Int. J. Engng Ed. Vol. 8, No. 1, pp. 43–55, 1992
Printed in Great Britain.

0742–0269/91 $3.00+0.00

Design and Development of an Expert System for Undergraduate Course Advising*

S. L. MILLER‡
L. G. OCCEÑA†
Department of Industrial Engineering, University of Missouri–Columbia, Columbia, MO 65211, U.S.A.

This paper describes the design and development of an expert system for undergraduate course advising in Industrial Engineering at the University of Missouri–Columbia. The primary purpose of this project was to create an expert system that puts more responsibility for course advising on the student. Expert System Environment (ESE), an expert system shell on the IBM mainframe, was chosen as the development tool. This paper describes the expert system, its operation and evaluation. Verification and validation were performed to ensure the accuracy and reliability of the system. The expert system was found to be helpful and easy for students to use. It also provided accurate results in a timely fashion.

INTRODUCTION

Background

THE COURSE advising of Industrial Engineering undergraduate students at the University of Missouri–Columbia is often a time-consuming process for the faculty advisors. Each of the faculty members is assigned approximately 15 students, with the exception of the Director of Undergraduate Studies who advises approximately 35 students. During the weeks prior to registration, students must schedule appointments with their faculty advisors to complete a trial study form and an enrolment form.

The purpose of the trial study form is to ensure that the student is taking courses in the proper sequence, and to eliminate any scheduling conflicts. Once the faculty advisor has approved the schedule, the enrolment form is then completed. The advisor signs both forms and the student proceeds to registration.

Problem

With the ever-increasing demands on the time of the faculty advisors, a systematic way of handling the undergraduate advising process was sought. Because students see their faculty advisors for schedule advising only once each semester, the faculty advisors must familiarize themselves with all the necessary advising facts each time. Every semester, faculty advisors must mentally update themselves on each student's file to see what courses have been taken, which prerequisites have been satisfied and what courses should be taken next. They must also remain informed of any curriculum changes. Although guidelines are available in an advising packet, the process can still be time consuming, especially if a faculty advisor is not completely familiar with the process.

Objective

The objective of this project was to put more of the responsibility for course selection on the student. The student will still meet with the advisor, but only for final approval. To do this, we chose an expert system medium. Expert systems are currently used in a variety of areas, including equipment diagnostics, project scheduling and process control. They are useful because they make expert knowledge accessible to all types of users. An expert system is an artificial intelligence (AI) technique that enables computers to utilize the knowledge of experts to help people analyze problems, make decisions and perform certain tasks [1]. The goal of this expert system, named IEADVISE, is to give important advising facts, ensure that students are aware of degree requirements, list course descriptions and prerequisites, and ultimately assist in planning a schedule.

Significance

Benefits from utilizing an expert system approach include: (1) a thorough analysis and understanding of the undergraduate advising process; (2) permanent storage of advising information; (3) preliminary course advising without the presence of a faculty advisor; and (4) more time for faculty advisors to devote to other work. The significance of an expert system for Industrial

* Paper accepted 15 November 1991.
† Assistant Professor to whom any correspondence should be addressed.
‡ Former graduate student.

Engineering undergraduate course advising is the simplification of the process for both student and faculty advisor. A student often only wants to know what courses one needs to take for the following semester. In this case, the student can consult IEADVISE and answer the questions posed by this expert system. Upon completion of the session, the student will be presented with a list of potential courses. The student will then be able to plan a schedule. Actual consultation with the faculty advisor can thus be limited to seeking opinions on electives and course loads, as well as for final approval of the student's schedule.

LITERATURE REVIEW

Expert systems

Rees [2] described an expert system as a computer program that embodies expert knowledge and can offer intelligent advice. Expert systems can manipulate knowledge as well as data, are easy to modify and update, will tolerate uncertainty in the answers, and are able to explain their operation in natural English language. Expert systems can also be executed and tested before completion [3]. These features are the primary differences between expert systems and traditional computer programs.

The knowledge stored (or knowledge base) is quite separate from the reasoning mechanism (or inference engine). The knowledge base of an expert system is a codified collection of expert-level knowledge that pertains to a specific domain and is available to assist a non-expert in performing a task [4]. The inference engine is the part of the expert system that interprets the knowledge and does the reasoning [3].

Many types of problems have been solved or have been attempted with an expert system approach. Some of the more common problems include analysis and interpretation of measurement data, error detection, design configuration, repair, planning, simulation and maintenance [5]. One reason for the success of expert systems is that they do not solve problems solely by the use of facts and calculations, but also incorporate heuristic and qualitative reasoning, much like human experts.

According to Paton [6], expert systems allow organizations to capture expert knowledge forever as human experts enter and leave the organization. Expert system development is considered such an emerging field that courses introducing expert systems have been taught at various universities [7]. In these courses, students are taught an overview of AI and expert systems, advantages and disadvantages, major components, basic development, and rule-based systems. Students are usually assigned an expert system project.

Expert systems in an advisory capacity

Hatfield [8] proposed an expert system to replace the human teaching assistant. The benefits of this approach included unique assignments for each student, and the assignment of open-ended problems. The Computer Teaching Assistant (CTA) was implemented at Northern Arizona University in electrical engineering and technology courses. The goal for CTA was to communicate as naturally as possible, while maintaining a knowledge base large enough to carry out several general tasks for the courses it served.

Wood [9] discussed the development of a Trainee Teacher Support System (TTSS), an advisory system to provide guidance to trainee teachers on their lesson practice. The two main components of this study were: (1) the development of a particular class of expert systems that had expertise in a social sciences area; and (2) the formalization of the knowledge from experienced teachers. The prototype provided advice based on the full understanding of the classroom process.

Another expert system, Advice, helped evaluate study plans of Systems and Industrial Engineering graduate students at the University of Arizona in Tucson [10]. It was designed to check for inconsistencies in graduate student study plans prior to graduation. It detected minor and serious mistakes, including the lack of prerequisites for a student with a non-engineering undergraduate degree that went unchecked by human advisors.

METHODOLOGY

As tasks that require expert knowledge are well-suited for an expert system [5], and with the availability of well-established human experts for Industrial Engineering undergraduate course advising, an expert system approach was a feasible choice for solving the course advising problem. The first step in designing this expert system was to describe the information that was needed and the way that the information should be used to advise students. The Engineering Advisor's Manual [11], the Industrial Engineering Student Advising Packet [12], the Department of Industrial Engineering Faculty, and the College of Engineering office were the primary sources for gathering this information. To advise properly a student on his or her subsequent semester's courses, the advisor must know what courses have already been taken, what courses may have sequencing problems, and if the student needs to repeat any courses. The IEADVISE expert system was designed to advise students in a manner similar to a human advisor. This system will eliminate routine course advising, and allow faculty advisors to focus student consultations on more complex problems. The current advising process is illustrated in Fig. 1.

In IEADVISE, the user is asked a series of questions. Based on the response, a course of action is initiated. Any vital information can be clearly presented. This format diminishes the probability of such information being overlooked, which is a problem with doing a manual search through an advising package.

Once the decision to use an expert system approach had been made, a choice between using a

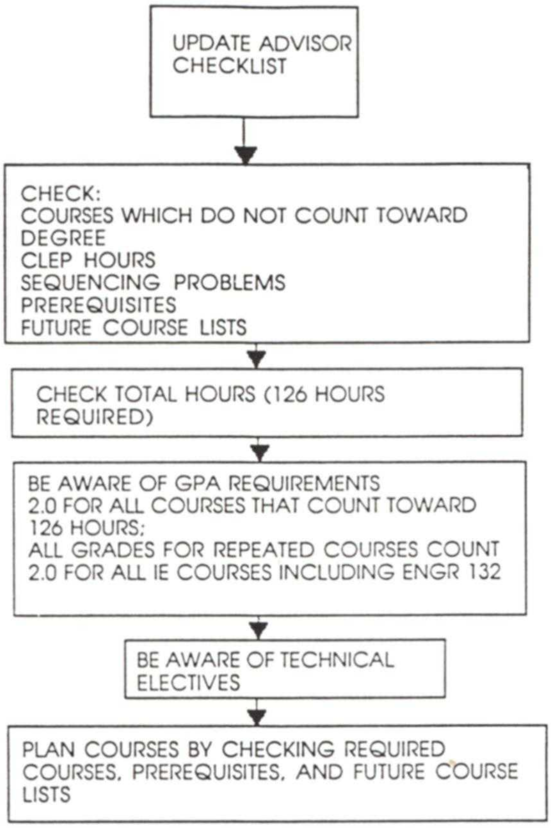

Fig. 1. Current industrial engineering advising process.

programming language and an expert system shell was necessary. The programming language examined was Prolog, a formal AI language based on logic structures. This alternative would have required sophisticated programming skills and extensive experience in expert system building. Expert system shells, on the other hand, provided an environment for expert system development that consisted of a user interface, inference engine, and facilities for developing and testing the knowledge base. An expert system shell allowed the authors to concentrate on knowledge extraction and representation, and thus became the choice for this project.

The particular expert system shell used was the Expert System Environment (ESE) [4], which is available on the University of Missouri mainframe. ESE facilitated the construction of expert system applications that were run using the Expert System Consultation Environment. The rules and parameters related to the problem were defined, and then put into expert system format. This definition involved examining the relationships of all the variables that were active in the advising process. From this point, the model acquired the structure that would determine the conclusion for any combination of given conditions.

After the knowledge base was put into the system, the consistency, completeness and correctness were verified. Consistency ensures that the rules are in agreement and that one rule does not negate or conflict with any other rule. Completeness means that all possible situations and combinations are taken into account. Any user, no matter how atypical, should be able to get accurate results from consulting the expert system. Correctness refers to the accuracy of the information in the parameters and rules.

Verification involved two steps: (1) checking that the knowledge was consistent and complete; and (2) verifying that the information was correctly applied [4]. When transferring knowledge from an expert to a knowledge base, a variety of errors can occur. ESE's editor was used to check each object for syntax errors upon data entry. The editor checks parameter constraints and rule clauses (these terms to be explained later). Inconsistencies and incompleteness had to be checked manually because ESE does no semantic checking between rule clauses in a rule or between rules. Debugging was then done to ensure that correct results will be given when a user consults the system. Various test consultations were run to see if the appropriate recommendations were obtained for different cases. When inaccurate results were obtained, the authors determined the source of the error with the use of the explanation facility and the Find, Trace and Rerun commands.

Following verification, the expert system was validated in two ways. Completed trial study forms on file for each student in the sample study were compared to the results obtained from the expert system. Currently enrolled students were also asked to consult the expert system and fill out a questionnaire for data analysis. Results of the model development, sample sessions and validation will be described in the following sections.

SYSTEM DESCRIPTION

Expert system structure

An expert system shell offers less flexibility of design and range of applications than programming languages [6]. They do, however, offer a built-in expert system structure, enquiry interface, storage and rule-generating framework that allows the developer to focus on knowledge extraction and representation. A shell is essentially an expert system without the specific knowledge required for a particular application [1]. The expert system shell used, ESE, resides in the University of Missouri–Columbia mainframe computer, UMCVMB, an IBM 3090 that runs the VM/CMS operating system. It is accessible 24 h a day through hard-wired workstations in 11 sites, and through a dial-up modem service. An expert system developer can take expert-level knowledge and use ESE to build a knowledge base. Users can then consult this knowledge base to obtain a course of action. Figure 2 illustrates the knowledge flow for an expert system.

From IEADVISE, students will receive a potential course schedule. Each student should be able to

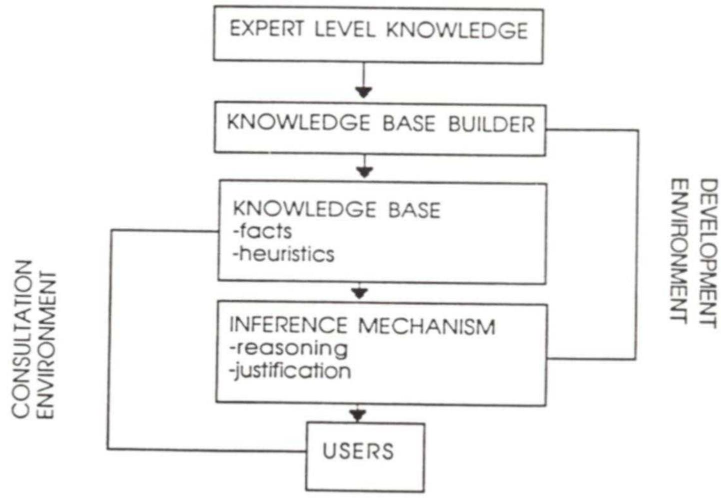

Fig. 2. Ilustration of the flow of expert knowledge.

provide selective information on previous courses taken, grades received and the semester for which they seek advising. The expert system will then take this information and advise the student on course selection based on predetermined rules.

Major system components

An important step in developing the knowledge base was to define the parameters and logical relationships between these parameters. A parameter is a domain fact and in this application is either a string, number or a Boolean. An example of a string parameter in IEADVISE is MATH. It contains a list of all the Math courses an industrial engineering student is required to take, as well as pre-calculus courses that certain students may take. Within the consultation environment, the student will be asked, 'What is the last Math course you completed or are currently enrolled in with a grade of "C" or better?' The student will be asked to mark the appropriate choice from a list of Math courses, and IEADVISE will then store this information.

A number parameter is used when IEADVISE requires a numeric value to evaluate a student's status. For example, incoming freshmen are required to take Math placement tests to determine the initial Math course for them to take. A number parameter in IEADVISE is MMPT_SCORE, which will ask, 'What was your MMPT score? (Enter a number ⩾0 and ⩽40)'.

A Boolean parameter is one in which the answer is either true or false. IEADVISE uses a Boolean parameter to determine initially the category of student consulting the system. IEADVISE asks, 'Are you an incoming freshman?' Based on the student's response, IEADVISE establishes one of two focus control blocks.

A rule defines the relationship between the parameters. It is an IF–THEN statement that consists of a premise clause(s) and an action clause(s). The premise clause is first tested. The action clause is acted upon if the premise statement is found to be true. There are two types of expert system shells available: rule-based and example-based [3]. Rule-based systems like ESE are the most common type. The inference mechanism uses input from the user to determine whether or not the condition in the premise clause is true. Rules are evaluated, assumptions are asserted and conditions for other rules may be formed. Step by step, the system moves through the solution process. Example-based shells, on the other hand, operate from a set of case studies. This type of shell is appropriate when many case studies are available for analysis, and when it is difficult for the expert to express knowledge in the form of rules.

A rule utilizing the MATH string parameter would be, 'If MATH = 80 then MAY_TAKE_MATH = 175'. This means that if the student had marked '80' when asked about their Math level with a grade of C or better within the consultation environment, this rule would set the MAY_TAKE_MATH parameter equal to 175 for the student's schedule. A rule utilizing the MMPT_SCORE and TRIG_SCORE number parameters and FRESHMAN_GROUP_NUMBER string parameter is 'If FRESHMAN_GROUP_NUMBER = "I" or FRESHMAN_GROUP_NUMBER = "II" and MMPT_SCORE ⩾ 30 and TRIG_SCORE ⩾ 16 then MAY_TAKE_MATH = "80"'. Similar rules were written for each range of MMPT and TRIG scores that pertain to different calculus and pre-calculus courses. A rule utilizing a Boolean parameter in IEADVISE is 'If CHEMISTRY = False then MAY_TAKE_CHEMISTRY = 5.', where CHEMISTRY is the Boolean parameter. IEADVISE also suggests that completion of College Algebra is advisable before enrolling in Chemistry 5.

Additional parameters were defined for Physics, English, Basic Engineering, Industrial Engineering, Humanities, History, Economics and Technical electives. Each of these parameters would elicit information from the student about their previous courses. For each of these parameters, a corresponding MAY_TAKE parameter was defined to determine new courses for which a student was eligible. Once a student answered a question about previous courses, IEADVISE looked for the appropriate rule to determine what the student may take.

At least one rule for each course in the Industrial Engineering undergraduate curriculum was defined to cover the entire range of options or choices available to the student. In total, 32 parameters and 75 rules were utilized in the design of IEADVISE. The primary difficulty in defining the rules was the uncertain nature of the undergraduate student. Although a recommended curriculum is available and advised, few students follow the suggested sequence exactly. Therefore, each rule was defined solely on the basis of the semester, course prerequisites and a student's previous courses. The rule, 'If IE = "Engr 132" and IE = "207" and SEMESTER = "WINTER" and IE ≠ "239" then MAY_TAKE_IE = "239"', is an example of a typical rule. If a student is currently enrolled in or has completed Engr 132 (Probabilistic Models) and IE 207 (Operations Research Models), and the student is enrolling for the Winter semester, and the student has not yet completed IE 239 (Evaluation of Engineering Data), then IEADVISE will recommend that the student enroll in IE 239.

IEADVISE, by design, requires three focus control blocks (FCBs). Focus control blocks are the primary building blocks for the Expert System Development Environment (ESE) [4]. Each FCB represents a single unit of work to be accomplished during problem-solving. The root FCB of IEADVISE, called the Parent FCB, determines whether the student is an incoming freshman (CFB:Freshman), or a returning/transfer student (FCB: All_Others). Each FCB contains instructions that are used to process the parameters and rules associated with the FCB. Figure 3 illustrates the IEADVISE framework.

FCB:Student (the Parent FCB) is the initial FCB established once a consultation of IEADVISE is initiated. Within this FCB, the system determines whether the student is an incoming freshman or a returning/transfer student. If the student declares him or herself as a freshman, FCB:Student will establish FCB:Freshman. FCB:Freshman will then ask questions based on rules and parameters contained within the structure. If, however, the student declares him or herself as a returning/ transfer student, FCB:All_Others is established and initiates its parameters and rules.

FCB:Freshman uses parameters and rules involving the Freshman Group Number, ACT score, MMPT (Missouri Math Placement Test) score, TRIG (Trigonometry Placement Test) score and ACT-Math score, if necessary, to determined an incoming freshman's recommended schedule, course load and any block courses. Once the student is issued a schedule, IEADVISE will allow the student to continue the consultation for an indefinite number of times.

FCB:All_Others uses parameters and rules involving the semester enrolled for, Senior standing if applicable, and courses in Math, Chemistry, Industrial Engineering, Basic Engineering, Physics, English, Humanities/Social Science, History, Economics and Technical electives. FCBs have editable properties that allow more specific instructions to be included. Every defined parameter or rule must be 'owned' by an FCB. However, a parameter or rule cannot be owned by both FCB:Freshman and FCB:All_Others.

SYSTEM OPERATION AND SAMPLE SESSION

The parameters and rules in this advisory system represent a comprehensive collection of degree requirements in the Department of Industrial Engineering at the University of Missouri–Columbia. Appendix A illustrates a sample session on IEADVISE for an incoming freshman student. If the user has a question about a course at any time during the consultation, a function key (PF4 key on an IBM 3270 terminal) can be pressed to obtain a complete course description. The user can also press another function key (PF10 key on an IBM 3270 terminal) at the final screen to see how IEADVISE arrived at the recommended schedule. IEADVISE will show the rules enlisted and the current value of each parameter.

TESTING AND VALIDATION

Basic debugging

The initial debugging of IEADVISE was based on the curriculum of the Department of Industrial Engineering. The authors consulted IEADVISE and answered the questions by entering the first semester of courses according to the curriculum sheet. The goal of this general checking was to see if IEADVISE would recommend the same courses as the curriculum sheet, and to see if IEADVISE would make any errors. An error was considered to be any recommendation by IEADVISE of a course that a student had already completed or was ineligible to take. Rules and parameters were then added or revised to rectify the errors.

Evaluation of current student files

The next testing stage involved the use of existing student files. The authors obtained a list of all undergraduate students currently enrolled in the Department of Industrial Engineering. This list was divided into Freshman, Sophomore, Junior and Senior classes. Eight students were randomly selected from each group. Information from their current transcript of courses were entered into the

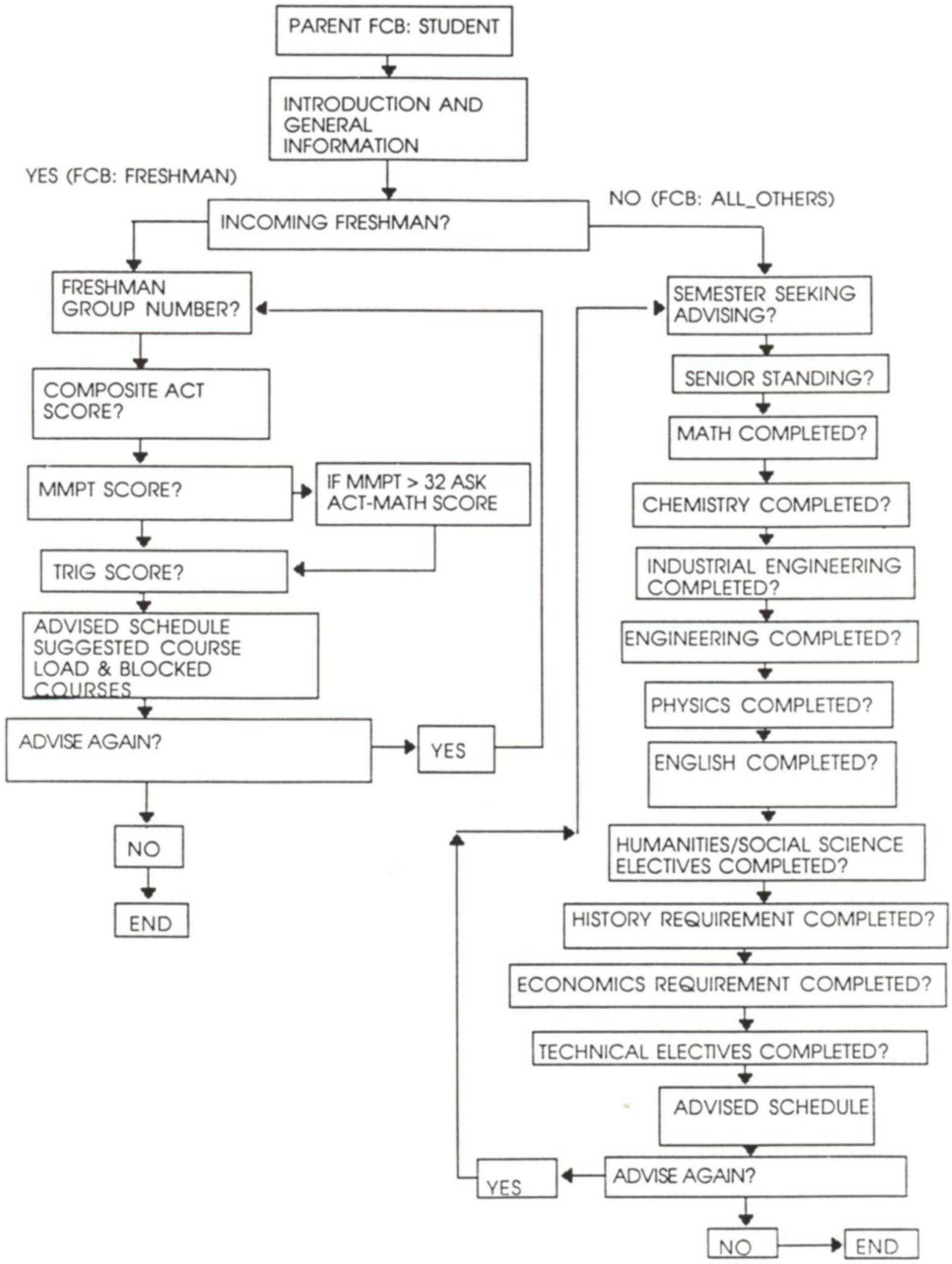

Fig. 3. FCB framework of IEADVISE.

consultation environment in response to IEADVISE questions. The advising schedule from IEADVISE was then compared with the current trial study form, i.e. the actual schedule as suggested previously by a faculty advisor, of each student to check for agreement between the advice given by the expert system and the human faculty advisor. The number of courses from IEADVISE that agreed with the trial study form was expressed as a percentage of correctness. Table 1 lists the results from this evaluation.

The average percentage from each class ranged from a high of 96.87% correct (for Freshman) to a low of 70.50% correct (for Senior). The outcome was not surprising because IEADVISE's goal is to advise students correctly based on the prescribed curriculum. This task becomes more difficult as a student progresses to the upperclass years and has more options and electives to choose from. In every case where there was a discrepancy, the reason why IEADVISE disagreed with a human advisor was due to one of the following reasons: (1) the student did not have all the necessary prerequisites according to the Industrial Engineering curriculum to enrol in the course the faculty advisor suggested; or (2) the course was not a requirement for a Bachelor of Science degree in Industrial Engineering. An example of a difference

Table 1. Percentage correct of IEADVISE recommendations in comparison with human advisor recommendations

	No.	Freshman	Sophomore	Junior	Senior
	1	100	100	80	100
	2	100	100	100	60
	3	100	80	25	67
	4	75	100	100	80
	5	100	100	80	40
	6	100	100	80	50
	7	100	100	100	67
	8	100	80	100	100
Average percent correct		96.87	95.00	83.13	70.50
Standard deviation		8.84	9.26	25.49	21.77

was when a faculty advisor suggested that a student take an advanced English course. IEADVISE, on the other hand, will be satisfied that the student has already completed the English requirement and will not suggest another English course. Instead, IEADVISE will suggest a different course that will count towards the student's degree requirements and move the student closer to completion.

Note that for Freshmen and Sophomores, the average percentage correct was well above 90% with correspondingly low standard deviations. These students typically require more advising than upperclassmen, and thus it was encouraging that IEADVISE gave results that were very similar to a human advisor in this particular group. Juniors and Seniors, on the other hand, have more flexibility and choices in their schedules, so it was not surprising that the average percentage correct was lower for them. However, with no average percentage correct below 70%, IEADVISE has achieved a fair degree of success in undergraduate advising. Much like a human advisor, IEADVISE found it more difficult to advise the upperclass students than the lowerclass students.

Results for percentage correct that were lower than 100% did not reflect courses suggested by IEADVISE that were not on the trial study form, rather courses that were on the trial study form but were not suggested by IEADVISE. IEADVISE lists all courses a student is eligible for, whereas a human advisor generally suggests courses within a 12–18 h per semester range. IEADVISE is unable to distinguish between a student who may need a lighter load to boost his or her Grade Point Average (GPA) and an exceptional student who wishes to be challenged. Although more of an exception than the norm, this situation is perhaps where the personal touch of a human advisor may be more desirable than an impersonal computer program. None the less, IEADVISE will save valuable time for the student and the faculty advisor by narrowing down the choice to a set of feasible courses.

Student evaluation

The second validation procedure involved recruiting 10 student volunteers from each Industrial Engineering year level, i.e. Freshman through Senior, for a total of 40 students. Each student consulted IEADVISE, received an advising schedule and filled out a short questionnaire. A sample questionnaire can be found as Appendix B. The objective was to evaluate the student reaction to a computerized course advisor. The questionnaire addressed six areas of interest, including ease of use, helpfulness of written and on-screen instructions, timeliness, accuracy of results, probability of using IEADVISE again, and overall rating of IEADVISE. A scale of 1–5 was used, where 1 was Poor, and 5 was Excellent. For IEADVISE to be considered a viable alternative to the current advising process, it was decided that responses of 3 and above were acceptable values. Table 2 lists the results of this evaluation.

Although the total number of students who found IEADVISE at least acceptable in ease of use, helpfulness, timeliness and accuracy ranged in proportion between 0.86 and 0.95, only 0.65 indicated there was an average chance or better

Table 2. Proportion of students responding 3 or higher to IEADVISE questionnaire

Characteristic	Class level				
	Freshman	Sophomore	Junior	Senior	Total
Ease	0.80	1.0	0.92	0.73	0.86
Helpfulness	0.90	1.0	1.0	0.91	0.95
Timeliness	0.90	0.90	1.0	0.91	0.93
Accuracy	1.0	0.80	1.0	0.82	0.91
P (use again)	0.80	0.40	0.67	0.73	0.65
Overall	0.70	0.70	0.75	0.55	0.68

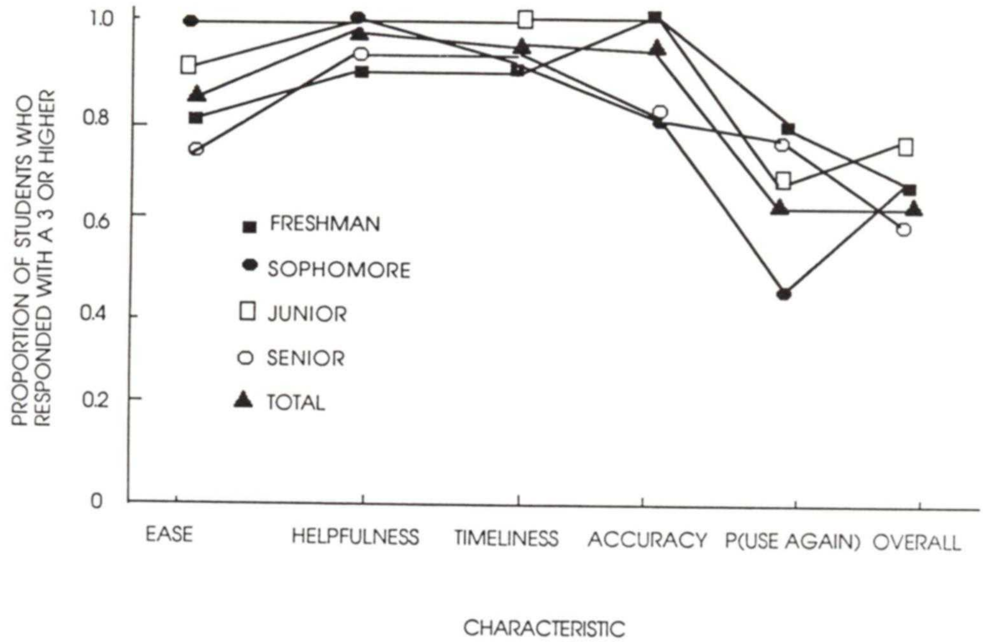

Fig. 4. Graphical representation of student response to IEADVISE questionnaire.

that they would use IEADVISE again. A proportion of 0.68 rated IEADVISE as at least acceptable when compared to a human advisor. The results seem to indicate that though IEADVISE is a fairly reliable and useful alternative for Industrial Engineering undergraduate course advising, students may be hesitant to give up the personal relationship they have developed with their human advisors. For individual class levels, ease of use, helpfulness, timeliness and accuracy were consistently high, with values all above 0.80 (except for Senior-Ease at 0.73). These numbers indicate that the value of IEADVISE itself is high. In each of the characteristics examined, the proportion of Freshmen who rated IEADVISE with a 3 or higher was always above 0.70. Owing to the fact that freshmen generally require the most guidance, it is encouraging that this sector of the population felt confident about IEADVISE. Figure 4 graphically illustrates the students' responses.

CONCLUSION

The use of an expert system approach as an Industrial Engineering undergraduate course advisor provides a promising alternative to the existing advising process, based upon the results of the two evaluation techniques, especially for Freshmen and Sophomores—who need the most guidance. Whether students will prefer it over the current method of faculty advisor interaction is a different matter. The expert system developed was implemented using a relatively simple and easy-to-learn expert system shell. The application was directed only at Industrial Engineering, but can easily be expanded or adapted to include other departments. A possible extension might be to utilize external data routines to access a student's academic history. Supplementing the undergraduate course advising process at an early stage with a computer may yet be an excellent way to prod even the most computer-illiterate student into becoming more computer-friendly.

REFERENCES

1. J. G. Burch and A. Grudnitski, *Information Systems, Theory and Practice*, John Wiley, New York (1988).
2. P. L. Rees, Practical considerations associated with expert systems, *IMDS*, 3–6 (1988).
3. G. A. Finn, Rules of thumb for implementing expert systems in engineering, *InTech*, **34**(4), 33–37 (1987).
4. *Expert System Development Environment (ESE) User's Guide*, IBM Corporation, 2nd edn (1986).
5. E. Konrad, Principles of expert systems, *Int. J. Appl. Engng Educ.*, **6**(2), 113–117.
6. R. Paton, Managing the expert, *IMDS*, no. 4, 20–23 (1989).
7. J. Durkin, Introducing students to expert systems, *Expert Systems*, **7**(2), 70–77 (1990).
8. J. M. Hatfield, A pseudo expert teaching assistant, *Int. J. Appl. Engng Educ.*, **6**(2), 265–268 (1990).
9. S. Wood, The trainee teacher support system: an expert system for advising trainee teachers on their classroom experience, *Expert Systems*, **5**(4), 282–289 (1988).
10. Y. Shen and A. T. Bahill, An in-depth study of an expert system that helps evaluate graduate study

programs, and a statistical summary of 25 little expert systems, *Proc. IEEE International Conference on Systems, Man, and Cybernetics*, **2**, 249–251 (1988).
11. *Engineering Advisor's Manual*, College of Engineering, university of Missouri–Columbia, Columbia, MO (1990).
12. *Industrial Engineering Undergraduate Student Advising Packet*, Department of Industrial Engineering, University of Missouri–Columbia, Columbia, MO (1990).

APPENDIX A:
SAMPLE IEADVISE SESSION: INCOMING FRESHMAN EXAMPLE

```
FILE: ESXPRINT SCRIPT    A1   UNIVERSITY OF MISSOURI-COLUMBIA


.SA ESE1;.TM 6
.RF CANCEL;.DH1 LEFT
.RH ON;.SX C //Page &//;.SP;.RH OFF;.GS TAG OFF
.FO OFF
 Down                                 Focus: student

                                                              | PF1  Help     |
                                                              | PF2  TogglePF |
            This is an Expert System that                     | PF3  End      |
                                                              | PF4  Review   |
            will help students to advise themselves           | PF5  Print    |
                                                              | PF6  Store    |
            on the courses that they are eligible to          | PF7  Up       |
                                                              | PF8  Down     |
            take in the upcoming semester.                    | PF9  Trace    |
                                                              | PF10 Undo     |
            It is not designed to replace the advisor         | PF11 Error    |
                                                              | PF12 FullMsg  |
            but to serve only as an additional guide.         |_______________|

 Before you begin the advising process, here is some

 general information for all students.

  It is very important that each student register for

  Engr 132, IE 207, and IE 261 as soon as possible once

  he or she is eligible.

  Courses which do not count toward the 126 hours

  necessary for a degree are

  Precalculus - Math 9, 10, 14, and 15

  English 1


 All Physical Education courses

 All Music Theory courses and Marching Band

 Military Courses (Exception:  Last nine hours can
 count as technical electives if the student needs
 technical electives.  The student must receive a
 commission for these hours to count)

 GPA requirement

 A 2.0 for all courses that count toward the 126 hour
 degree.  All grades count for repeated courses.

 A 2.0 for all Industrial Engineering courses.  This
 includes Engr 132 and all courses taken in the dept


                    To continue Consultation, press ENTER.

==>
```

```
.PA
                          Focus: student
                                                     PF1 Help
                                                     PF2 TogglePF
                                                     PF3 End
                                                     PF4 Review
                                                     PF5 Print
                                                     PF6 Store
Will you be an incoming freshman in the upcoming    PF7 Up
semester?                                            PF8 Down
                                                     PF9 Trace
                                                     PF10 Undo
(Choose one of the following:)                       PF11 Error
                                                     PF12 FullMsg
x____ Yes
_____ No



==>
```

```
.PA
                          Focus: GLOBAL                         2
                                                     PF1 Help
                                                     PF2 TogglePF
                                                     PF3 End
                                                     PF4 Review
                                                     PF5 Print
                                                     PF6 Store
                                                     PF7 Up
What is your freshman group number (from you freshman   PF8 Down
profile)?                                            PF9 Trace
                                                     PF10 Undo
(Choose one of the following:)                       PF11 Error
                                                     PF12 FullMsg
x____ I
_____ II
_____ III
_____ IV
```

```
.PA
                          Focus: GLOBAL                         3
                                                     PF1 Help
                                                     PF2 TogglePF
                                                     PF3 End
                                                     PF4 Review
                                                     PF5 Print
                                                     PF6 Store
                                                     PF7 Up
                                                     PF8 Down
What is your composite (overall) ACT score?          PF9 Trace
                                                     PF10 Undo
(Enter a number. >= 0 and <= 36)                     PF11 Error
                                                     PF12 FullMsg
30______________________________________________



==>
```

```
.PA
                                Focus: GLOBAL                              4
                                                          _______________
                                                         |  PF1 Help      |
                                                         |  PF2 TogglePF  |
                                                         |  PF3 End       |
                                                         |  PF4 Review    |
                                                         |  PF5 Print     |
                                                         |  PF6 Store     |
                                                         |  PF7 Up        |
                                                         |  PF8 Down      |
 What was your MMPT score?                               |  PF9 Trace     |
                                                         | PF10 Undo      |
                                                         | PF11 Error     |
 (Enter a number. >= 0 and <= 40)                        | PF12 FullMsg   |
                                                         |_______________|
 32___________________________________________



==>
```

```
.PA
                                Focus: GLOBAL                              5
                                                          _______________
                                                         |  PF1 Help      |
                                                         |  PF2 TogglePF  |
                                                         |  PF3 End       |
                                                         |  PF4 Review    |
                                                         |  PF5 Print     |
                                                         |  PF6 Store     |
                                                         |  PF7 Up        |
                                                         |  PF8 Down      |
 What was your trigonometry score?                       |  PF9 Trace     |
                                                         | PF10 Undo      |
                                                         | PF11 Error     |
 (Enter a number. >= 0 and <= 25)                        | PF12 FullMsg   |
                                                         |_______________|
 22___________________________________________



==>
```

```
.PA
                                Focus: GLOBAL                              6
                                                          _______________
                                                         |  PF1 Help      |
                                                         |  PF2 TogglePF  |
                                                         |  PF3 End       |
                                                         |  PF4 Review    |
                                                         |  PF5 Print     |
                                                         |  PF6 Store     |
                                                         |  PF7 Up        |
                                                         |  PF8 Down      |
 What is your ACT math score?                            |  PF9 Trace     |
                                                         | PF10 Undo      |
                                                         | PF11 Error     |
 (Enter a number. >= 0 and <= 36)                        | PF12 FullMsg   |
                                                         |_______________|
 30___________________________________________



==>
```

```
.PA
                                        Focus: GLOBAL

The english course you may take is 20GH.                    PF1 Help
The math course you may take is 80GH.                       PF2 TogglePF
The chemistry course you may take is 5.                     PF3 End
The humanity course(s) you may take are                     PF4 Review
history requirement (3-5 hrs)                               PF5 Print
economics requirement (3-5 hrs)                             PF6 Store
humanities/social science electives (6-10 hrs)              PF7 Up
The engineering course you may take is 30.                  PF8 Down
The recommended semester course load is 15 hours or less.   PF9 Trace
If you are allowed to enroll in an honors course            PF10 Undo
(designated by GH) you may still choose not to. You may     PF11 Error
enroll in the non- honors course of the same name..         PF12 FullMsg
The list of courses you are not allowed to take is none.
There are no courses that you will be blocked from
enrolling in.


                 To continue Consultation, press ENTER.
==>

.PA
                                        Focus: GLOBAL                 7

                                                            PF1 Help
                                                            PF2 TogglePF
                                                            PF3 End
                                                            PF4 Review
                                                            PF5 Print
                                                            PF6 Store
Would you like to go through the advising session           PF7 Up
again?                                                      PF8 Down
                                                            PF9 Trace
                                                            PF10 Undo
(Choose one of the following:)                              PF11 Error
                                                            PF12 FullMsg
____ Yes
x___ No
```

APPENDIX B: IEADVISE USER QUESTIONNAIRE

Year in School

(Please Circle One)

FR SO JR SR

Please circle the number that most closely represents your attitude about IEADVISE. Keep in mind that the purpose is to compare the computer expert to the human expert. Answer each questions based on your corresponding experience with your advisor.

How easy is IEADVISE to use?

1	2	3	4	5
Poor				Excellent

How helpful were the instructions (both written and on the screen)?

1	2	3	4	5
Poor				Excellent

How much time did it take to use IEADVISE compared to using an advisor?

1	2	3	4	5
Poor				Excellent

How accurate were the results? (Do you feel that you were advised to take the same courses that a human advisor would advise?)

1	2	3	4	5
Poor				Excellent

What is the probability that you would use IEADVISE again?

1	2	3	4	5
Poor				Excellent

Overall, how does IEADVISE compare to a human advisor?

1	2	3	4	5
Poor				Excellent

Shannon L. Miller is an industrial engineer with the US Postal Service General Mail Facility in Columbia, MO. She holds a B.Sc. in Psychology from Southeast Missouri State University (summa cum laude), and a M.Sc. in Industrial Engineering from the University of Missouri-Columbia. She is a member of Alpha Pi Mu and Tau Beta Pi honor societies.

Luis G. Occeña is an assistant professor of industrial engineering at the University of Missouri-Columbia, Columbia, MO. He holds a B.Sc. in Industrial Management Engineering from De La Salle University, a M.Sc. in Industrial Engineering and Operations Research from Virginia Polytechnic Institute & State University, and a Ph.D. in Industrial Engineering from Purdue University. He conducts research in the area of computer integrated systems.