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EDUCATION MANAGEMENT CONCEPT – CAREER DEVELOPMENT

SUMMARY

The expert system for occupation selection counselling is a reliable indicator of young people's inclinations toward certain occupations, whether they are aware of them or not. Even if they were completely positive about what they want in their lives, which is indeed the most important thing, it would be good to verify if in the characteristics of their personality there is anything that might pose an insurmountable barrier for the desired occupation.

The basic preoccupation of this work is the creation of the concept of expert system coefficients management. This implicitly includes the need to initially determine the personality attributes, or input coefficients, which need to be learned; in the next step on the basis of additional rules these attributes generate variable values which are the final occupation (very rarely) or they represent the logical course towards it. On the path towards the occupation as a multidimensional variable the occupations themselves are grouped into fields of related occupations and from them we extract the inclination towards individual occupations.

Since it can be expected that young people without the presence of adults will answer the questions truthfully, the results might be more correct than those offered by a human expert. Let us point out that 32 experts from the relevant field offered their knowledge for the creation of this electronic adviser. They were people well acquainted with the actual situation. Therefore, there is no reason for the final-grade primary and secondary school students, as well as unemployed people, not to use this form of counsellor which can be situated on the computers that can be found in great numbers in schools and/or many local and state government offices. This would facilitate the qualified and irreplaceable (living) experts to focus on important and relevant facts connected with the development of the young person's career. Even if it were a person with a feeling of rejection toward the computer, the responsible expert might be able to extrapolate the psychological, intellectual and physical profile of the person by asking questions and recording answers, as well as using the computer.

Occupation Selection Adviser is ideal for the use in schools, employment offices, social service offices and organizations with a developed staff and personnel management. It can also be used by employees in order to test their candidates and complete the initial selection. There are multiple application possibilities for thus conceived expert system, and the stated problems are very important and interesting for individuals, for their families and for the society in general.

1. INTRODUCTION

The expert system under the title *Occupation Selection Adviser* will contain a database transformed into rules. A large number of rules will enable the Adviser to give the individual a piece of invaluable advice in planning and directing of his career. The authors have convinced themselves that it is a feasible, although a very extensive, enterprise after the creation of a demo version of the *Adviser* using the programming tool – shell of the *Guru* expert system. The implementation is therefore possible within one of existing shells. However, due to the fact that during this work some major inadequacies of the applied shell were noticed, it is necessary to find a more suitable shell for the prototype and later for the real expert system. A possible failure would postpone, but not prevent, the completion of the project because this would require work on a project within a project – the creation of a suitable expert system shell.

The *Adviser* is aimed at:

- primarily **students** faced with a necessary choice of their future occupation;
- the **unemployed** looking for employment;
- the **employed** seeking to change their profession;
- **advisers** in order to give advice to their clients regarding occupation choice;
- **personnel experts** dealing with personnel questions in companies...

The **Adviser** will cover more than 260 key occupations that require professional education on secondary school or university level. They were chosen taking into account the existing “education profiles” in schools and universities, as well as the occupations without any training program that still exist in reality. *The national classification of occupations¹ was taken into account during the selection, as well as more important international publications with occupation descriptions. New occupations have been added which will become more present in near future.²* The description of occupations has been prepared by a large group of experts (32) who were primarily industrial or school psychologists employed in the relevant fields. The descriptions were based on:

- their own analysis of occupations and professions
- occupation descriptions from other sources and
- interviews with experts and employees from the relevant fields.

Their knowledge was made available to us through the book *Vodič kroz zanimanja (Occupations Guide)³* that was mostly used while working on the demo version of the *Adviser*.

The large number of different occupations requires them to be grouped. The Adviser takes over the grouping of occupations into 37 groups/clusters. Although the authors of Occupations Guide are not completely satisfied with their grouping system it would be

¹ Narodne novine, No. 3/97, National Classification of Occupations, <http://www.nn.hr/sluzbeni-list/>, February 2002.

² Šverko, Branimir (Ed.): *Vodič kroz zanimanja*, Razbor, Samobor, 1998., p. 9.

³ The same book is recommended for pupils attending the 7th and 8th grade of primary school.

pretentious to attempt another clusterization. *This classification is not unambiguous – it is partly based on the educational level of occupations and partly on the type of work and the area of activity.*¹

2. CAREER PLANNING AND ORIENTATION

Work is one of the most important human activities. With it we earn for our life. Besides, at our workplace we fulfil some of our social needs. We dedicate a lot of time to work: *7 to 8 hours a day, 5 or 6 days a week, 35 to 40 years of our lives.*² Therefore it is important that we do the work that makes us happy and in which we are successful. Although it is a fact that thanks to their adaptability some people are similarly successful in more lines of work, they will still be able to do some jobs with more satisfaction and less strain. We can certainly say that the choice of occupation is one of the most important decisions in human life. Moreover, rarely anybody will have just one job in his or her life. People usually change several jobs and occupations through life. *This sequence of jobs and occupations until retirement is called a career.*³ It is a process realized in a series of decisions made by an individual during his education and work and it is particularly closely connected with the choice of adequate education. *The individual's career essentially determines his or her life. It determines his or her financial position, social standing, place of residence, friends. It determines the way in which an individual sees and values him or herself, as well as the way in which other individuals behave in interaction with him or her. Therefore systematic planning and directing of one's own career is in fact planning of one's own life. In this planning and directing of one's own career each individual is faced with three basic questions:*

- *How to choose an appropriate occupation and vocational training?*
- *How to find a job in the right moment?*
- *How to present oneself in the best light and get a job?*⁴

3. OCCUPATIONS AND HUMAN CHARACTERISTICS

Work tasks and conditions determine the desirable characteristics. For every occupation it is possible to determine a certain group of characteristics that are of utmost importance. Thus defined groups of desirable characteristics, as well as necessary tendencies present in every human being, can considerably vary among different occupations.

It is desirable that one is aware of his or her characteristics. However, even if the individual is aware of them, the following question is raised: *Does this individual need the advice of this kind?* The answer to this question requires some argumentation:

1. supposition – the individual is well acquainted with his/her characteristics and propensities so that his or her statements can be applied to the reasoning of the expert system.
 - The need for the Advisor is certainly reduced, but, as will be shown later, knowing oneself if only one side of the medal;

¹ Šverko, Branimir (Ed.), op. cit., p. 9.

² Ibid., p. 11.

³ Ibid.

⁴ Ibid.

2. supposition – the individual is not well acquainted with his/her characteristics and propensities or is aware of them on the intuitive level and is not able to formulate them precisely
 - a survey is necessary for input of required entry facts.

The number, structure and formulation of survey questions should be set taking into consideration expert opinions of psychologists and sociologists, as well as all characteristics of the survey as a scientific research method.

3.1. Knowing Oneself

Knowing one's inner self is a precondition of valuable answers to expert system's questions. *Only if you really know yourself, your answers make sense. Knowing yourself means knowing your characteristics, primarily those that are connected with performing of various jobs.*¹ The questions to be answered are related to three types of human characteristics that are important for the search for occupation: values, interests and abilities.

3.1.2. Values

*Values (orientation of values) are basic aims that people seek to fulfil in their lives.*² Some people value and seek wealth, other people appreciate spirituality and/or orientation towards God, some look for power and influence over the others and yet another group wishes to fulfil their lives with a socially valuable goal. People from the first group might try to succeed as entrepreneurs, the others will feel the calling from God to become priests or nuns, people from the third group might wish to become directors, principals or customs officers, and those from the fourth group could find themselves in the role of a social worker or perhaps adviser. Of course, there are other goals in life: *to be physically active and lead an exciting life, to devote oneself to intellectual creativity, aesthetic atmosphere, quiet religious life...*³

*... Basic goals of an individual are not always obvious, but they are generally noticeable in his attitudes and behaviour.*⁴ A clear and sincere insight into one's own values enables a more mature choice of occupation and work. When an individual chooses his or her occupation, they should think about their goals in life, they should determine their hierarchy of values and take it into account. The expert system relieves the individual of this awareness.

3.1.3. Interests

Interests are situations in which an individual invests more time into some activities and gives these activities more attention that is objectively necessary. These interests, just like characteristics and affinities can be different; we can divide them, for example, according to content: interest for art, technology, natural sciences, literature, business activities... If we enter the higher levels of generalization, we can observe that some people show more tendencies towards intellectual activities, others towards physical or practical ones; some show interest for objects, others for people.

Different occupations cannot offer equal opportunities of fulfilment of individual interests. It happens very often that people move from one area of human activity into another because they are unable to satisfy their needs and interests; they change professions although

¹ Ibid., p. 14.

² Ibid.

³ Ibid.

⁴ Ibid., p. 15.

they had invested a respectable effort into the previous occupation, e. g. by graduating from an appropriate university. *The reality shows that people with more enterprising spirit sooner or later attempt to enter the profession that is consonant with their interests.*¹

It is clear that experience is important, even if one chooses the wrong calling. In this way, at least, the so called “hanger of knowledge” are created on which we can “hang” new knowledge from the area of our serious interest. However, we spend our own time and financial resources, as well as the resources of the society that finances (fully or partly) our education, be it formal or informal, practical or theoretical. Therefore, generally speaking, it is better to avoid the experience of choosing the wrong calling for which we have no real interest, and to choose the profession right away in which we can perform activities that are of real interest to us. It would be ideal, although not indispensable, for the individual to be well acquainted with his or own interests. It would therefore be ideal for the surveyed persons to think about all the matters and activities that are of interest to them, to make a list of them, group them according to similarity and establish dominant interests, before the Adviser is even activated.

3.1.4. Abilities

For success in a profession, interests are not enough. The abilities of the individual as the basic human characteristics determine the range of that individual in an activity. They do not have to correspond to his interests. Abilities can be:

- *intellectual* (e. g. the ability to form an opinion, verbosity, tenacious memory, speed of perception),
- *motor* (e. g. fast reactions, bodily strength, skill of hand) or
- *sensory* (e. g. quick-sightedness, tactile sensitivity).

We have already mentioned that every occupation or profession requires its own desirable group of characteristics; we can add that it also requires its desirable group of abilities. If persons possess them, *they will adopt the necessary skills easier, faster and more thoroughly and the final level of their professional success will be higher.*² When choosing an occupation the abilities must be taken into account which have to be as coordinated as possible with the characteristics needed for that particular profession. In this way we can realistically presuppose that the person in question will attain greater success in his or her future profession, with less effort and more pleasure. Before counselling with the expert system it would be advisable to survey the person’s abilities, to compare them with others and to estimate their advantages and disadvantages. When speaking of pupils or students, their school achievement so far, the ease with which they meet various school requirements, their success in sports or other activities can help in the evaluation of their abilities and limitations.

To become acquainted with ourselves, in the context of the choice of our future profession, means to learn of our values, interests and abilities. However, the individuals should not rely exclusively on their own evaluation in choice of profession. A discussion with friends can lend insight into how other people evaluate them and in this way they can complete the picture of themselves. Finally, they can ask for help from psychologists and other vocational guidance experts. Unfortunately, we are aware that we cannot expect this to happen in large numbers. An easily accessible computer in a school’s library, hallway or other appropriate spot, with an installed electronic expert, has considerable advantages, although it also has disadvantages because it is limited to written communication only and it cannot replace the experience of a real expert.

¹ Ibid.

² Ibid.

3.2. Knowing the World of Work

We have already stated that in order to choose one's future profession it is desirable to know oneself as good as possible, as well as the world of work. If we are not acquainted with various occupations, their main characteristics and requirements, conditions and prospects for employment, we lose the possibility to *choose* a profession. There is a myriad of occupations, thousands of them, and we may not even be aware of their existence. Besides that, just like every other sociological phenomenon, the world of work is susceptible to the constant change. The scientific and technological development and the change in people's needs and expectations create new professions but also abolish old ones.

An individual cannot become fully acquainted with all the possible occupations. Therefore it is necessary for people to orient themselves towards those occupations that interest them the most and they should consider them in more detail. But which are the occupation characteristics that require special attention? For most people the professional satisfaction depends on the coordination of their characteristics with the characteristics of the occupation in question. Some key characteristics which should be taken into account when choosing a profession are work description, work conditions, required education, possibility of employment and probable income.

3.2.1. Work Description

The work description or the content of work activities performed in a profession is to many people the most important criterion in the evaluation of an occupation. For every occupation we research it is necessary to find and examine the description of typical tasks. Generally speaking a classification into professions whose description of typical tasks predominantly include working with people, objects, data or ideas is of crucial importance. Moreover, the way work duties are assigned, i.e. their autonomous or hierarchical assigning, is very often of great importance in the final evaluation of profession desirability.

3.2.2. Work Conditions

The conditions in which work activities are conducted differ considerably from profession to profession both in physical and social, as well as organizational sense or context. Activities in some professions are conducted in enclosed spaces, in other occupations in open spaces; some are exposed to high and some to low temperatures; during some activities people are exposed to wind, humidity, polluted atmosphere, noise; some occupations in their nature require excessive sitting or walking; some professions require prolonged separation from families; some kinds of work require teamwork, some are individualistic...

3.2.3. Desirable Characteristics

Different frameworks of characteristics are inherent to different professions. They can, for example, be a combination of bodily strength and endurance, muscular sensitivity, tactile ability, ability to properly differentiate colours, mathematical ability, imagination, artistic talent and so on.

3.2.4. Required Education

For some professions only short training at workplace is sufficient; others require three or four years of vocational secondary school; still other occupations require a university degree; finally for some vocations postgraduate studies are a prerequisite. Let us point out that

*in many professions continual learning and training is required in all the years of employment.*¹

3.2.5. Employment Possibilities and Probable Income

Employment is to most people the main source of income; to many it is the only one. What is the point in choosing a certain profession when we know in advance that the possibility of employment in that line of work is non-existent. Even our existing educational system supports this illogicality. There are many examples for this. One of more obvious ones is a secondary school in Varaždin which educates students for occupations in textile industry in the situation when many such students cannot find employment after graduation.

The possibilities of employment are very diverse. Besides that they are constantly changed under the influence of the scientific and technological development, economic conditions and economic policy. This also influences average salaries in various professions.

4. EXPERIENCE GAINED WITH THE *DEMO* VERSION OF THE *ADVISER*

4.1. Rules and System of Knowledge Display

The demo version of the Adviser uses 241 rules covering information on 37 occupations, which makes 6,5 rules per occupation in average. The most considerable problem is of conceptual nature: **normalization of variables**.

Problem description

Entry data are transferred into *0 order* entry variables, i.e. the parameters which we refer to as *influence factors*. With the help of the rules that are *fired* within the expert system's shell they are transferred into the 1st order variables. The variables of the 1st order are entry variables for the variables of the 2nd order, etc. All variables that do not belong to the 0 order are called *parameters*. The parameters that represent the final affinities of a person towards a profession are simply called *interests*.

Now we can explain the problem of normalization. It needs to be pointed out that

- some parameters and occupations (groups of occupations or occupations themselves) are influenced by more factors and parameters than others;
- some factors of influence and parameters have different values for different occupations.

Easier than in the demo version this problem will be solved by the use of a database. In this way the system tuning will be conveniently separated from the rules themselves. Nevertheless the work that has to be invested is enormous because each and every factor of influence and every parameter need to be standardized.

Standardization is conducted through the influence on functions.

The system tuning may be accelerated by the use of **neuronal networks**. A neuronal networks consist of neurons. Contrary to the programming they can be trained. This means that they are given examples on the basis of which they adapt their connections according to some learning rules. In order to train a neuronal network we have to provide it with a large number of examples. First, the signals that are received by a neuron are multiplied with

¹ Ibid., p. 16.

weight values that can be changed (in learning process), they are added, and the sum of these signals is analysed with the transfer function or the so-called internal activation.

Remark: The earlier mentioned transfers are **not functional transfers**, with the exception of the transfer of $f_{i,j}$ from the entry data into factors of influence. The functions can also be null-functions. The semantic meaning of a null-function is that the connection does not exist, or that it is irrelevant for us.

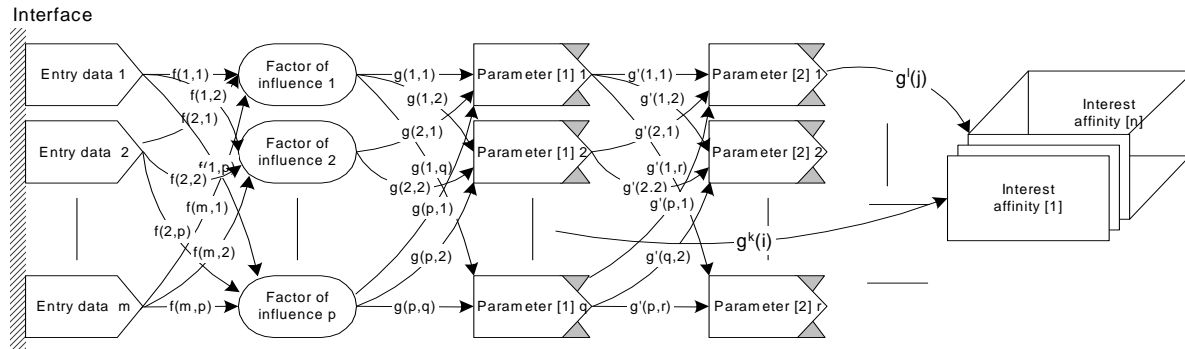


Fig. 1. Deduction procedure of the expert system Occupation Selection Adviser

We have used variables of all kinds that are supported by *Guru*:

- certain and uncertain;
- solid and fuzzy;
- strings, numeric and logical variables.

Searching is the basic way in which we reach a solution to a stated problem. In this, the initial and target conditions are reference points. If we start from the initial towards the target condition, we refer to it as data propelled search which is called forward chaining. It is most commonly used in expert systems. The other case is when we start from the target to the initial condition. Then we are talking about a target-propelled search, which is called backward chaining. In the demo version we have used the backward chaining.

4.2. Included Technologies

Besides the expert system itself the Adviser's demo version includes other technologies as well. These are the previously mentioned use and work with insecure and fuzzy variables and relevant rules, primitive (because Guru does not allow any other kind) graphics, and mostly procedural programming. The final version of expert system will make use of relations, i. e. a relational database. Printout of results must also be available.

4.3. Adviser's Perspective

The demo version lends such results that the development of the expert system is indeed warranted. The authors believe that with the Adviser's demo version they have reached the following goals:

- necessary experience in domain area has been gained
- experience has been gained that has resulted in considerable improvement of the project concept,
- the result shows that the realization is positively possible,
- the perspective has been gained that points at the long duration of project creation

- an approximate number of rules has been established (approximately 3000),
- the most significant problems have been observed:
 - the choice of the expert system's shell, i. e. the creation of the shell,
 - the problem of variable normalization.

5. PRESENTATION OF THE PROCEDURE OF EXPERT SYSTEM DEMO CREATION

The steps of the creation of this and any future expert system are the following:

- a. **Identification**
- b. **Conceptualisation**
- c. **Formalization**
- d. **Implementation**
- e. **Testing**

Identification

Year after year the same questions are being asked by pupils/students, their parents, but also by secondary school principals because it belongs to their line of work, although to a lesser extent, as well as university deans and ministry officials.

Let us focus on the pupils' questions: what am I going to do in my life, which is the most appropriate occupation for me, which work am I going to enjoy, am I capable of doing this, ... This Adviser gives the opportunity to reach the answers with less problems than before. Children are usually not even aware of the scope of their choice. Rarely any child in the 8th grade of primary school would be able to enumerate more than 50 occupations. This expert system will contain about 260 occupations. It is conceivable that a pupil surveyed by this expert system might get an answer describing an occupation he has never even heard about or has never paid attention to. The pupil might find this intriguing and might try to find out more about it.

Let us enumerate the immediate incentives for the creation of the *Adviser*:

- primary and secondary school graduates very often do not know what to do,
- their desperate parents,
- the unemployed who can not support their families,
- it is part of the job of various experts in schools, employment offices and other institutions,
- personnel experts in companies...

Many examples can be enumerated but these are sufficient to understand the high level of need for this kind of help supported by technology and knowledge. The problem is suitable for solving with the expert system. It possesses the following characteristics:

- it requires logical deduction,
- heuristic solution,
- it is not too simple,
- human experts would solve the problem in a **relatively** short period of time,
- its meaning is practical,
- the realization is possible because the total necessary knowledge is stored in one book and several documents,
- human expertise can be clearly identified,
- this knowledge is not immediately available and applicable.

We can conclude that the creation of the expert system is possible and justifiable. Is a properly advised and directed young person useful to the society? What is the level of damage if a young person is badly advised and directed?

Conceptualisation

The expert system’s conceptualisation phase generates outlines, control structures and relations. A modular approach is foreseen, so that occupations are divided into clusters – groups of occupations and corresponding groups of rules that can be consulted depending on realized preconditions. The target variable OCCUPATION is a fuzzy variable that contains the name of occupation and the affinities of that occupation and surveyed/counselled person.

The choice of profession depends on the following parameters:

Table 1. Parameters – future variables of expert system	
allergies	inclination towards work with computers
physical abilities	hearing
intellectual abilities	ability of oral expression
reporting and promulgation	ability to concentrate
communication skills	organizational and managerial skills
logic	ability of memorization
love towards plants	written expression skills
love towards people	cooperation with other experts
love towards animals	body mass
imagination	team work
mathematical abilities	punctuality
motor abilities	tidiness
orientation in space	additional training
pedantry	perseverance
precision	eyesight
transfer of knowledge and skills	university education
adaptability to harsh living conditions	health
independence at work	scientific curiosity
sensory abilities	knowledge of English
inclination towards experimenting	knowledge of more foreign languages

All these variables are insecure. They are used in the creation of higher order variables, on the basis of rules and logical operators applied within them.

Formalization

From entry variables we continue to a large number of higher order variables that are used together with the 1st order variables and changed in firing of rules. Most higher order variables are insecure variables while the target variable that represents interests is a *fuzzy* variable with a number of values of insecure variables.

Implementation

The implementation is realized in the *Guru* expert system shell, and the implementation of the future full version currently remains an open question of choice or a question of the creation of a new shell. One of additional criterions for a possible choice of shell is its ability to generate an executive program.

Testing and Maintenance

The testing in the demo version was being conducted continually, during the entire work process. Therefore the final testing is “only” a confirmation that the work up to that moment was really properly completed. The final testing of the Advisor should be conducted on a representative sample, using surveys and statistical result analysis.

6. CONCLUSION

It is obvious that the correct choice of profession is an important step, both for the young and for the unemployed or those who are not satisfied with their current occupation. This expert system – the Occupation Selection Adviser – has an ambitious task to facilitate this responsible, far-reaching and sometimes very difficult and painful decision.

A meticulous, systematic and systemic approach to the problem lends realistic pre-suppositions, perspectives and concepts for prototype creation and, eventually, for the creation of the full working version. This paper creates a theoretical basis of such expert system which could direct and lend information on affinities towards main occupations and professions, connected with formal and informal ways of life-long education.

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