THE USAGE OF DECISION SUPPORT SYSTEMS FOR IMPROVING MANAGERIAL DECISION MAKING PROCESS

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Abstract

The ten main managerial roles are classified into three categories and one of them is decision making. Managers need timely information to perform their roles in this category. However, managerial decision-making is synonymous with the whole managerial process. The environment in which managers operate today is much more complex, and the trends themselves lead to increasing complexity. Due to a number of factors, such as new technologies, global markets, competition and political stability, managers are increasingly faced with the choice of multiple alternatives, with higher costs due to mistakes made and greater uncertainty about the future. As a result of these changes in the environment, managers need to learn how to use the new tools and techniques developed to support their decision making.

Individual, group, and organizational success is particularly important, so information systems research is moving toward finding ways to improve support for the decision-making process. Therefore, different information systems are designed, developed and implemented to provide the needed support. This paper focuses on a specific research done on the territory of the Republic of North Macedonia to determine the impact that systems have in their company. The survey involved 52 managers from different levels of decision making, from medium to large companies in the Republic of North Macedonia, and the purpose of this research is from obtained results to identify the impact of the decision support systems (DSS) on the degree of managerial satisfaction and the impact of these systems on company productivity.

Key words: decision support systems (DSS), managerial decision making, productivity, managerial satisfaction.

Introduction

Managerial functions play a major role in the level of productivity of the company, so executing the various managerial functions involves a continuous decision-making process, and all managerial activities are reduced to decision making. To make decisions, managers need information that is mainly obtained through the company network and company information systems. Companies understand that in order to be able to "survive" and thrive in a global and competitive world, they must effectively manage and use their information resources. Today, information is the bloodstream of the companies and successful companies need to collect quality data that will further lead to quality information and effective managerial decision making (Wang, Hassan, 2015: 27). Decision support systems incorporate technology that enables them to acquire the necessary knowledge and thereby help managers to be more productive and innovative.

In order to improve the process of managerial decision making, the companies need to integrate decision support systems and, through their application, enhance the decision maker's ability to process knowledge, stimulate managers to new approaches of problem thinking, and reduce the time and costs of decision making, as well as to increase manager satisfaction in the decision making process.

Benefits from DSS Usage in the companies

According to Hung (2005), the success of DSS usage is generally measured by the efficiency and effectiveness of the system. Effectiveness is measured by the outcome of the decision, the quality and precision of the decision, and user satisfaction, while effectiveness is more oriented to the decision- making process and is measured by the amount of time needed to make a decision or by number of alternatives that could be considered.

In addition to the benefits of DSS usage, several researchers have also examined the user satisfaction with DSS usage (Adams, Nelson, Todd, 1992; Newman, Robey, 1992; McKeenGuimares, 1994). Their research boils down to the fact that users satisfaction with DSS usage exists when the level of user participation is high, furthermore, when users receive top management support for DSS usage, when appropriate training is provided prior to system implementation, also when end-users are involved in the system development and when users face unstructured problems that require greater effort.

The main benefit of using decision support systems is that it increases efficiency and reduces the possibility of human error in the decision making

process. Once decisions are implemented, they have the effect of reducing costs, using funds more efficiently, improving customer service, and reducing risks and so on. In fact, the purpose of using DSS is to enable a better decision-making process. An improved decision-making process can be viewed from different angles and may be the result of the same decision, but that decision was made more quickly or with less cost or with better documentation.

Hypothetical research framework

The general hypothesis in this study is: *The usage of decision support systems has a positive impact on the managerial decision making process and the productivity of the company*. The research is based on the assumption that decision support systems influence the managerial decision making process, as well as the satisfaction of the managers, from the point of view that the system contributes to the reduction of time and cost of the decision making. Testing the general hypothesis in this study included variables that were confirmed that have an impact on the managers' satisfaction and productivity of the company.

The first particular hypothesis is: *The usage of the decision support systems has an impact on the degree of managers satisfaction*. In order to determine the impact of decision support systems on managers satisfaction level, a correlation analysis of factors that influence managers satisfaction is made. The correlation coefficient is used to determine the dependence between the variables. The correlation describes the strength of the relationship of at least two variables, and for the purpose of the research the correlation analysis is presented by Pearson coefficient. First, a correlation analysis of the usage of the decision support systems to companies with managers involvement in the system development phase has been made, as more researchers have examined users satisfaction with the use of DSS and their research findings indicate that users satisfaction with the application of the system is greater when they are involved in the system development (Adams, Nelson, 1992; Newman and Robey, 1992; McKeen Guimares, 1994).

Correlations

		The company uses decision support systems	Managers were involved in the development phase of the decision support system
The company uses decision support systems	Pearson Correlation	1	,824**
	Sig. (2-tailed)		,000
	N	52	52
Managers were involved in the development phase of the decision support system	Pearson Correlation	,824**	1
	Sig. (2-tailed)	,000	
	N	52	52

**. Correlation is significant at the 0.01 level (2-tailed).

Table 1. Correlation analysis of DSS usage with managers involvement in the system development

The results obtained in the correlation analysis shown in Table 1. show that the analysis covers the responses of all 52 managers, and then excludes all responses with missed data that is of particular importance for both variables, so in this case are excludes those responses that indicate that managers do not use decision support systems. According to Cohen (1988: 79-81), the strength directions of correlation areas follows: small wherer=0.10-0.29,mediumwherer=0.30-0.49,largewherer= 0.50 - 1.0. According to the analysis, i.e. according to the Pearson coefficient, which is equal to 0.824, there is a great positive correlation between the usage of DSS and the involvement of managers in the system development phase, as a factor that increases the manager's satisfaction with the application of the system. Furthermore, the coefficient of determination indicates how much of the variability of the dependent variable is explained by the independent variable. In this correlation, the coefficient of determination is 0.678, i.e. 67.8% of the variability of managers satisfaction as a variable in this research is explained by usage of DSS as another variable in this research. This data shows that the use of decision support systems explains 67.8% of managers satisfaction, assuming that managers involvement in system development contributes to increasing managers

satisfaction. The statistical significance of the relationship between variables is determined by Sig, which in this case is .000, which is less than 0.01, i.. p <0.01, making the relationship between variables statistically significant. Since there is a link between the application of decision support systems and managers involvement in the system development as a factor to increase managers satisfaction, this variable is included in the testing of the general hypothesis.

The way DSS is used, or how easy is the system to use, has been taken into account as a second factor affecting managers satisfaction. In the following is a summary of the results of the correlation analysis between managers usage of the decision support system and their answers on whether the system is easy to use.

Correlations

		The company uses decision support systems	The decision support system is easy to use
The company uses decision support systems	Pearson Correlation	1	,890**
	Sig. (2-tailed)		,000
	N	52	52
The decision support system is easy to use	Pearson Correlation	,890**	1
	Sig. (2-tailed)	,000	
	N	52	52

**. Correlation is significant at the 0.01 level (2-tailed).

Table 2. Correlation analysis between DSS usage and whether the system is easy to use

According to the analysis presented in Table 2, i.e. according to the Pearson coefficient, which is equal to 0.890, there is a great positive correlation between the usage of DSS and whether the system is easy to use, as a factor that increases the manager's satisfaction with the usage of the system. Furthermore, the coefficient of determination indicates how much of the variance of the dependent variable is explained by the independent

variable. In this correlation, the coefficient of determination is 0.792, ie 79.2% of the variability of one variable is explained by the other variable. This data shows that the usage of decision support systems explains 79.2% of managers satisfaction, assuming that if it is easy to use, the system also contributes to increasing managers satisfaction. The statistical significance of the relationship between variables is determined by Sig, which in this case is.000, which is less than 0.01, i.e. $p < 0.01$, making the relationship between variables statistically significant. Since there is a relationship between the usage of DSS and whether the system is easy to use, as a factor in increasing managers satisfaction, this variable is included in the testing of the general hypothesis.

The focus of DSS is on effective decision making when a company faces semi-structured or unstructured business problems, and in this respect it is necessary for the system to be designed and developed according to the needs of the managers in order to help the companies achieve their goals. From this point of view, the adjustment of DSS to the needs of the company is taken as a factor contributing to the increase in managers satisfaction. In the following is a correlation analysis between the usage of DSS as a dependent variable and the adjustment of DSS to the needs of the company as an independent variable.

Correlations

		The company uses decision support systems	The decision support system is adjusted to the needs of the company
The company uses decision support systems	Pearson Correlation	1	,962**
	Sig. (2-tailed)		,000
	N	52	52
The decision support system is adjusted to the needs of the company	Pearson Correlation	,962**	1
	Sig. (2-tailed)	,000	
	N	52	52

**. Correlation is significant at the 0.01 level (2-tailed).

Table 3. Correlation analysis between DSS usage and system adaptation to the company needs

According to the analysis presented in Table 3, i.e. according to the Pearson coefficient, which equals 0.962, there is a great positive correlation between the usage of DSS and the adaptation of the system to the needs of the company, as a factor that increases the manager's satisfaction with the application of the system. In this correlation, the coefficient of determination is 0.925, ie 92.5% of the variability of one variable is explained by the other variable. This data shows that the usage of decision support systems explains 92.5% of managers satisfaction, assuming that if adopted to the company's needs the system also contributes to enhancing managers satisfaction. The statistical significance of the relationship between variables is determined by Sig, which in this case is .000, and is less than 0.01,
i.e. p <0.01, making the relationship between variables statistically significant. Since there is a link between the usage of DSS and the adaptation of the system to the needs of the company, as a factor in increasing the satisfaction of managers, this variable is included in the testing of the general hypothesis.

The fourth factor that is thought to contribute to increasing managers satisfaction is that the application of the system improves the communication and leadership direction of the managers. In order to determine the relationship between DSS usage and the improved communication and leadership guidance of managers, a correlation analysis is also performed, and DSS usage is presented as a dependent variable.

Correlations

		The company uses decision support systems	Communication and leadership guidance are enhanced by the implementation of the decision support system
The company uses decision support systems	Pearson Correlation	1	1,000**
	Sig. (2-tailed)		,000
	N	52	52
Communication and leadership guidance	Pearson Correlation	1,000**	1
	Sig. (2-tailed)	,000	

are enhanced by the implementation of the decision support system	N	52	52

**. Correlation is significant at the 0.01 level (2-tailed).

Table 4. Correlation analysis between DSS usage and communication improvement and managers leadership

According to the results shown in Table 4, the analysis covers the responses of all 52 managers, then excludes all responses in which missed data that is of particular importance for both variables, and in this case those answers which are excluded shows that managers do not apply decision support systems. The Pearson coefficient, which is 1 in this case, indicates that there is a complete and positive correlation between DSS usage and improved communication and leadership guidance for managers. In this correlation, the coefficient of determination is 1, i.e. 100% of the variability of one variable is explained by the other variable. This data shows that the application of decision support systems explains 100% of managers satisfaction, assuming that if the system is implemented in the company, it will also contribute to enhancing managers' satisfaction in terms of improving communication and leadership. The statistical significance of the relationship between variables is determined by Sig, which in this case is .000, which is less than 0.01, i.e. p <0.01, making the relationship between variables statistically significant. As there is a link between DSS usage and improved communication and leadership guidance as a factor in enhancing managers' satisfaction, this variable is included in testing the general hypothesis.

The last factor taken into account in determining the impact of DSS on managerial satisfaction is whether DSS provides certainty in the decision-making process and the outcome of the process itself. One of the benefits of using DSS is that it helps users make better decisions. Successful implementation of the decision support system fundamentally improves the quality of the decision making process, which further results in better decision making.

Correlations

		The Company use DSS systems	DSS provides certainty in the decision-making process and the outcome of the process itself
The Company use DSS systems	Pearson Correlation	1	,571[**]
	Sig. (2-tailed)		,000
	N	52	52
DSS provides certainty in the decision-making process and the outcome of the process itself	Pearson Correlation	,571[**]	1
	Sig. (2-tailed)	,000	
	N	52	52

**. Correlation is significant at the 0.01 level (2-tailed).

Table 5. Correlation analysis between DSS usage and certainty in the decision-making process and the process outcome itself

According to the analysis presented in Table 5, i.e. according to the Pearson coefficient, which is equal to 0.571, there is a great positive correlation between the usage of DSS and that the system provides confidence in the decision-making process and the outcome of the process itself, which further contribute to increasing manager satisfaction with the application of the system. In this correlation, the coefficient of determination is 0.326, i.e. 32.6% of the variability of one variable is explained by the other variable. This data shows that the use of decision support systems explains 32.6% of managers satisfaction, assuming that if the system provides certainty in the decision making process and the outcome of the process itself, it will also contribute to enhancing managers satisfaction. The statistical significance of the relationship between variables is determined by Sig, which in this case is .000, which is less than 0.01, i.e. $p < 0.01$, making the relationship between variables statistically significant. Given that there is a link between DSS usage and that the system provides certainty in the decision-making process and the outcome of the process itself, as a factor in enhancing managers

satisfaction, this variable is included in the testing of the general hypothesis. From the five correlation analyzes of the factors that influence the degree of satisfaction of managers, it can be concluded that decision support systems influence the degree of satisfaction of the manager, and therefore, the first particular hypothesis is accepted, i.e. *the application of the decision support systems have an impact on the degree of satisfaction of the managers.*

The second particular hypothesis is: *The application of decision support systems increases the productivity of the company*. Productivity involves two common dimensions as effectiveness and efficiency. Effective performance refers to measuring the performance of tasks or the achievement of goals through outputs, whereby productivity refers to meeting consumer demands, and efficient performance refers to measuring the cost of resources associated with achieving the objectives company. Any inefficient operation entails costs that reduce productivity. The following questions from the survey questionnaire were considered as independent variables for further analysis: - Does the decision support system contribute to the efficient allocation of resources in your company? - Does the decision support system contribute to meeting the demands of your customers? - Does the decision support system reduce the time for decision making? - Does the decision support system reduce costs? Using the simple linear regression statistical method it is necessary to determine the interrelationship between the application of decision support systems and the efficient allocation of resources in the company, ie to determine how the application of decision support systems in the company can predict the effective company resource allocation. The concept in the linear regression model is that if the random variable X has a certain value, a response to the random variable Y. is also expected. This means that the value it has X affects the value of Y. , or dependent or endogenous variables Y have values that depend on independent or exogenous variables X whose values are determined or influenced by external factors. The model evaluation is presented in Table 6. The correlation coefficient R is 0.925 and shows a high degree of correlation between the variables. In this linear regression model, the coefficient of determination shows how efficient the allocation of resources in the company is explained by the application of DSS in the company. According to the summary, the model explains 85.6% of the DSS contribution to the efficient allocation of resources in the company, while the Adjusted R Sguare coefficient of determination is 0.853 which explains the 85.3% of the DSS contribution to the efficient allocation of the company resources.

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,925[a]	,856	,853	,193

Table 6. Summary for Model 1

The ANOVA test, tests the statistical significance of the relationship between the variables, so according to the ANOVA test shown in Table 7, the statistical significance is p = 0.000 or p <0.0005 from which it can be concluded that the regression model statistically predicts the dependent variable,
i.e. the decision support system contributes to the efficient allocation of resources.

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	11,056	1	11,056	296,154	,000[b]
	Residual	1,867	50	,037		
	Total	12,923	51			

Table 7. ANOVA test for Model 1

Since the application of the system contributes to the efficient allocation of resources, this variable is tested in the general hypothesis.

Meeting the consumer demands and the usage of DSS in the company as a dependent and independent
variable represent the second linear regression model in this study. The model evaluation is presented in Table 8. The correlation coefficient R is 0.793 and shows a high degree of correlation between the usage of DSS in the company and the fulfillment of the consumer requirements. The coefficient of determination (R 2) shows how much of the dispersion of the dependent variable is explained by this model, and in this linear regression model, the coefficient of determination shows how much the fulfillment of consumer demands is explained by using DSS. According to the summary, the model explains 62.9% of the fulfillment of the consumer demands. The corrected coefficient of determination, according to Tabachnick and Fidell

(2007), is considered to give a better estimation of the actual coefficient of determination, due to the overly optimistic estimation of the coefficient of determination. In this case, the value of the Adjusted R Square correction coefficient is 0.621, i.e. 62.1% of the fulfillment of the consumer demands is explained by the model.

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,793[a]	,629	,621	,310

Table 8. Summary for Model 2

In Table 9 is shown ANOVA Test for Model 2, which shows the coefficient values for the independent variable, it is necessary to look at the value in column Sig. The value of Sig for Model 2 is 0,000 or $p = 0,000$, and since $p < 0.05$ it can be concluded that the regression model statistically significantly predicts the DSS contribution in the company to meet consumer demands, i.e. the DSS in the company contributes to the fulfillment to the consumers demands.

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	8,123	1	8,123	84,615	,000[b]
	Residual	4,800	50	,096		
	Total	12,923	51			

Table 9. ANOVA test for Model 2

Since the application of the system contributes to meeting consumer demands, this variable is tested in the general hypothesis.
Reducing the time for decision making and the usage of DSS in the company as a dependent and independent variable represent the third linear regression model in this study. The model evaluation is presented in Table 10. The correlation coefficient R is 0.890 and shows a high degree of correlation between the variables, while the coefficient of determination (R^2) indicates how much of the dispersion of the dependent variable is explained by this

model. In this linear model of linear regression, the coefficient of determination shows how the reduction of decision time is explained by the application of DSS. According to the summary, the model explains 79.2% of the reduction in decision time. In this case, the value of the Adjusted R Square correction coefficient is 0.788, ie the model explains 78.8% of the reduction in decision time.

Model Summary[b]

Mo del	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,890[a]	,79 2	,78 8	,23 2

Table 10. Summary for Model 3

In Table 11 is shown ANOVA test for Model 3 which shows statistical significance of this data in Model 3, and according to the ANOVA test, the statistical significance is $p = 0.000$ or $p < 0.0005$, from which it can be concluded that the regression model predicts statistically significant dependence variable.

ANOVA[a]

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	10,281	1	10,281	190,385	,000[b]
Residual	2,700	50	,054		
Total	12,981	51			

Table 11. ANOVA test for Model 3

Since the application of the system contributes to the reduction of decision-making time in the managerial decision-making process, this variable is taken into account when the general hypothesis is tested.

Cost reduction and DSS usage in the company as a dependent and independent variable represent the fourth linear-regression model in this study. The model evaluation is presented in Table 12. The correlation coefficient R, which in this model is 0.793, shows the correlation between the variables and shows a high degree of correlation, while the coefficient of determination (R 2) shows how much of the dispersion of the dependent variable is explained by this model. In this linear model of linear regression,

the coefficient of determination shows how much the cost reduction is explained by applying DSS. According to the summary, the model explains 62.9% of the company's cost savings.

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,793[a]	,629	,621	,310

Table 12. Summary for Model 4

The ANOVA test, tests the statistical significance of this data in Model 4, and according to the ANOVA test shown in Table 13, the statistical significance is $p = 0.000$ or $p < 0.0005$, from which it can be concluded that the regression model predicts statistically significant dependence variable or DSS in the company contributes to reducing the costs in the company.

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	8,123	1	8,123	84,615	,000[b]
	Residual	4,800	50	,096		
	Total	12,923	51			

Table 13 ANOVA test for Model 4

From the four linear regression models made for the factors that affecting company productivity and the usage of decision support systems, it can be concluded that decision support systems have impact on company productivity, so the second particularly hypothesis is accepted, that is, *the application of decision support systems has an impact on the productivity of the company.*

For testing the general hypothesis only the sample of companies that using DSS is tested, and the technique used is the nonparametric χ^2 test, in which the categorical variables are compared with hypothetical values. The

hypothetical values for each variable are as follows: - 60% of the respondents in the sample are affected by the system application - 40% of the respondents in the sample have no influence on the system use, and the impact is considered for each variable separately depending on which variable the test is applied.

Test Statistics

	Managers were involved in the development phase of the decision support system	The decision support system is adjusted to the needs of the company	The decision support system is easy to use	The decision support system contributes to the efficient allocation of resources	The decision support system contributes to meeting consumer demands	The decision support system provides security in the decision-making process	DSS reduces costs	The DSS reduces decision time
Chi-Square	$6,806^a$	$16,806^a$	$11,250^a$	$13,889^a$	$5,000^a$	$,556^a$	$5,000^a$	$11,250^a$
df	1	1	1	1	1	1	1	1
Asymp. Sig.	,009	,000	,001	,000	,025	,456	,025	,001

a. 0 cells (0,0%) have expected frequencies less than 5. The minimum expected cell frequency is 12,0.

Table 14. χ^2 test for testing the general hypothesis

The test results are presented in Table 14, which shows the statistical significance of the values compared with the expected ones. The statistical significance of the first variable, whether management was involved in the system development phase and refers to the increase in manager satisfaction is equal to 0.009 or p = 0.009, and for the result to be significant p must be

equal to or less from 0.05. Therefore we can conclude that the test is significant, i.e. there is a difference between the managers who were involved in the system development phase and those who were not involved in the system development phase. The second variable test of whether the system is adopted to the needs of the company also shows statistical significance or $p = 0.000$ and according to the result the difference between the companies in which the system is adopted to their needs and those that are not adopted is statistically significant and quite significant differs from expected value. The test for the third variable which is related to the increase in managers' satisfaction regarding whether the system is easy to use shows a value equal to 0.001 and in this case $p < 0.05$ and shows a difference between the respondents who consider the system to be easy to use and those who find the system not easy to use and it is statistically significant. The test of company productivity represented by the variable of whether the system contributes to efficient resource allocation al so shows statistical significance atp

= 0.000 which is the difference between the respondents who believe that the system contributes to efficient allocation of resources in the company.

According to the results of the test, the general hypothesis in this study is accepted, given that the expectations for the number of respondents who believe that the decision support system has an impact on the factors contributing to the improvement of the decision making process, i.e. increase managers' satisfaction with the usage of the system, such as the involvement of the management in the system development phase, adjusting the system to the needs of the company and making the system easy to use, but is rejected variable that the system provides security in the decision making process, given that the test did not show statistical significance for this variable. Expectations are also met for the number of respondents who believe that the decision support system has an impact on factors affecting company productivity, including efficient allocation of company resources, meeting customer demands, reducing company costs and reducing the time it takes for managerial decisions to be made. According to these indicators, the general hypothesis is accepted, that is, _the usage of decision support systems has a positive impact on the managerial decision making process and the productivity of the company._

Conclusion

From the five correlation analyzes of the factors that influence the degree of satisfaction of managers, it can be concluded that decision support systems influence the degree of satisfaction of the manager, and therefore, the first particular hypothesis is accepted, i.e. the usage of the decision support systems have an impact on the degree of managers satisfaction. From the four linear regression models made for the factors that affecting company productivity and the usage of decision support systems, it can be concluded that decision support systems have impact on company productivity, so the second particularly hypothesis is accepted, that is, the application of decision support systems has an impact on the productivity of the company. According to the results of this research, it can be concluded that decision support systems have a positive impact on the degree of satisfaction of the managers as well as on the productivity of the company.

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