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Particularities of the managerial selection decision-making process - comparative analysis between the railway and shipping sectors

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Abstract. The current economic climate has forced major changes in how human resources are organized in the transportation sector, especially when it comes to picking managers. Cutting back on staff and higher job requirements are making organizations change how they pick people, with more focus on skills and management abilities. In the railway sector, where safety and interoperability are critical, the selection of managers requires rigorous multi-criteria tools, such as the decision-making model implemented through the DEXi expert system. In the maritime sector, the selection process is influenced by international standards (IMO, STCW), global mobility, and the specific nature of port operations. The paper presents a comparative analysis of managerial selection decision-making processes in the two sectors, proposes a multi-criteria model applicable to both fields, and highlights structural, methodological, and institutional differences. The conclusions emphasize the need to professionalize managerial selection in transport and to adopt hybrid tools for assessing competencies.

Keywords: manager selection; expert system; DEXi; human resource management; rail transport; shipping; multi-criteria model; managerial decision.

1. Introduction

Manager selection is a strategic process that is essential for the efficiency of transport organizations, where the complexity of operations and associated responsibilities have a direct impact on the safety and performance of systems. In the railway sector, manager selection takes place in a context dominated by strict regulations on infrastructure interoperability, European requirements, and high responsibilities in railway traffic management.

Job satisfaction and managerial performance are influenced by the adaptation of training and selection methods, and the implementation of modern procedures within organizations contributes to improving the quality of decisions.

In Romania, the need to standardize and professionalize the managerial selection process is recognized in both the railway and maritime sectors. The increasing complexity of port activities, the digitization of operations, and international pressure regarding certification compliance require a distinct managerial profile with a competency structure adapted to the specific nature of the maritime sector.

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Job satisfaction and managerial performance are influenced by the adaptation of training and selection methods, and the implementation of modern procedures within organizations contributes to improving the quality of decisions.

In modern organizations, job satisfaction is largely determined by the successful implementation of professional training and the choice of the optimal option for the manager selection process. For this approach, it is important to choose the appropriate training methods and means, as they have distinct meanings. In this context, according to D. Currie, a method is understood to be the procedural technique selected as the most appropriate means for developing the knowledge and skills of employees, while means are the tools through which knowledge and skills are communicated. According to D. Currie (2016) and V. Petrovici (2007), managerial practice in the field of professional training offers a wide range of methods.

Increasing the interoperability of railway infrastructure and the connectivity of the main railway routes in Europe are current goals of the European Railway Agency (ERA), and to achieve these objectives, a series of measures have already been established, resulting in the adoption of European Commission directives, which our country, through the Ministry of Transport and Infrastructure, has transposed into national legislation (Dăneci-Pătrau, 2013, p.314). A measure to standardize practices among European Union countries regarding access control to railway infrastructure for all rail vehicles was adopted by the ERA, which organized a training course in Brussels in June 2025, a training course in Brussels, where railway management specialists from all European Union countries exchanged experiences. Romania was represented at this event by eight engineers from the public railway infrastructure administrator CFR SA, one from each regional operating center. In order to identify the appropriate persons to participate in this course, the Traffic Department of CN CFR SA requested each of the eight Traffic Divisions of the regional railway centers to identify a manager specializing in the control and operation of railway infrastructure.

In Romania, the need to standardize and professionalize the managerial selection process is recognized in both the railway and maritime sectors. The increasing complexity of port activities, the digitization of operations, and international pressure regarding certification compliance require a distinct managerial profile with a skill set tailored to the specific nature of the maritime sector.

At the same time, the railway sector is facing a reduction in management positions, successive reorganizations, and increasing pressure for performance. The selection of railway managers is often done empirically, without the use of multi-criteria assessment tools, which can lead to suboptimal decisions.

This paper presents a comparative approach to the managerial selection process in the two sectors, based on multi-criteria decision modeling and the analysis of expert systems, such as DEXi. At the same time, a section dedicated to the selection of managers in the naval field and the methodological differences from the railway sector is developed.

At the level of the CFR Constanţa Branch within the national company CN CFR SA, the identified problem concerned the decision to select the most suitable manager with the necessary qualities to participate in this scientific event. In this regard, the regional director and the head of the Traffic Division decided to select the manager from the division's organizational structure who was best placed in terms of professional and managerial performance evaluation in 2024. The decision to appoint the candidates was made by the head of the Traffic Division, who has direct authority over all organizational structures, and was approved by the regional director.

The list of candidates included the heads of services and departments subordinate to the Traffic Division, who have responsibilities in organizing, managing, and controlling traffic on the railway infrastructure, as well as extensive experience in the field. The six managers selected to decide on the optimal option, engineers specializing in railway transport technology, were: the head of the Infrastructure Access Control Service; the head of the Infrastructure Access Regulations Service; the

head of the Traffic Service; the head of the Constanţa Traffic Regulator; the head of the Constanţa CFR Station and the traffic sector inspector. Numerous types of decisions are mentioned in the specialist works, with classification being based on several criteria. The importance of these classifications lies, above all, in highlighting the psycho-social and organisational implications that can lead to significant changes at the level of human groups, affecting human interaction in various functional areas (Stanciu, 2024, p.79). From this perspective, the decision appears to be a regulator of human group behaviour.

2. Materials and methods

For the railway sector, a hierarchical multi-criteria model was used, implemented through the DEXi expert system, which allows for the qualitative evaluation of candidates by: defining evaluation attributes, scaling attributes, modeling utility functions, hierarchically aggregating criteria, and generating a clearly justifiable final evaluation. The method is justified by the literature, which supports the use of expert systems in complex decision-making situations with multiple qualitative criteria (Zaharie, D. & Năstase, P., 1999), (Stanciu, Ș. & Ionescu, M. A., 2024). The selection of the manager was based on professional evaluation forms, internal documents, and the analysis of the candidates' technical and managerial skills.

For the maritime sector, particularly port management and maritime operations, selection processes are heavily influenced by: international standards (IMO, STCW); mandatory certifications for managers and technical staff; global mobility of the maritime workforce; the demands of port digitization and terminal automation.

The selection of managers in the maritime sector is based on: assessments of specific technical skills (ISM, ISPS, navigation, port logistics), evaluation of international experience, compliance audits, behavioral leadership indicators, structured interviews, and scenario simulations.

This process is much more standardized than in the rail sector due to global pressures and international maritime regulations.

The approach is strictly based on the articulation of qualitative decision-making knowledge, which is represented by a branch of attributes and decision-making rules. The decision-making process is supported by the DEXi expert system, a specialized level for interactive database construction, option evaluation, and result explanation. The practical use of the system is illustrated by its application in the field of human resource selection for a managerial position at the Constanţa Branch of CN CFR SA. Considering the method of selecting the most suitable manager, established by the regional director together with the head of the Traffic Division, we initiated desk research by collecting and structuring information from the reports and records of the Traffic Division. To this end, we studied the forms for evaluating the professional performance of Traffic Division employees, completed annually by their direct line manager. This form is processed according to an established model and applies to all employees, regardless of their position (Pitariu, 2016, p.238).

The research hypotheses were formulated based on the findings obtained from desk research and discussions with managers from various departments within the CFR Constanţa Branch. These were:

I1: The assessment of human resources for selection purposes is inadequate, being carried out globally and not by employee category.

I2: The methodology for selecting railway personnel is outdated and does not take into account the new requirements of human resource management in rail transport.

Table 1 Comparative analysis between the methodologies used in the two fields, rail and naval

Dimension	Railway	Shipping
Type of criteria	internal, procedural	international, regulated
Modern Tools	DEXi, multi-criteria	simulations, certifications, competencies
Mobility	low	high
Decision-making autonomy	national	globally regulated

3. Results and discussions

In order to carry out the research based on the hypotheses formulated, a logical scheme for scientific research was designed, presented in Figure 1, regarding the decision-making process for the appropriate selection of railway managers using the multi-criteria model and the DEXi expert system. Since the branch management has not yet faced such a request and given the need for solid scientific rigor, we consider our proposal regarding the use of a methodology for selecting managers, namely the multi-criteria tree method, using utility functions and the DEXi expert system, to be appropriate.

The solution to the problem of selecting the right manager was based on the use of a proprietary multi-criteria hierarchical model, implemented with existing technological information. The basic principle of decision modeling was to break down the decision problem into smaller and less complex sub-problems expressed by professional performance evaluation criteria. According to the model, the options of the decision-making problem are broken down into several dimensions called attributes or criteria.

These attributes are qualitative variables that represent decision-making sub-problems organized hierarchically so that the attributes in the upper hierarchy depend on the attributes in the lower hierarchy. Each action is first described by a vector of values of the corresponding attributes, then the vectors are evaluated by a utility function, defined in advance by the expert. Utility functions define the relationship between attributes at different levels, serving to partially aggregate subproblems in the final evaluation or classification. The result of the evaluation F(ai) must be equal to the result of the utility function F(X1, X2, ..., Xn). The final evaluation of an option is obtained in the form of an attribute from the root. On this basis, the options are compared and graded, with the best one being selected by the decision maker.

Our approach was based on the use of a qualitative decision-making model. The DEXi expert system was used to create and apply the qualitative decision-making model. According to the definition given by a group of authors (Zaharie et al., 1999, p. 9), expert systems are computer programs based on artificial intelligence techniques that store the knowledge of human experts in a well-defined field and then use it to solve difficult problems in that field.

The DEXi program was created by Marko Bohanec in collaboration with researchers from the Jozef Stefan Institute of the University of Maribor, Slovenia, and allows the construction of multi-criteria models in the form of a decision tree, the description, evaluation, and analysis of options for decision-making, as well as the explanation of the evaluated results (Jereb and Rajkovic, 2005, p.199). DEXi is a decision-making program based on the evaluation of attributes arranged in the form of a tree structure. These attributes have discrete values, and words in the form of qualifiers are used to define them.

Results of the selection of managers in the railway sector

The DEXi model identified the optimal manager based on a complex multi-criteria hierarchy, integrating: professional skills, managerial skills, experience, specialized training, and annual results. The selected manager—the head of the Infrastructure Access Control Service—obtained the highest aggregate score, confirming the adequacy of the model. The model demonstrated: transparency in decision-making, reduced subjectivity, ease of use, and replicability in other organizational contexts.

Analysis of the managerial selection process in the shipping sector

The shipping sector has distinct characteristics:

- High level of professionalization: managers must hold mandatory certifications: ISM (International Safety Management), ISPS (International Ship and Port Facility Security), STCW (Standards of Training, Certification, and Watchkeeping). This strongly differentiates the selection process from that of the railway sector.

- Mobility and international competition: shipping managers are subject to global competition; selection requires an assessment of international experience and the ability to adapt to global standards.
- The importance of operational leadership: the shipping sector involves high-risk situations (navigation, terminal operations, port security), which requires advanced psychological assessments.
- Port digitalization: modern ports require managers with IT, data, and automated process skills, which substantially changes the managerial profile.

Comparative analysis between the selection of railway managers versus shipping managers looks like this:

Table 2 Differences between the selection of railway managers and the selection of shipping managers

Feature	Railway sector	The shipping sector
Regulation	National, EU	International (IMO)
Competency framework	technical + operation	technical + international + risk
Mobilitate	low	very high
Selection tools	internal assessments, DEXi	certifications, simulations, audits
Managerial complexity	high	very high

The similarities between the two sectors concern: the need to professionalise the selection process; the transition from empirical selection to competency-based selection; the importance of digitisation and continuous training.

Stages completed and results achieved

This initial stage began when the decision-making problem arose regarding the selection of the appropriate manager to participate in the training course and was considered sufficiently difficult and important to require a systematic approach, using a decision-making problem modeling support. The identified problem had certain properties specific to such an approach, because:

- it involved comparing alternative options, namely managers specializing in rail transport technology;
- the objective was to choose the best option or evaluate the options in order to rank them in order of preference;
- the problem could be broken down into smaller and less complex problems, each option being described by ratings assigned to the basic criteria, in accordance with the breakdown of the problem;
- the evaluation of the options was carried out by comparing the options according to one or more criteria, using utility functions to obtain intermediate and final ratings.

The model construction stage involved completing the steps presented in the logical diagram in Figure 2.

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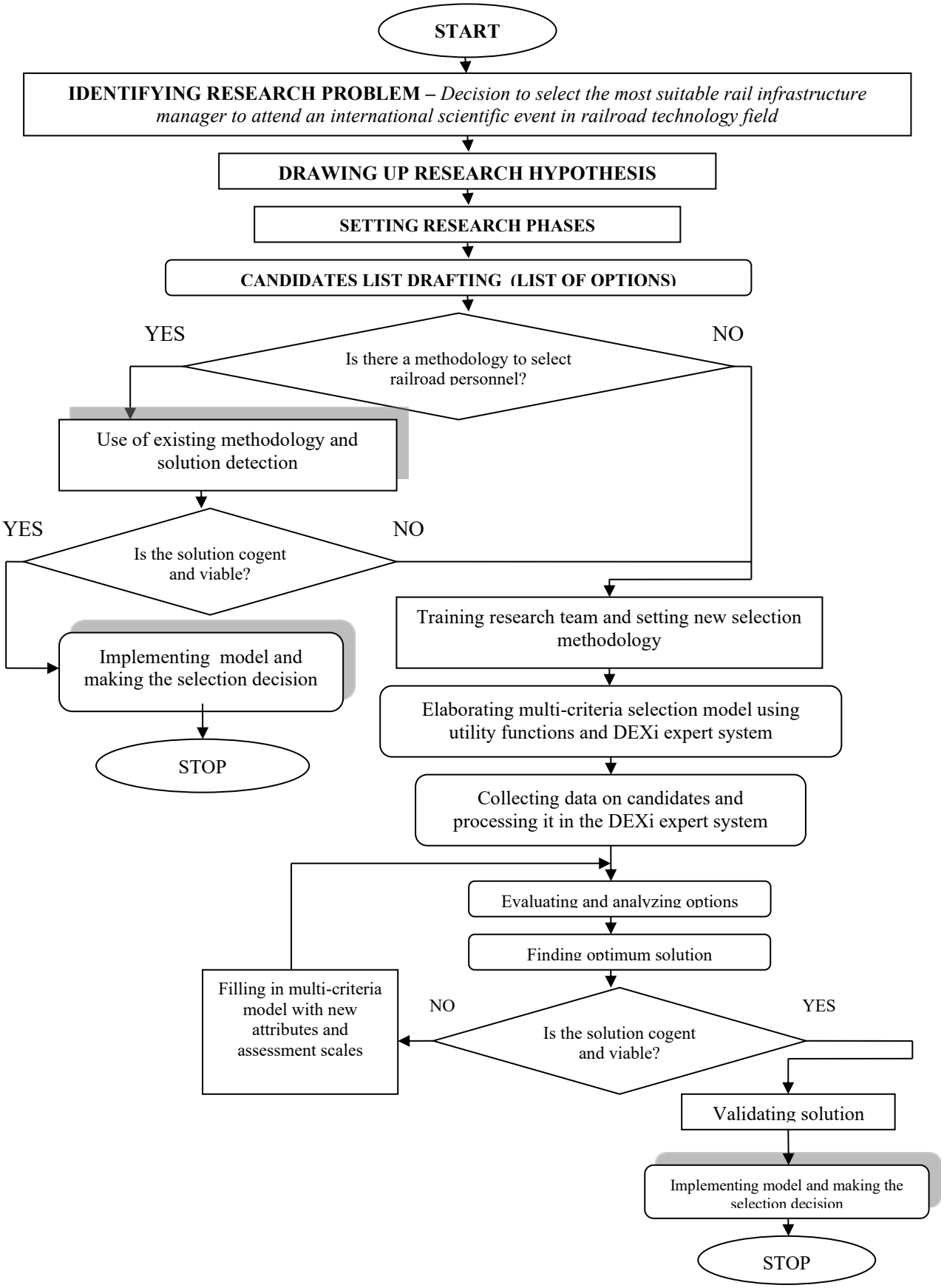

Figure 1 Integrated model for the selection of rail infrastructure management

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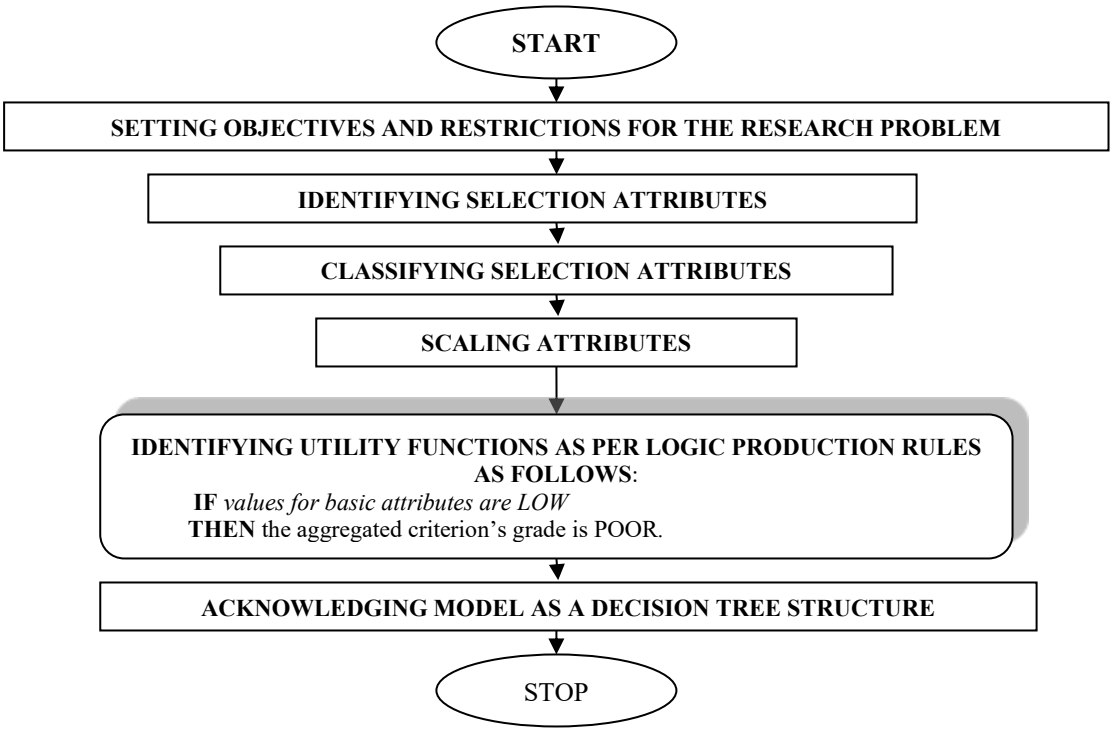

Figure 2 Logic construction chart for multi-criteria selection model

Identification of attributes, the objective of which was to obtain all the relevant attributes necessary for the evaluation of railway managers. This was achieved through three brainstorming sessions, in which we asked a group of evaluators consisting of the regional director, the head of the Traffic Division, and the head of the Human Resources Department to fill out a form with ten criteria that they considered to be the most important in evaluating the professional performance of railway managers, as well as to give a score from one to ten to indicate the order of importance of each criterion. The result was a list of twenty attributes, including additional or duplicate attributes, which were structured in the next step.

Structuring attributes, the objective of which was to create a hierarchy of attributes based on interdependencies and anticipated influences on the final decision. The process included the use of structuring, comparison, top-down decomposition, and attribute list cleaning techniques. To avoid an explosion of combinations in the fourth stage of this phase, DEXi requires that each aggregate attribute depend on as few basic attributes as possible. To this end, we used two or three attributes, and the result of this stage was the creation of the multi-criteria tree together with the corresponding scaling system.

Scaling of attributes, whose objective was to assign a scale of values to each ordinal or nominal attribute in the structure of the multi-criteria tree created. The number of values, represented by ratings expressing the position on the scale, was kept as low as possible, but at the same time sufficient to differentiate between qualitative situations. In our case, the attribute scale increases gradually in hierarchy from bottom to top, from three values at the base level, namely "low", "medium", "high", to five values for the root attributes: "very poor", "poor", "satisfactory", "good", "very good".

The role of utility functions was to provide values in the form of ratings, aggregated attributes from lower levels to the highest aggregated value. In DEXi, the utility function of each aggregated attribute is presented row by row in the form of a table, where each row represents a logical expression.

Each option representing a candidate manager was evaluated from start to finish, according to the decision-making rules provided by the utility functions. As a result, each option received a rating representing an evaluative value of individual professional performance. DEXi allows for immediate

understanding of the evaluation result if we use the "Graph" menu. According to this, by selecting the one-dimensional display, only from the point of view of the root aggregate attribute. The multi-criteria model, presented in Figure 3, thus became operational.

Figure 3 Final multi-criteria tree structure included in DEXi

DEXi provided us with the most effective manager who, according to the graph in Figure 4, turned out to be the Head of the IAC Department. From the comparative analysis of the options, the Head of the IAC Department surpassed the Head of the Railway Traffic Regulator, excelling in railway transport technology skills and having a higher level of education, namely a master's degree in railway technology.

What characterizes the decision tree model created is not only its simplicity in visual presentation, but above all, its high degree of complexity and difficulty in use, requiring multiple skills and knowledge to solve the problems for which it is intended. The amplification of the participatory dimension of human resource management activities requires the use of appropriate decision-making techniques, and the proposed model meets these requirements because, on the one hand, it allows the branch management specialists to be taken into account in establishing and analyzing the decision-making variables and, on the other hand, it allows for the efficient use of their time.

The novelty and necessity of implementing the practical model in solving various managerial decision-making problems are given by the fact that the probabilistic decision-making modeling technique through the DEXi expert system has not been used by railway companies in Romania or by other enterprises, with the economic literature in our country only tangentially addressing the theoretical approach to this problem.

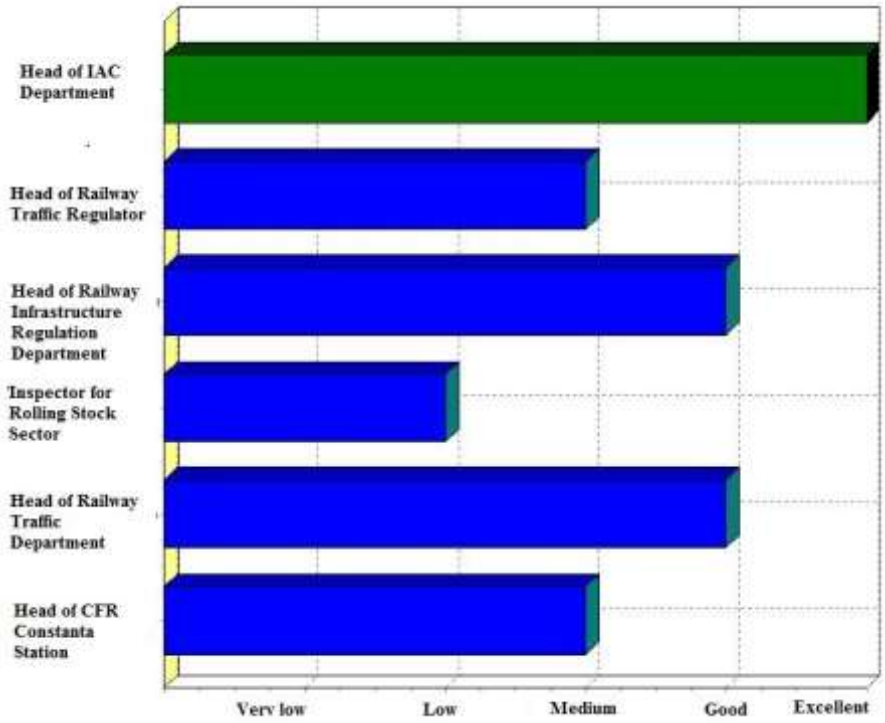

Figure 4 Final outcome of rail infrastructure managers' assessment

Training is an essential component of high-performance work systems because, according to a renowned American specialist, these systems rely on the practical knowledge and initiative of valuable employees to identify and solve problems, initiate changes in working methods, and take greater responsibility for quality (Pfeffer, 2020, p. 101). In agreement with the author, we believe that all of this requires a motivated and skilled workforce that has the knowledge and ability to perform the required tasks. In railway transport companies, only part of the above statement is true, in the sense that the staff is qualified, training and verification of specialist knowledge is carried out annually, but there is a significant lack of managerial involvement in motivating them through an appropriate reward system.

4. Conclusions

At the end of the process, based on the analysis of options facilitated by the use of the DEXi expert system, and agreeing with the multi-criteria model we proposed, the branch management made the final decision by selecting the head of the CAI Service to participate in the training course abroad. To increase the efficiency of human resource management activities in the national company CN CFR SA, we consider it particularly useful to implement the decision-making model created, with some specific adjustments, to optimize the training and professional development activities of all categories of employees, both executive and management. This is possible thanks to the DEXi expert system which, through the management of an appropriate database, can provide superiors and human resources specialists with information on the areas of professional development that each employee needs to improve.

At the same time, the use of the DEXi system becomes necessary in the context of ongoing restructuring in the rail transport system, providing assistance to senior managers in making future decisions on the redundancy of rail staff.

The study highlights significant structural and procedural differences between the selection of managers in the rail and maritime sectors. In the railway sector, the multi-criteria model implemented through DEXi is a rigorous solution for increasing the objectivity and effectiveness of the decision-making process. In the shipping sector, managerial selection is deeply influenced by international standards, labor mobility, and high operational demands.

Comparatively, the naval selection process is more standardized, more globally oriented, and more technical, while the railway process requires modernization and the integration of decision-making tools such as expert systems. The implementation of hybrid models could contribute to improving the quality of managerial decisions in both sectors.

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