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ABSTRACT

Group Decision Support Systems (GDSS) is widely viewed as a cognitive platform for the decision makers. It facilitates the decision making process of strategic formula through the availability of group support and helps the decision makers reach the best decisions by virtue of an efficient environment considering the witnessed high uncertainties. This paper studies the impacts of GDSS on making decisions through the mechanisms on which the high-level managers by applying modern technique making the right group decisions based upon the accuracy and vitality of information. It takes into considerations the components of the system: hardware, software and people. Questionnaire is used as a major tool of data gathering with personal interviews and field observations accompanied. The objective sample is targeted at the leading managers in the Ministry of Science and Technology, Iraq. The statistic results find that GDSS helps in achieving group understanding, group consensus and group satisfaction of decision makers. Thus, it suggests that it is important and necessary to adopt GDSS techniques for the decision makers to economize the process of decision making, as well as to evaluate the strategic decision efficiency by using the GDSS approach.

Keywords: Group Decision Support Systems (GDSS), Group Decision Outcome (GDO)

1. Introduction

The development of modern information systems has contributed to supporting the process of administrative decision makings to achieve various organizational goals or objectives. Amongst them, group decision making (GDM) currently becomes one of most difficult ones, as many important political, economic, environmental, and organizational decisions are made by groups.

GDM is the process of achieving a judgment or a solution for a decision problem based on the input and feedback of multiple individuals. In general, a group satisfactory solution (final decision) is one that is most acceptable by the group of individuals as a whole. Since the
impact of the selection of the satisfactory solution affects organizational performance, it is crucial to make the group decision-making process as efficient and effective as possible (Ma et al., 2010).

Thus, the efforts of modern management in organizations tend to provide proper information systems with the capacity to receive information supplied by group members at their electronic meeting to support their decisions. And one commonly adopted system is the Group Decision Support Systems (GDSS), which provides the decision-making groups with wide needs of information gathering and selection among the alternatives to realize the group decision outcome (GDO) with group satisfaction.

The basic orientation of this study is to discover the impacts of group decision-support systems on group decision making within organizations from the three dimensions of GDO: group understanding, group consensus and group satisfaction.

2. Literature Review

2.1 Group Decision-Support Systems

Generally, group decision-support systems (GDSS) are computer-based systems that includes communication, computer using and decision support techniques that facilitate formulation and solve non- or less- structural problems for a group of individuals in the group meetings, thus to improve the group decision making and task performance (Rees and Koehler, 2000; Eom, 2001; Paul et al., 2004; Laudon and Laudon, 2006; Chen et al., 2007). Like any computer information system, GDSS basically consists of hardware, software and people (Human Skills). But as featured by interactive specialty under a collaborative environment, communication and networking technologies are added for group participation from different sites.

Hardware is all equipment and physical tools that are needed in the decision room to support the group cooperation, such as public screens, printers, audio, networking, and storage media, etc. (Laudon & Laudon, 2006). Software, known as "the heart of Group Decision Support Systems (GDSS)", presents many useful tools, including information on the programs tab, database packages and word processors and other applications that can be placed and used by members of the group (Stairs and Reynolds, 1999). People (Human Skills) are the workers who have the ability to adapt to business requirements in the systems (Staire and Reynolds, 2003). They may be decision-making participants and /or facilitator. A facilitator is a person who directs the group through the planning process (Chen, 1998), coordination of activities within the system, running hardware and software and display the information when you need it, which acts as a link between information technology and the members of the group.

The three components of GDSS above are interactive and integrated. The availability of useful information system is achieved only through the integration of these dimensions as each dimension affects the other Fig. 1. Therefore, there requires a balance among the dimensions to get a good level of information to support group decision-making, which is the elemental base of this study.
2.2 Group Decision Outcome

Since GDSS are commonly used to improve the process of group decision-making by removing common communication barriers, providing techniques for structuring decision analysis, and systematically directing the pattern, timing, or content of discussion (Dennis et al., 1990; Eom, 1990; Chen, 1998; Chun and Park, 1998; Leinwand, 1999; Eom, 2001; Duggan and Virtue, 2004; Laudon and Laudon, 2006; Luo et al., 2011), this study will measure the group decision making following the idea of Kwok et al. (2000) by classifying the group decision outcomes into: group understanding, group consensus and group satisfaction.

2.2.1 The Impact of GDSS on Supporting the Group Understanding

When a group is facing a decision situation, the process includes a choice made by group members from alternative proposals available to them. The final decision making demands an enhanced understanding of how these alternatives can be compared and evaluated. As members discuss the implications of each alternative, they attempt to influence one another, directly and indirectly, to accept or reject a given alternative. This influence may be affected by the identification and understanding of decision elements (e.g. objectives, conditions, and evaluation criteria) that characterize a decision situation (Carneiro, 2001).

DeSanctis and Gallepe (1987), Nunamaker (1991), Alavi (1994) as well as Kowk et al. (2000) suggest that GDSS enhances group processes by increasing group process gains and/or reducing group process losses. Their effects on group process gains/losses contribute to the two attributes of effective learning attributes (i.e., active engagement and cooperation) which can enhance group understanding about the task domain to the group decision making process. (Duggan & Virtue, 2004). It achieves this objective by providing the several assistances to groups (Nunamaker et al., 1997; Duggan & Virtue, 2004), such as process
support to provide assistance with parallel processing of information, group memory, and anonymity; process structure to focus on the rules and protocols that direct the pattern of activities and the meeting strategy; task support to relate to the information infrastructure such as external databases, spreadsheets, and access to information from previous meetings as well as organizational memory that supports the accomplishment of the task; and task structure to refer to available techniques and models for assimilating task-related information and supporting task analysis.

Thus, a GDSS-supported meeting helps the decision makers better understand the task-related decision information by structuring the task. Integrated with the structured decision making process, the GDSS enables decision makers to perform a deeper analysis of the problem, resulting in a better understanding of the task. Decision makers can benefit from sharing information for successful problem solving. In addition, the anonymous GSS environment encourages objective evaluation and error catching in problem analysis. It is clear that those individuals in an environment’s decision-making that supported by GDSS hold a highest group understanding to the decision results of the individuals who are not supported by the GDSS.

2.2.2 The Impact of GDSS on Supporting the Group Consensus

The group decision making process emphasizes how members actually interact during a discussion period and how certain alternatives achieve consensus during group interaction. In general, group decision making problems using preference relations are faced by applying two different models (or processes) before a final solution can be given (Herrera-Viedma et al., 2007): the selection model and the consensus model. The selection model obtains the final solution according to the preferences given by the decision makers. It involves two different steps: the aggregation of individual preferences and the exploitation of the collective preference (Dong, 2010a). Some of the researchers, such as Choudhury et al. (2006), Ben-Arieh and Easton (2007), Herrera-Viedma (2007), Chiclana (2008), Chen and Cheng (2009), Ben-Arieh et al. (2009), Xu (2009) as well as Dong (2010b), agree that the consensus model is an important aspect in group decision making.

Traditionally, consensus is defined as the full and unanimous agreement of all the decision makers regarding all the possible alternatives. However, some researchers consider that complete agreement is not necessary in real life. Herrera-Viedma et al., (2007) referred this to the use of the consistency measure, which is also called soft consensus degree. The consistency measure is used to measure the difference among decision makers, and it is a vital basis of consensus models. For group decision making using preference relations, the consistency measure itself includes two sub problems: 1) when can a decision maker, considered individually, be said to be consistent; and 2) when can a whole group of decision makers be considered consistent (Herrera-Viedma et al., 2004). These problems can be avoided by using GDSS that support the group consensus for decision-makers. The decision-makers that supported through GDSS have a high level of participation of group members in decision-making to reach a group consensus, and this participation is compatible with the procedures substance generation of idea. GDSS can be used to deal with imprecision, uncertainty and fuzziness in group decision making. In addition, Ma et al. (2010) focus on
Multi-criteria decision making (MCDM) based on the GDSS applications to support access to the group consensus. They show that MCDM refers to making preference decision (e.g. evaluation, prioritization, and selection) over the available alternatives that are characterized by multiple, usually conflicting, criteria. As decision making requires multiple perspectives of different people, most organizational decisions are made in groups. They found that the use of GDSS improve the quality of group decision-making and lead to a high degree of group consensus to the results of Group Decision Outcome.

2.2.3 The Impact of GDSS on Supporting the Group Satisfaction

Fjermestad and Hiltz (1999) found that around 25% of the studies analyzed subjective satisfaction including process satisfaction, decision satisfaction, general satisfaction, and so on. Satisfaction of users with an information system is an effective measure of the success of the system. It is a surrogate measure of system effectiveness. Nunamaker et al. (1998) values user satisfaction of the participant group members in decision-making on the GDSS and discovered that there is a high level of satisfaction as result of the use of this system. Benbasat and Lim (1993) researched three dependent variables based on satisfaction using GSS, which are: the decision outcome satisfaction, the decision scheme satisfaction and confidence in the decision outcome (Bellefeuille, 1998; Martz and Shepherd, 2004). These satisfaction measures are important in GDSS research because a GDSS will unlikely long survive the disapproval of its users (Raman et.al, 1993). In addition, satisfaction of users with an information system indicated the conviction of participated group members in decision making to apply GDSS in group decision-making (Rao, 1994). Paul et al. (2004) examined the influences performance of GDSS supported groups influences various dimensions of satisfaction. The researchers focused on three indicators of group performance, namely decision time, thoroughness of decision making, and number of iterations in group decision process. Also they focused on different types of user satisfaction in GDSS based meetings: system satisfaction decision making process satisfaction, and decision outcome satisfaction; and explores interrelationships among them. They finding that group members’ satisfaction with system impacts the satisfaction with decision process and outcome. Satisfaction with decision outcome is also influenced by satisfaction with decision making process. Another interesting set of findings is the relationships between performance of groups members engaged in GDSS based meetings and their satisfaction with system, process, and outcome. Decision time has negative effect on system satisfaction and positive effect on process satisfaction. Thoroughness of decision making has positive effect on outcome satisfaction. Furthermore, their study findings have major implications for planners and facilitators of GDSS based meetings.

It could be argued that the increasing and equal exchange of information and participation in the group interactions among decision-makers will increase the group satisfaction with the decision-making process. In addition, the increased participation is also encouraged to equally contribute to the group decision; As a result, it will increase satisfaction with the decision outcome in a confidential environment of GDSS. Through the support provided by the components of GDSS (Hardware, Software and people) and its techniques (Group Support System, Electronic Meeting System and Videoconference), decision-makers can achieve a
group understanding of the Group Decision-Making Process (GDMP) and with high group understanding and consensus, high group satisfaction is also expected.

3. Methodology and Research Design

An organization that is able to improve its GDSS would be able to support group decision outcome. Previous research have shown that organizations with a well-developed GDSS Components would be able to improve the group understanding, to increase the effectiveness of group consensus and to increase group satisfaction to the decision makers. The study was conducted under the procedural scheme as shown in Fig. 2. It demonstrates the systematic steps to detect the impacts of Group Decision Support Systems GDSS on Group Decision Making Outcomes. It is the intellectual foundation of this study, which emerges from the ideas of Kwok et al., (2000), Jessup & Valacich (2003) and Laudon & Laudon (2006). In line with the view suggested in the literature, the study formulated the research hypotheses as below.

**H1: There are significant correlations between GDSS Components and GDO.**

H1a: There is a significant correlation between GDSS Components and Group Understanding.
H1b: There is a significant correlation between GDSS Components and Group Consensus.
H1c: There is a significant correlation between GDSS Components and Group Satisfaction.

**H2: There are significant Impacts of GDSS Components on GDO.**

H2a: There is a significant Impact between GDSS Components and Group Understanding.
H2b: There is a significant Impact between GDSS Components and Group Consensus.
H2c: There is a significant Impact between GDSS Components and Group Satisfaction.

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**Fig.2. The Proposed Model of Study**
The data for this study were collected via a questionnaire survey. Most of the measurement items in the questionnaire were based on previous studies. All the items adopt the same five-point Likert scale, where 1 represents “strongly disagree” and 5 represents “strongly agree.” Content validity was ensured through an extensive literature review of published material in academic and practitioner journals, and by discussion with several experts and scholars in this field. To know the face validity, questionnaire was distributed to a number of experts with different specialties related to the study, taking their opinions to suit the study variables and to improve the questioner more accurate.

The study was conducted on a sample of top managers in the Ministry of Science and Technology, Iraq, where there is an urgent need of the adoption of information systems and decision support systems. The Centre of the Ministry includes 14 organizations, 12 of which are headed by a general manager called CEO, while the rest two headed by manager. 50 persons participated in the survey. In accordance with the norm, participation in the study is voluntary and the subjects are free to withdraw at any time without obligation. They are free to decline to answer any questions they do not wish to answer. The subjects are informed that their responses would be anonymous and confidential with the promise of research results upon their request.

All the questionnaires were distributed and collected directly and personally. A total of 46 questionnaires were returned, but 6 of them contained incomplete information, thus leaving an overall response rate of 80%, which is reasonable for further analysis.

4. Results and Discussions

Data analyses were carried out by applying SPSS18.0. First, descriptive analysis was used to analyze the demographic characteristics of the respondents. Secondly, reliability test was conducted through Cronbach's Alpha to verify the internal consistency is guaranteed for the measurement index. Then, correlation analysis was followed to analyze the relations between Group Decision Support Systems components and the Group Decision Outcome (GDO). Finally, regression analysis was employed for the investigation of the impacts of the Group Decision Support Systems components on the Group Decision Outcome (GDO).

4.1 Descriptive Analysis

Amongst the 40 effective participants, 8 of them are general managers (CEO), 5 are the manager assistants, 5 are the heads of centers and the rest 22 are department heads. Amongst the samples, there are 37 (92.5 %) male and 3 (7.5%) female respondents. This may be due to the nature of the work of the ministry, which was formed from the integration of employees of the Military Industrialization Commission and the employees of the system of atomic energy abolished. Additionally, administrative leadership positions in the ministry are often occupied by males in the various Iraqi ministries. As for the scientific qualification, the largest portion of the respondents are PhD holders, 25 persons out of 40, up to 62.5%; 13 persons posse master degree, 32.5% of total; and the rest 2 persons are bachelors, only 5% of all. All of this indicates a positive qualification and experience are provided by the respondents.
4.2 Reliability Analysis

Reliability was tested for each variable GDSS and the Group Decision Outcome (GMO). The results score ranged from .749 to .908 as show in Table 1. The results are normally within acceptable limit for social studies.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Factors</th>
<th>Cronbach's Alpha</th>
<th>Number Of Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>I.V</td>
<td>GDSS Competent</td>
<td>.962</td>
<td>10</td>
</tr>
<tr>
<td>D.V</td>
<td>Group Understanding</td>
<td>.908</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Group Consensus</td>
<td>.749</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Group Satisfaction</td>
<td>.908</td>
<td>8</td>
</tr>
</tbody>
</table>

4.3 Correlation Analysis

In this section, Spearman's Rank Correlation Coefficient was used to determine the relationship among the study variables. In addition, it identifies significant that opposes the potential value of the error from first type, and it is the amount probability uncertainty value is at significance (0.05) and (0.01) to determine the moral differences between the study variables. The statistical results are shown in Table 2, which verifies the first main hypothesis, that is, there are significant correlations between the Group Decision Support Systems (GDSS) Components and the Group Decision Outcome (GDO). The details are as in the following.

**H1a: There is a significant correlation between GDSS Components and Group Understanding.**

As the statistical results shown in Table 2, Spearman's Rank Correlation Coefficient value on the relationship between GDSS Components and Group Understanding was 0.593 at a significant level of 0.01. Thus, it is a significant positive correlation, which means GDSS Components have strong significant correlation relationships with Group Understanding. Thus, the sub-hypothesis H1a is verified.

**H1b: There is a significant correlation between GDSS Components and Group Consensus.**

As the statistical results shown in Table 2, Spearman's Rank Correlation Coefficient value on the relationship between GDSS Components and Group Consensus was 0.668 at a significant level of 0.01. Thus, it is a significant positive correlation, which means GDSS Components have strong significant correlation relationships with Group Consensus. Thus, the sub-hypothesis H1b is verified.

**H1c: There is significant correlation between GDSS Components and Group Satisfaction.**

As the statistical results shown in Table 2, Spearman's Rank Correlation Coefficient value on the relationship between GDSS Components and Group Consensus was 0.554 at a significant level of 0.01. Thus, it is a significant positive correlation which means GDSS
Components have strong significant correlation relationships with Group Satisfaction. Thus, the sub-hypothesis H1c is verified.

Table 2: The Correlation results between GDSS Components and GDO

<table>
<thead>
<tr>
<th>Variables</th>
<th>Group Decision Outcome (GDO)</th>
<th>Total Group Decision Outcome (GDO)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Group Understanding</td>
<td>Group Consensus</td>
</tr>
<tr>
<td>(GDSS) Components</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hardware</td>
<td>0.539***</td>
<td>0.647***</td>
</tr>
<tr>
<td></td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Software</td>
<td>0.548**</td>
<td>0.647**</td>
</tr>
<tr>
<td></td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>People (Human Skills)</td>
<td>0.597**</td>
<td>0.641**</td>
</tr>
<tr>
<td></td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Total (GDSS) Components</td>
<td>0.593***</td>
<td>0.688**</td>
</tr>
<tr>
<td></td>
<td>0.000</td>
<td>0.000</td>
</tr>
</tbody>
</table>

**significant < 0.01, * significant< 0.05

As the statistical results shown in Table 2, Spearman’s Rank Correlation Coefficient value on the relationship between Total GDSS Components and the total GDO is 0.680 at a significant level of 0.01. Thus, it is a significant positive correlation which means the total GDSS Components has strong significant correlation relationship with the total GDO. Thus, the first main hypothesis is verified.

4.4 Regression Analysis

A series of linear regression analyses were conducted to measure the impacts between the independent variables and the dependent variable. The regression results are shown in Table 3. R square is the square of the multiple correlation coefficients; it indicates the proportion of the variance of the dependent variable explained by the independent variables. The closer R square near to 1, the better the linear regression model is. The F-value is computed as the ratio of the mean sums of squares of the regression equation and the residual. The coefficient indicates the number of units of increase in the dependent variable caused by an increase of one unit in the independent variable. The detailed verifications of the second hypothesis are provided in the following.

Table 3: Regression Results of GDO

<table>
<thead>
<tr>
<th>Model</th>
<th>Adjusted R Square</th>
<th>F</th>
<th>Sig.</th>
<th>Standardized Coefficients</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Beta</td>
</tr>
<tr>
<td>1</td>
<td>Group Understanding</td>
<td>0.272</td>
<td>15.583**</td>
<td>0.000</td>
</tr>
<tr>
<td>2</td>
<td>Group Consensus</td>
<td>0.408</td>
<td>27.847**</td>
<td>0.000</td>
</tr>
<tr>
<td>3</td>
<td>Group Satisfaction</td>
<td>0.235</td>
<td>12.996**</td>
<td>1.001</td>
</tr>
<tr>
<td>4</td>
<td>Total GDO</td>
<td>0.390</td>
<td>25.960**</td>
<td>0.000</td>
</tr>
</tbody>
</table>

a. Predictors: (Constant) GDSS Components

**significant < 0.01, * significant< 0.05
H2a: There is a significant Impact between GDSS Components and Group Understanding.

Table 3 shows that the regression relations between GDSS Components and Group Understanding are acceptable. As indicated in the F test, the calculated F value is 15.583, at a significant level of 0.01. Moreover, the value of the adjusted $R^2$ is 0.272, which means that the GDSS Components explain 27.2% of the gained changes of the Group Understanding. In addition, the value of the coefficient Beta for the GDSS Components as an explanatory (independent) variable for the respondent (dependent) variable Group Understanding is 0.428, at a significant level of 0.01. This refers to the change of one unit in the GDSS Components followed by an increase of 0.428 units in the Group Understanding. Thus, it verifies the sub-hypothesis H2a.

H2b: There is a significant Impact between GDSS Components and Group Consensus.

The statistical results in Table 3 illustrate that the regression relations between GDSS Components and Group Consensus are acceptable. As indicated in the F test, the F-value is calculated as 27.847 at a significant level of 0.01. The value of the adjusted R2 is 0.408. It means that the GDSS Components explain 40.8% of the gained changes of the Group Consensus. In addition, the value of the coefficient Beta for the GDSS Components as an explanatory (independent) variable for the respondent (dependent) variable Group Consensus is 0.644 at significant level of 0.01. In another word, the change of one unit in the GDSS Components is followed by an increase of 0.644 units in the Group Consensus. Thus, the sub-hypothesis H2b is verified.

H2c: There is a significant Impact between GDSS Components and Group Satisfaction.

The statistical results in Table 3 demonstrate that the regression relations between GDSS Components and Group Satisfaction are acceptable. As indicated in the F test, the F-value is 12.996 at a significant level of 0.01. The value of the adjusted $R^2$ is 0.235. This means that the GDSS Components explain 23.5% of the gained changes of the Group Satisfaction. In addition, the value of the coefficient Beta for the GDSS Components as an explanatory (independent) variable for the respondent (dependent) variable Group Satisfaction is 0.488 at significant level of 0.01. This means that the change of one unit in the GDSS Components causes an increase of 0.488 units in the Group Satisfaction. Thus, it verifies sub-hypothesis H2c.

As shown in Table 3, for the total GDO, the results of F-value is 25.960 at significant level of 0.01. It indicates that the regression result of GDSS Components on GDO is acceptable. The adjusted $R^2$ is 0.390, which indicates that GDSS Components explain 39% of the gained changes of the respondent (dependent) variable Group Decision Outcome (GDO). Moreover, the value of the coefficient Beta for the GDSS Components as an explanatory (independent) variable for the Group Decision Outcome (GDO) is 0.520 at a significant level of 0.01. This verifies the validity of the second main hypothesis.

5. Conclusions

The above statistical results prove that there are significant strong correlations between the GDSS components (i.e. Hardware, Software and People) and the Group Decision
Outcome (i.e. Group Understanding, Group Consensus and Group Satisfaction). More importantly, there are significant impacts of the GDSS components on the Group Decision Outcome. In others words, to improve the three dimensions of the GDSS may result in the improvement of the Group Understanding, the effectiveness of the Group Consensus and the level of the Group Satisfaction amongst the decision makers.

After the study, the researchers further visited the Ministry of Science and Technology, Iraq, with some simple personal interviews conducted. It is found that the Ministry has been using Intranet within the organization and is going to build an e-government project with a committee called the Subcommittee of the e-government has already been established. They are attempting to construct a room-headquarter information technology organization, with internal and external computerized sessions in various administrative levels. Taking advantage of the development of the information technology will lead to reach better decision makings, through GDSS, from the understanding to the consensus as well as to the satisfactions.

References


