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ABSTRACT

Expert systems, rule-based knowledge systems, have been widely heralded as an important tool in management and accounting. Expert system shells have become available for personal computers, and accountants are investing in systems which are supposed to be capable of intelligent decisions. The limitations of rule-based knowledge systems are discussed and illustrated by means of an expert system built to calculate and diagnose standard cost variances. It is argued that, because of the nature of human intelligence as intuitive and reasoning rather than rule-based, such a system is, at best, a proficient or competent system. The limitations and applications of expert systems, particularly in relation to training, are discussed. (10 references) (Author/GL)

EXPERT SYSTEMS - A COMPETENT TOOL FOR TRAINING?

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ABSTRACT

Expert systems, rule based knowledge systems, have been widely heralded as an important tool in management and accounting. Expert system shells have become available for personal computers, and accountants are investing in systems which are supposed to be capable of intelligent decisions. The limitations of rule based knowledge systems are discussed and illustrated by means of an expert system built to calculate and diagnose standard cost variances. This paper argues that such a system is, at best, because of the nature of human intellligence as intuitive and reasoning, rather than rule based, a proficient or competent system, and discusses the limitations and applications of expert systems, particularly in relation to training, in the light of these experiences.

INTRODUCTION

THe advent of relatively cheap personal computers and the associated software have changed the nature of computer usage in business and management. Whereas mainframe applications were directed towards transaction processing, eg payroll, and information systems for control, eg stock control, the new technology emphasises, as evidenced by the widespread use of spreadsheets, decision support systems for planning.

There has therefore been in business education an increase in interest in how to train managers/accountants in decision making skills rather than in the number crunching techniques. The necessity for cost cutting and increased productivity to boost profits puts a great value on the expert (and expensive) knowledge of senior managers, whose tasks have not so far been automated. Expert systems have consequently been widely heralded as an important means of replacing scarce (meaning costly) human expertise.

There has, in recent years, been a great interest in expert systems for management and accounting as reflected both in the number of books and research publications relating to expert systems in the accounting journals and the frequency and attendance at conferences on the issue. Grandiose initial expectations have not been born out in practice and have gradually given way to more modest proposals for narrowly focused expert systems (Ref 1).

THe characteristics, uses and applications of expert systems in accounting have been described elsewhere (Refs 2,3). Broadly speaking, the opportunities for introducing such systems depends on the characteristic of the task which include scarce expertise, the necessity for symbolic reasoning or inference based on logic rathor numerical reasoning alone, heuristic techniques (rules of thumb), the inadequacy of existing methods, a knowledge domain that is stable over time, a frequent requirement for this type of decision making, the existence of skilled expertise and the possibility of evaluating the decisions so reached.

One area in management accounting which has been seen as an application suitable for an expert system is in analysing variances in financial and production sytsems (Ref 4). In complex organisations, the source of the most significant variances may be obscured by other variances. An expert system could be used to detect the significant variances for follow up and correction, especially when thousands of individual variances must be examined to find the few warranting investigation. Thus the essence of the problem is how to decide which of the many variances to examine in detail.

The importance of investigating only material or significant variances is frequently stressed as it is a waste of time and money to examine immaterial or insignificant variances. The problem is how to decide which are significant and worthy of investigation. Some guidelines are suggested in the literature (Ref 5,6). In practice, because variance analysis is time consuming and costly to perform, this important element in the control process is infrequently carried out.

Therefore a system which can derive the necessary variances and then proceed to select those that warrant further investigation has the potential to be an invaluable decision support tool for management. It was decided to build an expert system to do this in order to assess the use of such a system in replacing human expertise and its role as a training device.

DESIGN OF A RULE BASED EXPERT SYSTEM SHELL

A system which would calculate the variances between the expected and actual costs of manufacturing three products, using three different materials (a total of 42 variances) and report which variances were worthy of further investigation was designed and built.

A combination of 5 different approaches was used to arrive at this decision. Firstly that the variance is less than zero,; secondly that it is less than some fixed , predetermined level of significance, eg the percentage of a suitable measure such as sales; thirdly that it is more than two standard deviations from the mean; fourthly that it is greater than the average variance multiplied by some factor and fifthly that the average variance is greater than a significant level. Thus trends, materiality and tests of statistical significance have all been incorporated into the model. Howver cost-benefit analysis and Bayseian methods have not been included.

It was decided to produce a conclusion for each variance rather than just a list of variances that appear to need investigation. There was a choice of three conclusions. First, investigation is advised as long as there are no extenuating circumstances such as a change in standard for that variance. Second, investigation is not advised because the variance is not significant and third, investigation is not advised because the variance, although significant is too small to be material.

Clearly, the crucial factor was the assignment of probabilities to each rule. These assignments were made on the basis of discussions with 'experts'.

The expert system was designed to run on an IBM Pc and uses LOTUS to calculate and print out the variances and produce bar charts of the variances for the previous six periods. The expert system shell EXSYS was used to produce the decision whether or not to investigate the variances. Data were obtained from a manufacturing company. The system is described more fully elsewhere (Ref 7).

RESULTS

The results obtained from the test data were approximately the same as those of the expert. (Of the 42 variances, 27 did not warrant investigation because they were not significant, 9 were significant but not material and only three were both sigificant and material, thereby warranting further investigation.) However that could be expected since the rules were derived in discussion with the expert in relation to these data. It would be useful to evaluate this by using more test data, consulting another expert or by actually using the system in a trial or controlled situation .

This system makes no attempt to discover the causes of the variances or to consider whether the variances are in fact controllable. There is also the problem that after a period of consistently favourable or unfavourable variances that they may be accepted by the system as normal or at least not abnormal. To counteract this, there are rules that attempt to identify this situation. Line graphs of the variances over several periods would bring this out more clearly. Regression coefficients could usefully be included to enable such trends to be detected.

DISCUSSION

THere are however more fundamental issues than the design limitations of this particular system which need to be considered, that is the nature of intelligence itself (Refs 8,9). Expert systems are based on rules and yet only a novice, in the process of acquiring a skill, operates on the basis of rules. Through practice, trial and error, the novice becomes more skilled and gradually dispenses with rules. The results are internalised and constitute the pool of experience which will enrich and subsequently supplant the rules. From conscious decision making after reflecting on various options, the novice moves to more automatic decision making.

Experts do not make detached, deliberate and rational selection from several alternatives. They see the situation as a whole, match it unconsciously or intuitively with similar past experiences which they can apply to the present, without having to break it down into its constituent parts. An expert continuously monitors the situation and takes evasive action before the situation becomes irreversable. Expertise is not about making 'one off' decisions, but continuous adjustive action. This is clearly the case in relation to a skill such as driving (Ref 10).

In relation to the five levels of skill outlined by Dreyfus and Dreyfus (Ref 9,op cit) the decisions of an expert system are at the level of those of a competent performer. This can be illustrated by means of an example. Variances are not discovered out of the blue and then acted upon. A manager who is experienced at his job will have recognised the problem and taken some evasive action long before the variances are calculated.

What then are the advantages and uses of an 'expert system'? An expert regresses to the level of analytical, detached, rule based decisions when the situation is outside his experience; when he has reason to doubt his own expertise. Some external factor may have changed so considerably that the expert has to go back to basics and the rules. In a case such as that, he will be making a competent decision.

'Expert systems' can used for problems where inferior decisions are still acceptable. In relation to the example used above, it may be a question of using a competent system to make a decision in preference to no decision at all.

If expert systems are, as explained above, proficient or competent systems, then it is potentially very useful as a training device for managers, ie. to give managers, new to a task, repeated practice. Particularly useful features of expert systems shells are the ability to rerun the system using slightly different inputs and secondly the ability to explain how the conclusion was reached.

However, it would be important for students as they became more proficient, to become aware of the consequences of their decisions, both 'right' and 'wrong', as this is how people actually learn, by trial and error. Thus it would be necessary to have a <u>series</u> of exercises which would build upon the decisions made in earlier exercises. Thus an expert system would be only one weapon in an armoury of training tools.

A second use for expert system shells as a training device is that building such a system is in its own right a valuable way of learning the nature of the task as well as the determinants of expertise. This is in itself a useful antedote to the heavy emphasis on rational and analytical reasoning rather than intuitive, holistic reasoning. Students could be set a case study, relating to a decision that has to be made, and asked to work in groups to produce an expert system to perform the task. THey should be encouraged to ask the experts, not only for an explanation of the rules, but also the history, philosophy and significance of the decision. THe emphasis would be on a comparison and evaluation of the nature of decisions made by human and artificial expertise.

In both cases however, 'expert systems' are only aids in acquiring skills rather than truly expert decision makers. To conclude, the point is that it is only by recognising the differences between the decisions made by an expert and those made by an expert system that we can most effectively exploit the real capabilities of both human and artificial intelligence.

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