Varazdin Development and Entrepreneurship Agency and **University North**
in cooperation with
Faculty of Management University of Warsaw
Faculty of Law, Economics and Social Sciences Sale - Mohammed V University in Rabat
Polytechnic of Medimurje in Cakovec

Economic and Social Development

57th International Scientific Conference on Economic and Social Development Development

Book of Proceedings

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CONTENTS

RATING SYSTEMS - OPEN MANAGEMENT CONCEPT

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ABSTRACT

Achieving the target conditions for the functioning of organizations, socio-economic systems is inextricably linked with increasing the efficiency of individual performers. The most important role here is played by the issues of integrated performance assessment, rational choice of metrics. In other words, any assessment system should embody the well-known paradigm of the process approach - effective management is possible only with qualitative measurements. Initially, any rating system should provide some degree of freedom, which allows you to quickly adapt to changing operating conditions. The article considers the issues of creating rating systems based on the concept of open (agreed) management. We consider the architecture of a mutable system, focused on the use of flexible software development methodologies in which the main subsystems interact with each other through interfaces. The main idea is to use a two-stage procedure for reconciling metrics and objects of activity at each reporting period of the system. On the one hand, this approach allows us to refine and specify the metrics used in the new planning interval, taking into account previous experience. On the other hand, in the control loop there is a feedback with the direct executors who form applications to the center, according to their needs, wishes and preferences. The system evolves, at each new stage of its activity, new elements and conditions are introduced that allow updating past experience in a new planning interval. Thus, the performers are directly involved in the formation of corrective actions. The purpose of using open control elements in rating systems is to create an architecture of a changing system, where the main participants are motivated to make changes. Changes are necessary because human, socio-economic groups are in motion and constantly evolving.

Keywords: *rating system, performance, concept of coordinated management, concept of open management, performance evaluation, multi-level system*

1. INTRODUCTION

The effectiveness of the functioning of human collectives is closely linked to a rational assessment of their activities. Design and process activities imply at a certain final stage a set of metrics [1] by which further management decisions are formed. Most often, when managing human collectives, metrics characterize quantitative indicators related to the performance of a

certain amount of work by performers and units (a group of performers). Far from always, industrial systems for rating activities and incentives take into account the administrative hierarchy of organizations that change at each period of the planning of needs, when performing calculations and reporting. In practice, systems adapted to specific business processes play an important role. One of the most important management functions is the control and approval of all applications of subordinate units by direct managers, which can be reflected in the coordination mechanisms built into information systems. The authors consider elements of the theory of management of organizational systems, typical structures of organizations, the concept of open (coordinated) management [2] and its specification in relation to the construction of rating systems on an industrial scale. Particular attention is paid to the construction of multi-level systems with role-based access, where the main emphasis is on the implementation of a phased procedure for the coordination of both individual metrics [1] and performance indicators in general. The authors proposed the architecture and implemented a software implementation of the system for assessing the activities of the faculty for the Siberian State Industrial University, using the concept of coordinated (open) management. The completed developments are of practical and scientific importance, because they can be used in managing human groups in various fields of activity.

2. BASIC ORGANIZATIONAL STRUCTURES AND THE CONCEPT OF OPEN CONTROL

For most practical cases, two multi-agent organization systems (MOS) structures are ideal. A tree-like multi-agent system with a single root of A-type, built according to the hierarchical concept, is typical for most organizations with a single managing center.

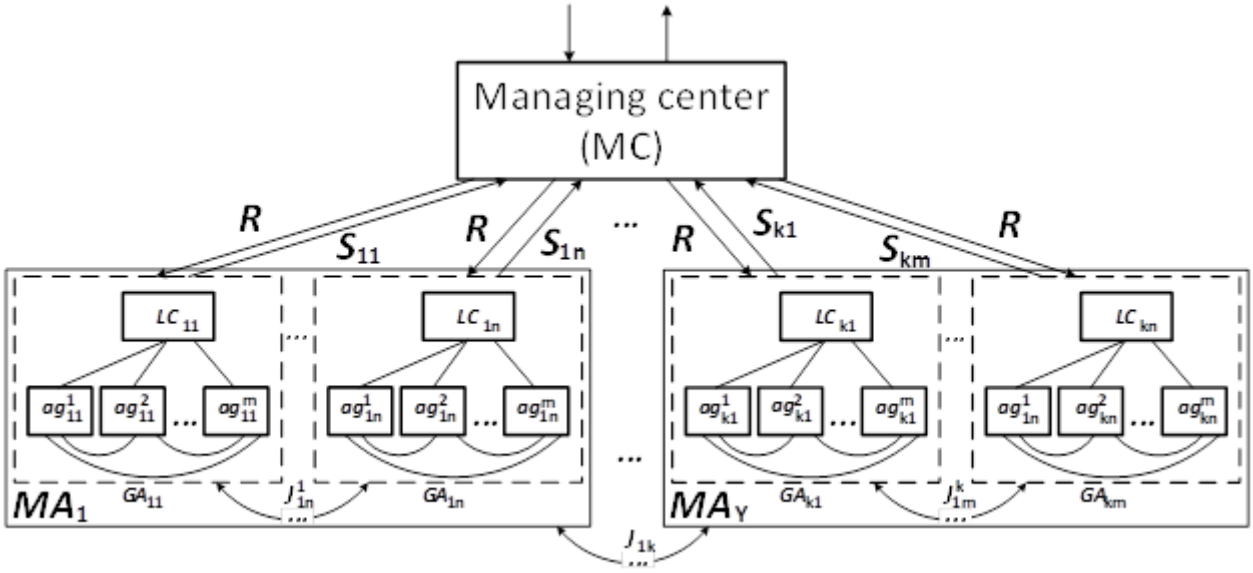

Figure 1: A-type MOS circuit

Designations in the figure include: MC- managing center; ; $LC_{11},...,LC_{1N}$; $LC_{K1},...,LC_{KM}$ - local centers of the agent group; $ag_{11}^{1},...,ag_{11}^{n},...,ag_{1n}^{1},...,ag_{1n}^{m}$ - agents belonging to groups of the first category; $ag_{k1}^{1},...,ag_{k1}^{l}$; $ag_{km}^{1},...,ag_{km}^{s}$ - agents belonging to $GA_{11},...,GA_{1N}$ groups of γ - category; $MA_{1},...,MA_{\gamma}$ - sets of group agents of the 1st,…,γ th category; R- schedule of work

of the MOS; $S_{11},...,S_{km}$ - information from agents to MC; $J^1_{1n},...,J^k_{1m}$ –information exchanged by group agents; J_{1k} - information exchanged between multiple $MA_1,...,MA_\gamma$ agents.

B-type MOS network characterizes a significant variety of control links and is suitable for distributed structures. B-type MOS network characterizes separate "control centers" - local centers; each of them submits a certain subset of performers. Information flows between local centers are formed in the order of subordination of one element to another, in other words, constructed according to the hierarchical concept of the MOS, is a special case of more complex systems with arbitrary connections. Modeling the organizational and informational structures of socio-economic systems, taking into account the various nuances of their interaction with other systems and using the mathematical apparatus of game theory [3], is associated with significant difficulties. First of all, difficulties arise due to a significant variety of interaction scenarios between individual elements and participants of the systems, taking into account more scenarios in practice, ultimately leads to an unlimited growth in machine computing. B-type MOC network is suitable for conditions where the management is carried out by separate independent entities, for example, shareholders on the board of directors, see Figure 2.

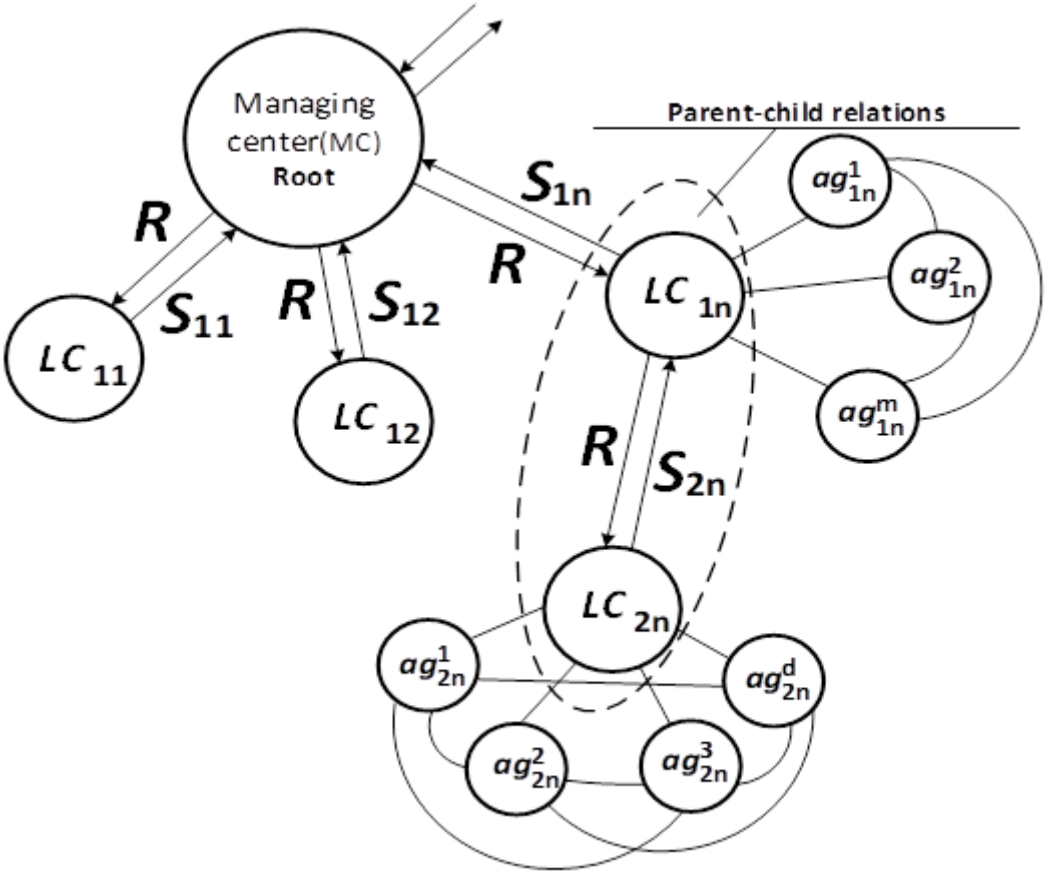

Figure 2: MOS scheme of B-type ("semantic" network)

Designations in the figure include: MC - managing center; $LC_{1n},...LC_{2n}$ - local centers are connected with each other by the relations "parent" - "child". All agents on ag^1_{1n}, ag^2_{1n}, …, ag^m_{1n} at the same level of the local center LC_{1n} are connected to each other by channels of

semantic communication or verbal communication. Interaction scenarios between individual participants can be described using recurrence relations and tree traversal algorithms. Within the framework of theories of active [4] and organizational systems [2], a set of management tools has been developed as applied to the class of two-level single or multi-agent organizational systems. However, a number of difficulties arise in practice, since real systems, as a rule, are multilevel. The main distinguishing feature of these tools is the idea of coordinated management, which allows the management center to form control actions taking into account the target functions (preference functions) of agents subordinate to it. Let us consider one of the most important tools of the theory of management of organizational systems in active systems, namely the concept of open (coordinated) management from the point of view of the possibility of its application in modern rating systems. The typical two-level multi-element active (organizational) system considered in the theory of active systems has the form shown in Figure 3. Obviously, the development and implementation of real systems in practice should include the use of N-levels of management.

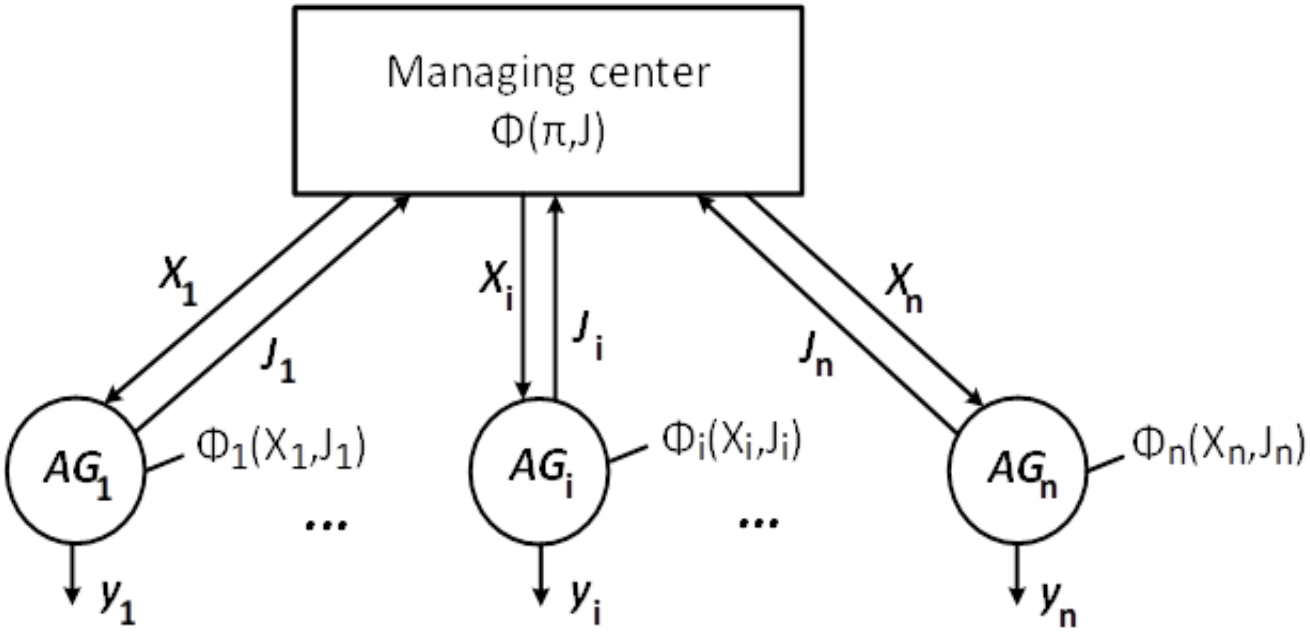

Figure 3: The structure of two-level active (organizational) system

The following designations are indicated in the figure: $x_1,\ldots,x_i,\ldots,x_n$ - plans established by the center (from among the admissible plans x_j) for agents $AG_1,\ldots,AG_i,\ldots,AG_n$; $\varphi_1(x_1,J_1),\ldots,\varphi_i(x_i,J_i),\ldots,\varphi_n(x_n,J_n)$ - preference functions of agents; $\Phi(\pi,J)$ – objective function of the center; $J=(J_1,\ldots,J_i,\ldots,J_n)\in\Omega=\Pi_{i\in N}\Omega_i$, $i\in N$ - vector of information (messages) from the agents that center needs for planning; $N=\{1,2,\ldots,i,\ldots n\}$ - set of agents; $y_1,\ldots,y_i,\ldots,y_n$ - actions (results of activities) of agents $\{AG_i, i=\overline{1,n}\}$. The concept is briefly described in Figure 3. The planning mechanism π_i implemented by the center establishes the compliance between the plan x_i and the vector of messages J received from agents $ag_j\in\overline{AG}$:

$$x_i=\pi_i(J)\in X_i, \text{ where } \pi_i=\Omega\to X_i, i\in N;\Omega_{i\in N}=\Pi\Omega_i \qquad (1)$$

The concept of open (agreed) management is such a planning procedure that maximizes the objective function of the center on a set of plans that correspond to the condition of perfect coordination:

$$\varphi(\pi_i(y), J_i) = \max \phi_i(x_i, J_i), i \in N, J \in \Omega, x_i \in X_i(J_{-i}) \quad (2)$$

where $X_i(J_{-i})$- set of acceptable plans x_i for a given situation $J_{-i} = (J_1,...,J_{i+1},...,J_n)$ in the system for the agent AG_i, $i \in N$. It is proved [9] that the application of the concept of open control makes each agent give reliable information to the center as the main (main) strategy for informing the center. The important aspect of using the concept of open (coordinated) management in rating systems is the phased coordination of all metrics and business requirements at all stages of the rating assessment life cycle.

3. LIFECYCLE RATING ELEMENTS

Evaluation of the performance of individual performers in real production and socio-economic systems comes down to taking into account various indicators (metrics) over a certain period of time and generating reports for making managerial decisions. The most important requirement for such systems is the ability to continuously evolve over time, together with the changing requirements of managers, business units and management structures. Simultaneously developed, "monolithic" systems freeze deep in time, like ghosts from the past and, in the best case, undergo constant redesigning and changing of program code (as performers are searching for new ways to increase the rating), which ultimately leads to a sharp increase in costs at later stages of the life cycle [5]. Obviously, already at the stage of design and development of rating systems, requirements related to time-varying assessment methods should already be laid down, which will allow the system not to lose its relevance after many years. The authors propose an approach based on an incomplete iterative model of the life cycle [8], for requirements and rating systems that change at each reporting period, within each iteration of which a two-stage coordination of needs is provided. Consider the structure of one iteration, in the reporting time interval, which includes the intervals and, also, the time required to generate reports and make decisions, see Figure 4.

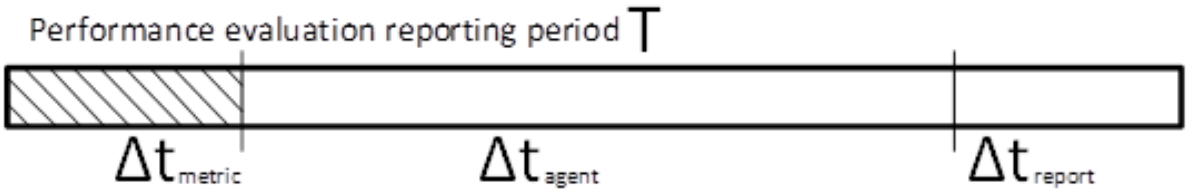

Figure 4: The structure of the iteration of the rating system performance assessment

At the first stage (interval Δt_{metric}), the local center asks agents for information J^{itr}_{metric} on the preferred performance metrics for individual performers and their weights in the future period, or forms a list according to their preferences based on their preferences. The second stage (interval Δt_{agent}) provides for the introduction of agents into the system of objects of activity, on the basis of which reporting is subsequently generated for management decisions. The center asks the performers for information on the results of the activities J^{itr}_{agent}, the threshold processing mechanisms form aggregate groups of performers performance.

Such an approach leads to increased competition between individual employees of the organization, the refinement of quantitative and qualitative indicators of metrics, to achieve the goals of the organization.

4. VARIABLE RATING SYSTEM ARCHITECTURE

Consider the architecture of the rating system, focused on supporting all of the above concepts. The basis of such systems is the object (resource) - role mechanism. Each level of the rating system represents one or a set of roles in the decision tree and contains a set of interchangeable hardware and software subsystems associated with a specific role. At the lower level of performers, direct registration of objects of activity of employees is carried out. The ability to replace individual components of the system during operation is provided through the use of dependency injection containers [6,7] (Ninject, Castle Windzor). The architecture of the variable system is shown in Figure 5.

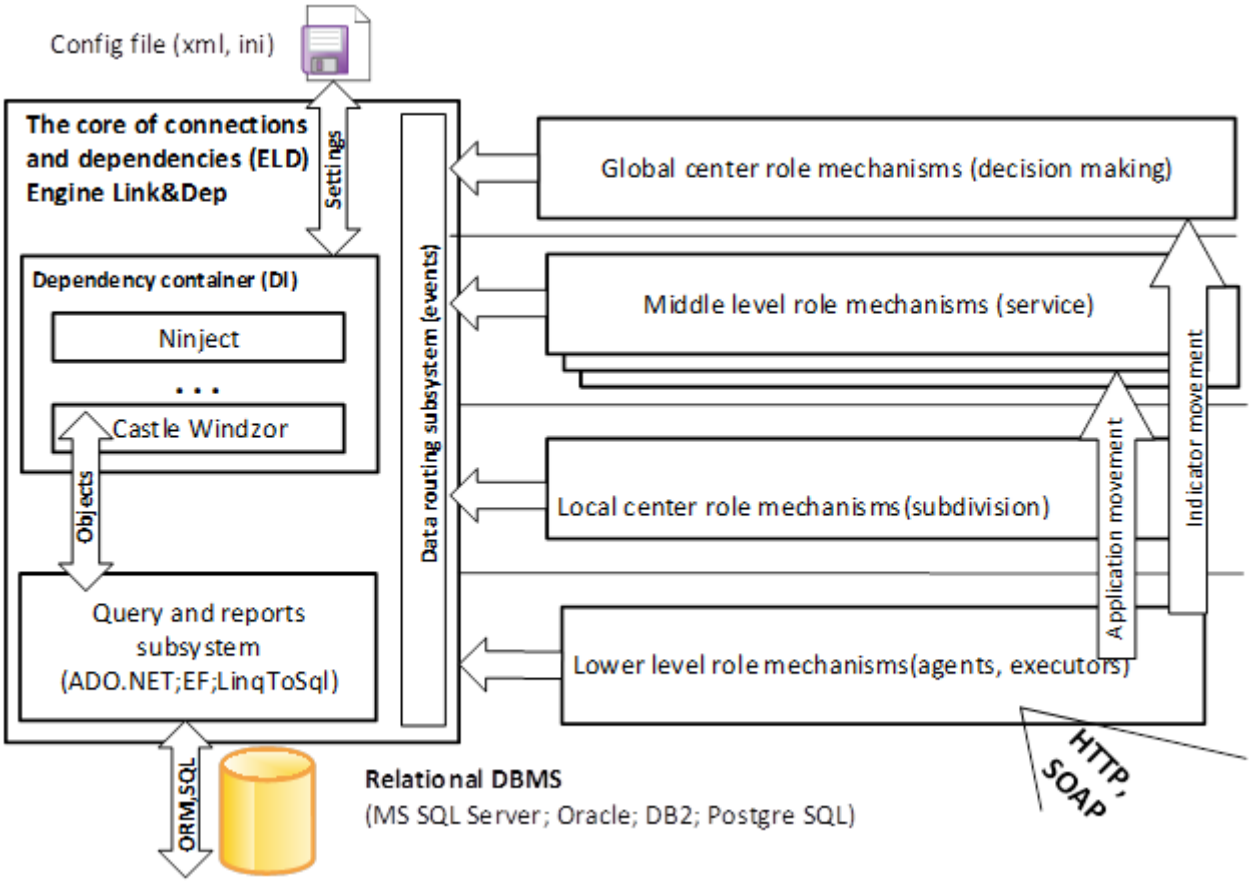

Figure 5: General architecture of a variable rating system

The ideas, approaches and principles set forth in this article were reflected in the rating system for monitoring the effectiveness of the faculty of Siberian State Industrial University (SibSIU) [9] (copyright certificate No.). The system provides many different roles that aggregate different functionality. The approval by the higher level of applications of performers is carried out in accordance with the principle of open (agreed management). The architectural principles inherent in the system reflect the idea of multi-level coordination of indicators for calculating the rating and approval of objects. Summarized, there are six levels of system operation, see Figure 6:

1) Employee level. At this level, applications related to the registration of objects of activity are formed. Applications (depending on type) are routed to the role of "Librarian" or

"Patent", which carries out their initial verification and approval. Further approval of the facilities is carried out at the level of the department head.

2) The level of initial registration of objects. It is implemented by the mechanisms of the roles "Librarian" and "Patent", depending on the type of application (patents and copyright certificates for software are approved by patent experts). Approved objects are routed to the level of the department head.
3) The level of head of the department. It approves the objects formed by individual employees of the department, forms the numerical values of general department performance indicators, approved by the directors of the institute.
4) The level of director of the institute. It approves performance calculation indicators introduced by department heads. Generates the numerical values of the performance indicators of institutes, which are approved by the university administration.
5) The level of administration of the university. Approval of indicators, management decisions. View performance indicators and ratings in various information "slices".
6) Level of full access. Access to all system features. Perform any actions.

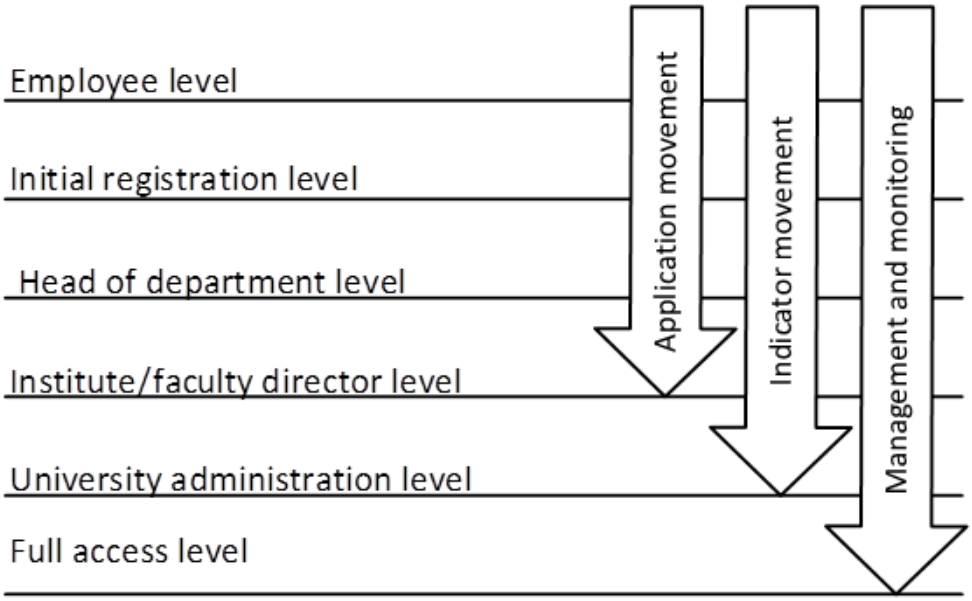

Figure 6: The conceptual scheme of the rating system of SibSIU

5. CONCLUSION

As a result of the work, the authors proposed the architecture of a variable rating system, which allows you to use a different set of metrics for each reporting interval (agreed with the contractors), as well as take into account the needs of people to optimize their activities. The scientific novelty is the thesis that it is necessary to use a two-stage procedure for reconciling both the metrics themselves in the reporting interval and the objects of activity in rating systems. The results of the work can be used to create high-quality systems for supporting management decision-making in the framework of production, socio-economic activities, focused on achieving set goals and success in the competition.

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