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EXPERT PROCEDURES IMPLEMENTATION IN SOFTWARE CATALOGUES

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1. Introduction

In the mechanical and industrial design it is often necessary to determine the "best" component that enables to perform a given function, with given requirements. The determination of the best component for the particular application is often strong influenced by subjective elements like the designer's experience. This happens also when the designers have too choose mechanical components from catalogues (nowadays from software catalogues too). This paper deals with the development of a procedure, implemented into a software program, that enables to build software mechanical components catalogues by using an expert system. The need of simplifying the choice process requires the assessment of simple rules to organise the parameters characterising the system or the mechanical component to be chosen. Nowadays the designer, when the aim is to choose a component, usually prompts up a wide search, maybe by using web-internet devices and search engines or simply directly contacting some resellers. This way of proceeding sometimes takes a lot of time, is rather costly and gives non optimal results (that is to say the designer, as an example, can choose the best component in economical terms by not as regards performances). The authors carried out a wide research. The results of this research put in evidence that, even if there are a lot of kind of software or paper catalogues that usually list the components of the specific industry, their principal characteristics and advantages, nevertheless the final decision is often left to the designer and the available kind of catalogue does not help much the designer in the choice process.

2. State of the art

With the aim of making the choice as objective as possible, many applications of value analysis were tempted. This can be applied also in case of software expert catalogue development by improving the available catalogues found in the literature. This should consist in increasing their performances adding an expert system that could help the designer in choosing the right component or system [Rovida et al 2000, Baragetti et al 2000, Proceedings AIPI 1999].
The work developed through the definition of the parameters characterising the choice procedure; different kind of parameters were taken into consideration: ecological and environmental, economical, overall dimensions, reliability, safety in service, performances. All parameters were grouped into categories and put in a tree decisional structure. Literature and appositely developed expert systems were used in order to help the designer in making the choice. At the beginning it was decided to take advantage from the implementation of a commercial decisional expert system. It was decided to implement, in a software developed by means of Visual Basic, the expert system of the decisional methodology Analytical Hierarchy Process (AHP) [Badiru 1991, Schniederjans 1991, Vargas 1990]**.** Notwithstanding the widespread utilisation of this last decision methodology, it seemed that, to the

designer, the comparison methodology together with the consistency analysis of the results could represent source of difficulties. The *AHP* methodology was simplified by means of the same tree approach but using a score rating method.

In Figure 1 an example of a decisional tree, regarding the choice of a material, is shown.

$$Choice\ of\ the\ material \begin{cases} -Mechanical\ Caracteristics \begin{cases} - \dfrac{E}{r} \\ - \dfrac{s_{FA}}{r} \\ - \dfrac{R_m}{r} \\ - A\% \\ - \dfrac{R_s}{r} \end{cases} \\ - Costs \begin{cases} - Cost\ of\ the\ material \\ - Payment\ modalities \\ - Costs\ as\ functions\ of\ the\ material\ quantity \end{cases} \\ - Availability \{ - Delivery\ time \end{cases}$$

Figure 1. Decisional tree for the choice of a material

3. The proposed choice scheme

An informatics catalogue of mechanical components should be utilized by the designer in three different ways:

1. Traditional
2. Introduction of the use parameters
3. Choice with behaviour aspects

3.1 Traditional utilization of the informatics catalogue

The designer consults the software catalogue (installed on a personal computer or on a compact disk) and chooses the “best” component, with respect to the design requirements, by using his experience and knowledge.

3.2 Utilization of the informatics catalogue by introducing the use parameters

The choice logical scheme is shown in Figure 2.

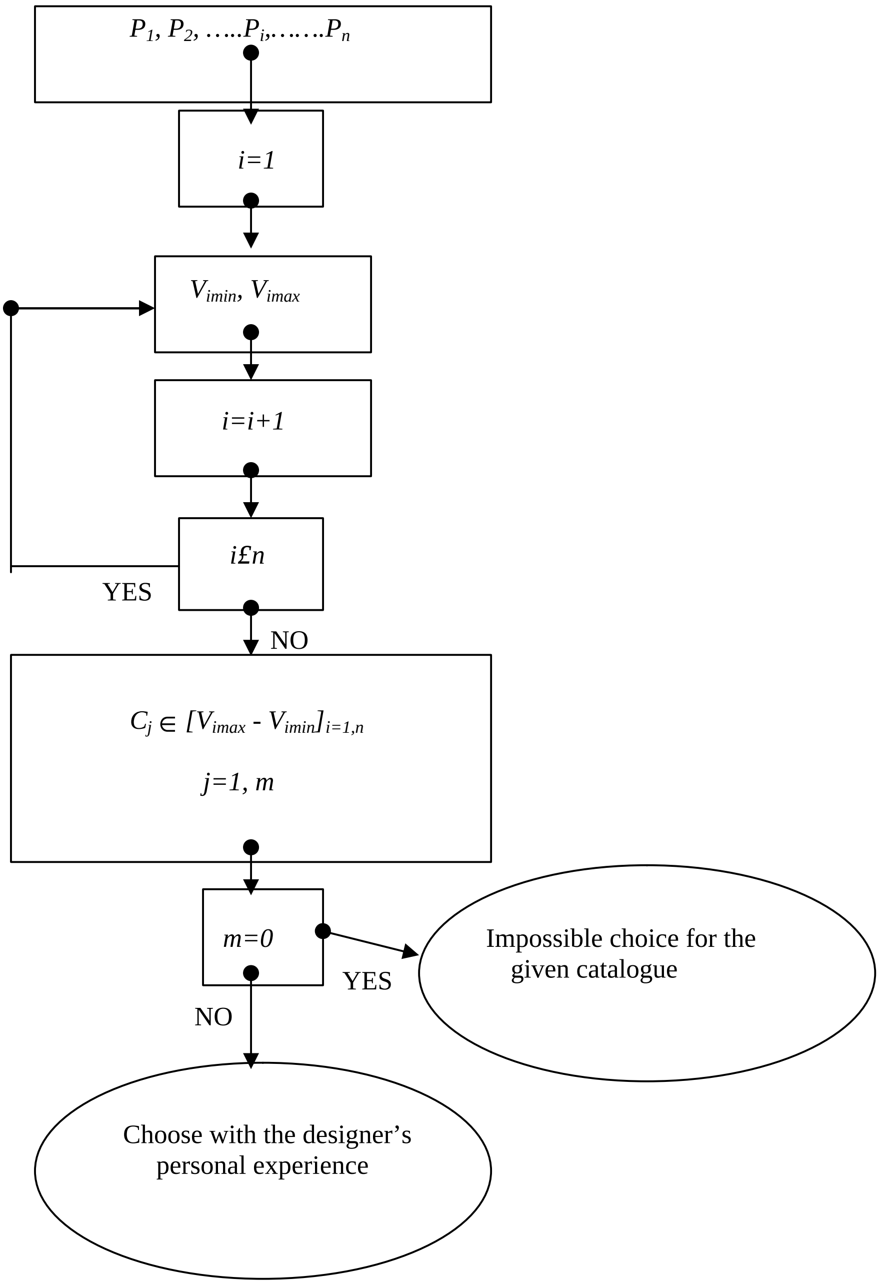

Figure 2. Logical scheme of choice (n° 1)

If P_1, P_2, …..P_i,…….P_n are the important parameters for the choice of the component, it is necessary to determine the limit values for each of them:

$$V_{imin}, V_{imax} \qquad i=1, n \qquad (1)$$

Afterwards, it is necessary to determine the set of components according to each imposed limit value. If the number of components in the set is 0, the choice, with the given catalogue, is impossible. In the other cases, the definitive choice can be made by the designer's personal experience.

3.3 Utilization of the informatics catalogue by means of behaviour aspects

Taking into consideration that the product should present a good behaviour in all of the phases of the life cycle, some behaviour aspects (fatigue resistance, dimensions, lightness, maintenance compliance) can be derived.

If A_1, A_2,… A_k,… A_n are the aspects describing the behaviour, and C_1, C_2,… C_i,… C_m the products that perform the same function, the link between A_K and C_i can be expressed by the matrix V_{ik} that contains the evaluation of the behaviour of A_k in relation to C_i.

V_{ik} represents a general database for the designer. The specific interest, for a given design, for C_i can be expressed by means of a weight system P_1, P_2,… P_k,… P_n where the P_k value is:

0, if the characteristic has no interest
1, if the characteristic has maximum interest
between 0 and 1 in all the other cases
-1, if the characteristic must be absolutely not present
2 if the characteristic must be absolutely present

With these values, the logical scheme of choice can be used as an expert system as shown in Figure 3.

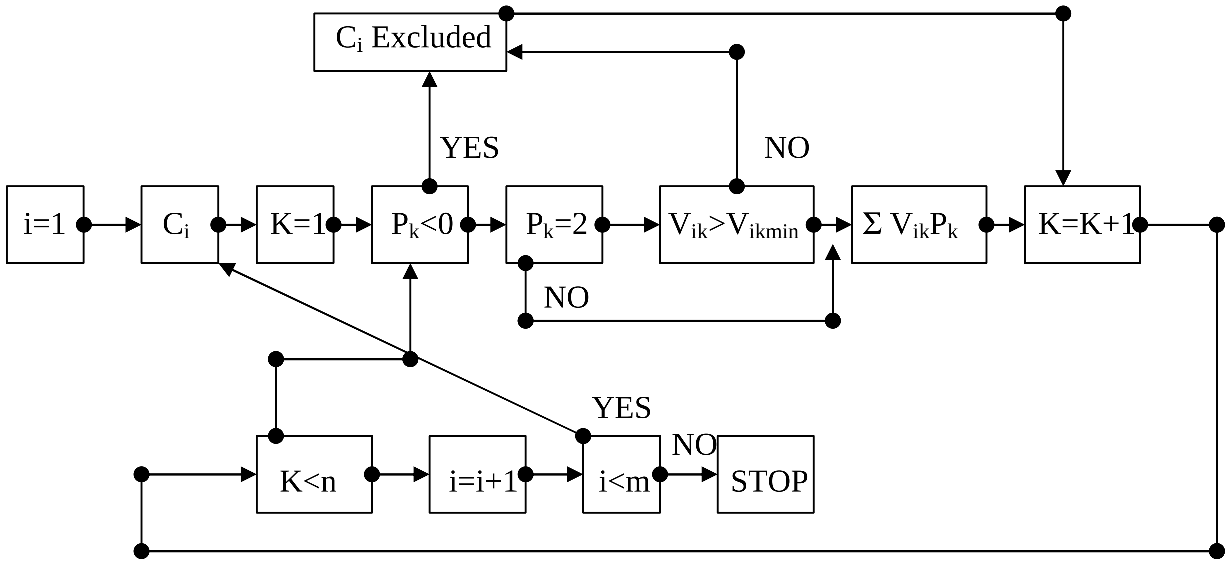

Figure 3. Logical scheme of choice (n° 2)

4. Application

The authors applied this procedure and built a valve catalogue, that is now in use in an Italian industry. Figure 4 shows the weight system assigned to the considered behaviour aspect.

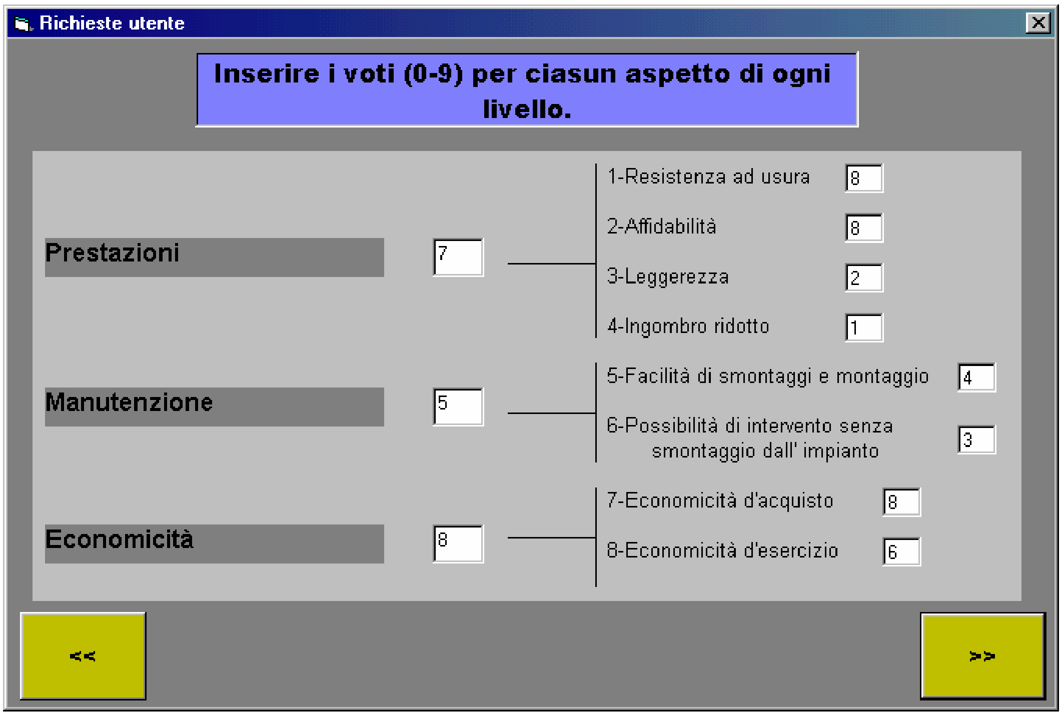

Figure 4. Weight system

In Figure 5 the results are shown: the first row contains the valve identification number (i.e. 265) while the second one contains the evaluation for the specific application.

The choice is completed by the automatic compilation of the E-order (the can be sent via Internet).

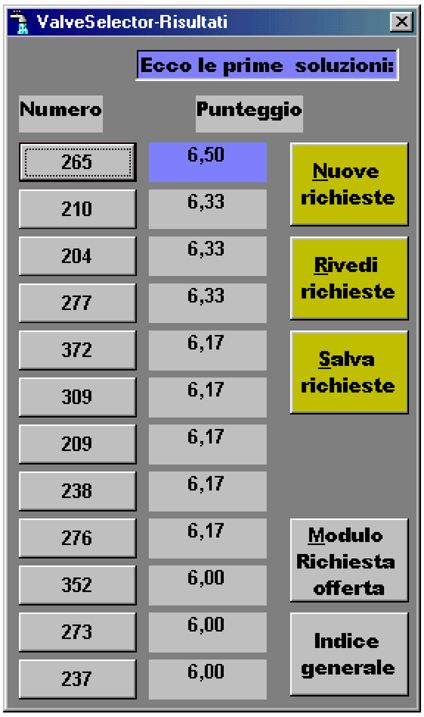

Figure 5. Results

5. Conclusions

The authors believe that the described procedure can represent an interesting step in the DfX application and a valid contribution to the E-design.

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