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ABSTRACT

The environment in which a DSS is developed can have a significant impact on the development and satisfaction provided by the DSS. A questionnaire was sent to nonacademic TIMS members in an attemmpt to identify specific DSS environments, the capabilities provided by these DSS, and environmental factors that significantly influenced the DSS environment. This paper presents the results of this investigation.

1. INTRODUCTION

The development of decision support systems (DSS) is a complex process that has been investigated by many researchers. Many methods, including prototyping and systems life cycle, have been suggested for developing DSS. Each method has strengths and weaknesses that are appropriate for certain DSS applications. Typically, these techniques have not adequately taken the role of the DSS or environment in which the DSS is developed into consideration (Ariav and Ginzberg 1985). In order to insure that the needs of the DSS user are meet, it is critical to identify the specific environment in which the DSS is developed and the role the DSS is to perform within that environment.

The first part of this paper identifies specific DSS structures. A DSS structure, for the purpose of this study, is defined as a DSS that provides a specific set of capabilities to the DSS user. The second part of the paper identifies key environmental factors that can significantly influence the structure of the DSS identified in the first part of the paper. The third part presents a framework that can be used for the development of DSS. The framework is based on general systems theory and the structural composition of the DSS investigated in this study.

2. STUDY BACKGROUND

During the early 1970s, DSS emerged as a practical approach for applying computers and information to the decision problems faced by management. These early DSS were different from earlier computerized systems in that emphasis was on decision making effectiveness rather than operational efficiency. The late 1970s saw the DSS movement begin to emphasize interactive computer-based systems that helped decision makers utilize databases and models to solve semi-structured and unstructured problems. The 1980s saw computer-based systems employing a variety of new technologies to improve the effectiveness of managerial and professional decision makers. Emphasis within DSS development shifted toward providing the decision maker with balanced support in the areas of decision making, design, and implementation of DSS (Keen 1987).

During the past two decades, there has been considerable disagreement as to what specifically constitutes a DSS (Alter 1980; Bonczek, Holsapple, and Whinston 1980; Ginzberg and Stohr 1982; Keen 1987; Kroeber and Watson 1986; Remus and Kottemann 1987; Sprague and Carlson 1982). Currently, there seems to be a consensus that DSS is composed of three interrelated components: he data management, the model management, and the dialogue management components. Each component provides specific capabilities to the decision maker and improves the effectiveness with which he/she works.

Past DSS research has focused on specific sets of related issues. Several studies have dealt with the nature of decision situations and the type of services provided by DSS (Gorry and Scott Morton 1971; Little 1970); others have examined components, tools, and technologies needed to provide decision support services (Bonczek, Holsapple, and

Whinston 1980); and still other researchers emphasized the processes of DSS design, implementation, and use (Keen 1976; Moore and Chang 1980). Ariav and Ginzberg have proposed a framework based on the concepts of system theory that requires understanding five distinct elements: environment, role, components, arrangement of components, and resources required to support the system (Churchman 1968). It is only by understanding the environment in which the DSS is to be developed and the role it is to perform that the specific capabilities can and the mechanism of these capabilities be considered.

Ariav and Ginzberg also suggested that a description of a DSS environment should only include factors that impact system structure. They identified two critical dimensions of a DSS environment: task characteristics and access pattern. Task characteristics include task structure, management level supported, decision phase supported, and levels of technology. Access pattern includes mode of user interaction, number of users supported, expertise in computer usage and/or problem area, the role of the user in the decision process, and the relationship to "neighboring" information systems.

3. RESEARCH HYPOTHESES

Two hypotheses are addressed in this study. The first hypothesis implies that unique DSS structures exist and that it is possible to identify these structures.

H1: Specific DSS structures exist and can be identified.

The second hypothesis suggests that the environment in which a DSS is developed impacts DSS structure. Figure 1 illustrates the relationship suggested between the two dimensions (ten factors) identified by Ariav and Ginzberg and a DSS structure.

H2: The environment in which DSS is developed significantly impacts DSS structure.

4. METHODOLOGY

The study used a questionnaire developed from previous surveys and DSS literature. The instrument was validated in several stages. The validated questionnaire was mailed to 1,613 randomly selected nonacademic members of The Institute of Management Science (TIMS). This frame was selected because of the interdisciplinary nature of the group and their expressed interest in computers and the decision making process. Each questionnaire included a cover letter, definitions page, and the validated questionnaire. The definitions page contained words (including the term "DSS") that could possibly be misunderstood by the respondent.

The questionnaire was composed of three parts. The first part contained twenty-four items designed to test the significance of the ten factors identified in literature as com-

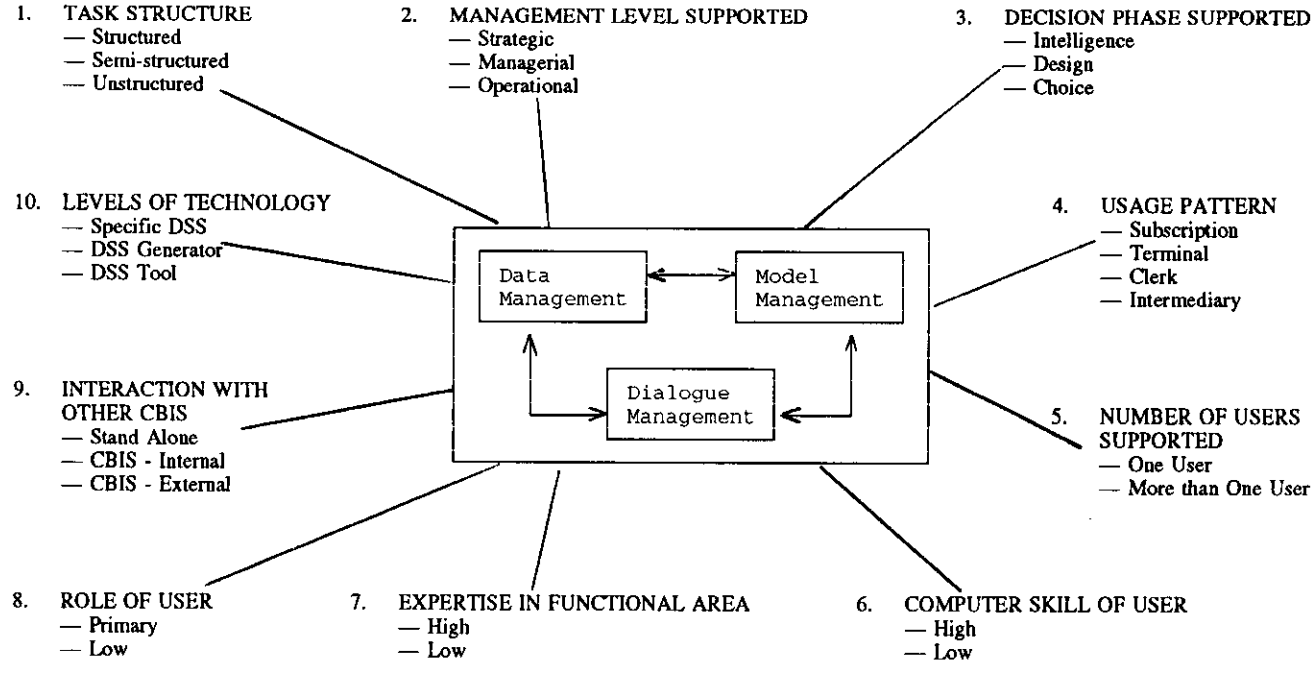
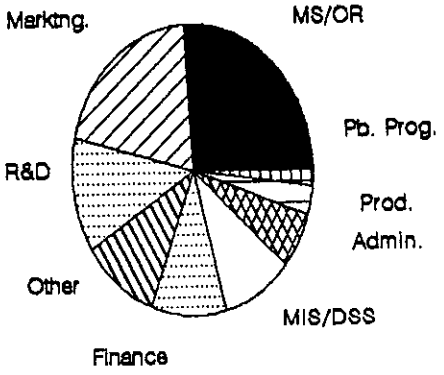


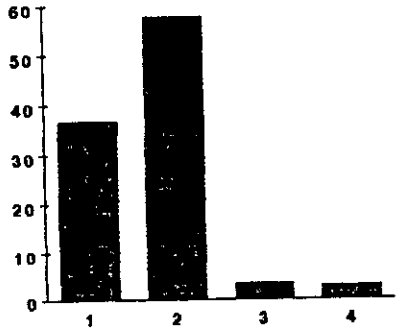
Figure 1. Environmental Factors that Influence the Structure of DSS Components

Primary Work Area



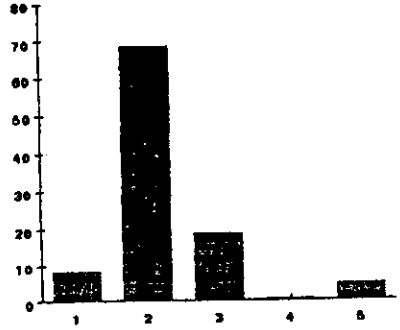
DSS Performance

1. Excellent 2. Satisfactory
3. Poor 4. N/A

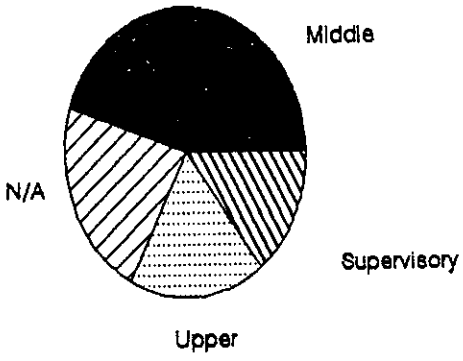


User Satisfaction

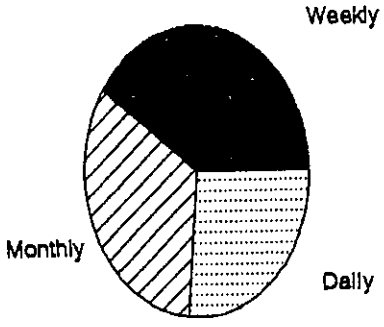
1. All the time 2. Most the time
3. Some of time 4. Rarely
5. Never



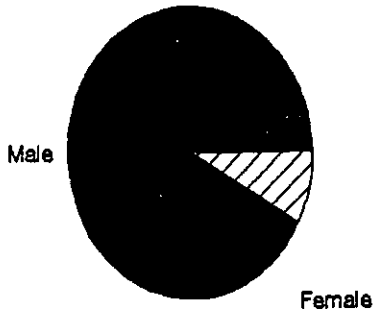
Management Position



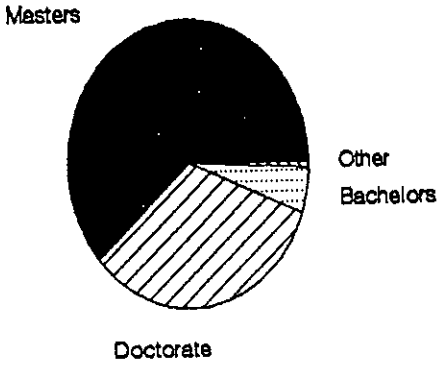
DSS Usage



Sex



Education Level



User Participation in DSS Development

1. Design 2. Construction 3. Implementation
4. Not Involved 5. Design/Const. 6. Design/Impl.
7. Const./Impl. 8. All Phases

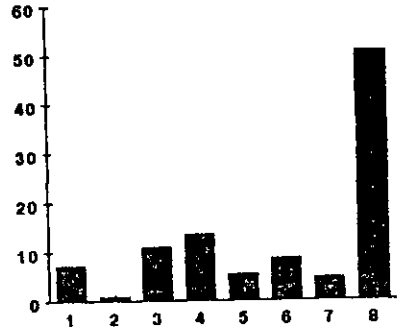


Figure 2. Demographics for DSS Respondents

prising a DSS environment. The second part of the questionnaire contained twenty items that solicited information about the specific capabilities of the DSS used by the respondent. Each item in the first two parts of the questionnaire had a seven-point Likert scale ranging from "strongly disagree" to "strongly agree." The third part of the questionnaire contained thirteen questions concerning demographics of the respondent.

5. RESULTS OF DATA ANALYSIS

In order to test the two hypotheses relevant to this study, four steps were followed.

5.1. Descriptive Statistics of Study

The sample base that resulted was 273 respondents (16.93% response rate). Not all returned questionnaires were usable since many were from individuals not current/past users of DSS. The mailing provided 158 usable questionnaires. Non-response bias was examined by comparing results obtained from the survey with known values of the population.

Figure 2 shows the demographics of the respondents who participated in this study. The majority of the respondents were male, with 145 men (91.8%) and 13 women (8.2%). The typical respondent was well educated with 94.3 percent having earned at least a Master's degree. All levels of management were represented: "upper" management (18.4%), "middle" management (44.9%), and "supervisory" management (14.6%). The remaining respondents indicated these levels were "not applicable" to them. The respondents' primary work areas were Management Science/Operations Research (25.9%), Marketing (20.3%), Research and Development (12.7%), Finance (10.1%), MIS/DSS (9.5%), Administrative (6.3%), Production (3.2%), and Others (12.0%).

As shown in Figure 2, respondents varied in the frequency with which they used DSS: daily (26.6%), weekly (40.5%), monthly (32.9%). About 37 percent of the respondents indicated the performance of their DSS was excellent, while another group (57.6%) found performance to be satisfactory. Only a small group (5.7%) felt their DSS performed poorly. A majority of the respondents (50.6%) took an active part in the design, construction, and implementation of their DSS. A small group (13.3%) indicated they did not participate in any phase of DSS development. The remainder (36.1%) participated in one or two stages of DSS development. Finally, Figure 2 illustrates the respondents' overall satisfaction with their DSS. About 8 percent of the respondents were satisfied all of the time, 68.4 percent were satisfied most of the time, 18.4 percent were satisfied some of the time, and only 5 percent were never satisfied with their DSS.

5.2. Tests of Reliability and Validity

Cronbach's coefficient alpha was calculated for the ten environmental factors identified by Ariav and Ginzberg. As shown in Table 1, eight of the ten factors proved to be reliable measures of the intended dimensions. The two unreliable factors (*Expertise in Functional Area* and *Role of User in Decision Making Process*) were deleted from further analysis. Cronbach's alpha was calculated across the remaining reliable environmental factors. This provided an alpha of .7161.

Table 1. Coefficient Alpha for the Ten Environmental Dimensions

Items	Alpha
Task Structure	.7899
Management Level Supported	.7448
Decision Phase Supported	.7754
Usage Pattern	.7050
Number of Users Supported	.7292
Computer Skill of User	.7530
Expertise in Functional Area	*
Role of User	-.3566
Interaction with Other CBIS	.7236
Levels of Technology	.8565
RELIABILITY COEFFICIENTS	24 ITEMS
Alpha =	.7161

*Expertise in Functional Area had only one question.

Cronbach's coefficient alpha was also calculated for each factor identified in the second part of the questionnaire (database, model, and dialogue management components). The three factors proved to be reliable measures of the intended dimensions (see Table 2). An overall alpha was also calculated for this part of the questionnaire and was .8463.

Table 2. Coefficient for the Three DSS Structure Dimensions

Items	Alpha
Database Management Component	.7699
Model Management Component	.8458
Dialogue Management Component	.7659
RELIABILITY COEFFICIENTS	20 ITEMS
Alpha =	.8463

Both parts of the questionnaire were checked for content and construct validity. This was done through a pre-test. Individuals familiar with DSS were given a draft of the

questionnaire and asked their opinion as to coverage and clarity. Evaluation continued until these individuals and the researchers were satisfied the questionnaire provided a fair representation of factors relevant to the DSS area.

Factor analysis and inter-item correlations were also used to determine how well the research instrument measured the underlying dimensions. The results agreed with the factors identified as being reliable earlier in the study.

5.3. DSS Structures

A hierarchical cluster analysis was used to classify the respondents' DSS according to the capabilities provided by the database, model, and dialogue management components. Analysis indicated that a five-cluster solution was appropriate. The initial cluster solution was checked for both internal and external validity. Sample replication was used to test the internal validity of the five-cluster solution. Most (82 of 100) of the replicated items maintained their original clusters. This provides evidence of high internal validity.

Multiple discriminant analysis was used to check the external validity of the cluster solution. The results indicated that clusters differed significantly on items used to identify the DSS environment. Differences between clusters on variables other than those used for cluster formation provide evidence of external validity.

5.3.1 DSS Structure Number 1: A Model-based DSS

DSS structure number 1 can be characterized as a model-based DSS. The majority of respondents within this cluster indicated their DSS possessed strong modeling capabilities while the database and dialogue management components offered less developed capabilities. Several respondents (27 of 39) stated that their DSS allowed access to several models. Most of the individuals (76.9%) responded that the models within their DSS were controlled by special model management software. Approximately one-half of the respondents within this structure indicated that these models could be integrated into other models within their DSS. Two-thirds of the respondents felt these models supported strategic, tactical, and operational decisions. Two-thirds of the respondents also indicated that the model management component maintained a directory of models available to help the decision maker. A majority of the respondents (22 of 39) indicated their DSS allowed them to utilize model building tools and subroutines to develop new models.

A majority (67%) of the respondents indicated their DSS interacts with at least one database. Approximately one-half (52%) of these respondents felt the database accessed was exclusive to their DSS. The remainder of the respondents indicated the database could be accessed by several other sources within the organization. Several respondents (25 of 39) indicated that database functions were not controlled by a database management system. About 56.4% of the individuals responded that their DSS could access data through multiple sources. A number of respondents (82.1%) stated that their DSS did not have access to a data dictionary. Several respondents (64.1%) also indicated that access to DSS databases was not controlled by a database management system.

Over 55% of the respondents indicated that the user interface was controlled by a dialogue management component. About 74.4% of the respondents indicated the dialogue management component was unable to support multiple dialogue styles. Although many respondents stated their DSS could not support multiple dialogue styles, approximately one-half indicated their dialogue management component was flexible. Only six respondents stated their DSS was capable of tracking dialogue usage. Approximately one-half of the respondents (51.6%) indicated their DSS was not able to interact with the database management component and the model management component.

5.3.2 DSS Structure Number 2: A Data-based DSS

DSS structure number 2 exhibits strong database management capabilities, moderate dialogue support, and a weak model management subsystem. All twenty-three respondents within this DSS structure stated their DSS interacts with a database. Approximately one-half of these respondents felt the database accessed was exclusive to their DSS. A majority of the respondents (60.4%) indicated their DSS could extract data from several different sources. The remainder (39.6%) responded that data could be accessed through one database only. Several respondents (20 of 23) indicated that database functions were controlled by a database management system. A majority of the respondents (56.5%) stated their DSS had access to a data dictionary.

All respondents within this DSS structure indicated their DSS had a dialogue management component that controlled the user interface. Many (17 of 23) responded that the dialogue management component was flexible and able to interact with the database management component and model management component. Despite indications of a well-developed dialogue management component, only four of twenty-three suggested their DSS was able to support multiple dialogue styles and only 56.5% thought their DSS was able to track dialogue usage.

The weakest component of DSS structure number 2 was the model management component. Approximately one-half of the respondents did not believe their DSS could support multiple models. Numerous individuals (16 of 23) indicated their DSS lacked the ability to use model building blocks and/or subroutines to develop more complex models. Only four respondents indicated their DSS was able to integrate multiple models. Most of the individuals (82.6%) responded that models within their DSS were not controlled by special model management software. All of the respondents indicated their DSS did not provide a directory of models within their system. The respondents (20 of 23) did indicate, however, that models within their DSS could

interact with the data management component and that available models primarily supported tactical and operational decisions.

5.3.3 DSS Structure Number 3: A Generic DSS

DSS structure number 3 is the weakest of the five DSS structures identified. Responses provided by this group indicated they were dissatisfied with all three of the components. All of the respondents agreed that their DSS interacts with a database and approximately one-half (56%) of the respondents indicated the database was exclusive to their DSS. A number of respondents (52%) stated their DSS could access data from several different sources. The respondents within this group appeared to be equally split, however, as to whether database activities were controlled by a data management system and as to whether or not it had access to a data dictionary.

Almost all of the respondents (24 of 25) indicated their DSS did not support multiple dialogue styles. Many respondents (64%) stated that their DSS did not support a flexible user interface. Only one-half of the respondents indicated their DSS had a dialogue management subsystem. Respondents were equally split over the ability of their DSS to interact with the model management component and the database management component. Nearly all of the respondents (23 of 25) indicated that their DSS did not track dialogue usage.

The weakest component of DSS structure number 3 was the model management component. Many respondents (64%) suggested their DSS was unable to support or maintain multiple models. The respondents also indicated their DSS did not provide the capability to build new models through model building blocks and/or subroutines. All of the respondents stated that a model directory was unavailable within their DSS and 80 percent of the respondents indicated it was not possible to integrate multiple models within their DSS. Models that existed within this DSS structure supported tactical (60%), strategic (53%), and operational (52%) decisions. All of the respondents indicated their DSS lacked special model management software to control model operations within their DSS.

5.3.4 DSS Structure Number 4: A Data/Model-based DSS

DSS structure number 4 provides the user with strong database capabilities, strong model capabilities, and moderate dialogue capabilities. Most of the respondents (93.7%) indicated that their DSS interacted with at least one database. The majority of respondents (65.6%) stated that the database was not exclusive to their DSS. Several members of this group agreed that database management functions were handled by a database management system. Many (69.2%) of the same individuals indicated that the database management component provided a data dictionary capability. Numerous respondents (69.2%) also stated that data could be extracted from several sources through the data management component.

The capabilities provided by the model management component equal that of the database component. Respondents (30 of 39) indicated their DSS allowed them to access several models. Individuals within this group suggested that the models supported strategic (76.9%), tactical (92.3%), and operational (74.4%) decisions. Several of the individuals (28 of 39) responded that models within their DSS were controlled by model management software. Many of the respondents (28 of 39) indicated they were able to use model building blocks and/or subroutines to develop more sophisticated models to support their decision making. Only six individuals indicated their DSS could not support the integration of multiple models. Several individuals (22 of 39) responded that the model management component maintained a directory of models available to help the decision maker. Two-thirds of the respondents indicated the model management component interacted with the database management component of their DSS.

Respondents within this structure indicated less satisfaction with the dialogue management component of their DSS. Several individuals (71.8%) stated that the dialogue management component provided a flexible user interface. Respondents were split, however, as to whether their DSS supported multiple dialogue styles. Many of the respondents (67.9%) indicated that the dialogue management component interacted with the model management component and the database management component. Most of the respondents (34 of 39) within this DSS structure indicated that the user interface was controlled by a dialogue management subsystem. Approximately one-fourth (10 of 39) of the respondents were unsure whether the dialogue management component tracked dialogue usage. The remainder were equally split as to whether or not their DSS could track dialogue usage.

5.3.5 DSS Structure Number 5: A Fully Developed DSS

DSS structure number 5 is the most developed of the DSS structures identified. All three components were rated very highly by the respondents within this group. Almost all of the respondents (30 of 32) stated that their DSS interacts with a database. Most of these individuals (65.6%) indicated that this database was not exclusive to their DSS. The database could be accessed by other individuals within the organization. Most of the respondents (62.5%) suggested their database activities were controlled by a database management systems (DBMS). The respondents (25 of 32) also indicated that the DBMS provided a query facility with which the respondents could access data within their database. A number of individuals (84.4%) stated that their DSS had access to a data dictionary. This differs from the respondents within the other DSS structures as they were unable to identify a data dictionary capability. Many respondents also indicated that the DBMS of their DSS allowed them to access data from several sources.

Table 3. Demographics Associated with Specific DSS Structures

	DSS #1	DSS #2	DSS #3	DSS #4	DSS #5
STRUCTURE SIZE:	39	23	25	39	32
SEX:					
Male	37 (94.9%)	21 (91.3%)	23 (92.0%)	35 (89.7%)	29 (90.6%)
Female	2 (5.1%)	2 (8.7%)	2 (8.0%)	4 (10.3%)	3 (9.4%)
EDUCATION LEVEL:					
Doctorate	12 (30.8%)	8 (34.8%)	9 (36.0%)	15 (38.5%)	8 (25.0%)
Masters	26 (66.7%)	15 (65.2%)	14 (56.0%)	21 (53.8%)	21 (65.6%)
Bachelor	1 (2.6%)	0 (0.0%)	2 (8.0%)	2 (5.1%)	3 (9.4%)
Other	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (2.6%)	0 (0.0%)
PRIMARY WORK AREA:					
Marketing	4 (10.3%)	3 (13.0%)	4 (16.0%)	10 (25.6%)	11 (34.4%)
MS/OR	14 (35.9%)	4 (17.4%)	7 (28.0%)	11 (28.2%)	5 (15.6%)
Public Programs	0 (0.0%)	0 (0.0%)	2 (8.0%)	0 (0.0%)	1 (3.1%)
Production	1 (2.6%)	1 (4.3%)	1 (4.0%)	2 (5.1%)	0 (0.0%)
Administrative	1 (2.6%)	4 (17.4%)	2 (8.0%)	2 (5.1%)	1 (3.1%)
MIS/DSS	0 (0.0%)	4 (17.4%)	4 (16.0%)	4 (10.3%)	3 (9.4%)
Finance	5 (12.8%)	1 (4.3%)	3 (12.0%)	2 (5.1%)	5 (15.6%)
R & D	8 (20.5%)	4 (17.4%)	0 (0.0%)	5 (12.8%)	3 (9.4%)
Other	6 (15.4%)	2 (8.7%)	2 (8.0%)	3 (7.7%)	3 (9.4%)
MANAGEMENT POSITION:					
Upper	7 (17.9%)	3 (13.0%)	4 (16.0%)	6 (15.4%)	9 (28.1%)
Middle	18 (46.2%)	12 (52.2%)	12 (48.0%)	17 (43.6%)	12 (37.5%)
Supervisory	5 (12.8%)	6 (26.1%)	5 (20.0%)	4 (10.3%)	3 (9.4%)
Not Applicable	9 (23.1%)	2 (8.7%)	4 (16.0%)	12 (30.8%)	8 (25.0%)
DSS USAGE:					
Daily	9 (23.1%)	5 (21.7%)	4 (16.0%)	11 (28.2%)	13 (40.6%)
Weekly	15 (38.5%)	11 (47.8%)	11 (44.0%)	13 (33.3%)	14 (43.8%)
Monthly	15 (38.5%)	7 (30.4%)	10 (40.0%)	15 (38.5%)	5 (15.6%)
USER PARTICIPATION IN DSS DEVELOPMENT:					
Design	0 (0.0%)	1 (4.3%)	3 (12.0%)	4 (10.3%)	3 (9.4%)
Construction	1 (2.6%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Implementation	4 (10.3%)	3 (13.0%)	2 (8.0%)	3 (7.7%)	5 (15.6%)
Not Involved	9 (23.1%)	2 (8.7%)	3 (12.0%)	4 (10.3%)	3 (9.4%)
Design/Construction	0 (0.0%)	2 (8.7%)	2 (8.0%)	3 (7.7%)	1 (3.1%)
Design/Implementation	4 (10.3%)	1 (4.3%)	2 (8.0%)	4 (10.3%)	2 (6.3%)
Const./Implementation	0 (0.0%)	3 (13.0%)	2 (8.0%)	2 (5.1%)	0 (0.0%)
All Phases	21 (53.8%)	11 (47.8%)	11 (44.0%)	19 (48.7%)	18 (56.3%)
DSS PERFORMANCE:					
Excellent	9 (23.1%)	7 (30.4%)	6 (24.0%)	12 (30.8%)	24 (75.0%)
Satisfactory	26 (66.7%)	15 (65.2%)	18 (72.0%)	26 (66.7%)	6 (18.8%)
Poor	2 (5.1%)	1 (4.3%)	1 (4.0%)	0 (0.0%)	1 (3.1%)
Not Applicable	2 (5.1%)	0 (0.0%)	0 (0.0%)	1 (2.6%)	1 (3.1%)
USER SATISFACTION:					
All of the time	2 (5.1%)	1 (4.3%)	4 (16.0%)	1 (2.6%)	5 (15.6%)
Most of the time	26 (66.7%)	16 (69.6%)	14 (56.0%)	29 (74.4%)	23 (71.9%)
Some of the time	8 (20.5%)	4 (17.4%)	7 (28.0%)	7 (17.9%)	3 (9.4%)
Rarely	1 (2.6%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Never	2 (5.1%)	2 (8.7%)	0 (0.0%)	1 (2.6%)	1 (3.1%)

Table 4. Summary of Specific DSS Environmental Items (Agreement)

		DSS #1	DSS #2	DSS #3	DSS #4	DSS #5
	n =	39	23	25	39	32
Q1.	Supports Structured Decisions	66.7%	30.4%	52.0%	48.7%	75.0%
Q2.	Supports Semi-Struct. Decisions	74.4%	82.6%	60.0%	82.1%	81.2%
Q3.	Supports Unstructured Decisions	39.9%	78.2%	40.0%	53.8%	37.5%
Q4.	Provides Upper Mgmt. Support	30.8%	87.0%	52.0%	35.9%	34.4%
Q5.	Provides Mid-Mgmt. Support	76.9%	91.3%	80.0%	84.6%	90.6%
Q6.	Provides Lower Mgmt. Support	35.9%	21.7%	80.0%	64.1%	71.9%
Q7.	Helps Identify Problems	76.9%	91.3%	60.0%	76.9%	90.6%
Q8.	Helps Identify Opportunities	69.2%	87.0%	32.0%	79.5%	93.7%
Q9.	Helps Analyze Alternatives	92.3%	55.2%	76.0%	82.1%	93.7%
Q10.	Helps Choose Alternatives	76.9%	65.2%	54.0%	84.6%	90.6%
Q11.	Direct User of DSS	74.4%	78.3%	56.0%	69.2%	82.1%
Q12.	DSS Used Interactively	64.1%	87.0%	56.0%	76.9%	81.2%
Q13.	DSS Staff Intermediary	25.6%	82.6%	96.0%	33.3%	15.6%
Q14.	Supports Single User	20.5%	13.0%	16.0%	10.3%	81.2%
Q15.	Supports Multiple Users	79.5%	91.3%	80.0%	82.1%	21.9%
Q16.	Skilled Computer User	92.3%	100.00%	92.0%	100.00%	96.9%
Q17.	Skilled DSS User	87.2%	87.0%	80.0%	92.3%	93.7%
Q18.	Skilled in Support Area	82.1%	95.7%	80.0%	94.9%	87.5%
Q19.	User Sole Decision Maker	20.5%	17.4%	0.0%	20.5%	15.6%
Q20.	User Supports Decision Maker	76.9%	75.9%	100.00%	82.1%	75.0%
Q21.	Internal Computer Systems	48.7%	73.9%	52.0%	71.8%	87.5%
Q22.	Outside Computer Systems	17.9%	13.0%	12.0%	23.1%	59.4%
Q23.	General Purpose DSS	17.9%	8.7%	12.0%	33.3%	18.7%
Q24.	Problem Specific DSS	87.2%	95.7%	92.0%	61.5%	90.6%

The majority of the respondents (20 of 32) indicated that the model management component supported multiple models and that integration (30 of 32) of these models was possible. Access to multiple models and the ability to integrate models allowed the respondent to use the DSS in support of strategic (93.7%), tactical (87.5%), and operational (84.4%) decisions. Most respondents (27 of 32) within this group indicated they were able to use model building blocks and/or subroutines to develop more complex models. All of the respondents stated that the model management component could interact with the available databases. A majority of the respondents (62.5%) were able to identify a formal model management system within their DSS. The respondents were split, however, as to whether a model directory was available within their DSS.

Most of the respondents (30 of 32) indicated their DSS provided a flexible user interface. All of the respondents within this DSS structure indicated that the user interface was controlled by a dialogue management component. Many respondents (90.6%) also indicated that the dialogue management component interacts with both the database management component and the model management component. Respondents appeared to be equally divided about whether or not their DSS supported multiple dialogue styles. One-half of the respondents (16 of 32) indicated that their DSS did not track dialogue usage, six individuals were not sure, and ten respondents stated that their DSS did track dialogue usage.

Table 3 provides the demographics associated with the specific DSS structures, while Table 4 summarizes the information presented in the previous sections. Table 5 compares the DSS structures according the capabilities they provide.

Table 5. Comparison of DSS Structures

	Database Component	Model Component	Dialogue Component
DSS Structure Number 1	Moderate	Strong	Moderate
DSS Structure Number 2	Strong	Weak	Moderate
DSS Structure Number 3	Weak	Weak	Weak
DSS Structure Number 4	Strong	Strong	Moderate
DSS Structure Number 5	Strong	Strong	Strong

5.4 Impact of Environmental Factors on DSS Structures

Multiple regression was used to identify which environmental factors significantly influenced the structure of the five DSS identified. Factor scores were used to create composite measures for both the dependent variable (DSS Structure) and the independent variables (the eight reliable environmental factors).

Table 6 presents the results of the multiple regression analysis. The five DSS structures were influenced by four different sets of environmental factors. DSS structure number 1 and DSS structure number 4 were both influenced by one environmental factor: *Interaction with Other CBIS*. DSS structure number 2 was primarily influenced by two environmental factors: *Management Level Supported* and *Computer Skill of User*. DSS structure number 3 was influenced by three environmental factors: *Management Level Supported, Task Structure*, and *Interaction with Other CBIS*. DSS structure number 5 was influenced by *Management Level Supported* and *Number of Users Supported*. three environmental factors tested did not significantly influence any of the five DSS structures. These were *Decision Phase Supported, Usage Pattern*, and *Levels of Technology*. There are three possible reasons why these factors did not significantly impact DSS structure. One possible explanation relates to the segmented research path cited by Ariav and Ginzberg. Typically, each DSS study has taken one or two environmental factors and carefully examined that factor's impact on DSS. It could be that when these environmental factors are analyzed in isolation they have a significant impact on DSS structure. When considered in combination with other environmental factors (as in this study), they may not have the significance suggested by previous studies. The second possible explanation would be that the research instrument did not adequately measure these environmental factors. This is not considered likely, however, since statistical analysis indicated the research instrument was both valid and reliable when measuring the intended dimensions. The final possibility is the DSS used by the respondents does not provide an accurate representation of the population. This is also considered unlikely since special care was taken in the selection of the sampling frame. Sample demographics and population demographics suggested that the sample closely corresponds to the intended population.

Table 6. Significant Environmental Factors for Specific DSS Structures

DSS Structures	Environmental Factors	Significance
DSS Structure Number 1	Interaction with Other CBIS	(.0009)
DSS Structure Number 2	Management Level Supported	(.0005)
	Computer Skill of User	(.0234)
DSS Structure Number 3	Management Level Supported	(.0030)
	Task Structure	(.0002)
	Interaction with Other CBIS	(.0161)
DSS Structure Number 4	Interaction with Other CBIS	(.0161)
DSS Structure Number 5	Management Level Supported	(.0232)
	Number of Users Supported	(.0421)

6. FINDINGS AND CONCLUSIONS

This study addressed two hypotheses. The first hypothesis stated that unique DSS structures exist and that it is possible to identify these structures. Analysis of data indicated that five distinct DSS structures can be identified. Each DSS structure provides the DSS user with a unique set of capabilities. Multiple discriminant analysis was used to verify that the five DSS structures differed significantly. Results of the analysis indicate that the first hypothesis is supported.

The second hypothesis stated that the environment in which a DSS is developed impacts the structure of that DSS. Multiple regression was used to test this hypothesis. Analysis of data indicated that the five DSS structures were influenced by four different sets of environmental factors. Three environmental factors tested did not significantly influence any of the five DSS structures.

Identification of the five specific DSS structures and environmental factors that influence each DSS structure provides a framework for developing DSS. The developmental framework suggested requires that the DSS builder go through six specific steps. These steps are:

1. *Identify the environment in which the DSS is to be built.* As suggested by Ariav and Ginzberg, the DSS builder should identify the specific characteristics of the task to be supported and the method in which the user will access the DSS.

2. *Ascertain the role the DSS is to have in support of the decision making process.* The role or purpose of DSS has long been defined as to provide support for the decision-making process. How this is to be accomplished and the type of support required of the DSS must be identified before the builder can consider the capabilities that must be built into the DSS.

3. *Identify the specific capabilities required to support the decision maker within the environment identified in Step 1.* DSS design literature typically identifies three major components necessary for a DSS: dialogue, model, and a data management component. Once task characteristics, access methods, and the role of the DSS have been determined, the specific DSS component capabilities necessary to support the decision maker can be identified.

4. *Design the "ideal" DSS.* Based on the information gathered in Steps 1 through 3, the DSS builder can begin the design of the "ideal" DSS. A conceptual model of the DSS should be developed that meets the support requirements of the decision maker and should not be limited by resource restrictions.

5. *Based on the DSS design, determine the resources required to support the decision maker.* Resources typically involved in a DSS include hardware, software, people, and data. The specific requirements for each of these areas must be determined and their usage secured before the DSS can be built.

6. *Build the DSS and provide for ongoing support.* Based on the "ideal" design developed in Step 4, the DSS builder can begin to develop a prototype of the DSS. The delivered DSS probably will vary from the "ideal" DSS because of organizational resource constraints.

Individuals who need to build a DSS can utilize this framework as a starting point in the developmental process. By identifying which environmental factors exist within the user's environment and comparing them with the results obtained in this study, the builder of a DSS should be able to determine the capabilities required within the DSS structure to best meet the needs of the user.

It is important to recognize that there may not be a perfect fit with the DSS structures identified in this study. When this occurs, the DSS builder should identify the environment that most closely fits the environment in which the DSS is to be developed and then use the DSS structure suggested as a starting point for the developmental process. The DSS builder should use the results of this study as a starting point for DSS development.

Future DSS research should attempt to verify the existence of the structures identified within this study. Additional research is also needed to improve the methods used for testing how the environment impacts DSS development.

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