

Decision Support Systems Research 1990 to 2003: A Descriptive Analysis

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Abstract

This paper is the first major report of a project that is investigating the theoretic foundations of decision support systems (DSS). The project was principally motivated by a concern for the direction and relevance of DSS research. The main areas of research focus are the decision and judgement theoretic base of the discipline, the research strategies used in published articles, and the professional relevance of DSS research. The project has analysed 926 DSS articles published in 14 major journals from 1990 to 2003. The findings indicate that DSS research is more dominated by positivist research than general information systems (in particular experiments, surveys, and descriptions of specific applications and systems), is heavily influenced by the work of Herbert Simon, is poorly grounded in contemporary judgement and decision-making research, and falls down in the identification of the nature of clients and users. Of great concern is the finding that DSS research has relatively low professional relevance. An overview of the direction of further analysis is presented.

Keywords

Decision support systems, group support systems, executive information systems, data warehousing, business intelligence, research, theory.

INTRODUCTION

Decision support systems (DSS) is the area of the information systems discipline that is

focused on supporting and improving managerial decision-making. In terms of contemporary professional practice, DSS includes personal decision support systems, group support systems, executive information systems, online analytical processing systems, data warehousing, and business intelligence.

This project was principally motivated by a concern for the direction and relevance of DSS research. We suspected that research in decision support was increasingly being distanced from professional practice. We also felt that DSS research was addressing an overly narrow range of concepts and issues and in particular we were concerned about the decision theoretic foundation of the area. Further, it seemed that unlike the general trend in information systems research, DSS was strongly dominated by a positivist, quantitative research orthodoxy. To explore these concerns we initiated the project described here. Arnott, Pervan, O'Donnell and Dodson (2004) provided some preliminary results for the project based on the analysis of 380 papers. Since that report we have changed the sample to remove non-academic industry publications and have added articles from 2003 to the sample. As a result this paper presents the first major report of the project. It presents descriptive results based on the analysis of 926 papers.

The paper is structured as follows: first, the background and rationale of the project is presented. The research methodology and design is then defined. The following sections discuss the results in terms of general research approaches, DSS specific factors, and judgement and decision-making. Finally, some concluding comments are made and the future directions of the project are described.

BACKGROUND AND RATIONALE

A number of information systems researchers are concerned that there is a widening gap between research and practice, particularly in the systems development area (Galliers, 1994; Saunders, 1998). Fitzgerald (2000) argues that most current systems development methodologies are based on concepts developed in the period 1967 to 1977. He also argues that changes in the organisational and technical environment since that period have been so great that these methodologies need fundamental review and believes that professional practice is currently leading theory in the development methodology area. This has usually been the case but the divergence is probably greater now than at any other time. Benbasat and Zmud (1999) identified five reasons why information systems research lacks relevance. The first is an emphasis of rigor over relevance in order to gain the respect of other academic disciplines; the second is the lack of a cumulative tradition that yields strong theoretical models that act as a foundation for practical prescription; the third is the dynamism of information technology, which means that practice inevitably leads theory; the fourth is a lack of exposure of IS academics to professional practice; and the fifth is the institutional and political structure of universities which limits the scope of action of IS academics. DSS research, as part of IS research, is likely to be subject to all five forces.

As mentioned in the Introduction, one of the triggers of this project was the perception that the judgement and decision-making foundations of DSS research are relatively narrow. In particular, where judgement is addressed explicitly in DSS research, Simon's process model seems ubiquitous. Simon's model of decision-making (Simon, 1956; 1977) has been used in DSS research since the field's inception and was an integral component of Gorry and Scott Morton's seminal MIS/DSS framework (Gorry & Scott Morton, 1971). Simon won the Nobel Prize for Economics in 1978 for his theory and as a result it is extremely influential in many

social sciences. His model remains the most cited instance of the phase theorem of decision-making. However, in psychological research grave doubts have been expressed about both the descriptive and prescriptive validity of the phase theorem (Lipshitz & Bar-Ilan, 1996). In management research the descriptive and prescriptive validity of Simon's theory has been repeatedly disconfirmed (Witte, 1972; Alexander, 1979). There is no convincing empirical evidence for the prescriptive validity of any form of the phase theorem, including Simon's.

These fundamental, and seemingly fatal, problems with a major foundation of DSS theory have not been widely acknowledged, although a small number of researchers have raised concerns. Angehrn and Jelassi (1994, p. 269) went as far as to claim: "Simon's theory has become a serious obstacle for the evolution of DSS theory and practice". Elam et al. (1992) argued for a broadening of the theoretical base of DSS through the incorporation of contemporary behavioural decision-making research via collaborative projects with psychologists, while Alter (1992) argued that research on DSS as a technical object had biased the field and called for a greater attention on managerial work and decision-making processes in DSS research. Alter's call for change was particularly important as he was an influential early researcher in the area.

METHODOLOGY AND DESIGN

The general research questions that guide this project are:

1. What strategies and methods are used in DSS research?
2. What is the decision support focus and professional relevance of DSS research?
3. What are the judgement theoretic foundations of DSS research?

To answer these questions this project involves the analysis of relevant published research.

This style of research has appeared under a number of descriptions in the information systems literature including ‘review and assessment of research’ (Robey, Boudreau & Rose, 2000), ‘literature review and analysis’ (Alavi & Leidner, 2001), ‘survey’ (Malone & Crowston, 1994), and ‘literature analysis,’ (Pervan, 1998).

Time Frame

The time period of published research chosen for this project is 1990 to 2003. The start of this analysis period is marked by two much cited reviews: Eom & Lee (1990) and Benbasat & Nault (1990). Both of these reviews covered the DSS field from its inception to the late 1980’s. A third review paper focusing on DSS implementation, Alavi and Joachimsthaler (1992), provides a further anchor for the 1990 starting date of our analysis, as does the TIMS/ORSA and National Science Foundation sponsored discipline assessment (Stohr & Konsynski, 1992). The period 1990 to 2003 also marks an interesting period in the development of the information systems discipline as it seemingly witnessed a significant growth in the use of non-positivist research methods. In industry, the analysis period saw the deployment of several new generations of DSS, especially the large-scale approaches of EIS, data warehousing, and business intelligence. To reflect these generations the sample has been divided into three time periods: 1990 to 1994, 1995 to 1999, and 2000 to 2003.

The Article Sample

The sample of articles analysed in this project is DSS research published between 1990 and 2003 in 14 journals: *Accounting, Management & Information Technologies/Information & Organization (I&O)*; *Decision Sciences (DS)*; *Decision Support Systems (DSS)*; *European Journal of Information Systems (EJIS)*; *Information & Management (I&M)*; *Information*

Systems Journal (ISJ); *Information Systems Research* (ISR); *Journal of Information Technology* (JIT); *Journal of Management Information Systems* (JMIS); *Journal of Organisational Computing & Electronic Commerce* (JOC&EC); *Journal of Strategic Information Systems* (JSIS); *Group Decision & Negotiation* (GD&N); *Management Science* (MS); and *MIS Quarterly* (MISQ).

Previous meta-analyses of information systems research have used a similar sampling approach (Benbasat & Nault, 1990; Alavi & Carlson, 1992; Pervan, 1998). Alavi and Carlson (1992) used eight North American journals for their sample. However, Webster and Watson (2002) have criticised the over emphasis on North American journals in review papers. In response we included three top-tier European information systems journals (*ISJ*, *EJIS*, *JIT*) and another (*JSIS*) which has a strong European connection. An alternative approach is to focus on a small number of influential papers (Alavi & Joachimsthaler, 1992) or to aim for a comprehensive sample of all published research in the area including journal papers, book chapters, and quality conference papers (Webster & Watson, 2002). We adopted a large set of journals as a basis of the sample because we believe that this best represents the invisible college of DSS research. The articles were selected electronically by examining key words and titles. The first and second authors performed a manual check of the table of contents of each issue of each journal. In addition, the text of each potential article for analysis was examined to verify its decision support content. The distribution of articles is shown in Table 1. *DSS* dominates the sample with 35.7% of articles. The discipline share of *DS*, *DSS*, and *JOC&EC* has fallen over time. The latter is probably due to that particular journal's declining interest in collaboration technology. The European journals have a surprisingly low DSS publication rate.

Table 1: Sample by Journal

Journal	1990 -1994		1995 -1999		2000 -2003		Total	
	No of Articles	% of Period	No of Articles	% of Period	No of Articles	% of Period	No of Articles	% of Sample
I&O	5	1.4	8	2.0	2	1.2	15	1.6
DS	32	8.9	20	5.0	10	5.8	62	6.7
DSS	118	33.0	166	41.8	47	27.5	331	35.7
EJIS	9	2.5	9	2.3	3	1.8	21	2.3
I&M	40	11.2	31	7.8	22	12.9	93	10.0
ISJ	7	2.0	4	1.0	3	1.8	14	1.5
ISR	16	4.5	11	2.8	5	2.9	32	3.5
JIT	14	3.9	6	1.5	2	1.2	22	2.4
JMIS	30	8.4	34	8.6	13	7.6	77	8.3
JOC&EC	36	10.1	25	6.3	8	4.7	69	7.5
JSIS	2	0.6	2	0.5	4	2.3	8	0.9
GD&N	13	3.6	59	14.9	39	22.8	111	12.0
MS	18	5.0	13	3.3	7	4.1	38	4.1
MISQ	18	5.0	9	2.3	6	3.5	33	3.6
Total	358	100.0	397	100.0	171	100.0	926	100.0

Procedure

A protocol was used to code each paper. Some papers, termed ‘example articles’, were selected as being representative of the various article types. To calibrate the coding process the example articles were coded independently by two researchers. The third researcher reviewed all responses. The articles were then coded by the three researchers working independently. In coding each paper the emphasis was on the dominant attribute of each factor for each paper. Any uncertainty in coding was referred to one researcher for adjudication. The coding of citations of judgement and decision-making research was also reviewed by one researcher. The coded protocols were entered into an SPSS database for analysis by another researcher. This researcher also performed consistency checks on the coding.

ANALYSIS BY GENERAL RESEARCH FACTORS

In addressing the first research question (what strategies and methods are used in DSS research?) the general research factors considered were research paradigm, research stage, and article type. These factors are not independent but each is a useful lens for analysis in itself. The period of analysis 1990 to 2003 saw a significant move in general information systems research towards interpretivism (Orlikowski & Baroudi, 1991; Walsham, 1995b; Cavaye, 1996) and to a lesser extent, critical theory (Hirschheim, 1992). A major consequence of this paradigmatic trend was the rise of the case study as a major research strategy in information systems (Walsham, 1995a). The movement to a more complex and sophisticated disciplinary structure also occurred in social science in general (Guba & Lincoln, 1994). Table 2 shows the empirical papers in the sample coded for paradigm. DSS research is overwhelmingly dominated by the positivist paradigm with 91% of empirical studies following that approach. Chin and Hirschheim's (2004) study of IS research from 1991 to 2001 reported that 81% of papers had a positivist orientation with 19% using an interpretivist approach. This means that DSS research is more dominated by positivism than general IS research. Examination of the temporal trends in Table 2 shows that interpretivism in DSS research is gradually expanding from its low base.

Table 2: Sample by Research Paradigm

Paradigm	1990 -1994		1995 -1999		2000 -2003		Total	
	No of Articles	% of Period	No of Articles	% of Period	No of Articles	% of Period	No of Articles	% of Sample
Positivist	204	93.2	241	92.0	113	89.0	558	91.8
Interpretivist	15	6.8	20	7.6	14	11.0	49	8.1
Mixed	0	0.0	1	0.4	0	0.0	1	0.2
Total	219	100.0	262	100.0	127	100.0	608	100.0

Galliers (1992) proposed a framework for understanding research and its interaction with theory by conceptualising the research process as a cycle of theory building, theory testing, and theory refinement. Table 3 shows the sample by the dominant stage in the research cycle.

It shows that DSS research is dominated by theory building. On the one hand this is surprising given the life of the area relative to IT in general. Given this longevity it could be expected that theory testing and refinement would now have a much greater focus. In the sample, theory testing has significantly expanded, albeit from a low base. An explanation for the statistics could come from the development of new DSS movements, especially EIS, data warehousing, and business intelligence. Each new movement has required significant theorising and this may keep the theory building percentage of research high in the sample.

Table 3: Sample by Dominant Research Stage

Research Stage	1990 -1994		1995 -1999		2000 -2003		Total	
	No of Articles	% of Period	No of Articles	% of Period	No of Articles	% of Period	No of Articles	% of Sample
Theory Building	251	70.1	255	64.2	101	59.1	607	65.6
Theory Testing	72	20.1	113	28.5	58	33.9	243	26.2
Theory Refinement	13	3.6	12	3.0	4	2.3	29	3.1
Unclear	22	6.1	17	4.3	8	4.7	47	5.1
Total	358	100.0	397	100.0	171	100.0	926	100.0

There are a number of different approaches to classifying the type of research in addition to paradigm and stage of research. The approach used in this project is that used by Pervan (1998) in his analysis of published group support systems research. Pervan's taxonomy was based on Alavi and Carlson (1992). The only modification has been to substitute "DSS" for "GSS". The article type taxonomy and the distribution of papers are shown in Table 4. Also provided in the table is an example of each article type.

Table 4 shows that around one-third (32.9%) of DSS research is non-empirical, with two-thirds (67.1%) empirical. Chin & Hirschheim's (2004) analysis of overall IS research reported a significantly different split between non-empirical (40%) and empirical (60%). DSS research has significantly more empirical research than general IS. The high 17.4% figure for

the category “Description of Specific Application, System etc” and the low combined case study score of 8.4% are particularly noteworthy.

Table 4. Sample by Article Type

Article Type		Number	%	
Non-Empirical	Conceptual Orientation	DSS Frameworks	41	4.4
		Conceptual Models	23	2.5
		Conceptual Overview	45	4.9
		Theory	20	2.2
	Illustrative	Opinion & Example	19	2.1
		Opinion & Personal Experience	4	0.4
		Tools, Techniques, Methods, Model Applications	91	9.8
	Applied Concepts	Conceptual Frameworks & Their Application	62	6.7
	Empirical	Objects	Description of Type or Class of Product, Technology, Systems etc.	29
Description of Specific Application, System etc.			161	17.4
Events/Processes		Lab Experiment	176	19.0
		Field Experiment	15	1.6
		Field Study	33	3.6
		Positivist Case Study	48	5.2
		Interpretivist Case Study	30	3.2
		Action Research	7	0.6
		Survey	68	7.3
		Development of DSS Instrument	4	0.4
		Secondary Data	23	2.5
		Simulation	27	2.9

ANALYSIS BY DSS FACTORS

In answering the second research question (what is the decision support focus and professional relevance of DSS research?) the DSS factors addressed were DSS type, organisational level of support, decision support focus, and practical relevance. Decision support systems, while addressing the computer-based support of management decision-making, is not a homogenous field in terms of applications. There are a number of different approaches to DSS and each has had a period of popularity in both research and practice (Arnott & O’Donnell, 1994). One way of classifying a DSS is by the nature of the information systems development. Each of these “DSS types” represents a different philosophy of support, system scale, level of investment, and potential organisational impact.

Personal DSS (PDSS) are small-scale systems that are normally developed for one manager (or a small number of independent managers) for one decision task. PDSS are the oldest form of decision support system (Keen & Scott Morton, 1978) and include modelling systems and what industry currently terms “analytics”. In a PDSS an individual manager has power or responsibility for the decision but in a group support system (GSS) decision responsibility is shared by a number of managers and a number of managers need to be involved in the decision process. GSS are typically implemented as electronic meeting systems (Dennis et al., 1988) or group decision systems (Pervan & Atkinson, 1995). Negotiation support systems (NSS) also operate in a group context but as the name suggests they involve the application of computer technologies to facilitate negotiations (Rangaswamy & Shell, 1997).

Executive information systems were originally systems that aimed to support senior executives (Rockart & DeLong, 1988) but quickly spread through all management levels. They are oriented towards reporting aspects of organisational performance using multidimensional databases or OLAP (online analytical processing) technology (Codd, Codd & Salley, 1993). A data warehouse is a set of databases created to provide information to decision makers (Cooper et al., 2000). There are two fundamental approaches to data warehouses: enterprise level data warehouses (Inmon & Hackathorn, 1994) and division or department level data marts (Kimball et al. 1998). Data warehouses can also be viewed as an attempt to provide a large-scale infrastructure for decision support in that PDSS and EIS can use data from the data warehouse and data marts.

Artificial intelligence techniques have been applied to decision support and these systems are normally called intelligent DSS or IDSS (Bidgoli, 1998) although the term knowledge-based DSS has also been used (Doukidis, Land, & Miller, 1989). Knowledge management as an

information systems movement has also had an impact on DSS research with a major conference on the topic being held in 2000 (Carlsson et al., 2000).

Table 5 shows that the research is mainly focused in three areas: personal DSS, group systems, and large data driven systems (EIS and data warehouses). Personal DSS and intelligent DSS are declining in attention while data warehousing, knowledge management-based DSS, and negotiation support systems are increasing significantly, although data warehousing and knowledge management-based DSS have a very low of exposure in major journals. This may be a factor in the professional relevance findings discussed later.

Table 5: Sample by DSS Type

DSS Type	1990 -1994		1995 -1999		2000 -2003		Total	
	No of Articles	% of Period	No of Articles	% of Period	No of Articles	% of Period	No of Articles	% of Sample
Personal DSS (incl. analytics)	134	37.4	135	34.0	44	25.7	313	33.8
Group Support Systems	104	29.1	125	31.5	55	33.9	287	31.0
EIS (includes BI & OLAP)	27	7.5	30	7.6	12	7.0	69	7.5
Data Warehouse	0	0.0	2	0.5	9	5.3	11	1.2
Intelligent DSS	58	16.2	55	13.9	14	8.2	127	13.7
Knowledge Mgt based DSS	3	0.8	6	1.5	8	4.7	17	1.8
Negotiation Support Systems	6	1.7	18	4.5	17	9.9	41	4.4
Many	26	7.3	26	6.5	9	5.3	61	6.6
Total	358	100.0	397	100.0	171	100.0	926	100.0

Another way of classifying a DSS is by the unit of analysis of the research. The unit of analysis specifies the focus of the research project and is usually guided by the reference theories and previous domain research used by the researchers. Table 6 shows that the decision support focus of the papers was reasonably spread across system development, information technology, the impact of the systems on the organization, and the decision-making process. Over time researcher focus on development and technology has declined and

research with a focus on decision outcome and organizational impact has doubled. Intuitively, this mirrors the increasing organizational and social focus of IS research in general.

Table 6: Sample by Decision Support Focus

Decision Support Focus	1990 -1994		1995 -1999		2000 -2003		Total	
	No of Articles	% of Period	No of Articles	% of Period	No of Articles	% of Period	No of Articles	% of Sample
Systems Development	83	23.2	87	21.9	30	17.5	200	21.6
Information Technology	95	26.5	96	24.2	35	20.5	226	24.4
Decision Outcome/Org Impact	40	11.2	68	17.1	39	22.8	147	15.9
Decision-making Process	75	20.9	71	17.9	35	20.5	181	19.5
Many	56	15.6	69	17.4	28	16.4	153	16.5
Unclear	9	2.5	6	1.5	4	2.3	19	2.1
Total	358	100.0	397	100.0	171	100.0	926	100.0

The final DSS factor that was analysed was the practical relevance of the research in each article. Any professionally focused academic area (like DSS) needs a reasonable balance between theory development and application since research and practice inform each other (Galliers, 1994). The assessment of practical relevance is a subjective judgement that was informed by the aims and objectives of the paper, the nature of the discussion, and in particular the content of the concluding comments of each paper. The researchers spent considerable time in discussing and reviewing their coding of this factor to assist in calibrating the independent coding processes.

Table 7 shows that overall, only 9.5% of research is regarded as having high or very high practical relevance. On the other hand, 53.2% of research was regarded as having no or low practical relevance. Even though the high and very high practical relevance statistics vary over time periods the figures are so low as to constitute a potential crisis in the DSS discipline. While the project was initiated with a concern for the relevance of DSS research we were surprised by the strength of this adverse finding. We believe that all of the factors identified by Benbasat and Zmud (1999) are in play in DSS research. The relative lack of

exposure of academics to contemporary professional practice is a particular problem for DSS.

Table 7: Sample by Practical Relevance

Practical Relevance	1990 -1994		1995 -1999		2000 -2003		Total	
	No of Articles	% of Period	No of Articles	% of Period	No of Articles	% of Period	No of Articles	% of Sample
Very High	3	0.8	2	0.5	4	2.3	9	1.0
High	31	8.7	22	5.5	26	15.2	79	8.5
Medium	121	33.8	164	41.3	80	35.1	345	37.3
Low	178	49.7	173	43.6	66	38.6	417	45.0
None	25	7.0	36	9.1	15	8.8	76	8.2
Total	358	100.0	397	100.0	171	100.0	926	100.0

ANALYSIS BY JUDGEMENT & DECISION-MAKING FOUNDATIONS

The third focusing research question was: What are the judgement theoretic foundations of DSS research? The first sentence of this paper defined DSS as “the area of the information systems discipline that is focused on supporting and improving managerial decision-making”. The managerial nature of DSS seems axiomatic and even one of the first DSS books was titled “Management Support Systems” (McCosh & Scott Morton, 1978). This project identified the primary clients and users in DSS research by evaluating what organisational role was played, or was assumed to be played, by the primary client and user in each paper. Table 8 shows the results of the application of this classification to the sample. Of note are the very high figures in the unclear category: 88.8% for the primary client and 57.3% for the primary user. This lack of identification of the client or sponsor is particularly noteworthy as research has repeatedly found that executive and operational sponsorship are critical success factors for information systems that support managers (Poon & Wagner, 2001). This lack of identification of primary clients and users is a major shortcoming in DSS scholarship.

Table 8: Sample by Primary Client and Primary User

	Primary Client		Primary User	
	Frequency	Percentage	Frequency	Percentage
Executive	52	5.6	67	7.2
Non-Executive Manager	15	1.6	83	9.0
Professional	24	2.6	118	12.7
Other Knowledge Worker	13	1.4	34	3.7
Many	-	-	93	10.0
Unclear	822	88.8	531	57.3
Total	926		872	

Each article was examined to see if any reference theory in judgement and decision-making was explicitly used. Surprisingly, 45.8% of papers did not cite any reference research in judgement and decision-making. Table 9 shows the number of citations to judgement and decision-making reference research for each type of DSS. Group and negotiation support have the most reference citations, with the current professional mainstream of data warehousing having the poorest grounding. As predicted in the Rationale section, of those who cited judgement and decision-making references, the work of Simon was by far the most popular. Another surprising finding was that 79.8% of DSS research did not use a form of the phase theorem of decision-making in their theoretical foundation.

Table 9: Number of Cited Judgement and Decision-making References by DSS Type

Type of DSS	No of Articles	Mean	Standard Deviation	Median
Personal DSS	313	2.28	3.87	1.00
Group Support Systems	287	2.69	3.22	2.00
EIS	69	1.67	2.95	0.00
Data Warehouse	11	0.00	0.00	0.00
Intelligent DSS	127	0.81	1.73	0.00
Knowledge Management Based DSS	17	1.24	1.86	0.00
Negotiation Support Systems	41	2.37	2.66	1.00
Many	61	2.92	4.88	1.00
Total	926	2.16	3.42	1.00

The general theoretical approach to decision-making can be classified in many ways. Two of the most common classifications are used in this project, with the first being the difference between descriptive and prescriptive approaches. A descriptive approach aims to describe how decisions are made in reality and these theories can be useful for understanding the context of

decision support. Prescriptive theories, which are often called normative theories, aim to recommend the best or most appropriate way to make a decision. Some authors use the terms differently and use “prescriptive” for the theory space between purely descriptive and purely normative (Bell, Raiffa, & Tversky, 1988). We use descriptive and prescriptive as descriptors as they are the most commonly used in DSS research, Both descriptive and prescriptive theories have been important for DSS since the early days of the field (Keen & Scott Morton, 1978). Table 10 shows that a prescriptive approach dominates DSS research.

Table 10: Sample by Decision-making Approach 1

	1990 -1994		1995 -1999		2000 -2003		Total	
	No of Articles	% of Period	No of Articles	% of Period	No of Articles	% of Period	No of Articles	% of Sample
Descriptive	90	25.1	86	21.7	49	28.7	225	24.3
Prescriptive	183	51.1	202	50.9	79	46.2	464	50.1
Both	0	0.0	0	0.0	1	0.6	1	0.1
Unclear	85	23.7	109	27.5	42	24.6	236	25.6
Total	358	100.0	397	100.0	171	100.0	926	100.0

The second classification of decision-making approach as being economic or behavioural overlaps with the first. Economic approaches are usually aimed at maximising some objective subject to constraints and tend to be prescriptive (Goodwin & Wright, 1991) while behavioural decision approaches, which come largely from psychology, are usually based on an understanding of actual behaviour (for example, Gigerenzer, 2000). Nevertheless, behavioural approaches can be prescriptive and some economic approaches have descriptive aspects. Table 11 shows that a behavioural approach dominates DSS research.

Table 11: Sample by Decision-making Approach 2

	1990 -1994		1995 -1999		2000 -2003		Total	
	No of Articles	% of Period	No of Articles	% of Period	No of Articles	% of Period	No of Articles	% of Sample
Economic	90	25.1	73	18.4	33	19.3	196	21.2

Behavioural	114	31.8	153	38.5	76	44.4	343	37.0
Both	34	9.5	28	7.1	9	5.3	7.1	7.7
Unclear	120	33.5	143	36.0	53	31.0	316	34.1
Total	358	100.0	397	100.0	171	100.0	926	100.0

CONCLUDING COMMENTS

This paper has reported the first results of a project that aims to critically examine the nature and theoretical foundations of DSS research. Although the reported analysis is only descriptive it does throw some light on the issues and concerns that motivated the study.

Amongst other findings, the analysis suggests that:

1. DSS research is focussed on three main application areas: personal DSS, group support systems, and large-scale data-driven systems. Personal DSS research is declining in influence while large-scale data-driven systems research is increasing.
2. DSS research is strongly dominated by empirical studies that adopt a positivist ontology and epistemology. The most popular research methods used in this group of papers are experiments, surveys, and descriptions of specific applications and systems. DSS research is more dominated by positivism than general IS research.
3. The assessment of the practical relevance of DSS research shows a discipline that is significantly distanced from professional practice.
4. The lack of identification of the nature of the primary clients/sponsors and the primary users of DSS is a major shortcoming of DSS scholarship.
5. Almost half of published DSS research is not grounded in judgement and decision-making research.
6. Prescriptive and behavioural approaches to decision-making are the most cited in DSS research.
7. The work of Herbert Simon is the most influential judgement and decision-making

reference theory in DSS research.

These findings provide DSS researchers with a call for reflexion and reassessment of their discipline. It provides signposts for redefining research agendas to ensure that the discipline prospers. Without this reflexion and redirection we believe that DSS will be increasingly distanced from professional practice, contemporary reference research, and other sub-specializations of IS.

The next stage of the project will involve more sophisticated and complex data analyses, in particular, cross tabulations and correlation analysis. In addition to the descriptive statistics reported in this paper, the questions that we are interested in pursuing include:

- What research paradigms are dominant in the various types of DSS?
- What judgement and decision-making theories underlie the various DSS types?
- What are the organizational and development focuses of the different types of DSS?
- What types of DSS have the highest practical relevance?
- Has the nature and amount of judgement & decision-making research cited changed over time?
- What is the nature of DSS research published in the different journals?
- How is DSS research different to general IS research?

Further, we intend to investigate the nature of the financial support of high quality published DSS research. In particular we are interested in which styles of research and which types of DSS are supported by major competitive grants.

It is hoped that this programs of research can help DSS researchers in understanding the trends in DSS research, suggest future research opportunities and improve the quality and

relevance of their research.

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