Communications of the Association for Information Systems

WHO PAYS FOR DECISION SUPPORT SYSTEMS RESEARCH? REVIEW, DIRECTIONS, AND ISSUES

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ABSTRACT

IS academics are under increasing pressure to apply for national competitive grants, internal university grants, and industry funding to support their research programs. This paper presents an investigation of the nature of DSS research funding through the analysis of 1,020 papers published in 14 high quality journals from 1990 to 2003. In the sample, 23.6% of DSS papers acknowledged grant support, 14.7% were supported by major competitive grants, and only 5.1% received industry grant support. This level of grant funding may be a major problem for the DSS field. Even more worrying is the finding that overall grant support is falling over time. The detailed analysis of DSS research funding shows what types of DSS are grant-funded, where the grant-funded papers are published, what paradigms and methods are grant-funded in DSS research, the relationship between research quality and funding type, and the relationship between grant funding and research relevance. The findings and conclusions relate to DSS research, but because of the proportion of IS research that concerns DSS, they are also important for IS research in general.

Keywords: decision support systems, research, funding, grants, review

I. INTRODUCTION

This paper arose from a series of discussions in early 2004 about the nature of the funding of information systems (IS) research. In Australia, IS academics are experiencing increasing pressure to apply for national competitive grants, internal university grants, and industry funding to support their research programs. University managers usually supplied this pressure, but in an

era of academic budget reductions and the general IT downturn, the pressure increased to unprecedented levels. Further, pressure to measure the research performance of individuals, departments and universities is increasing. External research funding is regarded as a key measure of that research performance, regardless of whether it is actually a measure of input to research rather than output from research.

Research can be financially supported in two ways: first, as an integral part of the standard work of an academic and the recurrent budget of the academic's department, and second, by grants from research funding agencies, industry, and intra-university grant schemes. The first class of support can be termed 'implicit funded', and the second 'grant funded'. Some Australian academics reported that grant funding is now the only source of support for their research; they need grant funding to 'buy out' teaching duties to make time for their research. This phenomenon is not a uniquely Australian academic issue. In informal discussions with a number of senior IS researchers from North America and Europe it is clear that the increase in grant funding pressure on IS academics is a global phenomenon.

One method of discovering the nature of the funding of IS research is to analyze quality publications. This task is large. The sub-field of decision support systems (DSS) was chosen as an appropriate sample to study. DSS is the area of the information systems discipline that is focused on IT-based systems that support and improve managerial decision-making. In terms of contemporary professional practice, DSS includes personal decision support systems (PDSS), group support systems (GSS), negotiation support systems (NSS), executive information systems (EIS), data warehousing (DW), and business intelligence (BI). It also includes those knowledge management systems (KMS) that are directed at management decision-making. If DSS is a representative microcosm of IS, an analysis of the funding of DSS research will provide a foundation for what will be an increasingly vigorous debate on obtaining research resources in our field. Such an analysis is the focus of this paper.

This paper is structured as follows: First, the research method and design is discussed (Section II), followed by the findings of the analysis of DSS research grant funding in the sample (Section III). This analysis provides understanding of how well DSS research is grant funded, what methods and paradigms receive stronger support, the journals popular with grant funded research, the types of DSS which receive funding, what levels of quality research receive grant funding, and the relationship between funding and relevance (Section IV). While the analysis relates to the grant funding of DSS research, important lessons are to be learned for funding IS research in general (Section V).

II. METHODOLOGY

This paper is part of a larger project that is investigating the nature of the DSS field through an analysis of published research. This style of research appears under a number of descriptions in the information systems literature including 'review and assessment of research' [Robey, Boudreau, and Rose, 2000], 'literature review and analysis' [Alavi and Leidner, 2001], 'survey' [Malone and Crowston, 1994], and 'literature analysis' [Pervan, 1998].

TIME FRAME

The time period of published research chosen as the basis of the project is 1990 to 2003. The start of this analysis period is marked by two much cited reviews: Eom and Lee [1990] and Benbasat and 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 starting date of the analysis, as does the TIMS/ORSA and National Science Foundation sponsored discipline assessment [Stohr and Konsynski, 1992]. The period 1990 to 2003 also marks an interesting period in the development of the information systems discipline as it witnessed a significant growth in the use of non-positivist research methods in IS, particularly interpretivist case studies and action research. 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 help identify trends in DSS funding the sample is divided into three periods: 1990-1994 (5 years), 1995-1999 (5 years), and 2000-2003 (4 years).

THE ARTICLE SAMPLE

The sample of articles analysed in this project was DSS research published between 1990 and 2003 in the 14 journals listed in Table 1.

Table 1. Article Sample by Journal

Journal	*No of DSS Articles Published*	*Total No of Articles Published*	*DSS Articles as a Percentage of Published Articles*
Decision Sciences	63	634	9.9
Decision Support Systems	420	777	54.0
European Journal of Information Systems	21	321	6.5
Group Decision and Negotiation	111	290	38.3
Information and Management	94	747	12.6
Information and Organization	15	155	9.7
Information Systems Journal	15	166	9.0
Information Systems Research	33	283	11.7
Journal of Information Technology	22	352	6.2
Journal of Management Information Systems	77	488	15.8
Journal of Organizational Computing and Electronic Commerce	69	211	32.7
Journal of Strategic Information Systems	8	223	3.6
Management Science	39	1664	2.3
MIS Quarterly	33	321	10.3
Total	1,020	6,632	15.4

This sample of journals includes broad ‘management science’ type journals, general IS journals, and, given the focus on DSS research, a few journals that specialise in various types of DSS, namely DSS, GD&N and JOC&EC.

Previous analyses of information systems research used a similar sampling approach [Benbasat and Nault, 1990; Alavi and Carlson, 1992; Pervan, 1998]. Alavi and Carlson [1992] used eight North American journals for their sample. However, Webster and Watson [2002] criticised the over emphasis on North American journals in review papers. In response we included four European information systems journals (ISJ, EJIS, JIT and JSIS). An alternative approach is to focus on a small number of influential studies [Alavi and 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 and Watson, 2002]. This project adopted a large set of journals as the basis of the sample because we believe that this approach best represents the invisible college of quality DSS research. The articles were initially selected by searching key words and titles. A final check was made of the table of contents of each issue of each journal. The text of each potential article for analysis was then examined to verify its decision support content according to the definition of DSS presented in the introduction. After applying this process, the sample comprised 1,020 articles. The nature of the article sample by journal is shown in Table 1. The proportion of DSS articles in each journal does confirm that DSS (54%), GD&N (38.3%), and JOC&EC (32.7%) are indeed journals which specialise in DSS research. Of the general IS journals, JMIS publishes the most DSS research (which is mostly GSS research, as will be discussed later).

CODING PROCEDURE

The protocol used to code each paper appears in the Appendix. 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 the researchers. The coding was discussed and a small number of changes were made to the initial assessments and the protocol. The 1,020 articles in the sample were then coded by the 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 another coder for adjudication. The coded protocols were entered into an SPSS database for analysis by one researcher. This researcher also performed consistency checks on the coding during data entry, after each batch was entered, and again when the final batch of data was recorded.

III. FINDINGS AND DISCUSSION

GENERAL FINDINGS

Only 241, or 23.6%, of the 1,020 DSS papers in the sample acknowledged the support of grant funding for the research in the paper. This statistic is reasonably reliable because the conditions for the award of formal grants normally includes a requirement that any publication that arises from research supported by the grant should acknowledge the granting agency. Major competitive grants from national agencies (for example, US National Science Foundation, Australian Research Council, Research Councils UK, and the Canadian National Research Council) and university grants were the easiest to identify. The identification of the nature of industry funding was more difficult and great care was taken to separate support in the form of cash, which we term an industry grant, from non-monetary support (for example, access to research subjects). Only the monetary support was included in the analysis.

Table 2 shows the nature of research funding in the sample. As can be seen, 19.9% of papers are funded from a single source and some papers (3.8%) involved multiple grant sources. Thus, a single source of funding is the norm. The low level of multiple funding sources in DSS projects demonstrates how difficult it is for DSS (and IS) research to obtain grant support. Overall, 23.6% of the published articles received some funding either from major competitive, industry, or internal

Table 2. The Funding of DSS Research

Funding of a Paper	Number of Articles	% of Sample
Major Competitive Grant	119	11.7
University Grant	56	5.5
Industry Grant	28	2.7
Major Competitive and University Grants	14	1.4
Major Competitive and Industry Grants	12	1.2
University and Industry Grants	7	0.7
Major Competitive, University and Industry Grants	5	0.5
No Grant Funding Acknowledged	779	76.4
Total	1,020	

university grants. What stands out is the dominant proportion (76.4%) of research that did not acknowledge grant funding (even though these papers were published in the major journals in the field). This percentage compares very unfavourably with the medical field. Stein, Rubenstein and Wachtel [1993] report that, in a sample of similar quality medical journals to our sample, 23% of medical research is not supported by grants. They argue that such a 'high' non-granted proportion places the medical discipline at risk! However, in emergency medicine, a relatively new and more applied medical research field, 63% was unfunded [Ernst, Houry and Weiss, 1997].

While this sub-discipline seems more 'at risk', it is still funded much more often than DSS research and, we would suspect, the size of the grants would probably be much greater. Thus, not surprisingly, DSS research is poorly funded by comparison with medical research.

Except for medicine, there is a dearth of analysis on discipline research funding. To investigate grant funding in other fields, keyword searches were performed using academic databases including ProQuest, ScienceDirect, Emerald, Expanded Academic, and EBSCOhost. These databases cover scholarly journals from the fields of business, economics, medicine, science, social science, technology, and law. Keyword searches were also performed using the Google search engine and the Monash University Library catalogue. Because these searches showed only a small number of relevant articles, and only from the field of medicine, several academics from software engineering, computer science, and marketing were consulted. Some specific journals were suggested and subsequently searched using appropriate keywords; this did not identify any relevant articles. Finally, the websites of government research funding agencies including the National Science Foundation, the Australian Research Council and Research Councils UK were explored without success. This lack of published research on research funding in all disciplines except medicine confirms the value of this paper's illumination of funding patterns in IS research.

Table 3. Competitive versus Other DSS Funding

Funding of a Paper	**Number of Articles**	**% of Sample**
Some Major Competitive Funding	150	14.7
Other Grant Funding Only	91	8.9
No Grant Funding Acknowledged	779	76.4
Total	1,020	

Table 3 shows the funding data in a simpler form than Table 2 by dividing the grant-funded papers into those that received some major competitive funding (14.7%) and those that are only funded by university or industry grants (8.9%). In many universities the level of major competitive funding is a key performance indicator for both individual academics and departments. In Australia this performance indicator generates approximately 50% of institutional funding from the government [DEST, 2004]. The very low percentage of major competitive funding in journal-level research therefore points to a difficult institutional environment for the DSS field.

In response to the difficulty of obtaining major competitive grants for DSS research, and IS research in general, deans and department chairs strongly encouraged researchers to approach industry for funding. If the figure for major competitive grants is alarmingly low, then the level of industry funding represents a potential crisis. Only 52 papers in our sample of 1,020, or 5.1%, acknowledge an industry grant. There could be many reasons for the low level of industry funding. Hirschheim and Klein [2004], in a critical assessment of the IS discipline, identified major disconnects between IS researchers and executives, and between IS researchers and IS practitioners. Fundamental to these disconnects is the perception that much IS research is of little relevance to the practice of these two vital constituencies. If this conjecture is true then senior practitioners will be unlikely to fund IS research.

The practical relevance of all papers in the sample was assessed on a five-point scale: none, low, medium, high, very high. While it could be argued that these assessments can be somewhat subjective, they were all evaluated and carefully checked by two researchers, both with extensive experience as DSS researchers and practitioners. As Tables 4 indicates, the relevance levels are disappointing. Half of the papers (50.5%) were considered to be of either low or no practical relevance while less than 10% were of either high or very high relevance. As a result, the median relevance level was the low relevance category, which clearly demonstrates Hirschheim and Klein's disconnect between research and practice.

Table 4. Practical Relevance

	Practical Relevance					
	None	**Low**	**Medium**	**High**	**Very High**	**Total**
Number	77	439	406	88	10	1020
Percent	7.5	43.0	39.8	8.6	1.0	100.0

Benbasat and Zmud [1999] identified five reasons why information systems research lacks relevance:

1. An emphasis of rigor over relevance to gain the respect of other academic disciplines;
2. The lack of a cumulative tradition that yields strong theoretical models that act as a foundation for practical prescription;
3. The dynamism of information technology, which means that practice inevitably leads theory;
4. A lack of exposure of IS academics to professional practice; and
5. 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. Benbasat and Zmud also made nine recommendations to IS researchers of which the following seven relate to improving relevance [Benbasat and Zmud, 1999, p14]:

1. Focus on future interests of key stakeholders.
2. Identify topics from IS practice.
3. Identify, as an academic community, the core research issues that can influence practice in the future.
4. Focus on the likely outcome (that can influence practice) rather than on inputs (academic and intellectual challenges) when choosing a research project.
5. Develop cumulative, theory-based, context-rich bodies of research to be able to make prescriptions and be proactive.
6. Develop frames of references to organize phenomena and provide contingency approaches to managerial action.
7. Portray research outputs in ways practitioners can utilize to justify and rationalize IT related decisions.

Business intelligence and data warehousing are examples of how at least the first four of these recommendations are largely ignored in DSS research. Despite the current downturn in the IT industry, business intelligence and data warehousing vendors continue to report substantial profits and revenue growth [Chen, 2002; Lei, 2002; Whiting, 2003]. The global BI market is expected to reach US $12 billion by 2006 [Darrow, 2003]. As will be discussed later, these two DSS types have received little attention from researchers, yet in terms of investment and impact, they should be the subject of the majority of DSS research. The findings of this study indicate that Benbasat and Zmud's advice should be carefully considered by many DSS researchers. Perhaps the situation will improve and the findings reflect a lag in publishing work of greater professional relevance. One thing that is certain, in our opinion, is that if the relevance of DSS research does not increase significantly, the very low level of industry grant funding will continue.

Even more worrying than the relatively low level of major competitive and industry grant funding is the finding that overall grant support is falling over time. Table 5 shows the situation. The percentage of major competitive grant funding remained fairly constant over the period of this study. However, the level of industry grant funding significantly declined from 8.5% of the published papers in 1990-1994 to only 2.7% in 2000-2003. This decrease shows that IS researchers are finding it more difficult to access industry funding over time. As a result, the proportion of non-grant funded research increased from 73.3% to 79% over the same period. This situation is the reverse of that deans and department chairs aim for.

Table 5. DSS Funding Over Time

Period	Some Competitive. Grant Funding		Some Industry Grant Funding		NonCompetitive Grant Funding Only		No Grant Funding	
	No of Papers	% of Period	No of Papers	% of Period	No of Papers	% of Period	No of Papers	% of Period
1990-1994	56	14.8	32	8.5	45	11.9	277	73.3
1995-1999	61	14.4	14	3.3	33	7.8	329	77.8
2000-2003	33	15.1	6	2.7	13	5.9	173	79.0
Total	150	14.7	52	5.1	91	8.9	779	76.4

One possible explanation for the declining proportion of grant-funded research is that if the number of DSS publications increased over time while the absolute number was constant, the grant-funded proportion would logically be smaller. However, the reverse is the case. The average number of DSS papers in the sample per year has dropped from 77.6 in the period 1990-1994 to 54.8 in the 2000-2003 period. This analysis amplifies the pessimistic nature of the findings.

THE FUNDING OF DIFFERENT TYPES OF DSS

As discussed in the Introduction (Section I), the DSS field consists of research into a number of distinct decision support types. These types are largely defined by the nature of the IT artifact that provides the decision support. Tables 6 and 7 show an analysis of DSS research funding by DSS type. A small number of papers (66 in the total sample) addressed more than one type of DSS and were coded as “Many”. These tended to be review papers.

Table 6: Grant Funding by DSS Type

DSS Type	Papers with a Grant	% of Grant Funded Papers
Personal DSS	87	36.0
Group Support Systems	74	30.7
EIS/BI	14	5.8
Data Warehouse	1	0.4
Intelligent DSS	37	15.4
KM-based DSS	5	2.0
Negotiation Support Systems	12	5.0
Many	11	4.6
Total	241	

Table 6 shows that the DSS types with the greatest grant support are personal DSS (36.0% of funded papers), group support systems (30.7%) and intelligent DSS (15.4%) while EIS/BI, NSS, and the “Many” category receive moderate support. However, data warehousing (0.4%) and KM-based systems (2.0%) are the least supported. Table 7 shows the data in a different way by calculating the percentage of grant-funded papers within each type of DSS. Note that the percentages do not add to 100% across each row because some papers received grant funding of more than one type.

Table 7 shows that negotiation support systems, GSS, and personal DSS proportionally received the most competitive funding (all above the overall average of 14.7%) and KM-based DSS and data warehousing the least. An analysis of competitive funding of types of DSS against time (not shown in a table, but summarised here) found that:

- some increased (EIS from 3.7% in 1990-1994 to 26.7% in 2000-2003, KM-based DSS from 0 to 16.7%, and NSS from 0 to 17.6% - though the latter was highest in 1995-

Table 7. Funding Sources of Different Types of DSS

DSS Type	Some Competitive Grant Funding		Some Industry Funding		Non Competitive Grant Funding Only		No Grant Funding	
	No of Papers	% of Type	No of Papers	% of Type	No of Papers	% of Type	No of Papers	% of Type
Personal DSS	55	15.3	14	3.9	32	8.9	273	75.8
Group Support Systems	48	16.1	24	8.1	26	8.7	224	75.2
EIS/BI	9	12.2	3	4.1	5	6.8	60	81.1
Data Warehouse	1	7.7	0	0.0	0	0.0	12	92.3
Intelligent DSS	20	13.6	6	4.1	17	11.6	110	74.8
KM-based DSS	2	9.5	3	14.3	3	14.3	16	76.2
Negotiation Sup Systems	10	24.4	0	0.0	2	4.9	29	70.7
Many	5	7.6	2	3.0	6	9.1	55	83.3
Total	150	14.7	52	5.1	91	8.9	779	76.4

1999), but all of these increases are based on low absolute numbers and may not imply a significant real trend;

- some were relatively stable over time (Personal DSS, data warehousing, intelligent DSS); and
- GSS declined (from 21.3% in 1990-1994 to 12.5% in 2000-2003), perhaps implying that its perceived importance is declining.

Further, when the research that received some industry funding is examined, KM-based DSS and GSS are above the average (5.1%) while none of the data warehousing papers received any industry funding. Examination of industry funding over time shows an almost identical pattern to competitive funding with GSS again declining (from 17.6% to zero).

These findings further reinforce Hirschheim and Klein's disconnect between research and practice proposition because data warehousing is by far the most commercially relevant DSS type, but received the lowest grant support. It could be argued that data warehousing is too new a DSS application area to have many major journal publications and grant funding. However, data warehousing has been one of the dominant professional area of DSS since the mid-1990s, with the publication of two best-selling professional books in the area marking its mainstream acceptance [Inmon and Hackathorn, 1994; Kimball, 1996]. DSS researchers have had ample time to conduct quality research into data warehousing and win major competitive and other important grants. This research and practice disconnect is also reinforced by the fact that negotiation support systems, a relatively less significant DSS type (particularly from an industry point of view), received the highest competitive grant proportion and no industry supported publications.

DSS FUNDING IN DIFFERENT JOURNALS

To facilitate the analysis of the funding of DSS research in different journals it was necessary to classify the journals into categories relating to regions and quality. Geographically the journals were classified by their European or United States' origin. Other analyses of IS journal publishing have found a significant difference between the nature of research published in North American and European journals [Chen and Hirschheim, 2004; Lowry, Romans, and Curtis, 2004]. The quality of journals was classified as 'A' level or 'Other'. The quality classification was based on a number of publications that address journal ranking [Mylonopoulos and Theoharakis, 2001; Whitman et al., 1999; Hardgrave and Walstrom, 1997; Walstrom et al., 1995; Holsapple et al., 1994; Gillenson and Stutz, 1991] and on discussions with a number of journal editors. The journal classification scheme used in this paper is shown in Table 8.

Table 8: Journal Classification

Group	Journals
US 'A'	Decision Sciences, Information Systems Research, MIS Quarterly, Management Science
US 'Other'	Decision Support Systems, Group Decision and Negotiation, Information and Management, Information and Organization, Journal of Management Information Systems, Journal of Organizational Computing and Electronic Commerce
Europe 'A'	European Journal of Information Systems, Information Systems Journal
Europe 'Other'	Journal of Information Technology, Journal of Strategic Information Systems

Table 9 shows DSS grant funding by class of journal. As would be expected, the table shows US journals dominate in number and percentage. Recall from Table 1 that the overall percentage of grant-funded papers in the overall sample is 23.6%; the final column of Table 9 confirms that the proportion of funded papers in the US journals is a little higher, particularly for the US 'A' journals (27.4%, compared to 24.3% for US 'Other' journals). This result arises from the rather surprising finding that virtually no grant-funded DSS publications appeared in European journals, with only four of the 241 grant funded publications (one of these in European 'A' journals and three in European 'Other' journals). Again, the final column shows this finding with only 2.8% of European 'A' papers and 10% of European 'Other' papers grant funded; much lower than the overall sample funding rate of 23.6%.

Table 9. DSS Grant Funding by Journal Classification

Group	Papers with a Grant	% of Grant Funded Papers	Total Papers	% of Total Papers	% of Papers of Journal Type
US 'A'	46	19.1	168	16.5	27.4
US 'Other'	191	79.3	786	77.1	24.3
Europe 'A'	1	0.4	36	3.5	2.8
Europe 'Other'	3	1.2	30	2.9	10.0
Total	241		1020		

Table 10 shows an analysis of papers within each journal classification, with a more detailed breakdown of funding source. The situation for European journals does not improve with this relative analysis. US 'Other' journals dominate the publishing of grant-funded papers in the sample with 79.3% of papers; they also dominate DSS publishing in general. As a result, the proportion of papers that are supported by major competitive grants within US 'Other' journals (15.4%) is similar to US 'A' journals (16.7%), though the US 'A' journals published 3.1% fewer non-grant funded papers. The proportion of US' A' journals with some industry funding is almost double that for the US 'Other' journals.

Table 10. DSS Funding by Grant Type and Journal Classification

Journal	Some Comp Grant Funding		Some Industry Funding		Non Comp Grant Funding Only		No Grant Funding	
	No of Papers	% of Type	No of Papers	% of Type	No of Papers	% of Type	No of Papers	% of Type
US 'A'	28	16.7	14	8.3	18	10.7	122	72.6
US 'Other'	121	15.4	35	4.5	70	8.9	595	75.7
Europe 'A'	1	2.8	0	0.0	0	0.0	35	97.2
Europe 'Other'	0	0.0	3	10.0	3	10.0	27	90.0
Total	150	14.7	52	5.1	91	8.9	779	76.4

Table 11 shows the funding sources of papers in each journal in the sample. The journals with the highest percentage of the high prestige major competitive grants are ISR (33.3%), JOC&EC (23.2%). MISQ (21.2%) and JMIS (20.8%) – two US 'A' and two US 'Other' journals. On the other hand, three of the four European journals published no major competitive grant-funded papers and neither did I&O, a US 'Other' journal. Table 11 suggests that with the exception of ISR, no strong relationship exists between the prestige of a journal and the prestige of the funding source.

Table 11. DSS Grant Funding by Journal

Journal	Some Competitive Grant Funding		Other Grant Funding Only		Some Industry Funding		No Grant Funding	
	No of Papers	% of Journal	No of Papers	% of Journal	No of Papers	% of Journal	No of Papers	% of Journal
DS	4	6.3	7	11.1	4	6.3	52	82.5
DSS	69	16.4	43	10.2	12	2.9	308	73.3
EJIS	1	4.8	0	0.0	0	0.0	20	95.2
GD&N	18	16.2	7	6.3	3	2.7	86	77.5
I&M	2	2.1	6	6.4	4	4.4	86	91.5
I&O	0	0.0	3	20.0	1	6.7	12	80.0
ISJ	0	0.0	0	0.0	0	0.0	15	100.0
ISR	11	33.3	4	12.1	3	9.1	18	54.5
JIT	0	0.0	3	13.6	3	13.6	19	86.4
JMIS	16	20.8	4	5.2	3	3.9	57	74.0
JOC&EC	16	23.2	7	10.1	12	17.4	46	66.7
JSIS	0	0.0	0	0.0	0	0.0	8	100.0
MS	6	15.4	4	10.3	2	5.1	29	74.4
MISQ	7	21.2	3	9.1	5	15.2	23	69.7
Total	150	14.7	91	8.9	52	5.1	779	76.4

While the numbers for industry grant funding are generally small and patterns are hard to identify, some points do emerge. Practice-oriented 'Other' journals, JOC&EC (from the US) and JIT (from Europe), include above average percentages of industry funded papers. Also, of the 'A' journals, MISQ would be regarded as the most practice-oriented and this is reflected with 15.2% of its papers industry funded.

Table 12. US Journal Grant Funding Over Time

		Some Competitive Funding	Some Industry Funding
US A Journals	1990-1994	18 (20.9%)	8 (9.3%)
	1995-1999	6 (11.3%)	4 (7.5%)
	2000-2003	4 (13.8%)	2 (6.9%)`
	Total	28 (16.7%)	14 (8.3%)
US Other Journals	1990-1994	37 (14.2%)	21 (8.1%)
	1995-1999	55 (15.8%)	10 (2.9%)
	2000-2003	29 (16.3%)	4 (2.2%)
	Total	121 (15.4%)	35 (4.5%)

While the level of competitive grant funding in US 'A' journals is respectable at 16.7% overall, Table 12 shows that it declined substantially from the 1990-1994 period in both absolute and percentage terms. On smaller numbers, the industry funding picture seems more stable, but little can be concluded about trends because of the low numbers. This result contrasts with the US 'Other' journals for which competitive grant funding has remained relatively stable over time (actually showing a slight increase), but the industry funding decreased significantly.

THE FUNDING OF DIFFERENT RESEARCH APPROACHES

So far the funding of DSS research was analyzed in terms of the sources of funding, the time period of publication, different types of DSS application, different classes of journals, and specific journals. This section examines DSS research funding in terms of the various research approaches adopted by the authors. As a microcosm of IS research, this analysis of the DSS research approaches that are favored for funding should contain significant implications for IS researchers generally. This subsection analyzes research approaches in the following order:

1. The funding differences between empirical and non-empirical studies,
2. The stages of the research cycle that are addressed,
3. The research paradigms under which researchers operated.
4. Individual research methods used in the sample.

Empirical vs. Non-Empirical Research

Table 13 shows the split between empirical and non-empirical research by grant-funded papers in the sample. Empirical research (68.5% of papers) is much more often funded than non-empirical (31.5%). However, these percentages are only marginally different from the overall number of empirical and non-empirical papers in the sample (66.5% and 33.5%, respectively). We can conclude that while empirical research is more frequently published than non-empirical research, it is only slightly more often grant-funded than non-empirical research.

Table 13: The Grant Funding of Empirical and Non-empirical DSS Research

Research Type	Papers with a Grant	% of Grant Funded Papers	Papers in the Sample	% of Papers
Empirical	165	68.5	678	66.5
Non-empirical	76	31.5	342	33.5
Total	241		1020	

Table 14 shows that in terms of the number of grant-funded papers empirical research dominates in all grant categories, although the percentage of papers within each funding source is similar within empirical and non-empirical research. For example, the percentage of non-grant funded empirical papers (75.7%) is similar to the non-grant funded non-empirical proportion (77.8%).

Table 14. Sources of Empirical and Non-empirical DSS Research Funding

Research Type	Some Comp. Grant Funding		Non-comp. Grant Funding Only		Some Industry Funding		No Grant Funding	
	No of Papers	% of Type	No of Papers	% of Type	No of Papers	% of Type	No of Papers	% of Type
Empirical	103	15.2	62	9.1	39	5.8	513	75.7
Non-empirical	47	13.7	29	8.5	13	3.8	266	77.8
Total	150	14.7	91	8.9	52	5.1	779	76.4

Stage of the Research Cycle

Galliers [1992] proposed a framework (based on Dubin [1978]) 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 15 shows the funding of DSS research according to the stage of the research cycle that each paper focussed on. It shows that around two-thirds (67.2% of papers) focussed on theory building. Theory testing was the second most common focus at 25.7%, while theory refinement comprised only 2.5%, or six papers.

Table 15. DSS Grant Funding by Research Stage Over Time

	Research Stage				
	Theory Building	**Theory Testing**	**Theory Refinement**	**Unclear**	**TOTAL**
1990 - 1994	72 (71.3%)	21 (20.8%)	3 (3.0%)	5 (5.0%)	101 (100%)
1995 - 1999	61 (64.9%)	24 (25.5%)	3 (3.2%)	6 (6.4%)	94 (100%)
2000 - 2003	29 (63.0%)	17 (37.0%)	0 (0.0%)	0 (0.0%)	46 (100%)
TOTAL	162 (67.2%)	62 (25.7%)	6 (2.5%)	11 (4.6%)	

The emphasis on theory building is surprising. It was expected that theory testing would dominate grant-funded research as it is more likely that granting agencies would prefer projects where the investigators worked on the topic area for some time to establish a track record, developed some theory, published, and then sought grant funding. As a result it was also expected that theory building would be predominately non grant-funded.

Table 15 also shows changes over time in research stage funding, and the signs are at least mildly encouraging. In the most recent period the proportion of grant funded papers allocated to theory building dropped slightly to 63%, and the theory testing category increased fairly significantly to 37%, so the field gained some maturity. Further, the proportion of grant-funded papers that were unclear on their research stage fell – a sign of better quality in research design. On the other hand, in a supposedly well-established field like DSS, it was expected that research which leads to theory refinement would be often conducted (and grant-funded). However, as shown in Table 15, little theory refinement research was grant funded overall, and none in the most recent 2000-2003 period.

Table 16. Sources of DSS Research Funding by Research Cycle

Stage	**Some Compet. Grant Funding**		**Some Industry Grant Funding**		**Non-compet. Funding Only**		**No Grant Funding**	
	No of Papers	% of Type	No of Papers	% of Type	No of Papers	% of Type	No of Papers	% of Type
Theory Building	102	15.1	34	5.0	60	8.9	515	76.1
Theory Testing	38	14.7	14	5.4	24	9.3	197	76.1
Theory Refinement	5	14.7	1	2.9	1	2.9	28	82.4
Unclear	5	10.0	3	6.0	6	12.0	39	78.0
Total	150	14.7	52	5.1	91	8.9	779	76.4

Table 16 shows detail of the funding sources within each stage of the research cycle. Examination of those papers that received some competitive grant funding shows that the percentage of papers is very consistent across each stage, and this also holds approximately true for industry funding, non-competitive funding and no funding. This shows that proportionally, overall grant funding (and non-funding) and individual sources of grant funding are independent of theory stage. Again, this contradicts the expectation that grant funding would favour research at a more advanced theory stage.Research Paradigms

Table 17. Research Paradigm vs. Time for DSS Grant Funded Papers

	Positivist	**Interpretivist**	**Critical**	**Mixed**	**Unclear**	**Total**
1990 - 1994	66 (65.3%)	6 (4.0%)	0	0	31 (30.7%)	103 (100%)
1995 - 1999	57 (60.6%)	2 (2.1%)	0	0	35 (37.3%)	94 (100%)
2000 - 2003	34 (73.9%)	1 (2.2%)	0	0	11 (23.9%)	46 (100%)
TOTAL	157 (65.1%)	7 (2.9%)	0	0	77 (32.0%)	

In Table 17 the grant-funded articles are classified by the research paradigm they adopted. The table shows that:

1. A significant proportion of these grant-funded papers are unclear on the research paradigm they utilise, though the time trend shows that this lack of clarity is much improved in more recent periods. This data is an indication of improving quality in DSS research.
2. The critical paradigm is non-existent in DSS research despite the promotion of this approach by leading IS research scholars (such as Hirschheim [1992]).
3. Grant-funded DSS research, where the paradigm is made clear, is almost entirely positivist, although during the period of analysis, 1990 to 2003, we saw a significant move in general information systems research towards interpretivism [Orlikowski and Baroudi, 1991; Walsham, 1995a; 1995b; Cavaye, 1996]. Further, the time trend is to even more positivist research being funded (73.9% in 2000-2003 compared to 65.1% overall).
4. None of the grant-funded DSS research adopted a mixed paradigm, in contrast to Mingers' [2001] view that "research results will be richer and more reliable if different research methods, preferably from different (existing) paradigms are routinely combined together". This view is supported by many other IS researchers [for example, Goles and Hirschheim, 2000; Schultz and Hatch, 1996].

The question remains, however, of whether the above findings apply only to grant-funded DSS research or are typical of DSS research in general.

Table 18. Research Paradigm versus Time for All DSS Papers

	Positivist	**Interpretivist**	**Critical**	**Mixed**	**Unclear**	**Total**
1990 - 1994	217 (57.4%)	15 (4.0%)	0	0	146 (38.6%)	378 (100%)
1995 - 1999	254 (60.0%)	21 (5.0%)	0	1 (0.2%)	147 (34.7%)	423 (100%)
2000 - 2003	146 (66.7%)	15 (6.8%)	0	0	58 (26.5%)	219 (100%)
TOTAL	617 (60.5%)	51 (5.0%)	0	1 (0.1%)	351 (34.5%)	1020

Table 18 shows the data for paradigm over time for the total sample of 1,020 papers. The table shows that the antipathy towards critical and mixed paradigm studies is the same for all DSS papers, whether they are grant funded or implicitly funded. Further, the frequent lack of clarity on paradigm and its improving trend also applies to DSS papers in general. Also, the positivist paradigm is dominant and there is a trend to greater dominance of positivism over time. However, the positivist dominance is not as strong in overall DSS research. There is proportionally more interpretivist DSS research in the overall sample than in the grant funded papers and the proportion of interpretivist DSS research is growing (6.8% in 2000-2003 compared to 4.0% in 1990-1994).

While the interpretivist DSS research published in the major journals increased, it seldom receives grant support. While IS and DSS conference chairs, reviewers and journal editors became more accepting of interpretivist research, it is clear that grant funding bodies have yet to recognise the value of such research. It remains largely unfunded by grants.

Table 19 shows the research paradigms adopted against the various types of grant funding. The last column of the table confirms that the highest percentage of non-grant-funded papers (86%) were interpretivist. An examination of those papers which received competitive grant funding emphasises the dominance of positivism with 15.9% of positivist DSS research receiving competitive funding

Table 19. DSS Funding Sources by Research Paradigm

Paradigm	Some Compet. Grant Funding		Some Industry Funding		Non-compet. Funding Only		No Grant Funding	
	No of Papers	% of Type	No of Papers	% of Type	No of Papers	% of Type	No of Papers	% of Type
Positivist	98	15.9	35	5.7	59	9.6	460	74.6
Interpretivist	4	7.8	4	7.8	3	5.9	44	86.3
Mixed	0	0.0	0	0.0	0	0.0	1	100.0
Unclear	48	13.7	13	3.7	29	8.0	274	78.1
Total	150	14.7	52	5.1	91	8.9	779	76.4

compared to only 7.8% (4 papers) for interpretivist research. However, there are also four industry-funded interpretivist papers (again 7.8%) compared to only 5.7% of positivist industry-funded papers. Though the numbers are small, it seems to be a sign that industry may be a little more open to funding interpretivist studies (which are invariably conducted in the field) than are competitive grant funding bodies.

Research Approaches

Alavi and Carlson [1992] developed a taxonomy of article types largely based on research methods. Pervan [1998] extended the taxonomy and applied it to group support systems research. This taxonomy first divides articles into non-empirical and empirical. Non-empirical studies are then divided into conceptual, illustrative, and applied concepts, while empirical studies are divided into those focusing on objects or events/processes. These categories are further divided into research types as shown in Table 20. Table 20 contains the application of this taxonomy to both the grant-funded papers and to all research papers in the sample.

Table 20. DSS Funding by Article Type

		Grant Funded Papers		Total Papers	
NON-EMPIRICAL		N	%	N	%
Conceptual Orientation	DSS Frameworks	13	5.4	47	4.6
	Conceptual Models	5	2.0	26	2.5
	Conceptual Overview	9	3.7	48	4.7
	Theory	4	1.7	21	2.1
Illustrative	Opinion and Example	4	1.7	21	2.1
	Opinion and Personal Experience	0	0.0	4	0.4
	Tools, Techniques, Methods, Model Applications	30	12.4	112	11.0
Applied Concepts	Conceptual Frameworks and Their Application	11	4.6	63	6.2
EMPIRICAL					
Objects	Description of Type or Class of Product, Technology, Systems etc.	10	4.1	34	3.3
	Description of Specific Application, System etc.	51	21.2	188	18.4
Events/ Processes	Laboratory Experiment	51	21.2	186	18.2
	Field Experiment	6	2.5	16	1.6
	Field Study	8	3.3	36	3.5
	Positivist Case Study	14	5.8	53	5.2
	Interpretivist Case Study	4	1.7	32	3.1
	Action Research	0	0.0	7	0.7
	Survey	12	5.0	69	6.8
	Development of DSS Instrument	0	0.0	4	0.4
	Secondary Data	5	2.0	25	2.5
	Simulation	4	1.7	28	2.7
		241		1020	

Clearly, a few specific research types dominate grant-funded DSS research. The two most commonly grant funded research types are description of specific applications, systems and laboratory experiments, each with 21.2% of the funded papers in the sample. The former are those studies where a specific technology, method, system, or product is developed and described, and was sometimes described as *systems development* [Nunamaker et al., 1991] or, more recently, *design science* [March and Smith, 1995; Hevner et al., 2004]. When these are combined with studies that describe classes of products, technologies, systems, etc. (4.1% of funded papers), we see that over one quarter of grant funded papers are about constructing technologies (where the term 'technology' is used in the broadest sense).

It should be pointed out that design science research also dominates the total DSS sample (note the last column of Table 19 which shows 21.7% of papers are of this type). However, the proportion of design science grant-funded papers is even higher, so the dominance in funding success is clear. While the argument that design science is an important and highly relevant part of IS research [Hevner et al., 2004] is valid, research of this type also constitutes almost all of computer science research which is often the main competition for IS researchers with granting organizations. It may be that this IS research approach is the most successful because it is the most like computer science.

The second most grant-funded research type is laboratory experimental research which, when combined with field experiments, shows experimental research is almost a quarter of grant funded papers (more if simulations are also included). The next most frequently grant-funded research is a type of illustrative research referred to in the taxonomy as "Tools, Techniques, Methods, Model Applications" with 12.4% of grant-funded papers. This research is closely related to design science research, essentially being the step in design science where the idea for the technology takes form, and confirms the dominance of the design science research type. Other points to note with respect to research types is that: (a) there is little action research and none is grant funded; (b) interpretivist case studies are seldom conducted or grant funded; and (c) some conceptual research receives grant funding (12.8% over the four conceptual types). Finally, it should be noted in Table 20 that a close association can easily be observed between the mix of types among the grant funded papers and the total sample (correlation is 0.989), so most of the results about funding of different research methods, with the few exceptions described above, reflect the frequency of use of that method in the total sample.

THE QUALITY OF GRANT-FUNDED RESEARCH

As discussed earlier, universities measure the research performance of individuals and groups in a number of ways. In the Australian university sector this performance is measured by

- the level of major competitive research grant funding,
- research degree completions, and
- refereed publications.

These performance measures are supposed to be indicators of research quality for individual academics and departments. Grant funding is usually regarded as the most significant of these quality measures. In Australia, for example, for the purpose of institutional research funding based on performance, it is weighted at 50%, compared to 40% for research degree completions and only 10% for refereed publications [DEST, 2004]. However, as indicated by the results for our sample of research from 1,020 DSS journal papers, only 23.6% of papers received any acknowledged grant funding at all, only 18.1% received any funding from outside the university, and only 14.8% received any competitive grant funding. These percentages show that by far the great majority of this research, which would normally be regarded as being of good quality because it was published in major journals, is funded implicitly. This finding raises important questions of research quality: Is implicitly funded published research of the same quality as the grant funded published research? Are there any discernible characteristics of quality that distinguish the grant funded research from the implicitly funded research? Is funding type a good

indicator of quality research? Are the funding bodies 'getting it right' and funding the better quality research?

In determining whether there are any characteristics of quality for DSS research papers by which the grant funded and implicitly funded papers could be compared, it was tempting to form a general overall quality judgement of each paper. However, it was felt that this would be (a) too subjective and (b) too difficult to judge given the great range of DSS types, research types, paradigms, and other features. We therefore chose a number of specific features by which DSS research quality might be judged, a strategy frequently used in the past when judging IS research of various types (for example, Pinsonneault and Kraemer [1993] on IS survey research and Benbasat et al. [1987] on IS case studies).

The clarity of the method, analysis, or discussion in a paper is an indicator of the quality of the work. As a result, any factor that is coded as unclear is, in part, a negative assessment of the quality of a paper. An examination of all of the factors coded showed that grant funded and implicitly funded papers were equally unclear on stage of theory, research paradigm, organisational level supported by the DSS, decision support focus, and types of decision-making approach built into the DSS. So, on most of these general factors, the quality of the grant-funded papers was no better than of implicitly funded papers.

This research focused on decision support *systems*. These systems support managerial decision making. Therefore users and clients (who may or may not be the user) should be clearly identifiable. The clear identification of DSS client and user are important criteria by which the quality of a DSS paper could be judged. Tables 21 and 22 contain data about how clearly clients and users were identified in the overall sample and for each type of funding.

Table 21. DSS Funding by Client and User Clarity

		Grant Funded Papers		**Total Papers**	
		No. Papers	%	No. Papers	%
Client	**Clear**	11	4.6	57	5.6
	Unclear	230	95.4	963	94.4
		241		1020	
User	**Clear**	75	31.1	276	27.1
	Unclear	166	68.9	744	72.9
		241		1020	

Table 22. DSS Funding Sources by Client and User Clarity

		Some Comp. Grant Funding		**Some Industry Funding**		**Non-comp. Funding Only**		**No Grant Funding**	
		No of Papers	% of Type	No of Papers	% of Type	No of Papers	% of Type	No of Papers	% of Type
Client	**Clear**	8	5.3	2	3.8	3	3.3	46	5.9
	Unclear	142	94.7	50	96.2	88	96.7	733	94.1
		150		52		91		779	
User	**Clear**	50	33.3	14	26.9	25	27.5	201	25.8
	Unclear	100	66.7	38	73.1	66	72.5	578	74.2
		150		52		91		779	

Examination of the total sample in Table 21 shows that DSS researchers clearly identify the users of their systems in only 27.1% of papers while grant-funded papers are only marginally better at 31.3%. Table 22 confirms that those receiving competitive grants are marginally (but not

significantly) better at 33.3%. Their performance on this criterion is even worse for identification of the client, with only 5.6% identified overall, 4.6% among grant-funded papers generally and 5.3% among competitively funded papers. Thus, quality in this sense is poor in the overall sample and specifically for grant-funded papers. Further, a separate analysis of the data in Tables 21 and 22 against time (not shown here), found no improvement in this quality proxy over time.

Good research is usually well-grounded theoretically [Dubin, 1978; Weber, 2003], and good DSS research should be well grounded in the judgement and decision making literature. Reference literature is cited in a paper for many reasons:

1. to provide background (often just to demonstrate that the author read up on the topic),
2. to discuss research method options, and
3. to demonstrate negative aspects of a paper [Pomfret and Wang, 2003].

In reviewing each paper for its use of judgement and decision making literature, the researchers were careful not to code citations blindly, but only to record those references that were actually used in defining hypotheses, developing research models, or substantiating the application of a technology. Under this strategy the number of 'real' citations is quite low with only 52.8% of all papers using judgement and decision making reference literature, with 54.4% for grant-supported papers, and 60.7% for competitively funded papers. It can be argued, therefore, that the quality of grant-funded DSS research is poor under this criterion, but they are slightly better than the quality of DSS papers overall.

A final aspect of research quality that must be considered in applied disciplines like IS and DSS is relevance. The disconnect between research and practice was discussed already and relevance figures for the overall sample were presented in Table 4. Table 23, presents relevance for the grant-funded papers.

Table 23. Relevance by Funding Type

	Some Competitive Grant Funding		**Some Industry Funding**		**Non-competitive. Funding Only**		**No Grant Funding**	
Relevance	No of Papers	% of Type	No of Papers	% of Type	No of Papers	% of Type	No of Papers	% of Type
Very High	1	0.7	0	0.0	2	2.2	7	0.9
High	14	9.3	3	5.8	2	2.2	72	9.2
Medium	59	39.3	24	46.2	38	41.8	309	39.7
Low	64	42.7	24	46.2	44	48.4	331	42.5
None	12	8.0	1	1.9	5	5.5	60	7.7
	150		52		91		779	

Table 23 shows that relevance is poor for most papers and grant funded papers (either competitive or industry) are almost identical in distribution to those that receive no grant funding. Using the scale from 1 (none) to 5 (very high), the average relevance was 2.52 for competitively funded papers, 2.56 for industry funded papers, and 2.53 for unfunded papers. A one-way ANOVA was performed which showed no significant differences among these categories.

Using relevance as a measure of a paper's quality we see that

- the quality is poor overall, and
- quality is equally poor for competitively funded, industry funded, and implicitly funded papers.

For many years leading IS researchers espoused the importance of making our research relevant (Keen, 1991; Galliers, 1994; Benbasat and Zmud, 1999; Hirschheim and Klein, 2004), but the relevance of DSS papers seems to continue to be fairly low and this low relevance applies as much for grant-funded papers as for implicitly funded papers.

IV. CONCLUDING COMMENTS

SUMMARY OF FINDINGS

The conclusions about DSS research funding that emerge from our analysis relate to

- how well DSS research is grant-funded,
- what types of DSS are grant-funded,
- where the grant-funded papers are published,
- what paradigms and methods are grant-funded in DSS research,
- the relationship between research quality and funding type, and
- the relationship between grant funding and research relevance.

The findings and conclusions relate to DSS research, but because of the high proportion of IS research that concerns DSS, the findings provide insight to IS research in general.

How Well Is DSS Research Funded?

If department heads are looking to their DSS researchers to ease their financial worries, then they may have a problem. DSS research is poorly grant-funded. Only 23.6% of DSS papers in the sample received any grant funding; only 18.1% received any external funding; and only 14.7% received any competitive grant funding. The 1,020 papers in the sample from 14 major DSS and IS journals should represent the best of DSS research. However, 76.4% of papers do not acknowledge funding. Further, only one in seven of these 'best' DSS papers attract the prestigious competitive grant funding which enhances the department or school's reputation and attracts further infrastructure funding from governments. While we found little information on how this funding ratio compares to other disciplines it is apparent that most DSS research is implicitly funded. Our performance in attracting competitive grants is poor compared to disciplines like medicine. Further, because only 5.1% of papers received any industry grant funding, approaching industry for funding is even less successful and, as the time trend showed, the success rate is declining. Lack of industry support represents a major problem in the funding of DSS research.

What Types of DSS are Funded?

The seven branches of DSS research received differing levels of grant funding. The most frequently funded were personal DSS followed by group DSS and intelligent DSS. Executive information systems and business intelligence systems, negotiation support systems and the 'many' category received moderate grant funding, while KM-based DSS and data warehousing papers received almost none. The time trend shows that EIS funding is improving, while personal DSS, data warehousing, and IDSS have been stable, and GSS funding is in decline. Further, these patterns also apply to industry funding over time. These data reinforce Hirschheim and Klein's (2004) proposition about a disconnect between research and practice in IS. For example, data warehousing systems, despite being one of the dominant professional areas of DSS, are studied very little and data warehouse research is almost never grant-funded.

Where are the Grant Funded Papers Published?

Grant funded (competitive or industry) DSS research is published mostly in US journals and almost never in the four major European IS journals. Most of these (in volume) are in US 'Other' journals though two US 'A' journals (MISQ and ISR) and two US 'Other' journals (JOC&EC and JMIS) attract a slightly higher proportion of grant funded papers, perhaps an indication of the quality of those journals. Practice-oriented journals such as JOC&EC from the US and JIT from Europe include above average percentages of industry funded papers. In a worrying trend, US 'A'

journal papers are less often grant-funded in more recent years, either from competitive grants or from industry.

What Paradigms and Methods are Funded in DSS Research?

A number of aspects of research approach were considered. Empirical research is funded by grants more often than non-empirical research for all funding types, but these percentages are mostly a reflection of the overall number of papers published. In terms of theory stage, it comes as somewhat of a surprise that theory building continues to be the dominant research stage among grant funded papers because granting bodies might normally be expected to fund studies where a track record is established and theory is developed and published. Over time, the proportion of grant funded theory building papers is decreasing and the proportion that are unclear about the research stage fell (a sign of improving quality). However, little or no grant-funded papers are devoted to theory refinement. In terms of research paradigm,

- grant funded DSS papers sometimes showed a lack of clarity but this problem is improving over time;
- the use of the critical paradigm is almost non-existent;
- grant funded DSS research is almost entirely positivist (and increasing over time);
- no paper adopted a mixed paradigm; and
- although a growing proportion of published DSS research uses the interpretivist paradigm, it seldom receives grant funding.

It seems that the funding bodies do not yet accept what journal editors and reviewers have been accepting for some time – intrepretivist IS research offers academic value.

The research types most often grant-funded are design science and laboratory experiments, and the least funded are action research and interpretivist case studies. Overall, however, the grant funding of different research methods generally reflects the frequency of the use of those methods in total DSS publishing.

Is Grant Funded DSS Research of Better Quality?

A number of measures of DSS research quality are discussed in this paper:

1. on a number of general and specific factors in the study, grant-funded papers were no clearer on this identification than implicitly funded papers,
2. the users of the DSS studied were usually unidentified (an important issue in DSS research and practice) whether the paper was funded or not,
3. the system clients were even less often clearly identified,
4. the majority of DSS research seems to involve a limited theoretical grounding in judgment and decision making. Grant funded papers are only marginally better grounded than implicitly funded papers.

Is Grant Funded DSS Research Relevant?

The review of these high quality DSS papers shows the disconnect between research and practice is significant. The relevance assessment was poor. Further, the relevance of grant-funded papers was no better than for implicitly funded papers.

LIMITATIONS AND CONCLUSIONS

No research study is free of limitations.

1. This study reviewed a finite set of DSS articles (1,020), but it could be argued that this number is large enough to support the validity of our conclusions.

2. Conducting a literature review and coding the content on various dimensions is, of necessity, rather subjective. However, this limitation is the case for any study of this type and the procedures used and the experience of the researchers ensured that the data was fairly reliable.

3. Any such study of journal papers is dependent on the set of journals chosen. We chose a mix of general management science, information systems, and decision support systems journals that should be sufficiently representative of the field, and also included four European journals to provide an international mix that is generally absent from other studies.

4. This study focused entirely on DSS research and its seven sub-disciplines: personal DSS, group support systems, negotiation support systems, executive information systems, data warehousing, intelligent DSS, and knowledge-based DSS. While DSS is a sub-discipline of the information systems field, our data shows that it is a fairly significant part of that field and the findings may provide lessons for IS researchers.

We believe that the results of this study should encourage a debate about the reliance on research funding, particularly that obtained from competitive grants, to ease the financial burdens of our IS schools and to measure our performance as IS researchers.

In conclusion, in the current global academic environment any discipline that relies on implicit funding of research will not prosper simply because implicit funding no longer provides adequate support for an academic's research career. As a result, the relatively low level of grant funding represents a potential problem for the DSS field. DSS researchers need to exploit existing grant schemes better and need to adapt their designs to the various funding possibilities. This conclusion is especially true for industry grant funding. Researchers need to shift their attention to the data warehousing and business intelligence areas because they are the current IT growth areas. Most, if not all, decision support issues can be studied in those domains. In terms of methodology it is clear that industry will support relevant intrepretivist field studies and design science research. With such a change in emphasis we believe that DSS, an important part of the IS discipline, will prosper.

ACKNOWLEDGEMENTS

This research was supported by a Monash University Small Grant. We would like to thank Rudy Hirschheim, Leslie Willcocks, Graeme Shanks, and Sven Carlsson who collectively triggered the writing of this paper.

Editor's Note: This article was received on February 7, 2005 and was published on August 30, 2005. The article was with the authors for four months for revision.

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EDITOR'S NOTE: The following reference list contains the address of World Wide Web pages. Readers who have the ability to access the Web directly from their computer or are reading the paper on the Web, can gain direct access to these references. Readers are warned, however, that

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APPENDIX I. ARTICLE CODING PROTOCOL

RESEARCH TYPE

R1. Dominant Research Stage:	Theory Building	Theory Testing	Theory Refinement	Unclear	
	1	2	3	4	
R2. Epistemology:	Positivist	Interpretivist	Critical	Mixed	Unclear	N/A
	1	2	3	4	5	6

R3. Article Type (coded according to Table 18) R4. Comments:

R5. Did the paper acknowledge the support of a formal grant? Yes No

R6. If yes, was it:

Major Competitive	University	Industry	MC&U	MC&I	U&I	All 3
1	2	3	4	5	6	7

DSS FACTORS

D1. What type of DSS is the paper addressing?

1. Personal DSS (includes modelling and analytics) 2. Group support systems
3. EIS (includes BI, OLAP and enterprise wide reporting) 4. Data warehouse (includes data marts)
5. Intelligent DSS (includes knowledge-based DSS) 6. Knowledge management-based DSS
7. Many 8. Negotiation support systems

D2. What organizational level is addressed?

1. Individual 2. Small number of independent managers
3. Group 4. Department
5. Division 6. Organization
7. Unclear

D3. What is the decision support focus of the paper?

1. Development 2. Technology
3. Decision outcome/organizational impact 4. Decision process
5. Many 6. Unclear

D4. What is the practical relevance of the paper?

1. Very High 2. High
3. Medium 4. Low
5. None

D5. Comments:

JUDGEMENT and DECISION MAKING FACTORS

J1. Who is the primary client?

Executive	Non-executive Manager	Professional	Other	Unclear
1	2	3	4	5

J2. What is the primary user's functional area? Unclear

J3. Who is the primary user?

Executive	Non-executive Manager	Professional	Other	Unclear	Many
1	2	3	4	5	6

J4. Is judgement and decision-making reference research cited? Yes No

J5. If cited what reference theories? (author/date citations)

What general approach to decision-making is used?

J6.

Descriptive	Prescriptive	Unclear
1	2	3

J7.

Economic	Behavioural	Both	Unclear
1	2	3	4

J8. Is a phase model of decision-making used? Yes No J9. If yes, then which

J10. Comments:

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Communications of the Association for Information Systems

ISSN: 1529-3181