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A study on the intellectual capital management over cloud computing using analytic hierarchy process and partial least squares

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Abstract

Purpose – In the age of a knowledge-based economy and following extensive socio-economic changes, the success of organizations is not limited to gaining financial and material resources. Instead, it depends on the acquisition of intangible assets that can be used to achieve a sustainable competitive advantage. In the new strategic environment, organizations will thrive when they see themselves as a learning organization whose goal is to improve intellectual capital continually; an organization that cannot increase its intellectual capital cannot survive. The term intellectual capital is used in the overlap of all assets, intangible resources and non-physical resources of an organization, including processes, innovation capacity and implicit and explicit knowledge of its members and partner network. However, despite the growing importance of intellectual capital and cloud computing as vital resources for organizations' competitive advantage, there is a limited understanding of them. Simultaneously, the management of intellectual capital enables organizational managers to create, nurture, control and preserves a strong competitive advantage source, the advantage that competitors will not easily capture. So, the main objective of the present investigation is to check out the factors affecting the adoption of intellectual capital management systems based on cloud computing in hospitals.

Design/methodology/approach – In the last two decades, we have moved toward economics, where investment in Information Technology (IT), human resources, development, research and advertising is essential to maintain competitive advantage and certify the sustainability of organizations. Therefore, it can be stated that the economic value is the creation and management of intangible assets, which are referred to as intellectual capital. On the other hand, cloud computing is presented as a new paradigm for hosting and providing services through the Internet. Cloud computing can lead to too many benefits to organizations, including cost reduction, flexibility and improved performance. The present article examines how optimal intellectual capital management can be achieved using cloud computing. So, seven hypotheses were developed through the dimensions of technology, environment, organization and innovation. In this study, the path analysis was performed using Analytic Hierarchy Process (AHP) and Partial Least Squares (PLS). By reviewing the literature related to the model of technology, organization, environment and innovation dissemination theory, four main criteria, and 15 sub-criteria were identified based on the opinions of specialists, professors and IT experts based on AHP and PLS methods.

Findings – The results of this investigation confirmed all the hypotheses. The results illustrated that environmental and technological factors should be regarded more when adopting intellectual capital management systems based on cloud computing. The results also indicated that intellectual capital highly influences improving performance. Furthermore, cloud apps, like other disruptive technology, deliver superior benefits while still presenting a slew of realistic challenges that must be tackled. In order to draw a growing customer base to this business model, software vendors should resolve these concerns. The literature revealed that the computing industry is making tremendous strides around the world. Nevertheless, in order to achieve a faster and softer adoption, newer and more advanced techniques are still required.

Research limitations/implications – The research outcomes can significantly impact a wide range of organizations, such as health-related organizations. However, there are some limitations; for example, the sample is limited to one country. Therefore, future studies can measure the data of this study in different samples in different countries. Future researchers can also boost the model's predictive capability to adopt cloud computing in other organizations by adding environmental, organizational, innovation and other technical factors.

Practical implications – Managers will use these emerging innovations to minimize costs and maximize profits in the intellectual capital management competition. An effective cloud computing based on an electronic human resource management system can significantly increase system performance in industries.

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The investigators expect that the results will direct clinicians and scholars into a more advanced and developed age of cloud-based apps.

Originality/value – Investigations on the impact of cloud computing on intellectual capital management are rare. Accordingly, this investigation provided a new experience in terms of intellectual capital in the field of cloud computing. This study filled the scientific research gap to understand the factors affecting intellectual capital management systems based on cloud computing. This study provides a better insight into the power of organizational and environmental structure to adopt this technology in hospitals.

Keywords Intellectual capital management, Cloud computing, Human resource management, Improvement of performance

Paper type Research paper

1. Introduction

About 200 years ago, in the age of agriculture and pre-industry, the two factors of work and land played an essential role in human life. From the beginning of the industrial age until the end of the twentieth century, the two factors of labor and capital were recognized as the main production factors. But currently, information and knowledge have found their role in the global economy and are among the important factors of production and value creation along with labor and capital (Gowdy, 2020). What has attracted the most attention is intellectual capital. In a knowledge-based business setting, novel intangible organizational assets like innovation, human resource knowledge, competencies, organizational culture, customer service, organizational system, structure, etc., are needed (Soewarno and Tjahjadi, 2020). The term intellectual capital is used in the overlap of all assets, intangible resources and non-physical resources of an organization, including processes, innovation capacity and implicit and explicit knowledge of its members and partner network (Kirwa, 2020). To better understand intellectual capital, the organization's assets can be divided into two main categories: 1. Tangible assets, 2. Intangible assets (Marr, 2004). In other words, the ownership of intellectual capital equips organizations with special capabilities (Bontis *et al.*, 2007; Schiuma *et al.*, 2008). The management of this strategic capital has become vital for the competitiveness of organizations (Polo and Vázquez, 2008). Intellectual capital management will also allow the organization to identify, maintain and rebuild its abilities and competencies in order to utilize them over time (Sudarsanam *et al.*, 2006).

On the other hand, cloud computing is the first item among the top ten items in the information technology (IT) industry (Demartini and Beretta, 2020). In times of recession, cloud computing can help businesses decrease costs and enhance efficiency. Besides, cloud computing is an important revolutionary technology that severely changes the industry environment or even the ideals of business operations. In this age of rapidly changing competition, many companies are actively investing in cloud technologies, hoping to be the first to reduce operating costs, improve efficiency or even create new operating models (Lu *et al.*, 2010). In this age, knowing how to use new technologies, stimulate innovation effectively and foster private enterprise is now a fundamental need in pursuing economic development. Under these circumstances, possessing, distributing, producing and using existing knowledge is an important driving force needed to launch and sustain the entire knowledge-based economy (Cheng, 2020). However, the complex and diverse nature of knowledge and its special importance characteristics often cause many problems in knowledge management (KM) (Nakajima *et al.*, 2007). KM is a field that needs to respond to external environmental changes, information gathering, decision-making and action. It is also a necessary criterion for flexible management that fits different situations. Intellectual capital is utilized to generate revenue for an enterprise in a knowledge-based economy (Makarichi *et al.*, 2018). The ability to control these properties is vital to any organization's survival in today's environment. The next decade is the decade of value creation through intellectual capital for organizations and countries. Therefore, paying attention to intellectual capital at the global and regional levels and the novelty of this discussion can be considered an advantage for countries. Intellectual capital or intellectual property is at the level of society,

government, industry and academia, and their accumulation constitutes the country's intellectual property. At the national level, according to the priorities of the 20-year vision document, the development of intellectual capital can be of great help in the field of innovation, entrepreneurship, development and the establishment of knowledge-based businesses. Therefore, the study of intellectual capital management based on cloud computing seems necessary. In this study, the question below is examined: can cloud computing affect intellectual capital management?

The objectives can be summarized as follows:

(1) Investigating the effect of environmental, technological, organizational and innovative features on the intellectual capital management based on cloud computing;

(2) Investigating if intellectual capital management based on cloud computing has a significant effect on improving hospital performance or not.

The remaining of this investigation is organized as below: The next section presents the research background. The methodology is explained in Section 3. Section 4 presents the results and discussion. The last section concludes the paper. Table A1 presents the questionnaire.

2. Background

This section is presented to understand past research results and their relevance to this research topic. On the basis of a literature review, experimental hypotheses were extracted, and a research framework was created. The literature review is presented concerning the report's key topics, including cloud computing, knowledge management, organizational performance and intellectual capital.

The role of intellectual capital is crucial in Human Resource Management (HRM) (Demartini and Beretta, 2020; Hariyati *et al.*, 2019). Intellectual capital is the primary source of innovation and business prosperity. The economic well-being of any organization in the world today significantly depends on the intellectual capital possessed by these institutions (Hamad *et al.*, 2019a). KM has to be on a high level to make new innovations and product developments (Bakator *et al.*, 2016). Intellectual capital frequently appears by three interrelated fundamental components: 1. human capital; 2. structural capital; 3. relational capital.

2.1 Human capital

The implicit knowledge of people inside the enterprise is found in human capital (Nelson and Winter, 1982). According to Roos *et al.* (1997), human capital includes employees' competence, attitude and smart thinking. Competence reflects the employees' knowledge, skills, talents and mastery. Attitude consists of the value created by employee behavior in the workplace that is influenced by motivation and leadership behavior. Smart thinking involves personal innovation and adaptability of the ability to apply knowledge from one environment to another. Human capital has also been defined as combining the four factors at the individual level, including genetic inheritance, education, experience and attitude toward work life. Human capital is the employees' knowledge and skills in an organization that is considered the innovation source in the strategic revitalization of the organization (Hudson, 1993).

2.2 Structural capital

Structural capital is characterized as any of the company's non-human knowledge sources, like organizational charts, databases, solutions, procedure manuals and everything else that adds value to the organization beyond its tangible properties (Sharabati *et al.*, 2010).

2.3 Relational capital

Relational capital is defined as the knowledge focused on creating value from its relationship with its current and future customers, which indicates the organization's potential to use external intangibles (Bontis, 2001).

On the other hand, cloud computing is rapidly becoming a viable IT choice for several companies due to the dynamic use of virtualized resources as a service distributed over the Internet (Zhuang and Ghouchani, 2020). The emergence of cloud computing has provided a slew of new options that are yet to be thoroughly discussed or used (Liao *et al.*, 2011). These include blockchain, knowledge management, knowledge sharing, human resource management (Dehghani *et al.*, 2021; Yu *et al.*, 2020). One of important these domains is KM (Liu *et al.*, 2020). Current methods, technologies or approaches were not able to do what an organization often needs for its advancement when identifying, creating, preserving, representing or disseminating knowledge are essential. Owing to inadequate KM techniques, the underused intellectual capital is not even adequate. The high costs of execution and preservation often add to the strategies' inappropriateness on a wide scale. A broad spectrum of knowledge and its parallel dexterous management are needed to incorporate cloud computing effectively. Whether service or business, businesses should follow policies, protocols and frameworks to mix successful and effective techniques (Dave *et al.*, 2013). Traditional on-premise software products have migrated to innovative and service-oriented applications as a result of using cloud systems. Traditional software vendors must evolve into service-oriented software offerings to keep up with this current development. This software evolution is very difficult and fraught with concerns (Colomo-Palacios *et al.*, 2012). In the following, several research works related to the studied subject have been reviewed (ordered by the year of the publications).

Colomo-Palacios *et al.* (2012) presented some realities involved while packaged software vendors face software evolution to cloud environments. They addressed the lessons learned and problems that resulted from a project to adapt Meta 4's PeopleNet solution to a cloud computing method. Their project, which takes a two-step approach, tackles a variety of concerns, including software processes and technologies, software evolution and staffing issues that were all covered in their article. The findings that followed, stressing the role of humans in this technological evolution, are valuable for businesses undertaking a product evolution process toward cloud-based environments.

Xizheng (2013) examined intellectual capital reconstruction strategy in enterprise upgrading and transformation by knowledge cloud combination. Their aims were at putting forward an intellectual capital reconstruction strategy for enterprise upgrading and transformation. They found that intellectual capital reconstruction based on the cloud knowledge base will efficiently solve the knowledge mismatch and gaps between enterprises' current and new fields. It also can reduce enterprise transformation costs to avoid the problems such as enterprise transformation risk.

Chiu and Chien (2015) investigated the impact of integrating KM and cloud computing on the operational efficiency of the industry utilizing intellectual capital as a dual mediator. The simple random sampling approach was used in this analysis and SEM. According to the findings of the report, in the Taiwan-listed communications network industry: (1) good KM influences the intellectual capital accumulation significantly and positively; (2) the intellectual capital accumulation influences organizational performance significantly and positively; (3) good KM influences organizational performance significantly; (4) the cloud technology involvement influences the intellectual capital accumulation significantly and positively; and (5) the cloud technology involvement influences organizational performance significantly. The findings revealed that "intellectual capital" has a "dual" partial mediating impact, suggesting that intellectual capital is crucial for enhancing organizational performance. However, improving financial efficiency is not strictly based on intellectual capital accumulation; a variety of other effective factors are available.

Cleary and Quinn (2016) investigated how the usage of cloud-based accounting/finance technology impacts business efficiency, drawing on prior reports on intellectual capital and business performance. A conceptual model was developed using the questionnaire to assess the association between cloud-based finance infrastructure and organizational performance via enterprises' intellectual capital lens. According to the findings, cloud-based accounting/finance technology has a substantive and statistically significant effect on human and relational assets. On structural capital, although positive, the association was not statistically significant. The association among the three business performance elements and intellectual capital was statistically significant and positive in all three cases.

Bakator *et al.* (2016) discussed the main concept and crucial importance of intellectual capital management and KM using cloud computing technology. Analyzing these factors also included the use of IT in information distribution and knowledge availability throughout the company's internal and external structures. Furthermore, the importance of KM is discussed to show just how much this affects business importance. Also, the use of IT in KM was showed that the main reason this research is conducted is the new dynamic environment in which companies realize their business. Correlation between business performance and effective KM showed the modern business environment's influence and the practical use of IT for information distribution.

Hamad *et al.* (2019a, b) identified the critical factors leading to adopt electronic HRM-based cloud computing systems for healthcare organizations. They found four dimensions for electronic HRM-based cloud computing systems: electronic HRM activities, the level of awareness of electronic HRM and cloud computing, IT and cloud computing infrastructure and management support system and quality for HRM. The crucial problems and concerns of electronic HRM must be solved and then controlled using control techniques.

Finally, Paoloni *et al.* (2020) conducted a comprehensive literature review that examines and highlights research fields in which scholars have previously investigated the importance of intellectual capital in the healthcare field. This study also looked at how they went about doing their analysis to figure out where further studies could go. The research was performed using a systematic literature review. As a result, 225 articles were selected using a systematic literature review procedure. The content was analyzed to determine the key points of contention and learn the aspects of intellectual resources that academics most researched. They stated that many investigators had not addressed intellectual capital elements in the healthcare sector with the same pace and severity. The findings suggested that some aspects of intellectual capital, like structural capital, have already been extensively debated, while others, like relational capital, have stayed in the shadows. The most undiscussed element is human capital.

The reviewed literature has discussed intellectual capital management over cloud computing from different perspectives. To highlight different literature features, Table 1 shows the factors discussed in different literature.

As a general conclusion from previous literature articles, this paper found that keeping in view the knowledge and intellectual capital management process; the following items can be provided efficiently with cloud computing (Dave *et al.*, 2013):

(1) Organizations can achieve quicker access to technology using cloud computing.

(2) Knowledge can turn into an advantage that stimulates creativity and investigation with the help of cloud.

(3) It speeds up the growth and adoption of knowledge work competencies and skills in any enterprise.

(4) It gives consumers access to a wide range of services.

(5) Cloud computing significantly lowers technology-related prices.

Table 1. Summarization of the key factors of the articles

Paper	Factors					
	Intellectual capital	Intellectual capital management	Business performance	Cloud computing	Knowledge management	Human resource management
Colomo-Palacios *et al.* (2012)		✓		✓		
Xizheng (2013)	✓			✓	✓	
Chiu and Chien (2015)		✓		✓	✓	
Cleary and Quinn (2016)	✓	✓	✓	✓		
Bakator *et al.* (2016)	✓			✓	✓	
Hamad *et al.* (2019a, b)				✓	✓	✓
Paoloni *et al.* (2020)	✓	✓			✓	

(6) It expands the utilization of open-source services and social production projects around the world.

(7) Software as a Service (SaaS) applications can be provided for the end-users to meet their needs.

(8) Cloud computing is an excellent method to organize knowledge and make it more accessible.

(9) It lowers the number of operations and expenses associated with infrastructure maintenance.

(10) It provides knowledge consumers with access to a variety of previously unavailable solutions.

As it can be seen, various sources have studied the role of cloud computing in intellectual capital. However, some gaps will be tried to be filled in this study. Most articles have studied the role of cloud computing in HRM generally, and very little has examined the role of cloud computing in intellectual capital management. Also, many articles have sporadically examined only one area of factors related to cloud computing and intellectual capital management. So, the objective of the current investigation is to investigate the impact of all main features of cloud computing on intellectual capital management, including organizational, environmental, technology and innovation features.

3. Research method

This research is descriptive based on the research category. Because the researcher collects data using sampling and then generalizes the results to the community using statistical analysis, it is considered survey research. To investigate the research subject, an integrated model was presented to explore the most critical factors influencing the decision of some hospitals in Harbin, China, to adopt cloud-based intellectual capital management systems. This model was developed by adapting the technology-organization-environment model (Tornatzky *et al.*, 1990), innovation diffusion theory (Rogers, 2010), and some factors such as trust and privacy and organizational culture. Examining these factors and their results can significantly impact the organization's decision to adopt cloud computing. Integrating the

technology-organization-environment model with the innovation diffusion theory model makes it possible to present many structures and provide a complete theoretical basis for understanding new technology acceptance. The model under study includes four main factors: technology, organization, environment and innovation. The cloud computing acceptance model and the corresponding hierarchical structure are shown in Figure 1.

The AHP is one of the most systematic processes for making multiple-criteria decisions developed by Prof. Thomas L. Saaty (Kou and Ergu, 2016). In short, it is a method to derive ratio scales from paired comparisons (Teknomo, 2006). AHP becomes one of the vital multi-criteria decision-making methods employed by management practitioners and academics (Hosseini Firouz and Ghadimi, 2016). With the development of software packages, its usage grows vastly across diverse business and management areas (Vaidya and Kumar, 2006). This process can infer judgments based on experience, knowledge or emotion using pairwise comparisons into a set of priorities that are considered a reasonable solution for deciding on an issue (Saaty, 1980). The AHP method was first introduced by Wind and Saaty (1980) and has been widely used in various decision-making fields.

Based on the principles of AHP, the first step is to analyze and identify the criteria on which the impact of cloud computing on intellectual capital management systems is based. Hence, hierarchical structures form relationships among detected factors. The selection of key dimensions of criteria for developing intellectual capital management systems based on cloud computing is taken from experts' opinions and reviews of articles based on a hierarchical technique. Participants were asked to rate the accuracy, adequacy and relevance of the criteria and confirm the content validation based on assessing cloud computing's influence on intellectual capital management systems. They identified four key aspects of cloud computing-based intellectual capital management systems that should be considered in this analysis. These aspects include technology features, organizational features, environmental features and innovative features.

To achieve accurate analysis, 3, 4, or 5 sub-criteria (for environmental features three subsections, for technology features five subsections, for organizational features four subsections and for innovation features three subsections) were considered for each of these key factors. Therefore, the effective factors of intellectual capital management systems based on cloud computing were classified into 4 dimensions and 15 sub-criteria for evaluation. Table 2 illustrates the relevant definitions.

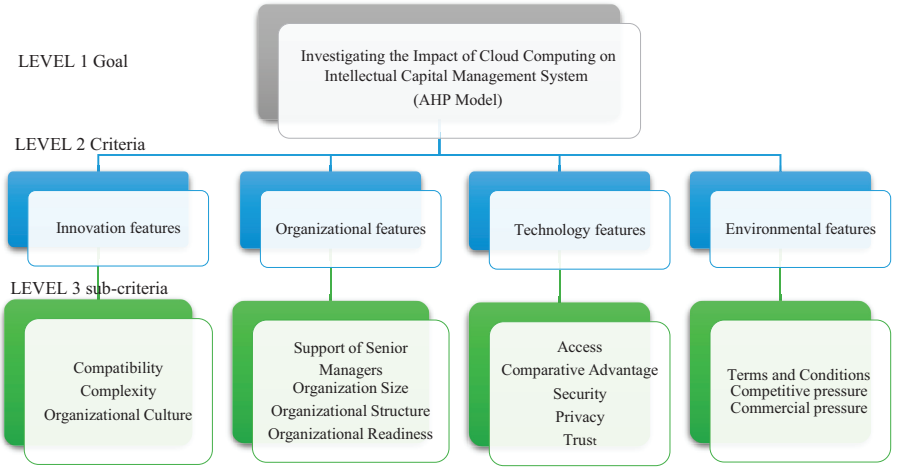

Figure 1.
Analytic hierarchy process (AHP) model for investigating the impact of cloud computing on the intellectual capital management system

Dimension	Criterion	Definition
Environmental features López-Gamero *et al.* (2008)	Terms and conditions	They are the regulations of the governmental laws that can support the organization
	Competitive pressure	The degree of pressure that an organization faces from other competitors
	Commercial pressure	This pressure comes from vendors with other partners who may adopt the new technology
Technology features Ashbaugh and Miranda, (2002), Tohidi (2011)	Access	Cloud computing provides online resources; the user can easily access information anywhere and anytime using cloud computing technology
	Comparative advantage	This factor refers to the amount of organizational profit if using cloud computing
	Security	It refers to the use of security methods in the organization to protect the information from unauthorized access or any other security event
	Privacy	It is data confidentiality that only authorized users can access
	Trust	Trust in the cloud computing environment depends on the organization and service provider to supply reliable accuracy, integrity and confidentiality related to the stored services and data
Organizational features Del Brìo and Junquera 2003, Fernández, Junquera and Ordiz (2003)	Support of senior managers	Senior managers have an important role in the organization and significantly impact adopting new technologies in the organization
	Organization size	The organization's size is defined based on the number of employees in the organization in a specific geographical location. This definition includes all large government organizations or small and medium enterprises
	Organizational structure	It includes size, scope and management structure
	Organizational readiness	It is the readiness level of the IT and human resources infrastructure in terms of cloud computing
Innovation features Angelo *et al.* (2012), Fernández *et al.* (2003)	Compatibility	It refers to the ability of available software to adapt to new technology
	Complexity	An organization typically considers the difficult steps of using new technology as an essential element in making decisions before adopting that technology
	Organizational culture	Organizational culture means that the organization is more focused on internal capabilities than external market position

Table 2.
Dimensions, criteria and definitions related to the cloud computing evaluation model in intellectual capital management systems

The second step is modeling based on Partial Least Squares (PLS). Modeling with PLS method requires fewer samples than other tools such as Amos and LISREL. This method is an appropriate alternative for LISREL and Amos (van As, 2001). In line with the objectives of the research, the following hypotheses have been proposed. The PLS method has been employed through Smart PLS 2.0 software to investigate measurement models, structural models and hypotheses.

Technology Features: The technological dimension refers to describing the innovation features (Basole, 2005). Technology features show that internal and external access to different technologies affects the adoption of new technology. Justification or rejection of

technology adoption is related to perceived direct and indirect benefits, access, comparative advantage, privacy and trust in technology. Thus, assuming the mentioned perspectives, the following hypothesis is proposed.

H1. The presented technology field is positively related to adopting an intellectual capital management system based on cloud computing.

Organizational Features: These features can affect the technological acceptance of an organization. Based on the Technology-Organization-Environment (TOE) model proposed by Tornatzky *et al.* (1990), three dimensions that influence the adoption of technological innovations according to organizational dimensions are suggested. Based on previous studies, the hospital information system identified four features as the most critical features of the organizational dimension that positively affect adopting new technology. These features include the support of senior managers, organization size, organizational readiness and organizational structure. Therefore, it can be said that the organizational dimensions of a hospital impact the adoption of intellectual capital management systems (Chang *et al.*, 2007; Chang *et al.*, 2006; Lin *et al.*, 2012). According to the experts' criteria, the support of senior managers, organization size, organizational readiness and organizational structure are all involved in the organizational context. Thus, assuming the mentioned perspectives, the following hypothesis is proposed.

H2. The presented organizational features are positively related to adopting intellectual capital management systems based on cloud computing.

Environmental Features: According to Tornatzky *et al.* (1990), the adoption of technological innovations influences the factors related to the environmental dimensions. The impact of environmental features is due to sectors such as industry, competitors and government. Measuring the environment, market uncertainty, competitive pressure, the need to comply with regulatory policies, consumer evaluation, business partner, and vendor readiness and support show the benefits of adopting new technology. According to the experts' criteria, the terms and conditions, competitive pressure and commercial pressure are involved in the environmental context. Thus, assuming the mentioned perspectives, the following hypothesis is proposed.

H3. The presented environmental context is positively related to adopting intellectual capital management systems based on cloud computing.

Innovation Features: From the innovation perspective, several factors affect the adoption of technology: (1) leadership methods; (2) organizational structure; (3) external features of an organization (Powelson, 2011; Ross, 2010). The context of innovation reflects adaptability, complexity and organizational culture. Salom (2017) stated five factors in his study, which affect technology. He argued that the decision-making process's main aim is to innovate and reduce uncertainty about its consequences. They stated that adaptation is the most important key factor influencing new technologies. Compared to other technology adoption theories, the innovation context can respond to the technology adoption at the organizational level instead of the individual level (Oliveira and Fraga, 2011). According to the experts' criteria, compatibility, complexity and organizational culture are involved in the innovation context. Therefore, assuming the mentioned perspectives, the following hypothesis is proposed.

H4. The presented innovation context is positively related to adopting intellectual capital management systems based on cloud computing.

As mentioned earlier, PLS path modeling is suitable for analyzing heuristic models without any strong theory (Ranganathan and Sethi, 2002). Other hypotheses are presented as follows. Experts suggest a positive or negative relationship.

Technology means cloud computing technology features, which effective factors in the organization's decision-making to adopt cloud computing. The following hypothesis is presented:

H5. Technology features have a positive effect on environmental features.

Organizational technology means the positive features of an organization to adopt a new technology that can significantly impact the adoption of intellectual capital management systems based on cloud computing. So, the following hypothesis is presented:

H6. Organizational features have a positive effect on innovation features.

Adopting cloud computing in the intellectual capital management health system as an important factor in improving organizational performance can greatly impact providing desirable services, increasing patient satisfaction and reducing costs. So, the following hypothesis is presented:

H7. Adoption of cloud computing in intellectual capital management systems has an impact on improving hospital performance.

Figure 2 presents a conceptual framework for modeling the impact of cloud computing on intellectual capital management systems.

4. Results and discussion

In this study, to determine the questionnaire's validity, the experts' opinions about the study field were used. Two types of questionnaires were designed under these experts' supervision. In the first questionnaire, the respondents compared each of the criteria based on the AHP method, which is a pairwise comparison questionnaire. In the second questionnaire, the respondents answered the questions based on the Likert 5-point spectrum, which was designed to test the hypotheses using the PLS method. These two questionnaires were emailed to the managers of hospitals, and 105 were returned. After the initial review of the questionnaires, nine questionnaires were deleted due to incompleteness. Finally, 96 questionnaires were used. Then, the obtained data were analyzed using a hierarchical method and structural equations. Table 3 summarizes the respondents' information. The questionnaire is added in Table A1.

First, the results are reviewed based on the AHP method. In reviewing the results, weighting and ranking dimension and criteria, each criterion's weight was determined by the

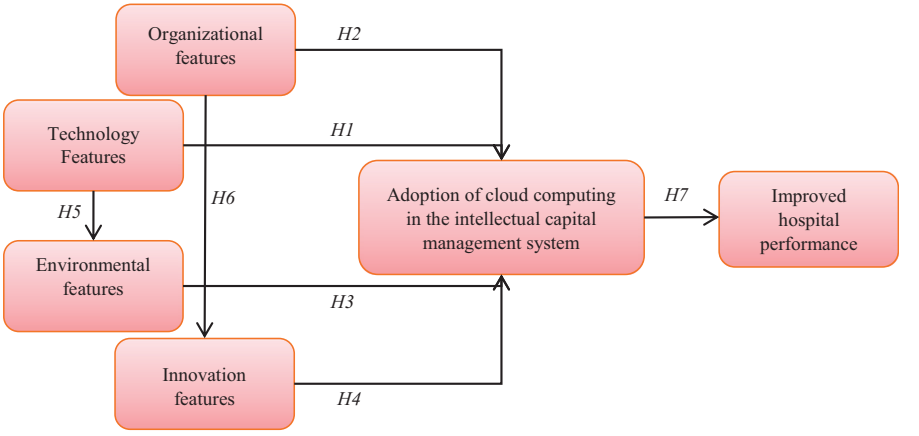

Figure 2.
Conceptual framework of the model based on the PLS method

Criteria	Items	Frequency	Frequency percentage
Gender	Female	55	57.3
	Male	41	42.7
Age category	20–25	18	75.18
	26–30	28	29.2
	31–35	22	22.9
	36–40	11	11.45
	41–45	15	15.62
	Over 46 years	2	2
Work experience	2–5 years	25	26.1
	6–10 years	38	40
	11–15 years	15	15.62
	16–20 years	11	11.45
	Over 20 years	7	7.3
Type of employment	Contractual	15	15.62
	Cooperation agreement	40	41.66
	Official	41	42.7

Table 3.
Descriptive statistics of the research samples

respondent in the questionnaire with a specialized selected guide. The incompatibility rate for all comparisons was at an acceptable level (incompatibility < 0.1). The results of investigating weight ranking factors that affect the dimensions of cloud computing evaluation on intellectual capital management systems are: "technology feature" (E1 = 0.285), "organizational feature" (E2 = 0.163), "environmental feature" (E3 = 0.465) and "innovation feature" (E4 = 0.048). From the managers' perspective, the results show that environmental and technology features are the most critical factors influencing the decision of hospitals to adopt intellectual capital management systems. Innovation feature is a minor dimension in evaluating the impact of cloud computing on intellectual capital management systems. Table 4 presents the final weights of each criterion and sub-criterion. Based on the results, among 15 criteria, competitive pressure (0.186), business pressure (0.140), terms and conditions (0.099), privacy (0.071) and organizational readiness (0.071) were selected as five important criteria in different dimensions.

Then, SEM software was used through Smart PLS 0.2 software to analyze the research hypotheses. SEM allows to examine the relationship between different key functions and to show their impact on indicators. The results of Table 5 show the average variance extracted, Cronbach's alpha, composite reliability and *R*-value obtained for this model. All values of the average variance extracted, Cronbach's alpha and composite reliability are acceptable and more than acceptable. As a result, it can be said that all variables contain the required reliability and convergence validity.

The first criterion for examining a structural model's fitness in research is the R^2 coefficient related to the model's latent dependent variables. R^2 is a criterion that shows the effect of a dependent variable on an endogenous variable. Three values of 0.19, 0.33 and 0.67 are the values for weak, medium and strong R^2 values. R^2 criterion of each endogenous variable is the environment (0.714), innovation (0.859), adoption of cloud computing in intellectual capital management systems (0.995) and performance improvement (0.511). The R^2 value has been calculated for the endogenous structures, confirming the structural model's suitability according to the three values.

Table 6 shows the path coefficients and their significance levels.

To test the SEM method's hypotheses, a *t*-statistic has been used, which is the main criterion for confirming or rejecting the hypotheses. If the significance value of these numbers is more than 1.96, it indicates the correctness of the relationship between the structures. Thus,

Dimensions/Criteria	Local weight	The final standard weight	Final ranking
E1 technology feature	0.285	–	2
Security	0.076	0.0459	9
Privacy	0.161	0.0718	4
Trust	0.252	0.0465	8
Access	0.331	0.0513	7
Comparative advantage	0.116	0.0102	16
E2 organizational feature	0.167	–	3
Support of senior managers	0.297	0.0484	6
Organization size	0.056	0.0091	17
Organizational structure	0.083	0.0386	11
Organizational readiness	0.437	0.0712	5
E3 environmental feature	0.465	–	1
Competitive pressure	0.402	0.1869	1
Commercial pressure	0.301	0.1400	2
Terms and conditions	0.214	0.0995	3
E4 innovation feature	0.088	–	4
Compatibility	0.490	0.0431	10
Complexity	0.163	0.0143	15
Organizational culture	0.231	0.0203	14

Table 4.
Survey results – weighting and rankings

Variables	R^2	Composite reliability	Cronbach's alpha	AVE
Technology	–	0.914	0.883	0.683
Organization	–	0.865	0.794	0.616
Environment	0.741	0.952	0.929	0.837
Innovation	0.859	0.920	0.884	0.743
Adoption of cloud computing in intellectual capital management systems	0.995	0.875	0.786	0.700
Performance improvements	0.511	0.885	0.806	0.720

Table 5.
Average extracted variance, Cronbach's alpha, composite reliability and R^2

Paths	Sample average (M)	Standard deviation (STDEV)	*t*-Statistics (O/STERR)
Organization → innovation	0.927	0.011	78.232
Organization → adoption of cloud computing in the intellectual capital management system	0.446	0.025	2.090
Technology → environment	0.8614	0.023	36.851
Technology → adoption of cloud computing in the intellectual capital management system	0.529	0.024	8.245
Environment → adoption of cloud computing in the intellectual capital management system	0.365	0.017	21.025
Innovation → adoption of cloud computing in the intellectual capital management system	0.418	0.021	19.054
Adoption of cloud computing in the intellectual capital management system → improved hospital performance	0.715	0.051	13.989

Table 6.
Total effects (average, standard deviation, *t*-statistic)

the research hypotheses are confirmed at the 95% confidence and ($p < 0.01$) error levels. Table 7 shows the results of the hypothesis test. As you can see in this table, the path-related coefficients are greater than 1.96, which indicates the significance of this path and the appropriateness of the structural model. The structural path model is presented in Figure 3.

In comparing the results obtained from the two models studied in this study using a composite model of AHP and partial least squares, it seems that the key and determining factors are different among the models. In the AHP model, the weight factors that affect the adoption of cloud-based intellectual capital management systems are: "Technology features" (E1 = 0.285), "Organizational features" (E2 = 0.163), "Environmental features" (E3 = 0.465) and "Innovation features" (E4 = 0.88). These results show that the environment is a key dimension when hospitals adopt this technology. But in the PLS model, ranking the path coefficients of the factors affecting the adoption of cloud-based intellectual capital management systems are an organization (0.058), technology (0.218), environment (0.365) and innovation (0.416). In the PLS method, innovation is a determining factor for adopting cloud-based intellectual capital management systems as a key dimension when adopting this technology in hospitals. In fact, it can be said that the results of these two models do not contradict each other. In the AHP model, four dimensions were proposed to be considered independently. In the AHP model, the relationship between cause and effect was not considered. The environment was considered a key dimension in studying the adoption of

Hypothesis path	*t*-statistic	Hypothesis	Result
Technology → adoption of cloud computing in the intellectual capital management system	8.245	H1	Confirmed
Organization → adoption of cloud computing in the intellectual capital management system	2.090	H2	Confirmed
Environmental → adoption of cloud computing in the intellectual capital management system	21.028	H3	Confirmed
Innovation → adoption of cloud computing in the intellectual capital management system	19.054	H4	Confirmed
Technology → environment	36.851	H5	Confirmed
Organization → innovation	78.232	H6	Confirmed
Adoption of cloud computing in the intellectual capital management system → improved hospital performance	13.989	H7	Confirmed

Table 7. Structural relationships of the model

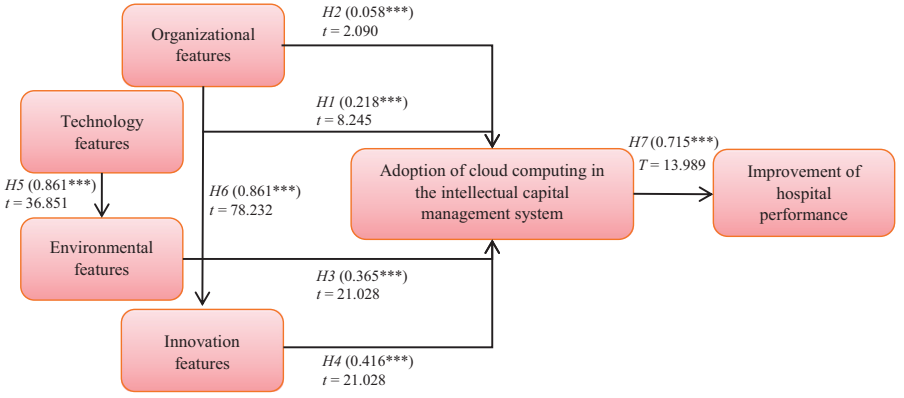

Figure 3. Structural path model

electronic health systems based on cloud computing, which shows that the environment is the most important determining factor. Dimensions of technology, organization, environment and innovation are considered as determining factors. But based on the results, environmental and innovation features are the main factors in the adoption of intellectual capital management systems based on cloud computing from the viewpoint of hospital managers. In this study, factors such as accessibility, organizational readiness, competitive pressure and compatibility were identified as high-priority factors for adopting e-health systems based on cloud computing.

Findings showed that the technology context positively affects the adoption of intellectual capital management systems based on cloud computing, which is also consistent with the findings (Alkhater *et al.*, 2014; Opala *et al.*, 2014). In reviewing cloud computing applications in intellectual capital management, information security and privacy were considered the most essential cloud computing challenges in healthcare. Security and privacy concerns are some of the most critical issues in adopting cloud computing in hospitals. Task-based access, network security mechanisms, data encryption, digital signatures and access monitoring are important factors to consider when accessing (Ahadi *et al.*, 2015). It is a valuable framework for organizational decision-makers (Calabrese and Cannataro, 2015). Reliability, security, privacy and accessibility can be the determinants of cloud computing for managing intellectual capital in health. Achieving a proper balance between security and access is an important success and vital factor in healthcare management systems (Ben-Zion *et al.*, 2014). Trusting the vendor is also a significant factor in adopting cloud computing (Alotaibi, 2014); especially, security and privacy are critical in healthcare among hospitals, which are important and correct issues due to the sensitivity of information stored in the cloud (Hyson, 2014; Sadoughi *et al.*, 2020).

Findings showed that the organizational context positively affects the adoption of intellectual capital management systems based on cloud computing, which is also consistent with the findings (Kinuthia and Chung, 2017; Opala *et al.*, 2014; Singh and Mansotra, 2019). Senior manager support can positively impact cloud computing decisions among high-tech organizations (Low *et al.*, 2011). Despite the potential and intellectual capital management solutions to improve healthcare quality in developing countries, studies show that their adoption rate is low in developing countries. This is due to perceived barriers such as poor infrastructure, healthcare managers' resistance and low technical experts (Simon *et al.*, 2007).

Also, findings showed that the environmental context positively affects the adoption of care management systems based on cloud computing, which is also consistent with the findings (Almubarak, 2017; Antlová, 2009; Lian *et al.*, 2014). Competitive terms and conditions can positively or negatively impact the adoption of cloud computing in hospitals. In fact, it can be said that internal requirements such as technical, organizational and decision-making attitudes are more important than competitive pressure. In a study conducted in Taiwan, competitive pressure positively affected cloud computing adoption (Low *et al.*, 2011). It can be said that environmental factors are not considered critical factors. Also, Lee (2015) showed that organizational structure affects the adoption of cloud computing. The legal environment in which hospitals operate does not necessarily have a negative effect on adoption. Dwivedi and Mustafee (2010) believe that regulations can act as a stimulus or barrier to cloud adoption.

Findings show that innovation positively affects the adoption of intellectual capital management systems based on cloud computing. Researchers such as (Alshamaila *et al.*, 2013; Hashim *et al.*, 2015) used the criteria of the DOI model. The comparative advantage of adopting cloud computing in hospitals can have a huge impact. It means that respondents believe that cloud computing is very useful in providing dynamic accessibility. The results also show that cloud computing helps to improve the quality of medical services to the hospital, thus consistent with studies such as (Lee, 2015; Powelson, 2011). Complexity can also play an essential role in the adoption of cloud computing. This fact will help cloud

computing companies and those using the technology to overcome the technical complexity. In Lee (2015), hospitals' most important factor influencing cloud computing adoption was complexity. In the conducted research by Lian *et al.* (2014), it was the fifth most important factor in adopting cloud in the Taiwan hospital industry. As expected, compatibility has been another important factor influencing the adoption of cloud computing by hospitals. It is consistent with studies such as (Alhammadi *et al.*, 2015) due to its significant impact on cloud adoption. It has also been an important factor in adopting cloud computing in hospitals in research such as (Alkhater *et al.*, 2014). In the conducted research by Tweel (2012), compatibility was the first factor in adopting cloud computing in US industries. This study showed that adopting any technology needs to ensure that existing systems and IT infrastructure are compatible with new technology. Organizational culture shows two dimensions of orientation to measure people's management from flexibility to sustainability and business management from internal capabilities to external position focus. In Lee (2015) organizational culture was confirmed as an important factor in internal ability vs external situation. Three hypotheses, the fifth, sixth and seventh, were also confirmed. The results show that cloud-based intellectual capital management systems can have a great impact on improving hospital performance.

5. Conclusion and limitations

Cloud computing is a computing and service model that has been improved quickly in recent years. Its emergence as an information system model coincides with the need for healthcare for continuous and regular innovation to reduce effective and efficient costs while providing high-quality services. Due to cloud computing's effect on the management and health system, this study tried to study the factors affecting adopting this technology in some hospitals. By implementing this system, the disease can be reduced in the country. The diagnosis of the disease among doctors can be made easier, and the patient's health status can be monitored. Using this system, some suggestions can be made to patients and increase their health. In this study, the impact of four important variables (organizational technology of environment and innovation on cloud computing adoption in intellectual capital management systems) and the impact of technology on the environment, the impact of the organization on innovation and the impact of the adoption of cloud on intellectual capital management systems have been investigated to improve hospital performance in some hospitals.

This study filled the scientific research gap to understand the factors affecting intellectual capital management systems based on cloud computing. This research provides a better insight into the power of organizational and environmental structure to adopt this technology in hospitals. The investigators expect that the results will direct clinicians and scholars into a more advanced and developed age of cloud-based apps.

Finally, the main restriction of this study is related to the sample size. Researchers who intend to conduct future research in this field recommend that researchers do so on a larger sample. In addition, by adding other environmental factors, they can improve the model's predictive power to adopt cloud computing in other hospitals. This study filled the gap of scientific research to understand the factors affecting the adoption of intellectual capital management systems based on cloud computing in the hospitals of this sample. This fact provides a better insight into the power of organizational structure and the environment to adopt this technology in hospitals.

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Appendix

Questionnaire

Factors	Questionnaire questions
Environmental features	(1) I am aware of how my job affects the organizational business objectives
	(2) My organizational fiscal well-being is stable
	(3) Do you feel tempted to contribute to the enhancement of workplace procedures?
	(4) Do you find yourself always acquiring new skills at work?
	(5) Do you see yourself working for this firm because of your career prospects?
	(6) Is everyone participating in the decision-making process?
	(7) Are you happy in your work?
	(8) Do you know what this company's goals are?
	(9) Are you familiar with this corporation's terms and conditions?
	(10) Do you think the services and products supplied by this firm to the market are necessary for life?
	(11) By innovating in goods, services and business methods, we create value and growth markets
	(12) To assist us maximize our creative activities, we bring in professionals from outside our business
	(13) To promote managed risk taking, we have procedures, measurements and systems in place
Technology features	(14) Diversity and inclusion are important to my company
	(15) The work of my organization positively impacts people's lives
	(16) I Am pleasant regarding my overall work security
	(17) My organization has a safe work environment
	(18) Is there training available for all in the corporation?
	(19) Do you trust your co-workers?
	(20) Do you feel your job at the firm gives you and your household with a sense of security?
	(21) Do you feel personally satisfied when you complete your day and leave work?
Organizational features	(22) Do you also get the info you require to complete your activities?
	(23) Do you think you'll be able to further your career at this corporation?
	(24) Is it possible to do your responsibilities with the aid of explanation and advice from your subordinates?
	(25) Do your bosses assist you in determining how to study and educate?
	(26) Is the organizational atmosphere conducive to employee relationships?
	(27) Are your coworkers constantly eager to lend a hand?
	(28) Do you wish you had more senior responsibilities?
	(29) Do you believe that your efforts are critical to the company's success?
	(30) Are you proud of the firm you work for? Do you have any family or friends that work here?
	(31) The pursuit and execution of great opinions is actively supported by leadership
Innovation features	(32) My firm is the industry's most forward-thinking
	(33) The company's culture is satisfactory to me
	(34) My company does business in a socially responsible way
	(35) Is there a healthy working relationship among this company's workers?
	(36) Do other staff respond quickly when you require assistance?
	(37) Do your coworkers share information in general?
	(38) Do you feel the time you spend at work each day is adequate to meet your responsibilities and obligations?
	(39) Do you believe that working for this firm helps you live a better life?
	(40) Managers recognize and reward innovative personnel
	(41) In our company, there is a tremendous passion for innovation

Table A1.
The questionnaire used in the article