

Analyzing the Impact of Cloud-Based Spatial Decision Support Systems on Decision-Making Efficiency and User Satisfaction

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Abstract

This study aimed to measure and evaluate the impact of cloud-based spatial decision support systems on both administrative decision-making efficiency and user satisfaction. The study was conducted in the General Directorate of Education in Anbar Governorate, Iraq, and employed a descriptive-analytical methodology. The study population consisted of administrative leaders, technical staff, and those responsible for human and educational resource management. A random sample of 221 respondents was selected, and their questionnaires were analyzed using the Statistical Package for the Social Sciences (SPSS). The results showed a statistically significant positive correlation between cloud-based spatial systems and their dimensions (system quality, information quality, and service quality) and the variables of decision-making efficiency and user satisfaction. The simple correlation coefficient for decision efficiency was 0.818, with a significance level of 0.001 and a coefficient of determination of 0.669. The study recommended the need to enhance investment in the geographic cloud infrastructure for education in Anbar to ensure that decisions regarding the distribution of educational resources and human resources and filling vacancies are made accurately, quickly and with the lowest error rate.

Keywords: Spatial Decision Support Systems (SDSS), cloud computing, decision-making efficiency, Anbar Education

تحليل تأثير أنظمة دعم القرار المكاني القائمة على الحوسبة السحابية على

كفاءة اتخاذ القرار ورضا المستخدم

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الخلاصة

هدفت هذه الدراسة إلى قياس وتقييم أثر أنظمة دعم القرار المكاني السحابية على كفاءة اتخاذ القرارات الإدارية ورضا المستخدمين. أجريت الدراسة في المديرية العامة للتربية بمحافظة الأنبار، العراق، باستخدام منهجية وصفية تحليلية. شمل مجتمع الدراسة القادة الإداريين، والموظفين الفنيين، والمسؤولين عن إدارة الموارد البشرية والتعليمية. تم اختيار عينة عشوائية مكونة من 221 مستجيباً، وجرى تحليل استبياناتهم باستخدام برنامج SPSS الإحصائي. أظهرت النتائج وجود ارتباط إيجابي ذي دلالة إحصائية بين الأنظمة المكانية السحابية وأبعادها (جودة النظام، وجودة المعلومات، وجودة الخدمة) ومتغيري كفاءة اتخاذ القرار ورضا المستخدمين. بلغ معامل الارتباط البسيط لكفاءة اتخاذ القرار 0.818، بمستوى دلالة 0.001 ومعامل تحديد 0.669. أوصت الدراسة بضرورة تعزيز الاستثمار في البنية التحتية السحابية الجغرافية للتعليم في الأنبار لضمان اتخاذ القرارات المتعلقة بتوزيع الموارد التعليمية والموارد البشرية وشغل الوظائف الشاغرة بدقة وسرعة وبأقل نسبة خطأ.

1. Introduction

Spatial decision support systems on clouds are the major breakthrough in the information system and they can process spatial data quickly and efficiently. [1] This helps in enhancing the efficiency of decision making and the level of user satisfaction at schools [2]. Although these systems are heavily used in Iraqi schools, they do not use them to fullest advantage, especially when it comes to efficiency and satisfaction of the users. [3]. This study seeks to study the effects of such systems on efficiency of decision making and user satisfaction, with questionnaires and SPSS software being used to examine the effects of system and information dimension and service dimension on efficiency. [4] The final objective is to offer viable suggestions that would lead to improvement of educational human resource management. [5].

2. Theoretical Framework

The theoretical framework of the research project deals with spatial decision support systems (SDSS), which are the tools that help the decision-maker to analyze spatial data and make informed decisions. [6]. These systems play an essential role in solving complex geographic data issues, with the fact that they are based on sophisticated methods of analysis of their location and the identification of patterns. [7].

One of the most important components in the decision support systems has been cloud computing which has given a flexible platform upon which cloud storage and operation of online applications can take place. This allows sharing of information and increases interaction with others, hence, the quality of the decision. [8].

Exploring the connection between cloud-based spatial SDS, the efficiency of its decision-making, and user satisfaction are key to developing a strong theoretical background. This framework is aimed at quantifying effectiveness of cloud solutions on speed and accuracy of decision-making and user requirements in regard to ease of use and reliability. [9].

This framework is based on past models and studies regarding the cloud-based spatial SDS applications and their overall effects on performance and user satisfaction. It will equip the researcher with all the aspects of research and relevance of innovation in the application of cloud technologies to enhance decision-making. [10]. The transition to cloud-based spatial decision support systems (SDSS) in the Iraqi educational environment, specifically in the General Directorate of Education in Anbar Governorate, is not merely a technological luxury, but a pressing administrative necessity. Human resource and educational management within the Ministry of Education involves decisions that are primarily geographical and spatial in nature, such as determining optimal locations for new school construction based on population density, and ensuring the equitable and spatial redistribution of teaching and educational staff to fill vacancies in remote and densely populated areas. The research gap addressed by this study lies in the scarcity of Arabic and local literature that examines the quality dimensions of geographic cloud systems and their direct impact on the speed and efficiency of educational decision-making, as well as employee and user satisfaction with these systems, particularly given the logistical and geographical challenges faced by education directorates in newly established governorates like Anbar.

2.1 Spatial Decision Support Systems

Spatial decision support systems form an important model in the analysis and aid of location-related and environmentally informed decision making. [11]. This is a system that is based on the gathering and analysis of geographic information that assists the user to perceive distribution patterns and influencing factors in the most accurate way. [12]. The role of it is to process complicated data to simple and easily comprehensible content hence aid in quicker decision-making. [13]. The system is important in the analysis of populations and natural resources using the latest technological features like 3D visualization and time analysis.[14]. It is designed based on a design methodology that incorporates proper data collection and provision of interactive user environment. [15]. The databases and spatial relationships analysis is carried out with the help of modern information technologies, including Geographic Information Systems (GIS). It is an essential system to assist with strategic decisions and enhance the quality of the results and time-saving of the decision-making process. Through the systematic coverage of spatial aspects, it helps in developing the holistic perspective of issues and opportunities, which could help organizations to better respond to environmental and social changes. [16].

2.2 Cloud Computing in Decision Support Systems

Spatial decision support systems depend on cloud computing that increases their ability to be flexible and scalable to various demands of dynamic geographic data. [17]. It offers the elastic hosting environment which combines the tools and applications required to make the classification and analytical decisions, less powerful investments are required, and the data and services could be accessed immediately and securely. As the databases are hosted in the cloud, the decision support systems are also in a better position to process and analyze large volumes of data hence enhancing accuracy of findings made by decision-makers. [18]. The use of cloud enhances collaboration among users, since they are able to access information at any time, and helps in efficient maintenance and update of the applications, which is further able to increase the user satisfaction. Research has established that cloud system migration enhances data quality, minimizes the rate of error, and maximizes the response time hence operational efficiency. Security and technological integrity offers a secure environment and guarantees user satisfaction in that sensitive information is secured. The application of cloud computing to the spatial decision support systems improves performance effectiveness and establishes a dynamic information set-up that satisfies user expectations. [19].

2.3 Decision-Making Efficiency and User Satisfaction

The efficiency of the process and the satisfaction of the users in the assessment of cloud-based spatial decision support systems are crucial to better performance and simplified processes. [20]. Cloud computing also increases the speed of information accessibility and thus allows users to make better and prompt decisions. These systems are easy to use and interactive technologies that enhance the effectiveness of the analytical tool and minimize the possibility of errors. Cloud systems are flexible and therefore can adjust to the needs and preferences of the users and this enhances their satisfaction and builds confidence in the system. Efficiency in processes may be enhanced through the automation of some functions, which will save time in the decision making process and will be more precise. [21]. The continuous data analysis will also enable the user to identify trends rapidly to facilitate the process of making decisions based on data. Current literature shows that the combination of the spatial decision support systems with the cloud technologies has led to efficiency in performance and business resilience to new challenges. [22].

3. Evaluating the Impact of Cloud-Based Systems on Organizational Decision-Making Efficiency

3.1 The Impact of Cloud Systems on Decision-Making Efficiency

The theoretical framework of the research project deals with spatial decision support systems (SDSS), which are the tools that help the decision-maker to analyze spatial data and make informed decisions.

3. 2. Theoretical Framework

The cloud-based spatial decision-support system is a powerful solution in improving the level of efficiency of the decision making process due to the flexibility environment created with the use of modern technologies that are effective in processing data efficiently and swiftly. These systems capitalize on cloud computing to save and process large volumes of geographic information and save time expenditure and infrastructure capital, and encourage prompt reaction to change. This improves transparency and accuracy, in the sense that it makes available the current information, thereby maximizing the efficiency of strategic decisions. [23].

Cloud systems help in increasing flexibility in operations and cooperation of entities and allow them to exchange data very fast and coordinate their work more effectively. This minimises mistakes caused by old information and enhances reliability of decisions. They also help in decreasing the emergency response, thus increase result accuracy. [24].

The dependency on the cloud systems will lead to better efficiency of the administrative and operational procedures facilitating the correct and dependable decision-making. This needs strict evaluation models so as to guarantee that the information technology is in line with the requirements of the business and to train the employees on how best to use them. The shift to cloud systems will offer a flexible and dynamic workplace environment and favor sustainable development, as well as speed up the introduction of decisions, thus making organizations more competitive. [25].

3.3 The Impact of Cloud Systems on User Satisfaction

The result of the analysis revealed that spatial decision support systems based on cloud computing are more effective in enhancing user satisfaction. . This change is associated with the forces that make users have a better experience and effectively address their needs. The cloud makes data accessible online at any place and any given time, hence, increasing speed of response and shortening the time to make decisions. . The cloud architectures also promote flexibility and scalability in that systems can be tailored and modified to the needs of the user and thereby increase the confidence of the system. In addition, flexibility lessens technical problems associated with maintenance, thereby minimizing system unavailability and enhancing more stability in operation, which further improves the level of user satisfaction. . It is also possible to access reliable information with the help of the integration of the decision support systems and cloud technologies that allow the users to be sure in the results and to increase their satisfaction with the results of the decision-making process.

Study Methodology and Field Procedures 1. Research Methodology: The study adopted the descriptive-analytical approach, as it is the most suitable approach for the nature of such administrative and technical studies. This approach describes the phenomenon of cloud-based spatial decision support systems as they exist in reality, and then analyzes its statistical data to extract relationships and impact. 2. Study Population and Sample: Study Population: The study population consisted of all administrative and technical staff, educational planning officials, and employees of the Human Resources and Information Systems Department at the General Directorate of Education in Anbar Governorate, Iraq. Study Sample: Due to the large size of the study population, a representative random sample of [221] employees and officials who deal directly with the Directorate's cloud systems, platforms, and geographic databases was selected. 3. Study Instrument (Questionnaire): A validated questionnaire was developed as the primary data collection instrument. It was divided into two main parts: The independent variable: "cloud-based spatial decision support systems, which was measured through three main dimensions based on the DeLone & Ullman model.

1. System Quality (SQ): Measured using six items.

2. Information Quality (IQ): Measured using six items.

3. Service Quality (SERVQ): Measured using five items. Dependent Variables: Divided into two axes:

1. Decision-Making Efficiency (DME): Measured using six items.

2. User Satisfaction (US): Measured using five items. 4. Statistical Methods: For data processing and hypothesis testing, data were coded and entered into a computer using the Statistical Package for the Social Sciences (SPSS v26). The following methods were applied: frequencies and percentages to describe the study sample.

* Arithmetic means, standard deviations, and relative weights were used for descriptive analysis of the axes.

* Pearson's correlation coefficient is used to test relationships and correlations between dimensions.

* Simple linear regression analysis is used to determine the effect of the independent variable and its dimensions on the dependent variables.

4. Results of the Field Study

Statistical Analysis Methods:

Results of the Descriptive Analysis of the Questionnaire Items:

The availability of elements that constituted the questionnaire dimensions was determined using some descriptive statistics such as the arithmetic mean, Standard deviation, and percentage weight. This enabled ranking of these dimensions in terms of their availability to the study sample as follows:

Descriptive Analysis Results of the Questionnaire Items:

The availability of the questionnaire elements in the view of the study sample based on arithmetic mean, standard deviation, and percentage weight among other descriptive statistics were determined as follows:

Measuring the dimensions of cloud-based spatial decision support systems (independent variable):

Table 1-Results of the descriptive analysis of the statements of the first dimension: System Quality (SQ)

No.	Statement	Mean	Standard Deviation	Relative Weight (%)	Importance Rank
1	X1	3.48	1.085	69.68	3
2	X2	3.60	0.994	71.95	1
3	X3	3.37	0.952	67.33	5
4	X4	3.38	1.036	67.60	4
5	X5	3.44	1.054	68.78	2
6	X6	3.21	1.081	64.25	6
Overall Mean of the First Dimension: System Quality (SQ)		—	3.41 0.854	68.16	3rd

Source: SPSS outputs: Researcher

As the table above presenting responses of the sample to the statements of the first dimension: System Quality (SQ) revealed, the mean of the dimension was (3.41) and the percentage of the sample agreed with it was (68.16%), which indicates that the sample agreed with the dimension. The statistics of the statements were in the range of. (3.21–3.60) with a percentage of (64.25% - 71.95%). These percentages indicate the study sample's agreement with the dimension's statements. The third dimension was ranked in relation to the dimensions of the independent variable.

Table 2-Results of the descriptive analysis of the statements of the second dimension: Information Quality (IQ)

No.	Statement	Mean	Standard Deviation	Relative Weight (%)	Importance Rank	
1	X1	3.78	1.074	75.66	1	
2	X2	3.66	1.000	73.12	2	
3	X3	3.39	1.041	67.78	4	
4	X4	3.13	1.084	62.53	6	
5	X5	3.24	1.057	64.71	5	
6	X6	3.40	1.139	68.05	3	
<i>Overall Mean of the Second Dimension:</i>		—	3.43	0.818	68.64	1st
<i>Information Quality (IQ)</i>						

Source: SPSS outputs: Researcher

The previous table presenting the response of the sample to the statements of the second dimension the Information Quality (IQ) dimension revealed that the total mean of the dimension was (3.43) with a percentage of (68.64%), which suggests the sample concurs with the dimension. The means of the statements were between (3.13 -3.78) and the percentage was (62.53%-75.66%). These percentages show agreement of the study sample. with the dimension's statements. The third dimension was ranked in relation to the dimensions of the independent variable.

Table 3-Descriptive analysis of the third dimension statements: Service Quality (SERVQ)

No.	Statement	Mean	Standard Deviation	Relative Weight (%)	Importance Rank	
1	X1	3.53	1.047	70.59	1	
2	X2	3.25	0.994	64.98	4	
3	X3	3.51	0.975	70.23	2	
4	X4	3.16	0.994	63.17	5	
5	X5	3.39	0.941	67.87	3	
<i>Overall Mean of the Third Dimension:</i>		—	3.37	0.783	67.40	2nd
<i>Service Quality (SERVQ)</i>						

Source: SPSS outputs: Researcher

The previous sample table of the responses of the sample to the statements of the third dimension Service Quality (SERVQ) revealed that the general mean of the dimension was (3.37) and the percentage (67.40%), which represents the agreement of the sample on the dimension. The average of the statements varied in between (3.16 - 3.53) at (63.17% - 70.59%). These percentages show the agreement the sample of the study has with the statements of the dimension. The second dimension was also ranked against the dimensions of the independent variable.

Measurement of (dependent variable): Decision-making efficiency (DME) and user satisfaction (US)

Table 4- Results of descriptive analysis of the Decision-Making Efficiency (DME) statements

No.	Statement	Mean	Standard Deviation	Relative Weight (%)	Importance Rank	
1	Y1	3.37	1.223	67.33	2	
2	Y2	3.45	1.059	69.05	1	
3	Y3	3.34	1.043	66.79	5	
4	Y4	3.34	1.171	66.88	4	
5	Y5	3.18	0.988	63.62	6	
6	Y6	3.35	1.129	67.06	3	
<i>Overall Mean of Decision-Making Efficiency (DME)</i>		—	3.31	0.898	66.12	—

Source: SPSS outputs: Researcher

The table that was provided before on the responses of the sample to the Decision-Making Efficiency (DME) statements indicated that the mean of the dimension in general was (3.31) and a percentage of (66.12%), which implies the sample agreed with the dimension. The statements had a mean that was between (3.18 -3.45) percent with a percentage of (63.62-69.05). These percentages represent the concession of the study sample with the statements of the dimensions.

Table 5- Results of the descriptive analysis of user satisfaction statements (US)

No.	Item	Mean	Standard Deviation	Relative Weight (%)	Importance Rank	Strength Level	
1	Y1	3.14	1.066	62.71	5	Moderate	
2	Y2	3.47	1.154	69.32	1	Moderate	
3	Y3	3.39	1.316	67.87	2	Moderate	
4	Y4	3.30	1.049	65.97	3	Moderate	
5	Y5	3.24	1.035	64.71	4	Moderate	
<i>Overall Mean of User Satisfaction (US)</i>		—	3.40	0.591	68.07	—	Moderate

Source: SPSS outputs: Researcher

The table used earlier to illustrate the responses of the sample towards the user satisfaction statements (US) indicated that the average of the dimensional was (3.40) with a percentage of (68.07%), implying that the sample agreed with the dimension. The mean of the statements was between (3.14 - 3.47) percentage (62.71 -69.32). These percentages show how the study sample agreed with the statements of the dimension.

The validity of the hypotheses of the study: Testing the Study Hypotheses:

The first main hypothesis will be tested:

This research hypothesis is as follows: There is a statistically significant effect of cloud-based spatial decision support systems on improving decision-making efficiency.

To verify the hypothesis through statistical analysis, Pearson correlation coefficients, simple regression, and multiple regression were used to measure the relationship between the independent variable (cloud-based spatial decision support systems) and the dependent variable (improving decision-making efficiency). The independent variable, cloud-based spatial decision support systems, with its dimensions (system quality, information quality, and service quality), was examined to measure its impact on improving decision-making efficiency.

Table 6-Correlation matrix between dimensions of cloud-based spatial decision support systems and decision-making efficiency

Variables	Decision-Making Efficiency (DME)	Significance Level	Strength Level
System Quality (SQ)	0.824**	< 0.001	Very Strong Positive Correlation
Information Quality (IQ)	0.814**	0.004	Very Strong Positive Correlation
Service Quality (SERVQ)	0.828**	< 0.001	Very Strong Positive Correlation

Source: SPSS outputs: Researcher

It is clear from the previous table of the correlation between cloud spatial decision support systems and decision-making efficiency that there is a statistically significant correlation at a significance level of less than (0.01) between the dimensions of cloud spatial decision support systems (first dimension: system quality (SQ), second dimension: information quality (IQ), third dimension: service quality (SERVQ) and improving decision-making efficiency, where the values of the correlation coefficient were significant at a significance level of (0.01).

Table 7- Simple Linear Regression Study of the Impact of Cloud-Based Spatial Decision Support Systems on Improving Decision-Making Efficiency.

Independent Variable	Dependent Variable	Regression Coefficient (B)	Correlation Coefficient (R)	Coefficient of Determination (R ²)	F-value	t-value	Significance Level
Cloud-Based Spatial Decision Support Systems	Decision-Making Efficiency	0.823	0.818	0.669	442.926	21.046	< 0.001

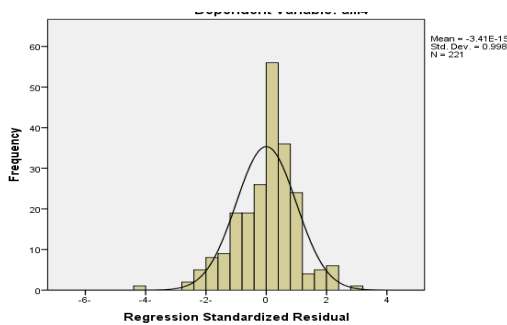
Source: SPSS outputs: Researcher

According to the above table of simple linear regression analysis of how cloud-based spatial decision support systems have helped to enhance the effectiveness of decision making, it is evident that:

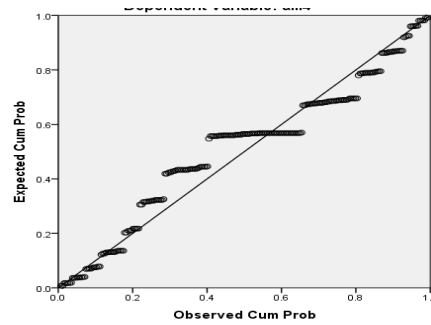
- The correlation coefficient (R) of 0.818 indicates that they are statistically significant correlation ($p < 0.001$) between cloud-based spatial decision support systems and improved decision-making efficiency (81.8%).
- The coefficient of determination (R²) predicts a statistically significant effect (66.9%) at a significance level of 0.01 for the criteria.
- The F-value (442.926) is statistically significant ($p < 0.01$), indicating the significance of the regression model. The regression coefficient (B) demonstrates a positive relationship between cloud-based spatial decision support systems and the impact of cloud-based spatial decision support systems. Furthermore, increasing the impact of cloud-based spatial decision support systems by 1 leads to an improvement in decision-making efficiency of 0.823.

We conclude from the previous results of testing the validity of the main hypothesis the following:

The first main hypothesis is valid: There is a statistically significant effect of cloud-based spatial decision support systems in improving decision-making efficiency



(a)



(b)

Testing the validity of the first sub-hypothesis:

which states: System quality has a statistically significant positive effect on decision-making efficiency.

Table 8- Simple linear regression of the effect of system quality on decision-making efficiency.

Independent Variable	Dependent Variable	Regression Coefficient (B)	Correlation Coefficient (R)	Coefficient of Determination (R ²)	F-value	t-value	Significance Level
System Quality (SQ)	Decision-Making Efficiency (DME)	0.910	0.824	0.679	463.142	21.521	< 0.001

Source: SPSS outputs: Researcher

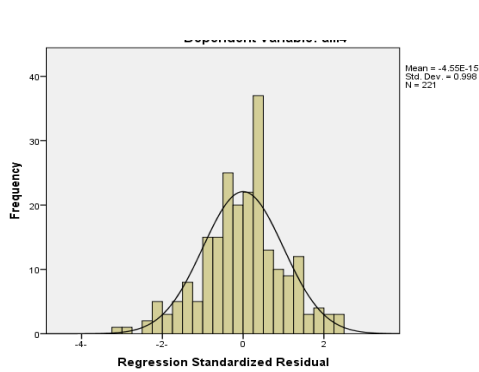
The preceding table of the effects of the quality of the systems on the efficiency of decisions, the following can be seen:

- The value of the correlation coefficient (R) is 0.824, which implies that it is statistically significant. significant correlation ($p < 0.001$) between system quality and decision-making efficiency) %82,4).
- The coefficient of determination (R²) indicates a statistically significant predictor of system quality (67.9%) at a significance level of 0.01.

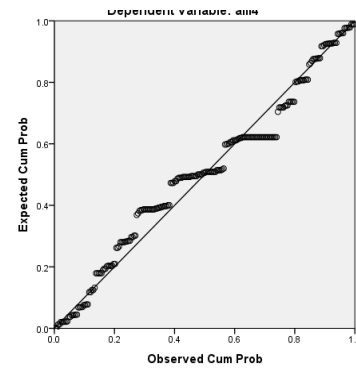
The significance of the regression model is found by the fact that the F-value (463.142) is significant at the level of significance of less than 0.01. Furthermore, the regression coefficient (B) demonstrates a direct relationship between system quality and decision-making efficiency, with an increase in the impact of system quality of 1 increasing decision-making efficiency by 0.910.

Based on the preceding results of the hypothesis test, we conclude the following:

The first sub-hypothesis is valid: System quality positively influences statistically significantly on decision-making efficiency.



(a)



(b)

Testing the validity of the second sub-hypothesis:

- The quality of information positively affects the efficacy of decision making statistically significantly.

This states: System quality is statistically significantly affecting the efficiency in decisions.

Table 9- Simple linear regression on how the quality of information affects the efficiency of decision-making.

Independent Variable	Dependent Variable	Regression Coefficient t (B)	Correlation Coefficient (R)	Coefficient of Determination (R ²)	F-value	t-value	Significance Level
Information Quality (IQ)	Decision-Making Efficiency (DME)	0.813	0.769	0.592	317.774	17.826	< 0.001

Source: SPSS outputs: Researcher

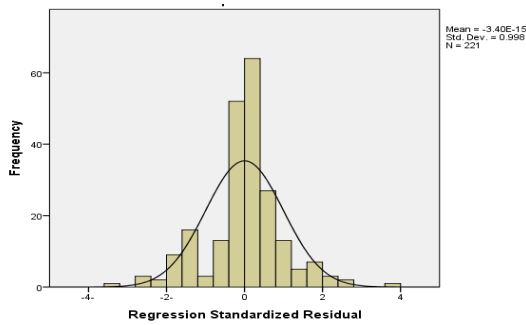
The preceding table of simple linear regression analysis of the impact of information quality on decision-making efficiency reveals the following:

- The correlation coefficient (R) of 0.769 shows that there is a statistically significant correlation. significant correlation (p < 0.001) between information quality and decision-making efficiency (76.9%).
- The coefficient of determination (R²) predicts a statistically significant impact (p < 0.01) on information quality (59.2%).
- The F-value (317.774) is statistically significant (p < 0.01), which implies that the regression model is significant. Moreover, the regression coefficient (B) shows that there is a direct relationship between the quality of information and efficiency in decision making. The more the influence of information quality [1] increases, the more efficient the decision-making is. (0.813).

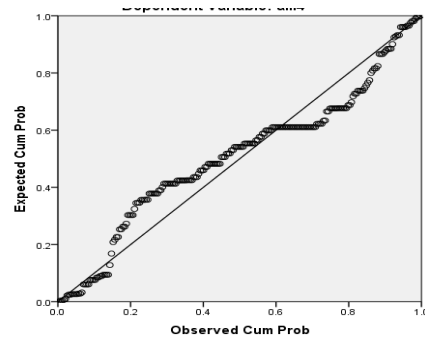
According to the above findings of the hypothesis test, we conclude the following:

The second sub-hypothesis is accepted: The information quality significantly and statistically positively influences the decision-making efficiency

Charts



(a)



(b)

To test the validity of the third sub-hypothesis:

which declares: Service quality is found to have statistically significant positive influence on the decision-making efficiency.

Table 10- Simple linear regression of the impact of service quality in the decision-making. Efficiency

Independent Variable	Dependent Variable	Regression Coefficient (B)	Correlation Coefficient (R)	Coefficient of Determination (R ²)	F-value	t-value	Significance Level
Service Quality (SERVQ)	Decision-Making Efficiency (DME)	0.754	0.890	0.791	830.649	28.821	< 0.001

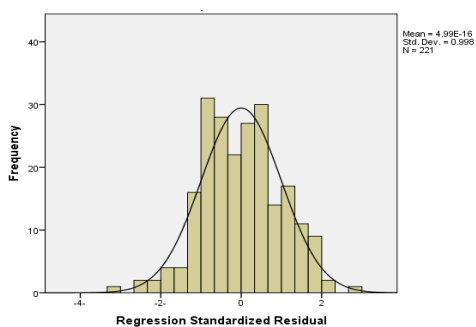
Source: SPSS outputs: Researcher

The simple linear regression analysis in Table [10] demonstrates that the F-value (830.649) is highly statistically significant ($p < 0.001$), confirming the overall validity and significance of the regression model. The correlation coefficient ($R = 0.890$) indicates a very strong positive relationship, while the coefficient of determination ($R^2 = 0.791$) reveals that service quality accounts for 79.1% of the variance in decision-making efficiency. Furthermore, the regression coefficient ($B = 0.754$, $t = 28.821$) proves that a one-unit increase in service quality directly yields a 0.754 improvement in administrative decision-making efficiency.

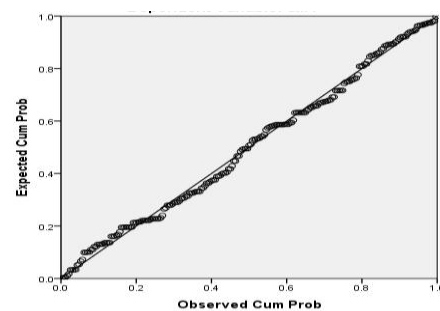
Based on the preceding results of the hypothesis test, we conclude the following:

The third sub-hypothesis is valid: Decision-making efficiency is statistically significantly influenced by service quality.

Charts



(a)



(b)

Main Hypothesis :

Cloud-based spatial decision support systems have a statistically significant influence on enhancing user satisfaction.

Sub-hypotheses:

- The positive effect of system quality on the user satisfaction is statistically significant.
- The user satisfaction is statistically positively influenced by the quality of the information..
- The effect of service quality on user satisfaction is statistically significant and positive.

The validity of the second major hypothesis is to be tested.:

which is as follows: The statistically significant effect of cloud-based spatial decision support systems on improving user satisfaction.

To verify the hypothesis through statistical analysis, Pearson correlation coefficients, simple regression, and multiple regression were used to measure the relationship between the independent variable (cloud-based spatial decision support systems) and the dependent variable (enhancing user satisfaction).

The independent variable, cloud-based spatial decision support systems, with its dimensions (system quality, information quality, and service quality), was examined to measure its impact on enhancing user satisfaction.

Table 11-Correlation Matrix between Dimensions of Cloud-Based Spatial Decision Support Systems and User Satisfaction.

Variable	Dependent Variable	Correlation Coefficient (R)	Significance Level (p)
<i>System Quality (SQ)</i>	User Satisfaction (US)	0.837**	< 0.001
<i>Information Quality (IQ)</i>	User Satisfaction (US)	0.879**	0.004
<i>Service Quality (SERVQ)</i>	User Satisfaction (US)	0.432**	< 0.001

Source: SPSS outputs: Researcher

(**) Significant at the significance level of (0.01) at the statistical level.

As is evident in the above table of the correlation between cloud spatial decision support systems and improving user satisfaction, there is a statistically significant correlation between the dimensions of cloud spatial decision support systems (first dimension: system quality (SQ), second dimension: information quality (IQ), third dimension: service quality (SERVQ) and improving user satisfaction) where the values of the correlation coefficient showed significance at a less than (0.01) significance level.

Table 12- Simple Linear Regression Research of the Effect of Cloud-based Spatial Decision Support Systems on Enhancing the User Satisfaction.

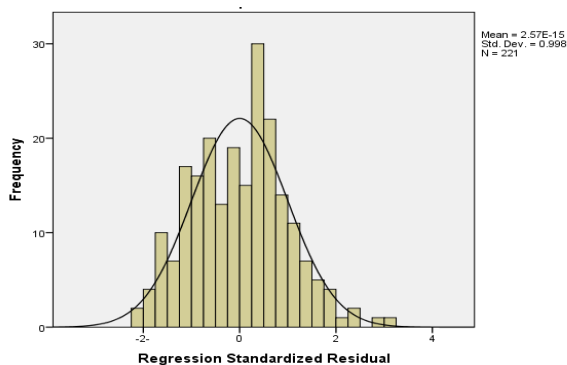
Independent Variable	Dependent Variable	Regression Coefficient (B)	Correlation Coefficient (R)	Coefficient of Determination (R ²)	F-value	t-value	Significance Level
(Cloud-Based Spatial Decision Support Systems)	User Satisfaction Improvement (US)	0.744	0.783	0.614	347.740	18.648	< 0.001

Source: SPSS outputs: Researcher

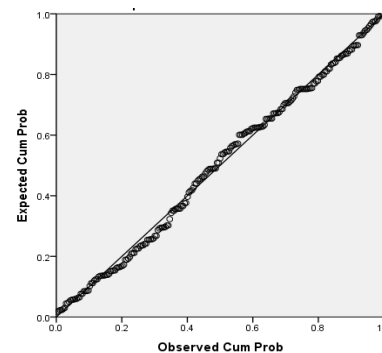
The preceding table of simple linear regression analysis of the impact of cloud-based spatial decision support systems on user satisfaction reveals the following:

- The correlation coefficient (R) of 0.783 indicates a statistically significant correlation ($p < 0.001$) between cloud-based spatial decision support systems and improved user satisfaction (78,3).
- The coefficient of determination (R^2) forecasts a statistically significant effect (61.4%) for the criteria ($p < 0.01$).
- The F-value (347.740) is statistically significant (p less than 0.01) which shows that the regression model is significant. The regression coefficient (B) demonstrates a positive relationship between cloud-based spatial decision support systems and user satisfaction. Furthermore, an increase in the impact of cloud-based spatial decision support systems by 1 leads to an improvement in user satisfaction of 0.744. From the previous results of testing the validity of the main hypothesis, we conclude the following:

The initial hypothesis is confirmed: There is statistically significant effect of cloud-based spatial decision support systems in improving user satisfaction.



(a)



(B)

Test of the validity of the first sub-hypothesis:

which reads: System quality positively and statistically significantly influences enhancement of user satisfaction.

Table 13- Simple linear regression of how quality of the system improves user satisfaction.

Independent Variable	Dependent Variable	Regression Coefficient (B)	Correlation Coefficient (R)	Coefficient of Determination (R^2)	F-value	t-value	Significance Level (p)
System Quality (SQ)	User Satisfaction Improvement (US)	0.910	0.824	0.679	463.142	21.521	< 0.001

Source: SPSS outputs: Researcher

The preceding table of simple linear regression analysis of the impact of system quality on user satisfaction reveals the following:

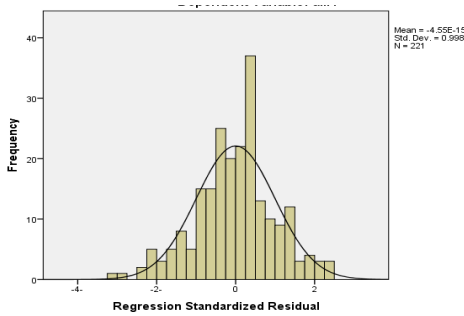
- Basically, an R value (0.824) of 0.001 shows that the improvement in the quality of systems and user satisfaction are statistically significant (82,4).
- The coefficient of determination (R^2) predicts a statistically significant impact ($p < 0.01$) of system quality) 67,9).

- The regression model is significant as the F-value (463.142) means that the p-value (0.01) is below the significant level of 0.05. In addition, regression coefficient (B) illustrates the direct correlation between the system quality and the improvement of user satisfaction. An increment of the system quality by 1 results in a rise in user satisfaction by 0.910.

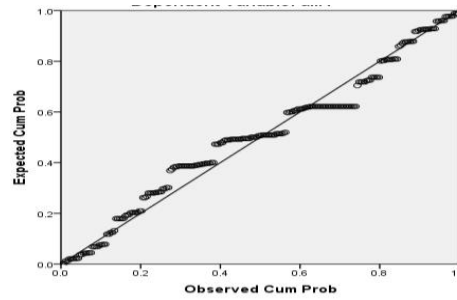
According to the above findings of the hypothesis test, we can support the following:

The initial sub-hypothesis is accepted, and the quality of the system has statistically significant positive effect in enhancing user satisfaction.

Charts



(a)



(b)

Testing the validity of the second sub-hypothesis:

- There is statistically significant positive effect of information quality to enhance user satisfaction.

This states: The quality of systems also positively influences the improvement of user satisfaction statistically significantly.

Table 14- Simple linear regression of the impact of information quality on user satisfaction.

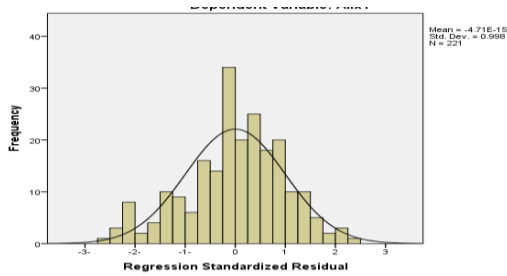
Independent Variable	Dependent Variable	Regression Coefficient (B)	Correlation Coefficient (R)	Coefficient of Determination (R ²)	F-value	t-value	Significance Level (p)
Information Quality (IQ)	User Satisfaction Improvement (US)	0.579	0.837	0.700	510.564	22.596	< 0.001

Source: SPSS outputs: Researcher

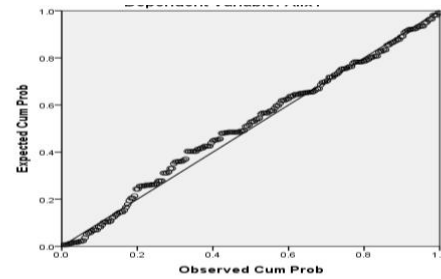
The above simple linear regression analysis of the influence of quality of information on the user satisfaction gives the following:

- The coefficient value (R) of 0.837 implies that the relationship between the quality of information and the improvement of user satisfaction [6837] is statistically significant (0.001).
- The coefficient of determination (R²) predicts a statistically significant impact (p < 0.01) of information quality(70%).
- The F-value (317.774) is statistically significant (p < 0.01) which means the importance of the regression model. Moreover, the regression coefficient (B) proves the direct correlation between improvement of user satisfaction and quality of information. Given the growth of the information quality, boosting user satisfaction growth (0,579) occurs.

The second sub-hypothesis is accepted: Information quality has a significant positive



(a)



(b)

Testing the validity of the third sub-hypothesis:

that is, states:Service quality positively affects the enhancement of user satisfaction statistically significantly.

Table [15] Simple linear regression of the effect of service quality on the enhancement of user satisfaction.

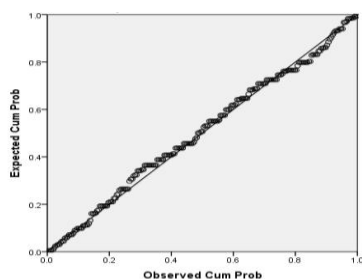
Analysis of the effects of service quality on user satisfaction by comparing the simple linear regression of the two variables shows the following:

- The correlation coefficient (R) of 0.879 suggests that there is a statistically significant correlation between service quality and improvement of user satisfaction
- The coefficient of determination (R²) predicts a statistically significant impact (p < 0.01) on service quality) %87,3).
- The F-value (747.115) is statistically significant (p < 0.01) which shows that the regression model is significant. Also, the regression coefficient (B) shows the direct correlation between the improvement in user satisfaction and service quality. A change in the influence of service quality of 1 results into an improvement in user satisfaction of 0.635.

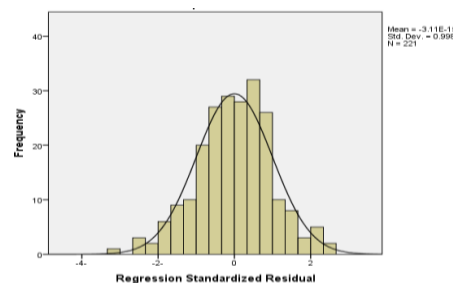
According to the previous outcomes of the hypothesis test, we will conclude the following:

Sub-hypothesis three is accepted: The quality of services provided has a statistically significant positive effect on enhancing user satisfaction.

Charts



(a)



(b)

6. Discussion of Results

The research findings revealed that one of the current strategic tools has been the cloud-based spatial decision support systems (SDS) which plays an important role in enhancing the efficiency of the decision making process in organizations. The descriptive analysis has shown that the level of implementing these systems is relatively high, which indicates that organizations have already

understood the relevance of cloud technologies in ensuring a progressive information environment that facilitates the operations of the administrative procedures.

The correlation analysis showed a statistically significant positive correlation between cloud-based SDS and decision-making efficiency which shows that the better the usage of such systems is, the better the ability of decision-makers to analyze information and choose relevant alternatives. This observation proves that cloud technologies offer a scalable platform of data processing and data analysis, which positively influences the quality of decisions.

The output of the regression analysis revealed that the effect of cloud-based SDS on decision-making efficiency is positive and significant and the facts explain a significant percentage Timely variation in the dependent variable. This implies that utilization of such systems will play a role in delivering accurate, timely and highly reliable information thereby cutting on uncertainty and enhancing efficiency of administrative decisions. These results can be balanced with the recent literature that suggests that cloud technologies and decision support systems are critical in terms of the improvement of organizational performance and the quality of administrative processes due to the availability of right information and the assistance of the analysis and strategic planning.

7. Practical Trends and Recommendations

1-The necessity to encourage the adoption of cloud-based spatial decision support systems within organizations because they can be effective in enhancing efficient decision-making.

2-Making efforts to enhance the quality of service, which is offered by providing constant technical support and effective user training to achieve optimum system usage.

3-Identifying the quality of information and making sure it is accurate and updated all the time since this directly reflects on the efficiency of making the decisions.

4-Enhancing the quality of systems, through enhancing usability, responsiveness and system reliability.

5-The investment in the infrastructure of cloud technology as a way to improve the efficiency of the cloud-based spatial decision support systems.

6-Developing training sessions on how the users should improve their expertise in the utilization of cloud-based spatial decision support systems.

7-Promoting the use of the modern cloud technologies among organizations since they have significant functions in enhancing the performance of organizations

Reference:

[1] S. I. Ali, D. M. Abdulqader, O. M. Ahmed, H. R. Ismael, S. Hasan, and L. H. Ahmed, Consideration of web technology and cloud computing inspiration for AI and IoT role in sustainable decision-making for enterprise systems, *J. Inf. Technol. Informatics*, vol. 3, no. 2, p. 4, 2024. doi: 10.58421/misc.v3i2.218

[2] A. Asghar, K. A. Khan, and A. U. Rahman, A multi-attribute decision-making context for hospital site evaluation using distance measures under complex picture fuzzy soft set environment, *Yugosl. J. Oper. Res.*, vol. 34, no. 4, pp. 795–812, 2024. doi: 10.2298/YJOR230715004A

[3] C. Atakari, A deep learning-based security model for ERP-integrated IoT in national defense manufacturing environments, *Int. J. Emerg. Trends Comput. Sci. Inf. Technol.*, vol. 5, no. 3, pp. 90–98, 2024. doi: 10.30942/ijetcsit.v5i3.102

- [4] R. U. Attah, I. Gil-Ozoudeh, B. M. P. Garba, and O. Iwuanyanwu, Leveraging geographic information systems and data analytics for enhanced public sector decision-making and urban planning, *Magna Scientia Adv. Res. Rev.*, vol. 12, no. 2, pp. 152–163, 2024. doi: 10.30574/msarr.2024.12.2.0152
- [5] R. Bordoni, Development of a Spatial Decision Support System (SDSS) for sustainable development: Spatially explicit analysis of ecosystem services provided by the Ligurian coastal area, Doctoral dissertation, Università degli Studi di Genova, 2025.
- [6] D. Coon, L. Lindow, Z. Boz, A. Martin-Ryals, Y. Zhang, and M. Correll, Reporting and practices of sustainability in controlled environment agriculture: A scoping review, *Environ. Syst. Decis.*, vol. 44, no. 2, pp. 301–326, 2024. doi: 10.1007/s10669-024-09967-y
- [7] E. I. Cota-Rivera, Advancing geographic information systems with machine learning: Innovations in spatial analysis and environmental management, in *Exploring Psychology, Social Innovation and Advanced Applications of Machine Learning*, Hershey, PA, USA: IGI Global, 2025, pp. 253–270. doi: 10.4018/979-8-3693-3567-3.ch013
- [8] S. Dalal, A. Kumar, U. K. Lilhore, N. Dahiya, V. Jaglan, and U. Rani, Optimizing cloud service provider selection with firefly-guided fuzzy decision support system for smart cities, *Meas. Sens.*, vol. 35, Art. no. 101294, 2024. doi: 10.1016/j.measen.2024.101294
- [9] E. Dritsas and M. Trigka, Remote sensing and geospatial analysis in the big data era: A survey, *Remote Sens.*, vol. 17, no. 3, p. 550, 2025. doi: 10.3390/rs17030550
- [10] G. Droj, A. Kwartnik-Pruc, and L. Droj, A comprehensive overview regarding the impact of GIS on property valuation, *ISPRS Int. J. Geo-Inf.*, vol. 13, no. 6, p. 175, 2024. doi: 10.3390/ijgi13060175
- [11] V. Evagelopoulos, N. D. Charisiou, M. Logothetis, G. Evagelopoulos, and C. Logothetis, Cloud-based decision support system for air quality management *Climate*, vol. 10, no. 3, p. 39, 2022. doi: 10.3390/cli10030039
- [12] H. Gou, Zhang, G., E. P. Medeiros, S. K. Jagatheesaperumal, and V. H. C. de Albuquerque, A cognitive medical decision support system for IoT-based human-computer interface in pervasive computing environment, *Cogn. Comput.*, vol. 16, no. 5, pp. 2471–2486, 2024. doi: 10.1007/s12559-024-10271-x
- [13] R. Hasan and S. Akter, Information system-based decision support tools: A systematic review of strategic applications in service-oriented enterprises, *Rev. Appl. Sci. Technol.*, vol. 1, no. 4, pp. 26–65, 2022. doi: 10.55640/rast-01-04-05
- [14] C. Kupfer, R. Prassl, J. Fleiß, C. Malin, S. Thalmann, and B. Kubicek, Check the box! How to deal with automation bias in AI-based personnel selection, *Front. Psychol.*, vol. 14, Art. no. 1118723, 2023. doi: 10.3389/fpsyg.2023.1118723
- [15] H. Liang, Z. Zhang, C. Hu, Y. Gong, and D. Cheng, A survey on spatio-temporal big data analytics ecosystem: Resource management, processing platform, and applications, *IEEE Trans. Big Data*, vol. 10, no. 2, pp. 174–193, 2023. doi: 10.1109/TBDATA.2023.3323145
- [16] Y. A. Otmane, Enhancing mobile network infrastructure through spatio-temporal analysis and decision support systems by geo-decisional prototype, *Int. J. Inf. Sci. Technol.*, vol. 8, no. 1, pp. 10–16, 2024. doi: 10.48550/arXiv.2402.04351

- [17] V. Pajić, M. Andrejić, M. Jolović, and M. Kilibarda, Strategic warehouse location selection in business logistics: A novel approach using imf SWARA–MARCOS—A case study of a Serbian logistics service provider, *Mathematics*, vol. 12, no. 5, p. 776, 2024. doi: 10.3390/math12050776
- [18] E. Pourrahimian, D. Salhab, F. Hamzeh, and S. AbouRizk, A decision support system for evaluating construction project recovery plans, *Can. J. Civ. Eng.*, vol. 52, no. 7, pp. 1336–1354, 2025. doi: 10.1139/cjce-2024-0012.
- [19] B. Qi *et al.*, Intelligent multi-objective decision support system for efficient resource allocation in cloud computing, *Ann. Oper. Res.*, pp. 1–29, 2025. . doi: 10.1007/s10479-024-06412-2
- [20] A. S. Saridou and A. P. Vavatsikos, Consumer satisfaction benchmarking analysis using group decision support system (GDSS) PROMETHEE methodology in a GIS environment, *Information*, vol. 15, no. 11, p. 694, 2024. doi: 10.3390/info15110694
- [21] S. Shi, Enhancing the interpretability of Multicriteria-Spatial Decision Support Systems (MC-SDSS) for non-SDSS-users: A case study of Sahtú-led Boreal Caribou Range Planning in Northwest Territories, Doctoral dissertation, Carleton University, 2024. doi: 10.22215/etd/2024-15822
- [22] I. Siddique, Machine learning empowered geographic information systems: Advancing spatial analysis and decision making, *World J. Adv. Res. Rev.*, vol. 22, no. 1, pp. 10–30574, 2024. doi: 10.30574/wjarr.2024.22.1.1024
- [23] F. Terribile *et al.*, The LANDSUPPORT geospatial decision support system (S-DSS) vision: Operational tools to implement sustainability policies in land planning and management, *Land Degrad. Dev.*, vol. 35, no. 2, pp. 813–834, 2024. doi: 10.1002/ldr.4954
- [24] R. Wen and S. Li, Spatial decision support systems with automated machine learning: A review, *ISPRS Int. J. Geo-Inf.*, vol. 12, no. 1, p. 12, 2022. doi: 10.3390/ijgi12010012
- [25] X. Ye, S. Li, S. Das, and J. Du, Enhancing routes selection with real-time weather data integration in spatial decision support systems, *Spatial Inf. Res.*, vol. 32, no. 4, pp. 373–381, 2024. doi: 10.1007/s41324-023-00561-1
- [26] Z. Zhang, Z. Li, and Wang, Z., Human-machine synergy in spatial decision-making: A multi-scenario SDSS prototype for high-rise buildings, *Cities*, vol. 165, Art. no. 106090, 2025. doi: 10.1016/j.cities.2024.106090
- [27] T. Zhao *et al.*, Leveraging immersive digital twins and AI-driven decision support systems for sustainable water reserves management: A conceptual framework, *Sustainability*, vol. 17, no. 8, p. 3754, 2025. doi: 10.3390/su17083754