

# An Intelligent System for Case Review and Risk Assessment in Social Services

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■ This article reports on the development and implementation of DISXPERT, an intelligent rule-based system tool for referral of social security disability recipients to vocational rehabilitation services. The growing use of paraprofessionals as caseworkers responsible for assessment in the social services area provides fertile domain areas for new and innovative application of intelligent system technology. The main function of DISXPERT is to provide support to paraprofessional caseworkers in reaching unbiased and consistent assessment decisions regarding referral of clients to vocational rehabilitation services. The results after four years of use demonstrate that paraprofessionals using DISXPERT can make assessments in less time and with a level of accuracy superior to the vocational rehabilitation domain professionals using manual methods. This article discusses the problem domain, the design and development of the system, uses of AI technology, payoffs, and deployment and maintenance of the system.

Case review and assessment of client need is an important task in many social service areas. The services and benefits that clients receive are based largely on such reviews and assessments. The failure to perform accurate reviews and assessments in a timely manner can result in a client being denied access to services when they most need them.

The typical scenario with regard to case review and assessment in social services situations involves a professional caseworker reviewing a client's file, conducting a phone or in-person interview if necessary, and making

an assessment using the information obtained from the review and heuristics developed from experience. The caseworker is generally a professional who possesses expertise in the appropriate field. Some examples of fields where this expertise is found include medicine, mental health, and education.

As pointed out by Ferns (1995), social service organizations are faced with a variety of challenges, including increased need for services, decreased funding for service, and growing government regulation. Many social service organizations have developed large backlogs of cases waiting for review and assessment. These backlogs have reduced the time that caseworkers can spend on other services, such as counseling clients. These pressures have forced many social service organizations to investigate technologies suitable for relief of their burden (Lewis 1994; Murrelle et al. 1992). One such technology is intelligent systems. The possibility of the development of intelligent systems that would contain the domain knowledge and heuristics exhibited by the most effective professionals in the review and assessment process became attractive.

## Social Security Disability Screening

The 1934 Social Security Act provides for financial assistance for individuals who have been declared disabled. In New York State, the task of disability determination for acceptance into either the Title XVI Supplemental Security

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Income (SSI) or Title II Social Security Disability Insurance (SSDI) program rolls rests with the New York State Department of Social Services Office of Disability Determination (ODD). In addition to its primary responsibility for disability determination, ODD refers any person whom they feel might benefit from vocational rehabilitation services to the New York State Department of Education Office of Vocational and Educational Services for Individuals with Disabilities (VESID).

The assessment of social security disability cases for referral to VESID has been accomplished through a cooperative program between ODD and VESID. The program consists of VESID professionals stationed at the ODD performing case assessments and referring appropriate social security–accepted cases directly to the VESID district offices.

The 1981 amendments to the Social Security Act changed the method by which the Social Security Administration (SSA) was authorized to pay for vocational rehabilitation services. Prior to the 1981 amendments, the SSA provided grants to cover the cost of vocational rehabilitation services for social security recipients. With enactment of the amendments, the SSA was authorized to pay for services only on a case-by-case basis and only in those instances where vocational rehabilitation services have resulted in the recipient performing at substantial gainful activity for a continuous period of nine months.

This change in reimbursement methods had an immediate and dramatic effect on the level of SSA funding available to New York VESID. SSA, under the grant system, used to provide approximately \$5 million a year to New York VESID. Post-1981 amendments reduced the funding to approximately \$1 million a year. The amendments forced New York VESID to reexamine its level of participation in the social security vocational rehabilitation assessment process with ODD. The effect of this reexamination was a sharp cutback in the number of VESID employees dedicated to the assessment effort. Prior to the 1981 amendments, VESID had 13 professional and 18 clerical staff persons assigned to the process. These staff members assessed approximately 70,000 cases a year. After the 1981 amendments, VESID had 4 professional and 3 clerical staff members assigned to this function, assessing approximately 15,000 cases a year.

This sharp reduction in case-assessment activity had a marked impact on the New York VESID case load as well as the amount of vocational rehabilitation services provided to social security recipients. SSI-SSDI referrals to voca-

tional rehabilitation services decreased 47 percent from the preamendment period, and successful rehabilitations for these clients declined over 31 percent during this same period.

Assuming that the level of funding by the SSA was not going to increase dramatically and knowing that there was still a desire on the part of New York State to reverse the downward trends in the successful rehabilitation of social security recipients, it appeared obvious that the method by which clients are first identified and then referred into the vocational rehabilitation system had to be changed. For vocational rehabilitation to work, social security recipients must be assessed effectively and referred appropriately into programs.

## Objectives for the New System

The economics of the VESID program precluded the dedication of large personnel service expenditures to the assessment process. However, VESID felt it might be possible to perform the review and assessment function at a relatively modest cost if an effective automated risk-assessment system could be developed. The objectives to be achieved by the development and deployment of the intelligent social security disability screening system were (1) faster processing of cases, (2) a substantially lower cost for each case assessed, (3) greater objectivity and accuracy in the assessment process, and (4) a report feature conforming to the requirements of the New York State Education Department and the SSA.

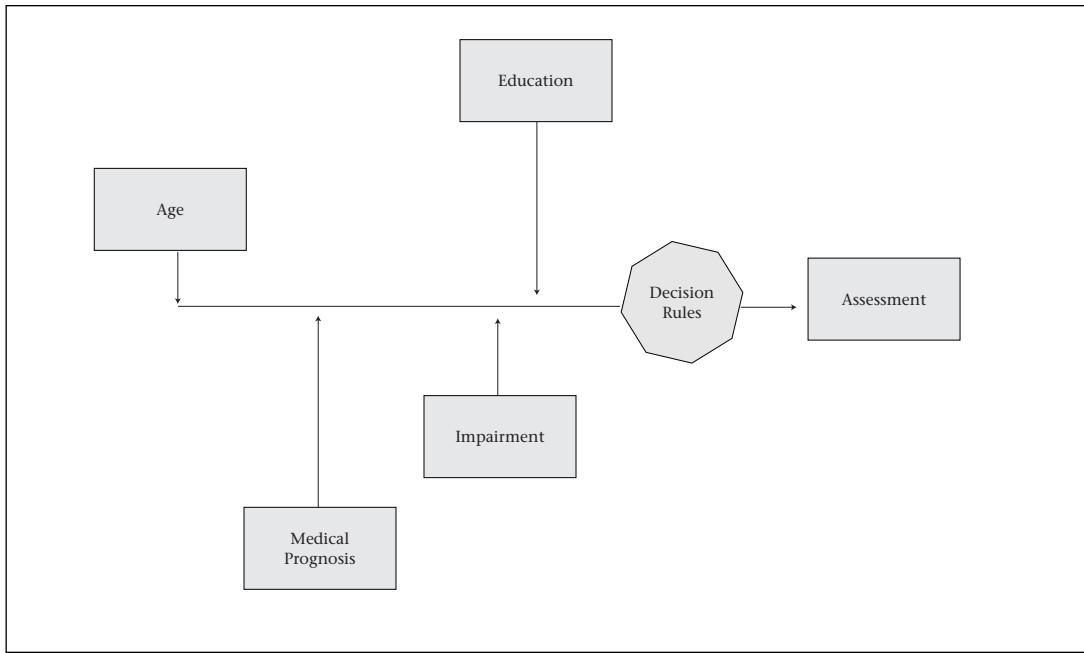
An AI solution was sought because successful intelligent systems have been developed in other risk-assessment domains. The assessment process involves the analysis of client information and the application of certain rules to determine what services would most benefit the client. This is an application that fits the criteria for problems suitable for intelligent rule-based system solutions.

## Application Description

This application can be described by explaining how the knowledge base was constructed and how the knowledge base was used in the development of a prototype.

### Knowledge Base

The knowledge base for DISXPERT consists of the results of empirical research in vocational rehabilitation services and the domain knowledge of three expert vocational rehabilitation counselors. The empirical research was a two-



*Figure 1. Overview of DISXPERT Knowledge Base.*

step process: First, a survey of the literature was conducted to identify factors thought to be important in predicting successful vocational rehabilitation after services are rendered. A list of 22 factors was identified. Second, a linear discriminant statistical analysis of 9000 past VESID cases was conducted to determine which of these 22 factors helped to discriminate between those individuals who have completed a service program and attained gainful employment and those individuals who have not completed a service program and have not attained gainful employment. This analysis revealed the following statistically significant factors: age, home geographic area, education, work history, and severity of disability.

In addition to the empirical results, the domain knowledge of expert vocational rehabilitation counselors needed to be captured in the knowledge base. To obtain the domain knowledge from the expert vocational rehabilitation counselors, each counselor was given the same 225 disability cases to review and make an assessment. Each of the counselors was asked to explain his/her reasoning for each of the 225 risk assessments. From these sessions, the knowledge and heuristics learned were encapsulated into rules that serve as the knowledge base for DISXPERT (figure 1).

The knowledge base was used to develop a model. This model was tested and went

through several iterations, with the expert counselors making changes to the rules as needed. When the expert counselors reached a consensus that the factors and heuristics included in the knowledge base were similar to what they considered in the vocational rehabilitation review and risk-assessment process, the development of the intelligent system began.

#### Prototype Development

The ultimate goal of this project was to provide expert assistance to individuals working in the ODD and VESID field offices. People in these offices had access to IBM PC-compatible personal computers. In addition, some, but not all, of the personnel had experience using a personal computer. These two facts required that the system be designed to run on an IBM PC-compatible computer platform—one incorporating a friendly, easy-to-use interface. Other attributes of the system that were desired were statistical analysis capabilities as well as the ability to access external spreadsheet and data base files. Finally, because there would be a need for several copies of the disability screening expert system software, it was desired that there be no run-time version charges associated with any commercial packages used.

After a careful examination of the software options, it was decided that the 1st-Class Expert Systems, Inc., expert system shell, called 1ST-CLASS FUSION, would be used in the

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New York State Education Department  
Vocational Educational Services for Individuals  
With Disabilities

[F1=Help] [Esc = Stop]

Automated Screening System

INDIVIDUAL'S SOCIAL SECURITY NUMBER:

NAME:

ADDRESS STREET: CITY: STATE:  
ZIP:

PHONE: VESID DISABILITY CODE:  
DDS

ENTITLEMENT: PRIMARY DISABILITY:  
SECONDARY DISABILITY:

KEYBOARD SPECIALIST'S INITIALS:

Press ↲ to continue

*Figure 2. DISXPERT Client-Information Screen.*

New York State Education Department  
Vocational Educational Services for Individuals  
with Disabilities

[F1=Help] [Esc=Stop]

EDUCATION

EDUCATION IS CLASSIFIED INTO FOUR CATEGORIES. ANYONE WHO IS CURRENTLY OR HAS BEEN ENROLLED IN SPECIAL EDUCATION SHOULD BE INCLUDED IN THE UP\_TO\_8 CATEGORY. HIGH SCHOOL AND COMMUNITY COLLEGE GRADUATES ARE CLASSIFIED IN THE 12\_TO\_15 CATEGORY. FOUR YEAR COLLEGE GRADUATES AND BEYOND SHOULD BE CLASSIFIED AS 16\_AND\_OVER.

UP\_TO\_8  
9\_TO\_11  
12\_TO\_15  
16\_AND\_OVER

*Figure 3. DISXPERT Education Classification Screen.*

developed from working with the expert vocational rehabilitation counselors. An additional feature of the software is the ability to easily create and modify input forms as well as report summaries. Finally, the input and resulting decisions could be saved in a form suitable for further analysis.

A prototype system was developed using the 1st-Class fusion product. The ID3 inductive-learning algorithm was utilized to produce rules made up of relationships among the previously identified statistically relevant factors (Nolan 1991). These rules were combined with those generated by the vocational rehabilitation domain experts. This prototype showed a high degree of agreement with the 225 cases used in part to create it. Specifically, the prototype intelligent disability screening system referred 93 percent of the clients who had benefited from these services in the past to vocational rehabilitation services. Although it is not unusual for a classification model to do well when examining the cases used to create it, the results did show that we had a viable prototype to continue development.

The prototype used a client-information screen (figure 2) and several data-acquisition screens (figure 3) and provided screen output and hard-copy output of the assessment (figure 4). In addition, all data entered and decisions made were stored in a database for later retrieval. Other features included an online help section that explained to the paraprofessional user the reason for asking a question.

## Uses of AI Technology

The main AI research results that this application depends on are in the areas of machine learning and intelligent rule-based systems. The fact that we were able to obtain a set of rules from the social security disability assessment experts dictated that an intelligent rule-based system be deployed. The success of the application also depended on the development of additional rules for classification using past client data. The ID3 inductive-learning algorithm allowed us to develop rules for assessment and classification that could not be elicited explicitly from the expert rehabilitation counselors. The project could not have succeeded without these AI techniques.

The combining of knowledge gained from statistical learning techniques with knowledge acquisition from experts was necessary because each represents a facet of the total knowledge needed to make effective social security disability assessment decisions. The statistical analysis of 9000 past VESID cases and the

development of the intelligent disability screening system. This package includes software for applying the ID3 inductive-learning algorithm to the task of creating rules mirroring relationships present in data (Michalski, Carbonell, and Mitchell 1983). This algorithm could be used to generate classification rules using the results of the empirical research cited previously. The resulting rules could then be customized and added to fit the heuristics

deployment of the ID3 inductive-learning algorithm was done to obtain historical knowledge about the successes and failures of past assessment decisions. Acquiring the expert rehabilitation counselors' rules for making assessment decisions was an attempt to encode knowledge about current social security disability assessment practice. In particular, the medical knowledge used by these experts is important because rehabilitation possibilities change as new therapeutic techniques are discovered.

Combining knowledge gained from different AI methods increases the chances of building effective intelligent systems. Even though the human experts are well trained, they might not be aware of significant information that can be obtained from other AI techniques such as machine learning.

## Application Use and Payoff

DISXPERT was implemented in all VESID and ODD offices starting in 1992. Prior to the 1981 Social Security Act amendment funding changes, 13 professional and 18 clerical staff members handled the VESID disability review and assessment process. They averaged 70,000 cases assessed each year. After the 1981 amendments to the Social Security Act were implemented, the number of professional and clerical staff persons was reduced to four and three, respectively. The assessment output dropped to 15,000 cases a year. After DISXPERT was in operation in all VESID and ODD offices, the number of assessed cases a year jumped to 85,000, with a slight increase in staff to 6 professional and 5 clerical people (table 1). By any measure, this is a tremendous increase in productivity. These results mean that more beneficiaries who have the potential for gainful employment will have the opportunity to enroll in vocational rehabilitation programs. In turn, the amount of funds reimbursed to New York State from the federal government is increased. Reimbursement of more than \$6 million in SSA funds is now generated and used to support vocational rehabilitation programs in New York State.

Increased efficiency is not the only result of using DISXPERT. The effectiveness of the assessment process has also been improved. In fact, the *dropout rate*, that is, the percentage of those referred into education and training programs who did not complete them, has declined over 80 percent. This significant increase in effectiveness can be attributed in part to the expert assessment advice given by DISXPERT. In addition, a significant factor in the lower dropout rate is the fact that the rehabilitation coun-

New York State Education Department Vocational Educational Services for Individuals with Disabilities		
Automated Screening System		
INDIVIDUAL'S SOCIAL SECURITY NUMBER: 999-99-9999		
NAME: John C. Doe		
ADDRESS	STREET: 12 Maple Avenue	STATE: New York
	CITY: Homer	
	ZIP: 11221	
PHONE: (518)555-4543	VESID DISABILITY CODE: 8190	
ENTITLEMENT: SSDI	DDS	
	PRIMARY DISABILITY: 7655	
	SECONDARY DISABILITY: 3456	
KEYBOARD SPECIALIST'S INITIALS: JRN		
FACTOR ASSIGNMENTS		
AGE: 16-40		
EDUCATION: 12-15		
PROGNOSIS: UP_TO_3		
IMPAIRMENT: 2480		
ASSESSMENT		
SCREEN IN FOR REFERRAL TO APPROPRIATE PROGRAMS		

Figure 4. A Sample of a disxpert Final Assessment as Displayed on the Screen.

selors now have more time to do what they are trained to do—counsel clients, helping them to complete program services and find gainful employment (figure 5). Thus, the payoff associated with this application can be measured in something other than dollars: The increased ability of VESID to effectively assess disability recipients for vocational rehabilitation means that many of those with disabilities will get the training and education they need to become productive members of society.

## Application Development and Deployment

Proper testing and validation of any intelligent system is important for determining the accuracy, completeness, and performance of a system (O'Leary et al. 1990). It is not uncommon for significant changes to be made to systems based on test results. This system was no exception.

A single VESID office was selected as a test site. It was felt that the employees selected to be involved with the testing should feel comfortable using a personal computer (Chaiklin 1993). In light of this, training in the use of personal computers was provided. All social security disability cases referred to this office

	Professional Staff	Clerical Staff	Cases Assessed
Prior to 1981	13	18	70,000
After 1981	4	3	15,000
DISXPERT era	6	5	85,000

*Table 1. Staffing and Cases Assessed.*

were sent through the DISXPERT system. Over a 9-month period, 12,431 cases were reviewed and a risk assessment made. During this testing process, two major changes were made to the DISXPERT system: First, the rules for orthopedic disabilities were modified to better match the thinking of the expert vocational rehabilitation counselors. Second, DISXPERT was modified to examine the new disability coding scheme established by the SSA. Using this new coding scheme allowed DISXPERT to more clearly delineate disability cases.

At the end of the nine-month testing period, the three vocational rehabilitation counseling domain experts agreed the system was effective at assessing whether referral should be made to vocational rehabilitation services. A controlled experiment was set up to determine just how well DISXPERT was operating compared to domain experts. Two hundred cases were selected for the experiment. The 3 vocational rehabilitation experts reviewed each of the 200 cases and made an assessment. The same 200 cases were independently reviewed and assessed by DISXPERT. The results indicated that DISXPERT agreed with the domain experts on 198 of the 200 cases, for an agreement rate of 99 percent. Given this success, it was decided that DISXPERT would be used by all VESID and ODD district offices in New York State.

The costs associated with the development and deployment of DISXPERT can be separated into software and hardware development costs and training costs. The expenses associated with the purchase of hardware and software and the development of the intelligent rule-based system, including knowledge acquisition and development of the rule base and user interface, totaled \$60,000. The training of district office personnel in the use of DISXPERT totaled approximately \$30,000 in costs and associated staff time. Total cost for the entire project was approximately \$100,000.

One of the main difficulties in the develop-

ment of any intelligent system is the level of acceptance the users will have for the new system. Knowing this to be a key ingredient in the potential success of the computerized assessment system, a concerted effort was made from the beginning of the project to involve several potential users in the development of the model. This caused a feeling of ownership to take hold and, frankly, was the key to acceptance of the system. This is a lesson well worth remembering.

## Maintenance

The knowledge base is maintained by individuals at the user site. At the end of each year, the rules are reviewed for accuracy by comparing the results of previous assessment decisions with respect to successful placement. If there is evidence that the system is underperforming in any area, the rules associated with it are checked.

The design of the application facilitates updates because the system is rule based. It is relatively easy to change selected rules because the intelligent system shell used to develop the system allows quick access to rules. They can be changed or deleted, or new rules can be added.

In the four plus years since DISXPERT was deployed, there have been two occasions where some rules were slightly modified. Most of these rule changes came about because of advances in rehabilitation procedures, resulting in quicker and higher levels of recovery from specific disabilities. In the future, changes in social security disability training and education programs and objectives, as well as advances in rehabilitation medicine, could lead to more substantial changes in the rules used to assess client needs. Again, the structure of an intelligent rule-based system provides a framework amenable to making these changes.



*Figure 5. Specialist Counseling Client.*

## Summary

This work has shown that paraprofessionals can, with the aid of an expert system, make accurate risk-assessment decisions—and in less time. In particular, the results demonstrate the utility of AI technology in the social service organization. There are several areas where systems such as DISXPERT can have an impact. First, many services provided by social service agencies are offered only after some form of assessment or screening takes place. Generally, the screening process serves to identify those individuals who are in need and could benefit the most from a service or services. DISXPERT provides for less time-consuming screening and assessment, leading to quick access to needed services and enabling the social service agency to handle increasingly heavier screening and assessment work loads.

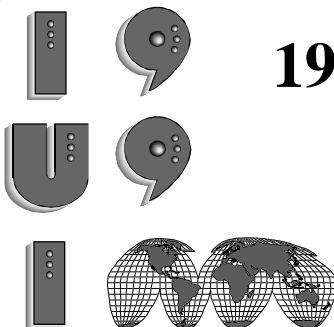
A second area of impact is the quality of screening and assessment activities. It does not do the social service agency any good to assess more applicants in a shorter amount of time if the accuracy of the assessment is compromised. The use of DISXPERT by the VESID offices has resulted in an increase in the quality of the screening and assessment process, as measured by the decrease in the dropout rate.

Finally, systems such as DISXPERT help to

structure a process for more uniform high-quality results yet have the flexibility to be changed when needed. The need for change is determined by tracking all screening and assessment decisions. The software generates statistics that can later be matched to service outcomes. If changes are needed in the assessment process, the system is flexible enough to allow changes to any of the heuristics.

DISXPERT provides several benefits to both the social service agency and the client: (1) it increases the accuracy of paraprofessionals screening clients into rehabilitation programs that lead to successful outcomes; (2) it reduces the amount of time needed to make an assessment, thus increasing the amount of time social service professionals can spend on counseling clients; (3) it improves the collection and recording of client data; (4) it enhances the training of less experienced caseworkers by letting them see how assessments are made by the domain experts; and (5) it serves as a repository of clinical and service knowledge and practice, documenting the policies and procedures of the agency. This knowledge is preserved for archival and future use.

The results indicate that certain types of decision problem can benefit from using more than one knowledge-acquisition strategy. In particular, the combination of statistical learn-



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ing methods and rule-based approaches has resulted in a system that proves to be even more effective than the experts whom the system is designed to imitate.

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