ISSN 3071-9658

European Journal of Interdisciplinary Issues

https://www.eujini.org.pl

Development of Software for Personnel Accounting and Payroll Calculation: Technical Principles and Industry Adaptation

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ARTICLE INFO

Research Article

Received:
14 December 2025
Revised:
2 February 2026
Accepted:
23 February 2026
Published online:
25 March 2026

DOI: 10.5281/zenodo.19652473

ABSTRACT

The article is devoted to the analysis of technical principles for creating specialized software systems for automating personnel accounting and payroll calculation in the context of the digital transformation of the economy. The purpose of the study is to systematize architectural approaches to the development of HR-ERP systems and to determine the criteria for their adaptation to the specifics of different industries and scales of organizations. The work uses methods of system analysis, a structural-functional approach, comparative research, and generalization of practical experience in using an internally developed HR system. The results of the study demonstrate that an effective HR-ERP system is based on a four-level architecture that integrates the level of centralized data storage, the level of business logic with calculation algorithms and workflow, the level of user interface, and the level of integration with other corporate systems. It was found that individually developed systems provide a significantly higher level of compliance with the specific business processes of the organization compared to the adaptation of typical solutions, which is critically important for enterprises with a complex organizational structure, non-standard remuneration systems, or specific industry requirements. Key functional modules were analyzed: electronic employee profiles with employment history, automated working time tracking with integrated access control systems, a payroll calculation module that takes into account taxes and deductions, automated generation of tax and regulatory reports in accordance with Ukrainian legislation, and personalized analytical dashboards for HR management. The implementation of a custom-designed system has reduced manual labor in processing personnel data, increased the accuracy of payroll calculations, accelerated the preparation of mandatory reports, and generally increased the efficiency of HR departments. The practical significance of the work lies in the formation of a conceptual model for building adaptive HR software with role-based access differentiation and a multi-level audit system, which can be used in the design of personnel management systems in various sectors of the Ukrainian economy.

KEYWORDS

HR-ERP systems, personnel accounting, payroll calculation, automation of HR processes, modular architecture, software, industry adaptation.

Introduction

The digital transformation of Ukraine's economy is reshaping human resource management. Market analyses show steady growth of ERP and personnel accounting systems in 2022–2024, with investments in software and databases reaching billions of hryvnias, reflecting enterprises' increasing focus on business process digitalization (Pro-Consulting, 2025).

Developing specialized software for HR, accounting, and payroll systems is a complex task that requires consideration of organizational specifics, industry characteristics, Ukrainian labor and tax legislation requirements, and integration with other corporate systems. According to SMART Business (2025), the critical requirements for replacing systems for financial and HR automation are: support for the simultaneous management of financial, tax, accounting and HR processes; compliance with international standards and Ukrainian tax and labor legislation requirements; and the reliability of releases, with updates synchronized with legislative changes.

Ukrainian research rarely offers a technical, system-level view of HR software development that considers sector-specific processes and Ukrainian legal requirements. Most studies focus on describing ready-made products or general digitalization trends. Architectural methodology and adaptation criteria receive limited attention.

The purpose of this article is to systematize the technical principles of developing specialized software for personnel accounting and payroll calculation, as well as to determine the criteria for its industry adaptation based on practical experience in operating an individually developed HR-ERP system.

Literature Review

Ukrainian and international research identifies HR automation as a practical driver of digital transformation and organizational responsiveness (Chernychko & Kozyk, 2024). By standardizing core HR processes, digital tools reduce routine workload, improve consistency, and enhance data protection when combined with secure cloud infrastructure and role-based access (Accace, 2025). However, adoption remains uneven, particularly among SMEs, where uptake ranges from 75–88% (Borovikov et al., 2024; State Statistics Service of Ukraine, 2024).

Hetmanczyk (2024) developed a method for assessing the maturity level of production process automation in the context of digital transformation. Although the study focuses on production processes, the proposed methodology can be adapted to assess the level of automation of HR processes (Hetmanczyk, 2024).

Wartime conditions in Ukraine have redirected management research toward adaptability and crisis-resilient systems, including HR solutions (Havrylyshyn et al., 2024). Although Vakulenko et al. (2025) examine public finance rather than HR, their analysis of planning under uncertainty reinforces the need for adaptive information systems in crisis contexts. Labor market indicators for 2023 published by the State Statistics Service of Ukraine further provide an empirical basis for assessing national demand for more efficient and automated HR processes.

According to a market analysis by Pro-Consulting (2025), the capacity of the ERP and personnel accounting systems market in Ukraine from 2022 to 2024 is measured in millions of hryvnia. The study includes an analysis of the market share of major ERP and personnel accounting systems in Ukraine in 2024, the geographic distribution of enterprises, and capital investments in software and databases (Pro-Consulting, 2025).

Problem Statement

The purpose of this article is to systematize the technical principles of developing specialized software for personnel accounting and payroll calculation, as well as to determine the criteria for its adaptation to the specifics of different organizations based on practical experience as a

primary user and requirements initiator. To achieve this goal, the following tasks are to be accomplished:

- to define the methodological approach to building specialized HR-ERP systems within a four-level architecture;
- to consider the principles of construction and technical solutions of the key functional modules of the system;
- to examine how industry-specific processes and regulatory constraints shape HR-system adaptability across sectors;
- to compare individually developed and typical HR solutions in terms of functionality and implementation efficiency;
- to generalize practical experience and measurable results of the application of an individually developed HR system.

Methods and Materials

The methodological basis of the study consists of general scientific methods of cognition. System analysis was used to identify the relationships between the components of the HR-ERP system and determine their role in ensuring overall functionality. The synthesis method was used to form a conceptual model of the multilevel architecture of the system. Comparative analysis was used to compare individually developed and typical HR solutions. Generalization and systematization made it possible to structure the technical principles of software development.

A structural-functional approach was used to study the architecture of the HR-ERP system, identify the functional purpose of each level and module, and analyze the interaction between system components. The modeling method was used to build a conceptual model of a four-level architecture, which includes the database level, the business logic level, the user interface level, and the integration level.

The empirical basis of the study consists of data on the implementation of an internally developed HR-ERP system in organizations of various sizes. In particular, the experience of using the system in the State Agency of Maritime Enterprise “Administration of Seaports of Ukraine” (Port Pivdennyi), where the number of personnel exceeds 480 employees, was analyzed in detail, which made it possible to evaluate the effectiveness of the system in a large organization with a complex structure.

The system was developed by the internal IT department of the organization. The author, serving as Head of Human Resources and Social Development, participated in the process as the primary initiator of functional requirements, submitting requests to the IT department for the development, modification, and refinement of the system. This role provided direct access to primary data on functional requirements, the stages of system development and deployment, and the practical results of its use in HR management.

For a comparative analysis of individual and typical HR solutions, we studied the technical documentation of the systems, including architectural diagrams, descriptions of functional modules, and specifications of integration capabilities. We analyzed implementation reports containing information on project implementation deadlines, identified problems and ways to solve them, and user satisfaction with system functionality.

A quantitative assessment of the effectiveness of the implemented system was carried out based on a comparison of indicators before and after implementation, in particular, the time required to process personnel data, the accuracy of payroll calculations (measured as a percentage of errors), the speed of mandatory reporting, and the productivity of the HR department. Data collection was carried out throughout the period of system use, which ensured the representativeness of the results.

The analysis of the industry adaptation of HR systems was carried out by comparing the functional requirements of enterprises from different sectors of the economy (maritime transport, public sector, and commercial structures) and identifying specific features that require software customization. In particular, the study examined the features of working time accounting for variable work schedules, the specifics of calculating wages taking into account industry bonuses, and the requirements for reporting in accordance with industry standards.

The study also draws on an examination of Ukraine's regulatory framework in the field of labor and tax legislation to determine the requirements for automated reporting. The Labor Code of Ukraine, the Tax Code of Ukraine, laws and regulations governing the maintenance of personnel records and payroll accounting, requirements for the preparation of tax reports and reports to the Pension Fund, and provisions on the protection of personal data were analyzed.

Content analysis of scientific publications and technical literature was used to form the theoretical basis of the work. In particular, approaches to designing the architecture of corporate information systems, methods of ensuring the security of personal data, and principles of integration with other corporate systems were systematized.

Thus, the comprehensive application of various research methods ensured a comprehensive analysis of the problem and allowed us to formulate reasonable conclusions regarding the principles of development and criteria for adapting HR software to the needs of Ukrainian organizations.

Results and Discussion

Methodology for creating HR-ERP systems and architectural principles

An effective HR-ERP system is built on a four-level architecture that provides flexibility, scalability, and security. The database level is the foundation of the system and is responsible for the centralized storage of structured information about employees, their employment, working hours, accruals, and deductions. The use of a relational data model with normalization ensures data integrity and minimizes information redundancy. The database structure includes tables of employee personal data (full name, date of birth, education, qualifications), tables of labor relations (date of hire, position, department, type of employment), tables of working time records (work schedules, timesheets, deviations from the norm), tables of accruals and deductions (salary, bonuses, allowances, taxes, deductions), tables of documents (orders, contracts, certificates, diplomas).

The business logic layer contains calculation algorithms, data processing rules, and business process execution procedures. This layer encapsulates the complexity of tax calculations, sick leave, vacation, compensation, and other payments in accordance with Ukrainian legislation. The implementation of a configuration approach allows calculation rules to be updated without changing the program code, which is critical for adapting to changes in legislation. Business logic includes algorithms for calculating wages taking into account different wage systems (hourly, piecework, mixed), procedures for calculating personal income tax, military tax, and social security contributions in accordance with current rates, mechanisms for calculating sick leave and vacation pay in accordance with the methodology of the Ministry of Social Policy, rules for determining overtime and night shifts with increased coefficients, workflow for coordinating vacations, business trips, and bonuses.

To ensure data integrity during bulk payroll operations, such as simultaneously calculating wages for hundreds or thousands of employees, the system uses transactional processing with rollback capabilities. This prevents partial updates and guarantees the consistency of financial records, even under high computational loads.

The system supports core HR workflows and secure integration with accounting, payroll, banking, and tax services, while ensuring access control and e-document management. Cross-system integration is recognized as essential for effective digital transformation (Bondar et al., 2024).

A critically important aspect of the methodology is ensuring role-based access to data in accordance with the requirements of the Law of Ukraine "On the Protection of Personal Data." The system implements differentiation of rights at the module level (for example, access to the payroll module only for accountants), functions (the ability to view, edit, delete data), individual data (employee access only to their own personal data), organizational structure (manager access only to subordinate employee data). A multi-level audit system records all data operations with a note about the user, date, time, and reason for changes, changes in system settings and access rights, and attempts at unauthorized access to data.

The system architecture was developed in accordance with cybersecurity principles. It incorporates data encryption (both at rest and in transit), audit logging of sensitive operations, and role-based access control that aligns with international data protection standards. These safeguards are especially important in the seaport sector, where the confidentiality and integrity of personnel data have operational and national security implications.

Principles of construction and technical solutions for key functional modules

The personal data accounting module is a central component of the HR system and contains complete information about employees. According to the requirements for effective HR administration formulated by Accace (2025), accurate personal data management is the basis for important processes such as payroll calculation, compliance with legal requirements, and strategic development of the company. The module includes electronic employee profiles with biographical data, education, qualifications, employment history with dates of hire, transfers, dismissals, and reasons for changes, storage of scanned copies of documents (passports, diplomas, certificates, employment contracts) with automatic indexing for quick search, structured information about positions, departments, functional responsibilities, contact details (telephones, email addresses, residential addresses), information about vacations, sick leave, business trips with automatic calculation of remaining days.

The working time accounting module integrates data from access control systems or allows manual entry of timesheets. A key technical solution is the automation of determining deviations from the schedule.

The module implements flexible work schedule settings (standard five-day week, variable schedules, daily shifts, shift method), integration with access control systems via API for automatic recording of arrival and departure times, automatic detection of lateness, early departures, overtime hours with customizable rules, accounting for vacations, sick leave, business trips, training with automatic timesheet filling, the ability to adjust the timesheet with the mandatory indication of the reason and saving the history of changes, generation of reports on the use of working time for different periods and departments.

The payroll module is the most complex in terms of business logic and requires numerous factors to be taken into account. Balan and Shepel (2024) emphasize that the implementation of innovative human resource management technologies requires special attention to the automation of calculations, which must be accurate and comply with legislation. The module includes support for various payroll systems (hourly with a fixed rate per hour of work, piecework with calculation based on products manufactured or services rendered, mixed with a combination of salary and piecework, project-based with payment for completed projects), a configured list of accrual components (salary, bonuses, seniority bonuses, bonuses for working in difficult conditions, compensation for the use of personal transport, additional payments for working at night and on weekends, rewards for performing special tasks), automatic calculation of taxes and deductions in accordance with the Tax Code of Ukraine (personal income tax at a rate of 18%, military tax 5%, single social contribution at the employer's rate of 22%), accounting for tax benefits and non-taxable minimum income of citizens, calculation of other deductions (trade union dues, alimony, loans, fines), integration with the working time accounting module for automatic accounting of hours worked, generation of pay slips with a detailed breakdown of all accruals and deductions.

The reporting module provides automated generation of all mandatory forms in accordance with the requirements of Ukrainian legislation. As noted by Borovikov et al. (2024), automation of reporting is a critical factor in the effectiveness of HR departments, as it significantly reduces the time required to prepare documents and virtually eliminates errors. The module implements the automatic generation of tax reports (form 1DF – tax calculation of income amounts, form No. 4DF - report on the amounts of the single contribution accrued), the generation of reports to the Pension Fund of Ukraine in accordance with the current forms, the preparation of statistical reports for the State Statistics Service, the export of reports in XML, Excel, PDF formats for submission to regulatory authorities, the ability to configure additional internal reports (report on the wage fund by departments, report on staff turnover, report on the use of working time fund), and saving the history of generated reports for audit and control.

The analytics and dashboard module provides managers with real-time visibility into workforce metrics to support day-to-day decision-making. As Slavkova (2024) argues, contemporary HR systems should combine analytics with decision support capabilities. Accordingly, the module aggregates key HR metrics in one workspace. It displays headcount by department, role, and employment type and summarizes workforce composition by age, gender, and education level. The module tracks turnover and computes average pay by role and unit. It also monitors wage-fund dynamics using trend analysis and forecasting. Dashboards support in-depth analysis with configurable filters, and results can be exported for reports and presentations. Automated alerts notify you of time-sensitive issues, such as upcoming contract expirations and deviations from planned wage fund limits.

Industry adaptability of HR systems to the specifics of different economic sectors

According to Borovikov et al. (2024), small and medium-sized enterprises (SMEs) demonstrate uneven readiness for digital transformation. This results in sector-specific expectations for human resources (HR) system functionality. In the maritime transport sector, for example, where the system was initially implemented, this includes variable shift schedules (day and night), weekend and holiday pay differentials, complex allowances for special working conditions, shift-based organization for certain employee categories, and accounting for hazardous work, which entitles employees to additional leave and early retirement.

Typical HR systems are designed for a standard five-day workweek with fixed schedules. These systems require significant modifications to function in the maritime transport environment.

The developed system implements a flexible mechanism for describing work schedules, which allows you to configure any options for alternating shifts, automatic calculation of allowances for night hours and work on weekends in accordance with the collective agreement, accounting for specific types of leave (additional leave for work in harmful conditions, leave for sailors calculated in proportion to the time spent on the voyage), integration with the access control system to the port territory for automatic recording of working hours.

For state institutions, it is critical to strictly comply with the requirements for document flow and reporting in accordance with regulatory and legal acts, to take into account the specifics of budget financing and limits on labor costs, to prepare reports on budget programs and economic classification codes for expenditures, to coordinate staffing tables with the bodies exercising budget control, adherence to a unified tariff scale and established official salaries for the relevant categories of employees. As Shostak (2024) emphasizes, innovations in human resource management in the public sector of Ukraine must take into account the specifics of regulatory and legal regulation, which differs from the commercial sector.

In manufacturing enterprises, the key feature is the need for integration with production accounting systems for automatic calculation of piecework wages based on actual output or operations performed, accounting for the fulfilment of production norms and calculation of bonuses for exceeding plans, taking into account product defects and corresponding reduction in accruals, integration with quality management systems to take quality indicators into account in the calculation of bonuses.

In trade, it is important to link the accrual system to sales indicators for calculating commissions for sales representatives and sellers, automatically calculate bonuses for fulfilling sales plans, take into account discounts and returns of goods in calculating commissions, and integrate with CRM systems to take into account work with customers in the motivation system.

Organizational size affects HR functional needs and the appropriate level of automation. For small firms with up to 50 employees, a basic HR module is usually sufficient. This module usually includes electronic employee records, simple time tracking, payroll calculations based on standard rules, core reporting, and a user-friendly interface with minimal configuration. Medium-sized organizations (50–500 employees) need to automate typical operations to reduce routine HR tasks, integrate with other systems (accounting, document management and access control) and have a developed reporting system to analyse HR metrics. They also need support for complex motivation and bonus schemes and the ability to customise workflows for document approval. Large enterprises (with over 500 employees) require full automation of all HR processes, advanced analytics with predictive models

for planning personnel needs, support for distributed work from multiple offices or branches, integration with a corporate portal for employee self-service, the ability to perform bulk operations (e. g. salary indexation or mass bonuses) and detailed auditing of all operations to ensure transparency and control.

Table 1. Industry-specific HRIS adaptation matrix

Sector/context	Sector-specific HR and payroll rules	Required HRIS adaptations and integrations
Maritime transport (ports, shipping, stevedoring)	Variable shifts (day/night); weekends and holidays with premium rates; shift method for some roles; allowances for outdoor work, physical exertion, material-responsibility; hazardous/dangerous conditions with additional leave and early retirement; voyage-proportional leave for sailors.	Flexible schedule designer (any shift rotation); automatic night/weekend premium calculation per collective agreement; rule engine for allowances and hazardous-work entitlements; sector-specific leave types (hazard leave, voyage-proportional leave); integration with access control to auto-capture working hours; audit trail for inspections.
State institutions (budget-funded bodies)	Strict document workflow and reporting by legal acts; budget financing limits and labor-cost ceilings; reports by budget programs and economic classification codes; staffing table coordination with budget control bodies; unified tariff scale and fixed official salaries per categories.	Features include configurable document templates and approval routes, mandatory fields and controls aligned with regulations, budget-limit checks during payroll accrual, a reporting pack for budget programs and classification codes, role-based access and immutable logs, and localization to Ukrainian legal requirements and an update process.
Manufacturing enterprises	Piecework wages are based on output and operations. There are production norms and bonuses for over-fulfillment. Defect accounting reduces accruals. Quality indicators affect bonuses.	There is integration with production accounting and MES to import output, as well as payroll formulas for piecework and norms. Bonus logic is tied to plan versus actual, and there are defect deduction rules. There is also integration with quality management systems for KPI-based incentives.
Trade (retail, distribution, sales networks)	Commissions linked to sales; bonuses for sales plan fulfillment; returns and discounts affecting commissions; motivation tied to customer work and pipeline activity.	Integration with CRM/POS for sales and customer activity; commission engine with discount/return adjustments; automated plan vs actual dashboards; configurable bonus schemes by role/region; controls to prevent double-counting.
SMEs across sectors (readiness varies)	Uneven digital maturity; preference for simple processes first; limited HR headcount; higher sensitivity to change-management effort.	Phased rollout (core HR -> time -> payroll -> analytics); minimal configuration baseline; guided setups and templates; training and embedded help; integrations prioritized by ROI (accounting first).

Comparison of custom-designed and standard HR solutions

A study of the advantages and disadvantages of custom-developed systems compared to standard ones reveals a complex picture that depends on the specifics of the organization. Standard systems available on the Ukrainian market include international solutions (SAP HCM, Oracle HCM Cloud, Microsoft Dynamics 365 Business Central, Workday) and local products from Ukrainian developers.

Standard systems have several advantages, including broad, proven functionality that covers most standard HR processes, regular updates from the vendor that take into account changes in legislation and new trends, technical support and user training from the supplier, the presence of a user community and accumulated implementation experience, and relatively quick initial implementation thanks to ready-made solutions.

However, typical systems also have significant limitations. According to an analysis by SMART Business (2025), adapting a typical solution to non-standard requirements can be limited or expensive. Other drawbacks include the need to adapt the organization's business processes to the logic of the system instead of adapting the system to the processes, limited integration capabilities with specific systems of the organization, dependence on the vendor's policy regarding updates and support for older versions, higher long-term licensing and support costs, especially for large organizations, and potential issues with localization and compliance with specific requirements of Ukrainian legislation.

Custom HR development provides organizations with full control over functionality, interface design, and workflow logic, which is critical when payroll rules are complex or standard software cannot accommodate existing processes. Consistent with this view, Bondar et al. (2024) emphasize that

effective digitalization requires flexible solutions tailored to organizational specifics. Key advantages of custom development include:

- Maximum compliance with specific business processes and organizational requirements;
- The ability to implement unique calculation algorithms and workflows;
- Flexible integration with any existing organizational systems through various protocols and APIs;
- Complete control over the code;
- The ability to make quick changes without dependence on the vendor;
- No license fees;
- Long-term cost savings for large organizations;
- The ability to expand functionality in stages as needs grow.

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- No license fees and long-term cost savings for large organizations;
- The ability to expand functionality in stages as needs grow.

At the same time, custom development requires more time for the initial creation of the system compared to the implementation of a ready-made solution, the need to form a qualified team of developers or engage external specialists, the need to create your own technical support service or conclude a support agreement, risks associated with design quality and possible implementation errors, higher initial investment in development, which pays off only with long-term use of the system.

Table 2. Standard HRIS vs custom development: decision criteria

Criterion	Standard HRIS (off-the-shelf)	Custom-designed HR system
Functional coverage	Typical HR processes are a good fit for this broad, proven feature set, but it's best when requirements align with common patterns.	Maximum fit to specific business processes and unique calculation algorithms.
Time to first value	Usually faster initial rollout due to ready modules and vendor onboarding.	Longer initial delivery; requires design, development, testing, and change management.
Adaptability to non-standard rules	Possible but can be limited or expensive; may require process changes to match system logic.	Non-standard rules are the foundation of the design, including shifts, allowances, budget limits, sector leave, and piecework/commission logic.
Integration flexibility	Depends on vendor APIs/connectors; some legacy or niche systems may be hard to integrate.	Flexible integration through APIs/protocols tailored to existing systems (access control, MES, CRM, etc.).
Compliance and localization	Regular vendor updates can track legal changes; localization quality varies and may lag.	Compliance can be built to local regulatory specifics; updates require internal support capability.
Vendor dependence	Higher lock-in (licensing, roadmap, end-of-support cycles).	Full control over codebase, release cadence, and prioritization.
Cost model (long term)	Recurring license and support fees; customization costs can accumulate, especially at scale.	Higher upfront investment; no license fees; can be cost-effective over long usage horizons and large headcounts.
Operational risk	Lower delivery risk if implementation is standard; risk shifts to vendor limitations for edge cases.	Higher delivery and design-quality risk; mitigated by strong architecture, testing, and support model.
Best-fit triggers	Rules are standard and integrations are limited for small to mid-size organizations, which have a strong need for quick deployment.	Large enterprises (>500), mission-critical integrations, heavy sector constraints, or frequent rule changes.

According to Pro-Consulting (2025), pricing indicates that the decision is primarily influenced by size and complexity. As of February 2024, solutions range from low-cost products for small-to-medium enterprises (SMEs) to enterprise suites. However, for organizations with 300 or more employees, custom development may be more economical in the long term by eliminating license fees and reducing cumulative spending on support and customization.

The results of the study enable us to draw several significant conclusions about the development and implementation of HR-ERP systems in Ukrainian organizations. The proposed four-level HR system architecture aligns with Chernychko and Kozyk (2024) findings on the need for flexible technological solutions in digital economic transformation. The advantage of individually developed systems over standardized solutions is further supported by Borovikov et al. (2024), who highlight enterprises' uneven readiness for uniform digitalization approaches.

In regulated sectors, HR systems must reflect the sector's procedures and compliance rules. According to Shostak (2024) and Balan and Shepel (2024), automation should be designed around legal constraints rather than added later. Strong integration with corporate systems improves coordination and consistency (Bondar et al., 2024). Role-based access and audit trails support data protection, which is crucial in crisis conditions (Havrylyshyn et al., 2024). In Ukraine, for example, automated tax and statutory reporting reduces compliance risks by improving the accuracy and timeliness of reports (Accace, 2025).

A comparative analysis of individual and typical solutions revealed the complexity of choosing the optimal approach. For small businesses, typical solutions may be more advantageous due to lower initial investments and speed of implementation. However, for large organizations with specific requirements, custom development provides significant long-term benefits. These findings are consistent with Pro-Consulting (2025) data on the structure of the ERP systems market in Ukraine.

A modular architecture makes it easier to roll out the system in stages and scale it as needs evolve. For Ukrainian organizations operating in crisis conditions, this flexibility is important because HR rules and practices can change quickly (Slavkova, 2024). Dashboards and decision-support tools shift HR data from routine administration to planning and oversight. According to Bondar et al. (2024), analytics strengthen decisions by basing them on verified data rather than assumptions.

The identified limitations of the study include a focus on operational experience in maritime transport and the public sector, which may limit the generalizability of the results to other sectors of the economy. In addition, the quantitative assessment of effectiveness is based on the experience of one large organization, which requires further verification on a broader sample of enterprises of different sizes and industry affiliations.

Future work can build upon the proposed approach in three ways: (1) AI-enabled predictive analytics, (2) mobile self-service applications for employees and managers, and (3) an evaluation of cloud deployment options for HR systems. Additionally, Getmanchik (2024) emphasizes the importance of assessing automation maturity in subsequent digital transformation research.

Conclusion

The study allowed us to systematize the technical principles of developing software for personnel accounting and payroll calculation in the context of the digital transformation of Ukraine's economy. It has been established that an effective HR-ERP system should be based on a four-level architecture that integrates the level of centralized data storage with a relational model, the level of business logic with configured calculation algorithms, the level of user interface with UX design principles, and the level of integration for data exchange with other corporate systems.

It has been found that the key factors for the success of HR systems are the flexibility of business logic, which allows adaptation to changes in Ukrainian legislation without changing the program code, the intuitiveness of the user interface with minimization of the number of operations to increase user productivity, integration capabilities for data exchange with accounting systems, access control systems, and electronic document management, a multi-level security system with role-based access differentiation and detailed operation auditing in accordance with personal data protection legislation.

Custom-developed HR systems provide a significantly higher level of compliance with the specific business processes of an organization compared to the adaptation of off-the-shelf solutions. This is especially important for companies with complex organizational structures, non-standard payroll systems with numerous components of accruals and deductions, specific industry requirements for

time tracking and payroll calculation, and large-scale operations, which makes custom development economically advantageous in the long term.

The practical results of implementing a custom-designed system at the Ukrainian Sea Ports Authority show a significant reduction in personnel data processing time thanks to automation and centralization, increased accuracy of payroll calculations with the practical elimination of errors, accelerated preparation of tax and statistical reports with automatic verification of correctness, increased overall productivity of the HR department with the ability to focus on strategic tasks, and improved information security in compliance with personal data protection legislation.

The study confirms that effective HR system implementation depends on how well the software is adapted to industry-specific requirements. In practice, these requirements concern (1) working time accounting (variable schedules, shift work, and special conditions typical for maritime transport), (2) payroll logic (industry allowances, specific coefficients, and additional compensation), and (3) reporting (additional forms in the public sector and features related to budget accounting). The developed system demonstrated both effectiveness and configurability across maritime transport, public institutions, and commercial organizations, indicating that the chosen architecture supports cross-sector use while remaining flexible for localized settings.

Further research may focus on the following:

- Expanding predictive HR analytics through AI and machine learning (e.g., turnover forecasting, talent identification, and optimization of motivation schemes)
- Developing mobile employee self-service applications (e.g., leave requests, payslip access, and personal data updates)
- Development of decision support tools based on integrated HR and corporate data analytics.
- Assessment of the feasibility of cloud-based HR solutions, including the expected benefits, risks, and constraints of migrating to cloud infrastructure.
- Analysis of the effects of HR process automation on employee satisfaction and organizational culture in Ukrainian companies.

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