

Expert Systems Evaluation Proposal

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Abstract. It is well recognized that the evaluation of the expert systems is very important and difficult. This paper relates to the important issue of Expert System evaluation. A methodology for addressing the problem is presented. As evaluation model is proposed with the following main criteria: Usability; impact of the system in the behaviour and decisions of the user; Impact of the quality of the information provided to the user; financial impact; usefulness.

Keywords: Expert systems; evaluation; criteria; quality.

1 Introduction

In the current context of global, intense competitiveness, the systems' performance is a key competitiveness factor for manufacturing companies. The organizations have been challenged to keep pace with the rapid evolution of technologies. Built and managed knowledge to support decision in manufacturing processes are crucial for the organization.

The manufacturing processes are characterized by a continuous control, step by step, using decisions that require the required knowledge from the expert to relate actions and results.

The use of knowledge based systems, namely expert systems, to support the managers in the decision processes has evolved very quickly in the last several years. Moreover, it has been widely reported as a useful tool to enhance the performance of managers as they helped them to gain more knowledge, and consequently improve the quality of decisions.

A great deal of attention has been given to the use of expert systems in solving manufacturing problems. However, determining whether or not an expert system is justified to be applied in a particular manufacturing application has received very little attention or has almost been ignored.[1] [2]

Thus, it is fundamental to evaluate expert systems. Evaluation is the process of determining if a specific system is appropriate for its original requirements and objectives and also to assess if its performance satisfies users.

The goal of this work is to propose a model for evaluating the performance of expert systems and presenting a case study of its implementation to an industry. The relevance of the topic is justified by the difficulties presented by the organization in evaluating expert systems.

So, an important question, related to the use of expert systems in organizations, is how to measure the results from its application. For this, it is necessary to identify the evaluation criteria and also how each criteria can be measured.

What to measure? Why to measure? How to measure? These are questions that are present at the organizational environment. The concern of evaluating results from the organization not only involves short term but also long term goals that can guarantee the sustainability of the previous defined strategy by the organization. It is important to point out that, independently of the methodology chosen by the organization, it has to consider that there are tangible results (essentially financial results) and intangible results (for instance users motivation) to be evaluated, both for the user of the system as well as for the organization.

From what has been exposed, it is necessary to propose an evaluating expert system performance model, composed by criteria (what needs to be measured) and metrics (what can be used to measure).

2 Methodology

In order to reach the main objective proposed by this study, the steps that will be followed are (see Figure 1):

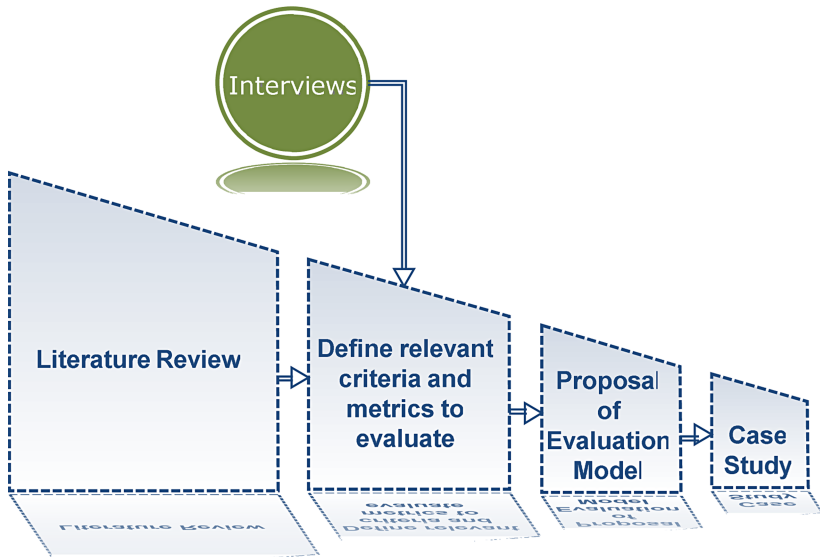


Fig. 1. Research Process

1. Literature review – this was used to build using literature references, an evaluation process to evaluate the performance of expert systems, grouping criteria and metrics. However it is important to say that there are no universally accepted standards for the evaluation of expert systems;
2. To find out from experts’ interviews, about what are the relevant criteria and metrics to evaluate these systems;
3. Application to an organisation of the elaborated model – this will result in a case study. As part of the evaluation process, the assumptions made during the proposal of the model will be re-examined. This procedure will help to validate and test the applicability of the model in a specific organization and also to derive important conclusions regarding the model and the evaluation process.

3 Evaluation of the Performance

Expert Systems can be classified in several ways. One way is by the general areas they address. Thousands of expert systems are in use today in almost every industry and in every functional area [3].

How to evaluate the performance of an expert system becomes very important, because different domain has different requirements, different application background, different technical support, and different targets, it is very difficult to propose the same approach and criteria for evaluating different domain expert systems [4].

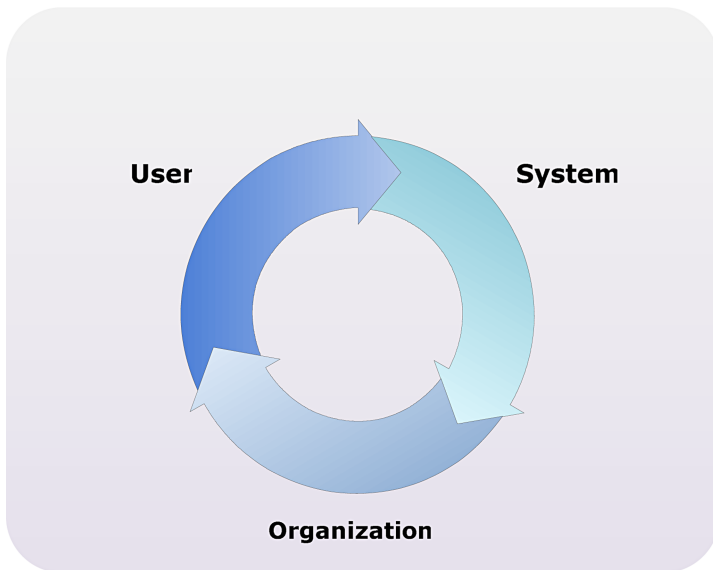


Fig. 2. Interactions between the entities involved in the evaluation of an expert system

Table 1. Performance Evaluation actor interrelations

<i>System</i> <i>vs</i> <i>User</i>	The system can provide the user with: <ul style="list-style-type: none"> ▪ Efficiency ▪ Efficacy ▪ Satisfaction
<i>System</i> <i>vs</i> <i>Organization</i>	The system can provide to the organization: <ul style="list-style-type: none"> ▪ Productivity ▪ Quality ▪ Decision taking, etc
<i>User</i> <i>vs</i> <i>Organization</i>	The user supported by the system contributes to improve the performance and to achieve the organization's goals

Several researchers point out as difficulties in the evaluation of an expert system the following:

- What characteristics should be evaluated?
- How to measure performance?

When one wishes to evaluate an expert system, one should have in consideration the evaluation as a global goal. An expert system cannot be seen as an isolated object but as an integrated entity, that is a product used by people, in a specific context, to reach certain goals. Therefore, in order to correctly assess and evaluate the performance of these type of systems, we have to analyse interactions between the three entities involved in the process: user, system and organization [5](see Figure 2).

4 Evaluation Model Proposal

Evaluation is the process of determining the likelihood that once deployed, the expert system will be used whenever appropriate. [6] Pertinent issues in evaluation are:

- Is the system user friendly and do the users accept the system?
- Does the system give correct results and is the logic of the system correct?
- Does the expert system offer an improvement over the practices it is intended to supplement?
- Is the system easy to learn and to become proficient on?
- Is the system useful as a training tool?
- Is the system in fact maintainable by the other than the developers?
- Can the system be used in the intended work environment?

As stated, after the literature review, one can conclude that there are no universally accepted standards for the evaluation of expert systems. However, there is a set of points that might be considered as essential in the evaluation of an information

system, e.g. impact of the system at the organizational costs and benefits; impact of the system at the attitude of users (decisions, actions and behavioural changes); quality of information made available to users.

For the proposal of a model it is necessary to select evaluation criteria and specify how each criterion will be measured.

1. Usability is measured in relation to the system characteristics and to the degree of user satisfaction (see Table 2). The user friendliness of the system and acceptance of the system by the users should also be evaluated.

"Usability: the extent to which a product can be used by specified users to achieve a specified goals with effectiveness, efficiency and satisfaction in a specified context of use" [7]

Table 2. Usability criteria proposed for Expert System Evaluation

Usability	<ul style="list-style-type: none"> ↳ <u>Easiness to Learn</u> <ul style="list-style-type: none"> - Does the user understand easily the interface, its different paths and what he can do with it? - Are there any help to use instructions? (instructions should be provided as required and Access to help must always be available without being mandatory its reading) [8] ↳ <u>Easiness to Use</u> <ul style="list-style-type: none"> - Does the user know what to do and how to navigate with easiness? ↳ <u>User Satisfaction</u> <ul style="list-style-type: none"> - Reaction to interface, to the contents, to the document structure, to the interaction and navigation process and to available help [9]
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2. Impact of the system in the behaviour and decisions of the user (see Table 3). The easiness of the users to learn how to operate the system influences their behaviour and the decisions that he or she has to make.

Table 3. Impact of the system in the behaviour and decisions of the user criteria proposed for Expert System Evaluation

<i>Impact of the system in the behaviour and decisions of the user</i>	<ul style="list-style-type: none"> - The system increases the users' confidence? - Does the system enable users to take decisions, establish compromises and provides guidance? - Does the system enable to improvements to decision makers performance? - Does the system change the nature of users' tasks and jobs in a matter that motivates continued use of the expert systems?
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3. Impact of the quality of the information provided to the user (see Table 4).

Table 4. Impact of the quality of the information provided to the user criteria proposed for Expert System Evaluation

<i>Impact of the quality of the information provided to the user</i>	<ul style="list-style-type: none"> - The system provides adequate explanations? (how and why the decision was taken) - Correctness of the logic of the system (correctness, consistency and completeness of the inference rules) - Are the decisions made by the system correct compared to what the experts consider to be right? - Is the system adequate to replace the intelligence of the human expert? - Does the system change the nature of the users' tasks and jobs in a manner that motivates continued use of the expert system? - Is the level of knowledge sufficiently high? - Can the system be used as a training tool to transfer the knowledge of the expert to middle and top management and thus improve the performance of new employees? [10] - Is the representation of knowledge suitable? [11]
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4. Financial impact - consideration of costs and benefits for the organization (see Table 5)

Table 5. Financial impact criteria proposed for Expert System Evaluation

<i>Financial impact</i>	<ul style="list-style-type: none"> - Does the system reduce cost? (does not require many experts; reduces routine tasks)
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5. Usefulness - consideration of costs and benefits for the organization (see Table 6)

While there may be no universally accepted standards for field evaluation of expert systems, interviews to the experts can improve the process.

As stated, after the literature review and the experts' interviews it will be possible to propose a more focused evaluation model. The interview to experts is presented in appendix.

Table 6. Usefulness criteria proposed for Expert System Evaluation

<i>Usefulness</i>	<ul style="list-style-type: none"> - Is the system helpful to the user? - Is the system fast enough to satisfy the user? - Does the system respond on time? - optimisation of the operation - improvements to user performance
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5 Conclusions

We can conclude that is difficult to evaluate the performance of an expert system especially when we intend to propose a standard model, because of its several applications. Moreover, not only it is necessary to select evaluation criteria but also to determine the minimum acceptable performance level for each criterion selected. In the formulation of the model it has been considered all the actors in the process: system, user and organization.

The paper describes the problem of the evaluation of expert systems and proposes a set of generic evaluation criteria. Implications of the evaluation and the evaluation criteria are discussed.

Nowadays the importance of quality in software development, and especially in expert systems development has greatly increased, and the risk of taking a wrong decision by using a non adequate decision making support system has decreased, but it is not inexistent yet[12].

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Appendix:

PART I

Below are enumerated some criteria that should be taken into consideration to evaluate expert systems.

Please rate :

1 - Disagree 2- Slightly Agree 3- Agree 4- Agree much 5- Totally agree

1 – Usability

Easiness to Learn

Disagree Slightly Agree Agree Agree much Totally Agree

Easiness to Use

Disagree Slightly Agree Agree Agree much Totally Agree

Systems' user satisfaction

Disagree Slightly Agree Agree Agree much Totally Agree

What additional aspects should be included in these criteria?

2 – Impact of the system in the behaviour and decisions of the user

Impact of the users in relation to the systems' use

Disagree Slightly Agree Agree Agree much Totally Agree

Improvement of decision makers performance

Disagree Slightly Agree Agree Agree much Totally Agree

Degree to influence decision making

Disagree Slightly Agree Agree Agree much Totally Agree

What additional aspects should be included in these criteria?

3 – Impact of the quality of the information provided to the user

Information made available by the system enables improvements to quality in work

Disagree Slightly Agree Agree Agree much Totally Agree

Correctness of the results given by the system

Disagree Slightly Agree Agree Agree much Totally Agree

Adequateness of explanations provided

Disagree Slightly Agree Agree Agree much Totally Agree

Adequateness of the system to replace the intelligence of the human expert

Disagree Slightly Agree Agree Agree much Totally Agree

What additional aspects should be included in these criteria?

4 – Financial impact

Task reduction

Disagree Slightly Agree Agree Agree much Totally Agree

Consideration of costs and benefits for the organization

Disagree Slightly Agree Agree Agree much Totally Agree

What additional aspects should be included in these criteria?

5 – Usefulness

Systems help to the user

Disagree Slightly Agree Agree Agree much Totally Agree

The system is fast enough to satisfy the user

Disagree Slightly Agree Agree Agree much Totally Agree

System's response on time

Disagree Slightly Agree Agree Agree much Totally Agree

Optimisation of the operation

Disagree Slightly Agree Agree Agree much Totally Agree

What additional aspects should be included in these criteria?

PART II

1 – What are the key advantages of evaluating expert systems?

2 – What are the main difficulties to evaluate expert systems?

3 – In what type of situations should the expert systems be evaluated?