

An Intelligent Digital Framework for Talent Management and Succession Planning in Thai Public Higher Education Institutions

Chatphat Titiakarawongse* 

Institute of Digital Arts and Science, Suranaree University of Technology, Thailand

ABSTRACT

Background and Objectives: Thailand's higher education sector faces significant challenges in talent management and succession planning, driven by demographic shifts, evolving academic roles, and rapid digital transformation. Many universities are experiencing an aging workforce, shortages of qualified successors, and increasing demands for digital competencies. Existing human resource systems often lack integration, predictive capabilities, and comprehensive analytics, which limit leadership continuity and workforce sustainability. In this context, there is an urgent need for a unified and intelligent system that supports evidence-based decision-making and fosters leadership pipeline development. This study aims to develop an intelligent digital framework for talent management and succession planning tailored to the Thai higher education context, enabling systematic talent identification, performance optimization, and strategic workforce planning to enhance institutional agility and resilience.

Methodology: The study employed a conceptual development and design research approach, integrating principles from Design Science Research (DSR) and the System Development Methodology (SDM). A five-phase process encompassing literature synthesis, standards alignment, and best practices integration, framework conceptualization, system modeling, and framework validation was implemented. Gaps in human resource management and succession planning were identified through an extensive review of both global and regional practices. Alignment with international standards, including ISO 30414 (Human Capital Reporting), IEEE Std. 830–1998 (Software Requirements Specification), Thailand's PDPA (Personal Data Protection Act), and ISO/IEC 27001 (Information Security Management), ensured compliance, interoperability, and data protection. Artificial Intelligence (AI)-driven analytics and digital HR best practices were incorporated to enhance predictive capabilities and operational efficiency. System modeling defined both functional and non-functional requirements, while expert validation confirmed the framework's practicality, robustness, and strategic alignment with institutional goals.

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Main Results: The proposed Talent Management and Succession Planning (TMSP) framework comprises six interrelated modules: Talent Identification and Development, Performance Management, Learning and Development, Succession Planning, Career Pathing and Internal Mobility, and Analytics and Strategic Insights. Functional capabilities include automated competency assessment, predictive succession simulations, Key Performance Indicator (KPI) and Objectives and Key Results (OKR) tracking, real-time dashboards, and AI-augmented analytics. Non-functional requirements emphasize security, usability, scalability, interoperability, and compliance with ethical and regulatory standards. The framework was underpinned by a three-tier architecture ensuring secure communication, seamless data integration, and adaptability to institutional growth and increasing complexity.

Discussions: The framework effectively bridges the gaps in traditional HR systems by integrating predictive analytics, modular interoperability, and alignment with both national and international standards. It enhances strategic decision-making, promotes transparency and accountability, and supports continuous learning and workforce development. Real-time monitoring, scenario-based simulations, and interactive dashboards enable proactive HR management, data-driven talent development, and institutional resilience in response to digital transformation.

Conclusions: The proposed TMSP framework offers a conceptually rigorous, technically feasible, and strategically aligned solution for higher education institutions. Through the integration of AI, analytics, and digital HR practices, it supports talent development, succession planning, and workforce sustainability while ensuring compliance, data security, and operational efficiency. This intelligent digital framework provides a robust foundation for advancing HR digital transformation, strengthening institutional capacity, and aligning human capital strategies with long-term organizational objectives and Thailand's higher education reform goals.

**Corresponding author*

E-mail address: chatphat@sut.ac.th

Introduction

In an era characterized by rapid digital transformation and demographic transition, talent management and succession planning have emerged as strategic imperatives for organizational sustainability, particularly within the higher education sector. In higher education institutions,

intellectual capital, pedagogical expertise, and leadership continuity are essential to sustaining long-term academic excellence and institutional success (Berger, L. A., & Berger, D. R. 2004; Schwyer, 2004). Talent management encompasses the integrated and systematic processes of attracting, identifying, developing, and retaining high-potential individuals who can drive organizational performance, foster innovation, and sustain competitive advantage (Michaels et al., 2001). Within talent management, succession planning plays a pivotal role in ensuring leadership continuity, facilitating knowledge transfer, and aligning workforce capabilities with long-term institutional objectives (Bunthong et al., 2019; Lewis & Heckman, 2006).

Thailand's higher education sector faces significant challenges in talent management and succession planning due to significant structural, demographic, and technological shifts. These challenges are particularly evident in Thai public higher education institutions, where workforce planning, leadership continuity, and compliance with government regulations are critical to institutional sustainability. The country has entered an aged society, with more than 20% of the population aged 60 or older, and projections indicate that it will become a super-aged society by 2030. The mandatory retirement age of 60 accelerates the loss of experienced educators, administrators, and researchers, leading to a decline in institutional knowledge, leadership capacity, and pedagogical expertise (Bunthong et al., 2019). At the same time, declining birth rates and changing career aspirations among younger generations have weakened the academic talent pipeline, intensifying succession gaps and leadership shortages. These demographic pressures are compounded by the rapid pace of technological advancement, which has created an urgent demand for competencies related to digital fluency, data analytics, and adaptive leadership. However, many academic and administrative personnel currently lack these capabilities, and such skills have not yet been systematically integrated into institutional development frameworks or succession pipelines (Jaroensook et al., 2015).

Despite growing awareness of these workforce challenges, many Thai public higher education institutions continue to rely on fragmented and largely reactive workforce and succession planning practices. Limited integration among human resource, performance management, and professional development systems constrains institutions' ability to align talent strategies with long-term organizational objectives. Furthermore, limited adoption of predictive and data-driven approaches restricts institutions' ability to anticipate retirements, forecast skill shortages, identify high-potential talent, and proactively prepare the next generation of academic and administrative leaders (Jaroensook et al., 2015; Schwyer, 2004). As a result, leadership gaps persist, organizational agility is reduced, and strategic workforce planning remains challenging.

Addressing these complex challenges requires a strategic transformation of human resource management in higher education institutions. Conventional, reactive approaches are no longer sufficient; institutions must adopt proactive, data-driven strategies that leverage emerging digital technologies. Tools such as Artificial Intelligence (AI), Machine Learning (ML), predictive analytics, and integrated intelligent Human Resource Information Systems (HRIS) enable evidence-based decision-making, allowing institutions to forecast workforce needs, identify leadership risks, and optimize talent development (Dima et al., 2024; Nawaz et al., 2024). This shift not only enhances operational efficiency but also aligns with international best practices and standards for human capital reporting and transparency, particularly as reflected in ISO 30414:2018 (Human Resource Management: Guidelines for Internal and External Human

Capital Reporting), which emphasizes evidence-based workforce analytics, governance, and strategic workforce planning.

In response to these pressing challenges, this study proposed the Talent Management and Succession Planning (TMSP) framework, a digital, AI-enabled platform designed to strengthen leadership pipelines, optimize talent utilization, and ensure organizational sustainability in Thai public higher education institutions. The system is based on international standards, institutional policies, relevant laws and regulations, digital technologies, and contemporary human resource digital transformation frameworks. The objective of the system was to integrate data across multiple subsystems, including the Individual Development Plan (IDP), Learning Management System (LMS), and performance evaluation platforms, to support holistic, end-to-end talent lifecycle management. The proposed TMSP framework facilitates the identification and assessment of high-potential employees using multi-source data and competency-based evaluations, enables strategic career pathing and professional development planning aligned with organizational objectives. It also supports continuous learning and skills enhancement through LMS and IDP integration, provides succession planning for key leadership roles using analytics and predictive modeling, and delivers dynamic reporting and visualization of human capital insights to support evidence-based decision-making.

This section describes the research contribution of the proposed TMSP framework. Unlike existing digital HRM and talent management models, which often focus on isolated functions such as recruitment, performance management, learning management, or succession planning, the proposed TMSP framework presents an integrated and AI-enabled architecture that connects talent identification, competency assessment, learning and development, career mobility, succession planning, and workforce analytics within a unified platform. While previous studies have generally examined these functions as separate domains or implemented them through disconnected systems, this study advances the existing body of knowledge by integrating them into a comprehensive framework that supports end-to-end talent lifecycle management and strategic workforce planning. The framework is specifically designed for Thai public higher education institutions and addresses contextual challenges that have received limited attention in prior digital HRM research, including an aging academic workforce, retirement-driven knowledge loss, a shrinking talent pipeline, and institutional governance requirements. In addition, the framework aligns with recognized standards and regulatory requirements, including ISO 30414 for human capital reporting, IEEE Std. 830–1998 for software requirements specification, Thailand’s Personal Data Protection Act (PDPA), and ISO/IEC 27001 for information security management. By integrating predictive analytics, competency-based decision-making, and standards-driven system design principles, the proposed TMSP framework extends existing talent management approaches from fragmented operational practices toward a comprehensive and intelligent platform that supports strategic workforce management, leadership continuity, and digital governance in higher education institutions.

The remaining sections of the paper are organized as follows. The Review of Literature synthesized research on talent management, succession planning, and digital transformation in higher education, highlighting gaps that informed development of the proposed framework. The Methodology section outlines the conceptual development approach, including procedures for framework design, alignment with international standards, and integration of best practices. The Data Analysis section describes how existing literature, policy documents, and HR management guidelines were examined to validate and refine the framework. The Findings and Discussion

section presents the proposed TMSP framework, details its core modules and functionalities, and evaluated its potential contributions to workforce management, leadership continuity, and strategic alignment. Finally, the Conclusion summarizes the implications of the framework for policy and practice, identified limitations, and suggested directions for future research in digital talent management within higher education.

Review of the Literature

Human Resource Management in Higher Education

Effective Human Resource Management (HRM) in higher education encompasses strategic approaches to attracting, developing, and retaining academic and administrative personnel, with the overarching goal of enhancing institutional performance, knowledge continuity, and organizational sustainability (Collings & Mellahi, 2009; Michaels et al., 2001). HRM in universities is inherently complex due to the dual role of faculty members as both educators and knowledge producers, coupled with the necessity of maintaining an adaptive administrative workforce to support evolving institutional goals. However, traditional HR practices in many higher education institutions primarily focus on transactional tasks such as recruitment, promotion, and routine performance evaluation, rather than implementing integrated, evidence-based workforce planning aligned with strategic objectives (Becker et al., 2001).

Beyond transactional limitations, effective HRM requires alignment with the institution's mission, culture, and long-term strategic priorities. This includes fostering a culture of continuous professional development, facilitating knowledge sharing, and ensuring equitable recognition of both faculty and staff contributions (Boxall & Purcell, 2022). Moreover, universities operate within an increasingly competitive global landscape in which human capital serves as a critical driver of innovation, research productivity, and student outcomes (OECD, 2020). Consequently, HRM must integrate recruitment, development, performance management, and retention within a coherent framework that reflects the academic lifecycle, tenure systems, and the interplay between teaching, research, and service responsibilities.

In the Thai higher education context, particularly within public institutions, these challenges are further intensified by demographic and structural shifts. Thailand's aging population, mandatory retirement policies, and declining birth rates have reduced the inflow of new academic talent, while younger generations increasingly pursue private sector, entrepreneurial, or freelance careers over traditional academic pathways. These trends have created leadership and expertise gaps, particularly in specialized and research-intensive disciplines, contributing to potential declines in teaching quality, research output, and institutional competitiveness (Bunthong et al., 2019). Furthermore, many Thai universities exhibit siloed HR practices that lack integration with learning and development, performance evaluation, and succession planning processes, thereby constraining the strategic potential of HRM interventions (Jaroensook et al., 2015).

The adoption of digital tools and evidence-based management practices has been recognized as a key mechanism for addressing these challenges. Integrated HRIS, competency-based assessments, and analytics-driven workforce planning can enhance decision-making and operational efficiency within universities (Schweyer, 2004). Such systems facilitate the

identification of high-potential employees, monitor performance trajectories, and link professional development initiatives with succession planning and institutional goals.

Additionally, strategic HRM in higher education must consider the evolving digital and technological landscape. HR practices that integrate data-driven insights, digital learning platforms, and workforce analytics create the foundation for adaptive capacity, evidence-based policy development, and alignment with national and international standards for human capital management or ISO 30414:2018 (Becker & Huselid, 2006). By embedding these capabilities within HRM processes, universities can ensure that workforce strategies not only respond to demographic and structural challenges but also foster innovation, academic excellence, and long-term institutional resilience.

Succession Planning in Higher Education

Succession planning is a critical function within human resource management aimed at ensuring leadership continuity, preserving institutional knowledge, and mitigating risks associated with faculty and administrative turnover (Bunthong et al., 2019; Lewis & Heckman, 2006). In higher education, effective succession planning involves not only identifying potential leaders but also assessing their competencies, providing tailored development opportunities, and aligning career pathways with long-term institutional objectives (Groves, 2007; Rothwell, 2023). Structured succession planning enables institutions to fill critical positions promptly, maintain operational stability, foster innovation, and safeguard the quality of academic and administrative leadership (Friedman & Phillips, 2004; Sarros et al., 2011).

Despite its strategic importance, succession planning in universities is often informal and reactive. Traditional approaches typically rely on mentorship, seniority, or experience-based promotion rather than on systematic, evidence-based frameworks that evaluate leadership readiness and potential (Day et al., 2014). Such practices may result in a misalignment between institutional needs and the capabilities of potential successors, increasing vulnerability in governance, strategic decision-making, and academic program continuity (Ready & Conger, 2007). Furthermore, many higher education institutions lack integrated systems that connect succession planning with performance management, learning and development, and strategic workforce analytics, limiting their capacity to make data-informed talent decisions (Collings & Mellahi, 2009).

Recent scholarship highlights the potential of digital technologies to transform succession planning from a reactive to a proactive and strategic process. Predictive analytics, AI-enabled talent assessments, and competency mapping can generate actionable insights into workforce readiness, identify high-potential individuals, and inform targeted development interventions (Chamorro-Premuzic et al., 2016; Mahamud & Suttikan, 2020; Mer, 2023). Furthermore, integrated systems that link succession planning with learning and development, performance evaluation, and HR analytics enable continuous monitoring of skill gaps, leadership readiness, and career progression (Jaroensook et al., 2015). The application of these technologies supports the development of dynamic succession pipelines that can adapt to both internal institutional changes and external environmental shifts, such as technological disruption or demographic transitions (Collings & Mellahi, 2009; Vaiman et al., 2012).

Digital Transformation in Higher Education

Digital transformation has emerged as a central driver of modern human resource management, enabling higher education institutions to move beyond traditional transactional practices toward strategic, data-driven approaches that integrate organizational strategy with workforce planning (Marler & Parry, 2015; Schweyer, 2004; Stone et al., 2015). The adoption of integrated digital platforms, including HRIS, LMS, performance management systems, and digital competency assessment tools, allows universities to collect, consolidate, and analyze multi-source data in real time. These systems provide actionable insights into employee competencies, skill gaps, learning progression, performance outcomes, and institutional capability alignment, thereby supporting evidence-based decision-making and strategic workforce planning (Bondarouk & Brewster, 2016; Jaroensook et al., 2015).

The incorporation of AI, ML, and advanced analytics into HRM further enhances the strategic management of talent. Predictive modeling can forecast retirements, turnover risks, and competency shortages, allowing institutions to proactively manage succession planning and workforce allocation (Chamorro-Premuzic et al., 2016; Mahamud & Suttikan, 2020; Mer, 2023). AI algorithms can also identify high-potential personnel, recommend personalized development programs, optimize career pathing, and monitor leadership readiness. Interactive dashboards, real-time visualization tools, and predictive scorecards further support institutional leaders in monitoring workforce trends, evaluating HR initiatives, and aligning human capital strategies with long-term academic and organizational goals (Marler & Parry, 2015).

Despite these global advancements, digital transformation in Thai higher education remains uneven. Many universities continue to operate fragmented HR and learning systems with limited integration across HR, performance, and development modules (Jaroensook et al., 2015). This fragmentation restricts the capacity to leverage AI-enabled predictive analytics, real-time monitoring, and integrated decision-making for talent development. As a result, HRM practices remain largely reactive, succession planning is ad hoc, and workforce development is insufficiently aligned with institutional strategy. Furthermore, challenges such as data governance, system interoperability, digital literacy, and cybersecurity concerns impede the full realization of digital HR capabilities within the Thai higher education context (Bondarouk & Brewster, 2016; Marler & Parry, 2016; Strohmeier, 2020).

Beyond operational efficiency, digital transformation embedded within HRM fosters institutional transparency, accountability, and governance by enabling real-time monitoring of workforce performance, leadership readiness, and human capital investment outcomes. Integration with international standards such as ISO 30414:2018 ensures systematic workforce analytics, robust reporting, and alignment with global best practices in human capital management. Ultimately, a digitally transformed HR ecosystem allows universities to proactively manage talent, strengthen leadership pipelines, enhance organizational resilience, and maintain competitive advantage in the twenty-first-century academic landscape (Bondarouk & Brewster, 2016; Marler & Parry, 2016; Stone et al., 2015).

In summary, the literature indicates that higher education institutions continue to face persistent challenges in human resource management, succession planning, and digital transformation. Conventional HRM practices remain largely transactional and reactive, often failing to integrate workforce planning, competency development, and performance management into a coherent strategic framework (Collings & Mellahi, 2009). Succession planning is frequently informal and ad hoc, relying on seniority or mentorship rather than

evidence-based assessment and predictive analytics, leaving institutions vulnerable to leadership discontinuity and skill shortages (Lewis & Heckman, 2006; Rothwell, 2023). Meanwhile, despite the transformative potential of digital technologies, adoption in Thai universities remains uneven, with fragmented HR, learning, and performance systems constraining the use of AI, predictive modeling, and real-time analytics for proactive workforce management (Chamorro-Premuzic et al., 2016). These interrelated gaps underscore the need for an integrated and intelligent framework that consolidates strategic HR processes, succession planning, and digital capabilities to enhance workforce effectiveness and institutional resilience, particularly within Thai public higher education institutions, where leadership continuity, regulatory compliance, and long-term workforce sustainability are critical concerns.

Building on the identified literature gaps and the conceptual rationale for the proposed TMSP framework, the following Methodology section outlines the systematic approach used to design and validate the proposed framework. It details the procedures for conceptual model development, alignment with international standards, the integration of best practices derived from empirical research, and the incorporation of digital and AI-enabled tools for talent management and succession planning. This methodological design ensures transparency, rigor, and replicability in developing an evidence-based and contextually relevant framework to address the complex HR challenges faced by higher education institutions.

Research Methods

This study employed a conceptual development and design research approach to construct and validate an integrated framework for a TMSP system tailored to the higher education context amid digital transformation. The research adopted a multi-phase methodology encompassing: 1) theoretical synthesis; 2) alignment with international standards; 3) incorporation of best practices; 4) system modeling, and 5) expert validation. This methodological design ensures that the proposed framework is both theoretically robust and technically feasible, while strategically aligned with global principles of human capital management. Consequently, the study offers practical relevance and a scholarly contribution to the digital transformation of talent management systems within academic institutions.

Conceptual Development and Research Design

The conceptual development of the proposed TMSP framework was grounded in Design Science Research (DSR) and System Development Methodology (SDM) principles, emphasizing iterative refinement between conceptual modeling and empirical validation. The study employed a multi-phase approach to ensure both scholarly rigor and practical relevance. The research process encompassed five main stages: literature synthesis, alignment with international standards and integration of best practices, framework conceptualization, system modeling, and framework validation.

Phase I – Literature Synthesis

This stage involved a comprehensive review of scholarly literature on HRM, succession planning, and digital transformation within the higher education sector. The analysis identified critical gaps in existing frameworks, particularly the lack of system-level integration, limited

interoperability among HR modules, and the absence of standardized performance analytics tailored to the unique context of higher education institutions.

Phase II – Standards Alignment and Best Practices Integration

In this phase, the proposed TMSP framework was aligned with internationally recognized standards for human resource management, succession planning, and digital governance, and integrated with operational best practices to ensure scalability, interoperability, and compliance with global benchmarks. The design process followed an iterative, standards-based approach, incorporating leading models, governance frameworks, and regulatory mandates.

Standards Alignment:

- ISO 30414:2018 – Human Capital Reporting: Established a quantitative and qualitative foundation for workforce analytics, providing measurable indicators for capability development, succession readiness, and leadership sustainability.
- IEEE Std. 830–1998 – Software Requirements Specification (SRS): Defined both functional and non-functional requirements, ensuring traceability, validation, and verification throughout the system lifecycle.
- Information Security and Data Protection Standards: Incorporated ethical and secure HR data management practices, including PDPA (Thailand), ISO/IEC 27001:2022, ISO/IEC 27701:2019, ISO/IEC 27002:2022, NIST SP 800-53 Rev.5, NIST SP 800-92, OWASP Top 10 (2025), OWASP API Security Top 10 (2023), and OWASP ASVS v5.0.0.
- IT Service and Business Continuity Standards: Ensured system resilience and operational continuity in accordance with ISO 22301:2019, ITIL Tier III+, and ISO/IEC/IEEE 12207:2017.

Each standard and regulation functioned as a design anchor guiding the development of key system attributes, including data governance, security, usability, and stakeholder alignment. This approach ensured that the framework remained compliant, adaptable, and contextually relevant to higher education institutions.

Integration of Best Practices:

The framework also embedded operational best practices from digital HR transformation, evidence-based management, and organizational learning to promote excellence and sustainability:

- Flipped HR Architecture: Shifted from reactive HR administration to proactive, analytics-driven workforce management.
- AI-Augmented Talent Analytics Applied predictive analytics and competency-gap mapping across interconnected data sources.
- Continuous Learning Ecosystem: Enabled personalized learning pathways, competency progression, and institutional capability development.
- Data Security and Privacy Compliance: Integrated two-factor authentication, encrypted APIs, and adherence to GDPR and ISO/IEC 27001 principles.
- Feedback and Continuous Improvement Loop: Embedded user feedback mechanisms, system audits, and iterative refinement processes.

By combining standards alignment with best practices, the proposed TMSP framework operates not only as a digital HR system but also as a strategic enabler of institutional resilience, leadership sustainability, and evidence-based workforce development.

Phase III – Framework Conceptualization

Building on insights from the literature synthesis and standards alignment, the proposed TMSP framework was conceptualized as a modular architecture consisting of six interrelated components: Talent Identification and Development, Performance Management, Learning and Development, Succession Planning, Career Pathing and Internal Mobility, and Analytics and Strategic Insights. Each module was designed to incorporate data-driven and AI-enabled decision mechanisms to enhance transparency, workforce readiness, and strategic continuity. The modular design also ensures flexibility for future scalability and adaptation, supporting the dynamic and evolving requirements of digital HR transformation within higher education institutions.

Phase IV – System Modeling

The proposed TMSP framework requirements were derived from organizational policies and guidelines, international human resource standards, and emerging digital technology trends. This ensured that the system design addressed real organizational needs, aligned with strategic HR objectives, and supported contemporary human resource management practices. During this stage, both functional and non-functional requirements were defined to operationalize the proposed TMSP framework.

Functional requirements encompassed module-specific capabilities such as:

- Automated competency assessment
- Performance tracking
- Succession scenario simulation
- Analytics dashboards and reporting

Non-functional requirements, categorized according to Sommerville (2016) included:

1. Product Requirements
 - Efficiency Requirements
 - Performance Requirements
 - Space Requirements
 - Dependability Requirements
 - Security Requirements
 - Usability Requirements
2. Organizational Requirements
 - Environmental Requirements
 - Operational Requirements
 - Development Requirements
3. External Requirements
 - Regulatory Requirements
 - Ethical Requirements
 - Legislative Requirements
 - Safety and Security Requirements

In addition, the system architecture was designed to address interoperability, data security, scalability, and compliance with relevant standards and regulations. To enhance workforce decision-making capabilities, the proposed TMSP framework incorporates AI-driven analytics and predictive modeling techniques that support automated reporting, workforce forecasting, and evidence-based talent management.

Within the Career Pathing and Internal Mobility Module, content-based filtering and collaborative filtering algorithms are employed to analyze competency profiles, historical development records, career interests, and IDP goals, enabling personalized learning and career development recommendations. In the Succession Planning Module, predictive analytics are operationalized through a digitalized 9-Box Matrix framework that integrates longitudinal performance data and multi-source competency assessments to identify High-Potential (HiPo) personnel, evaluate succession readiness, and support leadership pipeline development.

Furthermore, machine learning algorithms, including decision trees, random forests, and logistic regression models, are incorporated to forecast workforce risks, identify competency gaps, assess talent potential, and support strategic workforce planning. These algorithms were selected for their interpretability, predictive performance, and widespread adoption in workforce analytics, talent management, and decision-support applications. Collectively, these intelligent capabilities strengthen data-driven and competency-based decision-making, thereby contributing to more effective talent management and succession planning within Thai public higher education institutions.

This stage ensured that the conceptual framework was translated into a technically feasible, operationally robust, and standards-compliant system, fully aligned with organizational strategies and global human capital management practices.

Phase V – Framework Validation

The proposed TMSP framework was validated through expert consultation involving five experienced professionals in digital transformation, human resource management, enterprise information systems, information security, and higher education administration. The experts were selected using purposive sampling and were required to possess at least ten years of professional experience, demonstrated involvement in organizational development or digital transformation initiatives, and active participation in strategic decision-making within public-sector higher education institutions. The multidisciplinary composition of the panel ensured a comprehensive evaluation of the framework's organizational, technical, governance, and regulatory dimensions, including alignment with Thailand's PDPA, information security requirements, and higher education management practices.

A structured expert review was conducted using the SRS document, which included the conceptual framework, system architecture, functional and non-functional requirements, use cases, and workflow descriptions. The evaluation instrument consisted of 12 dimensions and 60 assessment items covering accuracy, completeness, clarity, consistency, testability, traceability, modifiability, requirement stability, understandability, design independence, system scope appropriateness, and document structure.

All items were assessed using a five-point Likert scale (1 = Needs Significant Improvement to 5 = Excellent), supplemented by qualitative comments and recommendations. Quantitative data were analyzed using descriptive statistics, while qualitative feedback was synthesized to identify areas for improvement and framework refinement.

To strengthen the rigor of the Design Science Research (DSR) evaluation, feedback and recommendations obtained through a structured expert review using a Software Requirements Specification (SRS) evaluation instrument developed in accordance with the requirements engineering principles and quality characteristics defined in ISO/IEC/IEEE 29148:2018 (Systems and Software Engineering—Life Cycle Processes—Requirements Engineering) were incorporated into iterative framework refinements. These refinements were implemented to improve the completeness, consistency, clarity, and practical applicability of the proposed TMSP framework, as well as to ensure alignment with applicable standards, regulatory requirements, and institutional policies. Key enhancements included the incorporation of public-sector promotion pathways, succession talent pools, AI-enabled analytical functionalities, and strengthened security controls to support compliance with Thailand's PDPA and best practices in human resource management, succession planning, information security, data privacy, and higher education governance and administration.

In summary, the methodology for developing the proposed TMSP framework integrated conceptual development, design science principles, and system development practices to ensure both theoretical rigor and practical relevance. The study followed a *concept-to-system trajectory* encompassing five key phases: literature synthesis, standards alignment and best practices integration, framework conceptualization, system modeling, and framework validation. This multi-phase approach identified gaps in existing talent management practices, designed a modular and standards-compliant architecture, operationalized functional and non-functional requirements, and refined the framework based on expert feedback. Ethical and quality considerations, such as transparency, adherence to publication ethics, peer review, and data triangulation, were embedded throughout the research process to ensure validity, reliability, and objectivity. The resulting iterative process produced a framework that is conceptually rigorous, technically feasible, interoperable, and strategically implementable, supporting AI-enabled human capital management and succession planning in alignment with institutional digital transformation strategies.

Results

This section presents and interprets the key findings derived from the system analysis and modeling stages of the study. The results reflect how the proposed TMSP framework operationalizes the conceptual framework into a technically feasible and strategically aligned digital solution for higher education institutions. The discussion highlights how the system's design addresses the identified gaps in talent management practices, ensuring integration, compliance, and adaptability in the context of digital transformation.

Proposed TMSP Framework

Functional Requirements

This subsection outlines the functional requirements that define the core capabilities of the proposed TMSP framework. These functions specify what the system must carry out to support effective talent identification, performance evaluation, learning and development, succession planning, and career mobility. Each functional requirement reflects the system's ability to automate HR processes, enhance decision-making through analytics, and ensure

seamless data integration across modules, thereby strengthening institutional agility and workforce sustainability.

The proposed intelligent digital framework for Thai public higher education institutions comprises six core modules: talent identification and development, performance management, learning and development, succession planning, career pathing and internal mobility, and analytics and strategic insights. The framework addresses workforce complexity by strengthening institutional capabilities to identify, develop, and retain high-potential personnel, ensure leadership continuity, and align workforce competencies with long-term strategic objectives. By leveraging workforce analytics and aligning with national development initiatives, including Thailand 4.0 and the 20-Year National Strategy (2018–2037), the framework supports the development of a resilient and future-ready academic workforce. Ultimately, the framework is designed to enhance institutional competitiveness, promote sustainable innovation, and support Thai public higher education institutions in responding effectively to demographic, technological, and workforce-related challenges.

The Talent Identification and Development Module enables universities to systematically identify, analyze, and nurture high-potential personnel through AI-driven analytics, data integration, and real-time monitoring. It automates talent classification, supports evidence-based decision-making through strategic dashboards, and aligns personalized IDPs with organizational goals and competency frameworks. The system continuously tracks progress, evaluates learning outcomes, and integrates insights across related modules such as Performance Management and Succession Planning. With intelligent features like AI-based career pathing, automated notifications, and real-time competency analytics, the module enhances accuracy, transparency, and efficiency in workforce development. Ultimately, it strengthens the talent pipeline, reduces leadership gaps, and fosters a culture of continuous learning and sustainable growth within higher education institutions.

The Performance Management Module enhances strategic human resource management by integrating performance evaluation with talent development and succession planning. It connects seamlessly with central university appraisal systems, automatically retrieving and analyzing performance data for evidence-based decisions. The system manages KPIs and OKRs, aligning them with goals defined in IDPs to ensure coherent talent development. It supports continuous, real-time feedback and performance reviews, fostering a culture of ongoing improvement and transparency. Through structured Performance Improvement Plans (PIPs), it addresses competency gaps and mitigates risks in critical roles. Furthermore, performance results are used to assess readiness for advancement and inform succession planning, ensuring fair and data-driven decision-making. Overall, the module builds an integrated, continuous, and transparent performance culture that strengthens workforce capability, enhances leadership continuity, and enables strategic workforce planning in higher education institutions.

The Learning and Development Module provides an integrated, data-driven framework for managing employee training and continuous development. It connects seamlessly with the LMS to deliver and monitor both online and instructor-led training, ensuring flexible and accessible learning. The module supports personalized learning paths aligned with individual goals and organizational needs and uses skill gap analysis to design targeted development plans. It offers comprehensive tracking and reporting of learning progress, certifications, and compliance, while evaluating learning outcomes and Return on Investment (ROI) to measure

impact on performance and organizational effectiveness. Key intelligent features, such as automated notifications, analytics dashboards, and integration with Talent Identification and Performance Management modules, promote a culture of continuous learning and adaptability. Overall, it enables systematic, measurable, and strategic workforce development aligned with institutional objectives and international standards.

The Succession Planning Module provides a comprehensive, data-driven system for identifying, developing, and managing high-potential employees to ensure leadership continuity. It enables the selection and grouping of talent into a centralized Talent Pool based on performance and competency assessments, allowing continuous updates to reflect organizational needs. The module supports real-time readiness assessment for leadership roles, successor mapping, and flexible succession plan management to align with organizational changes. It integrates with the IDP and supports mentorship and coaching to enhance future leaders' readiness. Through AI-powered predictive analytics, it forecasts talent potential and future workforce needs while performing competency gaps and risk analysis for key positions. The system ensures transparent, data-informed decision-making, automates tracking and notifications, and connects succession plans with the organization's long-term strategy. Overall, it strengthens leadership pipelines, minimizes talent risks, and enhances organizational resilience and sustainability.

In the Thai public higher education context, the Succession Planning Module supports leadership continuity in alignment with the personnel management regulations of the Ministry of Higher Education, Science, Research and Innovation (MHESI) and the Civil Service Commission for Higher Education Personnel (OCHEC). The module assists in identifying and developing potential successors for key positions, including department heads, deans, vice presidents, and university presidents, based on competency, performance, leadership readiness, and development outcomes. In addition, the module supports the establishment of succession talent pools and provides decision-support information for executive search and nomination processes, thereby facilitating transparent and evidence-based leadership selection in accordance with institutional governance practices.

The Career Pathing and Internal Mobility Module empowers organizations to design flexible, data-driven career development pathways that align employee growth with strategic workforce needs. It adopts a Lattice Model, supporting vertical, horizontal, and cross-functional career movements to encourage diverse skill development and leadership readiness. By integrating Job Descriptions (JD) and competency frameworks, the system identifies skill gaps, recommends targeted learning via IDPs, and matches employees with suitable positions based on their profiles and aspirations. Automated notifications alert employees to promotion opportunities, special projects, or learning programs, ensuring timely development and engagement. The module promotes internal mobility, reducing recruitment costs and dependency on external hires, while visual Career Maps link with Learning and Development modules to track progress and outcomes. Additionally, AI-driven alerts identify employees who meet promotion criteria in real time, supporting fair and transparent decisions. Overall, the system enhances talent utilization, workforce agility, employee engagement, and long-term organizational sustainability through clear, personalized, and data-informed career pathways. In the context of Thai public higher education institutions, the Career Pathing and Internal Mobility Module supports career progression for both academic and support personnel. For academic staff, the module aligns career development with academic promotion pathways and

competency requirements established by OCHEC. For support personnel, it facilitates preparation for future supervisory, managerial, and executive roles through competency-based development pathways and internal mobility opportunities. The module supports transparent career advancement while aligning workforce development with institutional and regulatory requirements.

The Analytics and Strategic Insights Module leverages advanced technologies such as AI, ML, and data analytics to provide real-time, data-driven insights that strengthen strategic decision-making in human capital management. It analyzes talent potential, workforce readiness, and succession risks, offering predictive insights into employee retention, leadership pipelines, and competency trends. The module enables customizable strategic reports tailored to different management levels, identifies competency gaps, and automatically links findings to IDPs for targeted employee development. It supports scenario simulations for workforce planning, helping organizations anticipate structural changes and allocate resources effectively. Interactive dashboards and visualizations, including talent heatmaps, HR scorecards, and readiness indicators, enhance monitoring and promote a data-driven culture. By integrating analytics across all modules in the proposed TMSP framework, the system creates a 360-degree view of each employee and the entire workforce, ensuring cohesive and evidence-based HR strategies. Overall, this module enhances organizational agility, reduces talent-related risks, and aligns workforce development with long-term strategic objectives.

Non-Functional Requirements

This subsection presents the non-functional requirements that determine the quality attributes and performance standards of the proposed TMSP framework. These requirements ensure that the system operates efficiently, securely, and reliably within organizational and regulatory constraints. They encompass product, organizational, and external dimensions, including usability, scalability, data protection, ethical compliance, and interoperability. Collectively, these attributes establish the foundation for a robust, standards-compliant, and user-centered HR digital ecosystem.

The non-functional product requirements specify that the system must deliver high efficiency, reliability, security, and usability to support organizational performance and user satisfaction. In terms of efficiency and performance, the system should display dashboards and reports within 3–5 seconds, support at least 100 concurrent users, and process AI-driven assessments and large datasets rapidly to enable real-time decision-making. Storage capabilities must allow for at least five years of historical data retention, daily automated backups, and flexible cloud or on-premises storage to ensure data integrity and long-term reliability. Dependability requirements emphasize continuous system availability of no less than 99% uptime per month, rapid recovery from failures within one hour, and compliance with ISO 22301:2019 and ITIL Tier III standards to maintain business continuity. Security provisions include two-factor authentication, strong encryption (AES-256, TLS 1.3), access control through RBAC, audit logging, API protection, and adherence to Thailand's PDPA, ISO/IEC 27001, and OWASP security frameworks to prevent data breaches and unauthorized access. Finally, usability requirements focus on a user-friendly, accessible, and multilingual interface that is compatible across devices, customizable in appearance, and compliant with WCAG 2.2 Level AA, ensuring inclusivity and ease of use for all personnel, including those with special needs.

Collectively, these requirements ensure that the system operates securely, efficiently, and reliably while delivering a seamless and equitable user experience.

The organizational requirements ensure the system's flexibility, interoperability, and long-term sustainability across diverse institutional contexts. It must support both cloud and on-premises deployment, function across major operating systems, and integrate seamlessly with existing IT infrastructure under Zero Trust Security principles. Operationally, the system must provide secure interoperability via well-documented APIs, implement Role-Based Access Control (RBAC), maintain comprehensive audit trails, and include structured user training to enhance adoption and data governance. Development requirements call for the use of internationally recognized programming frameworks (e.g., Java, .NET, Python, Angular, React), Agile or DevOps methodologies, and adherence to standards such as ISO/IEC/IEEE 12207:2017 and OWASP Top 10 to ensure security, maintainability, and scalability. Together, these requirements strengthen institutional IT resilience, reduce vendor dependency, and support continuous improvement in system performance and governance.

For External Requirements, the system must comply with external legal, ethical, and security standards to ensure lawful, transparent, and secure operations. It must fully adhere to Thailand's PDPA, cybersecurity regulations, and international standards such as ISO/IEC 27001, ISO/IEC 27701, and NIST guidelines, thereby enabling secure data storage, deletion upon request, and timely data breach reporting. Ethical safeguards must protect confidential information through controlled access and prevent unauthorized or discriminatory data usage. The system must also conform to applicable national laws and institutional policies, maintaining comprehensive access logs for auditing and legal compliance. Furthermore, it must implement robust cybersecurity measures, including real-time threat detection, anomaly alerts, and secure activity logging, aligned with OWASP standards and government cybersecurity practices. Collectively, these measures strengthen compliance, data protection, accountability, and user trust.

Proposed TMSP Framework Architecture

This subsection illustrates the system architecture of the proposed TMSP framework, representing the interaction among modules, data flows, and integration layers. The architecture visualizes how different functional components, such as talent identification, performance management, learning and development, and analytics, are interconnected through centralized databases and secure communication protocols. This modular and service-oriented architecture ensures interoperability, scalability, and resilience, enabling the system to adapt dynamically to institutional needs and technological advancements.

The architecture of the proposed TMSP framework was designed based on the Three-Tier Architecture model, comprising three main layers: the Presentation Tier, the Application Tier, and the Data Tier (Fowler et al., 2002). Each layer has clearly defined roles and responsibilities and operates in coordination through standardized communication protocols to ensure that data flows accurately, securely, and efficiently, as illustrated in Figure 1.

The Presentation Tier is the layer through which users directly interact with the system via web or mobile applications (iOS/Android). It employs modern User Interface (UI) frameworks such as Angular or React to manage the Document Object Model (DOM) and deliver a responsive, seamless user experience. When users perform actions such as generating reports, searching for information, or submitting data, the proposed TMSP framework issues RESTful API requests

with the appropriate parameters and transmits them over HTTPS to ensure secure communication and prevent data interception. This tier also includes a Backend API Controller that serves as an intermediary between the user interface and the Application Tier, managing request routing, response handling, and data validation before presentation to ensure that users receive accurate, complete, and timely information.

The Application Tier functions as the central layer responsible for processing and managing all business logic. It handles user authentication and authorization via Lightweight Directory Access Protocol (LDAP)/Active Directory (AD) systems and supports Two-Factor Authentication (2FA) to enhance data access security. This tier consists of six primary functional modules, each designed to address specific organizational requirements and directly linked to its corresponding database. The workflow in this layer begins when API requests are received from the Presentation Tier. The proposed TMSP framework first verifies user roles and permissions based on the RBAC principle to define access boundaries. It then selects the appropriate functional module corresponding to the request and generates Structured Query Language (SQL) or Object-Relational Mapping (ORM) queries to retrieve or manipulate data from the designated database. These queries are executed within the Data Tier. Once the results are returned, the Application Tier performs additional processing, such as data aggregation, predictive analytics, or data transformation, to prepare information for presentation. Finally, the system generates an API response in JSON or XML format and transmits it back to the Presentation Tier, ensuring that users receive accurate, complete, and timely information presented in user-friendly formats such as graphs, tables, or notifications.

The Data Tier is responsible for storing and managing all data within the proposed TMSP framework. Databases are categorized into Internal, External, and External Centralized databases, utilizing an RDBMS such as MySQL. The key components of this tier include the Query Parser, Query Optimizer, Query Executor, Transaction Manager, and Storage Engine, which collectively ensure that SQL commands are executed accurately, efficiently, and securely. In addition, the Data Tier supports authentication through LDAP/AD to control data access and employs automated encrypted backup mechanisms for both on-premises and cloud storage environments. These measures enhance the overall security, reliability, and availability of the system's data at all times.

The summary of the data flow in the proposed TMSP framework illustrates the process beginning with a user submitting a request via the Web Application or Mobile Application in the Presentation Tier. The request is transmitted to the Application Tier, where user authentication is verified, data is encrypted and validated, and the request is processed. The system then generates commands to retrieve or update data from the Data Tier. Once the results are returned, the Application Tier verifies completeness, formats the data, and prepares it in a user-friendly format before sending it back to the Presentation Tier for display.

In summary, the proposed TMSP framework's Three-Tier Architecture provides a clear and well-structured system framework in which each tier operates independently while coordinating seamlessly. This design enhances security and standards compliance, improves accuracy and processing efficiency, reduces complexity in system development and maintenance, and effectively supports future scalability in both data volume and user capacity.

Figure 1
System Architecture Diagram of the Proposed TMSP Framework

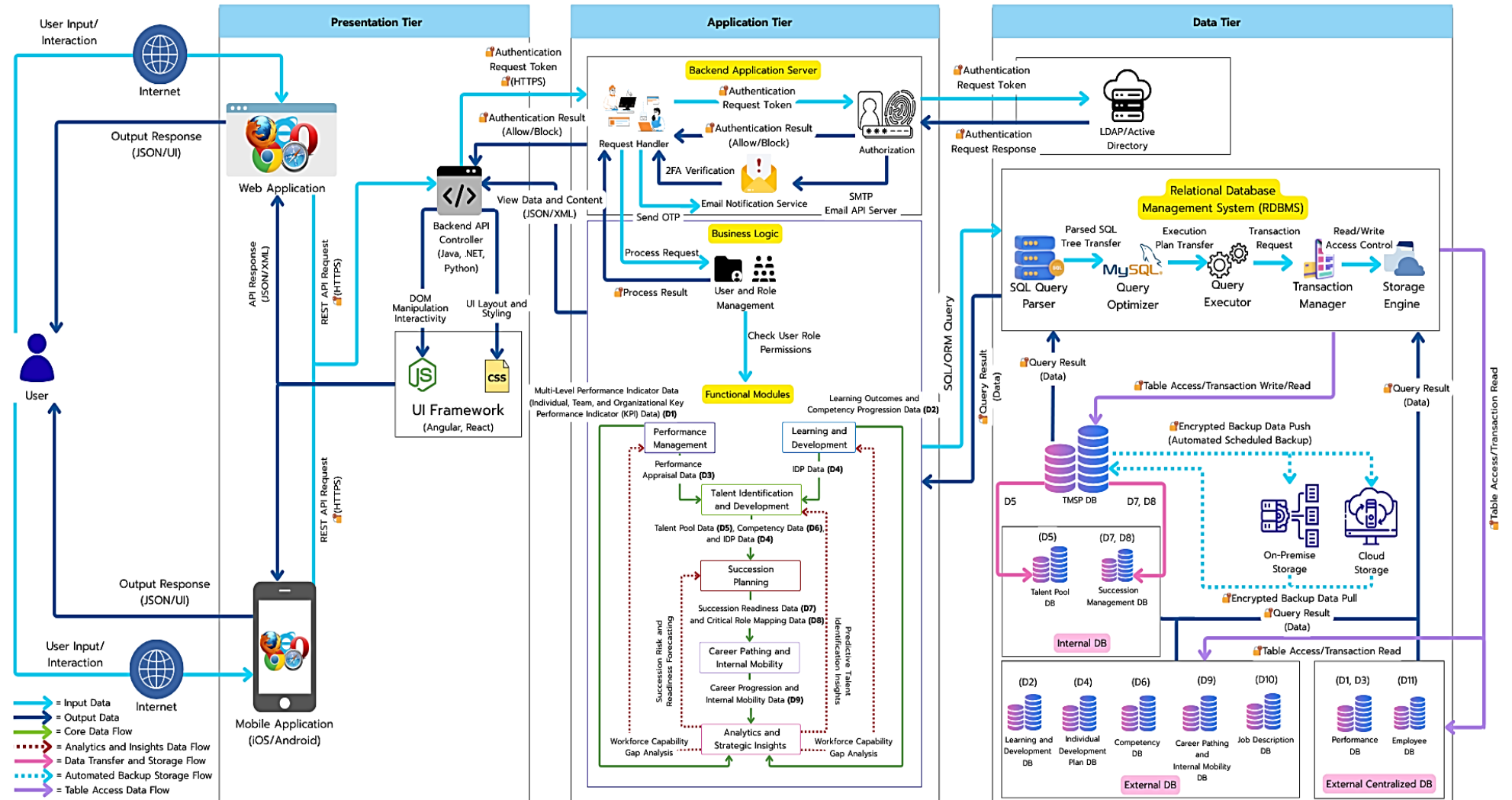


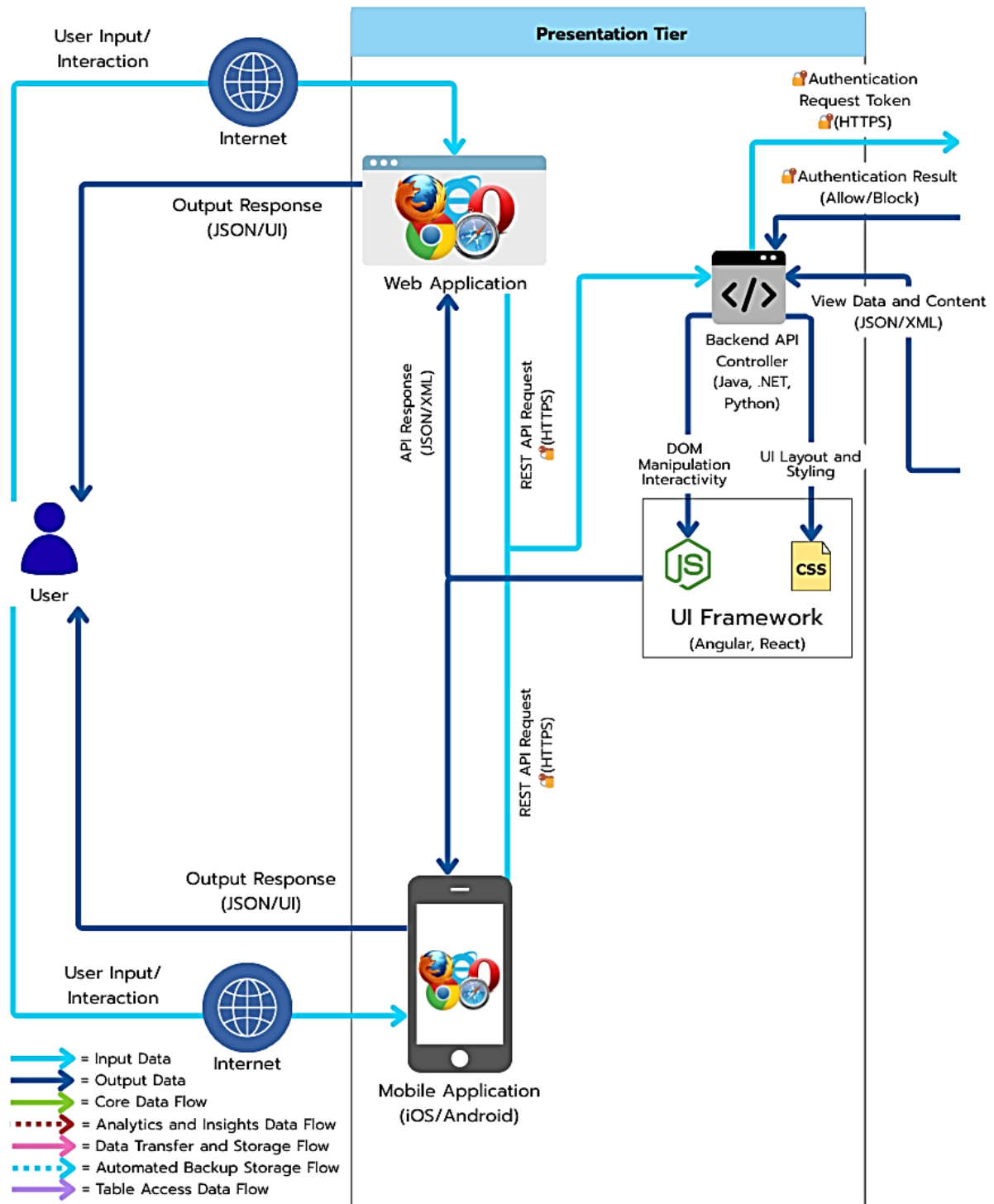
Figure 2*Presentation Tier of the Proposed TMSP Framework*

Figure 2 illustrates the data flow within the Presentation Tier, which can be described in the following steps:

1. Initiation by User Interaction

The user begins by opening the application on a web browser or mobile device (iOS/Android). They then click, type, or select various menus, constituting interaction (user input) with the proposed TMSP framework. This interaction instructs the system to perform specific operations such as logging in, searching for information, or submitting a form.

2. Submitting Requests to the Web or Mobile Application

Once the user provides input, the application generates a REST API request, which is transmitted via HTTPS with encryption to ensure data security during transit. This request is sent to the web or mobile application server to initiate processing.

3. Forwarding Data to the Backend API Controller

The web or mobile application receives the user input and forwards the request to the Backend API Controller, developed using programming languages such as Java, .NET, or Python. The Backend API Controller acts as an intermediary to manage business logic, verify user information, retrieve data from databases, and coordinate with relevant functional modules to process the request.

4. Authentication Request

If the request involves processes requiring user authentication, such as logging in, the system sends an authentication request with a token or credentials through a secure HTTPS channel to the authentication server. The server verifies the user information and returns an authorization result, either approval or denial, to the Backend API Controller, which then proceeds according to the user's access rights.

5. Receiving JSON/XML Data and Sending to the UI Framework

Once the backend has processed the request, the resulting data is returned to the Presentation Tier in JSON or XML format, which are standard data exchange formats. This data is then forwarded to the UI framework, such as Angular or React, for rendering on the user interface.

6. Managing DOM and UI Layout

The UI framework manages the webpage structure (DOM manipulation) and enables real-time interactivity with users, such as handling button clicks, opening or closing modal windows, or displaying dropdown lists. It also designs and styles the interface using CSS (Cascading Style Sheets) to control layout, themes, colors, fonts, and responsiveness, ensuring optimal display across different devices. This provides users with a seamless and engaging experience whether they access the system via computer, tablet, or mobile phone.

7. Displaying Output to the User (Output Response)

The data processed and prepared by the UI framework is displayed on the web or mobile application interface in user-friendly formats such as tables, dashboards, charts, or notifications. This represents the final output that the user views and can immediately interact with. If the user performs additional actions, such as clicking a button or navigating to another page, the entire process restarts in a new cycle, supporting continuous interaction and real-time responsiveness.

Summary of Data Flow in the Presentation Tier

Users interact with the proposed TMSP framework through web or mobile applications by sending requests via REST APIs to the backend API. The backend verifies permissions and processes the requests, returning data in JSON or XML format to the UI framework (e.g., Angular or React) for rendering on the user interface. This cycle repeats continuously in response to user interactions, ensuring dynamic and responsive system performance.

Figure 3
Application Tier of the Proposed TMSP Framework

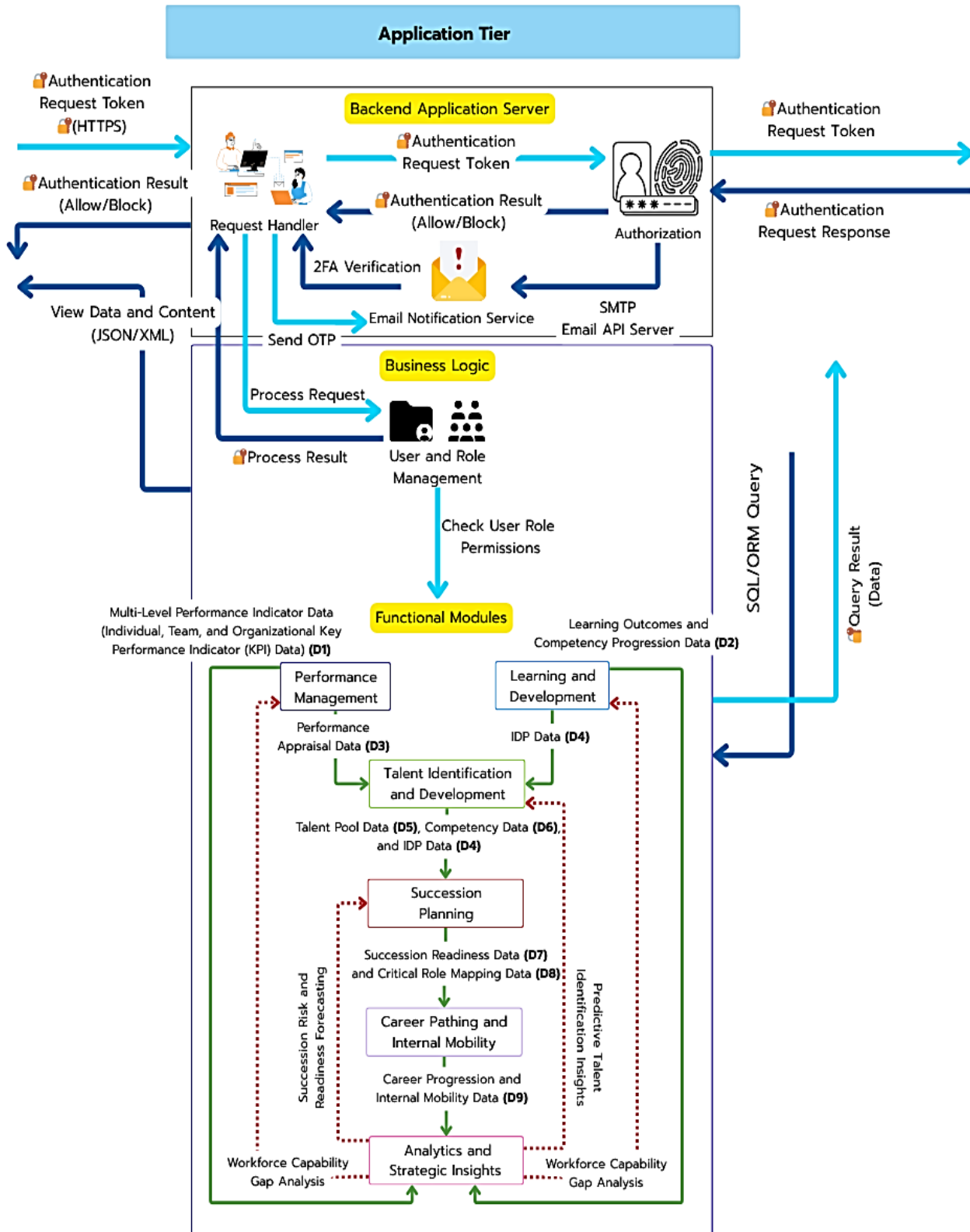


Figure 3 illustrates the data flow within the Application Tier of the proposed TMSP framework, which can be described in the following steps:

1. User Request and Authentication Token

Users accessing the proposed TMSP framework through web or mobile applications send requests via the HyperText Transfer Protocol Secure (HTTPS) to ensure secure data transmission. Each request includes an authentication token obtained after successful login. The request, received by the backend application server, contains both the token and the request type, such as GET, POST, PUT, or DELETE, indicating the operation and target resource. The server then forwards the request to the authentication system for verification.

2. Authentication

Upon receiving the request and token, the backend application server verifies the token through the authentication service connected to the user directory, such as AD or LDAP. If 2FA is enabled, a One-Time Password (OTP) is sent to the user's registered email address via the Simple Mail Transfer Protocol (SMTP) email Application Programming Interface (API) server. The user must enter the OTP to complete authentication. If the username, password, and OTP are valid, the system allows the request to proceed; otherwise, it blocks the request and terminates the process to maintain security.

3. Authorization

After successful authentication, the system evaluates the user's role to determine access rights to specific functions, data, or modules within the proposed TMSP framework, a process referred to as user and role management. The system verifies which modules or actions the user's role is permitted to access, thereby preventing unauthorized access and ensuring the protection of sensitive organizational data.

4. Forwarding Requests to Business Logic

Once authorization is verified, the proposed TMSP framework processes the request by analyzing its type and purpose, such as performance evaluation, talent development, or career path management. The request is then routed to the relevant functional module to perform the intended operation. This process is managed and coordinated by the Business Logic, which serves as the core engine defining rules, processing, and control of all business operations within the proposed TMSP framework. It also ensures seamless coordination between the Presentation Tier and Data Tier so that all processing aligns accurately and efficiently with organizational policies and requirements.

5. Invoking Functional Modules Based on User Requests

The functional modules within the proposed TMSP framework are invoked according to user requests. Each module has a specific role and is designed to address particular organizational needs. The selection of a module depends on the type of request and the user's verified access rights. The system automatically routes requests and associated data to ensure that processing is accurate, secure, and aligned with the intended operation.

6. Database Access

When a functional module requires data, it issues queries through the database access system using Object-Relational Mapping (ORM) techniques, which translate commands and data structures between the programming language and relational databases (RDBMS) such as MySQL or PostgreSQL. Queries are constructed to match the purpose of the request, and the retrieved data is transformed into the standardized format of the proposed TMSP framework for seamless processing in subsequent business logic operations.

7. Result Processing and Response

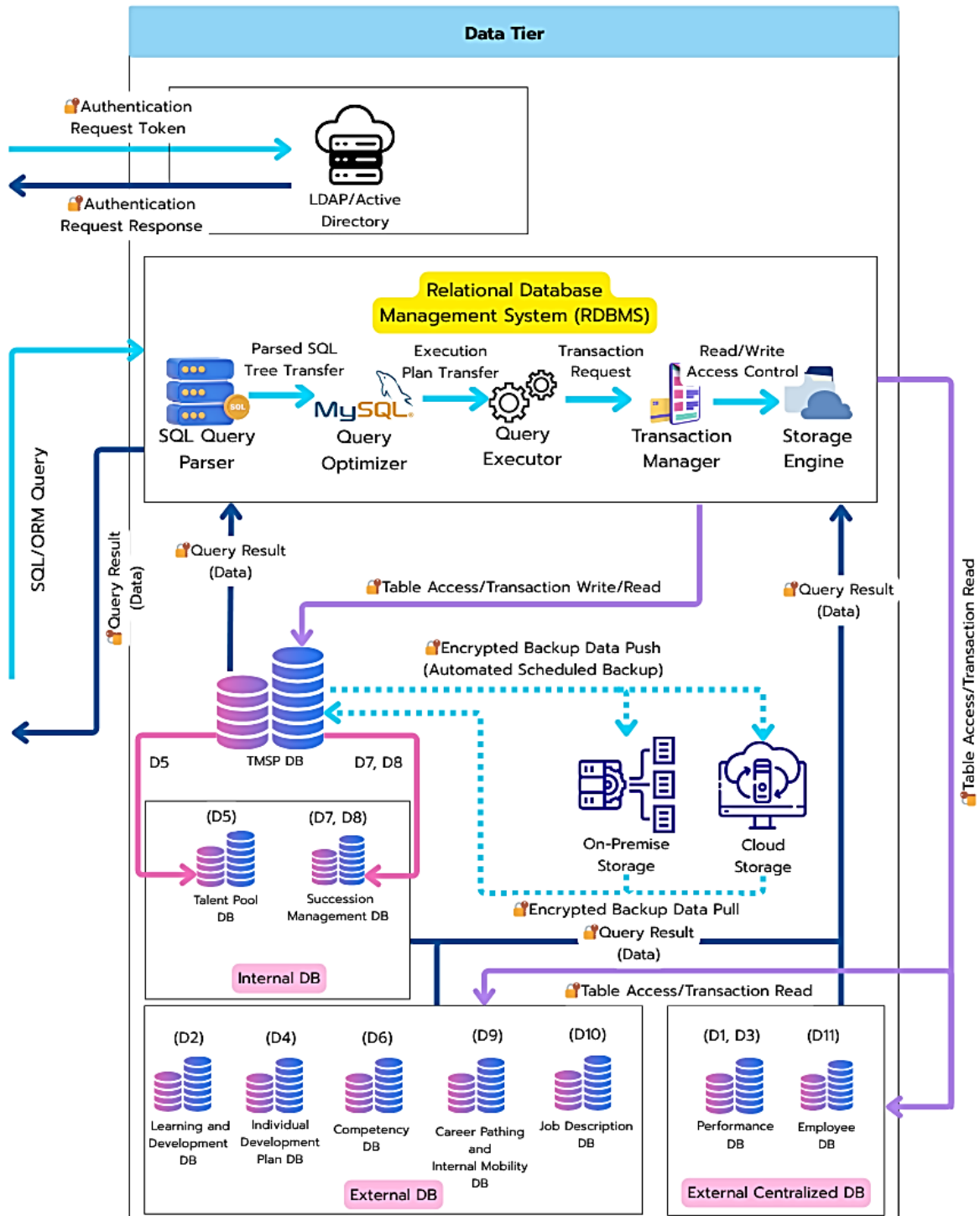
The query results from the database are further processed within the Business Logic layer, including filtering, sorting, and formatting the data for user presentation. The processed data is converted into formats that support integration with other systems, such as:

- JSON, which is lightweight and fast to process, suitable for REST APIs
- XML, which is flexible and supports complex data structures, commonly used in enterprise systems and web services

After processing, the system securely transmits the results back to the user via channels such as HTTPS, ensuring that the data is displayed on the web or mobile application accurately, efficiently, and securely.

Summary of Data Flow in the Application Tier

Users send requests with an authentication token via HTTPS to the backend server, which verifies user identity and access rights. The request is then routed to the Business Logic layer for processing and invokes the relevant functional modules connected to the Data Tier to retrieve data. The resulting data is transformed into JSON or XML format and securely returned to the user, enabling fast, accurate, and reliable presentation of results.

Figure 4*Data Tier of the Proposed TMSP Framework*

From Figure 4, the data flow in the Data Tier can be described as follows:

1. Authentication

Users send requests to access the proposed TMSP framework or its resources, and the system verifies their permissions to ensure security and strict access control. This process begins by sending an authentication request token to the LDAP or AD server. The system collects

authentication information, such as the username, password, or token, and forwards it to the LDAP or AD for verification. The LDAP or AD checks whether the user credentials match the records stored in the database. If the credentials are valid, the system returns an authentication response granting access (Allow) to the requested services or data. If the credentials are invalid or the user lacks the required permissions, access is immediately denied (Block) to prevent unauthorized entry.

2. Executing Commands and Processing Requests in the RDBMS

After authentication, users send SQL or ORM commands to access the database. These commands are processed by the RDBMS, which consists of several key components that manage and execute requests efficiently, including:

- SQL Query Parser: Converts received SQL commands into a parse tree structure to facilitate faster and simpler processing.
- Query Optimizer: Analyzes the parse tree and generates the most efficient execution plan, optimizing performance and resource usage.
- Query Executor: Executes commands according to the plan created by the optimizer, handling transactions that include read and write operations.
- Transaction Manager: Oversees all transactions, including read/write operations, rollback management, commit confirmation, and error handling, ensuring data integrity and enforcing access control.
- Storage Engine: Serves as the core mechanism that interacts with the physical data structures in the database, managing data storage, retrieval, and organization at the file or block level. It acts as an intermediary between the database system and the storage medium, such as hard drives or Solid-State Drives (SSDs).

3. Accessing and Managing Physical Data (Storage Engine Access)

Once the Transaction Manager authorizes a transaction, data access requests are passed to the Storage Engine, which directly interacts with the physical database layer. The proposed TMSP framework supports three types of databases:

- Internal Database – the system’s primary storage containing operational data.
- External Database – connected third-party or partner databases integrated through secure APIs.
- External Centralized Database – shared repositories used for cross-institutional or enterprise-wide data integration.

The Storage Engine efficiently manages these databases, supporting both transactional read and write operations to ensure data accuracy and maintain compliance with the principles of Atomicity, Consistency, Isolation, and Durability (ACID).

4. Returning the Result (Query Result)

After executing SQL or ORM commands, the Storage Engine returns the output through the RDBMS to the Application Layer that initiated the request. The RDBMS consolidates, formats, and structures the query results, either as raw records or ORM-mapped objects, so that the application can process and visualize them effectively. The Application then presents the results to users via the UI in the form of dashboards, reports, charts, or analytic tables. This enables users to interpret, analyze, and make informed decisions, thereby completing the data retrieval and feedback loop.

5. Automated Encrypted Backup

To safeguard data integrity and ensure high availability, the proposed TMSP framework implements an automated encrypted backup mechanism that operates continuously. The process includes:

- Periodically extracting data from the Internal Database at predefined intervals.
- Automatically encrypting the extracted data using industry-standard encryption algorithms to prevent unauthorized access.
- Storing the encrypted backups in both On-Premises Storage and Cloud Storage to enhance redundancy and disaster recovery capability.
- Enabling immediate Backup Data Retrieval when restoration is required or for purposes such as historical analysis, compliance verification, or data integrity validation.

This mechanism ensures that critical organizational data remains protected, recoverable, and compliant with information security standards.

Summary of Data Flow in the Data Tier

Users submit requests through an authentication system such as AD or LDAP to verify access rights. The SQL or ORM commands are then transmitted to the RDBMS for processing. The Storage Engine efficiently handles the physical reading and writing of data while maintaining ACID compliance to ensure data reliability. Once processing is completed, the system returns the results to the users for presentation through the interface layer. Furthermore, automated encrypted backups are executed regularly in both on-premises and cloud storage environments to guarantee continuous data security, integrity, and availability.

The analysis of the proposed TMSP framework architecture underscores the complementary roles of its three-tier design in supporting efficient, secure, and scalable talent management operations. The Presentation Tier enables user interaction through responsive web and mobile applications while maintaining secure communication via RESTful APIs over HTTPS. Frameworks such as Angular and React enhance interactivity, accessibility, and user experience across diverse platforms. The Application Tier functions as the central hub of business logic execution, overseeing authentication, authorization, and functional module coordination in strict adherence to RBAC and 2FA protocols. This design ensures accuracy, consistency, and data protection throughout operational processes. The Data Tier underpins the system by managing structured and centralized data storage using RDBMS, ensuring optimized query execution, transactional integrity, and encrypted backups that support business continuity and disaster recovery readiness.

Collectively, the three tiers form a coherent and modular architecture that distinctly separates concerns, enhances maintainability, and supports scalable, AI-enabled human capital management and succession planning. This design aligns technological implementation with institutional strategy and broader digital transformation objectives in Thai public higher education institutions.

Framework Validation Results

The evaluation results demonstrated a very high level of expert agreement regarding the proposed TMSP framework. Across 12 evaluation dimensions and 60 assessment items, the framework achieved an overall mean score of 4.97 (S.D. = 0.05), corresponding to 99.47% of the

maximum possible score and an overall rating of Excellent. These findings indicate that the framework was perceived as highly complete, feasible, clear, and practically relevant for implementation within Thai public higher education institutions.

Qualitative feedback further confirmed that the framework is well aligned with international best practices for digital transformation and workforce management in higher education institutions. Experts highlighted the clarity of the framework architecture, its modular and standards-aligned design, and its ability to support interoperability, security, scalability, and future system integration. The framework was also considered sufficiently flexible for adaptation across different institutional contexts. While several recommendations were provided to enhance clarity and implementation feasibility, such as refining user classifications, documenting requirement sources, and strengthening security specifications, no major structural modifications were deemed necessary.

Collectively, the validation findings confirmed that the proposed TMSP framework provides a theoretically sound, practically applicable, and standards-compliant foundation for AI-enabled talent management and succession planning in Thai public higher education institutions.

Discussions

Contributions and Implications

The proposed TMSP framework contributes to addressing critical workforce and succession planning challenges in Thai public higher education institutions through the integration of multi-source workforce data, competency mapping, and predictive analytics within a unified digital platform. By centralizing human resource information and linking it with performance and development metrics, the framework enables institutions to transition from reactive to proactive talent management practices. This integrated approach supports talent retention, leadership continuity, and long-term workforce sustainability while aligning workforce development initiatives with institutional strategic objectives (Bunthong et al., 2019; Collings & Mellahi, 2009).

Furthermore, the framework establishes a unified foundation for evidence-based workforce management by integrating HR, learning, and performance data within a single platform. This capability enables institutions to forecast workforce requirements, identify leadership risks, optimize talent deployment, and strategically align human resource initiatives with institutional priorities. The framework also supports continuous learning, professional development, and targeted upskilling, ensuring that faculty members and administrative personnel are equipped to respond to demographic shifts, technological disruption, and evolving organizational demands (Strohmeier, 2020).

A key contribution of the framework is the integration of succession planning within this broader AI-enabled ecosystem. Through predictive modeling, competency-based evaluations, and multi-source performance data, the framework supports the identification and development of high-potential personnel, facilitates leadership readiness assessment, and enables targeted professional development interventions (Groves, 2007). By linking succession planning with IDPs, learning and development activities, and institutional strategies, the framework helps ensure that future academic and administrative leaders acquire the competencies required to operate effectively in increasingly complex academic, technological, and policy environments.

Beyond operational improvements, the implementation of structured talent management and succession planning practices strengthens leadership pipelines, enhances organizational resilience, improves governance quality, and promotes transparency in workforce decision-making. By embedding AI-driven analytics and competency-based decision support within an integrated HR ecosystem, higher education institutions can mitigate the risks associated with leadership vacancies and critical skill shortages while maintaining continuity in academic and administrative excellence (Jaroensook et al., 2015; Ready & Conger, 2007; Rothwell, 2023). These capabilities enable institutions to respond proactively to demographic, technological, and market-driven changes while fostering a culture of continuous learning and professional growth (Mahamud & Suttikan, 2020; Mer, 2023).

Collectively, these findings demonstrate that the proposed TMSP framework provides a comprehensive, context-specific, and AI-enabled approach to talent management and succession planning. By integrating predictive analytics, competency-based workforce development, and strategic HR governance within a standards-aligned architecture, the framework offers a practical foundation for strengthening workforce sustainability, leadership continuity, institutional resilience, and long-term competitiveness in Thai public higher education institutions.

Limitations and Implementation Challenges

Although the proposed TMSP framework provides a comprehensive and standards-aligned approach to talent management and succession planning, several limitations and implementation challenges should be acknowledged. First, the framework was conceptually developed and validated through expert review rather than large-scale organizational implementation. Therefore, its operational effectiveness, user acceptance, and long-term organizational impacts have not yet been empirically evaluated in real-world settings.

Second, successful implementation requires substantial organizational resources, including financial investment, technological infrastructure, skilled personnel, and sustained institutional commitment to digital transformation. Many Thai public higher education institutions continue to operate fragmented and decentralized information systems, where Human Resource Information Systems (HRIS), LMS, and performance management platforms function independently with limited interoperability. Integrating these systems into a unified AI-enabled environment may require significant investments in system modernization, data governance, and standardized data management processes.

Third, the effectiveness of AI-driven analytics and predictive modeling depends heavily on the availability, accuracy, completeness, and consistency of workforce data. Institutions with fragmented, outdated, or low-quality HR data may experience reduced predictive accuracy and limited decision-support capabilities. In addition, the successful use of predictive analytics requires adequate digital literacy and analytical competencies among HR personnel, managers, and decision-makers. Users must be able to interpret analytical outputs appropriately to minimize potential algorithmic bias and avoid overreliance on automated recommendations.

Finally, differences in digital maturity, governance structures, organizational culture, regulatory requirements, and workforce management practices across Thai public higher education institutions may influence the transferability, scalability, and adoption of the framework. Consequently, successful implementation will require effective change management strategies, executive sponsorship, stakeholder engagement, and continuous

organizational capacity building to support the transition toward AI-enabled talent management and succession planning.

These limitations suggest the need for future empirical studies to evaluate framework effectiveness, user adoption, and contextual adaptability in real-world higher education environments.

Conclusions

This study developed and validated a comprehensive TMSP framework to support digital transformation in Thai public higher education institutions. By integrating conceptual development, DSR principles, and system development practices, the framework provides a robust, modular, and standards-compliant architecture that separates user interaction, business logic, and data management through a three-tier design. Ethical and methodological rigor, including transparency, expert review, and data triangulation, strengthened the validity and reliability of the study.

Expert validation confirmed that the framework is conceptually rigorous, technically feasible, and practically implementable. The framework demonstrated strong alignment with international standards and best practices for digital talent management, while supporting interoperability, scalability, security, and future system integration. Its standards-compliant architecture further supports governance, information security, and human capital management requirements within Thai public higher education institutions. Expert recommendations, including clarifying user classifications, documenting requirement sources, and strengthening security specifications, were incorporated to improve implementation readiness without necessitating major structural changes.

From both theoretical and practical perspectives, the proposed TMSP framework contributes to the advancement of digital talent management and succession planning by providing a systematic, AI-enabled, and data-driven approach to human capital management. By integrating talent identification, workforce development, succession planning, career mobility, and workforce analytics within a unified platform, the framework supports evidence-based decision-making, strategic workforce alignment, and proactive talent development. These capabilities strengthen workforce sustainability, enhance leadership readiness, and improve organizational adaptability in Thai public higher education institutions.

Several limitations should be acknowledged. The framework was conceptually developed and validated through expert evaluation rather than large-scale organizational implementation. Consequently, its long-term organizational impacts have not yet been empirically assessed. In addition, successful implementation requires adequate financial resources, technological infrastructure, skilled personnel, and institutional commitment to digital transformation. The effectiveness of AI-enabled analytics also depends on the availability, quality, and completeness of workforce data, while variations in institutional digital maturity and governance structures may influence framework adoption and scalability.

Future research should focus on pilot implementation and longitudinal evaluation of the framework within Thai public higher education institutions to assess its effects on leadership pipeline sustainability, employee development, workforce performance, and organizational effectiveness. Further studies may also investigate advanced AI and predictive analytics techniques, comparative institutional applications, and integration with broader enterprise

human resource systems to enhance framework capabilities and support wider adoption across diverse educational contexts.

Overall, the proposed TMSP framework provides a practical, standards-aligned, and AI-enabled foundation for strengthening workforce sustainability, leadership continuity, and strategic human capital management in Thai public higher education institutions.

Author Contributions

CT: Conceptualization, methodology, validation, formal analysis, visualization, writing—original draft, writing—review and editing, project administration, and funding acquisition.

Declaration of the Use of Generative AI

During the preparation of this manuscript, the authors used ChatGPT (OpenAI, GPT-5.5) to assist with language editing and manuscript polishing. The tool was used solely to improve clarity, grammar, and overall readability. The authors subsequently reviewed, verified, and revised the content as necessary. The authors take full responsibility for the accuracy, integrity, and content of the manuscript.

Ethics

This study adhered to accepted ethical standards for academic research, including voluntary participation, informed consent, confidentiality, and research integrity. Expert reviewers participated voluntarily and were informed of the study objectives prior to participation. No personally identifiable or sensitive data were collected, and all feedback was reported in a confidential and non-attributable manner. Formal ethical approval was not required because the study involved only voluntary expert review of the proposed framework and did not involve human-subject experimentation or the collection of sensitive personal data.

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