Decision Support Capabilities of Enterprise Management Information System: An Empirical Research

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Abstract

This paper employs quantitative research approach to unearth how the use of management information system (MIS) leads to certain decision-support capabilities among mining companies in Sierra Leone and in the process explores the moderating role of information access and information quality. By identifying the levels of decision support capabilities and MIS use, valuable insight is provided for local businesses on how to achieve IT capability and competitiveness. The correlation analysis demonstrates that all the variables except for speed of decision making had significant impact on the use of information system. The regression result further shows that information access and information quality moderate the impact MIS use have on decision support capabilities. The outcome of the paper can be of benefit to business executives in terms of simplifying their day to day decision making process based on the timely and relevant information. Management information system also ensures the information quality and speed of the decision making process which serve as valuable assets for business managers.

Keywords: Management information system, Decision making, Decision support, Information access, Information quality

1 Introduction

An exceptional and underground dilemma has emerged from the correspondence of new technology and increasing volume of data (Oh, 1998). The usual consequence of cheap storage and speedy connectivity has created the strategic tendency for organizations to accumulate data for the purpose of extracting collective knowledge (Laidner and Elam 1994, Alalwan, 2014). Nevertheless, as the information content becomes increasingly complex and isolated the ability to utilize this information for quick and effective decision making declines. One strategic approach to realize business value from the cumulative content assets is to employ appropriate decision support (DS) technology (Mead and Kennet, 2007). Decision Support technology offers a means to structure, filter, and analyze information in order to reduce uncertainty and increase efficiency in the decision making process. Traditionally, Decision Support technology encompassed tools such as decision support systems (DSS) (Ralph .H. Sprague, 1980) expert systems (ES) (Luconi F.L et. al., 1986), executive information systems (EIS) (Singh S.K., et. al., 2002; Watson H.J., et. al., 1991), and group decision support systems (GDSS) (DeSanctis G., Gallupe R.B., 1987). In recent years, newer technologies have emerged that are designed more specifically around the problem context of organizational data and include systems that support knowledge generation and management (Anderson-Lehman R., et. al., 2004; Oppong S.A., et. al., 2005; Zack M.H., 2007). Enterprise management information system (EMIS) belongs to this group.

Management information systems (MIS) are widely used in big corporations to collect, organize, filter and present data, resulting in more effective decision-making. Through the use of MIS, individuals shape the way they make decision. In our study, we point out that the use of MIS in the decision-making process impacts the decision support capabilities of systems. The use of MIS develops speed, quality and other features of decision-making (Jarupathirun and Zahedi, 2007). Moreover, improvement in decision-making is aimed to ensure customer satisfaction and excellent business results. MIS strategies should therefore be tailored in a way that all the business goals are achieved. The main problem that the study aims to solve is how the use of information system contributes to the development of decision support capabilities which previous scholars have failed to account for in their studies.

With the establishment that the use of information systems leads to the development of certain capabilities, management can argue for the implementation of such systems, as such, this research would be of interest to researchers, policy makers, and business managers. Following the introductory section, that is section one, the rest of the paper is structured as follows: section two provides a review of the theoretical and empirical literatures and model development that focus on management information systems and decision support capabilities to derive the research hypotheses. Section three presents the methodology that explains the instrument of data collection, data collection procedure and estimation techniques. Section four provides data analysis and presentation of results including model measurement and hypothesis testing. Section five focuses on the discussion of the results and implications while section six concludes the paper.

2 Literature Review and Model Development

2.1 Literature Review

It is a fact that there is hardly a scholarly work that could be completed without making references or drawing from the ideas of similar works that already exist. As researchers continue to build their ideas on previous works, the knowledge bank continues to flourish. Consequently, the foundation of this research is the literature that review relevant empirical theories that helps to develop the theoretical knowledge which gives an in-depth understanding on the field, it help to formulate the research questions, redefine the research objectives, identify research opportunity and maintain novelty.

While some previous studies have discussed the strategic capabilities of MIS, no published research has assessed the impact of MIS on decision support in an organizational context in Sierra Leone. Specifically, we know of no research that has been conducted to determine the extent to which MIS use enables decision makers to recognize problems, explore possible solutions, and improve decision making speed. In addressing this research gap, we developed a conceptual model that combines the sequential decision making framework of Mintzberg et. al., (1976) with the content stewardship activities of MIS identified by Smith & Mckeen (2003). We use this conceptual model as the basis to formulate our hypothesis, and our research model to analyze the effect of MIS use on problem description, speed of problem identification and decision making, decision quality, and decision satisfaction.

The importance of decision maker is found to be crucial in maintaining the activities of decision support systems. The solutions provided by the decision support systems are considered as being vital in ensuring efficiency of work by reaching high level of employee satisfaction. Apart from providing flexibility and automated work conditions, decision support systems are becoming popular for improving organizational efficiency. In this regard, Power (2002) and Ghazi (2016) highlighted that making decisions is an integral part of working especially in the organization. Improving financial performance is considered as a main priority for most companies therefore decision support system contributes to the operation of the firm through better explanation of business opportunities. One of the most efficient ways of making decision is ensured through management information system (MIS) which was conducted to collect manual data previously. The underlying motive behind MIS is to maximize the constant flow of information to the management which will be later used for decision making purposes. Uma (2009) provided some examples of decisions which are reached with the help of decision support systems including those such as merger acquisition, expansion of the plant and new product development. Therefore, it is necessary to shed more light on how management information systems ensure the quality of decisions made by decision support systems (DSS).

Review of the previous literature (Sanders and Courtney, 1985; Leider and Elma, 1994; Oh, 1998; Mead and Kennet, 2014; Jarupathirun and Zahedi, 2007; Alalwan, 2014; Ghazi, 2015) resulted in identification of the following important variables including impact on problem definition, speed of problem identification, decision making analysis, decision quality, speed of decision making and decision maker satisfaction. Through a detailed review of all factors belonging to the scope of capabilities the factors that are most conducive to creating a most favorable decision have been determined. The research model represents the possible generation of decision support capabilities as an outcome which is significant for organizational performance. Consequently, a relationship between use of MIS and problem definition, speed of problem identification and decision making, decision quality and decision satisfaction have been hypothesized. Decision support capabilities have implications for success for decision-making. However, in our model, we are assessing for which capability is MIS use more beneficial. Therefore, a link of MIS use with decision-support capabilities is tested.

2.2 Model Development

In this study, the use of management information system (MIS) was determined through a combination of decision support (DS) activities developed by Mintzberg et al (1997):The model of Mintzberg et al. consists of three phases; identification, development, and selection. To ensure content validity, the measurement items were developed based on existing instruments (Zain et al., 2005; Oh, C 1998; Leidner and Elam, 1994; Mead and Kannett 2007; Jarupathirun and Zahedi, 2007; Sanders and Courtney, 1985). All measurement items were modified to fit the context of management information system (MIS). The two identification Phase variables (i.e., problem definition and problem identification) were taken from Oh, C. (1998) and Leidner & Elam (1994). The development phase variable (i.e., decision making analysis) is adapted from Leidner & Elam (1994). The selection phase variables (i.e., decision quality, speed of decision making) were adapted from Jarupathirun and Zahedi, (2007) and Leidner & Elam (1994). The two moderating variables (i.e. information access and information quality) and MIS variable were adapted from Mead and Kannett (2007) and Zain et al. (2005) respectively. Consequently, our model takes the following form as in figure 1.

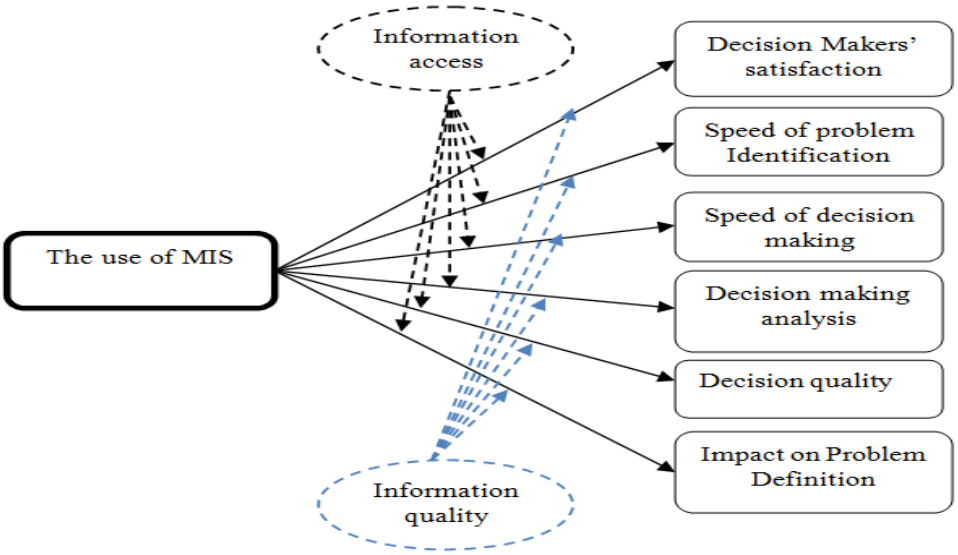

Figure1 Research Model

2.3 Research Hypothesis

Based on the above model, the following hypotheses are made:

H_1: The use of MIS positively influences decision makers' satisfaction, **H_2**: The use of MIS positively influences the speed of problem identification in the decision support process, **H_3**: The use of MIS positively influences the speed of decision making in the decision support process, **H_4**: The use of MIS positively influences decision making analysis in the decision support process, **H_5**: The use of MIS positively influences decision quality in the decision support process, **H_6**: The use of MIS positively influences impact on problem definition in the decision support process.

H7a: Information access quality has a moderating effect on the relationship between MIS use and decision makers' satisfaction, **H7b:** Information access quality has a moderating effect on the relationship between MIS use and the speed of problem identification in the decision support process, **H7c:** Information access quality has a moderating effect on the relationship between MIS use and the speed of decision making in the decision support process, **H7d:** Information access quality has a moderating effect on the relationship between MIS use and decision making analysis in the decision support process, **H7e:** Information access quality has a moderating effect on the relationship between MIS use and decision quality in the decision support process.

H7f: Information access quality has a moderating effect on the relationship between MIS use and impact on problem definition in the decision support process. **H8a:** Information content quality has a moderating effect on the relationship between MIS use and decision makers' satisfaction, **H8b:** Information content quality has a moderating effect on the relationship between MIS use and the speed of problem identification in the decision support process.

H8c: Information content quality has a moderating effect on the relationship between MIS use and the speed of decision making in the decision support process, **H8d:** Information content quality has a moderating effect on the relationship between MIS use and decision making analysis in the decision support process, **H8e:** Information content quality has a moderating effect on the relationship between MIS use and decision quality in the decision support process, **H8f**: Information content quality has a moderating effect on the relationship between MIS use and impact on problem definition in the decision support process.

3. Methodology

3.1 Instrument for data collection

This particular survey used closed-ended questions and a 5 point likert-scale ranging from strongly agrees to strongly disagree. The questionnaire first displayed multiple choice questions and allowed us to estimate the percentage of people who responded to the questionnaire in a unique way. We then used matrix questions for rating or ranking answer choices which included a weighted average so we could see which answer is picked most often. The questionnaire which was constructed to determine the employees' usage of the management information system of employees in mining companies in Sierra Leone was divided into two sections. The goal of the questionnaire survey was to test the use of management information systems (MIS) by employees in mining companies in Sierra Leone. It also attempted to capture an overview of the current level of management information systems in the overall industry in Sierra Leone, but to those companies using the management information system.

3.2 Data Collection

Data were collected through online survey approach. The reasons for choosing the online survey approach are as follows. First, this study investigates unique population of the employees with online application experiences from different mining companies (Sierra Rutile Limited., Shandong Iron & Steel Group Ltd., Cape Lambert Ltd., and Koidu Holdings Ltd.). An online approach was considered more effective to capture the validated respondents to meet the requirements of this research. Second, the online approach is an autonomous way for respondents to finish the survey at their convenience. This consequently increased active participation. Third, as quoted by many studies, online approaches can execute the survey faster and cheaper. Lastly, previous studies have also showed that online surveys have comparable response quality with offline surveys (Dickinger and Kleijnen, 2008).
To avoid repeat responses, respondents could only submit data once. The data collection stage lasted for three weeks (from June 20, 2017 to July 11, 2017). We had a total of 233 valid responses for all items in the constructs. Among the participants, 33.9 percent were female and 66.1 percent were male; 41.6 percent were bachelors' degree holders while 37.3, 5.6, and 15.5 percent were masters, doctorate and other degree holders respectively. A detailed display of demographic characteristics is shown in Table 1. The survey was conducted in large mining companies since it was important that these companies have a large and adequate developed IT and IS sector, to ensure reliability and authenticity of the obtained statistical results.

Table 1 Demographic characteristics of the research sample

Indicator	Designation	Frequency	(%)
Age	20-29	39	16.8
	30-39	94	40.3
	40-49	73	31.3
	≥ 50	27	11.6
Gender	Male	154	66.1
	Female	79	33.9
Education	Bachelor degree	97	41.6
	Masters degree	87	37.3
	Doctorate degree	13	5.6
	Others	36	15.5

4 Data Analysis and Results

The statistical package for social sciences (SPSS version 24) and excel were used to carry out the analysis to achieve the objectives of this research. The questionnaires were edited, coded and entered into the software where sample adequacy test, reliability test, factor analysis, correlation analysis and multiple regressions were carried out to establish relationships among variables.

4.1 Model Measurement

All the variables of the research model were measured with scales that were adapted from prior studies. A total of nine variables of the research model were measured. All the utilized scales exhibited sufficient level of validity and reliability. Principal component analysis (PCA) was performed to check the validity and reliability. In summary, the Kaiser- Mayer-Olkin (KMO) Test, which measures sampling adequacy, was done for each variable and the results showed acceptability. The average variance extracted (AVE) was also computed. In particular, the results of these statistical analyses showed that: (1) all the study variables exceeded the minimum standard of the KMO value of 0.5 and were significant in Bartlett's test of sphericity; (2) the items for each of the study variable exceeded factor loadings of 0.50 (as specified by Hair et al., 1998); (3) the AVE of each construct exceeded 0.5; and (4) all the Cronbach's α values were higher than 0.7, which indicates high reliability of the scales (Liu, 2015). The statistical results confirmed the measurement scale of this research met the acceptable standard of sample adequacy, reliability and validity analyses as shown in Table 2.

Table 2 Results of standardized item loading Cronbach's Alpha, KMO and AVE

Construct	Item	Loading	Cronbach's Alpha	KMO	Average Variance extracted
Enterprise Management Information System	MIS1	.835	.842	.725	.735
	MIS2	.954			
	MIS3	.833			
Decision Maker's Satisfaction	DMS1	.695	.905	.766	.595
	DMS2	.773			
	DMS3	.630			
	DMS4	.981			
	DMS5	.902			
	DMS6	.888			
	DMS7	.853			
	DMS8	.792			
	DMS9	.731			
	DMS10	.842			
	DMS11	.926			
	DMS12	.632			
	DMS13	.872			
Speed of Problem Identification	SPI1	.673	.763	.591	.634
	SPI2	.882			
Speed of Decision Making	SDM1	.901	.822	.680	.666
	SDM2	.738			
Decision Making Analysis	DMA1	.830	.863	.824	.724
	DMA2	.836			
	DMA3	.706			
Decision Quality	DQ1	.839	.725	.724	.607
	DQ2	.900			
	DQ3	.866			
	DQ5	.725	.915	.702	.823
Impact on Problem Definition	IPD1	.634			
	IPD2	.773			
	IPD3	.937			
	IPD4	.803			
	IPD5	.707			
Information Access	IA1	.843	.882	.526	.624
	IA2	.837			
	IA3	.634			
Information Quality	IQ1	.911	835	.679	.606
	IQ2	.737			
	IQ3	.708			

4.2 Hypothesis Testing

4.2.1 Correlation Result

Table 3 below illustrates the results of descriptive statistics and Pearson correlation analysis for the study variables. The table shows that the mean values for the variables are from 3.03 to 4.30, suggesting that the levels of MIS use, impact on problem definition, speed of problem identification, decision quality, speed of decision making, as well as the levels of decision making analysis and decision makers satisfaction are ranging between these values. The correlation coefficients for the relationship between the dependent variable (i.e., the use of MIS) and the predictors were less than 0.90, which signifies that the data was not affected by any severe problem of collinearity (Hair et al., 2005). Participants in the research reported a mean level of MIS use of 4.21. Bivariate correlations of five predictor variables with the use of management information system were statistically significant and in the hypothesized direction. As illustrated in table 3, decision makers satisfaction was positively related to the use of management information system and highly statistically significant (r = .734, p < .01). Thus, the first hypothesis (Hypothesis 1) was supported by the research. Similarly, the speed of problem identification in the decision support process by the employees in the selected mining companies was also positively correlated to the use of management information system with a statistically significant value (r = .485, p < .05). Consequently, the second hypothesis was also supported by the research. However, the third, hypothesis was not supported as the correlation coefficient between the speed of decision making and the use of management information system was negative and statistically insignificant (r = -.364, p > .05). Further in this paper, reasons why are suggested.

Furthermore, decision making analysis, decision quality and problem definition in the decision support process by the employees in the selected mining companies were also positively correlated to the use of management information system with statistically significant values of (r = .559, p < .05), (r = .548, p < .01) and (r = .432, p < .01) respectively. Consequently, the fourth, fifth and sixth hypotheses were also supported by the research.

Table 3 Descriptive statistics and correlation results for the study variables

	Variable	Mean	SD	Pearson correlation analysis						
				1	2	3	4	5	6	7
	1 MIS	4.21	0.12	1						
Model1	2 DMS	4.11	0.17	.734**	1					
Model2	3 SPI	3.94	0.19	.485*	.432*	1				
Model3	4 SDM	3.03	0.11	-.364	.058	.101	1			
Model4	5 DMA	4.30	0.18	.559*	.311	-.052	.113	1		
Model5	6 DQ	3.72	0.15	.548**	.204**	-.410*	.215*	.196	1	
Model6	7 IPD	3.43	0.18	.432**	.241**	.203	.184	.231	.107	1

Note: N = 233, Significant level: *p < .05, two-tailed, p <0.01** (2-tailed). Source: Authors computation from SPSS

4.2.2 Regression Results

In a bid to test for the moderating effect of information access, a regression model was assessed using the variance explained (R^2 measures) and the level of significance of the beta coefficients. Table 4 shows the model results. The results indicate that the moderating effect of information access (IA) on the relationship between DMS and MIS use (β=.065, p<0.05) and SPI and MIS use (β=.017, p<0.01) are statistically significant. Thus, hypotheses *H7a* and *H7b* are supported. The R^2 of dependent variables indicate that the model explains 17.63% of the variance in DMS and 17.69% of the variance in SPI. The beta coefficients for SDM (β= .003, p<0.01), DMA (β=.094, p<0.01), and DQ (β=.151, p<0.05) when moderated by information access are statistically significant. This confirms hypotheses *H7c*, *H7d*, and *H7e*. The model explains 17.76% of the variance in decision making analysis, 18.16% of the variance in decision quality, and18.80% of the variance in SDM. With regard to IPD with the use of MIS in decision support when moderated by information access, the beta coefficient (β=.043, p>0.05) is insignificant. Thus, hypothesis *H7f* is rejected.

Table 4 Moderating effect of information access

Independent Variables	Dependent Variable (MIS)						
	Model 7	*Model 7a*	*Model 7b*	*Model 7c*	*Model 7d*	*Model 7e*	*Model 7f*
DMS	.573**	.200*	.170*	.358**	.354*	.653**	.315
SPI	.328*	-.545**	.192	-.274	-.295	.351*	-.371*
SDM	.213*	.217*	.203	.425*	.037**	.103**	.061
DMA	.230**	.190	.291**	.069	.067*	.097	.425**
DQ	.389*	-.498*	.333**	.102*	.450*	.026*	.070
IPD	.095*	.201*	-.345**	.099*	.935**	-.307	.102*
(DMS*IA)		.065*					
(SPI*IA)			.017**				
(SDM*IA)				.003**			
(DMA*IA)					.094**		
(DQ*IA)						.151*	
(IPD*IA)							.043
F	10.07**	17.63**	17.69**	17.76**	18.16**	18.80**	14.15**
R^2	.322	.466	.419	.429	.312	.409	.329
Adj. R^2	.301	.442	.380	.396	.282	.373	.301

Note: N = 233, Significance at *p < .05, two-tailed. **p < 0.01, two-tailed; Source: Authors computation from SPSS

Similarly, in assessing the moderating role of information quality, a regression model was also done (table 5) using the variance explained (R^2 measures) and the level of significance of the beta coefficients. Table 5 shows the model results. The results indicate that the moderating effect of information quality (IQ) on the relationship between DMS and MIS use (β = .513, p<0.01) and SPI and MIS use (β=.481, p<0.01) are statistically significant. Thus, hypotheses *H8a* and *H8b* are supported. The R^2 of dependent variables indicate that the model explains 39.5% of the variance in DMS and 42.2% of the variance in SPI. The beta coefficients for SDM (β= .270, p<0.05), DQ (β=.411, p<0.01), and IPD (β=.518, p<0.01) when moderated by information quality are statistically significant. This confirms hypotheses *H8c*, *H8e*, and *H8f*. The model explains 42.9% of the variance in decision making analysis, 40.2% of the variance in decision quality, and 36.3% of the variance in IPD. With regard to DMA with the use of MIS in decision support when moderated by information quality, the beta coefficient (β=.020, p>0.015) is insignificant. Thus, hypothesis *H8d* is rejected.

Table 5 Moderating effect of information quality

Independent Variables	Dependent Variable (MIS)						
	Model 8	*Model 8a*	*Model 8b*	*Model 8c*	*Model 8d*	*Model 8e*	*Model 8f*
DMS	.573**	.434**	.647**	.519*	.434**	.647**	.326*
SPI	.328*	.069	.664*	.507*	.125	.664**	-.373**
SDM	.213*	.148	-.279**	.378**	.102	.276*	.064
DMA	.230**	.097	-.171*	.257	.097	-.296*	.351*
DQ	.389*	.216	.052	-.373*	.216*	.052	-.297
IPD	.095*	-.473**	.073	.063	.405**	.088	.053*
(DSM*IQ)		.513**					
(SPI*IQ)			.481**				
(SDM*IQ)				.270*			
(DMA*IQ)					.020		
(DQ*IQ)						.411**	
(IPD*IQ)							.518**
F	10.07**	19.63	14.71	17.65	14.55	12.43	14.97
R^2	.322	.395	.422	.429	.453	.402	.363
Adj. R^2	.301	.334	.351	.370	.355	.350	.332

Note: N = 233, Significance at *p < .05, two-tailed. **p < 0.01, two-tailed; Source: Authors computation from SPSS

5 Discussion and Implications

The study is an attempt to examine whether the use of management information system leads to certain decision-support capabilities among mining companies in Sierra Leone and in the process explores the moderating role of information access and information quality. In achieving that, we make use of the chronological framework of Mintzberg et. al. (1997), as it is widely accepted, and has established much empirical support (Mazzolini R., 1981; Shrivastava P., Grant J.H., 1985) and is in conformity with the procedures in Simon's rational decision making (Simon H.A., 1976). The model of Mintzberg et al. identifies the DS phases and activities for which the use of MIS would seem appropriate. Following a line of investigation on the empirical data, the following findings are purported: firstly, unlike for the speed of decision making, the use of management information system has a positive and statistically significant relationship with decision support capabilities. This finding is in line with theories and also in conformity with previous empirical studies (see for e.g. Alalwan, 2014; Ghazi, 2015) who found that decision support capabilities increases the use of management information system. Secondly, the moderating role of information access had shown a weaker positive contribution to the use of management information system in the sample mining companies in Sierra Leone as reported in table 4. This can be attributed to the fact that information access to complement decision support capabilities is not sufficiently available to the mining companies. On the other hand, the moderating role of information quality had shown a stronger positive contribution to the use of management information system in the sample mining companies in Sierra Leone as shown in table 5. This result confirms that information quality plays an important role as a moderating variable in the management information models of the mining company sample. Thus the findings draw attention to the relevance of information quality in the absence of decision support capabilities. An important policy implication immerging from this study is that business administrators should not underestimate the power of information quality in influencing the use of MIS in an organization.

6 Concluding Remarks

The study has examined how management information system influences decision support capabilities. Additionally, it examined how information access and information quality moderate the impact on these capabilities. The research contributes to empirically based knowledge concerning management information systems in large companies. However, this paper has some limitations as in every study. First and foremost, the research made up of 233 employees working at mining companies in Sierra Leone, the sample might not be adequate for generalization. Secondly, the use of management information system perceptions of the employees is sensitive to location. That means, surveys with the same sample in different locations may result in different outcomes. It is suggested that further researchers take the current constraints into consideration and use different measurement scales to measure the connection between MIS use and decision support capabilities.

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