conducted with a repeat value of 3,000. The results are summarized in Table 11.

Table 11. The significance levels of direct links (using bootstrapping).

Factor	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
Knowledge management with big data -> Research capacity	0.195	0.195	0.051	3.801	0.000
Knowledge management with big data -> Research motivation	0.183	0.186	0.051	3.589	0.000
Knowledge sharing -> Research capacity	0.123	0.126	0.059	2.086	0.037
Knowledge sharing -> Research motivation	0.016	0.016	0.054	0.290	0.772
Knowledge application -> Research capacity	0.069	0.069	0.047	1.455	0.146
Knowledge application -> Research motivation	0.096	0.098	0.048	2.015	0.044
Knowledge collection -> Research capacity	0.302	0.303	0.050	6.098	0.000
Knowledge collection -> Research motivation	0.028	0.029	0.054	0.529	0597
Knowledge creation -> Research capacity	0.270	0.267	0.055	4.921	0.000
Knowledge creation -> Research motivation	0.224	0.222	0.065	3.459	0.001
Research capacity -> Research motivation	0.368	0.364	0.057	6.428	0.000

The analysis results in Table 11 show that the links with a P value less than 0.05 are significant with 95% confidence and $t > 1.96$. Evidently, knowledge creation, knowledge collection, knowledge sharing, and knowledge management with big data have a direct relationship with a faculty's research capacity ($t > 1.96$, $p < .05$), and thus hypotheses H1a, H1b, H1c, and H1e are supported, while H1d is not supported. Also, no relationship was found between knowledge application and the faculty's research capacity ($t < 1.96$, $p > .05$).

The results of the bootstrapping test with a repeat value of 3,000 also showed that knowledge creation, knowledge application, and knowledge management with big data have a relationship with the faculty's research motivation ($t > 1.96$ and $p < .05$). Thus, H2a, H2d, and H2e are supported, while H2b and H2c are not supported, and it is suggested that knowledge sharing and knowledge collection have a relationship with a faculty's research competence ($t < 1.96$, $p > .05$).

The results in Table 9 also show strong support for hypothesis H3, which posits that motivation for research is directly related to research capacity ($t = 6.428$, $p < .05$).

Table 12 shows the indirect relationship between the factors in the knowledge management model and the faculty's research capacity through the mediating variable of research motivation. Knowledge creation ($t = 3.596$, $p < .05$), knowledge sharing ($t = 2.047$, $p < .05$), knowledge collection ($t = 4.181$, $p < .05$), and knowledge management with big data ($t = 3.500$, $p < .05$) have indirect relationships with faculty research capacity through research dynamics. However, the results showed no relationship between knowledge application through an intermediary variable of research motivation ($t < 1.96$, $p > 0.05$).

Table 12. The significance level of indirect links (using bootstrapping).

Factor	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
Knowledge management with big data -> Research capacity -> Research motivation	0.072	0.071	0.020	3.500	0.000
Knowledge application -> Research capacity -> Research motivation	0.025	0.025	0.018	1.440	0.150
Knowledge creation -> Research capacity -> Research motivation	0.099	0.098	0.028	3.596	0.000
Knowledge collection -> Research capacity -> Research motivation	0.111	0.111	0.027	4.181	0.000
Knowledge sharing -> Research capacity -> Research motivation	0.045	0.045	0.022	2.047	0.041

Figure 4 shows the p and t values of the direct links which represent the relationships of the factors in the model.

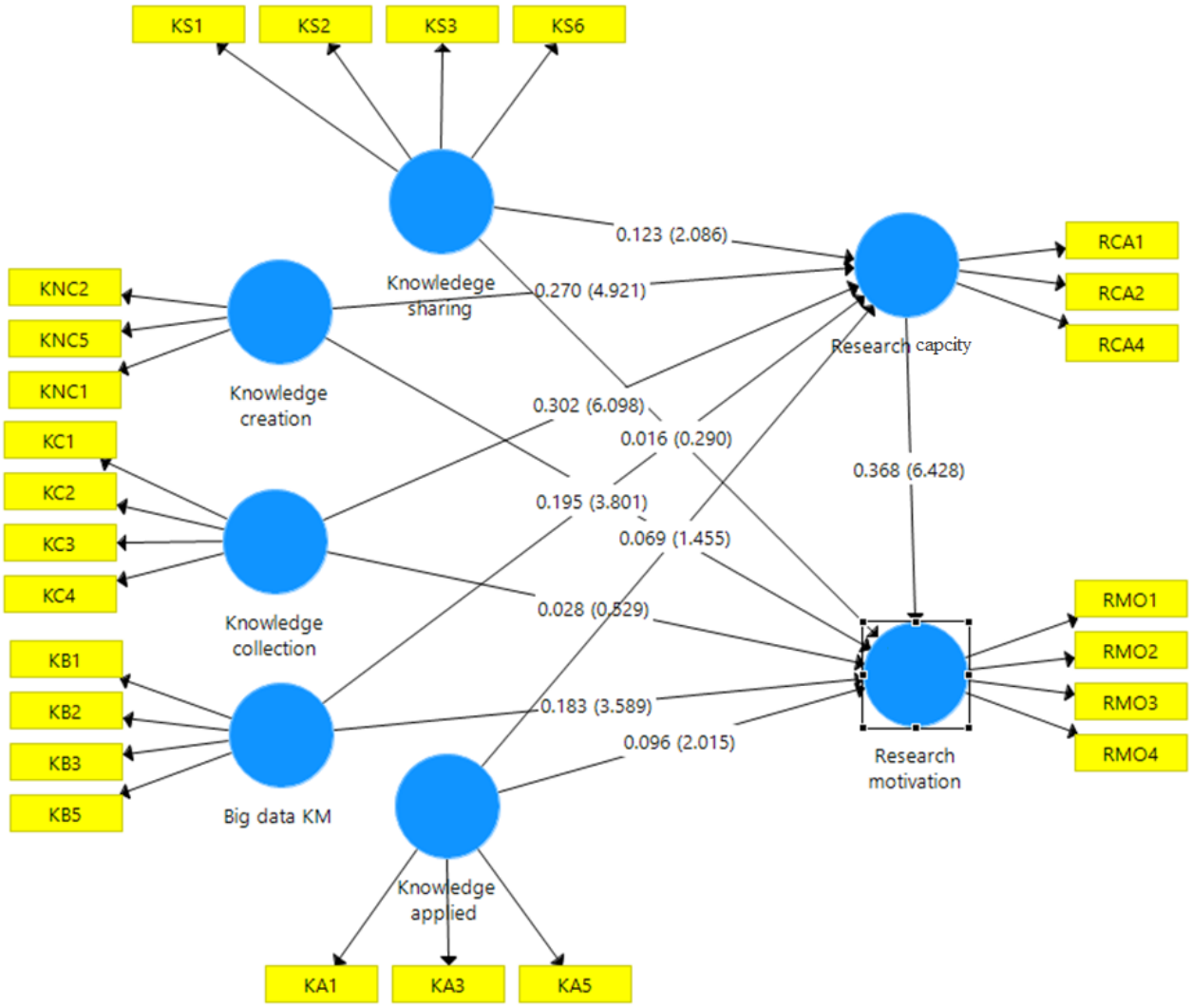

Figure 4. PLS-SEM path analysis diagram.

5. DISCUSSION

In this study, the knowledge management model with five factors that affect the motivation to carry out research and the research capacity of lecturers at universities in Hanoi was evaluated. The reliability and suitability

of the model was accepted. The analysis results showed that the factors of knowledge creation, knowledge collection, knowledge sharing, and knowledge management with big data have a significant relationship with the faculty's research capacity. Significant similarities to previous studies were observed (e.g., (Altbach, 2016; Aydin, 2017)), including the outcome of the relationship as well as the scales used.

Previous studies do not all agree on the scale of a faculty's research (Kotsemir, 2012). In addition to two scales derived from previous studies, the two proposed scales in the current model are suitable for testing. Similarly, the scales of research motivation and the scale for the new factor, i.e., knowledge management with big data, are also unique to this study. While Ardito et al. (2019) only described knowledge management with big data, this study has shown the reliability and relevance of the scales in the knowledge management model.

The results of the PLS-SEM analysis have shown that the factors of knowledge creation, knowledge application, and knowledge management with big data have a significant impact on the motivation of lecturers to conduct research. This study showed a correlation that is in agreement with the study by Kianto et al. (2016). However, these studies were conducted to analyze the knowledge management model in enterprises, while the research results of Nili et al. (2013) only showed the impact of the knowledge management model according to the processing, collection, evaluation, sharing, and application without the factor of knowledge management with big data. Therefore, the results of this study are a significant addition to the knowledge management model in general, and the relationship between knowledge management and research motivation of lecturers in particular.

The research results also showed the direct impact of research motivation on a faculty's research capacity. This result was also confirmed by Chen et al. (2006) and Chen et al. (2010). However, it should be noted that the addition of the scale from this study showed a stronger relationship between these two factors. The indirect relationships between knowledge creation, knowledge sharing and knowledge management with big data, and research capacity through research motivation is also a remarkable finding from this study. Previous studies by Hall and Martin (2019) and Vernon et al. (2018) showed that research should come from passion and management institutions that create an environment that stimulates passion, but not many studies confirm these relationships.

6. CONCLUSIONS

The results confirm the rationality of using the PLS-SEM method, especially in exploratory research, and require close linkage in the transition from a theory to a linear structural model. Through an investigation with 388 survey participants who are lecturers working in universities in Hanoi, the results showed that the knowledge management model of Pham et al. (2021) is reliable and appropriate in the context of Vietnam. Moreover, the hypothesis that the relationship between knowledge management with big data and the motivation for research and research capacity is supported both directly and indirectly and is considered a remarkable finding of this study.

The findings also provide a more comprehensive view of knowledge management activities in the context of higher education in Vietnam, as universities not only play a role in transmitting knowledge but are also centers of knowledge creation and technology transfer (Ngoc-Tan & Gregar, 2019). Gaining a deeper understanding of knowledge management models and their impacts on research motivation and a faculty's research capacity through specific criteria (indicators) is anticipated to bring positive results in the field of research in general, and training activities in universities in particular. According to Hedjazi and Behravan (2011), research capacity related to creative ideas are published as works in journals, newspapers, or registered for patents. Scientific papers bring reputation to educational institutions, and enhancing the competitiveness and prestige of universities is an urgent needs, especially because Vietnam's innovation indicators are underestimated and the requirement for research by lecturers is not very high (Ngoc-Tan & Gregar, 2019). The findings of this study are expected to help universities promote the research motivation and research capacity of lecturers through the proposed knowledge management model.

This study has some limitations. First, the survey was only conducted in Hanoi, which limited the representativeness of the research findings. Second, a number of factors have not yet been considered. From the results of this study, future studies can expand the scope to all provinces in the country. In addition, the variables of the knowledge management model (e.g., knowledge assessment, leadership, and knowledge development) and other target variables, such as job satisfaction and loyalty to the organization, should be included. Future research can also include participants from other dynamic cities in Vietnam, namely Ho Chi Minh City and Da Nang.

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