Study on the Decision-Making Process in Selecting Rail Infrastructure Managers

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Abstract

The current economic context led to a significant decline in job vacancies in parallel with the downsizing numerous organizations were forced to make. Some of them ceased the hiring process as in the case of the national company CFR SA, while those with available positions focus on multiple skills and abilities and expertise exhibited in certain fields. In the context of the research concluded by the author, the identified issue circled around the decision to select the most suitable manager possessing the necessary qualities to participate in a scientific activity within the railway sector. To deliver a scientifically based solution also objectively determined, we built a specific multicriterial tree pattern with utility functions for the professional performances assessment and used the DEXi expert system in view of reaching the optimum version and making the selection decision. This method is our own contribution for the assessment of managers' professional.

Key words: decision, rail transport, DEXi, utility functions
J.E.L. classification: M12

1. Introduction

Increase in rail infrastructure interoperability and main railroads interconnection throughout Europe is a current prerequisite demanded by the European Railway Agency (ERA), and for the accomplishing of those objectives a series of measures was already set, materialized through the adoption of certain directives imposed by the European Commission, that the Ministry of Transport in Romania transposed into our legislation (Dăneci-Pătrău, 2013, p.314). A measure among the European Union members to even out practices related to controlling access on the rail infrastructure for all railway vehicles was adopted by ERA, which organized a training course in Brussels in June 2017, where the theme pinpointed experience exchange between rail infrastructure management specialists from all European Union states. Romania was represented there by eight engineers from the public rail infrastructure management of CFR SA, every one of them from each operational territorial center. To select the suitable people to partake in this course, the Railway Traffic Directorate within CN CFR SA (Romanian National Railway Company) requested each of the eight Traffic Divisions that are part of the regional railway centers to identify a manager, expert in rail infrastructure control and operation.

Research hypothesis were drawn from the findings yielded by the documentary research and discussions held with the managers of different departments within "CREIR CF" Constanta branch. These were in respect of:

- I1. The assessment of human resources to be selected is inadequate, being developed globally and not according to types of employees.
- I2. The rail infrastructure personnel selection methodology is outdated and doesn't consider the new exigencies from the railway transport human resource management.

Within "CREIR CF" Constanta branch of CN CFR SA, the problem identified targeted the decision of selecting the most suitable manager that possesses the necessary qualities to attend this scientific manifestation. In this regard, the regional director together with the head of Traffic Division selected the manager from the Division's organizational chart who top-ranked following

high professional and management performances assessed in 2016. The decision to assign candidates belonged to the head of Traffic Division, also head manager over all organizational charts and was approved by the regional director.

The list of candidates comprised the heads of some departments and compartments subordinated to Traffic Division, who are responsible for the traffic organization, management and control on the rail infrastructure and have vast experience in the field. The six managers designated to be part of the final selection process, expert engineers in the railway transport technology were: the head of Railway Infrastructure Access Control Department, the head of Railway Infrastructure Access Regulations Department, the head of Railway Traffic Department, head of Constanta Railway Traffic Regulator; the head of CFR Constanta Station and the inspector for Rolling Stock Sector;

2. Research methodology

This subchapter debates the approach applied in the case of the selection decision-making in relation to human resource management which integrates multi-criteria modeling in an expert system. The approach is strictly founded on qualitative decisional know-how extensions, the equivalent of decision attributes and rules branching. The decision-making process is supported by DEXi expert system, a specialized expert system shell for databases interactive construction, options evaluation and outcome argumentation. Practical use of the system is illustrated by the application used for human resource selection for a manager position within "CREIR CF" Constanta branch of CN CFR SA. Allowing for the method established by the regional director and the head of Traffic Division to choose the most suitable manager, we initiated the documentary research by collecting and compiling data from the Traffic Division recordings and archives. In this respect, the professional performance evaluation forms of the Traffic Division's personnel annually filled in by the direct supervisor were studied. This type of form is processed in compliance with a renowned model and applied to all employees irrespective of the position held (Pitariu, 2016, p. 238).

To develop the research, the scientific research logic chart described in figure 1 was elaborated by laying out hypothesis carried forward. It involves the decisional process of selecting the appropriate railway managers making use of the multi-criteria model and DEXi expert system. As the branch management has never dealt with such request before and considering the need to use a sound scientific reflection, we consider as opportune our proposal with regard to the use of manager selection methodology, namely the multi-criteria tree structure which uses utility functions and the DEXi expert system.

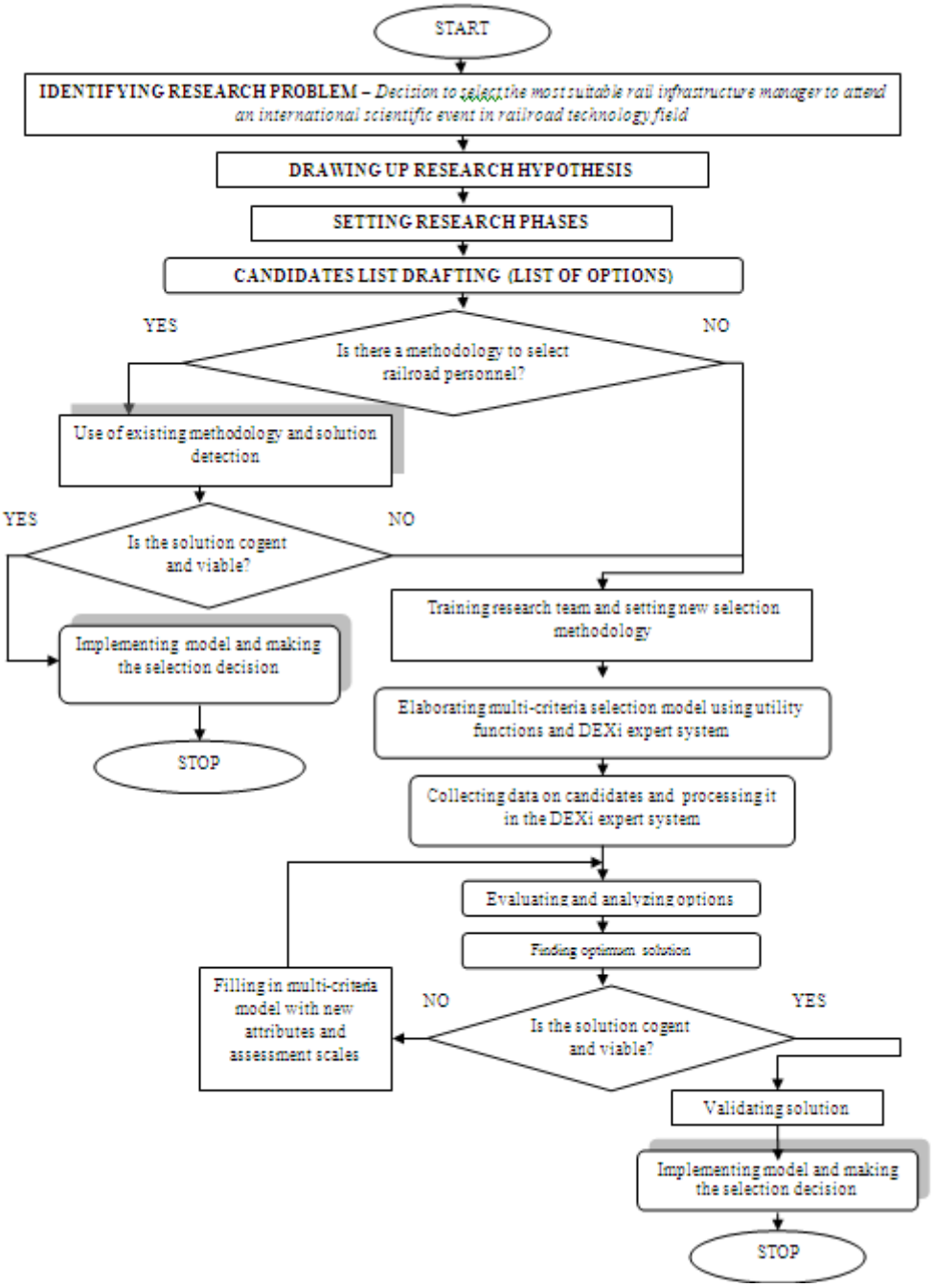
The answer to the problem concerning the suitable manager selection was based on the use of a specific multi-criteria hierarchical model, implemented with existing technological information. The basic principle lying at the bottom of decisional modeling was disintegrating the decisional problem in smaller less complex sub-problems expressed through professional performance evaluation criteria. As per the model, the decisional problem options are disassembled in more dimensions called attributes or criteria.

These attributes are qualitative variables which stand for decisional sub-problems hierarchically organized so as the attributes from the superior hierarchy to depend on the attributes from the lower hierarchy. Each action is firstly described by a value vector of the corresponding attributes, and then the vectors are examined by a utility function previously defined by the expert.

The utility functions define the relationship between attributes at different levels serving partial sub-problems aggregation in the final evaluation or classification. The evaluation outcome *F(ai)* must be equal to the utility function outcome *F(X1, X2, ..., Xn)*. Final evaluation of an option is given as an attribute from the root. On this basis, options are compared and graded, the best being selected by the decision-maker.

Our approach was built on the use of a qualitative decision model. To create and apply the qualitative decision model, DEXi expert system was used. According to the definition forwarded by a group of authors (Zaharie et al., 1999, p.9), expert systems are computer programs that use artificial intelligence technologies to simulate the judgment and behavior of a human with expert knowledge and experience in a particular field and subsequently use them to solve difficult problems in said field.

Figure no. 1. Integrated model for the selection of rail infrastructure management



Source: Author

DEXi system was created by Marko Bohanec in partnership with researchers from the "Josef Stefan" Institute within "Maribor" University, Slovenia and allows the creation of multi-criteria models as decision tree structures, the description, evaluation and analysis of options pursuing decision-making and reviewed outcome argumentation (Jereb and Rajkovic, 2005, p.199). DEXi is a decision program based on a tree-shaped attributes assessment. These attributes have discrete values and use categorization words to define them.

3. Introduction to completed phases and outcome

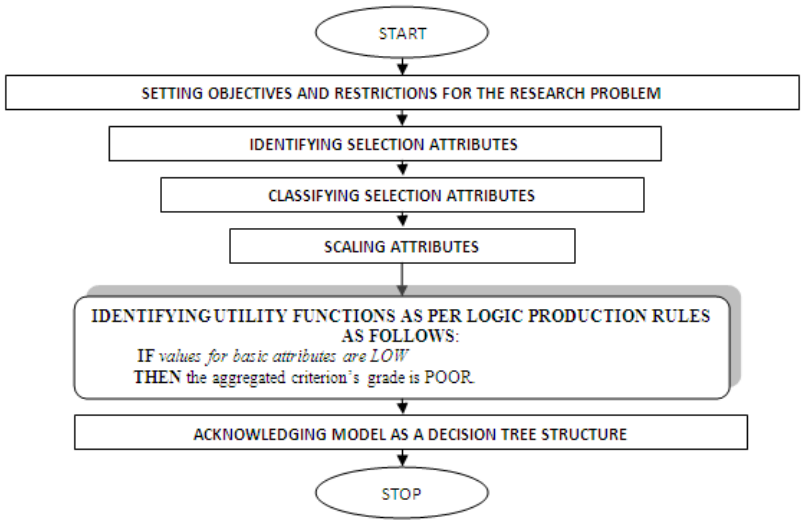
This initial stage started when the decision problem regarding the selection of the most suitable manager to participate in the training course surged and was reckoned to be difficult and important enough to require a systematic approach and the use of a decision problem modeling. The issue

identified had certain properties specific to such approach, as:

- it referred to comparing alternative options and namely experts in rail transport technology;
- the objective was picking the best option or options evaluation in view of classifying them in a preferential list.
- the problem could be disintegrated in smaller less complex problems, each option being described through grades applied to the basic criteria in alignment with problem disintegration;
- Options assessment was carried out by comparing options, considering one or more criteria, using utility functions to obtain intermediary and final grades.

The model construction underwent completion of all presented stages in the logic chart of figure 2.

Figure no. 2. Logic construction chart for multi-criteria selection model



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Identifying the attributes whose objective consisted of gathering all the relevant attributes necessary for the rail managers' evaluation was accomplished in three brainstorming sessions where we asked a group of assessors made up of the regional director, the head of the Traffic Division and the head of Human Resources Department to fill in a form of ten criteria they believed to be the most important in evaluating rail infrastructure managers' professional performances, as well as assigning them a grade from one to ten to show their significance. The result was a twenty-attribute list, including supplementary attributes or duplicates, categorized in the following stage.

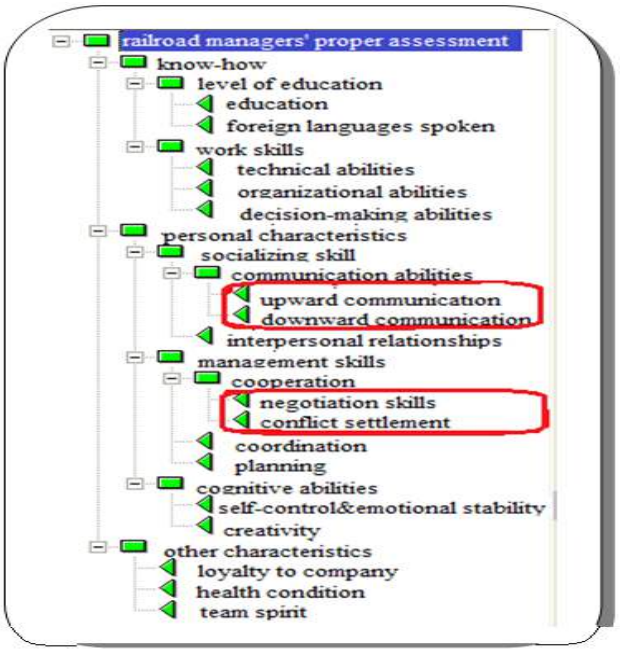
Attribute classification whose objective was putting up an attribute hierarchy based on foreseen interdependence and influences over the final decision. The process included the use of classification, comparison, top-down disintegration techniques and attribute list un cluttering. To avoid an explosion of combinations in the fourth stage of this study, DEXi requires that each aggregated attribute depend on the fewest possible basic attributes. In this respect we used two or three attributes, and the outcome of this stage regarded the creation of the multi-criteria tree structure and its associated scaling system.

Attribute scaling whose objective aimed the assigning of a value scale to each of the ordinal or nominal attribute in the multi-criteria tree structure built. The number of values represented by grades expressing the position on scale was kept as lowest possible, but at the same time, high enough to differentiate quality situations. In our case, attributes scale gradually and hierarchically raises from three values at the basic level, namely "low", "medium", "high" up to five values for root attributes: "very low", "low", "medium", "good", "excellent".

The role of the utility functions was to provide values as grades for aggregated attributes from inferior levels up to the highest aggregated value. In DEXi, the utility function of each aggregated attribute is progressively presented as a table where each row designates a logic expression.

Each option equating a candidate manager was assessed from the beginning to the end, compliant with the decision rules resulted from utility functions. As a result, each option received a grade corresponding to an assessment value for individual professional performance. Enabling immediate comprehension of the evaluation outcome is allowed in DEXi if "Graphic" menu is used. Consistent with the latter, by opting for unidimensional display only from the aggregated root attribute viewpoint. The multi-criteria model, exemplified in figure 3 has thus become operational.

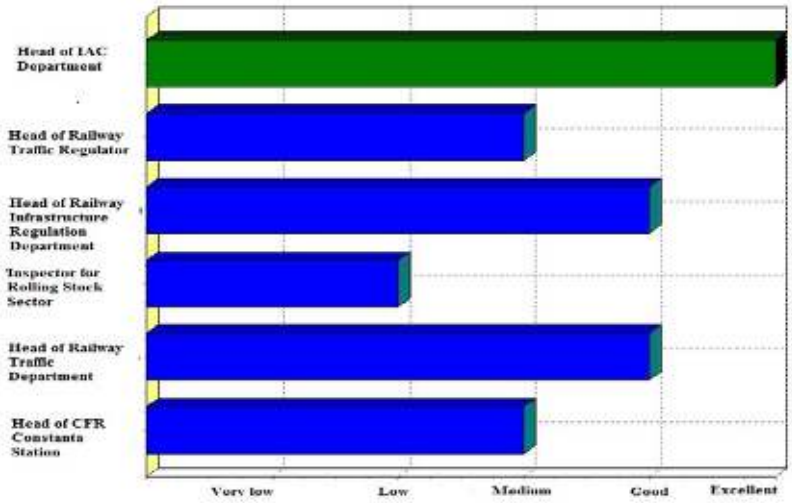
Figure no. 3. Final multi-criteria tree structure included in DEXi



Source: Author

Under these conditions, by finalizing the scaled values of the new criteria introduced, the DEXi expert system provided us with the best-performing manager who, according to the graph in figure 4, proved to be the head of the Head of IAC Department. From the comparative analysis of the options, the Head of the IAC Department surpassed the Head of Railway Traffic Regulator, excelled at the level of the competencies in the railway transport technology and having a higher level of graduated graduates, respectively a master in railway technology.

Figure no. 4. Final outcome of rail infrastructure managers' assessment



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Notable features stamped onto the decision tree created are not only the simplicity prevailing in its visual display but also the high complexity and difficulty degree in using it, imposing the use of numerous skills and knowledge to solve problems where need be. Expansion of participative dimension of human resource management activities brings in discussion the use of adequate decision techniques and the model suggested falls under these requirements as it allows, on one hand considering experts among branch management for the decision variables identification and evaluation and, on the other hand, efficient capitalization of the time they have at hand. The novelty and necessity to implement the practical model with regard to solving various management decision problems are provided by the fact that the probabilistic decision modeling technique through DEXi expert system was never used before by the railroad companies or other companies in Romania, economic literature in our country tangentially delving into the theoretical approach of this issue.

4. Conclusions

At the end of the endeavor, based on the options evaluation eased by the DEXi expert system, by agreeing with the multi-criteria model we suggested, the branch management made the final decision by choosing the head of IAC (Infrastructure Access Control) to participate in the training course organized abroad. To boost the efficiency of human resources management activities within CN CFR SA, we see the decision model implementation as extremely useful, with certain specific adjustments to optimize training activities for all employee categories, both with executive and management positions. This is possible due to DEXi expert system, which through an appropriate database management is able to provide the human resource managers and experts with the defective field for each employee's professional training. Moreover, the use of DEXi expert system becomes imperative under the conditions of permanent downsizing within the railway transport system, providing assistance to the superior management for future decision-making to cut back railway personnel

5. References

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