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A Method for Expert Systems Valuation

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Abstract

Many large organizations are now using Expert Systems (ES) to enhance their global and domestic competitive position. Introducing an ES requires a significant commitment of organizational resources. Therefore a means of justifying its value is paramount to making a prudent ES investment decision. Most ESs are typified by numerous intangible benefits and costs. Traditional cost benefit approaches to evaluation are unable to account for the contribution of intangible benefits to the value of an evolving ES project. This paper presents and applies a method which overcomes this problem by utilizing a scoring approach to ES valuation.

1. Introduction

This paper specifies a method based on the scoring approach to aid in justifying an organization's investment in an ES, by measuring the comparative perceived value of multiple ESs to the jobs of key employees over the ES lifecycle. The scoring approach to valuation uses people to estimate the value of an entity, by assigning perceived scores to its attributes or characteristics (Sullivan 1986). There are two main reasons for developing an ES valuation method using a scoring approach. First, there are numerous intangible benefits associated with an ES (Turban 1993). Intangible costs also exist (Hares and Royle 1994). These intangibles cannot be measured using traditional approaches such as Net Present Value, Internal Rate of Return, and Return on Investment because of difficulty in calculating their financial value (Turban 1993). In addition, there are circumstances where the dollar value of benefits and costs may not be known. For example, before the development of an ES, and during development and update when system capabilities change (Turban 1993). It is realized that traditional approaches are critical in the appraisal of ES projects. Especially when measuring the contribution to value of tangible costs and benefits.

2. Definition of Perceived ES Value

Perceived ES Value to a key employee is defined as the degree to which the perceived benefits exceed the perceived costs to his/her job of performing his/her role during the ESs life cycle. A review of the literature has revealed that several studies define value as the difference between costs and benefits (Clark and Soliman 1996).

3. Categories for Perceptions of Value

A review of the ES literature has found that the factors of time, finances, and quality are fundamental criteria for analysis of concepts such as system performance, effectiveness, and success in ESs (Clark and Soliman 1996). It is proposed that these factors can also be used as categories in measuring the perceived value of an ES project. Time and finances are tangible, while quality is intangible. The three factors will now be defined in terms of their application to ES project valuation.

Perceived Time benefit is defined as any perceived earnings of time to an individual in his/her job, resulting from his/her role in the ES lifecycle. *Perceived Time cost* is defined as any perceived expenditures of time or loss of time incurred on the part of an individual in his/her job, resulting from his/her role in the ES lifecycle. *Perceived Financial Benefit* is defined as any perceived earnings in monetary terms to an individual in his/her job, resulting from his/her role in the ES lifecycle. *Perceived Financial Cost* is defined as any perceived expenditures in monetary terms incurred on the part of an individual in his/her job, resulting from his/her role in the ES lifecycle. *Perceived Quality Benefit* is defined as the perceived positive

qualitative earnings to an individual in his/her job, resulting from his/her role in the ES lifecycle. *Perceived Quality Cost* is defined as the perceived negative qualitative expenditures incurred on the part of an individual in his/her job, resulting from his/her role in the ES lifecycle.

4. ES Lifecycle Phases and Key Employee Roles

The ES value method is designed to measure perceived value during each lifecycle phase of an ES. A review of several major ES development methodologies has identified a set of common phases (Clark 1992). These include: Phase 1: initial awareness of a need; Phase 2: cost justification, financial allocation, and identification of resources; Phase 3: system development; Phase 4: system testing and debugging; Phase 5: restricted implementation; and Phase 6: full implementation and update.

Key Employees relevant to an ES valuation include knowledge domain experts, users, and managers (Turban 1993). It is proposed that each key employee will be able to place a value on an ES from their own job perspective in terms of time, finances, and quality. The roles of these personnel in the ES lifecycle will now be defined. *A Knowledge domain expert* is defined as an employee whose role is to provide domain knowledge to the ES. *An ES User* is defined as an employee whose role is to use the ES. *An ES Manager* is defined as an employee whose role is to provide managerial support to the ES project. *Managerial support* is defined as those actions required to ensure that the ES is managed successfully. Each employee type will perform their respective role at various phases during the ES lifecycle. As a result each will receive benefits and incur costs in the context of his/her job.

5. Measuring ES Value Perceptions and Calculating Perceived Value

Since this ES valuation method aims to measure value based upon the perceptions of personnel, the Theory of Reasoned Action (TRA) was used to elicit and rate perceptions (Ajzen and Fishbein 1980). The reasons for choosing TRA are documented in (Clark and Soliman 1995). The components from TRA used in this ES valuation method are outcome belief and belief evaluation. *Outcome belief* is defined as "...a view held by an individual concerning the consequences of performing a behaviour (Ajzen and Fishbein 1980). A *Belief evaluation* is defined as "...the likelihood to which an outcome belief will occur or has occurred" (Ajzen and Fishbein 1980).

The method elicits outcome beliefs and corresponding evaluations in accordance with previously published guidelines (Ajzen Fishbein 1980). Outcome beliefs are elicited by asking each manager, user, and expert to list the costs and benefits to his/her job of performing his/her role in the ES lifecycle. Next these outcome beliefs and their evaluations are quantitatively measured. Each outcome belief and associated evaluation is then assigned to a value category. In order to calculate ES value for any individual, each belief and corresponding evaluation is multiplied. The net value to an individual is determined by summation of these resultant products. Value of a particular category is calculated by summation of the products pertaining to that category. Value of a system is calculated by summation of the products across all individuals.

6. Application of the Method

The method was applied to two ESs, ES A and ES B, from a large multinational manufacturing and sales organization. Sales personnel use ES A to provide customers with advice regarding the most appropriate product for their needs. ES B is a training system designed to make sales personnel learn about the technical background and functional capabilities of the products they are selling. At the time of data collection, both ESs were at the end of Phase 3: Restricted Implementation. Both systems were comprised of only one user, one expert and one manager. Table 1 shows summarized comparative results across the two ESs. A null result indicates there were no outcome beliefs relevant to that category for the employee. The ESs can be ranked in terms of: their total value; the total of any one value category; and the value to a particular employee type. It is envisaged that the decision maker will choose the way of ranking based upon his/her requirements. The results in Table 1 are aggregated. Detailed tables can be constructed which display the value of the individual perceived costs and benefits for each employee, classified into the value

categories. This shows the decision maker why one system is ranked higher than another in a wider organizational context.

Table 1: Comparative Valuation Results

ES Name / Phase	**Time**	**Finance**	**Quality**	***Total***
ES A				
Restricted Implementation				
Manager	-2	2	43	43
User	4	4	48	56
Expert	-11	Null	6	-5
Total	-9	6	97	94
ES B				
Restricted Implementation				
Manager	2	4	17	23
User	Null	Null	24	24
Expert	-14	Null	36	22
Total	-12	4	77	69

7. Contributions and Future Research Directions

This paper has presented and applied a method to aid in justifying an organization's investment in a ES, by measuring the comparative perceived value of multiple ESs to the jobs of key employees over the ES lifecycle. The value scores from each system can be compared and the system with the highest score can be chosen for investment. The method can be used whenever an investment decision needs to be made. For instance: when choosing among several ES project proposals; or when limited funds exist and ES projects have to be delayed or shelved. Since intangible benefits represent a large proportion of potential value present in an ES, a major strength of this method is its ability to measure the contribution of intangibles to ES value. In addition, the method enables estimation of tangibles when firm financial figures are not available. The method can be integrated to accommodate the use of traditional valuation approaches. The method can easily be extended for valuation by other system stakeholders. In future the method needs to be tested in all six ES lifecycle phases.

8. References

Ajzen, I. and Fishbein, M. *Understanding Attitudes and Predicting Social Behavior*, Prentice-Hall, Englewood Cliffs, NJ, 1980.

Clark, J. and Soliman F. "Appraising Knowledge Based System Investments" *Proceedings of the Third European Conference on the Evaluation of Information Technology*, Bath, UK, 29 November 1996 pp. 143-154.

Clark, J. and Soliman F. "A Conceptual Model of the Acceptance and Organisational Impact of Knowledge-Based Systems" in *Proceedings of the 1995 Pan Pacific Conference on Information Systems*, Singapore 29 June - 2 July, 1995 pp. 148-153.

Clark, J. "A Framework for Comparing Knowledge Based System Design Methodologies" *Proceedings of the 5th Australian Joint Conference on Artificial Intelligence*, Hobart, Tasmania 16-18 November, 1992, pp. 181-185.

Hares, J. and Royle, D. *Measuring the Value of Information Technology*, John Wiley & Sons, Chichester, 1994.

Sullivan, W. "Models IEs Can Use to Include Strategic, Non-Monetary Factors In Automation Decisions" *Industrial Engineering*, (18:3) March, 1986, pp. 67-77.

Turban, E. *Decision Support and Expert Systems: Management Support Systems*, Macmillan Publishing Company, 1993.