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Knowledge management systems: structural model of its success determinants in Latin America higher education institutions

Vidalina De Freitas
vfreitas@usb.ve
Universidad Simón Bolívar, Venezuela

Guillermo Yáber
gyaber@usb.ve
Universidad Simón Bolívar, Venezuela

Carlos Zerpa
czerpa@usb.ve
Universidad Simón Bolívar, Venezuela

Abstract

This study proposes a structural model of the causal relationships that organizational, strategic, technological, and implementation factors have with knowledge management (KM) processes, as well as those between KM processes and the implementation factors for knowledge management systems (KMSs) at higher education institutions (HEIs) in Latin America. The exogenous variables are: culture of sharing, leadership, KM approach, knowledge map, information management strategy, and ICT. In turn, the endogenous variables are: KM processes, system quality, service quality, KMS use, and user satisfaction. A causal, explanatory, cross-sectional, and ex post facto multivariate study was carried out, using a hypothetical–deductive approach. The sample consisted of 374 individuals (academics, administrators, and researchers), belonging to 193 HEIs across 15 Latin American countries. The resulting model presents a partial fit to the data, confirming the explanatory relationships between 12 of the variables. Based on the results obtained from calculation of the direct and indirect effects observed for each of the endogenous variables of the model, the following goodness of fit indices were calculated: absolute ($\chi 2$ = 48.908, P-value= .059, PCMIN= 1.397, RMSEA= .075, FMIN= .689) and incremental (GFI= .894, IFI= .790). It is concluded that leadership, KM approach, knowledge map, and ICT positively influence KM processes; KM processes have a causal relationship with system quality and service quality; and system quality and service quality have an influence on KMS use and user satisfaction.

Resumen

Este estudio propone un modelo estructural de las relaciones causales que los factores organizacionales, estratégicos, tecnológicos y de implementación tienen con los procesos de gestión del conocimiento (GC), así como aquellos entre los procesos de GC y los factores de implementación para los sistemas de gestión del conocimiento (SGC) en las instituciones de educación superior (IES) en América Latina. Las variables exógenas son: cultura de compartir, liderazgo, enfoque de GC, mapa de conocimiento, estrategia de gestión de la información, y TIC. A su vez, las variables endógenas son: procesos de GC, calidad del sistema, calidad del servicio, uso de SGC y satisfacción del usuario. Se realizó un estudio causal, explicativo, transversal y multivariado ex post facto, utilizando un enfoque hipotético-deductivo. La muestra estuvo compuesta por 374 individuos (académicos, administradores e investigadores), que pertenecen a 193 IES en 15 países de América Latina. El modelo resultante presenta un ajuste parcial a los datos, confirmando las relaciones explicativas entre 12 de las variables. Usando como base los resultados obtenidos del cálculo de los efectos directos e indirectos observados para cada una de las variables endógenas del modelo, se calcularon los siguientes índices de bondad de ajuste: absoluto ($\chi 2$ = 48.908, p-value = .059, PCMIN = 1.397, RMSEA = .075, FMIN = .689) e incremental (GFI = .894, IFI = .790). Se concluye que el liderazgo, el enfoque de GC, el mapa de conocimiento y las TIC influyen positivamente en los procesos de GC; los procesos de GC tienen una relación causal con la calidad del sistema y la calidad del servicio; y la calidad del sistema y la calidad del servicio influyen en el uso de SGC y la satisfacción del usuario.

Keywords: Success factors, knowledge management systems, higher education institutions, structural equation model.

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Introduction

At present, knowledge and information, both intangible assets, are considered just as vital for organizations as tangible assets. Today, ours is a dynamic economy in which the only certainty is uncertainty (Porter, 1996) and the only lasting source of competitive advantage is knowledge (Nonaka & Takeuchi, 1995; Kotecki, 2011). Knowledge management (KM) processes in the 20th century are constantly evolving across all spheres, but particularly so at higher education institutions (HEIs) for which knowledge is a particularly valuable resource that, managed effectively, can generate competitive advantages that are sustainable over time, creating value for all members (Benhayón et al., 2007).

HEIs , as knowledge-generating organizations, are key actors in the social fabric given their training, teaching, and research activities as well as their links with businesses (Naranjo, González & Rodríguez, 2016) and society, through extension. The training of high-quality human resources is the result of teaching; research seeks to find solutions to the problematics of the social context, and to develop the capacity to transfer knowledge to society through the creation and/or dissemination of products that assure its social appropriation (Chaparro, 2008); and extension is understood as the relations or mechanisms that connect HEIs to society, contributing to its sustainable development, to the socioeconomic growth of the country (D'Este, Castro & Molas-Gallart, 2009), and to social appropriation. The knowledge economy demands levels of quality and excellence in the actions of society and, thus, of HEIs.

According to Naranjo et al. (2016), at HEIs, KM entails three areas of reflection: 1) the identification of research priorities. That is, the strategic identification of changes and trends in the social environment, globally and locally, in search of opportunities; 2) the study of the intellectual capital and intangibles of institutions through the appraisal of knowledge generated and accumulated by way of research, teaching, and extension activities and; 3) the projection of the institution onto its environment. That is, the transfer of knowledge to society through scientific publications, the generation of innovation products, and the creation of companies and new products/processes that add to social wellbeing.

For their part, Pedraja-Rejas, Rodríguez-Ponce, and Rodríguez-Ponce (2006) argued that, from a strategic perspective, KG is the most fundamental task of an organization in the knowledge society, as it allows for a sustainable competitive advantage through strategic decision-making.

Knowledge has become the most important factor of production, so the need for experienced employees to capture, retain, and share it is imperative. This is because the exit from an organization of experienced employees incurs a loss of organizational knowledge and, in turn, reductions in competitive advantage, organizational productivity, and economic growth (Jennex, 2014). In this regard, KM serves as a tool with which to identify activities, critical processes, and personal know-how in order to turn tacit--individual knowledge into explicit knowledge and thus harness competitive advantages that are sustainable over time. Knowledge management systems (KMSs) are strategies used by many organizations to survive and thrive in a highly competitive economy, supported by software for managing knowledge (Nattapol, Peter & Laddawan, 2010).

The main aim of a KMS is to "make the best use of existing knowledge within organizations, serving as a basis for subsequent decision-making by fostering knowledge" (Caro, Jiménez & Toscano, 2011, p. 158; translation ours) with the aid of technology and by facilitating KM processes (identify, capture, codify, store, distribute, and create new knowledge), with the aim of applying these processes in everyday activities and in decision-making to improve competitive advantage.

However, the implementation of KMSs to date has not been entirely successful (Malhotra, 2005). Li, Liu, and Liu (2016) observed that these systems have a failure rate between 50 and 70%. For Jeng and Dunk (2013), one of the possible causes of KMS failure is that they are seen from a narrow perspective as mere information technology (IT) or human resources (organizational) issues, to the neglect of a holistic approach that encompasses all elements or aspects necessary to be complete. Along similar lines, Schniederjans and Yadav (2013) noted the importance of a systematic and strategic approach to successful KMS implementation. In turn, the factors that should be taken into account when starting a KM project are not a matter of exact science, as King, Kruger & Pretorius (2007) have pointed out; indeed, there are multiple factors that should be taken into account before embarking on such a project. Ali, Gohneim, and Al Roubaie (2014) observed that there is a wide range of studies on success factors, but few focusing on the academic environment, and practically none about the HEIs of Latin America.

Meanwhile, Nattapol et al. (2010) noted that few studies have sought to identify the elements that contribute to the success of KMSs, and fewer still have approached these elements from a holistic perspective that takes into account the three central perspectives of people/culture, processes, and technology (Liebowitz, Schieber & Andreadis 2009).

In this regard, it is worth stressing the need to formulate models of success factors based on a comprehensive approach; that is, one that comprises all necessary elements and their inter-relations, and in which these three perspectives are given equal weight.

As such, the aim of the present study is to compute a structural equations model (SEM) for certain observed variables; specifically, the effects of success factors (organizational, technological, and implementation) on KM processes; of KM processes on technical factors (KMS quality and service quality); and of technical factors on impact factors (KMS use and user satisfaction), in the implementation of KMSs at HEIs in Latin America.

This article is structured as follows: first, a literature review is presented, in which a distinction is drawn between KM models and KMS success models and a structural model is proposed. Then, the methodology is described, the data and the fit of the structural model proposed are analyzed, and, finally, the conclusions are presented.

Theoretical Approach

Knowledge Management

Al-Shawabkeh and Al-Sha'ar (2015) defined knowledge management as the planning, organization, motivation, and control of persons, processes, and systems in an organization to ensure that knowledge-related assets are improved and used effectively. In this respect, KM involves making available, to all members of an organization in an orderly, practical, and effective manner, not just explicit knowledge but also reliable sources of information, in order to contribute to problem-solving in the labor context, above all. The knowledge generated in everyday activities and projects implemented is key to helping organizations learn continually in the interests of better operation and their full development and growth (Del Moral et al., 2007).

For De Freitas and Yáber (2017), KM is:

> *"The formulation, application, and evaluation of the strategy that allows for combining tacit (personal) knowledge and explicit knowledge (supported by IT), in the organization's processes, to acquire and create, organize and store, share or disseminate, and apply existing knowledge, [and] to create and sustain new knowledge, facilitating the process of correct decision-making with the aim of achieving the organization's strategic objectives" (p. 6; translation ours)."*

Knowledge Management Systems

Kabir (2015) defined KMSs as "information technology based infrastructure aimed at organizing and facilitating knowledge related activities" (p. 162). In turn, the components of these systems are: knowledge repositories, knowledge maps, yellow pages, data compendium, user interfaces, search and retrieval systems, information interfaces, intelligent agents, business intelligence, among others (Nissen, 2005).

Ali et al. (2017) argued that a KMS makes it easier for an organization to learn by storing important knowledge and providing access for the people within it; these systems are no longer merely optional, but a necessity for improving the efficiency and effectiveness of managing valuable organizational knowledge.

Successful implementation of KM requires the long-term commitment of senior management (Akhavan, Atashgah & Adalti, 2010).

Knowledge Management Models

KM models arose as a viable option for explaining the nature of knowledge itself and its level of development, without this meaning the validation of a universal model for application to different organizations (Angulo, 2017). KM models provide organizations with essential aspects for inclusion, in a methodical and mindful manner, in KM efforts.

Researchers and academics have endeavored to study and propose KM models aimed at organizations in general and HEIs in particular. However, not all models have been evaluated empirically. Some models take into account both the social and the technological aspects, but others focus solely on one or the other.

Holistic models that focus on the social and technological aspects include those proposed by: Cáceres (2011), Nuryasin, Prayudi, and Dirgahayu (2013), De Freitas and

Yáber (2014), Sunalai (2015), Ali, Che Cob, and Sulaiman (2016), Ojo (2016), and Johnson (2017), among others. Meanwhile, the models oriented toward technology (also called success models) include those developed by: Nattapol et al. (2010), Jennex and Olfman (2011), Singhal (2012), Astuti and Suryadi (2015), Assegaff (2017), and Vangala, Banerjee, and Hiremath (2017), among others.

Based on these models and the holistic approach, Table 1 presents the components and factors that the literature has identified as most closely related to success factors in KMSs and/or metrics of success.

Table 1. Components of a Model of KMS Success Factors

			Variables	Models	Definition	Theoretical support for causality
Factors	Success factors	Organizational	**Culture of sharing**	Nattapol et al. (2010); Cáceres (2011); Nuryasin et al. (2013); De Freitas & Yáber (2014); Astuti & Suryadi (2015); Sunalai (2015); Ali et al. (2016); Ojo (2016); Johnson (2017).	Mutual trust among members of an organization, allowing peer-to-peer knowledge sharing; openness and willingness to create and share knowledge.	Allameh & Zare (2011); Ali et al. (2016)
			Leadership	Cáceres (2011); Jennex & Olfman (2011); Nuryasin et al. (2013); De Freitas & Yáber (2014); Sunalai (2015); Ali et al. (2016); Ojo (2016); Johnson (2017).	Consistent and continual commitment of senior management to all KM activities.	Ramachandran et al. (2013); Sunalai (2015)
		Strategic	**KM approach**	De Freitas & Yáber (2014); Sunalai (2015); Johnson (2017).	KM process aimed at explicit, tacit, or mixed knowledge.	Jennex & Olfman (2004)
			Knowledge map	Cáceres (2011); Johnson (2017).	Identification of knowledge assets and persons	Jennex & Olfman (2004)
			IM Strategy	De Freitas & Yáber (2014); Johnson (2017).	Strategy and policies aimed at managing information.	Original proposals
		Technological	**IT or ICT**	Cáceres (2011); Jennex & Olfman (2011); Nuryasin et al. (2013); De Freitas & Yáber (2014); Sunalai (2015); Ojo (2016); Johnson (2017); Vangala et al. (2017).	Set of tools that facilitate and support KM and its infrastructure.	Allameh & Zare (2011); Vangala et al. (2017)
	KM processes		**KIC process (knowledge identification and collection)** **KD process (knowledge dissemination)** **KSA process (knowledge sharing and application)**	Cáceres (2011); Nuryasin et al. (2013); Yánez & Yánez (2013); De Freitas & Yáber (2014); Sunalai (2015); Ojo (2016); Johnson (2017); Vangala et al. (2017)	Detecting types and sources of knowledge, information needs, competencies, and experts in different areas for subsequent dissemination, exchange, and application.	Original proposals
Implementation	Technical		**System quality**	Nattapol et al. (2010); Jennex & Olfman (2011); Singhal (2012); De Freitas & Yáber (2014); Astuti & Suryadi (2015); Ali et al. (2016); Assegaff (2017).	Knowledge-oriented system with a platform to capture the correct, available knowledge for the use of users.	Nattapol et al. (2010); Hayashi (2013); Assegaff (2017)
			Service quality	Nattapol et al. (2010); Jennex & Olfman (2011); Singhal (2012); De Freitas & Yáber (2014); Astuti & Suryadi (2015); Assegaff (2017).	Effective and appropriate support for KMS users.	Nattapol et al. (2010)
	Impact		**KMS use**	Nattapol et al. (2010); Jennex & Olfman (2011); De Freitas & Yáber (2014); Astuti & Suryadi (2015); Ali et al. (2016); Assegaff (2017).	Behavior, attitude, and action when using a system that exists and is being adopted, and its use in decision-making.	Nattapol et al. (2010)
			User satisfaction	Nattapol et al. (2010); Jennex & Olfman (2011); Singhal (2012); Astuti & Suryadi (2015); Ali et al. (2016); Assegaff (2017).	Extent to which a person believes that using a particular system would improve their performance at work.	Nattapol et al. (2010)

Source: Compiled by authors

Having reviewed these models, two overarching factors can be identified: determining factors and implementation factors.

Determining Factors

These factors are composed in turn of success factors and KM processes.

Success factors

Success factors are composed of organizational variables (culture of sharing, leadership), strategic variables (KM approach, knowledge map, and information management) and technological variables (ICT).

Allameh and Zare (2011) and Ali et al. (2016) found a positive relationship between a culture of sharing and KM processes. In turn, Ramachandran, Chong and Wong (2013) and Sunalai (2015) observed a positive relationship between leadership and KM processes. Jennex and Olfman (2004) indicated that the KM approach and knowledge maps define both the processes and the knowledge to be used, as well as the sources, users and form of knowledge, and the technological infrastructure for storing it. On the other hand, there is evidence that information management (IM) is a success factor in KM, as the studies by Almuiñas, Passailaigue and Galarza (2015) and De Freitas & Yáber (2014) have attested. Allameh & Zare (2011) y Vangala et al. (2017) pointed to a positive relationship between ICT and KM processes. Thus, the causal relationships between success factors and KM processes have been identified.

KM processes

There are three main KM processes: identifying and collecting (KIC process), disseminating (KM process), and sharing and applying (KSA).

It should be noted that there are causal relationships between KM processes and the technical factor, in that KM processes are part of or are integrated into KMSs, exerting an influence on system quality and service quality.

KMS Implementation Factors

Implementation factors are classified into technical and impact factors.

Technical

Technical factors are composed of the KMS quality and service quality variables (Nattapol et al., 2010; Jennex & Olfman, 2011; Singhal, 2012; Astuti & Suryadi, 2015), as factors that influence the success of KMSs, measured via KMS use and user satisfaction.

Impact

Impact factors are made up of KMS use and user satisfaction (Nattapol et al., 2010; Jennex & Olfman, 2011; Astuti & Suryadi, 2015).

Method

The aim of the present study is to compute a structural equations model (SEM) for certain observed variables; specifically, the effects of success factors (organizational, technological, and implementation) on KM processes; of KM processes on technical factors; and of technical factors on impact factors, in the implementation of KMSs in HEIs in Latin America.

The research design was qualitative, non-experimental (observational), and *ex post facto*. Kerlinger and Lee (2002) noted that this type of study is empirical and systematic with no direct control over the variables, because their manifestations are present in the subjects at the time of the research and are inherently non-manipulable. The research design was multivariant with a causal, explanatory, and cross-sectional influence, utilizing a hypothetical-deductive approach.

The study was conducted over the following stages:

In Stage 1, the literature in this field was reviewed so as to inform the KMS success factors model and prepare the instruments. That is, the instruments were constructed and the questionnaires were adapted and validated; this involved estimations of internal, external, and content validity by way of expert judgement and explanatory factor analysis to identify the dimensional structure of the variables measured. Finally, the reliability of each instrument was estimated through internal consistency analysis.

In Stage 2, the proposed model was validated. This, in turn, was carried out via four processes, as proposed by Casas (2002) and Correa (2007): specification, identification, estimation of parameters, and evaluation of the model. To this end, mathematical equations pertaining to the causal effects of the variables (in this case, observed) were proposed, as were the expressions that relate these observed variables to other observed variables were proposed (Casas, 2002). Then, the theoretical model was proposed and identified.

Sample

Intentional (or purposeful) and nonprobability sampling (Kerlinger & Lee, 2002), based on the use of deliberate judgments and intentions, was used to obtain a representative sample of academics, researchers, and administrative support staff pertaining to Latin American HEIs. The data were collected between June 13 and September 13, 2019. The sample was made up of a total of 374 participants.

Statistical Tools

To analyze the data, version 26.0. of SPSS-AMOS was used.

Instruments

Following a review of the literature, the instruments proposed in Sunalai (2015), Johnson (2017), and Nattapol et al. (2010) were taken. Because the original instruments did not possess the same factorial structure, they were reordered into factors through data reduction, and items were constructed to make up the measurement instruments applied to the variables associated with the success factors in KMS implementation. To this end, the following four instruments were designed: (a) success factors and (b) KM processes, taken and adapted from the instruments in Johnson (2017) and Sunalai (2015); and (c) technical and (d) impact factors, taken and adapted from Nattapol et al. (2010). The content validity of the instruments was carried out based on the judgement of four (4) experts, as Guba (1981) proposed: two in the field of KM, one in research methodology, and one in ICT.

To verify the validity and reliability of the instruments, a pilot test of 150 subjects was conducted; this resulted in purposeful and random sampling of subjects from different journals and universities. The participants belonged to 71 HEIs in Latin America across ten countries. The instruments were adapted through factorization -- that is, the psychometric analysis of the instruments from the model as originally proposed -- giving rise to a new theoretical proposal (underway).

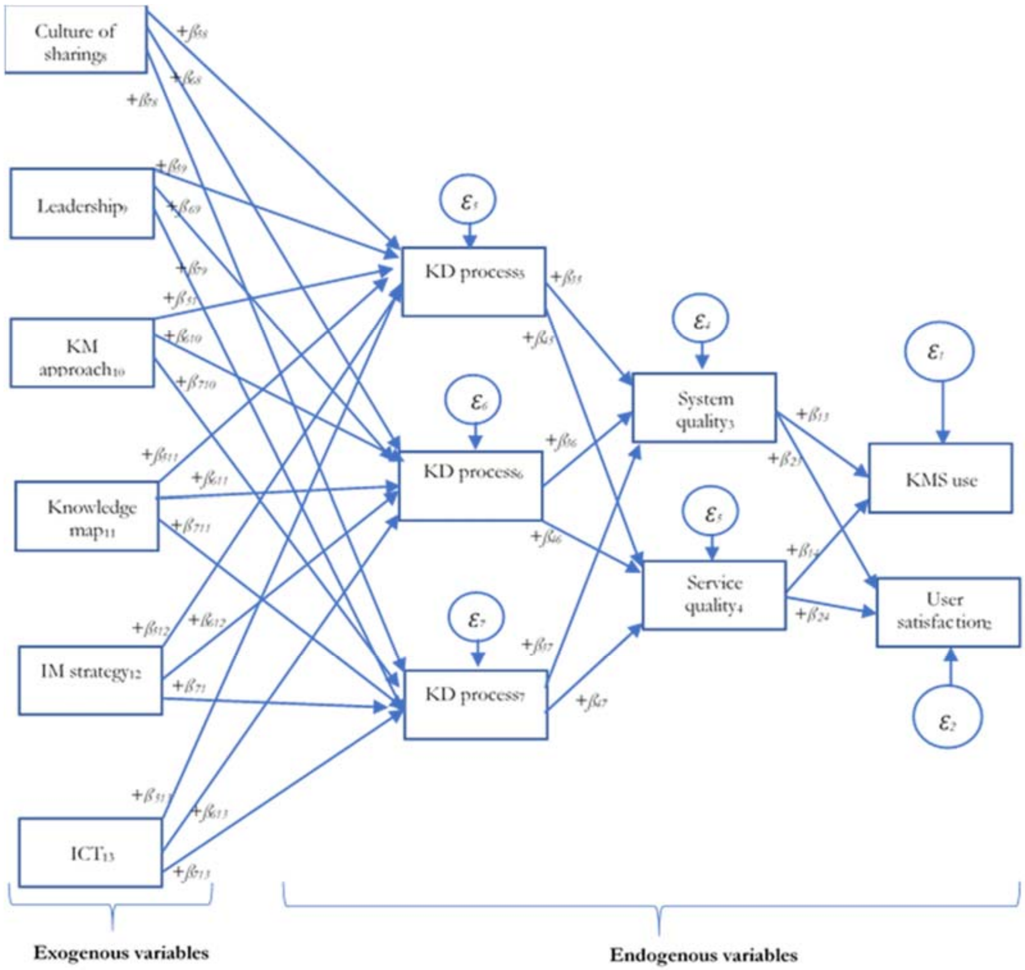
Measurement Scales

Each of the measures for the constructs making up the four (4) instruments were assigned a seven (7) point Likert scale ranging from “completely disagree” to “completely agree.”

Proposed Structural Model

Figure 1 presents the route model of success factors in the implementation of KMSs at HEIs in Latin America; this enables verification by way of the SEM, resulting in 28 causal relations. As noted, these components have been grouped into four overarching instruments: success factors, KM processes, technical factors, and impact factors. Based on Figure 1, Table 2 proposes the causal relations between the different variables.

Figure 1. Route Model for the Theoretical Model



Source: compiled by authors

Table 2. Hypotheses

#	B	Causal relations	#	B	Causal relations
H_1	$ß_{58}$	Culture of sharing → KIC process	H_{15}	$ß_{712}$	IM strategy → KSA process
H_2	$ß_{68}$	Culture of sharing → KD process	H_{16}	$ß_{513}$	ICT → KIC process
H_3	$ß_{78}$	Culture of sharing → KSA process	H_{17}	$ß_{613}$	ICT → KD process
H_4	$ß_{59}$	Leadership → KIC process	H_{18}	$ß_{713}$	ICT → KSA process
H_5	$ß_{69}$	Leadership → KD process	H_{19}	$ß_{35}$	KIC process → System quality
H_6	$ß_{79}$	Leadership → KSA process	H_{20}	$ß_{45}$	KIC process → Service quality
H_7	$ß_{510}$	KM approach → KIC process	H_{21}	$ß_{36}$	KD process → System quality
H_8	$ß_{610}$	KM approach → KD process	H_{22}	$ß_{46}$	KM process → Service quality
H_9	$ß_{710}$	KM approach → KSA process	H_{23}	$ß_{37}$	KSA process → System quality
H_{10}	$ß_{511}$	Knowledge map → KIC process	H_{24}	$ß_{47}$	KSA process → Service quality
H_{11}	$ß_{611}$	Knowledge map → KM process	H_{25}	$ß_{13}$	System quality → KMS use
H_{12}	$ß_{711}$	Knowledge map → KSA process	H_{26}	$ß_{23}$	System quality → User satisfaction
H_{13}	$ß_{512}$	IM strategy → KIC process	H_{27}	$ß_{14}$	Service quality → KMS use
H_{14}	$ß_{612}$	IM strategy → KM process	H_{28}	$ß_{24}$	Service quality → User satisfaction

Source: compiled by authors

Results

The data collected were analyzed statistically using the SEM in line with the aims of this study. This section details the following: first, the resulting structural model; second, the descriptive statistics about the participants; third, the data reliability and validity (level attained by the variables) as well as the fit of the model established using SPSS-AMOS version 26; and finally, the results for the direct effects obtained from the routes between the different variables.

Sample Characteristics

The sample for computation of the structural model was made up of 374 participants, of whom: 67.38% are men and 32.62% are women. 62.8% hold a PhD; 27%, an MSc; 4.5%, an undergraduate degree; 2.1%, a specialist qualification; 1.6%, a postdoctoral title; 0.5% are PhD candidates; and 0.3%, undergraduate students. 93.3% are academics; 5.9%, support staff; and 0.8%, researchers. 59.4% hold no formal position at the HEI. 51.4% have worked in KM for more than one year. The participants belong to 193 HEIs across fifteen Latin American countries, of which: 68.72% are public institutions; 28.88%, private; and 2.41% are public-private. Of the participants, 35.8% stated that their institution possessed a KMS; 37.16% stated that it did not; and 25% did not know/could not remember.

Prediction of Variables Observed in the Multivariate Model

The 374 instruments were statistically analyzed using SPSS-AMOS v26. The reliability of the variables and the instruments was calculated. The correlation coefficients were calculated, with Spearman's correlation employed to estimate the relationships between variables; this method was selected because the alternative, the Pearson correlation, is limited to cases in which the items are continuous, as Ledesma, Ferrando, and Tosi (2019) and Lloret-Segura et al. (2014) have pointed out. The prediction models were estimated through multiple regression, and their assumptions -- linearity, normality, independence of residuals, homoscedasticity, and absence of multicollinearity -- were satisfied. The necessary regression analysis then was carried out as a preliminary step for verification of the proposed route model.

The fit of the model was evaluated using the multiple determination coefficient (R2) and the statistical significance index (F) for each equation, as well as the significance of the coefficients (standardized β) of the relationship between the predictor and predicted variables.

Each of the variables and the instruments was found to have high reliability on the measurement scale ($\alpha > 0.8$); that is, all the items measured the desired characteristic in the same direction (success factors: $\alpha = 0.901$; GC processes: $\alpha = 0.881$; technical factors: $\alpha = 0.930$; and impact factors: $\alpha = 0.832$). Thus, the reliability of the instruments is $\alpha = 0.956$.

As for the correlation coefficients between the factors that make up each variable, each was above 0.5, with a strong linear relationship in values ranging from 0.5 to 0.75, and a significance = 0.01.

Table 3 shows the statistics referring to the variance explained in the prediction of each of the variables that make up the structural model. As can be seen, the model estimation yielded a medium to high multiple regression coefficient for each R, since all are greater than R> 0.6. In the case of the coefficient of multiple determination (R2), all were greater than R2> 0.41, which explains the variability of the data with respect to the variable they represent.

Table 3. Explained Variance by Variable

Explained Variance by Variable	R	R^2	St. error*	F	Sig.	Durbin-Watson
KIC process	0.641	0.411	1.452	42.722	0.000	1.867
KD process	0.827	0.683	0.97770	131.946	0.000	2.017
KSA process	0.826	0.682	0.93530	131.382	0.000	1.903
System quality	0.732	0.536	1.103	142.265	0.000	1.988
Service quality	0.701	0.491	0.167	118.877	0.000	2.138
KMS use	0.824	0.678	0.146	391.201	0.000	1.855
User satisfaction	0.777	0.604	0.157	282.893	0.000	1.930

Note: *. < .05

Source: compiled by authors

Table 4 presents the regression equations of the variables studied, taking into account the weights of the coefficients of each predictor variable. In turn, Table 5 shows that the variability of the KIC process variable is explained primarily by the leadership (31.8%) and knowledge map (27.7%) variables. The KD process variable is explained by the variability of the leadership (30.6%), knowledge map (39.6%), and IM strategy (18.5%) variables. The KSA process variable is explained by the variability of the sharing culture (15.8%), leadership (43.5%), knowledge map (15.0%), IM strategy (19.7%), and ICT (10.2%) variables.

The system quality variable is explained by the variability of the KD process (34.9%) and KSA process variables (29.1%).

Service quality is explained by the variability of the KD process (31.5%) and KSA process variables (34.7%). KMS use is explained by system quality (63.2%) and service quality (27.9%). Finally, the user satisfaction variable is explained by the contributions of system quality (61.2%) and service quality (22.3%).

Table 4. Variable Regression Equations

Prediction of the variable	Equation
KIC process	$Y_i = .291 + 0.110{*}X_8 + 0.318{*}X_9 + 0.101{*}X_{10} + 0.277{*}X_{11} + -0.009{*}X_{12} + 0.066{*}X_{13}$
KD process	$Y_i = -0.077 + 0.113{*}X_8 + 0.306{*}X_9 + 0.030{*}X_{10} + 0.396{*}X_{11} + 0.185{*}X_{12} - 0.087{*}X_{13}$
Process--KSA	$Y_i = 0.040 + 0.158{*}X_8 + 0.435{*}X_9 - 0.077{*}X_{10} + 0.150{*}X_{11} + 0.197{*}X_{12} + 0.102{*}X_{13}$
System quality	$Y_i = 1.163 + 0.113\ {*}X_5 + 0.349\ {*}X_6 + 0.291\ {*}X_7$
Service quality	$Y_i = 1.365 + 0.060{*}X_5 + 0.315{*}X_6 + 0.347{*}X_7$
KMS use	$Y_i = 0.347 + 0.632{*}X_3 + 0.279{*}X_4$
User satisfaction	$Y_i = 0.525 + 0.612{*}X_3 + 0.223{*}X_4$

Source: compiled by authors

Table 5. Contribution of Predictor Variables

Prediction of the variable	Constant	B										
		X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_5	X_6	X_7	X_3	X_4
KIC process	0.291	0.110	0.318*	0.101	0.277*	-0.009	0.066					
KD process	-0.077	0.113	0.306*	0.030	0.396*	0.185*	-0.087					
Process--KSA	0.040	0.158*	0.435*	-0.077	0.150*	0.197*	0.102*					
System quality	1.163							0.113*	0.349*	0.291*		
Service quality	1.365							0.060	0.315*	0.347*		
KMS use	0.347										0.632*	0.279*
User satisfaction	0.525										0.612*	0.223*

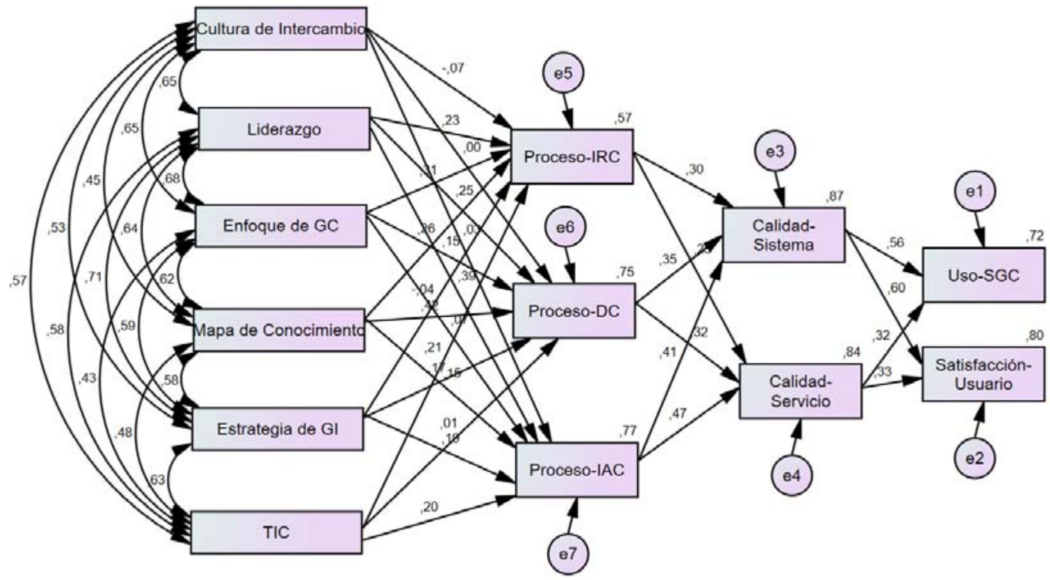
Note: *. < .05

Source: compiled by authors

Resulting Structural Model

Global adjustment measures were determined to establish the degree to which the model predicted the initial data matrix, through generalized least squares estimation. The model is recursive and consists of 13 indicators. There were 35 degrees of freedom and the number of estimated parameters was 56. Figure 2 presents the results for the routes model verified based on the theoretical review.

Figure 2. Route Model Resulting from the Model of Success Factors for KMSs at HEIs in Latin America.



Source: compiled by authors

Table 5 presents the fit of the resulting model. With regard to absolute fits, the p-value or level of the chi-square was 0.059; this is greater than 0.05, indicating that the observed covariances are similar and that the covariance matrix reconstructed through the model is not significantly different, with 35 degrees of freedom. The statistic $\chi2 = 48.908$ ($\chi2$ must be $\leq$ 2df: 2 * 35 = 70), indicating that the model fits the data, and is in the optimal range. The PCMIN = 1.397, attesting to the quality of the model fit, RMSEA = 0.075 indicating that the model fit is good when estimating based on the population instead of the sample, and the FMIN = 0.689. As to the incremental adjustments, GFI = 0.894 (close to 0.9) and IFI = 0.790 (close to 0.8), indicating a satisfactory fit between the theoretical structures and the empirical data.

Table 6. Overview of Results of Fits from the Model

Goodness of fit measure	Abbreviation	Value obtained	Acceptable levels of fit	Acceptability obtained
Absolute fit measures				
Chi-square	χ^2	48.908	≤ 2df	**Optimal**
Chi-square (p-value)	p-value	0.059	> 0.05	**Optimal**
Degrees of freedom		35		
Chi-square/degrees of freedom ratio	PCMIN/df	1.397	<3	**Optimal**
Root mean square error of approximation	RMSEA	0.075	≥0.00; < 0.05 ≥0.05; <0.08	**Satisfactory**
Minimum value of the discrepancy function	FMIN	0.689	≥0; ≤ 1	**Optimal**
Incremental fit measures				
Goodness of fit index	GFI	0.894	≥0.90	**Satisfactory**
Incremental fit index	IFI	0.790	≥0.80	**Satisfactory**

Source: compiled by authors

Six (6) fit indices were met, which means that the proposed model partially fits the data. In other words, the chi-square p-value, PCMIN/df, RMSEA, FMIN, GFI. and IFI indicate a reasonable fit for the model, in that the values obtained point to a correct estimation.

It can be inferred that there is a partial fit to the model; that is, that the relationships between the variables of the estimated model adequately reflect the relationships observed in the data.

Table 7 outlines the standardized direct effects (path coefficients) obtained after solving the respective equations.

Table 7. Overview of Significant Direct Causal Effects (as Partial Standardized Regression Coefficients) from the Model

Endogenous variable	Exogenous variable	Direct effect (DE)		Sig.	Hypothesis
KIC process	KM approach	0.311	2	*	H_{7}
KD process	Leadership	0.254	2.087	*	H_{5}
	Knowledge map	0.418	4.15	***	H_{11}
KSA process	Leadership	0.392	3.106	***	H_{6}
	ICT	0.204	2.158	*	H_{18}
System quality	KIC process	0.303	2.168	*	H_{19}
	KD process	0.347	2.168	*	H_{21}
	KSA process	0.407	2.336	*	H_{23}
Service quality	KSA process	0.470	2.603	***	H_{24}
KMS use	System quality	0.561	3,986	***	H_{25}
	Service quality	0.317	2.283	*	H_{27}
User satisfaction	System quality	0.600	2.878	**	H_{26}

*Sig. $p < 0.05$; **Sig. $p < 0.01$; ***Sig. $p < 0.001$

Source: compiled by authors

Table 8 shows that the explanatory variables presented multiple R2s greater than 0.5, which means that the model explains more than 50% of the variances of each of the factors. The relationship was stronger the closer the R2 value was to 1.

The system quality variable was that with the highest variance (0.870; close to 1).

Table 8. Squared multiple correlations

Construct	estimated (R^2)
KIC process	0.570
KD process	0.747
KSA process	0.771
System quality	0.870
Service quality	0.841
KMS use	0.719
User satisfaction	0.801

Source: compiled by authors

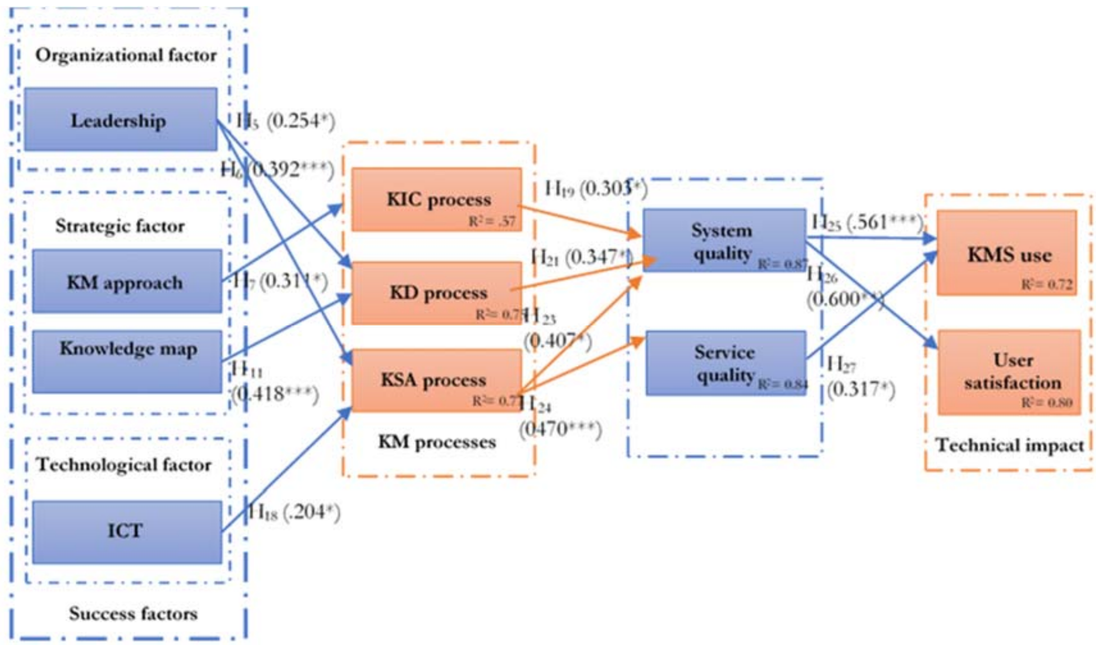
Discussion

The results of the verification through SEM of the route model, using AMOS 26.0 and the generalized least squares technique, are presented. It was found that the resulting model satisfies six (6) absolute ($\chi 2$ = 48.908; p-value = .0059; PCMIN/df = 1.397; RMSEA = .075; FMIN = .689), and incremental (GFI = 0.894; IFI = 0.790) fit indices with acceptable values.

It can be concluded that the model for the measurement of fit (Figure 3) -- the model of success factors for KMSs at HEIs in Latin America -- fits the data well, confirming 12 significant coefficients. The results attest to a very good fit, satisfying the minimum acceptance criteria and even more demanding levels.

The results, presented in Table 7 and Figure 3, demonstrate that 12 out of 28 of the relationships proposed in this study are compatible with the hypotheses. H5: leadership has a direct effect on KD process (ß= 0.254*); H6: leadership has direct causality on KSA process (ß= .0392***); H7: KM approach has a direct effect on KIC process (ß= .0311*); H11: knowledge map has a positive influence on KM process (ß= 0.418***); H18: ICT has a positive relationship with KSA process (ß = 0.204*); H19: KIC process has a direct positive influence on system quality (ß = 0.303*); H21: KD process exerts an influence on system quality (ß = .0347*); H23: KSA process has a direct effect on system quality (ß = 0.407*); H24: KSA process has a causal relationship with service quality (ß = 0.0470 ***); H25: system quality influences KMS use (ß = 0.561 ***); H26: system quality exerts an influence on user satisfaction (ß = 0.600**) and H27: service quality has an effect on KMS use (ß = 0.317*).

Figure 3. Model of Success Factors for KMSs at HEIs in Latin America.



Note: Chi squared= 48.908, RMSEA= .075
*Sig. p< 0.05; **Sig. p< 0.01; ***Sig. p< 0.001

Source: compiled by authors

The results confirm that the following variables should be considered among the success factors when starting a KM project: leadership (Sunalai, 2015; Ojo, 2016; Johnson, 2017), KM approach (Johnson, 2017)), knowledge map (Johnson, 2017; Gairín, 2017) and ICT (Sunalai, 2015; Johnson, 2017; Vangala et al., 2017), and that these have an influence on KM processes (Sunalai, 2015; Johnson, 2017). Similarly, the structural model tests (Table 7) show that the theoretical background of KM processes (KIC process, KD process, KSA process) have effects on system quality and service quality, which has not been mentioned in the literature. However, given that it is KM processes that facilitate the acquisition, codification, storage, maintenance and dissemination/sharing of knowledge--the basic tasks of all system development--it is a worthwhile contribution to the theory to indicate that these processes have a direct relationship with KMS quality and service quality, and an indirect relationship with KMS use and user satisfaction. The theoretical relationships between system quality and service quality and KMS use and user satisfaction were also confirmed (Nattapol et al., 2010; Jennex & Olfman, 2011; Assegaff, 2017); these last two variables measure KMS success.

Conclusions

This study shed light on scientific, academic and professional aspects of HEIs, focusing on variables that have been overlooked in previous research. Specifically, it made a contribution to the KM field by conceptually linking the relationships between success factors and KM processes; KM processes and technical factors; and technical factors and impact factors, uniting them in a single social and technological model that is new to the thematic literature, particularly in the context of KM at Latin American HEIs.

The final model is also novel because it captures, in their entirety, the causal relationships between the four overarching instruments: success factors (culture of sharing, leadership, KM approach, knowledge map, IM, and ICT), KM processes (KIC process, KD process, and KSA process), technical factors (system quality and service quality), and impact factors (KMS use and user satisfaction), which are only partially analyzed elsewhere in the literature. The structural model tests showed that the theoretical antecedents of leadership, KM approach, knowledge map, and ICT have a direct positive influence on KM processes; that KM processes have a causal relationship on system quality and service quality; and system quality and service quality have an influence on KMS use and user satisfaction.

Twelve of the 28 hypotheses originally formulated were confirmed. However, it is striking that a culture of sharing has not been a determining factor, a priori. It can be inferred that the KM process fosters a culture of exchange, and not vice versa, facilitated by leadership. As Gairín (2017) pointed out, organizations must introduce a culture that gives meaning to a new way of doing things marked by collective commitment and a permanent quest for the meaning connected to what is done and the consequences that arise from how it is done.

Another important variable that was not confirmed is the IM strategy, given that IM stands as a pillar of KM, as a prelude to or a process that facilitates it.

The computed route model was partially confirmed. To carry out the KM process, both the hard aspects (ICT, knowledge map, KM approach, system quality, service quality) and the soft aspects (leadership, KMS, user satisfaction) of the system to be implemented at a HEI should be taken into account, along with the functions and lessons learned. It is extremely important to develop reliable KMS to facilitate usage and improve user satisfaction, thus improving the competitiveness of HEIs which, by using the system, can apply the knowledge that results from the experience of experts in their daily operations. Finally, the proposed general model could be broadened and deepened, especially by incorporating new variables or modifying existing ones that influence each dimension.

Limitations and Future Lines of Research

The main limitation, based on the results obtained and given that the sample of participants was non-probabilistic, is that the conclusions and the formulation of the final reported models cannot be directly extrapolated to the population as a whole. Thus, the results must be considered only partial (or modest) contributions to the field of study.

It is hoped that future research can use the model to provide insights into the expertise that HEIs acquire through their interactions with their KMSs. Other aims should be to identify biases in the model, correlate the existence of KMs at HEIs and their effect on the model, and validate the effects of the experience of KM participants and of KMS success factors.

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