

Modeling Corporate Management Activities of Scientific Research in a Higher Education Institution

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Abstract - The main areas of application and tasks of the corporate information system, which is considered one of the modern large-scale systems of information technologies, have been determined and its current state has been analyzed. Having determined the purpose of the work, a list of scientific works required to evaluate the scientific activity of the professor-teacher contingent of a higher educational institution has been compiled, and a relational model of the database has been created. An algorithm has been developed to stimulate the activity of the professor-teacher contingent of a higher educational institution. The decision-making inference algorithm created for the evaluation process based on the production method used has high accuracy, efficiency and effective calculation.

Keywords — Corporate information system, higher education institution, research, database, production

I. INTRODUCTION

One of the latest achievements of new information technologies and computer technology is corporate information systems. As is known, corporate information systems are a set of complex automated technical, software and information tools that ensure the integration of all economic, production, scientific research, training and education, administrative, financial and accounting, business departments of corporations that unite the working areas of large enterprises and the production of quality products at the enterprise [1]. Depending on the field of specialization, the organization of corporate mutual information relations between all departments of the educational process in order to prepare specialists prepared for society in a higher educational institution is considered one of the urgent issues of the modern era.

The aim of training highly qualified specialists who meet international requirements in higher education institutions (HEIs), providing them with jobs in enterprises, more efficient organization of scientific and research work and, accordingly, objective assessment, is to increase the scientific rating of HEIs, improve the quality of the educational process, and involve students in practical work and business issues oriented towards scientific innovation. However, in order to achieve high efficiency of these works under consideration, it is important to apply the latest achievements of modern intellectually oriented corporate management systems and computer technology.

In modern times, the work of numerous educational, scientific-research, economic, etc. auxiliary departments operating in HEIs is centralized, with the help of modern information and computer technology, to ensure the automation and management of the educational process, scientific work, business process, the application of corporate information systems (CIS), its software,

technical and information support tools is envisaged [2, 3]. Analysis of existing [4-6] CIS of higher education institutions shows that for individual specialized higher education systems, different corporate software tools, corporate network tools, electronic documentation tools, database management systems and other tools are used, adapted to the educational process and scientific direction. Recreation of multifunctional, specialized, complex and interfaced CIS for engineering-oriented ATMs in particular and their application in HEIs is a long-term and staged process. In this sense, the creation of new algorithms, models, and corporate management software tools to improve the quality of the educational process of HEI, ensure automation of management and control, bring scientific research work to international standards, and ensure commercialization of the results of the scientific work performed is considered a scientifically relevant issue and is one of the main issues raised in the dissertation work. In this regard, the dissertation work is devoted to the selection, development, and study of algorithmic, technical, software, and information tools of corporate management for the complex automation of its educational, scientific research, and innovation-production departments on the example of the Faculty of Engineering of Sumgayit State University (SSU).

II. STATEMENT OF THE PROBLEM

The purpose of the work - It is the development of the algorithmic and information support of the corporate information system, which ensures the automation and management of the educational process, scientific research and innovation activities of HEI.

II. SOLUTION TO THE PROBLEM

In the example of the Faculty of Engineering Processing of HEI, data on scientific research is a very voluminous procedure, since in addition to the analysis of absolute indicators, it is necessary to analyze relative indicators (for example, the results of scientific research depending on the number of scientific and pedagogical employees). Increasing the efficiency of scientific research without changing the number of scientific and pedagogical employees depends on effective management, the transformation of theoretical research into practical startups, their application in production, the introduction of their work to well-known international scientific circles, their promotion, and the commercialization of the results of scientific work [7]. Therefore, the implementation of the Scientific Work module allows managers to be informed in real time about the current state of the scientific research work of the department's teaching staff, their participation in grant competitions, startups, the preparation of patents, participation in economic contracts, and the publication of articles in internationally indexed journals .

Thus, the Scientific Affairs module allows you to solve the following issues:

1. Ensures the preparation of data on monitoring the effectiveness of scientific research work of the Faculty of Engineering of HEI.

2. Provides mechanisms for stimulating the scientific and research work of the Faculty of Engineering of HEI and its departments:

2.1. Use of individual ratings of professors and teaching staff to calculate the rating of the faculty and departments (table 1);

2.2. Rewarding the professors and teaching staff of the departments according to the rating formed on the basis of the results of scientific research;

2.3. The rating indicators are calculated based on weighting factors formed based on grants, patents, publications, approvals at international conferences, international certificates, and doctoral dissertation defenses (initial data is entered before calculating the rating).

Based on the rating and score indicators, the annual incentive parameters (honorarium) of each professorial staff of the departments of the Faculty of Engineering are calculated as follows:

3. Provides stimulation mechanisms at the level of scientific research:

3.1. Calculation and awarding of individual ratings;

3.2. By publication activity (Web of An incentive payment order is issued if the articles are published in journals indexed in international databases (Science , Scopus, HAC), based on their impact factor and with foreign co-authors;

3.3. Determining effective contracts and providing incentive payments to the scientific and pedagogical staff and management of the HEI in accordance with the Roadmap of the Republic of Azerbaijan;

4. Ability to integrate with other existing systems.

For accurate reporting, it is required to build a mathematical model of incentives according to standards. Let us assume that the incentive of each researcher-agent (department employee) depends on his own scientific activity. Then the arbitrary activity vector of the researcher agent $x \in A'$ is determined. Thus, the incentive system is determined by the following formula [8]:

where $\{\delta_i\}_{i \in N}$ – is a positive constant – is a motivating supplement (money reward) for the researcher agent, for example, a material supplement for articles published in the journals Web of science (WS=500 man), Scopus (Sc=300 man), RINS core (RN=200 man), RINS (R=100 man). However, in each international indexing system, as the impact factor (IF) of the journal increases, the amount of the reward should also increase; x^* – is the optimal work that ensures equilibrium (EE) in the dominant strategy. EE is such an action vector of the research agent that it is expedient for each research agent to choose the appropriate component of this equilibrium, regardless of the choice of actions of other research agents.

According to the meaning of expression (1), when the i -th research agent chooses operation x_i , the material costs are compensated (the agent's work is rewarded). In this case, other research agents also choose the corresponding components x_i . If another operation is chosen, then the reward is 0. When using such a strategy, the university decomposes the work of research agents [9].

It is known that the current impact factors of journals are $IF_i \rightarrow [0.1, \dots, n]$ is accepted as. If we assume that each IF_i – in $\mu_i \in \{1.1, 1.2, \dots\}$ corresponds to the weight coefficient, then the following expression can be written to calculate the incentive reward [10]:

if $IF_{wsj} = [0.1, \dots, n]$, then $S_{ws} = \mu_i (IF_{wsj})$ for WS Web of science

if $IF_{scj} = [0.1, \dots, n]$, then $S_{sc} = \mu_i (IF_{scj})$ For Scopus journal

if $IF_{rnj} = [0.1, \dots, n]$, then $S_{rn} = \mu_i (IF_{rnj})$ RN RINS n root for the magazine

if $IF_{rj} = [0.1, \dots, n]$, then $S_r = \mu_i (IF_{rj})$ R for RINS journal where n is the accepted maximum impact factor of a computer science journal; μ_i the weighting factor n is selected depending on the impact factor of the journal and S_{ws} , S_{sc} , S_{rn}

, S_{rn} The following conditions are used to calculate incentive awards [11]:

$\mu_i (1.1) \rightarrow (IF_{wsj}=0.3)$; $\mu_i (1.2) \rightarrow (IF_{wsj}=0.4)$;...; $\mu_i (1.9) \rightarrow (IF_{wsj}=1.1)$.

$\mu_i (1.1) \rightarrow (IF_{scj}=0.3)$; $\mu_i (1.2) \rightarrow (IF_{scj}=0.4)$;...; $\mu_i (1.9) \rightarrow (IF_{scj}=1.1)$.

$\mu_i (1.1) \rightarrow (IF_{rnj}=0.4)$; $\mu_i (1.2) \rightarrow (IF_{rnj}=0.5)$;...; $\mu_i (1.9) \rightarrow (IF_{rnj}=1.2)$.

$\mu_i (1.1) \rightarrow (IF_{rj}=0.4)$; $\mu_i (1.2) \rightarrow (IF_{rj}=0.5)$;...; $\mu_i (1.9) \rightarrow (IF_{rj}=1.2)$.

x^* of optimally realized tasks of the research agent is determined as a result of the optimal coordinated planning solution:

The efficiency of the stimulation system is determined using the following expression:

the scientific work module, the following expert work is performed, ensuring its effectiveness:

1. With the help of this module, the efficiency of the scientific research work of the Faculty of Engineering of SSU and the efficiency of SSU's management decisions are increased.
2. The report on the scientific research work of the Faculty of Engineering of SSU within a year is prepared in a very short time.
3. The status of implementation of contracts concluded for scientific research work and transparency of incentive payments are ensured.
4. The execution time of operations spent on collecting information about the results of scientific research is shortened.
5. Re-entry of data is not allowed and data loss is prevented.
6. The quality of information provided on the results of scientific research is increasing.
7. The level of management of scientific research at SSU is increasing.

scientific work module consists of the following submodules:

1. Contract.
2. Incentive payment.
3. Protection document.
4. Private office.

the contract submodule is to automate the process of conducting business contracts and generating reports on them.

The issues resolved with the help of the contract submodule are as follows:

1. Conducting contracts depending on the characteristics of financing scientific research works (budgetary and non-budgetary).
 - 1.1. Formation of the contract and its annex;
 - 1.2. Entering data about the stages of the contract;
 - 1.3. Conducting calculations, completing acts of work performed, and concluding contracts;
 - 1.4. Sorting and conducting contracts according to priority development directions and types.
2. Collection and analysis of data on the technical equipment of scientific activity (accounting of acquired equipment and devices).
3. Collection and analysis of data on innovation activity and related organizations.
4. Formation of a contract report on the implementation of scientific research work for accounting of financial data.

A contract is concluded with the production enterprise of the scientific and pedagogical staff of the Faculty of Engineering, and the work of the contract is planned in stages.

The task of the Incentive Payments submodule is to automate the formation and adjustment of incentive payments to professors, teachers, students, and university employees . With the help of this submodule, the following issues are solved:

1. Adjustment of conditions and calculation algorithms for incentive payments, taking into account various factors, priorities and impact factor coefficients.
2. Data collection and calculation of incentive payments are ensured based on the following conditions:
 - 2.1. Publications prepared by the employees of the department must be in Web of Science, Scopus, RINS core, RINS international

- indexed impact factor journals, and the Hirsh indices of these employees must be determined;
- 2.2. Materials must be approved at Web of Science, Scopus, RINS core, and RINS international indexed conferences, and authors must have direct presentations at those conferences and receive certificates;
 - 2.3. The system should ensure that publications published in Web of Science, Scopus, RINS core, and RINS international indexed journals, as well as materials approved at conferences, are checked;
 - 2.4. Must participate in international scientific seminars and have certificates;
 - 2.5. Must be a winner of grant competitions;
 - 2.6. Doctoral students should defend their doctoral degrees and receive scientific titles based on scientific guidance and scientific advice.
3. Reports should be generated for incentive payments.
 4. Employees should be automatically notified of incentive payment orders.

IV.COMPUTER EXPERIMENTS

Based on computer experiments, the results of the rating procedure (Block 1. Evaluation of qualification indicators; Block 2. Evaluation of scientific work; Block 3. Organizational-scientific activity block) are determined (Fig. 1, Fig. 2, Fig. 3).

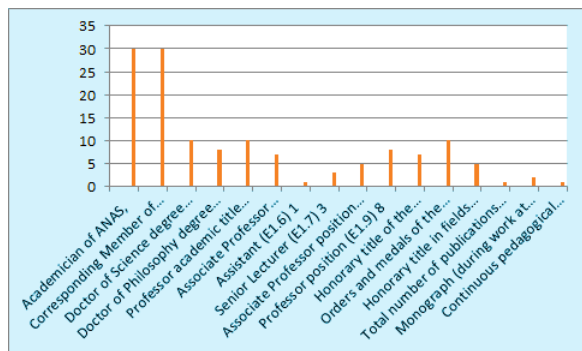


Fig. 1. Diagram of rating points for assessing the qualification indicator

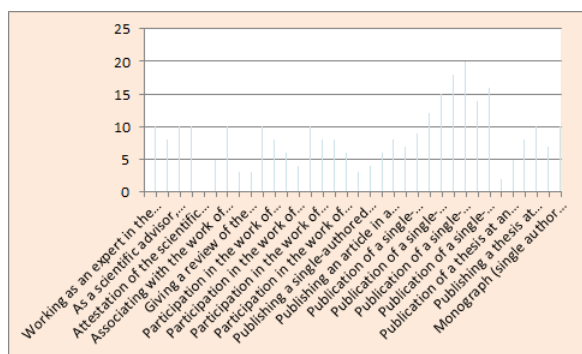


Fig. 2. Diagram of rating points for evaluating scientific work

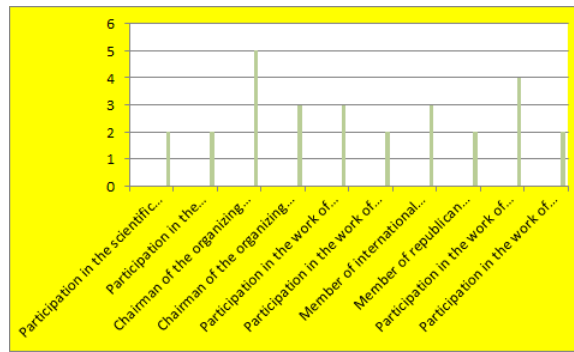


Fig. 3. Diagram of rating points for assessing organizational and scientific activity

IV.CONCLUSIONS

Scientific Work Platform of the HEI corporate information system were identified, and the results of the rating procedure (Block 1. Evaluation of the qualification indicator; Block 2. Evaluation of scientific work; Block 3. Organizational and scientific activity block) were determined based on computer experiments.

2. A stimulating mathematical and production logic model has been developed according to standards for accurate reporting.
3. Based on computer experiments, the results of the rating procedure are determined.

References

- [1. Lankhorst MM Enterprise architecture modeling – the issue of integration // Advanced Engineering Informatics. – 2004. – No. 18. - p. 205–216.
2. Lawrence R., Barker K. Integrating Relational Database Schemas using a Standardized Dictionary // Proceedings of the 2001 ACM symposium on applied computing (SAC). – 2001, p. 45-49.
3. Dorn, J., Pichlmair , M.: A competence management system for universities. In: Proceedings European Conference on Information Systems (ECIS), St. Gallen , Switzerland, 2007, pp. 759 – 770.
4. Becker J. Information Models for Process Management – New Approaches to Old Challenges // Emerging Themes in Information Systems and Organization Studies. - 2011. - Part 3. - p.145-154 .
- 5 . Antonio Principe . Board Composition and Innovation in University Spin-offs. Evidence from the Italian Context. Journal of Technology Management and Innovation. Vol 11, 2016 , No 3, pp. 33-39.
6. Swathi Vodithala and Raghuram Bhukya A Novel Political Optimizer-Based Feature Selection with an Optimal Machine Learning Model for Financial Crisis Prediction. International Journal of Cooperative Information Systems Vol . 33 , No. 03, 2350020 (2024) .-p. 34-45.
7. Tao Wang and Tianbang Song Application of Financial Big Data Analysis Method Based on Collaborative Filtering Algorithm in Supply Chain Enterprises. International Journal of Cooperative Information Systems Vol . 33, No. 04, 2350022 (2024) .-p. 65-78.
8. Cooperative Information Systems 7th International Conference, CoopIS 2000 Eilat , Israel, September 6-8, 2000 Proceedings.
9. Mammadov , J ; Talibov , N .; Mammadova, S. Development of a conceptual model of multi-skilled specialist training . 4TH International Conference on higher education advances (HEAD'18), 2018.- p . 1615-1622.

DOI 10.4995/HEAd18.2018.8383.

10. Mammadov , Javanshir ; Huseynov , Elkhan ; Talibov , Natic ; Akhmadova , Tamella ; Ganjaliyeva , Gulnara . Development of Program Tool for Expert Assessment of Innovation Projects in the Scientific Technopark . 18th International-Federation-of-Automatic-Control (IFAC) Conference on Technology, Culture and International

Stability (TECIS) . Baku , AZERBAIJAN, Sep. 13-15, 2018.-p. 571-574 . DOI 10.1016/j.ifacol.2018.11.248

11. Mammadov , J. F. , Abdullaev , K. S. , Agaev , U. H. , Aliev , I. R. , Huseynova , G. G. Searching and selection of a flexible manufacturing system by means of frame model. Studies in Systems, Decision and Control, 2021 .- p. 139–152.