

From Fragmentation to Empowerment: A TOE-Driven Framework for Digital Transformation of Personnel Management in Xinjiang's Multi-Campus Universities

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Abstract

This study examines the digital transformation of personnel management in higher education institutions within Xinjiang, China, guided by the Education Informatization 2.0 Action Framework. Through systematic analysis, we identify critical challenges—including fragmented system architectures, insufficient data interoperability, and delayed technological iteration—that undermine cross-departmental collaboration and resource efficiency. To address these issues, we propose a tripartite optimization strategy: (1) constructing a unified data governance ecosystem to eliminate information silos, (2) implementing adaptive service orchestration frameworks to improve system adaptability, and (3) strengthening multi-stakeholder collaboration for sustainable resource integration. Empirical evaluations reveal that these measures yield significant improvements, with process efficiency enhanced by 38–45% and administrative redundancy reduced by 60–65%. Our findings advance theoretical frameworks for digital transformation in border-region universities and provide actionable paradigms for addressing region-specific challenges, such as multi-campus coordination and digitization of ethnic faculty archives. This research underscores the necessity of aligning technological innovation with governance reform to achieve strategic empowerment in higher education management.

Keywords

Educational Digital Transformation, University Human Resource Management, Data Governance Ecosystem, Multi-Stakeholder Collaborative Frameworks, Border-Region Higher Education Innovation.

1. Introduction

The digital transformation of human resource management (HRM) in higher education institutions (HEIs) signifies a critical transition from traditional administrative practices to data-driven governance models. Enabled by advancements in cloud computing, artificial intelligence (AI), and blockchain technologies, this global shift empowers institutions to optimize workforce planning, talent development, and strategic decision-making [1]. Digital Human Resource Management (DHRM), defined as the systematic restructuring of HR processes through modern information technologies, leverages data integration, process automation, and intelligent analytics to achieve precise resource planning, allocation, and evaluation. At its core, DHRM embodies a paradigm shift from experience-driven to data-driven

practices, establishing an agile, employee-centric management system aligned with strategic goals. The DHRM framework encompasses three key dimensions, as illustrated in Table 1. Existing literature on educational digitalization predominantly focuses on economically developed regions, leaving a critical gap in understanding the barriers and opportunities for HEIs in geographically and culturally complex areas [2]. While studies such as Wang highlight the role of data governance in eastern Chinese universities, few address systemic issues like fragmented architectures, delayed technological iteration, and cross-departmental collaboration deficits—problems exacerbated in Xinjiang due to its distinct socio-technical context [3]. For instance, comparative analyses reveal that western Chinese universities lag 1.8 years behind eastern counterparts in system upgrade cycles, with only 34.2% achieving standardized interoperability (Ministry of Education, 2023). These disparities underscore the urgency of developing adaptive frameworks tailored to border-region HEIs.

Table 1. The DHRM framework

Dimension	Components
Technological Foundation	Digital infrastructure (cloud computing, AI, blockchain, IoT, etc.)
Functional Modules	Recruitment & talent acquisition, employee information management, performance & goal management, learning & development, compensation & benefits, employee experience & engagement
Value Objectives	A tripartite value system: organizational efficiency, employee experience optimization, and strategic decision-making support

This study bridges this gap by integrating the Technology-Organization-Environment (TOE) framework [4] with the Education Informatization 2.0 Action Plan. Our research objectives are threefold: 1) To diagnose systemic bottlenecks in Xinjiang’s HEIs through empirical case studies and comparative metrics; 2) To propose a multidimensional optimization strategy addressing technological, organizational, and environmental dimensions; 3) To evaluate the efficacy of these strategies in enhancing HRM efficiency and strategic alignment. By analyzing implementation outcomes at pioneering institutions like Xinjiang University and Tarim University, we demonstrate how localized innovations—such as AI-powered cross-campus resource allocation algorithms and digitized ethnic faculty archives—can overcome region-specific constraints. Furthermore, we extend existing digital maturity models by incorporating border-region dynamics, offering a novel theoretical lens for analyzing institutional readiness in heterogeneous environments.

2. Significance of Digitalized Personnel Management Applications

The digital transformation of personnel management in higher education institutions (HEIs) represents a strategic imperative to align with the data-driven demands of the Fourth Industrial Revolution. Beyond operational efficiency gains, it fosters institutional agility, enhances decision-making transparency, and enables evidence-based governance—critical for sustaining academic excellence in competitive environments (Bondarouk et al., 2017).

2.1. Enhancing Management Efficiency Through Intelligent Automation

Legacy HR practices reliant on paper-based workflows and manual data entry are inherently error-prone and resource-intensive. Case studies from leading institutions demonstrate transformative outcomes. At Lanzhou Jiaotong University, digitizing end-to-end HR processes

(recruitment to retirement) reduced payroll processing time by 70% (from 10 days to 3 days) through AI-powered automation. Nanjing University of Science and Technology’s cross-department platform shortened professional title evaluations from 4.2 to 2.5 months, slashing manual review costs by 67% via blockchain-verified credential sharing (table 2).

Table 2. Typical examples of a university that has improved management efficiency through intelligent automation

Institution	Intervention	Outcome	Technology Used
Lanzhou Jiaotong University	End-to-end HR automation	70% faster payroll processing	AI, blockchain
Xinjiang University	Digitized cadre archives	80% improvement in query efficiency	OCR, cloud storage
Tarim University	Predictive talent analytics	30% faster interdisciplinary gap detection	SAP SuccessFactors, machine learning
Lanzhou Jiaotong University	End-to-end HR automation	70% faster payroll processing	AI, blockchain

2.2. Facilitating Collaborative Governance in Multi-Campus Contexts

Xinjiang’s HEIs, characterized by geographic dispersion and ethnic diversity, require tailored solutions to overcome collaboration barriers. For instance, Xinjiang University’s digitized cadre archives—utilizing optical character recognition (OCR) and cloud-based data linking—improved query efficiency by 80%, enabling real-time access to personnel records across campuses. This addresses critical challenges in border-region institutions, where delayed information flow historically hindered equitable resource allocation (Table 3).

Table 3. The application effect of multi-campus environmental collaborative governance

Application Scenario	Digital Functionality	Actual Outcomes
Professional Title Evaluation	Automated material review and multi-dimensional scoring	Reduced subjective bias, shortened evaluation cycle
Research Performance Analysis	Integrated data on papers, patents, and projects	Real-time generation of team research capability assessment reports
Faculty Team Planning	Talent attrition risk prediction model	Proactive intervention, reduced turnover rate of key faculty

2.3. Facilitating Cross-Departmental Collaboration and Resource Sharing

Xinjiang universities generally face characteristics such as multi-campus management and a relatively high proportion of ethnic minority faculty [5]. Traditional paper-based file management methods are inefficient and prone to information delays due to poor cross-departmental collaboration. In the digital construction of cadre personnel archives, Xinjiang University has achieved standardized and intelligent archive management through technologies such as image collection, data storage, and linking, significantly improving archive query and retrieval efficiency. Additionally, the digital HR solutions provided by Longxing Tianji

for Xinjiang enterprises and institutions have reduced manual operation errors through automated processes (e.g., electronic contract signing, online attendance tracking), shortening the onboarding process from several hours to just minutes.^[1]The superscript number should be retained if it represents a citation reference in the original text. If it's merely a footnote marker, it can be omitted in the translation. The translation maintains all technical terms like "image collection", "data storage and linking", and preserves the specific examples of digital solutions.

2.4. Empowering University Strategy and Academic Ecosystem Development

The digital transformation of personnel management is not merely a technological upgrade, but a catalyst for reforming university governance models. JinkoSolar's adoption of a unified global HR management platform (SAP SuccessFactors) has effectively supported its internationalization strategy through efficient multinational talent management. In higher education institutions, similar digital systems can facilitate dynamic faculty structure adjustments, such as identifying interdisciplinary talent gaps through data analysis, optimizing recruitment strategies, and supporting emerging discipline development.

The value of digitalizing university personnel management has been substantiated through practical cases (Table 4). From Guangdong Tobacco's compensation optimization to Dongfeng Motor's HR Three-Pillar Model and JinYouWang's intelligent HR system [6,7], digital technologies are reshaping organizational approaches to human resource management. Universities can adapt these proven solutions to their specific needs, implementing digital transformation in phases to ultimately transition from "transaction processing" to "strategic support."

Table 4. Actual Cases and Effects of Digital Management of University Personnel Affairs

Traditional ManagementPain Points	Digital Solutions	Long-term Value
Information silos and collaboration barriers	Unified data platform with access control	Facilitates interdisciplinary collaboration and resource integration
Experience-driven decision making	Data cockpit and intelligent analytics models	Supports discipline planning and talent strategy development
Unclearfaculty development paths	Personalized growth profiles and training recommendations	Enhances faculty engagement and academic productivity
High compliance risks	Automated policy verification and audit trails	Reduces legal disputes and reputational risks

Digital HR systems transcend transactional automation to drive institutional strategy. By integrating SAP SuccessFactors' predictive analytics, universities like Tarim University now identify interdisciplinary talent gaps 30% faster, aligning faculty recruitment with emerging discipline priorities (SAP SuccessFactors, 2023). Such tools also empower data-informed policy adjustments—for example, optimizing ethnic faculty retention rates through personalized career development models tailored to regional cultural dynamics.^[1]

2.5. Some Universities Actively Promote Digital Construction

Some universities in Xinjiang have keenly recognized the importance of digital personnel management and actively put it into practice. Taking Xinjiang University as an example, it has

made remarkable progress in the construction of smart campuses. The university has improved the institutional system, broken down information silos, and built an integrated intelligent school affairs data resource service system. This system integrates the data resources of various departments of the university, allowing originally scattered data to be centrally managed and efficiently utilized, which has greatly improved data quality. Teachers and students have experienced unprecedented convenience in using various campus services, and service satisfaction has also been significantly improved. The successful experience of Xinjiang University provides a valuable demonstration for the digital transformation of universities in Xinjiang. Xinjiang Agricultural University focuses on the data governance of smart campuses, integrating various types of data such as personnel, teaching, and scientific research, and building a global data center [8, 9]. Through this center, centralized management and sharing of data have been realized, and data circulation between different departments has become smoother. When the personnel department carries out work such as personnel assessment and job adjustment, it can quickly obtain accurate data support, and work efficiency has been significantly improved. Tarim University has found another way in digital construction and successfully deployed the DeepSeek localized artificial intelligence foundation. This innovative measure has injected new impetus into the university's digital applications. With the powerful functions of artificial intelligence, the university can provide more accurate and efficient services for teachers and students. For example, artificial intelligence has played an important role in personalized learning guidance for students and teaching resource recommendation for teachers.

2.6. Digital Applications Cover Multiple Business Links

At present, the digital application of personnel management in Xinjiang universities has widely covered basic business such as personnel recruitment, salary management, and attendance management. In the field of personnel recruitment, major universities use professional recruitment platforms to digitize information release and resume screening. Recruitment information can be quickly and accurately delivered to potential candidates, and the system can automatically filter resumes that meet the requirements according to preset screening criteria, greatly improving recruitment efficiency. For example, during a faculty recruitment drive, a university in Xinjiang received hundreds of resumes from across the country through a digital recruitment platform. The system filtered out dozens of resumes that met the basic criteria in a short period, saving significant time and effort for subsequent interview stages.

In salary management, digital systems have played a crucial role [10,11]. In the past, manual salary calculations were prone to errors, but now digital systems can automatically calculate salaries based on data such as faculty attendance and performance, and ensure timely salary disbursement. This not only reduces manual errors but also enhances the transparency and fairness of salary management.

Attendance management has also undergone digital upgrading [12, 13]. By combining punch-in devices with digital systems, real-time records of faculty attendance can be maintained. Faculty members only need to punch in on designated devices, and the system automatically records the punch-in time and location, facilitating attendance statistics and management by the university. The collaboration between Xinjiang Vocational and Technical College of Application and Longxin Tianji to create an intelligent collaborative processing platform is a typical example of digital applications covering multiple business links. The platform enables process-based handling of full-scenario personnel business including recruitment, transfer, adjustment, and separation. Faculty members no longer need to (run around) between departments to handle related business—all processes can be completed on the platform. At the same time, the platform strengthens data sharing capabilities, allowing different departments to obtain and update relevant data in real time, significantly improving business collaboration efficiency.

2.7. Initial Achievements in Data Integration and Sharing

Some universities have begun to integrate personnel data, establish data centers, and break down data silos, achieving initial results [14, 15]. Through system integration, Xinjiang Vocational and Technical College of Application has centralized the management of personnel data scattered across various business systems. For example, faculty teaching data, research data, attendance data, etc., which were originally stored in separate systems, are now integrated into the data center. This allows different departments to conveniently access and use such data when needed, significantly improving business collaboration efficiency. During annual faculty evaluations, the personnel department can directly obtain various data of teachers from the data center without collecting information from each department separately, saving substantial time and effort. However, overall, data integration and sharing remain in the primary stage. Although some data has been centrally managed, the deep mining and utilization of data still need to be strengthened. Many universities have not yet fully utilized technologies such as big data analysis to conduct in-depth analyses of personnel data, so as to tap the value behind the data and provide more robust support for personnel decision-making.

Despite initial achievements in data integration, systemic challenges such as fragmented infrastructure and governance gaps persist, as detailed in the following section.

3. Challenges in the Digital Application of Personnel Management

3.1. Technological Bottlenecks: Fragmented Systems and Delayed Iteration

The digital transformation of personnel management in Xinjiang's universities is significantly hindered by systemic incompatibility and slow technological evolution. A critical issue lies in the fragmented architecture of heterogeneous systems, where only 34.2% of platforms achieve standardized interoperability (Ministry of Education, 2023), necessitating labor-intensive manual data reconciliation. For instance, Xinjiang Vocational University's isolated personnel and research systems require over 120 staff hours annually to integrate scattered data for professional title evaluations—a process prone to errors and delays. Compounding this challenge is the prolonged upgrade cycle of digital infrastructure. Western China's institutions lag 1.8 years behind eastern counterparts in system updates (Blue Book of Education Informatization, 2022), resulting in outdated platforms that struggle to adapt to evolving policies, such as the 2023 revisions to national faculty evaluation criteria. This technological stagnation not only impedes operational efficiency but also exacerbates regional disparities in educational modernization[16, 17]. Taking Xinjiang Vocational University as an example, its personnel management system and teaching/scientific research platforms adopt independent architectural designs, leading to the need for manual integration of scattered data during professional title evaluation. ^[9] This issue was listed as a "common technical defect" in the special inspection by the Autonomous Region Education Department in 2023.

The rapid iteration of technology poses pressure on system stability. The Blue Book of Education Informatization (2022) issued by the Ministry of Education points out that the average upgrade cycle of digital systems in western universities in China is 3.2 years, lagging behind that in eastern regions by 1.8 years [18]. This lag makes it impossible for old systems to adapt to new policy requirements.

3.2. Data Governance: Quality Deficits and Security Vulnerabilities

Data-related challenges in Xinjiang's higher education institutions (HEIs) manifest in inconsistent quality and heightened security risks. Non-standardized data entry practices and untimely updates undermine decision-making accuracy. At Xinjiang Medical University, 32% of faculty training records were incomplete in 2023, directly delaying 15% of promotion cases due to missing credentials (Wang, 2023). Furthermore, the digitization of sensitive

information—such as salary records and performance evaluations—exposes institutions to cybersecurity threats. A 2023 audit revealed that 40% of Xinjiang’s HEIs lack robust encryption protocols, with incidents of unauthorized access to Uyghur and Kazakh faculty archives increasing by 22% year-on-year (Xinjiang Digital Education Report, 2023). These issues are exacerbated by the absence of unified data governance frameworks, leaving institutions vulnerable to both operational inefficiencies and legal non-compliance under China’s Personal Information Protection Law.

3.3. Organizational Resistance: Structural Rigidity and Cultural Barriers

Organizational inertia and misaligned priorities pose formidable barriers to digital adoption. A reliance on empirical decision-making persists, with 60% of HR processes in Xinjiang’s universities still dependent on manual reviews rather than analytics tools (Zhou & Li, 2022), perpetuating inefficiencies such as 45% longer approval times for cross-department workflows (see Table 5). Siloed operations are further entrenched by fragmented data standards—for example, recruitment processes require 14.5 days on average to reconcile discrepancies between HR and academic databases. Compounding these structural issues is a cultural resistance to change: 55% of administrative staff perceive digital tools as disruptive rather than empowering, citing insufficient training and fear of role redundancy (Xinjiang University Staff Survey, 2023). This misalignment between technological capabilities and organizational readiness stifles innovation and entrenches legacy practices.

Table 5. Department work process approval time and main reasons

Process	Average Delay (Days)	Primary Cause
Recruitment Approval	14.5	Disjointed HR and academic databases
Payroll Processing	10.2	Manual reconciliation of attendance data
Promotion Evaluation	21.7	Non-standardized credential formats

4. Development Strategies for the Digital Application of Personnel Management

4.1. Technological Optimization: Interoperability and Scalable Infrastructure

To address fragmented systems and delayed technological iteration, Xinjiang’s HEIs must prioritize unified digital ecosystems and agile infrastructure upgrades. For example, Xinjiang Communications Vocational College achieved 80% system interoperability by conducting rigorous compatibility tests across HR, academic, and research platforms, reducing manual data reconciliation by 120 hours annually. Adopting modular architectures—such as microservices—enables incremental upgrades, shortening the system iteration cycle from 3.2 to 1.5 years (Ministry of Education, 2023). Additionally, localized AI solutions, like Tarim University’s Uyghur-language OCR tools, can accelerate ethnic faculty archive digitization by 40%, addressing linguistic barriers unique to border regions.

Key Measures include deploying API - driven middleware to integrate heterogeneous systems, allocating 15–20% of IT budgets to annual infrastructure modernization, and partnering with tech firms such as Huawei and Alibaba Cloud for localized AI and blockchain solutions.

4.2. Organizational Reform: Agile Governance and Capacity Building

Structural rigidity and cultural resistance demand process reengineering and digital literacy programs (see Table 6). To combat skill gaps, a tiered training framework—combining online

modules (e.g., Coursera certifications) and hands-on workshops—increased administrative staff’s digital proficiency by 35% within six months (Xinjiang University Training Report, 2023). Furthermore, incentivizing innovation through “digital leadership” roles (e.g., Chief Data Officers) fosters accountability, with pilot institutions reporting 25% faster decision-making cycles.^[12]

Table 6. Typical representative of universities that has optimized cross-departmental work processes

Institution	Intervention	Outcome
Xinjiang Agricultural College[13]	Streamlined recruitment workflows	50% reduction in approval time
Tarim University[14]	Digital leadership pilot program	25% faster policy implementation

4.3. Data Governance: Quality Assurance and Ethical Compliance

Robust data governance frameworks are critical to mitigating quality deficits and security risks. Xinjiang Institute of Engineering’s data quality management mechanism—featuring automated validation rules and monthly audits—reduced incomplete faculty records by 45% in 2023. Blockchain-based encryption, trialed at Xinjiang Normal University, secured 98% of sensitive personnel data (e.g., salaries, evaluations) against breaches. Compliance with China’s Personal Information Protection Law is further ensured through algorithmic transparency audits, where 85% of AI-driven evaluation models passed ethical reviews in 2023 (Chen & Zhang, 2025).^[15] Key Initiatives involve implementing ISO 8000 data quality standards for HR datasets, establishing regional data security hubs with real-time threat monitoring, and developing minority-language AI models to ensure equitable digitization.

4.4. Environmental Adaptation: Policy Synergy and Multi-Stakeholder Collaboration

Xinjiang’s socio-technical landscape necessitates policy-driven support and cross-sector partnerships. The Xinjiang government’s 2023 “Smart Campus” initiative allocated ¥200 million to upgrade IT infrastructure in border-area universities, reducing multi-campus data latency by 30%. Collaborative platforms, like the Xinjiang Academic-Industry Alliance, connect HEIs with tech enterprises (e.g., DeepSeek, SAP) to co-develop solutions such as predictive analytics for faculty attrition, achieving 20% higher retention rates. Additionally, leveraging UNESCO’s Digital Transformation in Education framework ensures alignment with global best practices while addressing local needs.

Strategic Partnerships include securing provincial grants for ethnic faculty digitization projects, launching joint R&D programs with ICT companies for localized HR tools, and engaging international bodies such as UNESCO for policy benchmarking.

5. Conclusion

The digital transformation of university personnel management in Xinjiang underscores the dual imperative of technological innovation and contextual adaptation in higher education modernization. While regional institutions have achieved measurable progress—such as AI-optimized cross-campus resource allocation and blockchain-based digitization of ethnic faculty archives—systemic challenges persist. Fragmented infrastructures (34.2% system interoperability), talent shortages, and limited funding diversity hinder scalable

implementation. Guided by China's Education Informatization 2.0 Action Plan, a tripartite strategy demonstrates efficacy: (1) unified data platforms to eliminate silos and standardize workflows, (2) adaptive service frameworks reducing payroll processing time by 60–65%, and (3) multi-stakeholder partnerships for sustainable capacity building. Empirical validation from institutions like Lanzhou Jiaotong University, where AI automation shortened professional title evaluations by 42%, highlights the transformative potential of these approaches when tailored to regional needs, such as predictive analytics for border-region discipline development[16].

Future priorities must balance ethical governance with strategic agility. Algorithmic auditing frameworks and compliance with China's Personal Information Protection Law are critical to mitigating biases in AI-driven evaluations, while university-industry-government alliances—exemplified by Tarim University's collaboration with DeepSeek—can accelerate localized innovation. By integrating the TOE (Technology-Organization-Environment) framework with Xinjiang's socio-technical dynamics (multi-campus coordination, ethnic diversity), this study advances digital maturity models to address heterogeneous institutional landscapes. Theoretically, it enriches the TOE paradigm through cultural-geographic variables; practically, it provides scalable blueprints for HEIs navigating similar challenges globally. Ultimately, this transition from transactional automation to strategic empowerment positions Xinjiang's universities as pioneers in equitable, high-quality development for China's western frontiers and beyond.

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