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Ephrem Eyob
Virginia State University

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An empirical evidence of determinant attributes on expert systems success

Ephrem Eyob
Virginia State University

ABSTRACT

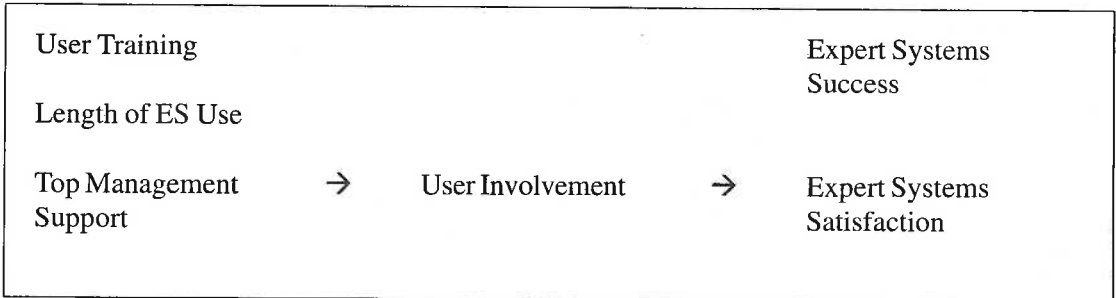
Expert Systems, in the last decade, have become the target of tremendous positive interest as well as consternation by the information systems professionals and end-users. This study surveyed twenty organizations to examine empirically the level of expert systems user satisfaction and success of these systems as perceived by the respondents of the survey.

INTRODUCTION

In the last few years much has been said and written about Decision Support Systems (DSS) and their usefulness in business organizations as tools to facilitate decision making. The accelerated introduction of Artificial Intelligence (AI) technology to support knowledge based decision making has increased the urgent need to recognize Expert Systems (ES) as tools for decision making purposes as well. The increased interest in ES, especially by specialized industries, has brought the need to design and develop expert systems in different domains of business, engineering, medicine, military, education, and government applications. Expert Systems have more capabilities in utilizing AI technology than does DSS, because of their ability to store expert knowledge. According to Turban (1992, p. 74), "an expert system is a system that employs human knowledge captured in a computer to solve problems that ordinarily require human expertise." For the most part ES are used as assistants in providing expertise in a specific problem domain. In other instances, ES can function as a replacement for an expert, and may function even better than a single human expert (Turban, 1990).

If ES technology is accepted in the business world then the issue of success is an important facet of inquiry. This paper is directed at organizational factors such as user training in using ES, length of ES use, and top management support to ES use affect ES success (see Figure 1 as the model for this study). It will attempt to strengthen accepted assumptions on how specific factors relate to the successful implementation of expert systems.

Figure 1. Expert Systems Success and Satisfaction Model



A tremendous amount of research has recently focused on the factors that explain the success factors of MIS, DSS, and lately, ES systems. Different approaches are used to measure success that provide use and decision making satisfaction (Kendall, 1987; Mahmood, 1989; Cheney, 1986; Eindor, 1978; Rivard, 1988; Sanders, 1985). In the DSS and MIS literature factors such as improved decision quality system usage, firm profitability and user satisfaction are commonly used as surrogate measure of DSS and MIS success. In this study, perceived benefits by the user and user satisfaction are the selected factors used to measure ES success. Due to the relative newness of ES applications in the marketplace, we know of practically no past research that covers ES success; however, some field studies that investigate MIS and DSS success have appeared in the past (Sanders & Courtney, 1985; Fuerst & Cheney, 1986). The aim of this study is to investigate factors that influence ES success. ES success will be measured through the perception of ES users in different industries. See Table 2 for a breakdown of the respondents' industries.

EXPERT SYSTEMS SURVEY

A survey on organizational factors affecting expert systems satisfaction and success by users was sent to the representatives of one hundred organizations (CIOs, IS directors and the like) that were thought likely to use expert systems in their organization. Only one copy of the questionnaires was sent to each of the one hundred selected organizations' representatives. A follow-up letter was sent to non-respondents six weeks later, with an overall 20% response rate. Twenty of these organizations returned usable forms of the survey. Table 2 shows detailed demographic characteristics of the survey participants.

VALIDITY OF SURVEY INSTRUMENT

The questionnaire was adapted from Sanders and Courtney's (1985) study concerning factors that influence DSS success which was initially designed by Van De Ven and Ferry (1980). The Van De Ven and Ferry questionnaires are psychometrically validated instruments

specifically designed to assess organizations. Therefore, the questionnaires used for this study are assumed to be reliable and have content validity in all aspects of the attributes used because of their extensive use in the literature of assessing the success of organizations.

Table 1. Selected Expert Systems Application*

Expert Systems	Applications
• Control Systems	Control of behavior system in interpretation, prediction, repairing and monitoring
• Debugging Systems	Prescribing remedies for malfunctioning equipment
• Design Systems	Configuration development of object design such as flow plan, plant layout, building design
• Diagnostic Systems	Applications include medical, electronic, mechanical and software diagnosis
• Interpretation Systems	Inference from observation situations such as speech, understanding, image analysis, writing analysis, signal interpretation
• Instructional Systems	Tutorial interface with a learner for instructions
• Monitoring Systems	Comparison of system behavior against standard such as air traffic control, fiscal management tasks
• Predictions Systems	Applications include weather, economic, financial forecasting, traffic, crop, military situation predictions
• Planning Systems	Long- and short-term planning, in project management, routing, communications, product development, military applications and financial planning
• Repair Systems	Develop and execute plans to administer a remedy

* Adapted from Turban (1992)

Table 2. Respondents' Demography

<u>Industry</u>	<u>Percentage</u>
• Manufacturing	40%
• Service	60%
 <u>Education Level of ES Users</u>	
• High School	3%
• Bachelor's Degree	52%
• Master's Degree	32%
• Doctoral Degree	13%
 <u>Position of ES Users</u>	
• Financial Analyst	17%
• Mgt. Science Analyst	13%
• Data Processing Personnel	20%
• Senior Management	8%
• Middle Management	17%
• Engineer/Consultant/Other	25%
 <u>Types of ES Applications</u>	
• Strategic Long Range Planning	15%
• Annual Planning	13%
• Economic Evaluation & Project Analysis	15%
• Financial Analysis	13%
• Tax Accounting	7%
• Miscellaneous	37%

SURVEY RESULTS

Twenty percent of the respondents returned completed questionnaires within an eight weeks' period. To clarify to respondents what an expert system means, a standard explanation as defined earlier by Brandon, Kanter and Kopsco (1989), was included in the questionnaires. Briefly the following text was included -- expert systems is used in your organization when the following situations exist:

- The problem domain is narrow and specific in scope;
- There are few or nonexistent in-house experts in your organization who have expertise in the specific domain;
- Logical rather than intuitional diagnostic processes are needed;
- Use of expert systems is less costly than human expertise after the initial hardware and software investments.

Table 3 shows a summary measurement of five key factors of expert systems uses in twenty organizations surveyed in the study. The mean length of ES use, according to the study, was 22.9 months ranging from 60 months on the high end to only 3 months on the low end. The training level of ES users was measured on a Likert type scale of 1-5 (one for strongly disagree and five for strongly agree). The mean of users' training satisfaction was 3.4 with a standard deviation of 1.05. This means that most users think an adequate level of training is provided by the systems developers in their organization before extensive ES use is expected of them. Top management support of ES use was measured by two items in the questionnaires: The first item dealt with resources availability issues in the development of ES, and the second item was directed at top management's beliefs in the practice of ES use in their organizations.

The mean of top management support is 3.35 on a Likert scale of 1-5 (one being low support level and five the highest possible support). The standard deviation is 0.89. One can infer that top management support of expert systems utilization is relatively high in the organizations surveyed. The next two factors in Table 3 are ES satisfaction by users and overall ES success as perceived by the respondents. ES satisfaction was measured by seven items in the questionnaires, and each item's scale ranged from 1 to 4. The seven items dealt with such issues as making better decisions, setting decision priorities, making convincing arguments, improving the quality of decision making, timely use of relevant information, and greater use of analytical tools in problem solving and decision making. The survey indicated that the mean ES user satisfaction is 2.98 on a scale of 1-4 with a standard deviation of 0.69. The next item is ES success which was measured by six items on the questionnaires. The six items encompassed issues such as dependency on ES by user, increased value of ES user to the organization, personal benefits to ES user, exclusive reliance of ES by user, importance of ES to the organization and ES's overall usefulness to the organization. The mean of ES success according to the survey is 2.99 with a standard deviation of 0.73. This means that respondents to the survey gave both ES success and satisfaction high marks (approximately 3 each respectively on a scale of 1 to 4) at least as practiced in their organizations.

Table 3. Summary Statistics of ES User Satisfaction and Success

FACTORS	Mean	Range	Standard Deviation
Length of ES Use (months)	22.9	57	18.4
User Training in ES	3.4	3	1.05
Management Support of ES	3.35	4	0.89
Expert Systems Satisfaction	2.98	2.86	0.67
Expert Systems Success	2.99	2.6	0.73

CONCLUSION

Although not prevalent in many organizations' information technology portfolios, the spotty evidence that resulted from our relatively small rate of response to the study showed that ES users are moderately satisfied with expert systems success. With the continuous proliferation of inexpensive, powerful microcomputer systems, the use of inexpensive ES should continue at a more sophisticated expert systems development. Although the study aggregated the data for both manufacturing and service industry, there are strong feelings by some ES advocates that ES is more prevalent in some industries than others. Because of the limited scope of the study, unfortunately, such conclusion cannot be reached in this study. Therefore, a field study targeting a specific industry or companies might bring an in-depth insight on ES success and satisfaction by its users. Moreover, other variables may be integrated into the model for further elucidation on the issue of ES success and satisfaction.

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APPENDIX A

Information About Your Organization and Users

1. My organization main line of business is:
 - a. Mining and Hydrocarbon Extraction
 - b. Construction
 - c. Manufacturing
 - d. Transportation and Communication
 - e. Utilities
 - f. Services (Finance, Professional, etc.)
 - g. Other _____

2. Educational background of expert systems users:
 - a. High School Diploma
 - b. Vocational or Craft Certificate
 - c. Bachelor's Degree
 - d. Master's Degree
 - e. Doctoral Degree

3. The position of the expert systems user in the organization is:
 - a. Financial or Planning Analyst
 - b. Management Science or Operation Research Analyst
 - c. Data Processing Personnel
 - d. Senior Management
 - e. Middle Management
 - f. Other

4. Types of application expert systems users have been involved in:
 - a. Strategic Decisions, Long Range Planning, Market Share
 - b. Annual Planning, Budgeting, Cash Management
 - c. Economic Evaluation and Project Analysis
 - d. Financial Structure, Cost of Capital, Debt Analysis
 - e. Mergers, Acquisitions and Consolidations
 - f. Tax Accounting
 - g. Miscellaneous

Questionnaire for Expert Systems Users

Task Newness

1. To what extent are the problems you encounter new (that is, you have never encountered them before)?
 1. No extent
 2. Little extent
 3. Some extent
 4. Great extent
 5. Very great extent

Task Difficulty

2. In some jobs, outcomes are unpredictable - if you do something to solve a problem you don't know what will happen. What percent of the time are you unsure that things will not work as expected:
 1. 0-20%
 2. 21-40%
 3. 41-60%
 4. 61-80%
 5. 81-100%
3. In the past 3 months, how often did difficult problems arise in your work for which there were no immediate or apparent methods in dealing with the problems?
 1. Once a week or less
 2. About 2-4 times a week
 3. About once a day
 4. About 2-4 times a day
 5. 5 times or more a day
4. About how much time did you spend solving these work problems?
 1. Less than 1 hr./week
 2. About 1-4 hours/week
 3. About 1 hour/day
 4. About 2-3 hours/day
 5. 4 hours or more/day

Task Variability

5. How much the same are the day-to-day situations, problems, or issues you encounter in performing your major tasks (how much variability is there in your tasks or job)?
 1. Very much the same
 2. Mostly the same
 3. Quite a bit different
 4. Very much different
 5. Completely different
6. How many of your tasks are the same from day to day.
 1. Almost all
 2. Many
 3. About half
 4. Some
 5. None

7. During a normal week, how frequently do exceptions arise in your work which require substantially different methods or procedures for doing them?
- | | |
|-----------------|---------------|
| 1. Very seldom | 4. Very often |
| 2. Occasionally | 5. Constantly |
| 3. Quite often | |

Task Interdependence

8. To what extent do you have a one-person job? That is, to get your work out, to what extent do you work independently of others to accomplish your assigned tasks?
- | | |
|------------------|----------------------|
| 1. No extent | 4. Great extent |
| 2. Little extent | 5. Very great extent |
| 3. Some extent | |
9. To what extent do you meet with your colleagues to discuss how each task, case, or claim related to your work should be performed or treated?
- | | |
|------------------|----------------------|
| 1. No extent | 4. Great extent |
| 2. Little extent | 5. Very great extent |
| 3. Some extent | |

Task Standardization

10. How many written rules and procedures exist for doing your major tasks?
- | | |
|----------------------|-------------------|
| 1. Very few if any | 4. A large number |
| 2. A small number | 5. A great number |
| 3. A moderate number | |
11. How precisely do these rules and procedures specify how your major tasks are to be done?
- | | |
|----------------------|-------------------|
| 1. Very general | 4. Quite specific |
| 2. Mostly general | 5. Very specific |
| 3. Somewhat specific | |
12. To what extent did you follow standard operating procedures or practices to do your major tasks during the last 3 months?
- | | |
|------------------|----------------------|
| 1. No extent | 4. Great extent |
| 2. Little extent | 5. Very great extent |
| 3. Some extent | |
13. When considering the various situations that arise in performing your work, what percent of the time do you have written or unwritten procedures for dealing with them?
- | | |
|-----------|------------|
| 1. 0-20% | 4. 61-80% |
| 2. 21-40% | 5. 81-100% |
| 3. 41-60% | |

Task Authority

How much influence do you have in making each of the following decisions? (Circle a number on the right for each decision).

Amount of Influence I Have on Each Decision

	<u>None</u>	<u>Little</u>	<u>Some</u>	<u>A Bit</u>	<u>Much</u>
14. Determining what tasks to work on from day to day	1	2	3	4	5
15. Determining how much work I have to complete	1	2	3	4	5
16. Establishing rules and procedures about how my work is to be done	1	2	3	4	5
17. Determining how work exceptions are to be handled	1	2	3	4	5

Length of Time User Has Been Using Expert System

1. How many months have you been using Expert Systems? _____

Top Management Support

2. Top management feels that the time and resources spent on the development of Expert Systems is wisely invested.
- | | |
|------------------------------|-------------------|
| 1. Strongly disagree | 4. Agree |
| 2. Disagree | 5. Strongly agree |
| 3. Neither agree or disagree | |
3. Top management is strongly in favor of the concept of Expert Systems.
- | | |
|------------------------------|-------------------|
| 1. Strongly disagree | 4. Agree |
| 2. Disagree | 5. Strongly agree |
| 3. Neither agree or disagree | |

User Training

4. I was given sufficient training to utilize the Expert Systems.
- | | |
|------------------------------|-------------------|
| 1. Strongly disagree | 4. Agree |
| 2. Disagree | 5. Strongly agree |
| 3. Neither agree or disagree | |

Expert Systems Success Factors*

- 1. I have become dependent on Expert Systems.
 - 1. Strongly disagree
 - 2. Disagree
 - 3. Agree
 - 4. Strongly agree

- 2. As a result of Expert Systems, I am seen as more valuable in this organization.
 - 1. Strongly disagree
 - 2. Disagree
 - 3. Agree
 - 4. Strongly agree

- 3. I personally benefitted from the existence of Expert Systems in this organization.
 - 1. Strongly disagree
 - 2. Disagree
 - 3. Agree
 - 4. Strongly agree

- 4. I have come to rely on Expert Systems in performing my job.
 - 1. Strongly disagree
 - 2. Disagree
 - 3. Agree
 - 4. Strongly agree

- 5. All in all I think that expert systems is an important system for this organization.
 - 1. Strongly disagree
 - 2. Disagree
 - 3. Agree
 - 4. Strongly agree

- 6. Expert system is extremely useful.
 - 1. Strongly disagree
 - 2. Disagree
 - 3. Agree
 - 4. Strongly agree

Decision-Making Satisfaction*

- 1. Utilization of Expert Systems has enabled me to make better decisions.
 - 1. Strongly disagree
 - 2. Disagree
 - 3. Agree
 - 4. Strongly agree

- 2. As a result of Expert Systems, I am better able to set my priorities in decision making.
 - 1. Strongly disagree
 - 2. Disagree
 - 3. Agree
 - 4. Strongly agree

- 3. Use of data generated by Expert Systems has enabled me to present my arguments more convincingly.
 - 1. Strongly disagree
 - 2. Disagree
 - 3. Agree
 - 4. Strongly agree

4. Expert Systems has improved the quality of decision I make in this organization.
 1. Strongly disagree
 2. Disagree
 3. Agree
 4. Strongly agree

5. As a result of Expert Systems, the speed at which I analyze decision has increase4.
 1. Strongly disagree
 2. Disagree
 3. Agree
 4. Strongly agree

6. As a result of Expert Systems, more relevant information has been available to me for decision making.
 1. Strongly disagree
 2. Disagree
 3. Agree
 4. Strongly agree

7. Expert Systems has led me to greater use of analytical aids in decision making.
 1. Strongly disagree
 2. Disagree
 3. Agree
 4. Strongly agree

* Adapted from Van De Ven, I. H. and Ferry, A. L. (1980) and Sanders and Courtney (1985).

