The development of an expert system for effective selection and appointment of the jobs applicants in human resource management

M. Saidi Mehrabad *, M. Fathian Brojeny

Department of Industrial Engineering, Iran University of Science and Technology, Tehran, Iran

Available online 15 June 2007

Abstract

Today, artificial intelligence especially the expert systems are used in science, engineering, business, manufacturing, management and many other fields. Human resource is one of the most strategic resources for a society and so forth for every type of organization, therefore offering a reasonable and intelligent service for employees of an organization is very essential. For this purpose, we have to pay a special attention collecting correct information about job applicants and employees of the organization. It would help the managers for optimal decision making in respect to selection process, recruitment, job rotation, training, payment system, job classification, evaluation and the other personnel operations.

This research work is going to present a model for design and subsequently implement an expert system for:

- Making preferences and selection of suitable applicants for a considered job with respect to job and organizational requirements (selection).
- The selection of suitable jobs for applicants and correct job rotation with respect to organizational requirements and jobs classification (appointment).
- Determination of the salary and benefit for the applicants based on their qualifications.

© 2007 Elsevier Ltd. All rights reserved.

Keywords: Human resource management (HRM); Selection process; Expert system; Research and development; Multidimensional scaling

1. Introduction

The concept of human resource management (HRM) took the management world by storm during the 1980s and has represented a significant change of direction. The difference needs to be explored, even though the nature and degree of the difference remain largely matters of opinion rather than fact, and the similarities are much greater than differences (Torrington & Hall, 1998).
The use of intelligent and systematic methods in HRM and personnel operations of an organization has certainly a high effect in organizational evolution. Some of the most important personnel operations of an organization which can use expert system, are as follows:

- Decision making about selection the best applicant for a job and suitable job for an applicant with respect to applicants and organizational characteristics.
- Decision making about suitable future jobs for employees in job rotation system with respect to employees and organizational characteristics.
- Decision making about required training terms for employees with respect to their characteristics.
- Decision making about the work place of employees with respect to their psychological conditions and organizational environment.
- Describing the important duties of job or job description.
- Calculating and determining the salary parameters of employees with respect to their jobs.
- Representing a clear image of working environment and future of their career.

Now, we pay attention to one of the most important personnel operations which are usually named selection and appointment process.

2. Selection and appointment process

Usually personnel and line management use a variety of imperfect methods to aid the task of predicting which applicant will be most suitable in meeting the requirements of the job. They are able to draw on their expertise to recommend the most effective selection methods for each particular job or group of jobs (Torrington & Hall, 1998).

Some of the selection methods which usually use are as follows (Flippo, 1984; Scarpello & Ledvinca, 1988):

- Use of application forms.
- Self-assessment.
- Telephone screening.
- Testing (such as: aptitude, intelligence, trainability, personality, interest test, . . .)
- Interviewing.
- Group methods.
- Work sampling.

A combination of selection methods is usually used, based up on the job nature, cost, time, accuracy, culture, acceptability and etc. Regardless of the different methods as mentioned above, Lewis (1985) suggests that selection criteria can be seen in three aspect:

- Organizational criteria.
- Functional/departmental criteria.
- Individual job criteria.

And finally, for doing a correct selection and appointment, we must consider adaptation of the job and departmental and organizational characteristics to applicant characteristics.

3. The comparison of expert system and operation research methods in HRM

According to Fig. 1, expert systems in comparison with operation research methods have differences and the benefits in purpose, process, application field and output for human resource management.
In comparison with OR methods, Expert system approach can use for the personnel operations of organizations extensively. The most appropriate domains in which expert system can be belt successfully include planing, job analysis, recruitment, selection, performance evaluation, compensation, training and labor-management relations (Byun & Suh, 1994).

4. Making the knowledge base

The process of building an expert system is called knowledge engineering and is done by a knowledge engineer (Michie, 1973). Making the knowledge base and selection of knowledge representation technique is a very essential part in knowledge engineering. The use of rule and frame representation for selection and appointment process in human resource management are best (Byun & Suh, 1996). In this research work we use rule representation for developing model. For this purpose, in the first the basic criteria for job/person specification should be extracted. There is a wide range of formats: the two most widely known are Alec Rodger’s seven point plan and John Munro Frase’s five-fold framework (Fig. 2) (Torrington & Hall, 1998).

Usually for Extraction of job/person specifications in an organization, job analysis along with experts judgements is used. This process is on the basis of experts judgements about basic criteria and the required person specifications for successful performance in a specific organizational job. Because hidden factors for successful job performance isn’t considered, the judgements usually is along with error and the selection process results isn’t acceptable completely. For extraction of the basic criteria for successful job performance with respect to hidden factors we use multidimensional scaling model (MDS). Multidimensional scaling technique has been developed in the psychometric field for finding the hidden structure. Since in selection and appointment process confront hidden factors for successful job performance, MDS technique use for making the knowledge base of expert system.

<table>
<thead>
<tr>
<th>Subject</th>
<th>Operation Research</th>
<th>Expert System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purpose</td>
<td>decision making</td>
<td>decision making and decision support</td>
</tr>
<tr>
<td>Process</td>
<td>algorithmic</td>
<td>learning and inference dependent</td>
</tr>
<tr>
<td>User</td>
<td>manager</td>
<td>human resource information system</td>
</tr>
<tr>
<td>Knowledge Base</td>
<td>-----</td>
<td>knowledge base</td>
</tr>
<tr>
<td>Application Field</td>
<td>structured problems</td>
<td>ill structured problems</td>
</tr>
<tr>
<td>Output</td>
<td>optimized solution</td>
<td>explanation and recommendation</td>
</tr>
</tbody>
</table>

Fig. 1. Comparison of the OR & ES.

In comparison with OR methods, Expert system approach can use for the personnel operations of organizations extensively. The most appropriate domains in which expert system can be belt successfully include planing, job analysis, recruitment, selection, performance evaluation, compensation, training and labor-management relations (Byun & Suh, 1994).

Fig. 2. Rodger’s seven point plan and Fraser’s five-fold grading.
5. A model with using expert system for intelligent selection and appointment process

This model is expressed in the steps below according to Fig. 3:

- Determining and identifying the understudied organization.
- Determining the required personnel operations.
- Interviewing managers and experts within the organization and collecting suitable information about required personnel operations such as, jobs conditions and classification, payment system, training terms and etc.
- Extraction of logical rules which define required relations between applicant and vacancy or between employee and job or other logical relations for making the knowledge base of the expert system with using of MDS technique.
- Choosing of suitable tools for implementing expert system (e.g. software tools such as clips,…)
- Designing and implementing the expert system for decision making in respect to considered personnel operations.
- Test and verification of the expert system on real problems in the organization by knowledge engineers and experts.

6. Using the model in an R&D organization

In an understudied organization such as an R&D center, which had variety of jobs available, we considered the R&D jobs. These jobs included activities and tasks which had a great variety of nature with a low analyzability (Triandis & Jain, 1996), and were placed on the following organizational divisions:

- Hardware department.
- Software department.
- Mathematics department.
- Communications department.
- Manufacturing department.
- Laboratories.
For example manufacturing department had the jobs such as industrial design expert, senior, industrial design expert, mechanical technician, senior mechanical technician, manufacturing manager and so forth. We extracted about 60 jobs and studied the required conditions of jobholders which would be suitable for their occupation. Then the suitable expert system for the required personnel operations of the organization was designed. The most important of these operations were as follows:

1. The development of Decision making procedures about suitable R&D jobs for applicants and also about suitable future jobs for employees.
2. Decision making about required job training for employees.
3. Decision making about the work place of employees with respect to their psychological conditions and organizational environment.
4. Calculating and determining the effective salary parameters.

In this regard logical rules for developing knowledge base was extracted by interviewing the experts within the organization. Therefore we developed a rule based expert system with using the CLIPS shell.

6.1. Collecting input data for the expert system

Collecting input data for the expert system can be accomplished by information forms. Since validity of the input data is very important for correct decision making, therefore an extreme care must be exercised for designing the forms. Job applicants fill out the form and then the obtained data applied to expert system.

6.2. Knowledge base and inference engine

The required knowledge and expertise for reasonings can be created by the clips constructs, such as DEF-TEMPLATE, DEFRULE and DEFFACTS (Giarratano & Riley, 1994). A sample part of this program is presented in Appendix A.

6.3. Output results

After running the program (expert system), we need the results and recommendations, therefore these results is saved in a output file for the subsequent use.

7. Conclusions

The use of intelligent methods for decision making in the variable branches of human resource management has a high value especially in today’s organizations. In this research work, it is demonstrated that an expert system is a very useful tool in the support of personnel operations. Some of the important features of this work are flexibility in knowledge base and the ability of the presentation of explanations about the reasonings and decisions which are made.

Acknowledgement

We thank all those who helped us in this research work.
Appendix A. Some selected parts of the program

```
(deftemplate job "an organizational job"
(slot name-of-job)
(slot code-of-job)
(slot organizational-units)
(slot job-score)
(slot responsibility-score))

(deftemplate level-exp
(slot educational-level)
(slot work-experience)
(slot management-experience))

(deftemplate salary "salary parameters"
(slot rial-coef 1000)
(slot responsibility-coef 20)
(slot performance-coef 1.1)
(slot occupation-percent 100)
(slot record-coef 50)
(slot living-coef 12))

(deffacts salary-param "salary parameters"
(salary rial-coef 1000)
(responsibility-coef 20)
(performance-coef 1.1)
(occupation-percent 100)
(record-coef 50)
(living-coef 12))

(defrule hardware-project-manager
(declare (salience 4))
(not (job))
(or (level-exp
  (educational-level #level&(:= ?level 4))
  (management-experience #year&(:>= ?year 4)))
(level-exp
  (educational-level #level&(:= ?level 5))
  (management-experience #year&(:>= ?year 3)))
(level-exp
  (educational-level #level&(:= ?level 6))
  (management-experience #year&(:= ?year 1)))
(electronic-field #field &electronics&kumputer)
(work-tendency hardware)
=>
(assert (job
  (name-of-job "hardware project manager")
  (organizational-units "hardware department")
  (code-of-job 14)
  (job-score 9)
  (responsibility-score 5)))

(defrule senior-hardware-expert
(declare (salience 3))
(not (job))
(or (level-exp
  (educational-level #level&(:= ?level 4))
  (work-experience #year&(:>= ?year 8)))
(level-exp
  (educational-level #level&(:= ?level 5))
  (work-experience #year&(:>= ?year 2)))
(level-exp
  (educational-level #level&(:= ?level 6))
  (work-experience #year&(:= ?year 0)))
(electronic-field #field &electronics&kumputer)
(work-tendency hardware)
=>
(assert (job
  (name-of-job "senior hardware expert")
  (organizational-units "hardware department")
  (code-of-job 13)
  (job-score 9)
  (responsibility-score 0)))
```
References


