# DSS EVALUATION CRITERIA: A MULTIPLE-CONSTITUENCY APPROACH

Sean Maynard, David Arnott, Frada Burstein

Department of Information Systems, Monash University, Melbourne, Australia.
Email: smaynard@ponderosa.is.monash.edu.au

Abstract

*Despite extensive research into the evaluation of the success of decision support systems (DSS), criteria important in measuring success are rarely defined. This may be critical when a number of reference groups, or constituencies, are considered. In multiple-constituency DSS evaluation the understanding of each criteria may be different for each constituency. Also, each constituency will have distinct requirements of the DSS and will consider a different set of criteria to measure these needs. This paper defines criteria for use within a multiple-constituency evaluation process and determines appropriate hierarchies of criteria for such a process. This forms the basis for ongoing research into multiple-constituency DSS evaluation.*

## INTRODUCTION

In general, evaluation of a decision support system (DSS) is usually based on the opinions of a single reference group, rather than on the opinions of all relevant groups involved with the DSS project. Including each relevant reference group, or constituency, may produce a more balanced evaluation that could be used to improve the DSS from each constituency's perspective. An example of this type of approach is the multiple-constituency approach (Connolly, Conlon and Deutsch 1980, Maynard and Arnott 1994).

Given that a number of constituencies are involved with a DSS project, an adequate evaluation process should measure the success of the system from each constituency's perspective. To accomplish this, a number of sets of evaluation criteria will be required: one generalised set for each constituency, plus any specific criteria relevant for that constituency.

The aim of this paper is to identify generic criteria for each DSS constituency. First, evaluation domains will be briefly discussed and criteria of importance to each domain will be identified and defined. A hierarchy of criteria for each constituency will then be developed. This hierarchical structure allows for evaluation results to be viewed at any level within the hierarchy and provides the flexibility for criteria to be added or removed as necessary without distorting the overall evaluation process. The measurement of the criteria will then be briefly discussed with relation to continuing research. The hierarchies identified in this paper will become part of a practical multiple-constituency evaluation process.

## EVALUATION CRITERIA

The measurement of system success is accomplished through the assessment of DSS from four perspectives which we call domains. These domains are effectiveness, efficiency, use and satisfaction. Within each of these domains a number of criteria exist that may be important for one, or more constituencies. In past research, criteria have been referred to using various terminologies and they are rarely defined. Rather, they are identified as important, and then are directly used in questionnaire analysis to determine their relevance in an evaluation process. One notable exception is DeLone and McLean (1992) who develop a taxonomy of IS success. Their taxonomy provides a more comprehensive view of IS success and helps to clarify a rich but confusing body of research.

Some of the criteria identified by researchers are common in many studies. In a multiple-constituency approach, constituency groups may not have the same understanding of meaning for each criteria when criteria are not formally defined. Thus, it becomes critical for each criteria to be explicitly defined. This section identifies criteria within each domain and defines these criteria to enable an improved and shared understanding from each constituency's perspective.

## Effectiveness

The effectiveness of a DSS is essentially the level to which the goals of the DSS project are fulfilled.. *Table 1* summarises criteria within the effectiveness domain and references where these criteria are used. Definitions of criteria are also given in *Table 1*. For those criteria that have not been formally defined, definitions have been created based on our own experience and understanding. In addition, criteria numbers are included which are referred to in the hierarchies presented later. In this section the criteria that are used to measure the effectiveness of the DSS are discussed.

The ability of the system to adjust to changing requirements and to provide simulation type capabilities is termed the "flexibility of the system". Similar terms used elsewhere that refer to this criteria include the "ability of the DSS to carry out *ad hoc* analysis" (Keen 1981), and the "ability of the system to produce alternative solutions" (Adelman *et al.* 1985). We consider these terms to be synonyms for the "flexibility of the system" as they measure a similar concept of effectiveness.

Table 1: Effectiveness criteria

| Criteria Number | Criteria | Definition | References |
|---|---|---|---|
| Effec1 | Accuracy of information | The correctness and exactness of the information provided by the DSS. | Bailey & Pearson (1983), Evans & Riha (1989), Udo & Davis (1992), Ives *et al.* (1983) |
| Effec2 | Adequacy of information provided | Whether the information provided to the DSS is sufficient for the decision task. | Hamilton & Chervany (1981a) |
| Effec3 | Cognitive style | The habitual ways that individuals process and utilise information. | Alavi & Joachimsthaler (1992),Ramamurthy *et al.* (1992), Baroudi & Orlikowski (1988) |
| Effec4 | Completeness of data files | How complete the data files are with regard to the decision task. | Adelman *et al.* (1985) |
| Effec5 | Completeness of information | Output that contains all the information required for the decision. | Bailey & Pearson (1983), Ives *et al.* (1983), Baroudi & Orlikowski (1988), Udo & Davis (1992) |
| Effec6 | Data summarisation | The ability of the system to summarise output. | Mahmood & Sniezek (1989) |
| Effec7 | Effect of DSS on organisation | The organisations view on how the DSS affects its make-up. | Adelman *et al.* (1985), Hopple (1987) |
| Effec8 | Effect of DSS on people's position in the organisation | The organisations view on how the DSS alters its job structure. | Adelman *et al.* (1985) |
| Effec9 | Effect on information flow | The effect of the DSS on how information flows throughout the organisation. | Adelman *et al.* (1985) |
| Effec10 | Effect on organisational effectiveness | The effect of the DSS on the fulfilment of the goals of the organisation. | Finlay (1993), Sanders (1984) |
| Effec11 | Flexibility of system | The ability of the system to adjust to changing requirements and to provide simulation type capabilities. | Hopple (1987), Udo & Davis (1992), Mahmood & Sniezek (1989), Bailey & Pearson (1983), Ives *et al.* (1983), Keen (1981), Adelman *et al.* (1985), Udo (1992) |
| Effec12 | Increase in analytical tools used | Any increase in the amount of analytical tools used as a result of the DSS. | Sanders & Courtney (1985) |
| Effec13 | Individual ability improvement | An improvement in the ability for you to carry out your job resulting from the DSS. | Mahmood & Sniezek (1989) |
| Effec14 | Individual differences (gender, attitude, experience) | Those demographic variables that influence the make-up of the individual. | Alavi & Joachimsthaler (1992), Ramamurthy *et al.* (1992), Barki & Huff (1990), Adelman *et al.* (1985), Zmud (1979) |
| Effec15 | Individuals willingness to change | The extent to which you are willing to undergo changes that the DSS may cause to your job. | Barki & Huff (1990) |
| Effec16 | Level of task independence | Independent tasks are those that do not require assistance from others for completion. | Sanders & Courtney (1985) |
| Effec17 | Market growth | The growth of the organisation in the market as a result of the DSS. | Finlay (1993) |

Table 1: Effectiveness criteria (cont)

| | | | |
|---|---|---|---|
| Effec18 | Match between technical approach and task requirements | The compatibility of the problem and the DSS. | Adelman *et al.* (1985), Hopple (1987), Sanders (1984) |
| Effec19 | Operational needs | The needs that you have to complete your work. | Adelman *et al.* (1985) |
| Effec20 | Personality | The cognitive and affective structures maintained by individuals to facilitate adjustment to events, people, and situations. | Alavi & Joachimsthaler (1992), Ramamurthy *et al.* (1992) |
| Effec21 | Political acceptability | The acceptability of the system by senior management from a political viewpoint. | Adelman *et al.* (1985) |
| Effec22 | Provision of training | The adequacy of the training conducted. | Adelman *et al.* (1985), Hopple (1987), Baroudi & Orlikowski (1988), Hamilton & Chervany (1981a), Ives *et al.* (1983), Bailey & Pearson (1983), Udo & Davis (1992), Finlay (1993), Ein-Dor & Segev (1978) |
| Effec23 | Quality of the decision making process | The affect of the DSS on the quality of the decision making process. | Sanders (1984), Ein-Dor & Segev (1978), Finlay (1993), Keen (1981), Adelman *et al.* (1985), Udo & Davis (1992), Udo (1992), Hopple (1987), Baroudi & Orlikowski (1988) |
| Effec24 | Range of objectives | The objectives of the DSS project. | Adelman *et al.* (1985), Udo & Davis (1992) |
| Effec25 | Role of IS | The role that information technology has within the organisation. | Ramamurthy *et al* (1992) |
| **Criteria Number** | **Criteria** | **Definition** | **References** |
| Effec26 | Structurability of task | How well the task can be structured for the DSS. | Adelman *et al.* (1985), Bailey & Pearson (1983), Ives *et al.* (1983), Finlay (1993), Hopple (1987), Ramamurthy (1992), Chandler (1982) |
| Effec27 | Support from the organisation | The support of the organisation for the DSS and in your use of the DSS. | Ramamurthy *et al.* (1992), Bailey & Pearson (1983), Ives *et al.* (1983), Keen (1981), Udo & Davis (1992), Barki & Huff (1990), Sanders & Courtney (1985), Sanders (1984) |
| Effec28 | Time-frame of task | The time required to complete the decision task. | Adelman *et al.* (1985), Ramamurthy *et al.* (1992) |
| Effec29 | Timeliness of information | Information that is current and available in a time frame allowing the decision to be made within the decision time frame. | Bailey & Pearson (1983), Ives *et al.* (1983), Evans & Riha (1989), Udo & Davis (1992) |

For the decision task to be supported successfully by the DSS the system must be appropriately designed for the decision environment. This is measured using the criteria "match between technical approach and task requirements". A synonym used for this criteria is the "match between the decision task and the system" (Hopple 1987). These terms focus on the measurement of the compatibility of the decision task with the DSS. For instance, the DSS should process information in similar stages to those required by the decision task.

Training is an issue of importance in determining the effectiveness of the DSS. It is referred to as "training quality" (Udo and Davis 1992) and sometimes the "degree of training provided to users" (Bailey and Pearson 1983). The adequacy of training provided to relative constituencies is measured by these terms. The criteria "provision of training" is introduced here to reflect this characteristic.

A major focus of DSS is the support of the decision making process, improving it where possible. The criteria "quality of the decision making process" is used to measure how the DSS effects the decision making process. It is referred to by the terms "quality of decisions" (Sanders 1984), "better decision making" (Keen 1981), "decision accuracy" (Adelman *et al.* 1985) and "decision process quality" (Hopple 1989). The similarity between these terms and the "quality of the decision making process" criteria is their measurement of how effectively the DSS supports decision making quality. For instance, the quality of the decision making process is thought to be improved through the use of the DSS as it may allow more alternative solutions for the decision problem to be considered.

The support of the DSS from an organisational perspective is thought to be critical to the effectiveness of the DSS. This is measured using the "support from the organisation" criteria, which is also referred to as "top management support" (Barki and Huff 1990, Sanders 1984).

The focus of each of these is the measurement of the backing of the organisation for the DSS project. Another critical aspect of effectiveness is having the information required for decision making available when it is needed. The criteria "timeliness of information" is used to determine if the system provides current information within a time period that allows the decision to be made. This criteria has also been referred to as the "currency of output" (Ives *et al.* 1983), reflecting that output which is current and on time can be used for decision making.

## Efficiency

The *efficiency* domain focuses on the degree of performance of the DSS project. This includes how well each constituency performs, in addition to the performance of the DSS. *Table 2* summarises these criteria listing their definitions and references in a similar manner to *Table 1*.

Table 2: Efficiency criteria

| Criteria Number | Criteria | Definition | References |
|---|---|---|---|
| Effic1 | Chauffeured decision-maker productivity | Effect of the DSS on chauffeured decision-maker efficiency. | Finlay (1993), Sanders (1984), Mahmood & Sniezek (1989), Evans & Riha (1989) |
| Effic2 | Cost effectiveness | Effect of the system on the profit of the organisation. | Udo & Davis (1992), Evans & Riha (1989), Finlay (1993), Keen (1981), Alavi & Joachimsthaler (1992), Udo (1992), Ein-Dor & Segev (1978), Sanders (1984) |
| Effic3 | Decision-consumer productivity | Effect of the DSS on decision-consumer efficiency. | |
| Effic4 | Decision-maker productivity | Effect of the DSS on decision-maker efficiency. | Finlay (1993), Sanders (1984), Mahmood & Sniezek (1989), Evans & Riha (1989) |
| Effic5 | DSS developer productivity | Effect of the DSS on DSS developer efficiency. | |
| Effic6 | Management productivity | Effect of the DSS on organisational efficiency. | Finlay (1993), Sanders (1984) |
| Effic7 | Reliability of system | Dependability and reliability of the DSS. | Baroudi & Orlikowski (1988), Ramamurthy *et al.* (1992), Hopple (1987), Chandler (1982), Adelman *et al.* (1985), Bailey & Pearson (1983), Ives *et al.* (1983), Evans & Riha (1989) |
| Effic8 | Response/turnaround time | The time required for the DSS to process queries. | Adelman *et al.* (1985), Ives *et al.* (1983) |
| Effic9 | Throughput | The sufficiency of the amount of material flowing though the DSS. | Chandler (1982), Evans & Riha (1989), Van Tran (1990) |
| Effic10 | Time taken for task accomplishment | Effect of the DSS on the time required for completing a decision making task. | Alavi & Joachimsthaler (1992), Sanders & Courtney (1985), Udo & Davis (1992), Evans & Riha (1989), Finlay (1993), Udo (1992), Hopple (1987), Keen (1981), Van Tran (1990) |
| Effic11 | User productivity | Effect of the DSS on user efficiency. | Mahmood & Sniezek (1989), Hamilton & Chervany (1981a), Hopple (1987), Udo & Davis (1992), Udo (1992) |
| Effic12 | Utilisation of assigned resources | The allocation of staff, machines, materials and money within the DSS project. | Bailey & Pearson (1983), Ives *et al.* (1983), Evans & Riha (1989), Chandler (1982), Hamilton & Chervany (1981a) |

The productivity of each relevant constituency may be affected by the DSS project. Ideally, as a result of the DSS, the productivity of a constituency will be improved. This has been referred to by the terms "increased productivity" (Evans and Riha 1989, Finlay 1983), "user decision process utilisation" (Mahmood and Sniezek 1989), and "user performance" (Hamilton and Chervany 1981). From a multiple-constituency perspective it is useful to measure the effect of the DSS on each constituency's efficiency. A group of criteria have been introduced to measure this from the basis of each constituency. These criteria are: "chauffeured decision-maker productivity", "decision-consumer productivity", "decision-maker productivity", "DSS developer productivity", "management productivity" and "user productivity".

The criteria "cost effectiveness" measures the effect of the DSS on the profit of the organisation. The terms "cost-benefit"(Finlay 1993, Evans and Riha 1989), "cost savings"(Keen 1981), "cost-profit"(Alavi and Joachimsthaler 1992) and "profitability" (Finlay 1993, Evans and Riha 1989, Sanders 1984) are closely related to this criteria. All of these factors measure the trade off between the cost of the DSS and the benefits saved and gained through its use.

For a DSS to be successful from an efficiency perspective it must be available when required and should be reliable. The criteria "reliability of system" measures the dependability and reliability of the DSS. Criteria that are also used to measure this factor include "output reliability"(Ives *et al.* 1983) and the "availability of the DSS" (Evans and Riha 1989).

The efficiency of the DSS from a decision standpoint can be determined through measuring any time savings within the decision making process. "Decision speed" (Sanders and Courtney 1985), "time savings" (Evans and Riha 1989, Finlay 1983, Keen 1981, Udo 1992) and "time taken for decision making" (Alavi and Joachimsthaler 1992) are terms that have been used in measuring the time required for the decision process. If the DSS is to be considered efficient the system should reduce, or at worst cause no change to the decision making time. This is measured through the criteria "time required for task accomplishment".

## Satisfaction

The *satisfaction* domain deals essentially with how adequate the DSS is with respect to the views of each constituency. A summary of satisfaction criteria; their definitions and references are shown in *Table 3*. Where criteria have not been defined, definitions have been provided.

Table 3: Satisfaction criteria

| Criteria Number | Criteria | Definition | References |
|---|---|---|---|
| Satis1 | Accurate model construction | The model constructed for the DSS accurately details the decision. | Mahmood & Sniezek (1989), Ramamurthy *et al.* (1992) |
| Satis2 | Adaptiveness | How well the system can change with respect to the decision situation. | Mahmood & Sniezek (1989) |
| Satis3 | Alternative discovery | The ability for the DSS to allow for judgements to be made based on the output of the system and to then be incorporated within the system. | Mahmood & Sniezek (1989), Keen (1981) |
| Satis4 | Attitude of constituency towards the DSS | How you feel towards the DSS. | Bailey & Pearson (1983), Ives *et al.* (1983), Baroudi & Orlikowski (1988), Barki & Huff (1990), Udo (1992), Finlay (1993), Zmud (1979), Hopple (1987), Udo & Davis (1992) |
| Satis5 | Chauffeured decision-maker participation in development | Chauffeured decision-maker involvement with the DSS project during development. | Baroudi & Orlikowski (1988), Zmud (1979) |
| Satis6 | Communication between groups in the DSS project | The manner and methods of information exchange between DSS project groups. | Mahmood & Sniezek (1989), Bailey & Pearson (1983), Ives *et al.* (1983), Baroudi & Orlikowski (1988), Keen (1981), Udo (1992), Udo & Davis (1992) |
| Satis7 | Confidence in the DSS | Feeling certain that the system will perform correctly. | Bailey & Pearson (1983), Ives *et al.* (1983), Adelman *et al.* (1985), Hopple (1987), Mahmood & Sniezek (1989) |
| Satis8 | Convenience of access | The ease of physical access to the DSS. | Bailey & Pearson (1983), Ives *et al.* (1983) |
| **Criteria Number** | **Criteria** | **Definition** | **References** |
| Satis9 | Critical question answering | The ability for the DSS to support questions critical to the business. | Mahmood & Sniezek (1989) |
| Satis10 | Decision complexity decrease | Affect of the DSS on the complexity of the problem from your perspective. | Mahmood & Sniezek (1989), Ramamurthy *et al.* (1992), Adelman *et al.* (1985) |
| Satis11 | Decision-consumer participation in development | Decision-consumer involvement with the DSS project during development. | |
| Satis12 | Decision-maker participation in development | Decision-maker involvement with the DSS project during development. | Baroudi & Orlikowski (1988), Zmud (1979) |
| Satis13 | Decision process extension | Extension in the depth of the decision process. | Mahmood & Sniezek (1989) |

Table 3: Satisfaction criteria (cont)

| | | | |
|---|---|---|---|
| Satis14 | Documentation | The notes provided on how the DSS operates. | Bailey & Pearson (1983), Ives *et al.* (1983) |
| Satis15 | DSS interface applicability | How well the DSS interface matches how you work. | Adelman *et al.* (1985), Hopple (1987), Udo & Davis (1992) |
| Satis16 | Expectations of computer support | Your anticipated benefits of DSS support are met. | Bailey & Pearson (1983), Ives *et al.* (1983), Udo & Davis (1992) |
| Satis17 | Extensive retrieval functions | The access of the system to a wide range of information sources. | Mahmood & Sniezek (1989) |
| Satis18 | Learning facilities provided | The DSS enables learning about the decision task. | Mahmood & Sniezek (1989) |
| Satis19 | Management participation in development | Management involvement with the DSS project during development. | Barki & Huff (1990), Bailey & Pearson (1983), Ives *et al.* (1983), Sanders & Courtney (1985) |
| Satis20 | Perceived information quality | The quality of information from your perspective. | Finlay (1993), Van Tran (1990), Zmud (1979), Ives *et al.* (1983), Evans & Riha (1989), Ramamurthy *et al.* (1992), Hopple (1987) |
| Satis21 | Perceived usefulness of system | How useful you think the DSS is to your work. | Alavi & Joachimsthaler (1992), Bailey & Pearson (1983), Sanders & Courtney (1985) |
| Satis22 | Planning horizon broadening | The DSS helps to extend the planing horizon. | Mahmood & Sniezek (1989), Yoo & Digman (1987) |
| Satis23 | Program modification facilities | Facilities for user defined procedures or functions. | Mahmood & Sniezek (1989), Adelman *et al.* (1985) |
| Satis24 | Relevance of information | Output that relates directly to the decision situation. | Bailey & Pearson (1983), Ives *et al.* (1983), Udo & Davis (1992), Baroudi & Orlikowski (1988) |
| Satis25 | Reliance on DSS | Your dependence on the DSS for your work. | Sanders & Courtney (1985), Mahmood & Sniezek (1989) |
| Satis26 | Security of data | How well the DSS is protected through security measures. | Bailey & Pearson (1983), Hopple (1987) |
| Satis27 | Technical competence | The competence of staff in the development of the DSS. | Bailey & Pearson (1983), Ives *et al.* (1983) |
| Satis28 | Understandability of system | How well the DSS can be comprehended. | Bailey & Pearson (1983), Ives *et al.* (1983), Baroudi & Orlikowski (1988), Mahmood & Sniezek (1989), Adelman *et al.* (1985) |
| Satis29 | User participation in development | User involvement with the DSS project during development. | Baroudi & Orlikowski (1988), Hamilton & Chervany (1981), Zmud (1979) |

Participation of constituencies in the development of DSS is considered a useful indicator of the satisfaction they exhibit towards the system. Terms used to reflect development involvement include "top management involvement" (Bailey and Pearson 1983), "ensuring user involvement" (Zmud 1979) and "ensuring decision-maker involvement" (Ives *et al.* 1983, Hamilton and Chervany 1981). From a multiple-constituency perspective, criteria used to measure the involvement of constituencies in development are "decision-consumer participation in development", "decision-maker participation in development", "management participation in development" and "user participation in development". Each of these criteria measure the level of involvement of each constituency in the development of the DSS. This may affect the level of satisfaction of each constituency with the DSS.

The development and use of the DSS may provide opportunities for constituencies to learn about the decision, or to discover new facets of the decision task. Constituency satisfaction with this is measured using the criteria "alternative discovery", which is also referred to as "new insights and learning" (Keen 1981). The focus of each of these is the measurement of whether the DSS project has enabled constituencies to learn about the decision task.

The satisfaction that constituencies have for the DSS may be affected by their attitudes towards computers, the problem and IT staff. Terms used to measure this elsewhere include "attitude of EDP staff" (Bailey and Pearson 1983), "attitude of IS staff" (Baroudi and Orlikowski 1988), "attitude towards computers" (Hopple 1987) and "attitude towards the problems addressed" (Hopple 1987). Each of these terms focuses on an aspect of the criteria "attitude of constituency towards the DSS".

The satisfaction for the DSS may be effected by the ability of constituencies involved in the DSS project to communicate. This may occur from two major perspectives; the communication dealing with the decision task, and the communication of development issues. Terms used to describe this include "communication facilities" (Mahmood and Sniezek 1989) and "improved communication with IT staff" (Bailey and Pearson 1983).

"Communication facilities" refers to the facilities incorporated into the DSS that enable communication during the decision making process (particularly important for complex decisions that may have multiple decision-makers and users). The other term refers to the communication between the DSS developer constituency and the user, decision-maker and chauffeured decision-maker constituencies. The criteria "communication between constituencies in the DSS project" is introduced here to cater for these issues.

A factor thought to effect the satisfaction of constituencies with the DSS is their confidence in the system. The terms used to refer to this factor include "user confidence" (Mahmood and Sniezek 1989) and "decision-maker confidence" (Adelman *et al.* 1985) which enable measurement from the perspective of only these two constituencies. The criteria used to measure the confidence that a constituency has for the DSS in the multiple-constituency approach is called "confidence in the DSS". An advantage of a DSS project is thought to be the apparent reduction of decision complexity from the perspective of relevant constituencies. The terms "complexity of task" (Ramamurthy *et al.* 1992) and "understandability of task" (Adelman *et al.* 1985) were used to measure the effect of the DSS on the complexity of the decision task. These terms are considered to be synonyms for the criteria "decision complexity decrease".

The satisfaction of each constituency will be affected by their perceptions of the usefulness of the DSS. The criteria "perceived usefulness of the system" focuses on the measurement of how useful the DSS is for the work of a constituency. This essentially measures the utility of the DSS. The "perceived utility" (Bailey and Pearson 1983) of the system and "DSS usefulness" (Sanders and Courtney 1985) have also been used as terms to describe this criteria.

A useful advantage that some constituencies may find as a result of the DSS project is the ability to extend their planning horizon. The satisfaction that each relevant constituency has with the DSS may be affected by this factor. "Long range planning" (Mahmood and Sniezek 1989) and "more effective strategic management" (Yoo and Digman 1987) are terms that are used as synonyms for the criteria "planning horizon broadening". These terms measure the effect that the DSS has on the time frame of strategic plans within the organisation.

An indicator of the satisfaction of constituencies for the DSS may be how much they rely on the DSS to complete their work. The term "DSS dependence" (Sanders and Courtney 1985) has been used as a synonym for the criteria "reliance on DSS". The focus of this criteria is on measuring the dependence of relevant constituencies on the DSS to complete the decision task. The criteria "understandability of system" measures how easy the system and its output are to understand from each relevant constituency's perspective. System understanding is referred to elsewhere as the "understanding of text" (Adelman *et al.* 1985) which measures a subset of this criteria.

## Use

The *use* domain focuses on the direct utilisation of the DSS for the tasks that were intended. *Table 4* summarises criteria within the "use" domain, presenting definitions and references to each criteria.

Table 4: Use criteria

| Criteria Number | Criteria | Definition | References |
|---|---|---|---|
| Use1 | Ease of use | How easy you find the system to use. | Adelman et al. (1985), Van Tran (1990) |
| Use2 | Frequency of use | How often the DSS is used. | Barki & Huff (1990), Udo & Davis (1992), Udo (1992), Lucas (1978), Finlay (1993), Evans & Riha (1989) |
| Use3 | Voluntary use | The use of the DSS without compulsion. | Barki & Huff (1990), Finlay (1993), Lucas (1978) |
| Use4 | Widespread use | How widely the DSS is used. | Ein-Dor & Segev (1978), Sanders (1984) |

The criteria "ease of use", "voluntary use" and "widespread use" are widely used in research to refer to how easy the system is to use, whether use is forced upon constituencies and how widely the DSS is used respectively. How often the DSS is used is measured by the criteria "frequency of use". This criteria is termed elsewhere as "repeat use" (Finlay 1993) and "utilisation" (Evans and Riha 1989). If the frequency of use is high (relative to the type of decision task) then it is likely that the system would be considered successful, although in some rare cases a very successful system may only be used once.

## HIERARCHIES OF CRITERIA

It is not sufficient to merely list criteria within each domain from a multiple-constituency evaluation perspective, as some criteria will not be relevant to all constituencies. A means of presenting the criteria important to each constituency within a multiple-constituency evaluation process is through hierarchical structures, one for each constituency. It is important to note that a given individual may play roles in more than one constituency. A hierarchy is defined as a structure consisting of nodes which occur at different levels, one below the other within a tree like structure. At the top of the structure there is a single node. As we progress down the hierarchy the number of nodes on each level increases as higher level nodes are broken down into their components. The use of a hierarchical structure of criteria has several advantages. First, a hierarchical structure allows criteria to be grouped within similar areas. This will allow the criteria identified above to be grouped within their respective domains, and allows further groupings to occur if necessary. In addition, sub-criteria can be introduced as subordinates to criteria if further depth of evaluation is required. Secondly, a hierarchical structure allows criteria and sub-criteria to be added and removed from the structure as necessary without distorting the evaluation of the DSS. Criteria that are not important for a particular system may be removed from the hierarchy and disregarded during the evaluation process. In addition, if specific criteria are identified by a constituency for a particular DSS these may be included in the hierarchy at any level. Using a hierarchy of criteria in the evaluation process will enable the evaluation of the DSS at any level. That is, a constituency may view the evaluation outcome at any level within the hierarchical structure. For example, management may view the evaluation from the perspectives of the effectiveness, efficiency, satisfaction and use domains to determine how the DSS is performing. If any of these domains indicate that a problem exists with the DSS then management can "drill down" on that domain to determine what criteria are contributing to the problem. The hierarchical structure allows this to be accomplished at any level. Finally, the presentation of the hierarchy in a graphical form enhances the evaluation process as each constituency is able to easily visualise the relationships between criteria. This will enable each constituency to view, in as much detail as they deem necessary, how they have evaluated the system. This will in turn allow problem areas that each constituency have with the system to be quickly identified.

Several constituencies have been identified in previous research. We propose six constituencies that may be involved in the development and evaluation of a DSS. These constituencies are: *the users* (Sprague 1980, Ahituv and Getz 1986, Mahmood and Sniezek 1989), *the chauffeured decision makers* (Sprague 1980, Mahmood and Sniezek 1989), *the decision makers* (Keen 1980, Sprague 1980, Ahituv and Getz 1986, Hamilton and Chervany 1981, Mahmood and Sniezek 1986, Watson *et al.* 1987), *the decision consumers* (Maynard and Arnott 1995), *the DSS developers* (Keen 1980, Sprague 1980, Ahituv and Getz 1986, Hamilton and Chervany 1981, Watson *et al.* 1987) *and management* (Gorry and Scott-Morton 1971, Hamilton and Chervany 1981, Mahmood and Sniezek 1989, Rainer 1989, Watson *et al.* 1987).

This section presents hierarchies of criteria, one for each constituency. Criteria are categorised within domains on the second level, with success forming the top level. They are further grouped, where necessary, on the third level within criteria subgroups dealing with specific areas of interest within the project. At subsequent levels the criteria and sub-criteria, where necessary, are present. These criteria are presented in the hierarchies using criteria numbers from *Tables 1, 2, 3 and 4.*

A number of third level categories are present which are used to group criteria with a similar focus. These categories include issues dealing with: individual personnel, information quality, the decision task, the system, the organisation, the IS group, time, flexibility, constituencies and costs. Not all of these may be present in each constituency's evaluation hierarchy

## A Hierarchy of DSS Evaluation Criteria for Decision-Makers

A hierarchy of criteria important in measuring the success of the DSS from a decision-makers perspective is presented in *Figure 1*.

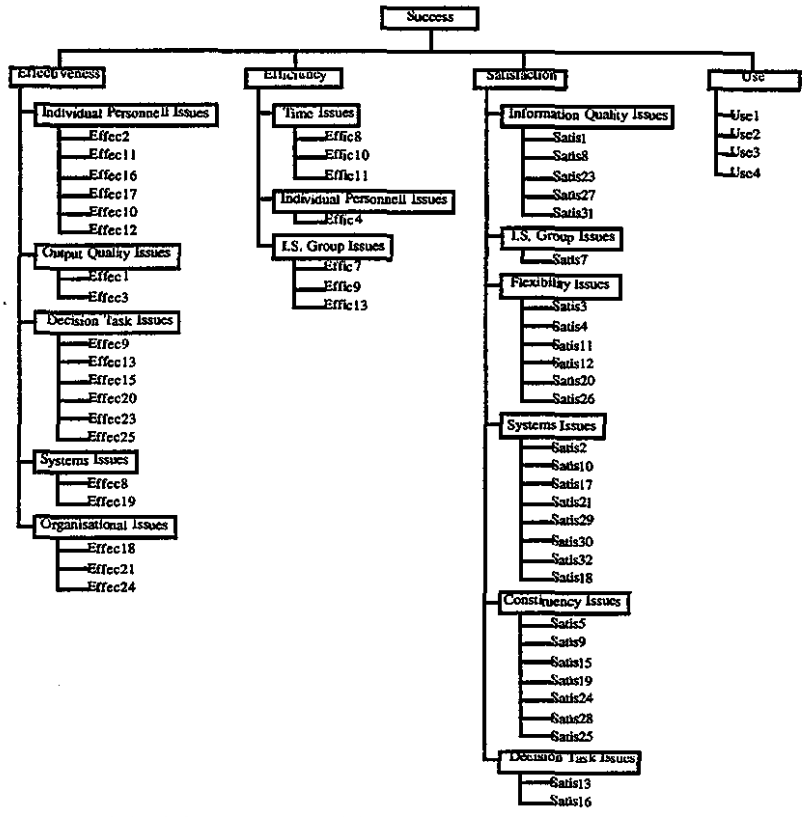


*Figure* 1: A hierarchy of decision-maker DSS evaluation criteria

Criteria in relation to the decision-maker focus on the effect of the DSS on the completion of their job. The decision-maker is one of two constituencies whose job it is to analyse and carry out the decision task. As such, major criteria for the decision-maker focus on the support of the DSS for the decision task, the quality of the decision making process, and the effect of the system on the decision-maker's ability to make decisions. In addition, as the decision-maker also physically uses the system, a focus on criteria dealing with how they work is important. These are captured within the "individual personnel issues" criteria group. These criteria are common for all constituencies who directly interact with the system and its output. Thus, the overall concerns for the decision-maker constituency encompass the needs of the decision task (time, quality and flexibility) and the ability of the DSS to support the decision task.

## A Hierarchy of DSS Evaluation Criteria for Chauffeured Decision-Makers

The chauffeured decision-maker constituency, does not directly use the DSS, rather an intermediatory physically uses the system for the decision maker. A chauffeured decision-maker hierarchy of criteria is presented in *Figure 2*. Criteria important in measuring the success of the DSS from the chauffeured decision-makers perspective are similar to those of the decision-maker constituency, although some differences based on the use of the DSS exist.

The chauffeured decision-maker is less concerned with the operation of the DSS program, focusing on the output of the system to support their decisions. Thus, criteria focusing on

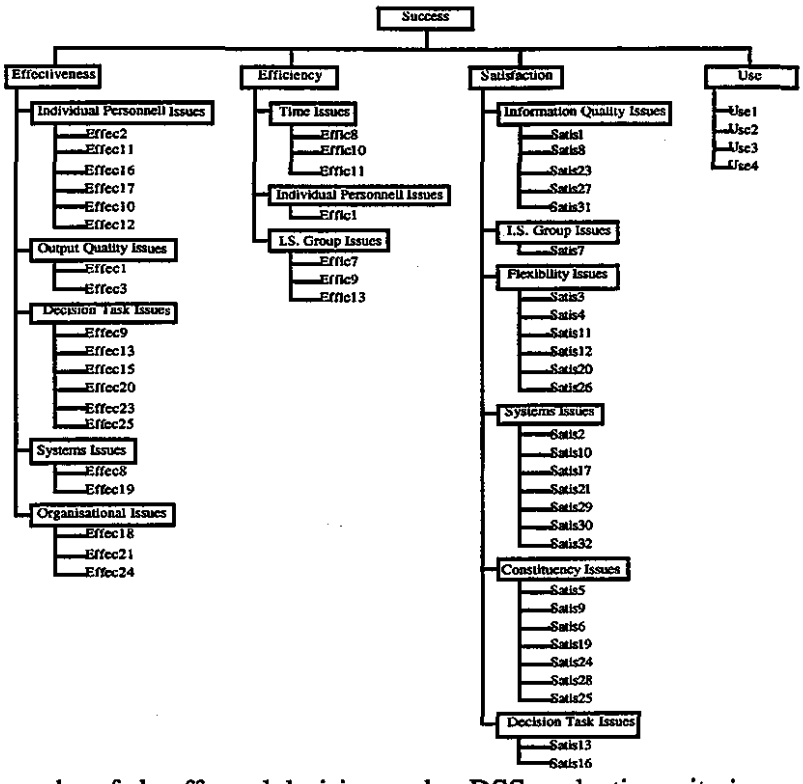


*Figure* 2: A hierarchy of chauffeured decision-maker DSS evaluation criteria

areas dealing with the direct use of the system are not critical in determining the DSS's success.

The chauffeured decision-maker criteria primarily focus on the decision making process and the quality of output produced by the DSS on which decisions are based.

## A Hierarchy of DSS Evaluation Criteria for Management

Management constituency concerns deal with how the DSS has affected the business. A hierarchy of criteria important in the measurement of success from the management perspective are shown in *Figure 3*.

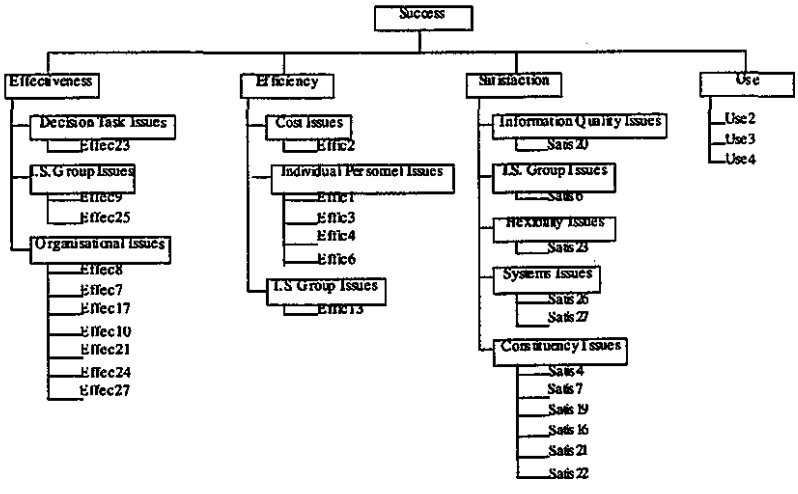


Figure 3: A hierarchy of management DSS evaluation criteria

The role of the management constituency in the DSS project is to determine the benefits that the system will provide to the organisation and to then support the project if the benefits are worth while. A focus on the productivity of constituencies, the quality of decisions and the effect of the DSS on organisational effectiveness will enable the management constituency to rate their perspective of the success of the DSS. The criteria used to determine this are generally more high level than other constituencies, giving the management constituency an overview of the DSS's performance.

## A Hierarchy of DSS Evaluation Criteria for DSS Developers

*Figure 4* shows a hierarchy of criteria that the DSS developer may use to determine the success of the DSS.

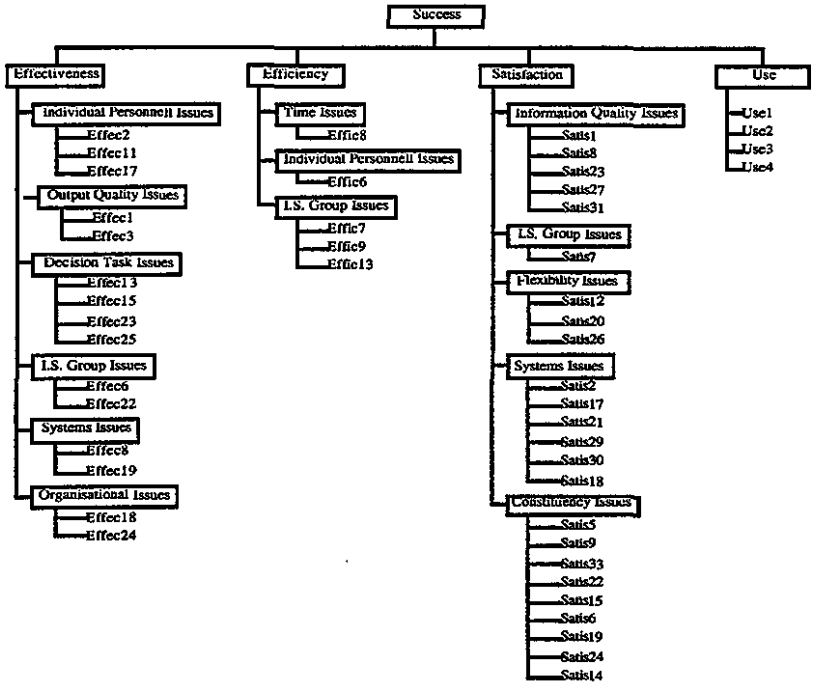


*Figure* 4: A hierarchy of DSS developer DSS evaluation criteria

The role of the DSS developer is to build and support the DSS within the requirements of relevant constituencies. Given this role, the issues that are important to the DSS developer in measuring the success of the system will encompass many of those from the user, decision-maker and chauffeured decision-maker constituencies. The main focus of the criteria for the DSS developer constituency is on meeting the requirements of each constituency. An indicator of this are criteria measuring the involvement of constituencies in development. Also, rather than measuring how well the DSS performs in respect to the criteria, DSS developers may focus on how well they provide that capability within the system.

## A Hierarchy of DSS Evaluation Criteria for Users

The user constituency's role within the DSS project is to use the system on behalf of the chauffeured decision-maker. A hierarchy of criteria important in determining the success of the DSS from the user constituency's perspective is shown in *Figure 5*.

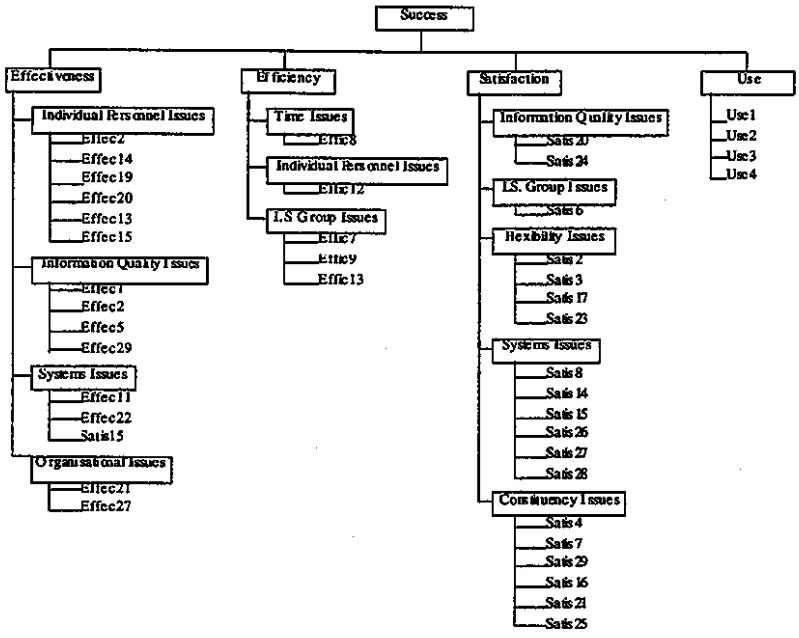


Figure 5: A hierarchy of user DSS evaluation criteria

Criteria important in determining the success of the DSS from the user constituency perspective are mainly based around the use of the system. Criteria such as the ease of system use, adaptiveness of the DSS, throughput and flexibility of the system are important. Where this constituency differs from that of the decision-maker, and chauffeured decision-maker constituencies is the relative unimportance of criteria dealing with the decision task. In addition, like the decision-maker and chauffeured decision-maker constituencies, the user constituency is not concerned with management issues. In summary, the user constituency is primarily focused on the successful use of the system to support the chauffeured decision-maker.

## A Hierarchy of DSS Evaluation Criteria for Decision-Consumers

The decision-consumer constituency is mainly concerned with the appropriateness of the decision being implemented as a result of the DSS. For example, in a decision concerning the purchase of computer equipment those employees who would use the equipment are decision-consumers. *Figure 6* shows the hierarchical set of criteria that the decision-consumer may use to determine the success of the DSS. Decision-consumers are not concerned with the system itself, but rather with the results of the system. The criteria considered important by the decision-consumer constituency focus on the decision being accurate and being made in the appropriate time frame. Criteria such as "accuracy of information", "quality of the decision making process" and "support from the organisation" measure how well the DSS project is performing with regard to the decision being made from a decision-consumer perspective.

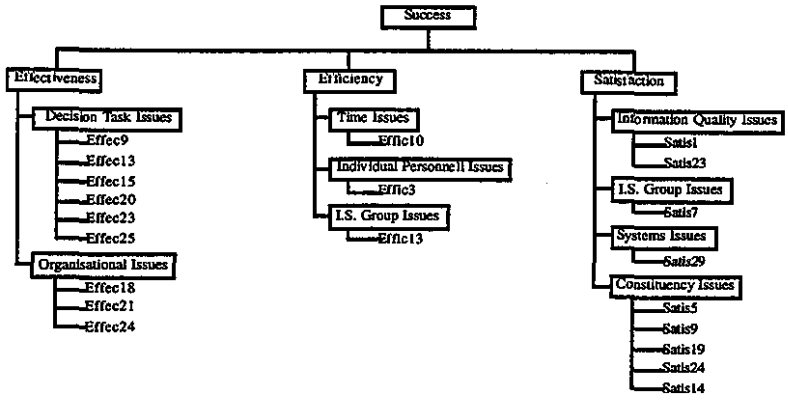


*Figure* 6: A hierarchy of decision-consumer DSS evaluation criteria

This constituency is the only constituency involved in the DSS project that does not consider any criteria to be important within the use domain.

## THE MEASUREMENT OF CRITERIA

The hierarchies of criteria, ,allow each constituency to view their evaluation outcomes within any level of detail within the hierarchy. This may enhance the interaction and understanding that constituencies have of the evaluation. In an evaluation process currently being developed, the identified hierarchies will be used to evaluate the success of DSS projects from a multiple-constituency perspective.

In the multiple-constituency evaluation process currently being developed, criteria will be measured using a bi-polar attitudinal scale. For example, a constituency may be asked to rate how well the system performs with respect to the criteria "perceived usefulness of the system". Measurement may occur along the bi-polar scale "not useful - very useful". Within the evaluation process, members of constituencies will also weight the importance of each criteria to their work, and will then rate the DSS with respect to the criteria at the bottom levels of the hierarchy. These ratings and weights then will be aggregated throughout the hierarchy and each node in the hierarchy will be given an evaluation "score". Scores equate to the success rating of the DSS based on the perspective of each constituency for that criteria.

## CONCLUSION

This paper identifies criteria important to determine the success of a DSS. Within a DSS evaluation it is likely that each constituency will have differing opinions about the factors that are critical to the success of the DSS. Most of the published work dealing with the identification of criteria to be used within an evaluation process neglects to define those criteria. This paper provides definitions of each criteria. As a result, the evaluation process may be improved as constituencies will know precisely what each criteria means.

This paper proposes a hierarchical set of criteria for the evaluation of DSS by each constituency. These hierarchies may further enhance the evaluation of the success of a DSS by providing the ability for each relevant constituency to evaluate the system from their own perspective. Through the use of a hierarchical structure, criteria will be structured in a manner that will enable constituencies to view the evaluation results at any level within the hierarchy. Focusing on the first level of the hierarchy will give an overall view of the success of the DSS. This can become more focused, when necessary, by progressing to the next level of the hierarchy. Presenting hierarchies in a graphical manner will further enhance this process. Constituencies will be able to visualise each level of the hierarchy and can traverse the hierarchy as necessary.

Further research into the multiple constituency evaluation of DSS is currently progressing. The identified generic evaluation criteria is the basis for measuring requirements for each constituency within an evaluation process. Each constituency can add criteria to the generic set contained within the hierarchy as they see fit. In addition, research is being conducted to determine the appropriate delivery mechanisms for evaluation results for each constituency. A prototype computer based evaluation tool which applies this approach is under development.

## REFERENCES


Adelman, L.; Rook, F.W. and Lehner, P.E. (1985). 'User and R&D Specialist Evaluation of DSS'. *IEEE Transactions on Systems, Man, and Cybernetics*, 15:3, 334-342.

Ahituv, N. and Getz, I. (1986). 'A Semiotics Approach for Evaluating DSS'. *DSS-86 Transactions*, 128-135.

Alavi, M. and Joachimsthaler, E.A. (1992). 'Revisiting DSS Implementation Research: A Meta Analysis of the Literature and Suggestions for Researchers'. *MIS Quarterly*, 16:1, 95-116. (March).

Bailey, J.E. and Pearson, S.W. (1983). 'Development of a Tool for Measuring and Analysing Computer User Satisfaction'. *Management Science*, 29:5, 530-544.

Barki, H. and Huff, S.L. (1990). 'Implementing DSS: Correlates of User Satisfaction and System Usage'. *INFOR (Canada)*, 28:2, 89-101. (May).

Baroudi, J.J. and Orlikowski, W.J. (1988). 'A Short-Form Measure of User Information Satisfaction: A Psychometric Evaluation and Notes on Use'. *Journal of Management Information Systems*, 4:4, 44-59. (Spring).

Chandler, J.S. (1982). 'A Multiple Criteria Approach for Evaluating Information Systems'. *MIS Quarterly*, 61-74. (March).

Connolly, T., Conlon, E.J. and Deutsch, S.J. (1980) 'Organisational Effectiveness: A Multiple Constituency Approach'. *Academy of Management Review*, 5:2, 211-217.

DeLone, W.H. and McLean, E.R. (1992) 'Information Systems Success: The Quest for the Dependant Variable'. *Information Systems Research*, 3:1, 60-95. (March).

Ein-Dor, P. and Segev, E. (1978). 'Organisational Context and the Success of Management Information Systems'. *Management Science*, 24:10, 1064-1077. (June).

Evans, G.E. and Riha, J.R. (1989). 'Assessing DSS Effectiveness Using Evaluation Research Methods'. *Information & Management*, 16:4, 197-206. (April).

Finlay, P.N. (1993). 'Measurement of Success for Lone User MIS'. *Journal of Management Information Systems*, 3, 47-67.

Gorry, G.A. and Scott-Morton, M.S. (1971). 'A Framework for MIS'. Sloan Management Review, Reprinted 1989, 49-61. (Spring).

Hamilton, J.S. and Chervany, N.L. (1981). 'Evaluating Information Systems Effectiveness'. *MIS Quarterly*, 5:3, 55-59. (September).

Hopple, G.W. (1987). 'DSS: Software Evaluation Criteria and Methodologies'. *Large Scale Systems*, 12:3, 285-300.

Ives, B.; Olson, M. and Baroudi, J. (1983). 'The Measurement of User Information Satisfaction'. *Communications of the ACM*, 26:10, 785-793.

Keen, P.G.W. (1980). 'DSS: A Research Perspective'. *Data Base*, 12:1/2, 15-25, (Fall).

Keen, P.G.W. (1981). 'Value Analysis - Justifying DSS'. *MIS Quarterly*, 5:1, 1-14. (Mar).

Lucas, H.C. (1978). 'Unsuccessful Implementation: The Case of a Computerised Order Entry System'. *Decision Sciences*, 9, 68-79.

Mahmood, M.A. and Sniezek, J.A. (1989). 'Defining DSS: An Empirical Assessment of End-User Satisfaction'. *INFOR (Canada)*, 27:3, 253-271.

Maynard, S.B. and Arnott, D.R. (1994) 'A Multiple-Constituency Approach to the Evaluation of DSS'. *Proceedings of the Fifth Australasian Conference on Information Systems*, Vol2, 743-753, (September).

Maynard, S.B. and Arnott, D.R. (1995) 'The Major Constituencies in DSS Development, Use and Evaluation' *Working Paper Number 4/95*, Department of Information Systems, Monash University, (Mar).

Rainer, R.K.,. (1989). Successful Executive Information Systems: A Multiple Constituency Approach. University of Georgia. Georgia.

Ramamurthy, K.; King, W.R. and Premkumar, G. (1992). 'User Characteristics - DSS Effectiveness Linkage: An Empirical Assessment'. *International Journal of Man Machine Studies*, 36:3, 469-505. (March).

Sanders, G. (1984). 'MIS/DSS Success, Measures'. *Systems, Objectives, Solutions*, 4, 29-34.

Sanders, G.L. and Courtney, J.F. (1985). 'A Field Study of Organisational Factors Influencing DSS Success'. *MIS Quarterly*, 9:1, 77-93. (March).

Sprague, R.H. (1980). 'A Framework for the Development of DSS', *MIS Quarterly*, 4:4.

Udo, G. (1992). 'Rethinking the effectiveness measures of DSS'. *Information and Management*, 22, 123-135.

Udo, G.J. and Davis, J.S. (1992). 'Factors Affecting DSS Benefits'. *Information and Management*, 23:6, 359-371. (Dec).

Van Tran, H. (1990). 'Successful DSS Development with Traditional Tools and Techniques'. *Journal of Information Systems Management*, 7:3, 46-55. (Summer).

Watson, H.J.; Boyd-Wilson, T. and Magal, S.R. (1987). 'The Evaluation of DSS Groups'. *Information and Management*, 12:2, 79-6. (Feb).

Yoo, S. and Digman, L.A. (1987) 'DSS a New Tool for Strategic Management'. *Long Range Planning*, 20:2, 114-124

Zmud, R.W. (1979). 'Individual Differences and MIS Success: A Review of the Empirical Literature.'. *Management Science*, 25, 966-979.