

CLUES: Comprehensive Life Underwriting Expert System

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Expert Systems have revolutionized the way Mutual of New York underwrites Life Insurance applications.

Background

One of the most critical functions in the Life Insurance Industry is that of an underwriter. Underwriters evaluate life insurance applications and accompanying supplementary information received from agents and brokers. They use judgment and knowledge developed through formal training and years of experience, to assess each application. Each insurance company has a set of complex rules and procedures for underwriter to follow, to minimize the risk associated with each life insurance policy. Additional complexity is added by a variety of rules and regulations imposed on the industry by regulatory agencies. These rules make underwriter training difficult and time-consuming.

The underwriting process at our company had always been labor-intensive, manual and paper driven. While the process was effective, we realize that an expert system would further increase the efficiency and consistency of our underwriting operations.

Like other insurers, we had been able to automate the processing around underwriting, but we were unable to automate the underwriting function itself. Through research, we learned that underwriting is just the type of application that can be enhanced by a well designed expert system.

The first step in the development of our Comprehensive Life Underwriting Expert System (CLUES) was undertaken in late 1985. We held a Joint Application Design session which brought all relevant parties together to review current underwriting, policy issue and processing functions. Our mission was to identify potential improvements in processing which would help meet our business objectives. We wanted to identify ways to provide better service through faster underwriting and issue turnaround, increase our capacity to do more business, without increasing the size of our Selection Department.

Business projections indicated that growth in the number of new individual life application was likely, and that the company would be introducing new products at a rapid pace in the future to provide a broader range of policy options to customers. This would require the Selection Department staff to process and underwrite significantly larger numbers of new applications, and we would have to increase our capacity to process these applications quickly, without increasing the size of the department.

In addition to keeping the costs to process each new application at current levels, we wanted to develop techniques that would assure consistent and proper classifications on the more than 150,000 life applications processed each year. We also wanted to find more effective ways for underwriters to use their talents so that each one would perform as a true expert.

CLUES had to meet several technical and application design objectives. At the onset of the project, we made a decision that proved critical to the success of CLUES at MONY. From a technical perspective, we recognized that an independent or stand-alone expert system would be ineffective and would not meet our long-term strategic needs. We decided to develop a true decision making expert system fully integrated with the existing new business systems.

Our goal was to build a facility that would totally automate the new business processing cycle for a significant percentage of cases. We realized that a stand-alone solution, although simpler to implement, would not meet our business needs as CLUES needed access to both the internal and external databases used by our underwriters and existing systems. We also knew that a mere advisory system would not provide us with a foundation for additional automation steps in the future.

The work on the CLUES project started in September, 1986 and continued on three parallel but closely synchronized tracks. One team was conducting the knowledge acquisition sessions and developing the knowledge bases. Another was designing and developing the programs and architecture to facilitate integration of the new expert system with existing systems. The third team was responsible for the modifications to the existing New Business System.

A model office pilot version of the system was implemented in April, 1987, just seven months after the inception of the project. The model office environment was constructed complete with separate floor space and staff. That way, limited production volumes could be diverted through it to provide a preliminary testing facility of the system. The model office gave us an opportunity to analyze and restructure our procedures and workflow, then to retrain both our administrative staff and, to a lesser degree, our underwriting staff, to react to their new environment. It also provided us with the opportunity to audit and analyze the expert system's decision making process and its knowledge base.

The model office allowed us to experiment in a live environment without disrupting normal procedures. As new underwriting rules were incorporated into CLUES and existing

rules relaxed, the model office continued to provide an ideal evaluation environment before these changes were widely distributed. A gradual deployment schedule was developed to provide a smooth transition within the department. This approach allowed us to measure the impact of the system in a controlled fashion. In October of 1987, the first full production version of CLUES was implemented in one of our underwriting regions, to include automatic approval decisions being made by CLUES. It was fully deployed across all underwriting units in April of 1988. CLUES currently underwrites both non-medical and medical applications.

Current System

An application is entered into our system from either our Agency Offices or in our Syracuse Operation Center. Upon completion of data entry and successful validation, MIB is automatically accessed to determine if there is a record on the applicant in MIB's data base. In addition, through our own data bases (ALPHA, TOPS) we obtain any other information MONY may already have on the applicant (e.g., total face amount, reinsurance, prior rated or declined application, medical or non-medical issues, etc.). The application information plus all the additional data collected from MIB, ALPHA and TOPS is then forwarded to CLUES for underwriting.

After a thorough review of the entire application and all the information from our policyholder data base and MIB, CLUES applies about 800 rules and goes through approximately 8,000 steps to determine if a case can be approved and released or if additional underwriting requirements are necessary.

If CLUES approves the application, it will trigger a "release" transaction. The release will generate an ENVOY (electronic mail) message to the appropriate agency informing the Field Underwriter that the case has been approved, and initiate the printing of policy pages on a laser printer. In such a case, neither manual intervention nor paper handling is required. In one case an agency submitted an application and received an ENVOY notification that the case was released 12 minutes later.

Obviously, the process becomes somewhat more complicated whenever the expert system does not approve a case and indicates that additional review by an underwriter is necessary. If CLUES does not automatically approve a case, it will electronically route the case to an underwriter for further review (CLUES Screen Review). CLUES will assign cases to different underwriters based on their level of authority, workload, part of the country they work, schedule (considering vacations, etc.) and the difficulty of the case.

When an underwriter signs on to the system using a computer terminal (or a PC), he/she sees a list of cases that have been assigned to him/her and are awaiting review. An underwriter can select any one of the cases assigned to him/her for processing. The underwriter is then able to review the entire application electronically, along with CLUES underwriting decisions, which include: (a) the reasons for CLUES failing the case, (b) underwriting requirements necessary, and (c) CLUES recommended action for additional work-up. If the underwriter

feels the case can be approved without further requirements, they can "override" the non-approval decision of CLUES and release the case. In such instances there was manual intervention, but again, there is still no paper handling. Sufficient application information is presented to the underwriter to allow judgement without the original paper file being requested.

If an underwriter determines that additional requirements are necessary (e.g., Attending Physician's Statement, Inspection Report, etc.), the underwriter may request these requirements through the same CLUES Screen Review facility. Such action will then automatically trigger an ENVOY message to the agency for the need for these requirements, and the system will record the requirements for follow-up processing. When the requirements are received, the case will be underwritten in the traditional manner using the paper application file.

Knowledge Base

The brains of CLUES is the knowledge base which represents the encoded knowledge of our underwriting experts.

The process of reducing the art of underwriting with all its rules, procedures, knowledge, and judgmental factors to a set of rules was, and still is, a very time consuming complex process. For example, in reviewing insurable interest we identified over 1,750,000 potential combinations of relationships between the fields of beneficiary, rightsholder, premium payer and applicant, while at the same time considering the applicants age and marital status. Of these 1,750,000 possible combinations, we identified almost 300,000 acceptable ones which represent a legitimate insurable interest, and the system has knowledge of all 300,000, which we feel is very close to, if not 100% of all acceptable combinations.

CLUES does approve cases and issue standard policies, in the name of the company, totally on its own without any manual intervention. (CLUES has underwritten approximately 140,000 applications, and has approved more than 40,000 applications for a total face amount exceeding \$2,000,000,000.) Because of this, it is essential to always know exactly what underwriting rules are in the knowledge base and how they are being applied. This goal was accomplished by designing the system in a way which would only allow authorized knowledge engineers to add, change or modify any rules, knowledge or programs in the knowledge base. Additionally we developed a sophisticated testing facility to test the validity and correctness of all the rules and program code within the system, and all conclusions reached by CLUES.

This testing facility allows the experts to submit test cases through the knowledge base and verify the underwriting decisions reached by CLUES. The expert can then easily change any parameter of the case to further test the correctness of any rule. This facility also allows us to create and process large files of test cases designed to test all the parameters of every rule and procedure in the knowledge base.

As of this writing, we currently have approximately 8,000 test cases. Seven thousand of these were created as we developed

the rules in the knowledge base and 1,000 are copies of actual applications we have received. Any time any rules or line of code in the knowledge base is added, changed or modified, we process all 8,000 test cases through CLUES before we maintain the change. Not only must CLUES reach the proper final decision on every case, but it must also process every step of the case correctly. We continue to add test cases as we add new knowledge to the system.

The knowledge base was also designed to be easily expandable and able to underwrite cases without full underwriting knowledge. Yet, at the same time, CLUES was designed not to release any case in which it did not have all the knowledge necessary to underwrite the case. This allowed us to implement the system much sooner, and reap benefits from the system while we were continuing to add new knowledge to the system. When we first implemented CLUES it was releasing 3% of the non-medical applications. Today, it is releasing more than 50% of these cases totally on its own without any manual intervention.

Finally, the knowledge base was designed to process and interpret natural language. Our data entry people are able to enter into our system exactly what appears on the application. They do not have to look occupations up in a table or codify medical histories. It is up to CLUES to be able to recognize and understand all words which have been input. This requirement proved to be one of the biggest challenges in developing CLUES.

When it comes to the medical information received on a life insurance application, one has to deal with ambiguities of the English language. In order to understand better the magnitude of the problem, think about what takes place before CLUES receives the data.

The first step is when the applicant and the agent strive to describe, in the limited space provided on the application, the impairment, its treatment and results a doctor had described sometime in the past. Here is the first potential for inaccuracy—confusion of medical terms and misspellings. The second step is the data entry of the medical information. At this point in the process, a data entry person attempts to make sense of what was put on the application and enters this information into the system. Another possibility of errors and misspellings.

Finally, this information has to be analyzed by CLUES. At this point, CLUES needs to muster all its powers to not only detect, and possibly recover from, errors introduced in one of the earlier steps, but also to overcome the inherent ambiguities of natural language. For example, it is not sufficient to define "good" and "bad" words in order to understand a sentence describing medical history. Often the meaning of a word depends on the context in which it appears. For example the word "positive" can be either "good" (as in "treatment brought positive results"), or "bad" (as in "required tests were positive").

Consequently, a good deal of sophistication had to be

provided in the knowledge base to maximize its "understanding" of medical history descriptions.

Benefit of Clues

1. Improved Time Service

Service has become a market niche which brings about increased production due to positive attitudes of our field force.

2. Increased Underwriting Capacity

CLUES can automatically approve applications, issue policies, identify underwriting requirements necessary, and recommend actions to the underwriter. This helps improve job satisfaction, relieves boredom, and removes mundane labor intensive error prone tasks from the underwriting functions.

3. Assures Consistency of Decisions

Expert systems don't forget, they do not have Monday morning blues or Friday afternoon blahs. Expert systems always interpret the same data the same way and they help ensure all underwriters initially analyze the same basic data the same way, which is almost impossible in any large underwriting department. Also, any changes in procedures or rules are immediately applied to all new business received, there is no learning curve. This increased consistency can help: (a) our fight against unfair discrimination with legislators, (b) actuaries in pricing our policies, and (c) the field force in knowing what to expect from us.

4. Retention and Dissemination of Experts Knowledge

We are now able to have our best underwriting expert with all their knowledge and experience review every new business application, applying their years of expertise and judgement to reach a conclusion. Additionally, we will never lose the knowledge and expertise of our experts, although we can change and update this knowledge as necessary.

5. Underwriting and Market Research

We now have an enhanced data base with a complete record of all of our applicants who have applied to us for life insurance. This data base allows us to more easily examine our results and perform cost benefit studies, to better control our expenses and react faster to trends. Additionally, it should allow us to reduce our underwriting requirements and increase our claim analysis.

The additional data can also be used to shape new product development and it can be used for cross marketing other lines of business.

CLUES design, implementation and results, have allowed us to meet our objectives as we identified in late 1985. Additionally, our underwriters are now using their talents more effectively, which allows them to perform as true experts.