

Design and Implementation of an Automated Information System for Managing Scientific and Academic Staff in the Kyrgyz Republic

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Abstract—The research describes the development process of an automated information system (AIS) that handles scientific and academic personnel management across the Kyrgyz Republic. The AIS system unifies personnel information from the Ministry of Education and Science Institutions that operate under its authority to eliminate current disorganized paper-based systems. The system uses the Python Django web framework and PostgreSQL relational database to build its structure, which includes multiple layers for presentation, application, data, and integration functions. The system provides Power BI dashboards for advanced analytics and secure real-time personnel record verification through its link to the national “Tunduk” interoperability platform. The system uses role-based access control (RBAC) for access management, implements HTTPS encryption for secure data transfer, and follows all requirements of national personal data protection laws. The system implementation proves that it shortens staff data collection and consolidation processes by more than 50% while minimizing paper usage and human mistakes. The proposed solution provides a unified system that enables educational institutions and scientific organizations to carry out their digital transformation in human resource management.

Index Terms—Automated information systems, scientific staff, academic staff, digital databases, information and communication technologies

I. INTRODUCTION

The successful management of higher education and research systems depends on having exact and up-to-date data about academic and scientific staff members. The Ministry of Education and Science (MES), along with universities and research institutes, requires complete staff information, including qualifications, research activities, and institutional roles, to make informed decisions about budget allocation, accreditation, personnel management, and national research policy development. The Kyrgyz Republic maintains personnel data through multiple disconnected manual systems, which include paper forms, separate local databases, and spreadsheet systems. The current system produces unpredictable results, causing delays in reporting and preventing analysts from conducting real-time analysis.

MES, along with higher education institutions (HEIs), faces obstacles in tracking academic personnel due to insufficient workforce data, which prevents the identification of talent

shortages and the development of specific intervention strategies. The process of manual staff data consolidation becomes extremely prolonged when institutions need to submit detailed statistics about personnel, publications, and qualification data during national reporting campaigns. The lack of standardized centralized records creates problems for system interoperability with other government information systems, which hinders digital governance development in the country [1–4].

We created AIS, also known as the “Single Window” platform, to handle scientific and academic staff management in the Kyrgyz Republic. The system enables universities and research organizations to store personnel data through a web-based platform, which produces standardized reports. The system allows staff members to update their profiles and track their academic records, while the MES accesses official national data through the system.

The system uses the Django web framework (Python) together and the PostgreSQL database management system (DBMS), to build its modular multi-layer structure. The system connects to the national “Tunduk” interoperability platform for secure data exchange with government systems, including civil registry, tax, and education-related registries, thus enabling real-time personnel identity and position. The system produces visual reports through Microsoft Power BI dashboards, which access data from the AIS database. The research delivers three essential outcomes to the field of study, namely:

- 1) The research establishes specific operational and performance requirements that an AIS needs to handle scientific and academic personnel management in transitional education systems under national digitalization plans.
- 2) The system uses Django and PostgreSQL to build a modular structure that separates presentation from application, data, and integration functions, while implementing RBAC for institutional responsibility management.
- 3) The research explains security features and data protection methods, including encryption, authentication, and compliance with national personal data laws. A pilot study demonstrates reduced costs, enhanced data accuracy, and shorter processing times.

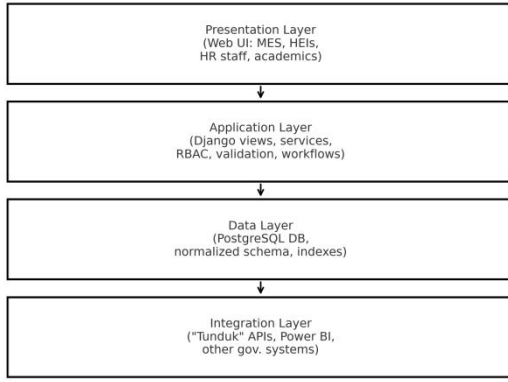


Fig. 1. Layered architecture of the automated information system (AIS).

II. RELATED WORKS

Research studies together with practical projects investigate how digitalization transforms human resource management systems, educational information systems, and public administration operations [1–3,5]. Organizations need to develop centralized personnel databases that should connect to national e-government platforms through secure access systems, according to the research. The current systems for human resource management exist mainly for university administration and basic HR operations; however, they do not address the specific needs of national-level academic staff management in transitional environments.

The AIS system presented in this paper operates within the framework of Kyrgyz higher education and research organizations, while maintaining complete integration with the “Tunduk” interoperability platform and national reporting standards.

III. SYSTEM DESIGN AND ARCHITECTURE

The AIS is implemented as a multi-layer web application that separates responsibilities into four main layers:

- 1) Presentation Layer: A web-based user interface that enables MES officials, university administrators, HR managers, and academic staff to access the system through standard web browsers.
- 2) Application Layer: The business logic implemented through Django views and services, operates at this level to perform data validation, workflow management, and access control functions.
- 3) Data Layer: A PostgreSQL relational database system that maintains normalized records about personnel, institutions, positions, and their related entities.
- 4) Integration Layer: The AIS connects to external government systems by using application programming interfaces (APIs), including the national interoperability platform “Tunduk” and analytics tools such as Power BI [5–7].

The high-level architecture of the AIS is shown in Fig. 1, which demonstrates how users interact with the web application, database, and external systems.

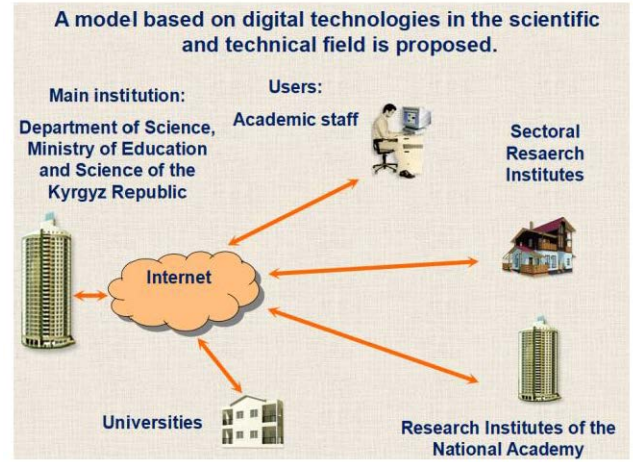


Fig. 2. Digital technology-driven model of the system.

The AIS is built using the Python Django web framework as the core server-side platform. Django was chosen because it provides a robust Model–View–Template (MVT) pattern that enforces clear separation of concerns and accelerates development.

The framework contains pre-built functionality which enables user authentication and authorization management and handles form processing operations.

The selection of PostgreSQL as the DBMS occurred because it provides excellent support for complex queries and maintains referential integrity and transactional guarantees through its ACID properties. The system needs to process extensive personnel records and historical data from various institutions, PostgreSQL is particularly appropriate, because it offers efficient indexing, query optimization, and support for complex data types, including JSON .

The solution enables scalability through its implementation process that consists of multiple stages. The web application needs deployment behind a reverse proxy and load balancer system, enabling horizontal scaling through multiple application server instances. The database system allows vertical scaling through resource addition and horizontal scaling through replication mechanisms when needed. The deployment process becomes simpler through Docker containerization because Django and PostgreSQL support this technology, which enables seamless operation in government data centers and cloud environments.

The system maintains current government system compatibility through its implementation of RESTful APIs and open standards. The AIS operates through standardized data formats (JSON over HTTPS), which enable it to connect with the national “Tunduk” platform for better integration with civil registry, tax, and other sectoral systems.

The AIS uses a relational data model to store essential entities and their connections, which support scientific and academic staff management operations.

The system contains employee data, which includes personal information, academic credentials, contact details, and essential identification numbers.

TABLE I
EXAMPLE OF PROCESS IMPROVEMENTS BEFORE AND AFTER AIS DEPLOYMENT.

Process	Before AIS	After AIS
Preparing annual staff report (per institution)	1–2 weeks of manual collection and consolidation	3–5 days using AIS forms and automated exports
Updating an individual staff record	Several days with paper forms and e-mail exchanges	Within one workday via the centralized AIS database
Consolidating national staff statistics	Several weeks of merging spreadsheets from institutions	A few days using the centralized AIS database
Share of paper-based operations for HR reporting	More than 70% of operations with paper documents	Less than 20% of operations require paper documents
Staff involved in routine data consolidation	Multiple HR and administrative staff per institution	Reduced the number of staff due to centralized processing

faster national statistical compilation on scientific and academic personnel, as the system performs automated data validation and aggregation.

The institution needs several days to modify staff information through its manual form verification process. Users can now access the web interface to update records during a single business day.

The process of creating annual staff reports for each HEI requires 1–2 weeks of manual data combination. In contrast, the process of using AIS exports for this task takes 3–5 days.

The process of national staff statistics consolidation requires multiple weeks of manual data combination. The process requires only a few days to complete when using the centralized data. The AIS system enables institutions to decrease their paper document usage for staff information management. The majority of reporting tasks no longer require institutions to distribute printed lists and forms. The decrease in paperwork expenses enables administrative personnel to dedicate their time to essential duties instead of performing basic data entry tasks. The institutions participating in the survey reported that their personnel data management administrative tasks decreased by 40%, which enabled staff members to dedicate their time to essential duties, including strategic planning and quality assurance.

The combination of personnel data centralization with the “Tunduk” national platform improves both data accuracy and accessibility. The system enables instant verification of personal identifiers together with institutional affiliations, which helps remove duplicate and inconsistent records from the system. The MES, together with institutions, now accesses reliable personnel data for their staff qualification tracking, professional development planning, and incentive program design. The AIS database also enables users to access Power BI dashboards that provide visual analytics on academic degree distribution across regions, publication output, and staff age demographics. The system enables MES to monitor national human resource policy execution through evidence-based decision support and real-time monitoring capabilities.

The system interface and functions received positive feedback from MES staff, university administrators, and academic

personnel, who participated in the pilot deployment. The web interface provides users with an easy-to-use interface through its basic navigation system and customizable dashboard views, which adjust according to user permission levels. The system enables academic staff members to access their profiles and view academic records, while the administrators can use automated reporting and validation tools [10,11].

The system generates beneficial results; however, its operational restrictions impact its total system performance. In the current version, the AIS system is accessible only through desktop browsers, with mobile access not yet available. The system would achieve better accessibility through the implementation of mobile-friendly or responsive user interfaces. The system requires two new modules for project funding management and international collaboration tracking, as the institutions need these features for their upcoming system development. The system will undergo quantitative performance and usability assessments through controlled benchmarks and user surveys once it reaches full development and gains more users.

V. CONCLUSION

The AIS for scientific and academic staff management in the Kyrgyz Republic solves multiple problems that stem from the current manual personnel data management systems. The AIS system unites staff records from universities and research organizations under the Ministry of Education and Science control to achieve better operational efficiency, enhanced data accuracy, and visibility.

The system uses the Django and the PostgreSQL to build a modular layered structure that enables secure data exchange between agencies through the national “Tunduk” platform. The Power BI analytical dashboards display real-time academic workforce data about composition and movement patterns, which users can view immediately.

The system succeeds by reducing the time needed for personnel report preparation at institutions and the Ministry level, while reducing paper consumption and human mistakes. The system maintains proper protection of sensitive information through its security features, which include RBAC [12], encrypted communication, and national personal data legislation compliance.

The system development will continue through additional module additions for project funding management, scientific performance assessment, international collaboration support, mobile interface enhancements, complete system performance, and usability assessments. The knowledge acquired from this project will help other nations and public sectors to develop their own automated information systems for digital governance implementation.

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