Eliciting Potential Expert Systems Projects

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Abstract

This paper describes the methodology and how we developed it for eliciting potential expert system projects at the Internal Revenue Service (IRS). We intertwined demonstrations of existing IRS expert systems and examples from non-IRS applications with questions like "Do you have anything like this?" to stimulate ideas of similar tasks that might be amenable to solution via an expert system. We also interspersed minitalks on artificial intelligence (AI) terminology at the appropriate level when we felt that such use could not be avoided. The result in one division of the IRS was over 20 potential future expert systems.

Overview

This paper describes how we elicited potential expert system projects for Criminal Investigation (CI), a major functional area within the Internal Revenue Service (IRS). Basically, we used focus group techniques intertwined with demonstrations of existing IRS expert systems and examples from non-IRS applications. We also gave minimal lectures of artificial intelligence (AI) terminology when we felt that its use could not be avoided. Our model of methodology resulted from the scientific method—do the process, evaluate what was done, refine methods, then iterate.

In science, the first problem is always "define the problem or formulate the hypothesis." Hence it is no surprise that we must do this in AI. Scott, et. al. [6] states it precisely, "...first step in the knowledge engineering process is identifying a potential application." Despite the seeming simplicity of this task, it is by no means simple. The dearth of papers in this area also illustrates that the task is not straightforward. The need for some kind of process to define the problem is clear. This paper describes such a process and illustrates its use and result in a practical situation.

Background

There was nothing described in the Artificial Intelligence (AI) literature that dealt with the elicitation of projects for any aspect of AI. The work that we have tested thus far dealt only with expert systems, but the extension to any other aspect of AI is straightforward.

We have called our group process, "ideation," which is defined as "the creation of ideas without judgment", by Basadur and Thompson [1]. It has also been called a synectic group by Kawenski [3]. The word focus group is also used in some places in the literature, but we prefer to reserve the phrase "focus group" to denote a more general term than the other two. Feig [2] states that, "In a focus group, a handful of people focus their discussion on a certain topic, product, or product category. They describe how they use a product and what caused them to buy it." Focus groups debuted in the 1950s. In our estimation the effort of a focus group is to find out the participants thoughts and feelings about a subject or product. The effort of an ideation group or synectic group is to come with new ideas or innovations about some concept or subject. A focus group is more limited in time, usually to two hours; the other concepts have more flexible time limits.

We developed our methodology and tested it in Washington DC, on February 3–5, 1992, on a group of (mostly) Special Agent Supervisors from Criminal Investigation, Internal Revenue Service. Based on our observations of this test, we made several changes to eliminate dead spots, where either the moderator, lecturer or the participants were bored, noncontributors. We tried to ensure that every item presented was important, to the point, and interesting. After refining the methodology we elicited prospective projects from six Special Agents from six regions throughout the United States at the Federal Law Enforcement Training Center (FLETC) in Brunswick (Glynco), Georgia on March 24–25, 1992.

The Group

Composition of the group

We wanted to target the functions and duties of an IRS Special Agent in Criminal Investigation. We wanted to find out what the agents' skills were in criminal investigation to elicit possible projects in AI which would benefit the Special Agent's daily work.

After testing our methodology in Washington, DC, we modified our material based on what we had learned in the first iteration. We wanted to focus on Criminal Investigation activities by CI Special Agents in an enactment of the methodology in Glynco, GA. Special Agents from six of the seven IRS regions were supplied for the session. For the group in Washington, DC, we weren't insistent about the type of person from CI that we included

in the group. We found out that the best results are obtained if we narrow our focus and be very specific about the type of person that we get. If additional areas of interest (beyond the true target) are represented, then the group can become segmented into areas of similar interest, and poor group interaction will result, hence fewer ideas in the target area. In our case we had a mix of backgrounds in the Washington group. Many times one or two individuals would bring up a topic that the rest of the group had no background or interest in. The discussion would stall and limited ideas would come out in that particular area. In the Glynco group we insisted on similarity of function for the group members. We got better, deeper ideas with that approach.

We chose Glynco, GA because it is away from the workplace, and few interruptions were likely to occur.

We requested practicing Special Agents with about 10 years of field experience. We requested the best of the lot. Many of these people were not well-versed in computers, but, with the demonstrations and the many examples of expert systems given, together with the AI concepts instruction, their lack of exposure did not pose a problem. One person even prided himself on doing his job without the use of computers—but his contribution to the session was outstanding, lots of good ideas.

Furthermore, we requested that no supervisors be present because that introduces a factor which interrupts the focus of the session and the flow of ideas. A group composed of one or more managers and subordinates will be inhibited since nonmanagement participants often feel compelled to please or impress management. They don't focus on their own thoughts, but on what they think management wants to hear. We observed this inhibiting effect when managers dropped in "to observe" the process. The process immediately changed. It could not be observed in a manager's presence. It becomes the classical classroom-teacher/student situation, and it is best to avoid it.

Size of Group

We did not get the size group that we hoped. We wanted 8-10 people in the group; management promised seven with others possibly showing up from the facility plus maybe a manager or two to yield 10 to 12. Only six showed up.

Length of Group Session

In the first group in Washington, DC, we held the group for four days. We also asked them to do some other related tasks. In the second group we used two days. We now recommend that 1 1/2 days is about optimal. The participants felt the same way.

Small Group Concepts

The idea elicitors of the small groups must have skills in elicitation concepts such as those obtained by moderators in focus group training. They must have the skill to let ideas of the participants come out, without interjecting their own concepts into the effort. This is critical. If the moderator's own ideas are introduced, the group wants to please the moderator (in his teacher role), which then inhibits the group's ideas. A good moderator is a good listener, not necessarily a good speaker.

Moderators

Moderators were briefed in detail on CI procedures before the session. The two moderators prepared a detailed guide with possible topic areas and prompts. The moderators also prepared for "dead times" from the group—late afternoons, etc. We used some role playing activities to enliven and refresh the group. We were flexible and had tools available to be used, if needed. They were needed and we were ready.

We used a two moderator approach in our group because of the length of the session, to ameliorate any possible sexism, and to give the participants a change of pace, as well as providing support for the pair of moderators. When two moderators are used special care must be taken so that they work well together and are of one mind during the session. When this is not the case, we have observed that unnecessary tension may be introduced into group, which then detracts from the task at hand.

AI Focus

Effective elicitation of expert system or artificial intelligence ideas requires that the participants have a basic understanding of terminology and concepts. Hence, the focus of the 2 days was to provide AI background to the participants as triggers for eliciting ideas for potential projects. We provided themes of the session—capture knowledge and analytical tasks—to continually refer to during the session. As time moved on we would discuss increasingly more complex concepts. We also showed demonstrations of existing IRS expert systems, and examples of non-IRS expert systems, then let the participants talk about similar uses that would be helpful in their work environment. Thoughts and opinions of varying diversity were brought forward. After each new major concept was introduced we would remind the group of the common themes—capture knowledge and analytical tasks— and trigger the group to use the new concept to engender one or both of the common themes. To aid in the movement of the idea elicitation, we had a periodic recapture of what has happened thus far in the form of brief summaries.

AI Understanding

The AI background that we provided was aimed at the type of group, that is, it was at the appropriate educational and technical level. Clearly, the better job that we did of targeting this presentation, (hence the more they learn), the more they help bring out ideas for new projects. Our material was based primarily on Waterman [7] and Rolston [5], revised according to our needs.

The demonstrations that we gave were obtained from the Internal Revenue Service's AI Lab. More detailed information about these products may be obtained through the Lab or through the authors. Briefly, we showed the participants four demonstrations of increasingly difficult expert system concepts.

Introductory Material

As an introduction, we pointed out that they had accumulated a lot of expertise in their careers and it would be useful to novices and others to have a ready access to their knowledge. We told them that we expected to construct a list of potential AI tasks that would be helpful to the IRS Special Agent in the two days alloted to the activity. We wanted them to look at their tasks and think about the aspects of the tasks which require thinking, especially the more analytical ones. We pointed out that possible uses of an AI product were as a training device, a reference device, a passive tool, and an interactive tool. We reiterated that our focal themes are capture knowledge and analytical tasks.

AI Overview and Simplest Expert System Concepts

Keeping in mind that the participants had little or no knowledge about computers and even less about AI, we wanted to introduce them to AI and point out some of the more important differences between AI and traditional computing. We used Rich's [4] definition of AI, "Artificial Intelligence is the study of how to make computers do things at which, at the moment, people are better." We pointed out that computers can do some things better than people, e.g., numerical computations, information storage, and certain repetitive operations, noting that these things are essentially "mindless," mechanical activities. Some of the things that people do better involve intelligence, analysis, and common sense.

We also noted that AI has components from the following fields: (1) psychology, (2) linguistics, (3) neuroscience, (4) operations research, (5) philosophy, and (6) all of computer science. The principal differences are that AI tasks are typically symbolic, incorporate knowledge in some sense, and seek "good enough" answers, not necessarily optimal ones. Also AI can deal with uncertainty, typically has an easy to use interface, and an explanation facility.

We then focused more on the need for expert systems. This need arises because (1) a key expert is retiring, (2) the problem can't be solved with current tools, (3) no skilled people in specific areas of expertise, (4) it would be more cost effective, (5) there is a need to distribute the expertise to other locations, (6) it is not feasible to have a human expert, (7) there is a need for multiple human experts, (8) it can free experts for more difficult tasks, and (9) it can make the job more interesting.

First Demonstrations

Demonstrations of two current IRS expert systems were then shown to the participants. Hands on use in a stroll around format was encouraged, after we gave simple descriptions. One of the systems, called Maggie, has processed requests for waiver from the legal requirement to file information returns on magnetic media since 1988. It is a straight forward rule based system, IRS's first expert system. The other system shown at this time was TSEAS which could aid a Taxpayer Service Representative in giving more accurate answers to taxpayers' questions over the telephone. This system prompts the representative with a sequence of questions, then provides the correct tax advice, calculation worksheets, examples, citation of the IRS's Publication 17, etc. without human aid.

More Complex AI Concepts and Examples

We next described briefly and gave examples of more complex types of expert systems: (1) intelligent text and documentation, (2) diagnostics and troubleshooting, (3) process monitoring, (4) design and configuration, (5) planning and scheduling, (6) selection and classification, and (7) decision management and recommendations.

Second Demonstrations

The second set of demonstrations of two more IRS expert systems were then shown to the participants in the format described above. One of these systems, the International §482 Expert System assists International Revenue Agents in identifying tax adjustment issues on the tax returns of Controlled Foreign Corporations. The other system, the Reasonable Cause Assistant handles "soft" or "fuzzy" ideas. Taxpayers assessed a late filing (or a failure to file, or an estimated tax) penalty, may request cancellation of the penalty for "reasonable cause". What denotes this concept has always been (and still is, though to a lessor degree) soft and difficult to deal and be consistent with. This system has numerous questions that should occur to a tax examiner when processing such a request. The questions were grouped in categories based on actual requests.

Evaluating the Process

The measure of success for using the methodology to elicit potential projects will be apparent once an expert system identified by this process has been properly pursued, developed and fully implemented. We were also interested in the participants' immediate feedback on how successful they felt the session was in identifying project ideas.

A survey was given to all participants for anonymous reply. None of the participants knew anything about AI technology before the session began, and most of them had only a limited knowledge of computers. Before the participants could come up with ideas for potential expert

systems, it was important the training we provided gave them a basic understanding of general AI concepts and what expert systems can do. All of the participants indicated on their surveys that the demonstrations, examples, and informal talks or lectures gave them a good grasp of expert systems. Furthermore, all the participants agreed that the session was successful in identifying potential expert system applications.

One of the goals during the 2 day session was to ensure that people were not getting bored and inattentive. A variety of techniques were used: short lectures with overhead projector and flipcharts, role playing, group exercises, and 1-2 hour ideation sessions using flipcharts as an intervention. Every member in the group indicated on their survey that they liked the interweaving of demonstrations and discussions. This interweaving of techniques seemed to keep everyone alert and involved in the process and waiting for what was going to happen next.

When asked if they thought expert system technology was relevant to Criminal Investigation's problems and needs, one participant said the use of expert systems was a possible solution and one other person failed to answer that question. All of the other participants agreed that expert systems was a viable solution for some of the CI problems.

We asked the group to rate on a scale of 1 to 10 the effectiveness of using the combination of training and ideation sessions to identify potential expert system applications. Two of the participants felt that although the methodology seemed to be good; they were too inexperienced at this point to make a determination of its effectiveness. The average score among the other respondents was 7.5 with a median score of 8. The general feeling at the culmination of the session was that a lot of good ideas had emerged. The size of the group is too small for inference, but we feel that the feedback was positive.

We also asked the participants to offer suggestions for improving the methodology and for any other comments they wanted to offer. We found it interesting that one individual suggested that we continue to make use of the people in the group once a project was selected for development. This individual felt that the group could continue to offer valuable input in assisting our efforts. Another remark stated that if the agents had been given a better description of what the session was about, they could have gathered up more definitive examples of the processes involved in their jobs. Another person wanted more examples.

The group felt that one and one-half days of fairly intensive group work produced what we needed, and felt that any more time would be wasted. The examples and demonstrations of actual expert systems was probably the single most important device used in the elicitation process. Each time a new system was demonstrated, new ideas emerged in the ensuing ideation sessions.

Results

Twenty potential CI expert system projects were identified—some are now under development as Expert Systems for the IRS.

Future plans

AI Expansions

We envision expansion to AI areas other than Expert Systems, and expect to pursue this tack as soon as possible. Presently at the IRS there is a scarcity of demonstrations for other AI areas such as machine learning, neural networks or causal networks, but we expect to eliminate this problem soon. Also, there is a wealth of other application areas to expand into if the IRS so desires. Within the Criminal Investigation area, we can pursue possible expert systems for Criminal Investigation Branch at the Service Center, or the Criminal Investigation National Forensic Laboratory. We can also look at other IRS Functions, such as Examination, Collection, Taxpayer Service, etc.

Expansion to concepts other than AI

Finding good research topic ideas would be interesting to try in lots of diverse organizations—from private businesses, such as pharmaceuticals—to public organizations such as the Bureau of Prisons, as well as the IRS.

Summary

We have described in detail how we elicited potential expert systems projects in one division of the Internal Revenue Service. We used focus group techniques intertwined with demonstrations of existing IRS expert systems and outside examples. We also gave minimal lectures of AI terminology. The methodology described in this paper was the result of the usual scientific approach to investigation and problem solving. That is, to formulate a method, test that method, evaluate its performance, reformulate, and then test, etc., until stability is achieved. In our case, we were happy with the methodology after two iterations. Our resulting approach successfully elicited over 20 potential expert system projects, several of which are currently being pursued by artificial intelligence specialists within the IRS.

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