1994-01-01

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AN EXPERT SYSTEM-BASED APPROACH TO HOSPITALITY COMPANY DIAGNOSIS

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INTRODUCTION

Hospitality managers operate in an increasingly difficult business environment. The buoyant market of the 1980's has resulted in an oversupply of hotel rooms[1]. In addition, adverse inflationary, regulatory and economic pressures have made the words "Failure", "Workouts" and "Turnarounds" all too common in the hospitality community.

To survive, hospitality managers must constantly review all aspects of their business. They must ensure that each function is operating at an optimum level in order to achieve satisfactory profitability. Using an iterative process, they analyse both their internal and external environments to identify potential problems and alternative solutions[2].

In many cases, "gut feeling" - based on emotion, experience or intuition - predominantly direct the decisions making process[3]. Management information systems can, however, increase the probability of success by supplying relevant and timely information to aid the manager in the decision making process. A key element of the entire process is the integration of this information with the experience of the decision maker.

This paper describes the development of a prototype Expert System-based Analysis and Diagnostic (ESAD) package. This computerised tool aids the hospitality manager in methodically scrutinising the hotel unit and environment, combining key information with systematic reasoning. The system searches through its extensive knowledge base, investigating complicated relationships. The number of possibilities considered is increased which will broaden the depth and breadth of the analysis and therefore should improve the quality of the managers decision making.

The paper starts by discussing Expert Systems, decision making and company diagnosis. This is then applied to the development of the prototype system, with an investigation into the applicability of Expert Systems to the problem area. The system as perceived at the early stages of the research is described. The knowledge acquisition and representation is discussed, pointing out development problems encountered.

EXPERT SYSTEMS

Expert systems, a branch of artificial intelligence, are computer programs which attempt to imitate the reasoning process of humans. An expert system is composed of a knowledge base, which stores expert knowledge in the forms of facts and rules, an inference engine, which interprets this knowledge and performs logical deductions and a user interface which simplifies interactions between the user and the system. The process of transforming knowledge into facts and rules which can be included in a knowledge base is known as knowledge engineering[4].

The language of if-then rules, also known as production rules, is the most popular method for representing knowledge within an expert system. These rules are conditional statements which can have various formats for representing knowledge. This allows the developer to have greater flexibility for knowledge engineering.

Once knowledge is represented in some from, a reasoning procedure, to draw conclusions, must be established. For If-then rules, there are two basic ways of reasoning: backward and forward chaining. Both of these describe a method for searching the knowledge base, but they differ in the direction of the search. Backward chaining searches from goals to data, from diagnosis to findings. In contrast, forward chaining searches from data to goals, from findings to diagnosis. Because backward chaining starts with goals , it is called goal driven. Similarly, since forward chaining starts with data, it is called data driven.

IF Precondition P THEN Conclusion C	**IF Revenue is decreasing THEN A problem exists within sales/marketing**
IF Situation S THEN Action A	**IF Poor motivation in staff THEN Review remuneration**
IF Condition C 1 AND C2 hold THEN Condition C holds	**IF Market is growing AND Sales are static THEN Market share is declining**

Figure 1 - Examples of *If-Then* rules

If-then rules have the following characteristics which make them useful for developing expert systems[5]

Using the If-Then rule structure, knowledge on a specific subject can be captured and applied to solving relevant problems. As a result, these systems may be used to assist

(1) Modularity	Each rules defines a small, relatively independent, piece of knowledge.
(2) Modifiability	As a consequence of modularity, rules can be changed relatively easily and independently of other rules in the knowledge base.

in areas which normally require a human decision maker. Although incapable of creative thought, the knowledge represented in the system enables a meticulous reasoning process[6]. This process ensures that the system can be developed so that critical information cannot be overlooked as may happen when the human decision maker is working under time constraints. In addition, the knowledge base is structured in a manner which allows it to explain the reasoning process which leads to any proposed solution. As a result, the user can examine and evaluate which factors were taken into account when considering the implementation of a suggested solution.

Traditionally, computer programs generally employed precise rules, which, when followed in a generally sequential manner, led to a "correct" solution. Many decisions, being ill-structured, cannot be solved perfectly and as a result, cannot be solved using these methods[7]. An expert system may tackle such problems as it uses heuristics or 'rules of thumb' to search through alternatives, in any order, and recommend a solution which is not necessarily the best but is at least satisfactory..

DECISION MAKING

When developing a system that would replicate a decision making process, it is first necessary to understand this process. There are three generally accepted approaches to decision making[8]:

- The *Rational-Analytical* approach. The decision maker, acting on his own, considers all possible alternatives and selects the solution which will produce the optimum results. The consequences of implementing the solution are also analysed. This approach prescribes a rational, conscious, systematic and analytical approach to decision making.

However, this method is subject to criticism for, primarily, two reasons. Firstly decision makers rarely act alone. Instead they tend to work within a team. Secondly they seldom have access to enough information to consider all possible alternatives. As a result many decision makers tend to choose courses of action which will result in a satisfactory, as opposed to the best possible result for the organisation.

- The *Intuitive-Emotional* approach relies on experience and instinct rather than on logical analysis. Decision makers consider a number of alternatives, randomly jumping from one step in the analysis to another and back again. Use may also be made of analytical tools but only where intuition calls for examination of the available data.

Critics of this approach point out that intuitive decision makers often fail to consider the consequences of implementing a chosen solution. For example, an intuitive decision maker may decide to increase prices as a method of increasing revenue, but may neglect to consider factors such as fall in demand, competitive reaction or loss of customer good will. In addition, the lack of emphasis on the use of analytical tools reduces the probability of a successful decision being made.

- The *Political-Behavioural* approach considers a variety of pressures from people affected by the decision. It attempts to merge the demands of all stakeholders to form a coalition of interests which will support the decision. The main criticism of this approach is that the objectives of the stakeholders may not correspond to those of the company.

Each of these approaches has its merits but must not be considered in isolation. The typical decision maker uses a combination of both emotional and rational thinking[9]. Similarly, the business environment is a combination of both predictable and un-predictable elements[10]. As a result, the best decisions should be made using rational conscious analysis in conjunction with unconscious intuition.

The prime functions of management are decision making, planning and control. All of the other activities carried out by management - information gathering, analysis and following-up - flow around this central core[11]. However decision making can be argued to be relatively more important. It is the prime constituent of the planning process and the control process ensures that decisions are implemented successfully. Decisions must be taken constantly, ranging in importance from major issues such as the future direction and policies of the business to smaller decisions relating to the amount of each stock item to hold.

Simon distinguished three major phases in the decision making process[12]. The first phase, known as the intelligence phase consists of scanning the environment for conditions calling for decisions. Data is obtained, processed and examined for clues which might identify problems or opportunities. This "problem finding" process is followed by a "problem formulation" process which attempts to clarify the problem in order to ensure that the correct problem is solved.

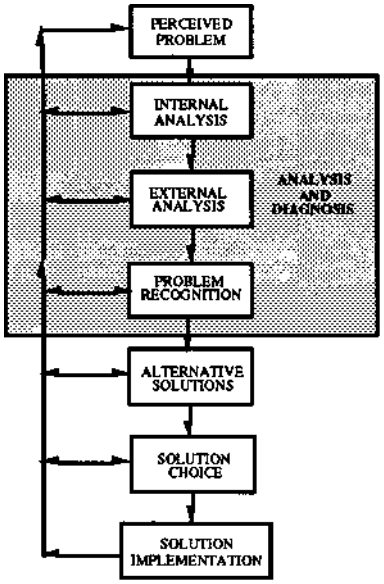

Figure 2. - Adaptation of Simon's Model of Decision Making

Once a problem is identified, the design phase begins. This involves inventing, developing and analysing possible courses of action or solutions for the problem. These solutions are subsequently critically examined to form a list of feasible solutions.

The final or choice phase involves the selection of a solution from the alternatives generated by the previous phase.

This process, although described in distinct phases, occurs on an continuous basis, jumping forward and backward between the stages as required. It might be suggested that the analysis and diagnosis stage is of utmost importance. Unless a problem is correctly identified, a solution cannot be drawn up, evaluated, chosen and implemented. Moreover, hastily guessing at the cause and subsequently choosing an incorrect solution may have catastrophic results. Therefore, the internal and external analysis and problem recognition stages are crucial to the entire decision making process.

Instinct may suggest to an experienced manager that a problem exists within one of the business functions. However, to correctly analyse a decision situation and identify a problem, the following must be considered:

1) Is the decision environment fully understood? The less you know about the situation, the more likely it is that an apparently obvious solution may actually be incorrect. As the situation is comprehensively analysed, the more the diagnosis may change and thus the original apparent solution may now appear inappropriate.

2) Once the real or "core" problem has been identified, alternative solutions must be generated and their implications evaluated. Selection of the solution will be based on how well it solves the problem and how realistic it is in terms of the goals and resources of the operation.

These considerations primarily describe the rational-analytical approach to decision making - a systematic, logical investigation of the business

combined with due consideration being given to potential consequences. For the purpose of this research, it was decided that this comprehensive approach would be developed within the Expert System so as to replicate the most effective decision making process.

RESEARCH OUTLINE

The aim of the ESAD project is to develop a prototype system capable of systematically analysing the internal and external environment of a hotel unit and diagnosing problems. Using the format suggested by Stockdale and Wood[13], the following sections outline the development process of an Expert System Based Analysis and Diagnostic package. Knowledge acquisition and representation are discussed and the perceived benefits and limitations are described.

THE PROBLEM DOMAIN

The problem domain for this research is defined as the systematic analysis and diagnosis of the internal and external environment of a hotel unit. The objective is to pin-point potential areas of concern which are limiting or adversely affecting the profitability of the business and to suggest the most appropriate solution.

The enquiry process should follow an organised pattern to be economical of effort and efficient in pursuing its aims. As a problem may not be immediately apparent, the decision maker should analyse all business functions and identify potential problems. Possible solutions should be examined, systematically analysed for adverse affects, and the most appropriate identified. On completion of this process the manager should be aware of the most appropriate solutions to implement.

CAN EXPERT SYSTEMS BE APPLIED TO THIS PROBLEM.

Expert Systems lend themselves to supporting decisions which are not well structured and rely to a great extent on experience and acquired knowledge[14]. It has been suggested that ES can contribute to the overall performance of the business, potentially provide a competitive advantage and enable the user to make educated decisions based on experience which they themselves may not possess[15]. Whether these benefits can be realised depends on the selection of an appropriate use for the expert systems. Barrett and Beerel have summarised the criteria for selection as follows[16]:

1) The use of ES must contribute to the overall objective of the organisation.

2) The task should be one for which success has material value.

3) The experience and know-how being applied by the human expert must make a real contribution to the success of the task.

4) Solving the problem must rely on reasoning rather than calculating or physical skill.

5) It is preferable if books and test cases exist on the subject and if the subject has been taught to novices in the past.

If these criteria are applied to the area of hotel unit diagnosis, the following observations can be made. Firstly, the objective of most commercial hotel organisations is to be profitable in the long term. Any system which can diagnose where a unit is under-performing and suggest where changes could be made is clearly beneficial. The logical, structured enquiry process will focus the decision makers efforts on areas which are most relevant. Lindblom[17] contends that complete investigation of alternatives is not always possible because the intellectual capacity of man and the availability of required information are limited. Expert Systems, by their very nature, can store and scan vast quantities of information and the search for alternatives is speeded up and is more thorough. As a result, decisions are based on more accurate and pertinent information and are more likely to be successful.

The diagnosis of any business involves the utilisation of various analytical tools. Reading and interpreting the financial statements requires both general financial and heuristic knowledge. However, during this reasoning process, analysts rely to a lesser extent on such financial statements and more on pattern matching, comparing the new data with historical and personal knowledge[18]. Expert systems can be applicable in situations such as this, as the inferencing facility allows such relationships to be easily identified.

The conceptual system

The system carries out its analysis and diagnosis in five stages.

1) Pertinent data about the business in its present state are collected. All areas of the business are initially considered separately. However, at a later stage, each area will be explicitly linked in a comprehensive analysis, as can be seen from figure three. This model is similar to that used by Grundy with the addition of personnel and the external environment to the diagnostic area[19]

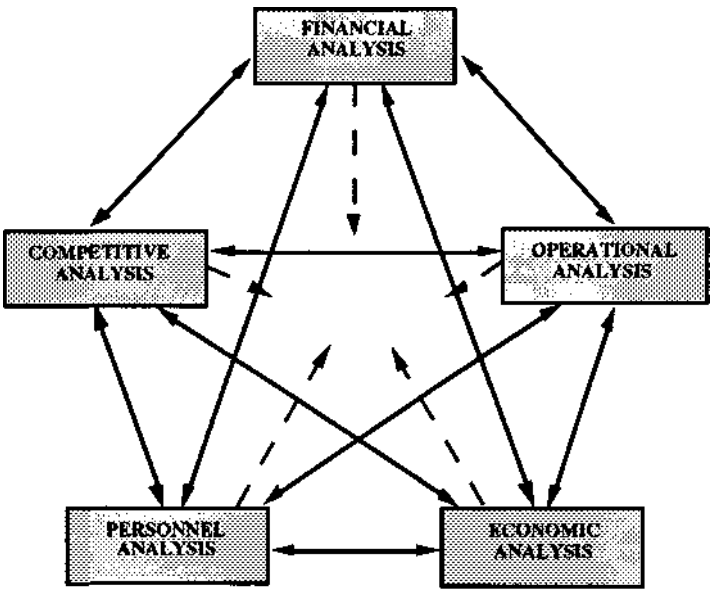

Figure. 3 - Components of the diagnostic

Quantitative data, such as financial statements, are collected in its

most basic form to minimise work for the user. Data of this kind is analysed using a computer spreadsheet and drawn into the expert system through an interface.

Qualitative data are also collected at this stage. As much of this type of data involves measuring the attitudes and opinions of the user, a tool based on the Likert scale is utilised.

2) The data are evaluated and interpreted to identify areas which may be symptomatic of problems.

3) The identified areas are then systematically evaluated to identify the possible root causes of the issue.

4) Based on the diagnosed causes and other factors identified in the business's environment (e.g. financial, competitive, etc.), the system recommends possible solutions.

5) The user, using experience and intuition, selects from the solutions those which he or she feels are most appropriate to the situation. Although the recommended solution may not apply to that specific situation, the interactive logical process of analysis and diagnosis may be a thought-provoking experience. The decision maker may, as a result, view the situation from a different perspective and formulate a more appropriate solution.

KNOWLEDGE ACQUISITION

It is generally accepted that expert systems should only be applied to areas which are narrow in scope[20]. Examples of existing applications include market share analysis[21], assessing the allowance for bad debts[22] and evaluating the financial position of a potential lendee[23]. Although these applications are narrow in scope, they consist of several hundred rules. In contrast the diagnosis of a hospitality unit is a much broader area consisting of many individual analysis models. As a result the knowledge acquisition process for this system covers a much wider area leading to problems in collecting and representing the rules for the knowledge base.

Knowledge acquisition for expert systems can be carried out with the use of one or several industry experts, suitable textbooks or a combination of both. For the purpose of developing the prototype model, textbook analysis has been used to collect and model both general and hospitality business knowledge. This approach has been selected as knowledge acquisition through interviews is time-consuming and does not always yield satisfactory results. The process involves a succession of interviews which must be carried out continually until the results from the system truly replicate the expert's decision making process. This process is further complicated as many experts find it difficult to verbally describe how they make decisions[24]. As much of the decision making process involves unconscious intuition, key elements of the decision analysis process may be overlooked.

It was decided that, for research purposes, a system which replicated the "right" way to manage a hotel would be sufficient to prove the applicability of expert systems to the domain area. For a more comprehensive system,

heuristic knowledge could be sourced and easily added to the existing system because of the previously mentioned modularity of expert system rules.

To carry out a comprehensive analysis and diagnosis, knowledge must be acquired on all areas of hospitality management. At the beginning of the project, a data driven approach was utilised which focused on the raw data available . This proved unsuccessful as the sheer volume of data prevented effective knowledge representation.

A goal driven approach was found to be more appropriate. This approach concentrates on identifying the most common problems that occur in business and on elements which would characterise these problems. Appropriate texts were then used to source solutions to these problems and the inherent consequences or requirements when selecting a solution. This approach proved more successful and established some of the key areas to be analysed, as shown in appendix I.

Within these areas, facts and rules have been developed and engineered into the prototype system. Facts, representing things which are always, unconditionally true and rules, representing things which are true depending on a given condition.

SYSTEM STRUCTURE

When developing the prototype, it was decided that the system should collect the most pertinent information first and then analyse areas which needed the most consideration. Profitability was selected as the key area of analysis as a decrease in profitability is usually symptomatic of other areas which are failing[25]. Selecting this area enabled a clear structure to be identified for logically following a decision tree through to possible causes of problems. Figures 4.1 and 4.2 show an example of the tree format developed. In this example, it has already been established that profitability is deteriorating. The elements of profit (i.e. revenue versus costs) are then analysed systematically to diagnose where the problem is occurring. Each level suggests an area which must be further analysed until the path can go no further and hence the real problem has been identified.

The original enquiry process asked the user for an answer to each of the questions in figures 4.1 and 4.2. This allowed the system to proceed along a logical path where further questions were asked until the end of the path was reached and the core problem established.

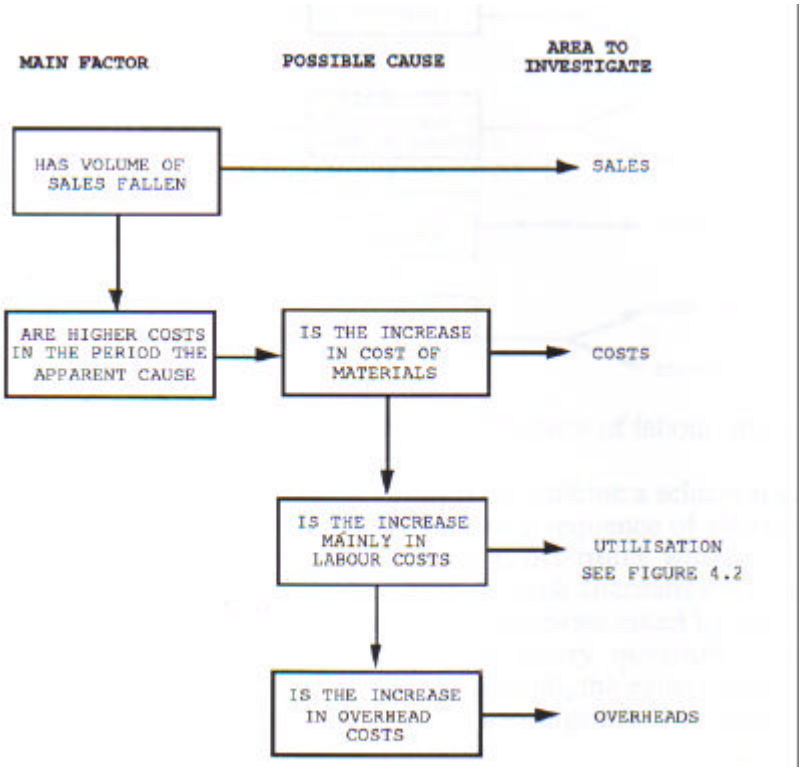

Fig. 4.1 - Analysis of fall in profitability

This path format however led to a very substantial limitation. Once a path was selected, the other elements were disregarded; for example, in the analysis of factors affecting the efficiency of labour, if overtime was blamed for the increase in labour costs, unoccupied time and wrong skills were ignored. This is clearly unsatisfactory as it is quite likely that an under-performing company will show symptoms of problems in several areas.

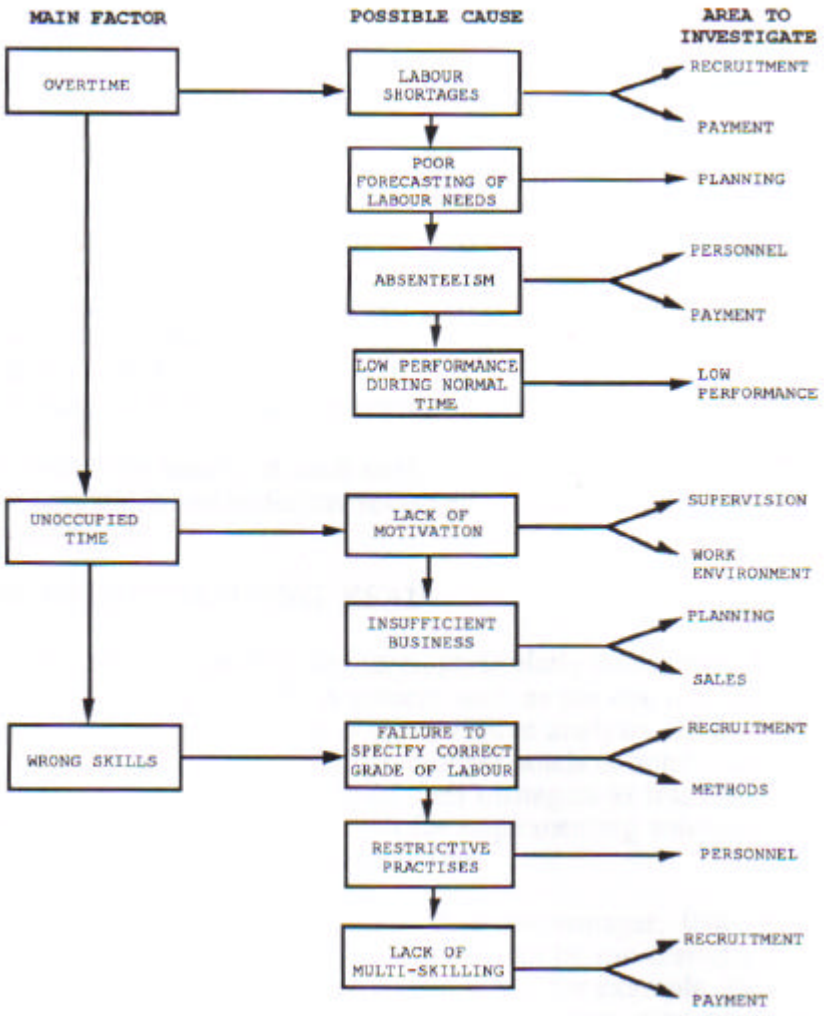

Figure 4.2 - Analysis of factors affecting the efficiency of labour utilization.

A solution to this problem of question structure was to combine a selection system with the diagnosis system. A selection structure allows for a sequence of alternatives, each of which consists of a rule containing conditions that determine whether it should be selected. To allow a multiple item selection structure each alternative is examined and scored depending on the responses of the user. The questions asked by the system will be those represented in the diagrams. However, every question will be asked regardless of the answer to previous questions. As a result, the expert system will have a database of information against which the areas to investigate will be analysed.

Example***:*** ***If*** Absenteeism has increased
and Motivation has decreased
and Amount of overtime paid is increasing
and Increase in labour cost
and Higher costs in the period
and profitability is decreasing
Then **Analyse personnel function**

The above example demonstrates how the first level of analysis and

diagnosis is completed. All areas identified as requiring further analysis are established and presented to the user. To proceed to the next level the user selects from the list of alternatives. For example, recruitment, supervision and sales are selected as problem areas. The user analyses each of these individually until a second level set of problems is identified. The analysis and diagnosis process finishes when all applicable problem areas have been analysed and the core problems of the business have been established.

The second element of the expert system contains knowledge related to the solutions which may be applied to the diagnosed problems. The user selects a solution which he feels appropriate and the system proceeds by ensuring the user is aware of the requirements for and the consequences of implementing the selected solution. Each alternative is analysed in the same manner and scored for its appropriateness.

As well as storing the results of each analysis and diagnosis, the expert system also produces a report which can be further reviewed at a latter date or compared with other users diagnosis results.

BENEFITS OF DEVELOPING ESAD.

In Irish industry, many hospitality managers, particularly those in small hotels, have no formal training in management[26]. A system such as the one discussed in this paper could be beneficial for carrying out comprehensive analysis which managers would understand through a simple user interface. Larger hotels or hotel chains could also use the system to increase the productivity of their managers as less time would be spent analysing the business and more time left for implementing solutions while ensuring that a constant analysis process is used each time.

The expert system can also be used by more than one manager. Individual perceptions of the unit and industry and how it will change can be run through the system. As managers will have different views on certain areas, for example, their own personal perception of service quality, each usage of the system may produce a different diagnosis. The reports generated could then be the basis of a management team meeting where the most likely diagnosis can be selected and thus the best solution for facing it.

This system will have an application to both operational and strategic level management. Department managers will use the system to analyse their specific areas while being made aware of the relationship with other functional areas of the unit. Strategic managers will use the system to comprehensively analyse how the unit is presently performing before deciding on an overall strategy for the business. In both cases the system will ensure that the user is aware of internal problems of the business. Attention will be focused on the most important issues, ensuring that forces in the environment are considered or that there is a full attempt to understand the range of threats and opportunities facing the business. The environment is constantly changing and as a result creating solutions and strategies is not a once off process. This technology enables the expert based diagnosis to be carried out time and again without incurring high consultancy fees.

As well as an industry application, the system will also be used in the training of hospitality management students. The system can be used with

case study work, showing the student the steps which are made in the analysis and diagnosis of the hotel unit.

ANTICIPATED PROBLEMS

As, at the time of writing, this project is at a relatively early stage, it is difficult to describe the completed system in any way other than conceptually. However several areas have been recognised as potentially difficult:

1) Expert systems are powerful tools for reasoning but are weak on analysis. Crystal, the expert system shell chosen for this project, has the capability of carrying out calculations. However it does this using cumbersome variables, which can be quite long and for all intents and purposes must be written individually. As the system may have to calculate several hundred figures, a spreadsheet solution was selected to collect and analyse any quantifiable data.

2) In ensuring that the system is applicable to all hospitality units, the analysis will have to kept as general as possible. The effect will be that the most important information will have to be identified. Is it possible to determine what are the key issues involved that will affect every business?

3) As already discussed, expert systems should be developed for areas that are limited in their domain. This causes problems for hospitality industry management applications as many managerial decisions are based on broad, inter-disciplinary knowledge[27].

4) It is estimated that eighty percent of an expert systems knowledge is generally available from such sources as textbooks, user guides, procedures manuals and interviews with the people who do that work. It is the other 20% that makes an expert system a true expert. Without this level of accuracy, Dreyfus and Dreyfus[28] suggest the system should be termed competent rather than expert. Whether this information can be captured is difficult to answer. If the term expert is to be applied to a system, it is important that it is complete as possible.

SUMMARY

Expert Systems are powerful computer programs for solving problems which could not be solved using traditional methods. Even considering their limitations, their effective use is only limited by the ability of information technology managers to apply them to areas which until now could not have been solved using computer technology.

Properly utilised, they offer benefits such as improved decision making by nonexperts, more consistent decision making in less time within the company, training improvements, operational cost savings. As a result of all the above, competitive advantage can be established.

From the perspective of this research into the technology, it was attempted to develop a system that could comprehensively analyse and diagnose a hospitality unit. Although a very broad area and contradictory to the

argument that Expert Systems should only be developed for specific tasks, it is suggested that there is nothing to stop the individual and specific diagnosis areas being developed and combined into one complete and comprehensive package.

BIOGRAPHICAL NOTE ON THE AUTHORS

Andrew J. Balfe is a lecturer in computer applications in the school of Hotel, Tourism and Catering management, at the Dublin Institute of Technology, Ireland. He holds a B.Sc. (Management) from Trinity College Dublin and a Higher Diploma in Hotel and Catering Management from the Dublin Institute of Technology. This paper is a synopsis of his current research for his masters degree from Dublin City University.

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Ciaran McDonnell has worked within the computer industry and education for twenty years. He holds a Ph.D in computer science and has worked for the past ten years at the Dublin Institute of Technology, College of Catering as Head of Computing and Information Technology.

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1 Berg, P. - **"Exploring solutions in hotel workouts"** Real Estate Review, Summer 1992. pp 33-41

2 Jones, R/Jacobs, L van't Spijker, W. - **"Strategic decision processes in international firms".** MIR vol. 32, 1992/3 pp 219-236.

3 Jauch & Glueck. - Business policy and strategic management 5tn- edition., McGraw Hill 1988, Singapore.

4 Bratko, I. - Prolog, programming for artificial intelligence 2nd. Edition, Addison Wesley 1990, USA.

5 Bratko, I. Op. Cit.

6 Jackson, P - Introduction to expert systems 2ncl- Edition, Addison Wesley 1990, U.S.A.

7 Thow-Yick, L & Huu-Phuong, T. - **"Management expert systems for competitive advantage".** Information and management Vol. 18 1990, pp 195-201.

8 Jauch & Glueck. Op. Cit.

9 Hickson, D J. et al. - **"Decision and organisation - processes of strategic decision making and their explanations."** Public Administration, Vol. 67 Winter 1989.

10 Jauch & Glueck. Op. Cit.

11 Owen D.E., **"Delivering On The Promise Of Management Information Systems",** IMC Journal, September / October 1987

12 Simon, H.A., **"The** New **Science Of Management Decision",** Harper And Brothers, New York, 1960, p54.

13 Stockdale, A & Wood, M. - **"Building an Expert System for a routine task: a case study."** Management Decision Vol. 30 Iss. 3 1992, pp 46-49.

14 Barrett & Beerel. - Expert systems in business: a practical approach.

15 Millman, H & Harding, E. - **"'Potential' still describes Al-rooted knowledge tools".**

Software magazine, September 1991. pp 40-52.

16 Barrett & Beerel. Op. Cit.

17 Lindblom, C. - **"The science of 'muddling through'".** Public Administration review Vol. 19 1959. pp 79-99.

18 Keyes, J. - "A **Financial Expert's Way of Knowledge"** Financial & Accounting Systems Vol: 7 Iss: 3 Fall 1991 pp 41-44

19 Grundy, T. - **"Competitive and financial business analysis for strategic and operational decision taking".** Management accounting. Febuary 1992 pp 50-52

20 McCool, A. - **"Some considerations in developing Expert Systems for the hospitality industry".** International journal of hospitality management Vol. 6 No. 4 1987, pp 191-198.

21 Alpar, P. - **"Knowledge based modeling of marketing managers' problem solving behaviour".** Internation journal of research in marketing Vol. 8 1991, pp 5-16.

22 Mockler, R.J. & Dologite, G.G. - **"Knowledge based systems for strategic corporate planning".** The planning forum, Oxford, Ohio, 1987.

23 Duchessi, P. - **"Contrasting successful and unsuccessful Expert Systems".** European journal of operational research Vol. 61 1992, pp 122-134.

24 Alpar, P Op.Cit.

25 Acca Manual 3.2 - Financial Management. BPP Publishing Ltd. 1990, Great Britain.

26 Cert. Manpower survey of the hotel, catering and tourism industry in Ireland Vol. 1. 1993, Ireland.

27 Lin, E. - **"Expert Systems for business applications: potentials and limitations".** Journal of systems management Vol. 37. July 1986, pp 18-21.

28 Dreyfus, H. & Dreyfus, S. - **"Why Expert Systems do not exhibit expertise".** IEEE Expert Summer 1986, pp 86-90.