



Strategies for Improving DSS Research

Daniela Gotseva*, Ivajlo Simeonov**, Ioannis Dimakopoulos ***

Computer Systems Department

Technical University of Sofia

Sofia, PostCode 1000, boulevard Kliment Ohridski 8
Bulgaria

Abstract: This paper analyses the nature and state of decision support systems (DSS) research. To understand the state of DSS research an empirical investigation of published DSS research is presented. This investigation is based on the detailed analysis of 1,020 DSS articles published in 14 major journals from 1990 to 2012. The analysis of the professional or practical contribution of DSS research shows a field that is facing a crisis of relevance. Using the history and empirical study as a foundation, a number of strategies for improving DSS research are suggested.

Keywords: Artificial Intelligence, Decision support systems, group support systems, executive information systems, data warehousing, business intelligence, research.

I. Introduction

Decision support system (DSS) is the area of the information systems (IS) 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. Over the three decades of its history, DSS has moved from a radical movement that changed the way information systems were perceived in business, to a mainstream commercial IT movement that all organizations engage. DSS has continued to be a significant sub-field of IS scholarship.

IS, as an academic discipline, is currently at an important stage of its development. It faces a significant downturn in IT activity in commerce and government, which has led to serious decline in student numbers in IS degree programs. At the same time there is a groundswell of concern about the nature and direction of IS research. These concerns include the object of IS research [1], the relevance and rigor of research [2-4], and the general place of IS in academe [5]. An important vehicle in understanding the current state of IS scholarship is the critical analysis of published research [6]. Combined with a reasoned reflection on the discipline, the analysis of quality publications helps understand how IS research can be improved. This paper provides such an analysis for DSS. It is structured as follows: first, a brief history of the DSS field is presented. The history traces its evolution from its radical beginnings to a complex disciplinary structure of partially connected sub-fields. The history provides the context for a critical analysis of published DSS research. The method and design of the literature analysis is described in detail, followed by the presentation and discussion of the analysis findings. Finally, a number of strategies for improving DSS research are suggested.

II. The Current State of Decision Support Systems

Arguably, the premier specialist academic conference on DSS is the biannual IFIP Working Group 8.3 Conference. This conference has been held continuously since 1983 and virtually all leading DSS scholars have presented their ideas in this forum at some time. In 2004 the conference (branded as DSS 2004) was held in Prato, Italy [7]. DSS 2004 comprised 86 research papers; Table 1 shows their breakdown according to the DSS types discussed above. Seven articles were classified as not DSS according to the definition adopted by this paper.

Table 1 shows that almost 40 years after the birth of the field, personal DSS, the oldest type of DSS, still dominates the agenda of researchers. Further, it shows that, as suggested by Nobel Laureate Rabindranath Tagore, "the past is always with us". Every type of DSS, regardless of its age and contemporary professional relevance is represented in the conference program. As each new approach to managerial decision support is added to the information systems research and practice portfolio, each older DSS approach remains in play.

What stands out, as a serious concern in Table 1, is the low proportion of EIS/BI/DW papers at 12.7% of the DSS papers in the program. The low relative frequency in the distribution cannot be explained by novelty, because, as discussed above, they have been mainstream in practice for some time [8-9]. There are no academically rigorous market statistics for EIS/BI/DW but conversations with senior chief information officers indicate that almost all major commercial expenditure in decision support involves these DSS types. The industry research firm, Meta Group, estimates that the data warehouse market is currently worth US\$25billion [9]. IDC, another commercial research firm, believes that data warehousing and business intelligence are central to contemporary IT investment and will remain so for some time [10]. Even allowing for serious overestimation by the CIOs and the commercial researchers, the distribution of papers at DSS 2004 shows a marked disconnect between the agendas of DSS researchers and senior IT professionals.

Table 1. DSS 2004 Papers by DSS Type

DSS Type	No of Articles	% of DSS Articles
Personal DSS	30	38.0
Group Support Systems	9	11.4
EIS (includes BI)	6	7.6
Data Warehouse	4	5.1
Intelligent DSS	10	12.7
Knowledge Management-based DSS	11	13.9
Negotiation Support Systems	6	7.6
Many	3	3.8
Total		79

The analysis of the IFIP Working Group 8.3 Conference proceedings does not provide a definitive assessment of research in the DSS field, only an insight into work-in-progress at that time. To gain a definitive view, a detailed analysis of DSS publications in high quality journals is needed.

III. Literature Analysis Method and Design

To rigorously investigate the nature of the DSS field we analysed 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’ [11], ‘literature review and analysis’ [12], ‘survey’ [13], and the term we adopted, ‘literature analysis’ [14].

There have been a number of critical reviews of DSS publication over the life of the field. Sean Eom’s series of analyses have used bibliometric approaches, including co-citation analysis, to analyse the intellectual structure of the field [15-19]. Other reviews have examined the content of articles but have concentrated on one aspect of the field; for example, Benbasat and Nault [20] only examined empirical research, while Pervan [14] only analysed group support systems. The literature analysis documented in this paper included all sub-groupings, or types, of DSS. It involved the content analysis of each of the 1,020 papers, that is, reading each paper and applying a data collection protocol. This form of data capture is a very labour intensive process but, importantly, it has the advantage that it can illuminate the deep structure of the field in a way that is impossible with citation studies.

A. Time Frame

The time period of published research chosen for this project is 1990 to 2012. The start of this analysis period is marked by two much cited reviews: Eom and Lee [15] and Benbasat and Nault [20]. 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 [22], provides a further anchor for the 1990 starting date of our analysis, as does the TIMS/ORSA and National Science Foundation sponsored discipline assessment [21]. The period 1990 to 2012 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 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 research we divided the sample into three eras: 1990-1997 (7 years), 1998-2005 (7 years), and 2006-2012 (6 years).

B. The Article Sample

The sample of articles analysed is DSS research published between 1990 and 2012 in 14 journals:

Decision Sciences (DS); Decision Support Systems (DSS); European Journal of Information Systems (EJIS); Information and Management (I&M); Information and Organization (I&O), formerly Accounting, Management and Information Technologies; Information Systems Journal (ISJ); Information Systems Research (ISR); Journal of Information Technology (JIT); Journal of Management Information Systems (JMIS); Journal of Organisational Computing and Electronic Commerce (JOC&EC); Journal of Strategic Information Systems (JSIS); Group Decision and Negotiation (GD&N); Management Science (MS); and MIS Quarterly (MISQ).

Previous analyses of information systems research have used a similar sampling approach [14, 23-24]. Alavi and Carlson [24] used eight North American journals for their sample. However, Webster and Watson [25] have criticised the over emphasis on North American journals in review papers. In response we included four European information systems journals (ISJ, EJIS, JIT, JSIS) in our sample. An alternative approach is to focus on a small number of influential papers [22] or to aim for a comprehensive sample of all published research in the area including journal papers, book chapters, and quality conference papers [25]. 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. A manual check was performed 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. This procedure identified 1,020 DSS papers. Table 2 shows the distribution of these papers by journal as well as identifying the percentage of papers in each journal that were

classified as DSS. Overall, 15.38% of published papers between 1990 and 2003 were in the DSS field. When only the general IS journals are examined, the proportion of DSS articles is still a healthy 11.9%. Alternatively, if the journals Management Science and Decision Sciences are removed (as both are generalist journals covering a much wider field of which IS is a relatively small part), the proportion of DSS papers rises to 21.2%. Each of these different measures indicate that DSS is an important part of the IS discipline.

Table 2. Article Sample by Journal

Journal	No of DSS Published Articles	Total No of Published Articles	DSS Articles as a Percentage of Published Articles
Decision Sciences	63	634	9.9
Decision Support Systems	420	777	54.1
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	6.3
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	1,664	2.3
MIS Quarterly	33	321	10.3
Total	1,020	6,632	15.4

C. Procedure

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 and compared. A small number of changes to the initial assessments were made. The remaining articles were then coded by the two authors and a research assistant working independently. The time taken to code each article varied considerably, ranging from one hour for large, complex papers, to ten minutes for the straightforward coding of a known paper. In coding each paper the emphasis was on the dominant attribute of each factor for each paper. For consistency, the coding of articles by the research assistant was reviewed by the first author. The coded protocols were entered into an SPSS database for analysis by the second author, who also performed statistical consistency checks on the coding.

D. The Client and User in DSS Research

As DSS is the area of the information systems discipline that is focused on supporting and improving managerial decision-making, it is important that authors make explicit which type or level of management is addressed by their research. In addition, there are two major roles that managers can play in a DSS: client and user. User is an obvious role. The client is the manager who pays for the system and acts as a champion of the development with other managers. For small systems the client and user are often the same person. This project identified the clients and users in DSS research by evaluating what organisational role was played, or was assumed to be played, by the primary client and primary user in each paper. Table 3 shows the results of the application of this classification to the sample. Of note are the very high figures in the unclear category: 89.3% for the primary client and 58.6% 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 [28]. Further, Poon and Wagner found that effective sponsorship is one of three meta-factors that determine success. The lack of identification of primary clients and users in the sample is a major shortcoming in DSS scholarship.

E. Research Methods and Article Types

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 [14] in his analysis of published group support systems research. Pervan’s taxonomy was based on [24]. The article type taxonomy and the distribution of papers are shown in Table 4.

Table 4 shows that around one-third (33.6%) of DSS research is non-empirical, with two-thirds (66.4%) empirical. Chen and Hirschheim’s [6] analysis of overall IS research reported a significantly different split between non-empirical (40%) and empirical (60%). This means that DSS research has significantly more empirical research than general IS. The high 18.4% figure for the category “Description of Specific Application, System etc” is particularly interesting. As discussed above, DSS was founded with the development of experimental systems for managers. As a result, it has a long history of the publication of descriptions of DSS applications that are novel or important, part of what is now called design science [27]. There is no explicit theory

being tested or being developed by reflecting on the case. As a result, the low combined positivist and interpretivist case study percentage of 8.4% is lower than would be expected in IS research.

Table3. Sample by Primary Client and Primary User

	Primary Frequency	Client Percentage	Primary Frequency	User Percentage
Executive	57	5.6	73	7.2
Non-Executive Manager	15	1.5	94	9.2
Professional	24	2.4	124	12.2
Other Knowledge Worker	13	1.3	34	3.3
Many	-	-	97	9.5
Unclear	911	89.3	598	58.6
Total	1,020		1,020	

Table4. Sample by Article Type

	Article Type		Number	%
Non-Empirical	Conceptual	DSS Frameworks	47	4.6
		Conceptual Models	26	2.5
		Conceptual Overview	48	4.7
		Theory	21	2.1
	Illustrative	Opinion and Example	21	2.1
		Opinion and Personal	4	0.4
		Experience		
		Tools, Techniques, Methods, Model	112	11.0
	Applied Concepts	Applications		
		Conceptual Frameworks and Their Application	63	6.2
Empirical	Objects	Description of Type or Class of Product, Technology, Systems etc.	34	3.3
		Description of Specific Application, System etc.	188	18.4
	Events/Processes	Lab Experiment	186	18.2
		Field Experiment	16	1.6
		Field Study	36	3.5
		Positivist Case Study	53	5.2
		Interpretivist Case Study	32	3.1
		Action Research	7	0.7
		Survey	69	6.8
		Development of DSS	4	0.4
		Instrument		
		Secondary Data	25	2.5
		Simulation	28	2.7

IV. Conclusion: suggestions to improve DSS research

The low practical relevance of DSS research is in part a symptom of research inertia. The architecture of the field is a complex disciplinary structure of partially connected sub-fields. Unfortunately, the earliest sub-fields, now 30 to 40 years old, still dominate quality research publication. It is paradoxical that while DSS publication rate has fallen to early 1990s levels, in practice DSS is one of the only areas of commercial IT that is booming. DSS research is simply focusing on the wrong application areas. As a result CIOs will find little DSS research relevant in planning their IT portfolios. To overcome this disconnects DSS researchers must engage the data warehousing and business intelligence domains. This does not mean a fundamental change of academic activity as many of the theoretical issues that are of interest to PDSS/GSS are also important to, or can be studied in a DW/BI domain.

Another strategy for improving the relevance of DSS research is to increase the number of case studies, especially interpretive case studies. DSS is lagging behind general IS and the adoption of this research paradigm. Put simply, a field that is so removed from practice needs case study work to ensure that the questions it is addressing are both relevant and important. Interpretive case studies can illuminate areas of contemporary practice in ways that natural science-like studies such as laboratory experiments and surveys cannot [26]. Importantly, they can inspire researchers to focus on issues of current importance and build lasting links between academics and senior professionals.

The analysis of the research approaches in our sample showed a significant amount of design science research. The quality of this work varies greatly with a large number of papers focusing on the reporting a

particular implementation. Design science is an important movement in IS research and DSS researchers should be more involved in this style of work, especially as it usually scores highly on relevance assessments. The suggestions of Hevner in [27] should be consulted to help add rigor without compromising the relevance of projects.

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