E. IANCU, T. SOCACIU, T. COLOMEISCHI

ISSN 0543-5846
METABK 52(4) 557-560 (2013)
UDC – UDK 669:061.5:338.91=111

SELECTION OF HUMAN CAPITAL IN METALLURGICAL COMPANIES USING INFORMATION TECHNOLOGY (IT)

Received – Prispjelo: 2012-12-08
Accepted – Prihvaćeno: 2013-03-30
Review paper – Pregledni rad

Personnel selection is a process that takes place in a company in order to have better business performance and competitive advantage. Nowadays, companies have realized the importance of human capital as a necessity for survival in today's competitive market. There are several methods for selecting staff, but this paper seeks to demonstrate that this selection can be done with the help of an expert system. Metallurgical companies face even greater challenges for managing personnel selection. This research will discover and test the key elements of management personnel selection and implementation of an expert system.

Key words: metallurgical companies, capital, knowledge, database, algorithm

INTRODUCTION

During both prosperity and recession period as well, companies seek to realize maximum income by applying a policy resulting from the optimization of processes by increasing efficiency and economic changes [1]. This can be achieved through a rigorous selection of personnel serving company.

What determines the success of a company is the value generating process in which organizations generate value from their intellectual assets and knowledge [2]. To convert information into knowledge and knowledge into information a company needs human resources to generate models, norms, rules [3]. In a company specialist such as technological, economists, lawyers, sociologists help develop the company [4].

The notion of artificial intelligence gradually emerged and developed, driven by the growing variety of problems in society, diversification of general needs, the ability to transform data into information and information into knowledge. Artificial intelligence provides new dimensions in automation concept, assuming greater autonomy of production systems, machinery, different robots [5].

Today, expert systems are used in various industries, design and implementation of each type of expert systems (ES) requiring a separate effort and closely connected to the type of problem to be solved. Typically, problems for which expert systems are designed and developed must be sufficiently complex (whether in medicine, economics, etc.) to be associated with a database derived from human expertise; solely from such knowledge base it becomes effective designing inference engine. [6-9].

E. Iancu, T. Socaciu, T. Colomeischi, Stefan cel Mare University, Faculty of Economics and Public Administration, Suceava, Romania

Murphy has shown that the use of expert systems has an adverse effect on the development of subject's semantic memory (declarative knowledge). Therefore, expert systems could function as viable training aid but should not be used as substitutes for actual instruction [10].

Without emphasizing historical perspective on the ES, we must consider that P. Harmon and D. King predicted in the 80s two distinct stages of development [11]:

- first period until the early 90s, characterized by medium-sized application of expert systems to solve specific problems, narrowly defined on different sectors;
- second period, expected to be between 1990 and 2000 would be marked by a major focus on quality afforded by the ES built, meaning that they were getting closer to the human reasoning.

The idea of using rule-based methods was first proposed by Post [12] and the approach is used in grammar specification and construction of grammatical analysis for specific programming languages.

Finally, we conclude that a period of nearly six decades of theoretical developments and practical applications of ES specific results have been obtained in this field of AI, namely:

- costs of constructing ES on areas such as medicine, economics, geology or biology were reduced; current generations of SE are undoubtedly much cheaper than the previous ones;
- although achieved at lower costs, ES came gradually to provide better solutions (although the complexity of the issues for which it was designed increased);
- more extensive use of computer networks – Internet connected naturally with the use of ES in different organizations; work routine and complex iterations once made by skilled workers were transferred to ES duty.

To describe the basic concept of an expert system, Giarratano Riley identifies three components: the user providing facts and information to the expert system, basic knowledge containing specific information and interference engine that uses rules [13].

PROBLEM DEFINITION

Personnel selection is an area in which ES can provide elements for easy and objective development of the process. Frequently, in company personnel selection takes place in two stages: the first stage is intended to application tests and the second allocated to interview candidates. In the first stage, since the implementation of evaluation tests is a problem, the ES can facilitate the evaluation process. The idea is that tests can be built on four areas frequently used - knowledge, intelligence, skills and personality - with the help of software to extract the test items[1] from items files created for each of the four areas.

The general module includes the following steps [14][1]:

a) defining (M) sets generated by items:
 - knowledge (C) $\{M_i^C\}$ with i=1,2,....N^C
 - intelligence (Q) $\{M_i^Q\}$ with i=1,2,....N^Q
 - skills (A) $\{M_i^A\}$ with i=1,2,....N^A
 - personality (P) $\{M_i^P\}$ with i=1,2,....N^P

 where N^C, N^Q, N^A, N^P are the maximum numbers of items from each set (M^C, M^Q, M^A, M^P)

b) for each item it will be defined a number of reductions (R) such as:
 - knowledge
 $\{R_{i,j}^C\}$ with i=1,2,....N^C; $j=1,2,...,S^C$
 - intelligence
 $\{R_{i,j}^Q\}$ with i=1,2,....N^Q; $j=1,2,...,S^Q$
 - skills
 $\{R_{i,j}^A\}$ with i=1,2,....N^A; $j=1,2,...,S^A$
 - personality
 $\{R_{i,j}^P\}$ with i=1,2,....N^P; $j=1,2,...,S^P$

 where S^C, S^Q, S^A, S^P are the maximum numbers of reductions

c) defining collectivities of selection (m) from each area:
 - knowledge
 $\{m_i^C\}$ with i=1,2,....n^C; $n^C \le N^C$
 - intelligence
 $\{m_i^Q\}$ with i=1,2,....n^Q; $n^Q \le N^Q$
 - skills
 $\{m_i^A\}$ with i=1,2,....n^A; $n^A \le N^A$
 - personality
 $\{m_i^P\}$ with i=1,2,....n^P; $n^P \le N^P$

 where n^C, n^Q, n^A, n^P are the maximum numbers of items with the reductions afferent to the items:
 - knowledge
 $\{r_{i,j}^C\}$ with i=1,2,....n^C; $j=1,2,...,S^C$
 - intelligence
 $\{r_{i,j}^Q\}$ with i=1,2,....n^Q; $j=1,2,...,S^Q$
 - skills
 $\{r_{i,j}^A\}$ with i=1,2,....n^A; $j=1,2,...,S^A$
 - personality
 $\{r_{i,j}^P\}$ with i=1,2,....n^P; $j=1,2,...,S^P$

 where S^C, S^Q, S^A, S^P are the maximum numbers of reductions

d) building general test (T)
 $\{T\}$ made of selection sets $\{m_{t1}^C, m_{t2}^Q, m_{t3}^A, m_{t4}^P\}$ with the reductions $\{r_{t1,j1}^C, r_{t1,j1}^Q, r_{t1,j1}^A, r_{t1,j1}^P\}$, where:
 $t1= 1,2,...,n^C$; $j1=1,2,...,S^C$
 $t2=(n^C+1),(n^C+2),...(n^C+n^Q)$
 $j2=1,2,...S^Q$
 $t3=(n^C+n^Q+1),(n^C+ n^Q +2),...(n^C+n^Q+n^A)$
 $j3=1,2,...S^A$
 $t4=(n^C+n^Q+n^A+1),(n^C+ n^Q + n^A+2),... (n^C+n^Q+n^A+n^P)$
 $j4=1,2,...S^P$

e) conducting surveys for a number of candidates (K):
 - building the vectors with the correct answers
 $U(t)$, $t=1,2,...(n^C + n^Q + n^A + n^P)$
 - building the matrix with the candidates' answers:
 $W(t,k)$, $t=1,2,...(n^C + n^Q + n^A + n^P)$; $k=1,2,...K$
 - calculating the score for each candidate
 $$Z(t,k) = \begin{cases} 1 \text{ for } W(t,k)=U(t) \\ 0 \text{ for } W(t,k) \ne U(t) \end{cases}$$
 - calculating the total score of the candidates:
 $$Z\left[(n^C + n^Q + n^A + n^P)+1, k\right] = \sum_{t=1}^{(n^C + n^Q + n^A + n^P)} Z(t,k)$$

The schematic diagram is shown in Figure 1, The system may be a component of an expert system that has attached a module for personnel selection.

Procedural components are:
- creating files with items and reductions;
- creating surveys;
- applying surveys for a number of candidates
- calculating scores and descending sorting of the candidates.

The search algorithm used by the expert system that includes (Search Procedure) is preceded by an ascending sort of rules depending on the complexity of the rules (usually the most complex is the one with the greatest number of facts in the premise), then conflicts are resolved; the situation is as follows: [15]

[1] Item - element of a test, survey with a specific note in a problem referring to a fragment of its unique and strict determination

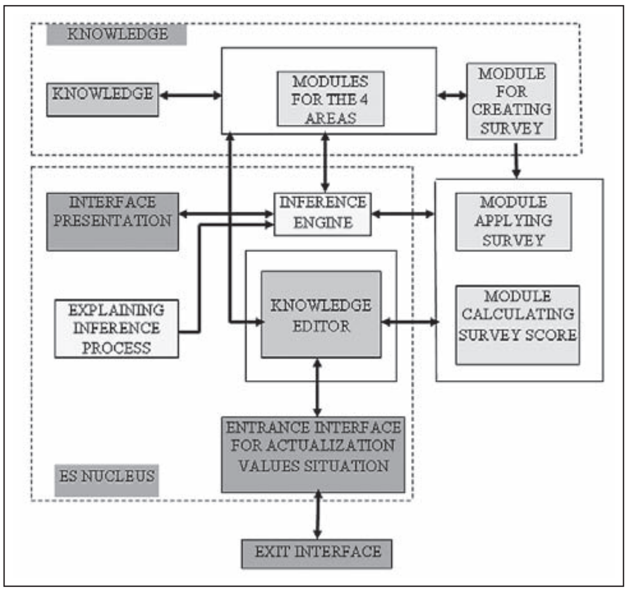

Figure 1 Model of personnel selection expert system in a company [15]

```
*         Search Algorithm
*
*********
DO Search
*********
*
REPLACE ALL Formule.Nr WITH Formule.Max_INFO + 1

REPLACE ALL Formule.T_INF  WITH Formule.E_INF,;
        Formule.T_INF    WITH StrTRAN(Formule.T_INF,']',''),;
        Formule.T_INF    WITH StrTRAN(Formule.T_INF,'[',''),;
        Formule.E_INFO   WITH Formule.T_INF,;
        Formule.T_INF    WITH Formule.F_INF
INDEX on STR(Formule.Nr,5)+upper(Formule.Name) to Formule.IDX
******************************************************************
```

In the sequence below, we make a description of how the problem is being raised in making formulas and the possibilities of working with formulas (create, add, change, delete); illustrating a sample is given solely for the purpose of argument:

a) relating to the calculation formulas:

```
SELECT 0
USE      Formule.DBF
INDEX on Formule.Len_Inf to Formule.IDX

GO BOTTOM
kLEN = Val(Formule.Len_IDX)
DIMENSION nW(kLEN)
FOR J = 1 to kLEN
   nW(J) = ''
ENDFOR
GO TOP
DO WHILE !EOF()
    nume_War= ALLTRIM(Formule.Name)
    &nume_War        = Formule.Nr
  SKIP
ENDDO
*
*         Search Algorithm
*
*********
DO Search
*********
*
REPLACE ALL Formule.Nr WITH Formule.Max_INFO + 1

REPLACE ALL Formule.T_INF  WITH Formule.E_INF,;
        Formule.T_INF    WITH StrTRAN(Formule.T_INF,']',''),;
        Formule.T_INF    WITH StrTRAN(Formule.T_INF,'[',''),;
        Formule.E_INFO   WITH Formule.T_INF,;
        Formule.T_INF    WITH Formule.F_INF
INDEX on STR(Formule.Nr,5)+upper(Formule.Name) to Formule.IDX
******************************************************************
```

b) relating to formulating and handling expressions:

```
Go TOP
DO While !EOF()
 IF substr(Formule.Id_Name,1,1) = 'E'
   TxtExp = '* '+alltrim(Formule.Expr)+ CHR(10) ;
       + '* '+CHR(10)
 ELSE
   TxtExp = '*<IF>     ' + alltrim(Formule.IF) + CHR(10) ;
        + '*<Then> ' + alltrim(Formule.Then) + CHR(10)
 ENDIF
*   Memorez TextFormule
    m.TextExpres = m.TextExpres + '* Start '+alltrim(Formule.Id_Name)+CHR(10) + TxtExp;
                + Formule.FORMULE+CHR(10)+'* END Start'+alltrim(Formule.Id_Name)
 SKIP
EndDO

 TextFormule = '* Gen_Exp.PRG'+m.StartFormula+m.TextExpres + 'RETURN'
*
 DO F_Crea_TXT.PRG WITH fileNameX,TextFormule
*
IF FILE(fileNameFXP)

 DO &fileNameFXP with a_Anul              &&    Gen_Exp.FXP

ENDIF

* Salvez valorile calculate
Save to War_An.MEM ALL LIKE w*
```

c) algorithm relating to the appeal of determining minimum and maximum functions:

```
****************
Procedure Search
****************
*
*         Search Algorithm
*
GO TOP
DO WHILE !EOF()
    MaxINFO = 0
    m.LenINFO = VAL(Formule.Len_IDX)
    FOR J = 1 TO m.LenINFO
      nW(J) = ALLTRIM(SUBSTR(Formule.T_INF,1,AT(';',Formule.T_INF)-1))
      REPLACE T_INF WITH ALLTRIM(SUBSTR(Formule.T_INF,AT(';',Formule.T_INF)+1))
      IF MaxINFO < &nW(J)
        MaxINFO = &nW(J)
      ENDIF
      REPLACE Formule.Max_INF  WITH
ALLTRIM(Formule.Max_INF)+ALLTRIM(STR(&nW(J),5))+' ; '
    ENDFOR
    REPLACE Formule.Max_InfO WITH MaxINFO
*
  SKIP
ENDDO
RETURN
```

RESULTS

The innovations introduced by the expert system to other expert systems in which decision makers do appeal in companies are:

- designing expert system architecture using a special module that contains data on four different areas: knowledge, intelligence, skills and personality;
- realizing a comparative analysis of the results generated by applying an expert system
- describing representation methods for various types of data:
- descriptive data;
- experimental data grouped in different forms for the models used by the expert system;
- allows „dynamic” calculations according to the user’s/expert’s requirements through the generator module
- modularization and generalization of the types of problems with a specially built model; generating expressions and formulas that will be used by the inference engine to define production rules;
- facilitates other processing taking into account possibilities for human expert to develop related applications;

- enables exporting the results into Excel files which offer graphic and printing facilities;
- displaying or printing of the results/conclusions of the expert system for the company which selects staff.

CONCLUSIONS

This paper has showed the main factors influencing the selection of staff in a company and if the selection is more efficient by using an expert system rather than using human factor in decision making. Due to this objective, large metallurgical companies may employ personnel when using modules of items that consider knowledge, intelligence, skills and personality. The research shows that organizational infrastructure and IT culture are significant in implementing knowledge management. So, metallurgical companies should consider these factors and try to improve organizational culture in terms of KM and IT infrastructure, which has a large impact on all aspects of organization.

REFERENCES

[1] K. Grzybowska, B. Gajdzik - Optymisation of Equipment Setup Processes in Enterprises, Metalurgija 51 (2012) 4, 555-558
[2] Levinson M. - Knowledge management definition and solutions. [Online] Available: http://www.cio.com/article/40343/Knowledge_Management_Definition_and_Solutions,(2003)
[3] Nickols F. - The knowledge management yearbook, Google books, (2008), 12-13
[4] B. Gajdzik, A. Wyciślik - Assessment of Environmental Aspects in a Metallurgical Enterprise, Metalurgija 51 (2012) 4, 537-540
[5] I. Stanković, M. Perinić, Z. Jurković, V. Mandić, S. Maričić - Usage of Neural Network for the Prediction of Surface Roughness after the Roller Burnishing, Metalurgija 51 (2012) 2, 207-210
[6] Feigebaun E.A., Buchanan, B.G., Ledeberfg, J. – On generality and problem solving: A case study using the DENDRAL program, In Meltzer, B., Michie, D., Editors, Machine Intelligence, Edinburg University Press, Edinburg UK, (1971), p. 6
[7] Frenzel Louis E. Jr., Crash - Course in Artificial Intelligence and Expert Systems, Indianapolis: Howard W. Sams & Co., (1987)
[8] Pigford D. V., Baur, G. – Expert Systems for Business. Concepts and Application. Featuring VP Exert, Body & Fraser Pub.Co., (1990), 14
[9] Jackson P. - Introduction to Expert Systems. Addison-Wesley, (1999)
[10] Murphy, D.S - Expert System Use and the Development of Expertise in Auditing: A Preliminary Investigation, The Journal of Information Systems, 4, (1990), 18-35
[11] Harmon P., Maus R., Morrissey W. – Expert Systems Tools and Applications, New York, John Wiley &Sons, Inc., (1988)
[12] Post E. L. - Formal Reductions of the General Combinatorial Decision Problem, American Journal of Mathematics 65 (1943), 197-215
[13] Giarratano, J.C., Riley, G.D. - Introduction To Expert Systems. Expert Systems 4th Edition. Thomson Course Technology, (2005),(19,29,32,34)
[14] Constantin A. Bob; Mirela Visean; Mihai Fulea; Andreea Saseanu - Sisteme informatice in comert, Editura ASE, Bucuresti, (2003)
[15] E. Iancu – Sisteme expert in contabilitate si informatica de gestiune, Ed. Politehnica, Timisoara, (2011), 114-116

Note: The responsible translator for English language is lecturer N. Gales and E. F.G. Iancu, Faculty of Economics and Public Administration, Suceava, Romania