



Employing the Digitization in Sudanese Higher Education institutions to Enhance the Decision Making Process: Challenges and Barriers

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Article History

Received: 25.02.2025

Accepted: 02.04.2025

Published: 21.04.2025

Abstract: This study aims to explore the challenges and barriers impeding the employment of digitization to enhance decision-making processes in Sudanese higher education institutions. Due to the proliferation of digital technologies, the integration of Information and Communication Technology (ICT) with traditional management operations has become vital for organizational transformation, which results in informed and efficient decision-making. The study utilized a quantitative methodology, gathering data from 198 employees across Sudanese higher education institutions through structured questionnaires to investigate the managerial and financial, technological, and social challenges and barriers. Quantitative analytical techniques, such as descriptive statistics, Pearson correlation, and simple linear regression were employed. The findings reveal statistically significant impacts across the three challenges and barriers dimensions. The study hypotheses were tested using correlation and simple regression test, the result reveals a strong relation between the dependent variable and independent variables. The results also indicate that managerial challenges and barriers such as strategic discontinuity, limited ICT competencies, and budgetary constraints explain 67% of the changes in digitization employment ($R^2 = 0.669$). Technological challenges and barriers, including infrastructure incompatibility and poor internet coverage, account for 70% of the changes in digitization employment ($R^2 = 0.700$), while social challenges and barriers including low digital literacy and resistance to change, explain 71% in digitization employment ($R^2 = 0.707$).

These findings underscore the necessity for strategic planning and infrastructure development to fully utilize the digitization in managerial decision-making.

Keywords: Digitization employment, Decision Making process, Sudan, Sudanese higher education, Digitization Challenges and Barriers.

1. Introduction

The widespread adoption of digital technologies today has driven many organizations to pursue digital transformation initiatives (Hefan et al., 2024). The lack of information-driven decision-making, strategic operations planning, and the presence of regulatory restrictions have hindered the decision process (Marda, 2018). The failure rate of many firm start-ups appears to be high due to a lack of information to support the decision-making process (Annabella & Henk, 2008). The decision enhancement process involves the merging of tools, processes, and people to make an accurate decision (Keen & Sol, 2008). Employing digitization in the decision-making process offers numerous benefits, such as faster processing, better data insights, and increased accuracy. The aim of this paper is to examine the challenges and barriers hinder the employment of digitization to enhance the decision making

process. Managers everywhere strive to make precise decisions. Decision process faces several challenges and limitations such as scarce of resources, lack of information's and cultural beliefs. Employ ICT can reduce some of these limitations and challenges (Rafael & Loyda, 2017).

Nowadays process automation, data analysis, artificial intelligence science, and the Internet of Things have reshaped managerial processes (Chander et al, 2022). The decision-making process is also changing concurrently due to predictive modeling and real-time data insights, which enable stakeholders to make decisions with significant sustainability outcomes (Peng et al, 2023). Digitizing decision-making activities through digital technologies, such as social media, mobile service, IoT, cloud, and big data, are being consolidated (Berman, 2014). Change in managerial process through ICT technology is an essential factor for organizations to be equipped with (Feroz et al, 2021). The

Cite this article:

Elhadi, O. A. M., Mohamed, E. H. G., Hasabelgawi, E. A., (2025). Employing the Digitization in Sudanese Higher Education institutions to Enhance the Decision Making Process: Challenges and Barriers. *ISAR Journal of Economics and Business Management*, 3(4), 34-45.

employment of ICT in the decision-making process decreases the time required to gather information, and it improves access to new information (Rafael & Loyda, 2017). With ICT employment we need less time than before to obtain information. Lukić, concluded that ICT employment provides information which in the past was available to one or few levels to all the organization, achieving more effectiveness in the decentralization of decisions (Lukić, (2014).

In decision making process development, evaluation and alternatives selection would benefit from information exchanges among employees, which may be consuming a huge time and, in some cases, require a great effort. The use of ICT (digitization), compared with traditional communication methods that was determined the relation between superior subordinate, strengthens the flow of information within the organization in all directions, vertically, horizontally and laterally (Lukić, (2014)). One of the natural steps in the decision-making process that demands time and effort in collection of information, the use of ICT (digitization) decreases the time required to gather information, and it improves access to new information. By utilizing ICT tools such as e-mail, mobile phones, social networks we need less time than before to have information (Rafael & Loyda, 2017).

2. Literature Review:

2.1 Decision Making Concepts:

In fact, whenever more than one possible action is available, a decision must be made (Takemura, 2021). A decision is easy to make when one option clearly brings a better outcome than any other (White, 2011). The decisions become more difficult when more than one alternative seems reasonable and when the number of alternatives is great (EFFY, 2008). Decision-making is the process of selecting the most appropriate course of action from various alternatives to achieve a desired goal or objective (Urbach & Röglinger, 2019) (website: [geeksforgeeks.org](https://www.geeksforgeeks.org), feb. 2025). The term decision-making is an integral part of daily life and a crucial component of organizations management. It involves selecting the best action from various available alternatives through considering resources, outcomes, and personal preferences (Abdelrahman, 2022). The primary goal of decision-making is to identify the choice that best fulfills the objective of the decision problem while outperforming other alternatives.

Herbert A. Simon's (website: <https://www.ifla.org>, feb. 2025) identified three-phases of decision-making process such as follow:

First phase: Intelligence phase, identifying and diagnosing the problem, defining objectives, and collecting data from inside and outside of the organization.

Second phase: Design phase, generating and evaluating alternatives, organize the data; and select a model to process the data.

Third phase: Choice phase: selecting the best course of action, followed by implementation.

2.2 Decision-making Process Steps:

The decision-making is a systematic process that comprises the steps in the following shape (figure-1): (website: [geeksforgeeks.org](https://www.geeksforgeeks.org), feb. 2025).

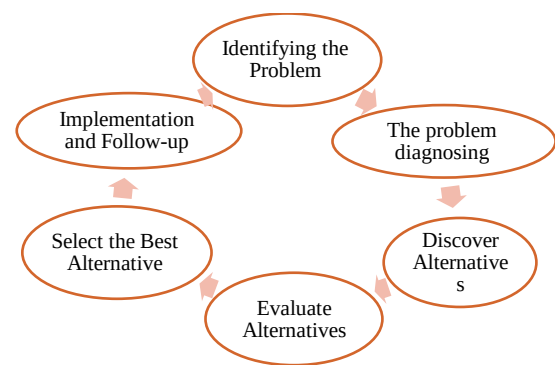


Figure (1)-Decision making steps

- **Identifying the Problem:** The decision-making process begins by recognizing a problem that requires resolution (website: [geeksforgeeks.org](https://www.geeksforgeeks.org), feb. 2025). Managers need to monitor the situation continuously to identify the real decision problem. Defining the problem accurately is crucial for establishing a clear decision-making process (Figueira & Ehrogott, 2005), if the problem formulation is inadequate it may lead to disastrous consequences (László, 2020).
- **The Problem diagnosing:** Diagnosing the real problem involves analyzing its elements and its relationship with other problems (Diego et al, 2018). Managers must gather all relevant facts and analyze them carefully to diagnose the problem accurately (Robbins & Coulter, 2020).
- **Discover Alternatives:** This step is to investigate the various possible alternatives. The goal is to keep the number of alternatives manageable while considering time and cost constraints (Yin, 2017). The management must ensure thorough consideration of the best alternatives before finalizing the decision, gathering and analyzing relevant information for this purpose (Freeman, 2010).
- **Evaluate Alternatives:** The positive and negative effects of each option are measured in this phase (Saaty, 2008). The decision maker should establish evaluation criteria to weigh the option effectively, considering factors that influence the decision process, such as the risk, timing, and limitation of resources within the organization (Phillips & Bana, 2007).
- **Select the Best Alternative:** Once we have evaluated the alternatives, we will select the optimal option, the optimum alternative is the option that maximizes outcomes under the given conditions. This step is crucial in decision-making, and it distinguishes between successful managers and unsuccessful ones (Johnson et al, 2020).
- **Implementation and Follow-up:** In this phase, following the decision-making process, this step starts up with the communications and obtaining feedback (Johnson et al, 2020). Ongoing monitoring mechanisms are employed to track progress and ensure alignment with intended objectives (Mintzberg, 2018).

2.3 The evolution of digitization concept:

The spread and the expansion of the internet and cloud computing in the 21st century revolutionized digitization. Organizations began leveraging digital transformation strategies to enhance efficiency and competitiveness (Westerman et al, 2014).

Furthermore, big data analytics and artificial intelligence have expanded digitization beyond data storage, allowing for predictive analysis and automated decision-making processes (Brynjolfsson & McAfee, 2014). Nowadays, digitization is employed in most (if not all) organizations (Kuusisto, 2015). The work process has transformed enormously since digitization has emerged (Castells, 2010). In the last two decades, we have observed an enormous amount of digitization projects in archival institutions (Panayides et al, 2020), this move has generated valuable experiences and established digitization policies to help archivists execute projects effectively ensuring the preservation of original materials while meeting rising user demands for digital accessibility (Ritter & Pedersen, 2019). The term digitization refers to the process of converting a material into a digital format, this process involves transforming materials, such as documents, into electronic forms, the digitization offers numerous benefits such as (Lina, 2017) & (Ritter & Pedersen, 2019):

- Access to archival material 24/7
- Allowing users to download and reuse the digitized content for educational, research, and other purposes
- Digitization enables multiple and parallel access to materials, enhanced by descriptive and technical data.
- Facilitating efficient retrieval.

By using the term digitization, we aim to change the impact and consequences of information and communication technology on society and its systems (Legner et al, 2017). Digitization is deeply reshaping the core principles of work and lifestyle in a postmodern society that is growing increasingly globalized and digitally driven like never before (Anamarija & Lea, 2019). Digitization reshaping how businesses, governments, and individuals interact with information and technologies. The concept of digitization refers to the conversion of analog information into digital formats, enabling data to be processed, stored, and transmitted efficiently (Kinza & Katie, 2025). Digitization is a term that describes the phenomenon of adopting digital technologies in business and society (Anamarija & Lea, 2019). The term digitization covers the affiliated changes in the connectivity of individuals, organizations, and objects (Urbach & Röglinger, 2019). However, it is important to note that digitization requires significant human, financial, and technical resources from archival institutions. The reasons for implementing a digitization project, or more precisely for digital conversion of non-digital material, are varied and overlapping. The decision to digitize material and process return to (website: <https://www.ifla.org,feb.2025>):

- To increase access: this is the most obvious and primary reason; so, digital copies can be accessed remotely by multiple users simultaneously, breaking down geographical barriers and time constraints associated with physical materials.
- To improve services for large user groups by providing enhanced access to the institution's resources.
- To reduce the handling and use of fragile or heavily used original material: Digitization creates a copy, safeguarding the content from damage or loss. The digital copies can then be used for access, while the original is stored in a safe environment. Moreover, digitization leads to creates a copy of endangered material such as brittle documents

2.4 The evolution of digitization in Sudanese higher education institutions:

According to Daniels (Daniels, 2002) ICTs have become within a very short time one of the basic building blocks of modern society (Salih & Yousuf, 2017). ICT equipment provides significant advantages in enhancing the decision-making process, thereby providing an opportunity to improve the lives of peoples. Moreover, the employment of new technologies to raise the quality and efficiency of the decision-making process cannot be ignored (Hamdy, 2007). The rapid growth in ICTs and digitization has brought remarkable changes since last century, as well as affecting its adoption and integration by the decision-making process (Djuraev et al, 2025). The transformation that is significantly driven by the ongoing digital revolution has profoundly changed the practice of the decision-making process (Ritter & Pedersen, 2019). In Sudan since 1990 the first steps was to digitize the higher education admission process initiated by developing a computerize system to save the admitted students data (Rasha, 2024). After the admission procedures were computerized in 1990, the director of the admission office stated that it is time to computerize the process of competition for seats in Sudanese higher education institutions, especially since most of the admission office employees received a training course on the ABCs to deal with computers (Rasha, 2024) & (Bikas & Yacoub, 1975). The rapid evolution of digital technology has significantly influenced higher education institutions worldwide, including those in Sudan. Digitization in the education field refers to the integration of digital tools, resources, and technologies to enhance teaching, learning, and administrative processes (Bates, 2019). In Sudan, the digitization of the higher education sector has evolved over the past two decades, driven by technological advancements, managerial changes, and social factors. The adoption of digital technologies in Sudanese higher education institutions traced back to the early 2000s, when institutions began adopting basic computing facilities and internet access. Initially, digital transformation was limited due to inadequate infrastructure and financial constraints (Ahmed, & Osman, 2018). The current trends of digitization in Sudanese higher education institutions have witnessed increased adoption of Learning Management Systems (LMS). Platforms such as Moodle and Google Classroom have become popular in facilitating virtual learning (Amada et al, 2023). In addition, the COVID-19 pandemic accelerated the transition to online education, clarifying both the potential and limitations of digital learning in the country (Abdelrahman, 2022). Despite progress, several challenges hinder the adoption of digitization in Sudanese higher education to enhance managerial decisions, key obstacles include technological issues such as insufficient internet connectivity, managerial and financial limitations, inadequate training for employees, and resistance to change (Elhadi & Ibrahim, 2020). Furthermore, political instability, such as recent wars and economic crises, has affected funding for technological advancements, which leads to slowing the pace of digital transformation.

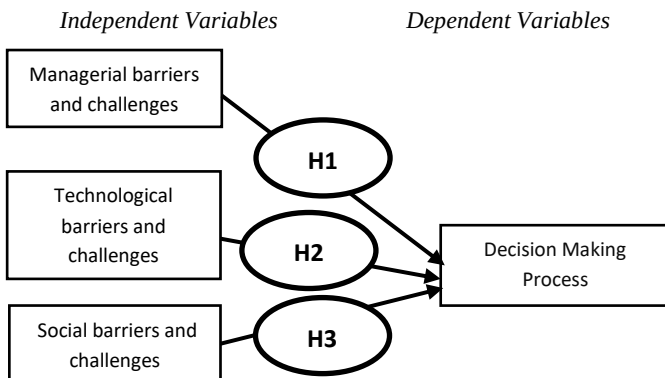
3. The study hypotheses:

First hypothesis H1: There are managerial barriers to employ new technologies impeding decision making process in higher education sector in Sudan.

Second hypothesis H2: There are technological barriers to employ new technologies impeding decision making process in higher education sector in Sudan.

Third hypothesis H3: There are social barriers to employ new technologies impeding decision making process in higher education sector in Sudan.

Conceptual Framework



4. Research Methodology

This study investigates the barriers and challenges impeding the employment of digitization in Sudanese higher education institutions to enhance the decision-making process. The study sample consisted of 198 collected through a questionnaire distributed to Sudanese higher education institution employees. The quantitative methods were employed to analyze the respondents' answers.

5. Sample of the Study:

The study sample means a set of individuals, events, or observations that constitute the subject of the research (Majid, 2016). The population of this study consists of employees and staff of Sudanese higher education institutions. Due to the large size of the population and the difficulties in reaching all samples of the study, the researchers applied the sampling methods to represent the study populations, and the sample size was 198 participants; the samples were selected randomly.

6. Data Collecting Tools:

The study utilizes the questionnaire as an instrument for data collection. The questionnaire included several questions to measure the study's variables. The questionnaire was designed using a five-point Likert scale ranging from (Strongly Agree – Agree – Neutral – Disagree – Strongly Disagree) with scores of 5, 4, 3, 2, and 1, respectively.

7. Validity and Reliability

It was important to validate the items of the questionnaire to obtain credible results. Ensuring the validity and reliability of the data was a major concern to maintain the accuracy and the truthfulness of the study. The aim of the study is to identify the challenges and barriers facing the employment of digitization to enhance decision-making in Sudanese higher education institutions. A survey research method was employed to enhance the validity and gather representative data. Due to addressing validity and reliability considerations, the study generates credible results regarding the challenges and barriers faced by Sudanese higher education institutions to employ digitization to enhance decision-making.

Table No (1) Reliability and Validity Statistics

Dimensions	Reliability Coefficient	Validity Coefficient	Number of Statements
First Dimension	0.81	0.90	13
Second Dimension	0.84	0.92	12
Third Dimension	0.85	0.92	10
The general dimensions	0.91	0.95	35

Source: Prepared by researchers from study data

The above table No. (1) demonstrates that Cronbach's alpha coefficients for the three dimensions exceeded 0.80 and the general dimension above 0.90, these results indicate a high level of internal consistency reliability among the questionnaire statements. We also noted that all self-consistency coefficients for the three dimensions and the general dimension exceeded 0.90, indicating that the questionnaire has good reliability. Overall, the results in table No. (1) indicate that the questionnaire used in the study has high reliability and validity, which means that it is a good and appropriate measurement tool for the study.

8. Descriptive analysis of the study variables:

Table No (2). Demographic characteristics of participants

Variables	Variable Categories	Frequency	Percent
Gender	Male	117	59.1
	Female	81	40.9
Age	less than 30	6	3.0
	30 and less than 40	27	13.6
	40 and less than 50	71	35.9
	50 and above	94	47.5
Experience	less than 5 years	8	4.0
	5 and less than 15	60	30.3
	15 and less than 25	70	35.4
	25 and above	60	30.3

Source: Prepared by researchers from study data.

The table No. (2) above shows the distribution of the sample demographic characteristics based on gender, age group, and years of experience.

8.1 Gender:

The sample largely consists of males, representing 59.1% (117 individuals), while females represent 40.9% (81 individuals).

8.2 Age group:

The prominent of the study sample members are 50 years of age or above (47.5%), with 94 individuals, followed by those between the ages of 40 and 50 (35.9%, with 71 individuals).

8.3 Years of experience:

The table above demonstrates that the study participants have a wide range of experiences, the group with the most experience (5-25 years) representing 65.7%, followed by the group

with 25 years or more representing 30.3%. The presence of a significant number of participants with relevant expertise indicates that experience may play an essential role in the study.

9. The Descriptive Analysis of the Study Dimensions:

The researchers analyzed the study data utilizing the Statistical Package for Social Sciences (SPSS). To test the study variables, frequencies, percentages, mean, and standard deviation were used in descriptive analysis; Cronbach's alpha was used to calculate the stability coefficient, which measures the degree of

reliability; and Pearson's correlation coefficient was used to determine the strength and direction of the relationship between the dependent variable and independent variables. Multiple linear regression analysis was used to examine the impact of the independent variables (administrative and financial challenges and barriers, technological challenges and barriers, and social challenges and barriers) on the dependent variable (employing digitization to enhance decision-making).

9.1 First dimension: Managerial, organizational and financial challenges and barriers:

Table No (3). first dimension participants answer frequencies, means, percentages and standard deviation

#	statements	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Mean	Std. Deviation
1	Failure to follow sustainable development methodology to ensure work continuity	135	50	8	4	1	4.59	0.713
		68.2	25.3	4.0	2.0	0.5		
2	The digitization strategies changes according to the change of the concerned institutions managers.	83	69	16	28	2	4.03	1.078
		41.9	34.8	8.1	14.1	1.0		
3	lack of managers awareness regards digitization concepts	125	65	3	5	0	4.57	0.655
		63.1	32.8	1.5	2.5	0.0		
4	Managers and employees' change resistance	87	80	14	14	3	4.18	0.949
		43.9	40.4	7.1	7.1	1.5		
5	The lack of necessary knowledge and skills required in digitization	101	85	1	11	0	4.39	0.765
		51.0	42.9	0.5	5.6	0.0		
6	Lack of financial resources to develop digital applications	114	69	4	10	1	4.44	0.808
		57.6	34.8	2.0	5.1	0.5		
7	shortage of financial resources necessary to train employees' and mangers to use digital applications	81	92	4	20	1	4.17	0.924
		40.9	46.5	2.0	10.1	0.5		
8	The limited budgets allocated to develop digital applications	107	74	10	6	1	4.41	0.767
		54.0	37.4	5.1	3.0	0.5		
9	The weakness in developing legislations to follow technological development	90	78	10	20	0	4.20	0.934
		45.5	39.4	5.1	10.1	0.0		
10	The lack of standardization in the digital applications used	84	99	13	2	0	4.34	0.646
		42.4	50.0	6.6	1.0	0.0		
11	the managers slowness in adopting the digitization concept	102	82	8	6	0	4.41	0.713
		51.5	41.4	4.0	3.0	0.0		
12	the absence of the initiatives to adopt digital applications	80	71	28	19	0	4.07	0.964
		40.4	35.9	14.1	9.6	0.0		
13	The incompatibility to set clear goals for the digital applications uses	75	96	19	6	2	4.19	0.808
		37.9	48.5	9.6	3.0	1.0		
	the first-dimension statements	1264	1010	138	151	11	4.31	0.851
		49.1	39.2	5.4	5.9	0.4		

Source: Prepared by researchers from study data.

The table No (3) above shows respondents' descriptive analysis results for the first dimension statements on digitization employment to enhance decision-making in Sudanese higher education institutions. The mean scores for each statement in the first dimension statements range between 4.03 and 4.59; according to the Likert scale, this reveals a high level of agreement among participants across first dimension statements about the existence of managerial, organizational, and financial challenges and barriers in utilizing digitization to enhance decision-making. So, this provides support for the first hypothesis (H1).

From the results in the table above, participants strongly agree or agree that factors such as failure to follow sustainable development methodology, lack of managers awareness regarding digitization concepts, change of digitization plans and strategies due to institutions managers change were significant challenges and barriers. Furthermore, participants express agreement regarding the challenges and barriers shaped by the slowness of higher education institutions managers in adopting the concept of digitization, insufficient financial resources to develop digital

applications, shortage of financial resources necessary to train employees and managers and limited budgets allocated to develop digital applications. In addition, participants agreed with the challenges and barriers posed by factors such as managers and employees change resistance, lack of knowledge and skills required to employ digitization. Furthermore, participants agree on challenges related to legislative issues, lack of standardization in digital applications, slowness of adopting digitization from institutions managers, initiatives absence to adopt digitization, and lack of harmony to set clear goals to employ digitization.

These findings identify the multifaceted complexity of the challenges and barriers impeding the employment of digitization to enhance decision making process in Sudanese higher education institutions which emphasize the importance of addressing these issues to facilitate successful implementation and progress in digitization initiatives.

9.2 Second dimension: Technological challenges and barriers dimension

Table N0(4). participants answer frequencies, means, percentages and standard deviation

#	Statements	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Mean	Std. Deviation
1	The incompatibility of digital application infrastructure	80	96	10	12	0	4.23	0.804
		40.4	48.5	5.1	6.1	0.0		
2	The poor coverage of telecommunications and internet services in many departments	133	51	2	12	0	4.54	0.767
		67.2	25.8	1.0	6.1	0.0		
3	The high cost of telecommunications and internet services	94	68	8	24	4	4.13	1.082
		47.5	34.3	4.0	12.1	2.0		
4	Low penetration rates of computers and smart devices	45	56	26	67	4	3.36	1.221
		22.7	28.3	13.1	33.8	2.0		
5	Slow or intermittent internet connection	41	58	29	65	5	3.33	1.204
		20.7	29.3	14.6	32.8	2.5		
6	Lack of ICT knowledge among staff and administrators	60	85	16	30	7	3.81	1.131
		30.3	42.9	8.1	15.2	3.5		
7	Lack of regular access to the internet and digital services	13	99	75	11	0	4.31	0.851
		6.6	50.0	37.9	5.6	0.0		
8	The weakness of securing the data and information exchange through networks	75	83	20	18	2	4.07	0.967
		37.9	41.9	10.1	9.1	1.0		
9	lack of unified standards to store and exchange data	59	107	19	13	0	4.07	0.809
		29.8	54.0	9.6	6.6	0.0		
10	The Incompatibility of Technology Standards utilized	53	96	33	15	1	3.93	0.885
		26.8	48.5	16.7	7.6	0.5		
11	Inflexibility in information systems used	40	102	34	22	0	3.81	0.886
		20.2	51.5	17.2	11.1	0.0		
12	Technical gap between technicians and beneficiaries	52	106	13	24	3	3.91	0.937
		26.3	53.5	6.6	12.1	1.5		
	The second dimension statements	831	983	221	315	26	3.96	1.034
		35.0	41.4	9.3	13.3	1.1		

Source: Prepared by researchers from study data.

The above table (4) shows participants descriptive analysis results for the second dimension statements (represented by means and standard deviations). The mean scores for each statement in the second dimension statements range between 3.4 and 4.54. The second dimension statements have a mean of 3.96, according to Likert scale, this indicates a level of agreement among participants across second dimension statements for the existence of technological challenges and barriers to utilize digitization to enhance decision-making. The overall means for all statements provides evidence that supports the second hypothesis H2. The statements of the second dimension mean scores indicate that participants agree or strongly agree that challenges and barriers such as incompatibility of digitization infrastructure, poor coverage of telecommunications and internet services, high costs of telecommunications and internet services, low penetration rates of computers and smart devices shaped significant challenges and barriers to utilizing digitization. Therefore, participants perceive

challenges and barriers in the slow or intermittent internet connection, lack of awareness and knowledge about ICT, Lack of regular access to the internet and digital services, weaknesses in data and information security, lack of unified standards to store and exchange data and incompatibility of technological standards used. Additionally, participants identify challenges and barriers related to inflexible inherited systems and information systems designs do not meet the beneficiary needs.

These findings highlight the multifaced challenges and barriers facing Sudanese higher education institutions to employ digitization in the decision-making process. The findings also reveal the need for comprehensive strategies to address technology infrastructure, technology awareness, information security, and other technological issues to facilitate successful digitization utilization.

9.3 Third dimension: Social challenges and barriers dimension

Table No (5). Third dimension participants answer frequencies, means, percentages and standard deviation

#	Statements	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Mean	Std. Deviation
		Frequency						
		Percent						
1	The lack of employee's awareness regarding the concept of digitization	73	82	8	32	3	3.96	1.094
		36.9	41.4	4.0	16.2	1.5		
2	Technology illiteracy among employees	74	85	17	22	0	4.07	0.951
		37.4	42.9	8.6	11.1	0.0		
3	The immigration of qualified and well-trained employees in the fields of ICT	87	69	15	24	3	4.08	1.066
		43.9	34.8	7.6	12.1	1.5		
4	The qualified employee's reluctance to work due to spread of bureaucracy	67	74	25	32	0	3.89	1.051
		33.8	37.4	12.6	16.2	0.0		
5	The absence of competency-based evaluation to qualified employees	66	110	15	7	0	4.19	0.720
		33.3	55.6	7.6	3.5	0.0		
6	The absence of employee's creativity appreciation	77	98	8	15	0	4.20	0.835
		38.9	49.5	4.0	7.6	0.0		
7	Relying on foreign experts to develop digital applications	54	60	35	42	7	3.57	1.198
		27.3	30.3	17.7	21.2	3.5		
8	The employees resist the adoption of digitization	44	52	45	55	2	3.41	1.144
		22.2	26.3	22.7	27.8	1.0		
9	poor communication between experts engaged in digitization projects and the beneficiaries	42	103	20	33	0	3.78	0.967
		21.2	52.0	10.1	16.7	0.0		
10	The inadequate confidence in digital applications among employees	50	91	19	36	2	3.76	1.056
		25.3	46.0	9.6	18.2	1.0		
	The third dimension statements	634	824	207	298	17	3.89	1.045
		32.0	41.6	10.5	15.1	0.9		

Source: Prepared by researchers from study data.

Table No (5) shows respondents descriptive analysis results for the third dimension statements (represented by means and standard deviations). The mean scores for each statement in the third-dimension statements range between 3.41 and 4.20. The third dimension statements have a mean of 3.89, according to Likert scale, this result indicates a level of agreement among participants across third dimension statements that social challenges and barriers influence the employment of digitization to enhance decision-making. The overall means for all statements provides evidence supports the third hypothesis H3.

The mean scores of the third dimension statements indicate that respondents agreed social challenges and barriers such as lack of awareness of the digitization concept, technology illiteracy among employees, and the immigration of qualified employees in the ICT field constitute significant challenges and barriers for employing digitization to enhance the decision-making process. Therefore, respondents noted that qualified employee's reluctance to work, the absence of competency-based evaluation to qualified employees and the absence of the employee's creativity appreciation shaped challenges and barriers for employing digitization in decision-making processes. In addition, respondents identify challenges and barriers such as reliance on foreign experts in the field of ICT to develop digital applications, the employees resist the adoption of digitization, poor communication between technical experts engaged in digitization projects and employees and inadequate confidence in digital applications among employees.

These findings spotlight the diverse array of challenges and barriers facing employment of digitization to enhance decision in Sudanese higher education institutions which emphasize the need for comprehensive strategies to handle technology illiteracy, creativity appreciation, workforce retention, organizational culture and confidence-building to facilitate successful digitization employing in decision making process.

10. Test of Hypothesis and discussion:

To examine the study hypotheses, the qualitative variables were transformed into quantitative variables representing the mean of the participants responses for each dimension. The statistical technique employed according to the data characteristics is simple linear regression. The simple linear regression model can be applied when there is one independent variable (X) and one dependent variable (Y) in the study hypothesis. The predicted simple linear regression model follows the following equation:

$$\hat{Y} = \hat{B}_0 + \hat{B}_1 X_i$$

Where:

$\hat{B}_0$ represent the model stator

$\hat{B}_i$ represent the regression coefficient

To examine the study's (first, second, and third) hypotheses, the simple linear regression model was employed for each hypothesis individually to investigate the presence of a significant relationship between the dependent variable and the independent variable. For instance, to determine whether managerial, financial, and organizational challenges and barriers restrict the employment of digitization to enhance decision-making. Consequently, the null hypothesis for each hypothesis is as follows:

$$H_0 : B_i = 0$$

The above hypothesis means that the regression coefficient is zero, indicating that the independent variable has no significant effect on the dependent variable, and therefore there is no correlation between the two variables, i.e. no relationship between the independent variable and the dependent variable. The alternative hypothesis is formulated as follows:

$$H_a : B_i \neq 0$$

The above hypothesis indicates that the regression coefficient is not zero, showing that the independent variable has a significant impact on the dependent variable. Thus, we may deduce that there is a significant correlation between the two variables. For instance, there is a significant correlation between the dependent variable (employing digitization to enhance decision-making) and the independent variable (technological challenges and barriers). In order to make a decision on whether we accept or reject the null hypothesis (H_0), the statistical significance level test for the correlation and regression coefficients is used and compared with the value of the allowed error; if the level of statistical significance is less than the allowed error ($\alpha=0.05$), we reject the null hypothesis, but if the level of statistical significance is greater than or equal to the allowed error, we accept the null hypothesis. If the level of statistical significance is greater than or equal to the allowed error, we accept the null hypothesis and deduce that there is no statistically significant relationship between the two variables (dependent and independent), where (H_0) refers to the null hypothesis while (H_1) refers to the alternative hypothesis in all statistical hypothesis tests.

10.1 Test the first hypothesis:

Analysis of variance (ANOVA) and simple linear regression were used to test the impact of managerial, financial, and organizational challenges and barriers impeding the employment of digitization to enhance the decision-making process.

Table No (6). Summary of SPSS Analysis Results for Hypothesis H1

Correlation Coefficient (R)	Coefficient of Determination (R ²)	F-Value (ANOVA)	Sig (P-Value)	Regression Coefficient (B)	Impact Significance
0.818	0.669	396.713	0.000	0.832	Very strong Significant Impact

Source: Prepared by researchers from study data.

The coefficient of determination (R^2) = 0.669 indicates that managerial, financial, and organizational challenges and barriers explain 67% of the change in the utilization of digitization to enhance the decision-making process, which means that there is a strong influence of these challenges and barriers.

The correlation coefficient (R) = 0.818 shows that there is a very strong positive correlation between managerial, financial, and organizational challenges and barriers and the employment of digitization to enhance the decision-making process.

The value of $F = 396.713$, which is statistically significant at the ($\text{Sig} = 0.000$) level, which means that the model used is statistically significant.

The regression coefficient $B = 0.832$ indicating that increasing the managerial, financial and organizational challenges and barriers by one unit leads to a decrease in the level of digitization employment by 0.832 units.

The probability value (P -value) = 0.000, which less than 0.05, this confirms that there is a significant effect of these challenges and barriers.

Findings: The results support the acceptance of the alternative hypothesis and the rejection of the null hypothesis, demonstrating that managerial, financial, and organizational challenges and barriers have a significant influence on the employment of digitization to enhance the decision-making process.

10.2 Test the second hypothesis:

Analysis of variance (ANOVA) and simple linear regression were utilized to test the impact of technological challenges and barriers on the employment of digitization to enhance the decision-making process.

Table (7): Summary of SPSS Analysis Results for Hypothesis H2

Correlation Coefficient (R)	Coefficient of Determination (R^2)	F-Value (ANOVA)	Sig (P-Value)	Regression Coefficient (B)	Impact Significance
0.837	0.700	457.623	0.000	0.667	Very Strong Significant Impact

Source: Prepared by researchers from study data

The coefficient of determination (R^2) = 0.70 indicates that technological challenges and barriers explain 70% of the change in the employment of digitization to enhance the decision-making process, which means that there is a strong influence of these challenges and barriers.

The correlation coefficient (R) = 0.84 shows that there is a very strong positive correlation between technological challenges and barriers and the employment of digitization to enhance the decision-making process.

The analysis reveals an F-value of 457.623, which is statistically significant at the 0.000 level ($p < 0.05$), indicating that the regression model is highly significant. The regression coefficient (B) is 0.667, indicating that a one-unit increase in technological challenges and barriers is associated with a 0.667 unit decrease in the level of digitization employment. Furthermore, the p-value of

0.000 confirms the statistical significance of this effect, demonstrating that technological challenges and barriers have a significant impact on digitization employment to enhance the decision-making process.

Findings: The results support the acceptance of the alternative hypothesis and the rejection of the null hypothesis, indicating that technological challenges and barriers have a statistically significant impact on the utilization of digitization to enhance the decision-making process.

10.3 Test the third hypothesis:

Analysis of variance (ANOVA) and simple linear regression were utilized to test the impact of social challenges and barriers on the employment of digitization to enhance the decision-making process.

Table (8): Summary of SPSS Analysis Results for Hypothesis H3

Correlation Coefficient (R)	Coefficient of Determination (R^2)	F-Value (ANOVA)	Sig (P-Value)	Regression Coefficient (B)	Impact Significance
0.841	0.707	472.290	0.000	0.592	Very Strong Significant Impact

Source: Prepared by researchers from study data

The coefficient of determination ($R^2 = 0.71$) indicates that social challenges and barriers explain 71% of the change in the employment of digitization to enhance decision-making, suggesting a strong influence of these challenges. The correlation coefficient ($R = 0.84$) demonstrates a very strong positive relationship between social challenges and barriers and the employment of digitization in the decision-making process. Additionally, the F-value of 472.290 is statistically significant at the 0.000 level ($p < 0.05$), confirming that the regression model is highly significant.

The regression coefficient ($B = 0.592$) indicates that a one-unit increase in social challenges and barriers results in a 0.592 unit decrease in the level of digitization employment. Additionally, the probability value ($p\text{-value} = 0.000$), which is less than 0.05, confirms the statistically significant impact of these challenges and barriers.

Findings: The results support the acceptance of the alternative hypothesis and the rejection of the null hypothesis, indicating that social challenges and barriers have a statistically significant impact on the adoption of digitization to enhance the decision-making process.

11. The Results:

- The study sample consisted of 198 higher education employees in Sudanese higher education institutions. The results indicated that the majority (59.1%) were male, 47.5% were over the age of 50, and 65.7% had an average work experience of 5 to 25 years.
- The findings indicate that managerial, financial, and organizational challenges and barriers significantly influence the employment of digitization to enhance the decision-making process, as perceived by higher education employees in Sudan. The most prominent challenges include a lack of awareness regarding the concept of digitization among employees in higher education institutions, which serves as a barrier to the effective utilization of digital tools. Furthermore, the emigration of trained and qualified employees in information technology field results in a loss of expertise essential for implementing digitization. In addition, the limited recognition of creativity and innovation among employees in higher education institutions reduces motivation for utilizing digital tools in decision-making processes.
- The results revealed that technological challenges and barriers significantly influence the adoption of digitization to enhance the decision-making process, as perceived by higher education employees in Sudan. The most prominent challenges and barriers include inadequate telecommunications and internet service coverage, high costs associated with telecommunications and internet access, rigid legacy systems, and information system designs that fail to meet the needs of beneficiaries.
- The findings revealed that social challenges and barriers significantly influence the employment of digitization in enhancing decision-making, as the study sample perceived. The most notable challenges and barriers include the absence of competency-based evaluation for qualified employees, the insufficient recognition of employee creativity and innovation, and resistance to digital adoption among employees. Notably, 46.0% of the study sample strongly

agreed on the impact of employee resistance as a critical challenge and barrier to digitization.

- The findings indicate that managerial, financial, and organizational challenges and barriers have a significant and strong impact on the adoption of digitization to enhance decision-making. The managerial, financial, and organizational challenges and barriers explain 67% of the changes in employment digitization. Furthermore, the significance level is less than 0.05, supporting the acceptance of the alternative hypothesis and the rejection of the null hypothesis.
- The results show that the technological challenges and barriers have a significant impact on digitization adoption. The study revealed that technological challenges and barriers explain 70% of the changes in digitization employment. The significance level is less than 0.05, which means accepting the alternative hypothesis and rejecting the null hypothesis.
- The results show that social challenges and barriers have a significant impact on employing digitization to enhance decision-making. This dimension explains 71% of the changes in the employment of digitization, and the level of significance is less than 0.05, which means accepting the alternative hypothesis and rejecting the null hypothesis.

12. Conclusion:

The study demonstrates that despite the widespread use of digital technologies recently, Sudanese higher education institutions face significant managerial, technological, and social challenges and barriers that impede the successful employment of digitization in the decision-making process. Managerial challenges such as awareness regarding digitization concepts, inconsistent strategies, and limited financial resources pose substantial challenges and barriers. Technological challenges and barriers such as poor internet connectivity, high communication costs, and outdated systems significantly impact digitization adoption. Socially, low digital literacy, resistance to change, and a lack of employee motivation further aggravate these challenges. The regression analyses confirm that all three dimensions—managerial, technological, and social—have a statistically significant impact on the adoption of digitization. Addressing these barriers through strategic planning, financial investment, training programs, and change management initiatives is essential for enabling digital transformation and improving decision-making in Sudanese higher education institutions.

13. Recommendations:

The following recommendations can be made based on the results and discussion provided in the study on the employment of digitization to enhance the decision-making process, focusing on challenges and barriers from the views of Sudanese higher education institution employees.

- Higher education Institutions should establish clear, long-term strategies for digitization, ensuring continuity and avoiding disruptions due to changes in administrations.
- The higher education institutions should secure financial resources for digitization initiatives, including funding for infrastructure, training, and maintenance.
- Upgrade telecommunication and internet infrastructure to improve connectivity and accessibility. Also, they should

build collaborations with government and private sector stakeholders to reduce the cost of internet and digital services

- To promote the advantages of digitization, higher education institutions should adopt awareness campaigns that highlight its benefits. Additionally, competency-based evaluations should be established to assess and reward employees. Furthermore, digital literacy training programs should be provided to both employees and managers to enhance their confidence and skills in utilizing digitization.
- Build and implement standardized systems for data storage and exchange to improve interoperability and data management
- Implement Comprehensive security measures to protect data and ensure secure information exchange across networks. Also, regularly review and update digitization policies to keep pace with technological advancements
- Implement flexible and adaptable information systems that can meet the evolving needs of higher education institutions and their beneficiaries.
- Overcome employee resistance to digitization through implementing change management strategies to resolve employee resistance problems, including communication, training, and involvement in the digitization process.

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