The object of the study is the automation of accounting and reporting of scientific activities in educational organizations. The problem addressed is the inefficiency and high labor intensity of existing approaches, as well as the limited adaptability of available solutions to institutional needs. With the digitalization of educational organizations, there is a growing demand for effective information systems that automate accounting processes and generate reports on academic and pedagogical activities. Existing solutions, mainly international and local Enterprise Resource Planning (ERP) systems, offer extensive functionality but are complex, resource-intensive, and poorly adapted to educational institutions.

A modular information system was designed and implemented, managing data on staff, publications, and awards, with a unified data model and automated report generation. The essence of the results lies in the development and validation of the SciTrack (Republic of Kazakhstan) system, which integrates all scientific activity data into a single structured environment and ensures automated processing and reporting.

Its modular design and centralized database eliminate data duplication, reduce manual work, and accelerate report preparation. SciTrack is easy to customize, simpler to implement than traditional ERP systems, and automatically calculates summary indicators, such as total publications and awards. Standardized data structures, centralized storage, and automated algorithms implemented in Python with a Tkinter interface explain these results.

The system improves reporting efficiency, reduces labor costs, and enhances analytical quality, demonstrating practical value for educational organizations. It can be deployed in universities with basic information technologies infrastructure requiring regular monitoring of research performance

Keywords: Information system, Python, Tkinter, Reporting automation, Smart technologies

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DEVELOPMENT OF THE SCITRACK INFORMATION SYSTEM FOR AUTOMATING REPORTING IN THE EDUCATIONAL PROCESS

Zhanna Shangitova
PhD*
ORCID: https://orcid.org/0000-0001-7494-5208
Malika Shangitova
Master**
ORCID: https://orcid.org/0009-0008-1746-6903
Baktygul Assanova
PhD*
ORCID: https://orcid.org/0000-0003-1029-6266
Shynar Yelezhanova
Candidate of Physico-Mathematical Sciences*
ORCID: https://orcid.org/0000-0001-9815-9594
Zhadra Moldasheva
Corresponding author
PhD*
E-mail: Zhadira1985@mail.ru
ORCID: https://orcid.org/0000-0002-0559-3410
Elvira Gaisina
Master**
ORCID: https://orcid.org/0009-0004-4635-4573
*Department of Program Engineering***
Department of Informatics*
***Kh. Dosmukhamedov Atyrau University
Studencheskiy ave., 1, Atyrau, Republic of Kazakhstan, 060000

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1. Introduction

In the era of information technology advancement, the need has arisen to automate the accounting and storage of data at educational and scientific institutions. Today, educational organizations must ensure transparency of scientific activities, prepare reports on time, and support informed management decisions. These tasks increase the amount of information that needs to be processed, making manual work inefficient. Currently, the collection and storage of reports at these institutions is primarily done manually. Departments involved in collecting and submitting reports typically handle large volumes of information. Therefore, the reporting process is time-consuming and fraught with risks of data loss and duplication. Microsoft Word is typically used for this process. While it's convenient to use, it also carries the risk of duplication and unstructured storage of information. In the context of digital transformation and the increasing need to regularly monitor scientific performance, the development of specialized information systems becomes especially important. Without such systems, educational institutions may struggle to maintain accurate data, work efficiently, and prepare reliable reports for decision-making.

The aforementioned shortcomings require the use of programs capable of storing information in a structured manner and eliminating duplication, which necessitates further research.

Therefore, research on automating the accounting and reporting of scientific activities in educational institutions is relevant today, as it helps keep data accurate, save time, and support better management.

2. Literature review and problem statement

In recent years, educational organizations have actively implemented information systems aimed at optimizing data management and reporting processes. The paper [1] studied how technology can transform teaching and learning. This study focuses on educational process optimization but does not investigate the integration of scientific activity accounting and automated reporting. The problem identified is the lack of systems supporting both academic and research activities.

Study [2] focuses on learning management Systems (LMS). While LMS improves course management, they do not integrate faculty research tracking with administrative tasks, which means research and administrative data are still processed separately and entered manually.

In paper [3] examined administrative processes in universities. The study highlights data duplication and fragmented reporting but does not provide integrated solutions. As a result, research and administrative data are still handled manually.

Study [4] describes ERP systems. It shows the benefits of ERP, but does not discuss flexible solutions for universities. The problem is that the high cost and complexity limit their use in educational institutions.

Study [5] provides a review of ERP systems in higher education. The authors describe problems such as ERP implementation difficulties, poor adaptation of systems to the specific needs of individual universities, insufficient alignment with institutional requirements, and limited effectiveness for tracking scientific activities and generating reports. However, they do not provide a ready-made solution for automating the management of research activities.

Study [6] discusses modular ERP systems. Modules reduce complexity, but the study does not take into account the specifics of local universities, such as Kazakhstan. The problem is the lack of integrated solutions that take into account the specific context.

From these studies, several problems can be seen:

– faculty research and administrative reporting are still separate and not integrated;

– existing ERP and LMS systems are often complex, expensive, and hard to adapt to local university needs;

– automatic generation of reports on scientific activities is not fully implemented;

– manual processes cause duplication, errors, and take more time.

Therefore, it is necessary to develop an information system that stores all data in one place, manages research activities, and automatically generates reports. The system should be adaptable, easy to implement, and help universities work more efficiently.

3. The aim and objectives of the study

The aim of this study is to develop an information system for automating scientific reporting in educational organizations, which will enable the efficient collection, storage, and analysis of data on the results of staff research activities. This will help educational institutions reduce manual labor, improve transparency in reporting, and facilitate data-driven decision-making.

To achieve this aim, the following objectives were accomplished:

– to design the architecture and database structure of the information system based on defined functional requirements;

– to develop of core functionality;

– to develop a mechanism for generating reports;

– to evaluate the effectiveness of the implemented system.

4. Materials and methods

4. 1. The object and hypothesis of the study

The object of the study is the automation of accounting and reporting of scientific activities in educational organizations.

The main hypothesis of the study is that the development of a specialized modular information system with centralized data storage and intelligent reporting will improve the efficiency of reporting, reduce the workload of employees, and increase the transparency of scientific activity analysis.

Accepted assumptions:

– the sources of data on employees, publications and awards are reliable;

– the functional requirements of educational organizations have a similar structure and can be formalized for automation;

– analytical reporting should be compatible with the Excel format for ease of use.

Simplifications used in the study:

– the system is developed as a desktop application for a single user with the possibility of expansion;

– data on publications and awards is aggregated by department, without deep integration with external databases Scopus, ORCID, etc.;

– visualization is limited to standard Python and Tkinter tools.

4. 2. Requirements elicitation methods

The requirements for the SciTrack information system were formulated based on an analysis of the subject area and the experience of reporting at the university. The annual template for reporting on the scientific activities of an educational organization served as the basis for determining the functional and informational requirements. A structural analysis of its sections, indicators, and data presentation forms identified the key entities of the system. Based on this analysis, the database structure and the list of functions that automate the reporting processes were determined, and the choice of architectural solutions and design methods was justified.

4. 3. Design methods

The system was designed using a modular and object-oriented approach. This allowed for a logical separation of the system's components. This approach ensured a transparent architecture and the ability to expand functionality gradually.

Structured data about employees, publications, and awards was used to generate reports. This data served as the basis for analyzing employee activity and generating analytical insights.

The following methods were used:

1. Rule-based classification – determination of the level of activity of employees (high, medium, low) based on the comparison of individual indicators with the average values of the department and the formation of an analytical conclusion on the dynamics of activity [7, 8].

2. Data aggregation and descriptive statistics – calculation of the total number of publications and awards, average values and distributions of indicators to identify key trends.

3. Heuristic methods – prioritization of employees with high activity, filtering of insignificant data, highlighting of key indicators of the department and assessment of the dynamics of activity relative to the previous period.

4. Structuring and visualizing information – organizing data into reports that show individual and aggregate employee performance [9].

5. Data mining – automated processing of information to identify patterns and ensure that results are reproducible and interpretable.

The application of intelligent methods for analyzing employee activity and generating analytical reports is based on the approaches described in [10–12].

4. 4. Tools and technologies

To implement the SciTrack information system, a stack of technologies was chosen that provides ease of implementation, reliable data storage, and the ability to expand functionality:

1. Programming language: Python.
2. Development environment: Visual Studio Code.
3. User interface: Tkinter.
4. Data storage: SQLite.
5. Working with Excel tables: openpyxl.
6. Additional libraries: PIL (Pillow) for working with images and scipy for data processing and analysis.

The use of these tools and technologies allowed for the implementation of the system's functional modules, which are described in the following section.

5. Results of the study of the SciTrack information system

5. 1. System architecture and database design

The architecture of the SciTrack information system was developed taking into account the formulated requirements, as well as the need to expand the functionality and ease of maintaining the system.

The system is based on a modular architecture that includes a user interface module, a data processing module, a reporting module, and a centralized relational database. This structure ensures flexibility, scalability, and independent modification of system components.

The functional requirements define the list of tasks that the SciTrack information system solves:

1) collection and storage of data on employees and scientific activity;
2) import and export of data;
3) generation of reports;
4) display and calculation of statistics.

The implementation of these functions requires compliance with a number of non-functional requirements that determine the quality and reliability of the system.

The non-functional requirements are aimed at ensuring the stable and correct operation of the information system in practical operation. The developed system must provide a user-friendly and intuitive interface, reliable data storage, performance when working with large amounts of data, correct calculations, and ease of implementation and maintenance.

In addition, the system must be compatible with Microsoft Excel formats, allowing for the import and export of reporting data into standard spreadsheets for further processing and reporting.

These requirements have influenced the choice of information storage structure and the data model of the system.

The relational database serves as the core component of the architecture, providing centralized storage and ensuring interaction between system modules.

The data model of the SciTrack information system was developed to ensure the integrity and consistency of information about employees and their scientific activities. It is implemented as a relational database that provides structured storage and efficient access to data.

The database structure is shown in Fig. 1.

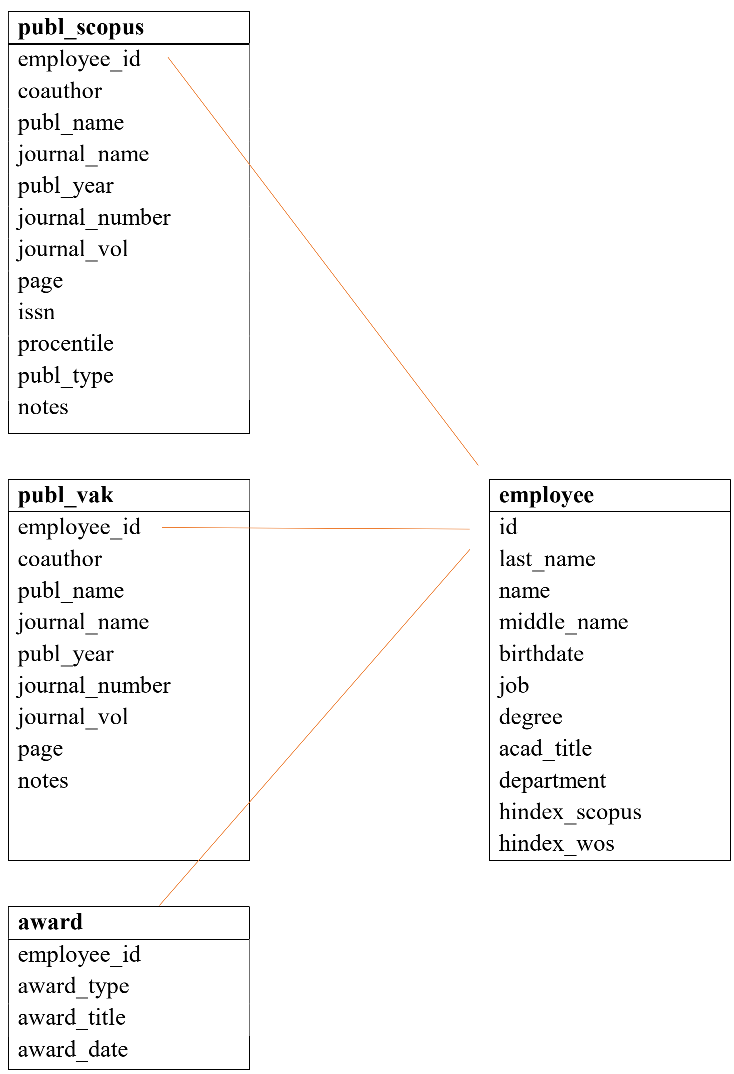

Fig. 1. Database structure of the information system

The main table is the employee table, which contains information about employees, including their last name, first name, middle name, department, position, and other characteristics. The employee's unique identifier is used to establish connections with other tables in the database.

Such an organization of the database enables hierarchical data aggregation at the level of an individual employee, department, and the institution as a whole. Unlike traditional LMS and ERP systems, where research reporting is often implemented as an additional module, SciTrack integrates reporting mechanisms directly into the core system architecture, enabling automated analytical processing based on structured relational data.

Data storage in the system is implemented using the SQLite DBMS, which is built-in, does not require a separate server environment, and meets the project's requirements in terms of scale and functionality. The database structure is designed with the specific features of the subject area in mind and includes the main entities that reflect information about employees, scientific performance indicators, publications, and awards.

The following main tables are implemented in the system: employee (employee table), award (award table, which is linked to the employee table by the employee_id foreign key), publ_scopus (Scopus publication table), publ_vak (VAK publication table).

To ensure data integrity, primary keys are used to uniquely identify records, and relationships between entities are implemented using foreign keys. This structure allows for the automatic consolidation of data related to a single employee, including information about publications and awards, ensuring consistency and accuracy in reporting. The relationship between tables is based on a one-to-many principle, where a single employee can have multiple publications and awards. In the award table, this is implemented through a constraint:

FOREIGN KEY (employee_id) REFERENCES employee(id) ON DELETE CASCADE.

To prevent duplication of information, mechanisms for controlling the uniqueness of records based on a set of employee identifying attributes have been implemented. This ensures the reliability of calculated indicators during analytical data processing.

The data storage organization allows for the execution of aggregated queries for calculating key indicators, such as the number of teaching staff, publication activity, the number of awards, and the level of academic qualifications of employees. Thus, the developed architecture forms the structural foundation of the SciTrack system and ensures integrated data management, consistency of research indicators, and automated analytical reporting at different organizational levels.

5. 2. Development of basic functionality

The development of the basic functionality of the SciTrack information system was aimed at providing the basic data operations necessary for employee accounting and generating reliable reports.

The system implements the following functions:

– search – the search module allows to find records by various attributes (name, ID, date), which speeds up access to information;

– add – authorized users can create new records through convenient forms;

– edit – data can be modified through forms, which increases the accuracy and relevance of information;

– import – the system supports automatic import of data from .xlsx files, with line-by-line processing, which reduces the time required for initial database filling and reduces the impact of human error;

– export – data can be exported in .xlsx, which facilitates the preparation of reports and integration with external tools;

– deleting – to delete outdated data, there is a confirmation of the operation and the possibility of backup, which increases the reliability of the system.

Fig. 2 shows the employee input window. When you click on the "Add Employee" button, a form opens where the user fills in the required fields. For convenience, drop-down lists (Combobox) are implemented for selecting the position, degree, academic title, and department. The "Date of Birth" field is mandatory for validation. After successful validation, the data is saved in the corresponding table.

The Awards table provides automatic substitution of related data. For example, when adding an award, the department of the selected employee is automatically substituted (Fig. 3).

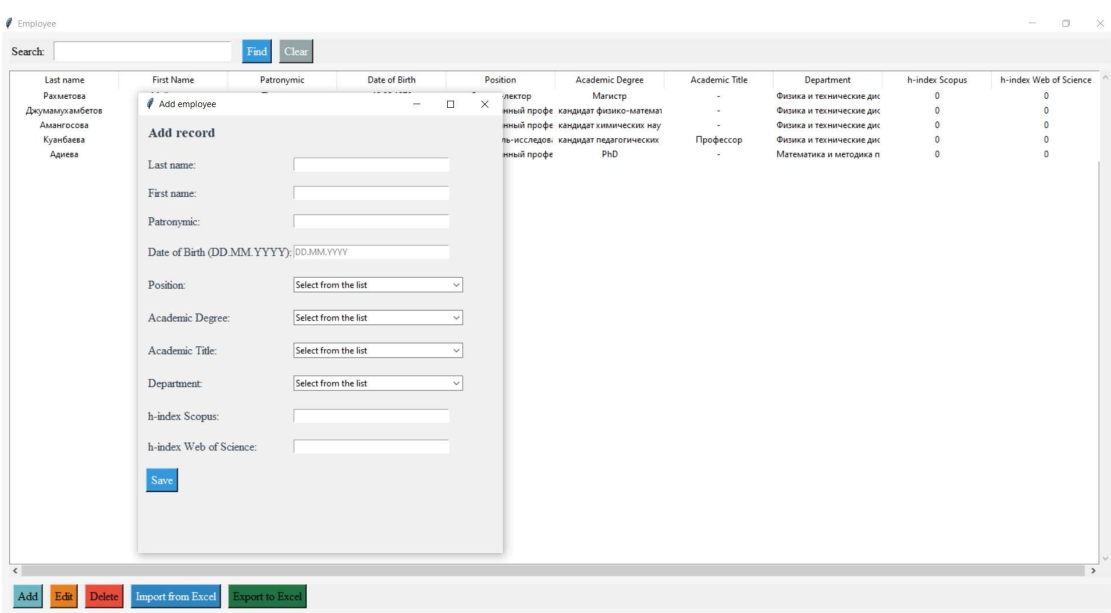

Fig. 2. Employee data entry window

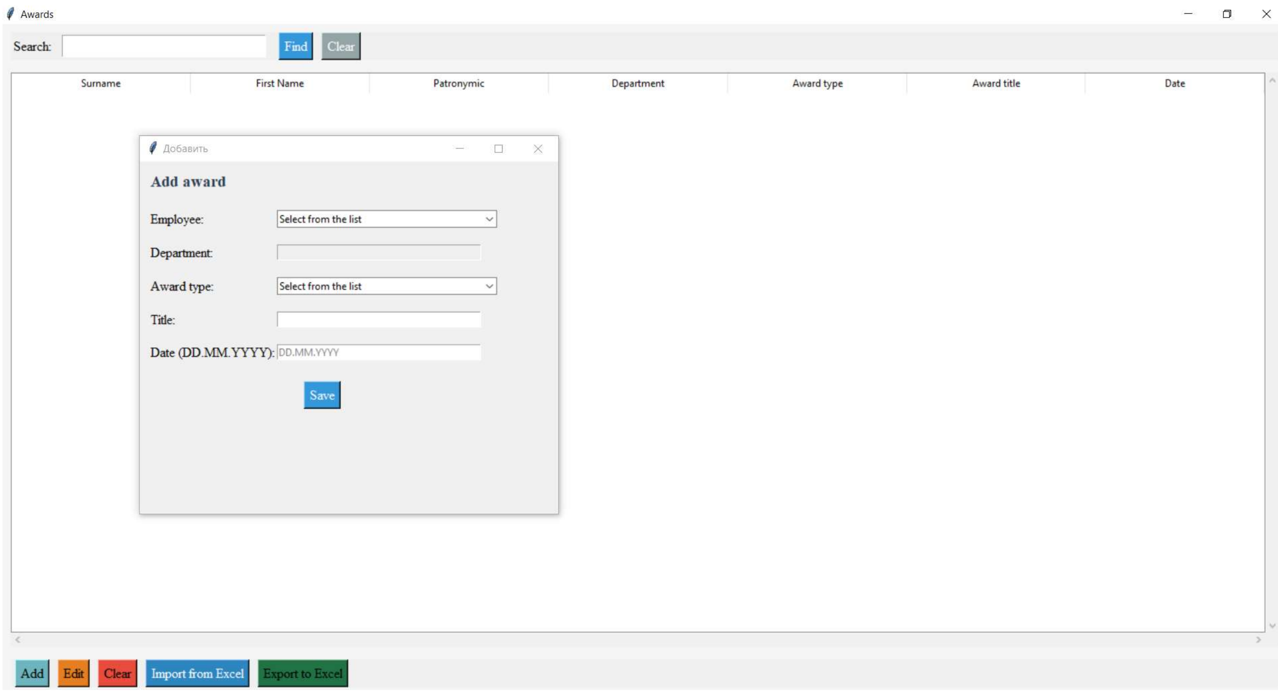

Fig. 3. Award addition window

During the data input and import process, validation mechanisms are implemented, including checking for mandatory fields, correct formats, and compliance with established reference books. This ensures the accuracy of information and prevents the storage of incorrect records.

To avoid duplication of information, the system uses a unique record check based on a combination of employee identifiers. If a match is detected, the addition of duplicate data is blocked, ensuring the integrity of the database and the accuracy of statistical calculations.

Information storage is organized in a structured form based on logically related entities that reflect the main elements of the subject area. This data representation simplifies search, processing, and analytical operations, as well as allows for the generation of summary indicators for reporting purposes.

The implementation of the basic functionality has created a foundation for further analytical data processing and the generation of reporting indicators, which are discussed in the next section dedicated to reporting generation.

5. 3. Development of a reporting generation function

The reporting function allows for the automatic generation of reports and the calculation of the educational institution's scientific indicators.

The information system has a data export function. Fig. 4 shows the data export file.

The main page displays the function of summary calculation of scientific indicators (Fig. 5).

The information system features intelligent reporting. It analyzes data and generates department-specific reports. The reports are displayed in the system window (Fig. 6).

Stages of implementation of intelligent reporting:

Stage 0. The input data will be represented by a set of department employees (1)

$$E=\{e_1,e_2,\dots,e_n\}, \tag{1}$$

where each employee e_i is described by a set of quantitative indicators (2)

$$e_i=(P_i,A_i), \tag{2}$$

where P_i is the number of publications and A_i is the number of awards.

Aggregated metrics are calculated for the department (3)

$$Total\_Pub=\sum_{i=1}^{n}P_i,\ \ Total\_Awards=\sum_{i=1}^{n}A_i. \tag{3}$$

	A	B	C	D	E	F	G	H	I	J	K
1	Surname	First Name	Patronymic	Date of Birth	Position	Academic Degre	Academic Title	Department	h-index Scopus	h-index Web of Science	
2	Рахметова	Майрагуль	Тілепқызы	12.05.1976	Сеньор-лектор	Магистр	-	Физика и техн	0	0	
3	Джумамухамб	Джангирхан	Гильманович	17.08.1957	Ассоциированный п	кандидат физик	-	Физика и техн	0	0	
4	Амангосова	Ардак	Ганибаевна	16.02.1961	Ассоциированный п	кандидат химич	-	Физика и техн	0	0	
5	Куанбаева	Баян	Улжагалиевна	15.01.1969	Преподаватель-иссл	кандидат педаго	Профессор	Физика и техн	0	0	
6	Адиева	Айнагуль	Жанибековна	17.12.1970	Ассоциированный п	PhD	-	Математика и	0	0	
7											
8											
9											
10											
11											
12											
13											

Fig. 4. Exported data file

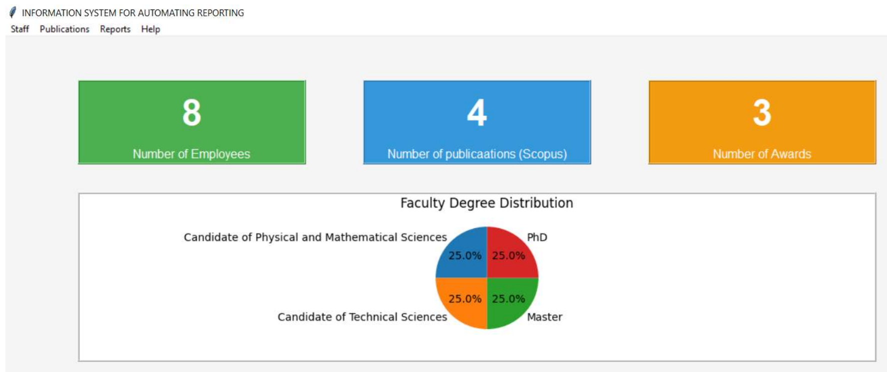

Fig. 5. Main page of the system

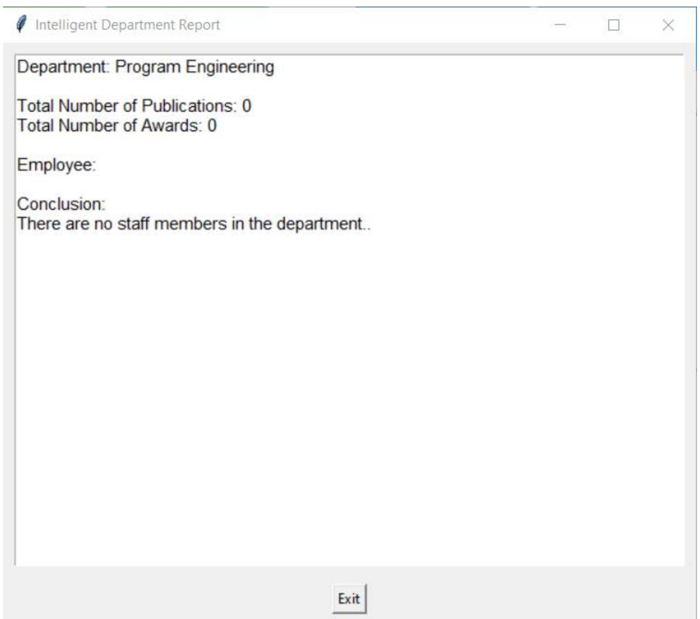

Fig. 6. Intelligent report generation window

Average employee publication activity

$$P^* = \frac{1}{n}\sum_{i=1}^{n} P_i. \quad (4)$$

Stage 1. Determination of employee activity level.

For each employee, the activity level is determined based on the following rule (5)

$$\text{Activity}(e_i) = \begin{cases} \text{High activity}, P_i \geq 1.2 \times P^* \\ \text{Medium activity, } 0.8 \times P^* \leq P_i < 1.2 \\ \text{Low activity, } P_i < 0.8 \times P^* \times P^* \end{cases}. \quad (5)$$

In Python, this is implemented using the function define_activity_level(pub_count, avg_pub):

```
def define_activity_level(pub_count: int, avg_pub: float) -> str:
 if pub_count >= avg_pub * 1.2:
 return "High activity"
 elif pub_count >= avg_pub * 0.8:
 return "Medium activity"
 return "Low activity"
```

Stage 2. Generation of departmental analytical summary.

To assess the dynamics of publication activity, a comparison is made with the previous reporting period Prev_Pub:

Conclusion = { Insufficient data, Prev_Pub=0
Increased activity, Total_Pub>Prev_Pub
Reduced activity, Total_Pub<Prev_Pub
Stable activity, Total_Pub=Prev_Pub}

In Python, this is implemented using the function generate_conclusion(Total_Pub, Prev_Pub):

```
def generate_conclusion(Total_Pub: int, Prev_Pub: int) -> str:
 if Prev_Pub == 0:
 return "Insufficient data to analyze activity trends"
 if Total_Pub > Prev_Pub:
 return "An increase in publication activity is observed"
 elif Total_Pub < Prev_Pub:
 return "A decrease in publication activity is observed"
 return "Publication activity indicators remain stable"
```

Stage 3. Departmental report generation.

The final report is created as a data structure called DepartmentReport:

DepartmentReport = <Name, $\{e_i\}$, Total_Pub, Total_Awards, Conclusion>,

where $\{e_i\}$ – a list of employees with their attributes (6)

$$e_i = \left(\text{ID}, \text{Name}, P_i, A_i, \text{Activity}\left(e_i\right)\right). \quad (6)$$

Stage 4. Report output.

For visualization and verification, a textual output is generated:

```
def print_department_report(report):
 print(f"Department: {report.department_name}")
 print(f"Total publications: {report.total_publications}")
 print(f"Total awards: {report.total_awards}")
 for e in report.employees:
 print(f"-{e.full_name}:{e.publications_count}publications,"
 f"{e.awards_count} awards, {e.activity_level}")
 print("Summary:", report.conclusion)
```

The implemented intelligent report generation function utilizes:

– rule-based logic for classifying employee activity levels;

– statistical aggregates for the overall assessment of publication and award activity;

– simple dynamic interpretation to indicate trends (increase, decrease, or stability).

Stage 5. Report structure formation and generation.

At the final stage, the structure of the report document is created depending on its type (employee report, departmental report, accreditation report). The final report includes aggregated metrics, ranking and clustering results, and automatically generated analytical conclusions.

Thus, the implemented report generation mechanism provides comprehensive analytical support for the educational process and forms the basis for evaluating the effectiveness of the information system, the results of which are discussed in the following chapter.

5. 4. Testing of the information system

5. 4. 1. Test case design

The study revealed that the information system automatically tracks employees and their research activities, enables data input and output, and facilitates automated data analysis.

After receiving the results, the system was tested. Manual functional and usability testing were used.

During functional testing, test cases were created and the functions of the modules were tested: search, adding, editing, deleting, importing, exporting (Table 1).

The test cases were developed and successfully executed, which indicates that all functions of the information system work correctly. Each module, including addition, editing, deletion, search, import, and export of data, operates according to the expected results without any detected errors or failures. This confirms the reliability, completeness, and readiness of the system for practical use.

Table 1

Functional testing test cases

Functionality	Preconditions	Steps	Data	Expected result	Actual result	Pass/ fail
Addition	User is in the Employees window	User clicks the Add button	N/A	The data entry window is displayed	Works as expected	Passed
	User is in the Add Employee window	User fills in the fields	Last Name, First Name, Middle Name, Date of Birth, Position, Degree, Academic Title, Department, h-index Scopus, h-index Web of Science	Fields are populated	Works as expected	Passed
	User is in the Add Employee window	User clicks the Save button	N/A	Save button is active; data appears in the table	Works as expected	Passed
Editing	User is in the Employees window	User selects the required record and clicks the Edit button	N/A	The record is selected, the Edit button is active, and the Edit Record window opens	Works as expected	Passed
	User is in the Edit Record window	User fills in the fields	Last Name, First Name, Middle Name, Date of Birth, Position, Degree, Academic Title, Department, h-index Scopus, h-index Web of Science	Fields are updated	Works as expected	Passed
	User is in the Edit Record window	User clicks the Save button	N/A	Save button is active; updated fields are displayed in the table	Works as expected	Passed
Deletion	User is in the Employees window	User selects the required record and clicks the Delete button	N/A	The record is selected, the Delete button is active, and a confirmation window opens	Works as expected	Passed
	User is in the Confirmation window	User clicks the Yes button	N/A	The Yes button is active; the record is removed from the table	Works as expected	Passed
Excel Import	User is in the Employees window	User clicks the Import from Excel button	N/A	The Import from Excel button is active; the Select Excel file for import window opens	Works as expected	Passed
	User is in the Select Excel file for import window	User selects the Excel file to import	N/A	The Import Completed window opens; if the table is correctly populated, the data appears in the system	Works as expected	Passed
Excel Export	User is in the Employees window	User clicks the Export to Excel button	N/A	The Export to Excel button is active; the Select Excel file for import window opens	Works as expected	Passed
	User is in the Select Excel file for import window	User selects the Excel file for export	N/A	The Import Completed window opens; a file save dialog appears; the data file is saved to the selected folder on the computer	Works as expected	Passed
Search	User is in the Employees window	User clicks on the search field and enters text	N/A	The system displays rows matching the search criteria	Works as expected	Passed

5. 4. 2. Usability testing

During usability testing, a survey of employees of the educational institution was conducted to assess the functionality of the information system and identify errors [13].

During testing, the following scenarios were tested:

– searching, adding, editing, and deleting employee data;
– searching, adding, editing, and deleting award data;
– searching, adding, editing, and deleting publication data;
– data import and export.

The following key performance indicators were assessed:

– ease of use of the interface and construction of system logic;
– ease of use of tables and windows;
– ease of use of import/export;
– difficulties encountered while using the system;
– clarity of error messages and system notifications;
– overall user satisfaction with the system interface.

The assessment was conducted on a 5-point scale, with 5 being the maximum score. The questionnaire also included questions to collect feedback on the system's performance (Fig. 7).

Fig. 7. SciTrack usability testing results radar chart

The usability testing results show that the system is intuitive, easy to use, and effectively supports staff in managing data and generating reports.

6. Discussion of findings and prospects for the Scitrack system

The test results (Table 1) confirm the correct operation of the SciTrack system: all modules function properly, and usability testing (Fig. 7) showed an average score of 4.8, indicating a clear and user-friendly interface.

Compared to studies [1–6], SciTrack addresses several identified issues. Study [1] focused on improving educational processes but did not consider the accounting of research activities. Study [2] showed that LMS improves course management, yet they do not integrate faculty research tracking with administrative tasks, leaving data entry largely manual. Study [3] highlighted fragmented reporting and data duplication, while study [4] pointed out the high cost and complexity of ERP systems, limiting their use in educational institutions. Study [5] identified poor adaptation of ERP systems to local university needs and limited capabilities for tracking research activities. Study [6] studied modular ERP systems but did not account for the local context, such as universities in Kazakhstan.

SciTrack addresses these gaps by integrating research and administrative data within a single centralized system and providing automated and intelligent report generation. Its modular architecture ensures flexibility and adaptability for different educational institutions, while hierarchical data aggregation enables accurate reporting at the level of individual staff, departments, and the institution as a whole. The system also includes visualization tools within the reporting modules and lays the foundation for future AI-based forecasting. Limitations include its focus on educational environments, the need for server-based operation with large datasets, and limited integration with other systems; these can be addressed in the future through API development, enhanced visualization, and user activity logging.

Overall, SciTrack provides a practical solution for automating the accounting of research activities, improving efficiency, accuracy, and usability compared to existing LMS and ERP systems.

7. Conclusion

1. The SciTrack information system design is based on a modular architecture that integrates a user interface, data processing, reporting mechanisms, and a centralized relational database. Its design is based on a modular architecture that integrates a user interface, data processing, reporting mechanisms, and a centralized relational database. This architecture provides flexibility, scalability, and independent modification of components, while the relational database organizes data clearly so that information about employees, departments, and the organization as a whole can be easily collected, summarized, and analyzed. By structuring data in this way, SciTrack resolves the fragmented reporting and manual data entry issues identified in the literature, offering a reliable and centralized foundation for automating research activity reporting.

2. The core functionality of the system, including data input, validation, and processing, is embedded directly within this modular architecture. This integration guarantees coherent interaction between modules and stable operation. Functional testing confirmed the correctness of all modules and the absence of critical errors, demonstrating the system's reliability. As a result, SciTrack efficiently manages data on employees and their research activities, significantly reducing manual labor and improving operational efficiency compared to traditional LMS or ERP systems.

3. A key feature of SciTrack is its automated report generation mechanism, which produces reports directly from structured relational data. This eliminates the need for manual data consolidation and reduces the risk of errors, ensuring that reporting is timely, accurate, and transparent. The system can generate detailed reports at the employee, department, and institutional levels, effectively addressing the lack of integrated reporting highlighted in previous studies.

4. Comprehensive system evaluation, including usability and functional testing, confirmed the stability, correctness, and practical applicability of the developed solution. The issuance of a Certificate of Authorship further confirms the technical novelty and originality of SciTrack. Its modular architecture, embedded analytical mechanisms, scalability, and adaptability distinguish it from existing LMS and ERP solutions. Overall, the results demonstrate that SciTrack successfully achieves its aim: automating the reporting of scientific activities, centralizing data management, enhancing transparency, and improving usability within educational institutions.

Conflict of interest

The authors declare that ty have no conflict of interest in relation to this study, whether financial, personal, authorship or otherwise, that could affect the study and its results presented in this paper.

Financing

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Data availability

Data will be made available on reasonable request.

Use of artificial intelligence

The authors confirm that they did not use artificial intelligence technologies when creating the current work.

Authors' contributions

Zhanna Shangitova: Conceptualization, Methodology, Software, Data Curation, Writing – review & editing, Project administration; **Malika Shangitova**: Conceptualization, Validation, Data curation, Writing – review & editing, Supervision; **Baktygul Assanova**: Investigation, Funding acquisition; **Shynar Yelezhanova**: Resources; **Zhadra Moldasheva**: Formal analysis, Writing – original draft; **Elvira Gaisina**: Resources, Visualization.

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