



The South African Institute for Computer Scientists and  
Information Technologists

**ANNUAL RESEARCH AND DEVELOPMENT  
SYMPOSIUM**

23-24 NOVEMBER 1998

CAPE TOWN

Van Riebeeck hotel in Gordons Bay

Hosted by the University of Cape Town in association with the CSSA,  
Potchefstroom University for CHE and  
The University of Natal

**PROCEEDINGS**

**EDITED BY**

D. PETKOV AND L. VENTER

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**EDITED BY  
D. PETKOV AND L. VENTER**

**SYMPOSIUM THEME:**

**Development of a quality academic CS/IS infrastructure in South Africa**

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Proceedings of the 1998 Annual Research Conference of the South African Institute for Computer Scientists and Information Technologists.

Edited by Prof. D. Petkov and Prof. L. Venter

Van Reebeck Hotel, Gordons Bay, 23-24 November 1998

**ISBN: 1-86840-303-3**

**Keywords: Computer Science, Information Systems, Software Engineering.**

The views expressed in this book are those of the individual authors and not of the South African Institute for Computer Scientists and Information Technologists.

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**Produced by the Library Copy Centre, University of Natal, Pietermaritzburg.**



## **FOREWORD**

The South African Institute for Computer Scientists and Information Technologists (SAICSIT) promotes the cooperation of academics and industry in the area of research and development in Computer Science, Information Systems and Technology and Software Engineering. The culmination of its activities throughout the year is the annual research symposium. This book is a collection of papers presented at the 1998 such event taking place on the 23<sup>rd</sup> and 24<sup>th</sup> of November in Gordons Bay, Cape Town. The Conference is hosted by the Department of Information Systems, University of Cape Town in cooperation with the Department of Computer Science, Potchefstroom University for CHE and and Department of Computer Science and Information Systems of the University of Natal, Pietermaritzburg.

There are a total of 46 papers. The speakers represent practitioners and academics from all the major Universities and Technikons in the country. The number of industry based authors has increased compared to previous years.

We would like to express our gratitude to the referees and the paper contributors for their hard work on the papers included in this volume. The Organising and Programme Committees would like to thank the keynote speaker, Prof M.C.Jackson, Dean, University of Lincolnshire and Humberside, United Kingdom, President of the International Federation for Systems Research as well as the Computer Society of South Africa and The University of Cape Town for the cooperation as well as the management and staff of the Potchefstroom University for CHE and the University of Natal for their support and for making this event a success.

Giel Hattingh, Paul Licker, Lucas Venter and Don Petkov



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# **CRITICAL SUCCESS FACTORS FOR IMPLEMENTATION OF DECISION SUPPORT SYSTEMS**

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## **Abstract**

Decision Support Systems (DSS) are used to support decision-making for a non-structured management problem. DSS utilises data, provides an effective user interface and allows for the decision maker's insights to be applied.

The authors identified from the available literature nine critical success factors (CSFs) namely, User Involvement, Top Management Support, User Training, Information Source, Level of Managerial Activity being Supported, User Information Satisfaction, Relative Use, Perceived Utility and Goal Realisation. A survey of South African organisations which have implemented DSS was conducted. Of these, some were successful and others less successful in their implementation.

Only three of the nine CSFs identified in the literature, namely, Top Management Support, User Training and Perceived Utility, were found in successful organisations. The survey suggested that critical success factors may be absent and yet an organisation's DSS may be successful. The authors suggest the remaining six CSFs be labelled as "important but not essential for success". A previously unidentified CSF is reported on.

**Keywords:** Critical success factors, DSS, Top Management Support, User Information Satisfaction

## **Introduction**

Changes in Information Systems (IS) technology have produced a significant revolution in the opportunities for improved managerial performance. PC-based processing technology connected via networks and the development of "user-oriented" fourth generation languages have resulted in an explosion of DSS and end-user computing activities. In today's competitive environment, organisations cannot afford to miss opportunities for better quality decision-making through the use of elegant DSS [17].

The authors explore published findings of identified critical success factors (CSFs) for the implementation of DSS. As no previously published literature exists, the authors seek to establish whether these same CSFs exist in the developing country of South Africa. This paper explores some of the non-technical issues for organisations embarking on a DSS implementation program. The scope of the research was limited to existing DSS in the KwaZulu-Natal province. This paper intends to provide senior IS management with some guidelines for the implementation of DSS.

The guidelines are developed as a set of CSFs. Rockart [20] defines CSFs as those few key areas of activity in which favourable results are *absolutely necessary* (italics added by authors) for a particular manager to reach his or her goals. CSFs for an organisation are the limited number of areas in which results, if they are satisfactory, will ensure successful competitive performance for the company. They are the key areas where "things must go right". As Thierauf [25] states, if the results in these areas are not adequate, the organisation's efforts for the period will be less than desired. As a result, the critical success factors are areas of activity that must receive constant and careful attention from management [2].

## Background to the Study

Implementation phenomena have been one of the earliest and most actively researched topics in the IS field [3] [8] [18] [15]. As a result of this research, a wealth of knowledge exists regarding those factors which are most likely to influence an information system's successful implementation [14].

Despite the availability of this extensive literature, Kivijärvi and Zmud [13] note that understanding of information systems implementation has not progressed very far in moving from quite general prescriptions to situation-specific prescriptions *i.e.* guidelines for facilitating the implementation of a particular type of information systems within a particular organisational context. Whilst many reasons may exist to explain this lack of progress [14], one explanation is that most research has been focused on examining only first-order effects rather than interaction effects of the variables under investigation.

Kivijärvi and Zmud [13] contend that DSS differ from many other information systems in two major ways. Firstly, the DSS development process tends to be much more evolutionary and iterative in nature than observed with more traditional information systems. Secondly, the specific objectives for implementing a DSS are often more equivocal and numerous than those associated with more traditional information systems. Both these characteristics arise because of the tight bonding that must occur between a DSS and its target problem domain. Implementation of DSS is complex because these systems are not merely information systems that collect, manipulate and distribute information. They are rather linked to tasks that may significantly change the manner in which organisations operate.

Kivijärvi and Zmud [13] believe that defining and measuring the success of an information system has been the most difficult issue with which implementation research has contended. They also believe that evaluating DSS success is particularly burdensome because of the very tight bonding of DSS to the problem context and the DSS propensity to be characterised by broad, ambiguous goal sets when they are initiated. Arising therefrom a number of different measurement approaches have been used with prior DSS research. These have reflected both individual and organisational as well as economic and personal outcomes [23] [21] [27] [7] [26].

A comprehensive DSS implementation model was proposed and tested by Guimares *et al* [10]. These researchers found a positive correlation between DSS success and 1) user involvement, 2) top management support, 3) user training, 4) information source, 5) the level of managerial activity being supported and, 6) the characteristics of the task involved. These success factors form an integral part of the authors' research hypothesis.

The question which arises is why some organisations are succeeding with their DSS implementations while others are not. The design and implementation of a DSS is planned technological change and the success or failure of a proposed DSS depends upon how well the change process is managed [17].

## The Research Hypothesis

There is no general agreement on an absolute indicator for successful DSS implementation [26]. One possible, seemingly quantifiable approach is a cost/benefit study but in practice it is difficult to provide meaningful estimates. Even though detailed records may be maintained during the development stages of the system, an evaluation of the benefits of an information system has eluded most researchers. The question is posed: How does one quantify the benefits of better-informed decision making?

The works of Guimares *et al* [10] and Kivijärvi and Zmud [13] suggest various conditions are critical to the successful implementation of DSS. The authors have combined the conditions suggested by these researchers as being critical to the successful implementation of DSS. For the full text of the questionnaire used by the authors, see Averweg [1]. The associated evidence items were extracted from the available literature.

The questionnaire establishes whether evidence exists in each organisation and for each specific CSF. The CSFs and associated evidence item statement numbers are reflected in Table 1. For the User Involvement CSF and Top Management Support CSF, ownership of the DSS and the existence of a DSS project champion were incorporated in Part One of the questionnaire.

**Table 1. CSFs and associated evidence item statement numbers**

CSF	Associated Evidence Item Statement numbers
User Involvement	1, 5, 17
	A user accepts DSS ownership
Top Management Support	2, 3, 11
	There is a DSS project champion
User Training	4, 6, 7
Information Source	8, 9, 10, 23
Level of Managerial Activity Being Supported	13, 14, 15
User Information Satisfaction	16, 19, 20
Relative Use	18, 21, 22
Perceived Utility	24, 25, 26
Goal realisation	12, 27, 28

## The Research Method

During the period October 1997 to May 1998, the authors sought to establish the presence or absence of the evidence items referred to in Table 1 by conducting a series of structured interviews with:

- business managers/users whose organisations utilise DSS;
- IS department members whose organisations have implemented DSS; and
- academics who have an interest in DSS.

The organisations considered for interview were chosen over a spread of industries and were contacted via academics and industry colleagues. In order to ensure that the interviewee replied specifically relating to DSS, the authors identified DSS as having a set of characteristics.

Eighteen sizeable, well-established, non-government (except one quasi-government) organisations were selected; all of them located in KwaZulu-Natal. In order to evaluate the initial questionnaire design, two DSS User Managers participated in a separate field test. Their comments led to a refinement of the questionnaire instrument. Their contributions are gratefully acknowledged.

Interpretation of the results was based on the answers as provided. This was supplemented by the authors' interpretation of the responses to the open-ended questions. Only after the completed questionnaires had been analysed was it possible to assess the interviewees' responses and to categorise the degree of success in DSS implementation. Thereafter, the results were revisited to determine frequencies of occurrence of evidence items for successful and not successful organisations.

The grading of each organisation's DSS as successful, partially successful or not successful is an assessment by the respondents interviewed. A summary of their assessments is as follows:

Successful organisations : 11 organisations.  
Partially successful : 4 organisations.  
Not successful : 3 organisations.

The questionnaire instrument consisted of three parts:

- Part One dealt with the organisation's demographics, the clarification of the various types of Information System and the distinguishing characteristics of DSS. This preamble to the actual interview meant that the interviewee was properly focused on the DSS information systems in the organisation;
- Part Two consisted of 28 evidence item statements each on a 5-point Likert scale; and
- Part Three contained open-ended questions regarding factors expected to be significantly important to DSS implementation.

Interviews were conducted at the organisations' premises.

## Findings

The structured interviews resulted in some of the evidence items being strongly supported and other issues also emerged. Table 2 reflects those CSFs where **all** the associated evidence items were found present in successful DSS organisations. The percentage of not successful organisations and the percentage of organisations interviewed reporting each of these evidence items is reflected.

**Table 2. Strongly supported evidence items and associated CSF**

CSF and associated evidence items	% of successful organisations	% of not successful organisations	% of all organisations interviewed
<b>Top Management Support CSF</b>			
All managers agreeing on the purpose of the DSS	100	0	78
Management being committed to the success of the DSS	100	0	78
Receiving tremendous support from senior management for the DSS	100	0	78
A project "champion" exists	100	33	89
<b>User Training CSF</b>			
The organisation regarding training as important	100	33	83
Every DSS user was properly trained	100	33	78
The DSS training which was given was timeous	100	33	83
<b>Perceived Utility CSF</b>			
As a result of DSS, the user is seen as more valuable in the organisation	100	100	94
The user believes his DSS is an important system for the organisation	100	100	89
The user personally benefits from the existence of the DSS in his organisation	100	100	94

Considering each evidence item and CSF in turn, the authors' findings are as follows:

### User Involvement CSF

Ten of the successful organisations reported that there must be user involvement during the project. A possible explanation for the eleventh organisation was the fact that the DSS developer and user was



the same person. The level and timing of user involvement during DSS implementation were not established. Two of the eleven successful organisations rated User Involvement as the most important factor which contributed most significantly to their organisation's DSS success. All organisations reported an "owner" of the DSS. In the case of the successful organisations, all owners were non-IT personnel (e.g. general managers, financial directors) whereas in the case of less successful organisations, ownership was sometimes vested with the IT department. Turban [26] notes that the user is left with a system at the end of a project: if the user does not "own" the system from a psychological point of view, the system is unlikely to be successful.

#### **Top Management Support CSF**

Sanders and Courtney [22] and Kaiser and Srinivasan [11] both concluded that the support of top management was critical to DSS success. The authors' results serve to underscore these previous studies.

Organisations successfully introducing DSS regard it as a strategic, important direction actively supported by management. All successful and partially successful organisations had a DSS "champion" either when interviewed or when implementation first took place. The champion in successful organisations, however, was not only at IT Manager level, sometimes it was at the financial director level. This ensured support from senior management. This status was not always present in less successful DSS implementing organisations. Of the eleven successful organisations, four identified Top Management Support as the factor which contributed most significantly to their organisation's DSS success. This serves to underscore Turban's [26] recent research wherein he states that the most consistent finding across implementation studies is the importance of *management support and leadership* in successful implementation. It is significant to note that in the case of the three unsuccessful organisations, all identified the lack of Top Management Support for their DSS failure.

#### **User Training CSF**

All successful and partially successful organisations reported that their organisations regarded training as important. However, the time and costs spent in training their users was not documented. Not all respondents confirmed whether training had been properly conducted and whether it had been timely. They felt that the individual users needed to be consulted. Those users who had been trained, had such training conducted "in house". The educational characteristics of users (*i.e.* number of years of education) did not form part of the survey.

#### **Information Source CSF**

Even though the eleven successful organisations reported that not all the information was always readily available, it was nevertheless always current. However, both the partially successful organisations reported that the required information was readily available and that it was always current. For the unsuccessful organisations, the term "current" had different connotations (e.g. data from a month-end file, data captured from a previous population census) and this may be a possible explanation for not ascribing a relative sense of recency to the information source. One organisation from each of the partially successful and unsuccessful groupings, rated Information Source as the factor which least significantly contributed to their DSS implementation.

#### **Level of Managerial Activity being Supported CSF**

Two of the eleven successful organisations rated the above-mentioned CSF as the most important factor which contributed most significantly to their organisation's DSS success. Another three successful organisation rated this CSF as the least important one. All organisations reported that their DSS facilitated better decisions even though some implementations were not entirely successful. This tends to indicate that in these circumstances some benefit was derived by the organisation as partial decision-making was facilitated. Most successful organisations reported that arguments are presented more clearly.

#### **User Information Satisfaction CSF**

The satisfaction of users with the "final" product and the acceptability of the DSS to users is an important measurement for the evaluation of DSS success. Most successful organisations agreed on the evidence items and one respondent reported that as he was the project "champion", he was not a user and therefore he was not able to confirm the existence of all these items. Most organisations confirmed that User Information Satisfaction is an important determinant for DSS success and three

successful organisations reported it as the factor which contributed most significantly to their respective organisation's success.

#### **Relative Use CSF**

Most successful organisations reported a high usage of their respective DSS; frequencies ranged from hourly, daily, weekly and monthly depending on the organisation's particular environment. The eleventh successful organisation recorded an "uncertain" response as the respondent indicated that his organisation's DSS was only used during a four to five month period during the year. This occurred during the organisation's annual strategic planning exercise. During this period there is a relative high use of the DSS but thereafter it becomes dormant. Consequently there is relative high use of this DSS only during a fixed annual period. Seven of the eleven successful organisations reported that their DSS was used on a voluntary basis. Three respondents indicated that they were indirectly "forced" to use their organisation's DSS in the sense that there was no alternative system available to each of them. The eleventh respondent indicated that he was not "forced" to use his organisation's DSS. Instead he felt that usage was not strictly voluntary but that it rather formed part of a daily procedure. The above results tend to underscore the findings of Welsch [27] whereby DSS success may be measured by a frequency of use (if the use is voluntary). The use of such measures is well established in cases where such system use is voluntary [6] [9] [12] [19] [24]. This is also confirmed by Turban [26] who adopts "high levels of use" as a sign for successful implementation. During the interviews no assessment was undertaken on the cognitive style measures in relation to system usage.

#### **Perceived Utility CSF**

It is significant to note that the Perceived Utility CSF was the only factor found to be present in all successful and unsuccessful organisations (see Table 3 and Table 4).

**Table 3. CSFs "totally" supported by all successful organisations**

CSF
Top Management Support
User Training
Perceived Utility

**Table 4. CSFs "totally" supported by all unsuccessful organisations**

CSF
Perceived Utility

Whilst there was consensus that the DSS is perceived as an important system for the organisation, a reservation was expressed by a partially successful organisation. The respondent recorded that whilst he personally believed the DSS to be important, the same opinion may not be shared by some users who display a resistance to change with the introduction of new technologies. This tends to suggest that whenever DSS implementation programmes are initiated, cognisance should be taken of possible psychological barriers and DSS context issues (e.g. cultural, organisational, task-, role- or individual-related). These issues interact and influence each other and may impact on DSS success.

#### **Goal realisation CSF**

Nine of the successful organisations reported that the DSS expectations had been met. One organisation had only completed its implementation a few days prior to the interview. Consequently no evaluation had been conducted by that organisation to establish whether any shortcomings existed with the achievements and whether all expectations had been fulfilled. The other successful organisation reported that the results achieved had far exceeded earlier expectations and hence a (positive) gap existed between what the DSS was expected to achieve and what was actually achieved. Two of the three unsuccessful organisations reported a divergence between the expected and actual achievements and this may reflect exaggerated expectations of their DSS.

#### **Indication of Previously Unrecognised CSF**

At the end of each interview, the interviewee was asked whether there were any additional factors which contributed to his organisation's DSS implementation. Some of the interviewees' responses could not be

classified into one or more of the nine identified CSFs. This led the authors to suspect that there may be another CSF in existence. In addition to the above CSFs an **additional and previously unrecognised** CSF was identified: the ability to utilise appropriate DSS tools was a significant issue mentioned by ten of the successful organisations and the inability to accomplish this was an issue for unsuccessful organisations. Therefore, although the intention of the research was to explore previously reported CSFs, successful DSS organisations were also successful users of appropriate DSS tools and the less successful organisations either experienced difficulties or limitations with this aspect when attempting to implement their DSS. The authors' contend that this additional and previously unrecognised CSF is quite distinct from the previously identified User Training CSF.

#### **Implications for Management: Is 'critical' critical?**

As Crossman *et al* [4] indicate, wise judgement is needed when deciding on the selective use of IT. The authors feel that this is particularly relevant to DSS. No matter what can, or has been undertaken in other countries, the extremes of optimism or pessimism are likely to be wrong. The authors suggest support for Odedra *et al* [16] that instead of trying to "catch up" with the industrialized world, South Africa follows the route that extreme care must be exercised by all the parties involved in the transfer of technology from one country to another.

Table 3 showed that organisations embarking on DSS implementation must ensure that three CSFs, viz. Top Management Support, User Training and Perceived Utility are properly addressed during the implementation process as these CSFs were found to be present in **all** successful organisations. These findings suggest that the remaining six CSFs may not be critical, in the sense that they are "absolutely necessary" to ensure success [20] [5]. This does not imply that the remaining six CSFs (see Table 5) need not be addressed but the authors contend that it may be inappropriate to regard the remaining six CSFs as "critical". Consequently, a contingency approach is suggested by labelling them as "important but not essential for success".

**Table 5. CSFs "totally" not supported by all successful organisations**

CSF
User Involvement
Information Source
Level of Managerial Activity Being Supported
User Information Satisfaction
Relative Use
Goal realisation

Table 4 showed that only the Perceived Utility CSF was present in all unsuccessful organisations. A possible explanation is that at the outset all these respondents felt that there was potential for their organisation's DSS to succeed. All other eight identified CSFs were not found to be present in these unsuccessful organisations.

Turban [26] suggests that there is a need to concentrate on the relationship between DSS designers and users. During the early stages, it is important for the individuals involved with the system to develop trust in each other's objectives and competence. The designers have to want to help users and users must be willing to spend time working with designers and on their part of the design to develop a cooperative relationship. If those involved become adversarial, Turban [26] states that the system is doomed. Consequently, during the design process, a major objective is for users to accept ownership of the system. From the interviews of the less successful organisations, the support levels offered by external DSS vendors appeared to be limited. This tends to indicate that DSS support levels should be evaluated by organisations prior to embarking on DSS implementation programs. Organisations not confining themselves to these guidelines are likely to be dissatisfied in the medium term. Whilst the existence of some evidence items may be inconclusive, this may be attributed to the sample size. A larger study is currently in progress which should serve to address these issues and produce statistically better results.

In summary, this study suggests that there are four CSFs for successful DSS implementation in KwaZulu-Natal. These are Top Management Support, User Training, Perceived Utility and the newly

recognised Appropriate DSS Tools. Whilst the existence of the other success factors is recognised in developed countries, the authors' findings suggest that they are *not critical* to successful DSS implementation in South African organisations. CSFs should serve South Africa's own needs rather than echoing those of developed countries.

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