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MECHANISM FOR IMPLEMENTING THE PROCESSOF INTEGRATED MANAGEMENT OF THE DIGITAL DEVELOPMENT OF ENTERPRISE HUMAN CAPITAL[1]

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This study explores the mechanisms for implementing an integrated system for managing the digital development of human capital within enterprises in the context of Kazakhstan's transition to a digital economy. The research substantiates the need for a holistic model of human capital assessment and development that combines technological, organizational, and educational components. Using an integrative approach, the authors propose a structural-functional mechanism encompassing evaluation, formation, and growth of human capital through collaboration between enterprises, universities, and state institutions. The model includes a multi-level algorithm linking mission, goals, and sub-goals of the process, ensuring systemic coordination and adaptability to digital transformation. The paper also introduces the design of an information system that automates data collection, monitoring, and forecasting of human capital indicators, enabling quantitative evaluation of digital competencies and efficiency of investments in workforce development. The proposed methodology integrates principles of economic efficiency, feasibility, and innovation sustainability. The results contribute to strengthening Kazakhstan's scientific and practical foundation for digital workforce management and can be applied to industrial enterprises, educational institutions, and policymaking. The study highlights the theoretical significance of defining digital competence as a multidimensional construct encompassing literacy, creativity, and analytical capacity to use technology productively. Overall, the proposed integrative mechanism enhances the methodological toolkit for managing human capital under digitalization and provides strategic insights for ensuring competitiveness and socio-economic resilience in the digital age.

Keywords: *digital human capital, digital transformation, competency model, management mechanism.*

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МЕХАНІЗМ ВПРОВАДЖЕННЯ ПРОЦЕСУ ІНТЕГРОВАНОГО УПРАВЛІННЯ ЦИФРОВИМ РОЗВИТКОМ ЛЮДСЬКОГО КАПІТАЛУ ПІДПРИЄМСТВА

У статті досліджено механізми впровадження інтегрованої системи управління цифровим розвитком людського капіталу на підприємствах у контексті переходу Казахстану до цифрової економіки. Дослідження обґрунтовує необхідність цілісної моделі оцінки та розвитку людського капіталу, яка поєднує технологічні, організаційні та освітні компоненти. Використовуючи інтегративний підхід, автори пропонують структурно-функціональний механізм, що охоплює оцінку, формування та зростання людського капіталу через співпрацю між підприємствами, університетами та державними установами. Модель включає багаторівневий алгоритм, що пов'язує місію, цілі та підцілі процесу, забезпечуючи системну координацію та адаптивність до цифрової трансформації. У статті також представлено проект інформаційної системи, яка автоматизує збір даних, моніторинг та прогнозування показників людського капіталу, що дозволяє кількісно оцінювати цифрові компетенції та ефективність інвестицій у розвиток робочої сили. Запропонована методологія інтегрує принципи економічної ефективності, доцільності та інноваційної стійкості. Результати сприяють зміцненню наукової та практичної бази Казахстану для управління цифровою робочою силою та можуть бути застосовані до промислових підприємств, навчальних закладів та політики. У дослідженні підкреслюється теоретичне значення визначення цифрової компетентності як багатовимірного конструкту, що охоплює грамотність, креативність та аналітичні здібності до продуктивного використання технологій. Загалом, запропонований інтегративний механізм розширює методологічний інструментарій для управління людським капіталом в умовах цифровізації та надає стратегічні ідеї для забезпечення конкурентоспроможності та соціально-економічної стійкості в цифрову епоху.

Ключові слова: *цифровий людський капітал, цифрова трансформація, модель компетенцій, механізм управління.*

Introduction. The process of assessing, forming, and developing human capital as elements of its management system is a pressing management task in the digitalization field, as human capital enables digital development in a dynamically changing external environment. This task is achieved through a number of subprocesses: assessing, forming, and developing human capital at enterprises.

Materials and Methods. The study is based on integrative and system-functional approaches, providing a comprehensive consideration of the processes of assessing, forming, and developing human capital in the context of digital transformation. This approach allows us to consider human capital not in isolation, but as a key element of the digital economy ecosystem, where enterprises, universities, and government institutions interact.

In the global scientific literature, this issue is actively explored within the framework of theories of intellectual capital, digital competencies, and innovative human resource management. For example, Becker [1] laid the foundation for assessing the contribution of knowledge and skills to economic growth. Schwab [2] and Brynjolfsson & McAfee [3] emphasized the need to rethink HR management models in the era of artificial intelligence. Contemporary research [4–6] proposes integrating Big Data and competency analytics to assess the impact of digitalization on human capital, which requires the development of new methodological tools. Davenport & Harris [7] demonstrate the effectiveness of data-driven analytics (HR Analytics) in forecasting talent needs. The OECD [8] emphasizes the importance of systematically assessing digital skills for building sustainable employment strategies, while Autor [9] points to a shift in professional roles toward cognitive-innovative professions.

The integrated approach involves the creation of a unified research and education center (REC) for the assessment and development of human capital, combining the resources of universities, technology parks, and business incubators. This center will implement the subprocesses of assessing, forming, and developing human capital, as well as test analytical models and digital tools in practice (Fig. 1).

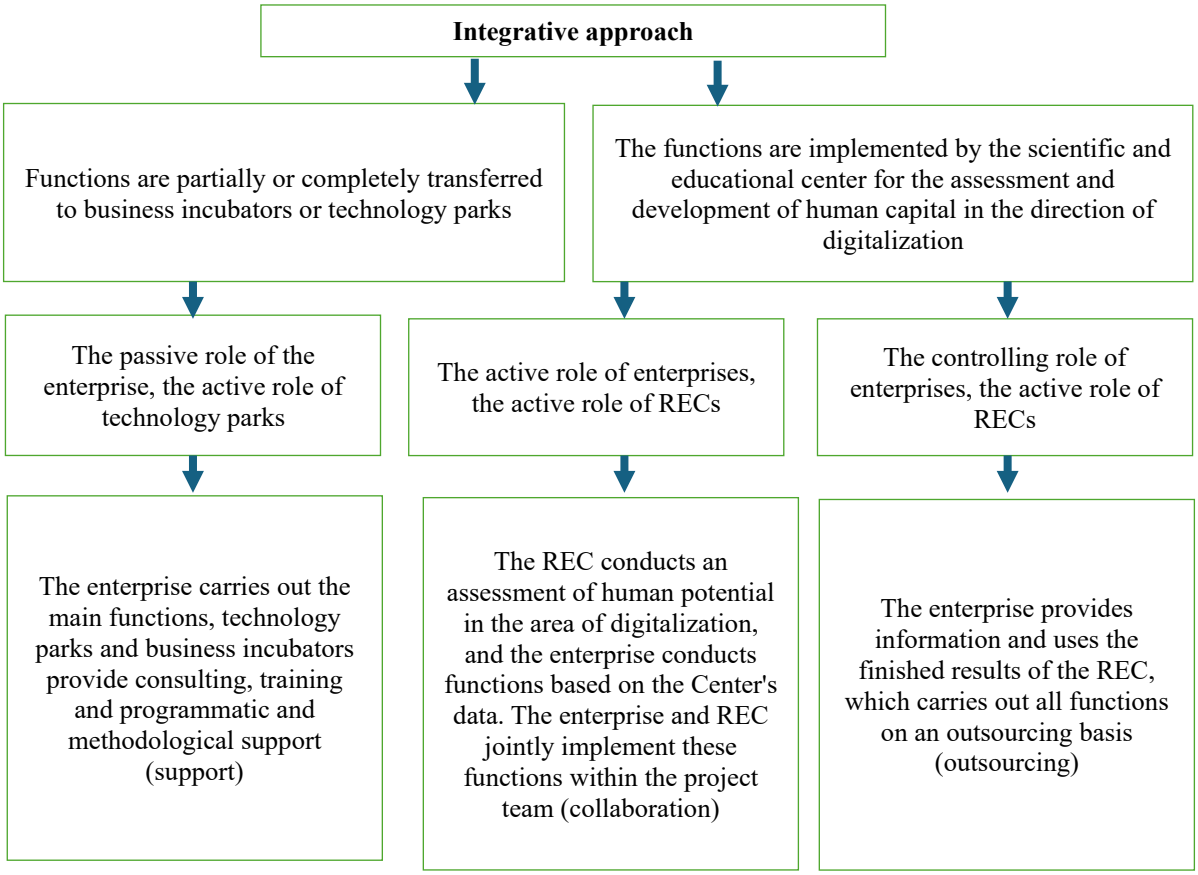

Fig. 1. Functions and approaches in organizing the assessment, formation, and digital development of human capital

Note: compiled by the authors

The study utilizes methods of structural-functional analysis, modeling, economic-mathematical analysis, and expert assessment to identify key factors in the effectiveness of human capital management.

Results. The design of a mechanism for implementing the integrated digital human capital development management process at an enterprise will be based on the following principles: feasibility, cost-effectiveness, consistency, variability, and standardization. The general algorithm for designing a mechanism for implementing the integrated digital human capital development management process at an enterprise is presented in Fig. 2.

In the first stage, "Formulating the Target Function", a typical target function for providing services is defined:

– assessing the structure and degree of human capital development towards digitalization;

– developing a human capital development program towards digitalization, taking into account the specifics of the research object.

In the second stage, "Constructing a System of Goals", the typical goal is transformed into a system of goals grouped into two areas:

1) Target objectives specify the areas of activity of the mechanism for implementing the integrated digital human capital development management process at an enterprise, such as primary, auxiliary, maintenance, and management.

2) The target indicator system is based on the balanced system of R. Kaplan and D. Norton [10]:

Thus, the structure of goals can be represented as a function:

$$PI = \{M, Di, Zij, zjk\},$$

where M is the mission; Di are the activities of the i-th functional block; Zij are the tasks of the i-th functional block, $j = 1…n$ is the number of tasks of a given activity; zjk are the subtasks of the j-th task, $k = 1…n$ is the number of subtasks of the tasks of a given task.

Figure 3 shows the specification of target objectives for the activities of the integrated digital human capital (HC) development management process at an enterprise.

This system of target objectives will enable monitoring of human capital assessment and development in the direction of digitalization and the development of measures to achieve these objectives.

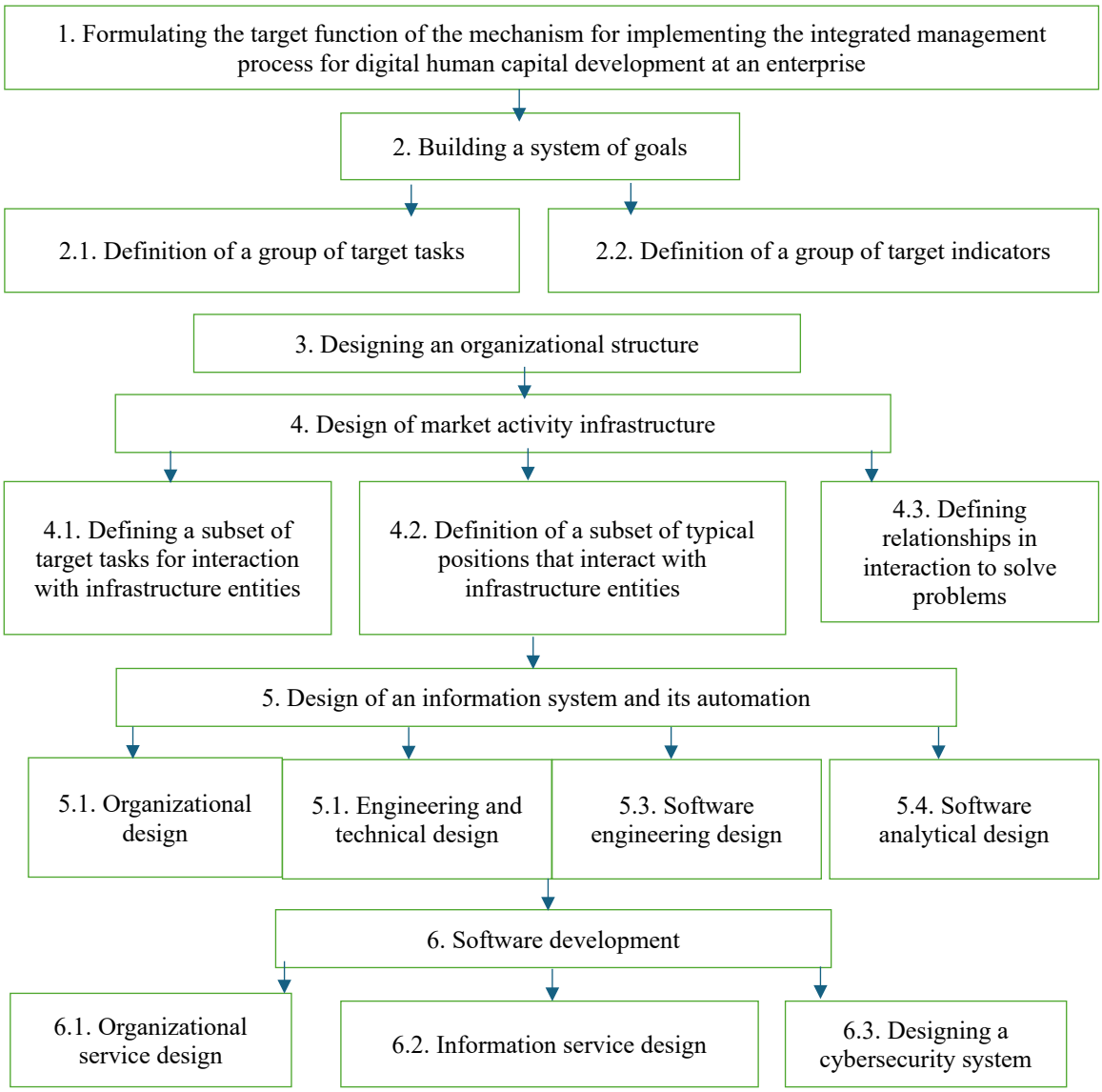

Fig. 2. Algorithm for the implementation mechanism of the integrated digital human capital development process at an enterprise

Note: compiled by the author

At the third stage, the number of standard positions is determined based on the number of identified subtasks, as the kth subtask corresponds to the jth task of each *i*-th activity. Thus, another hierarchical level {*djk*} is added to the goal tree. The objective function of the integrated digital human capital development process at an enterprise will take the form:

$$PI = \{M, Di, Zij, zjk, dkt\},$$

where *M* is the mission; *Di* are the activities of the *i*-th functional block; *Zij* are the tasks of the *i*-th functional block, *j* = 1…n is the number of tasks in this type of activity; *zjk* are the subtasks of the *j*-th task, *k* = 1…n is the number of subtasks within the tasks of this task; dkt are the positions of the *k*-th subtask, *t* = 1…n is the number of positions.

At the fourth stage, the infrastructure for the integrated management of digital human capital development at the enterprise is designed, including the following subprocesses:

1. Defining a subset of target tasks based on interactions with specific infrastructure entities, through collaboration, procurement, or outsourcing.

2. Defining a subset of typical positions that interact with infrastructure entities.

3. Defining interaction relationships for problem solving. Relationships between positions depending on the form of interaction can be formalized as:

$$G3 = \{d, r\},$$

where *d* are typical positions depending on the form of interaction; *r* are the types of relationships between them;

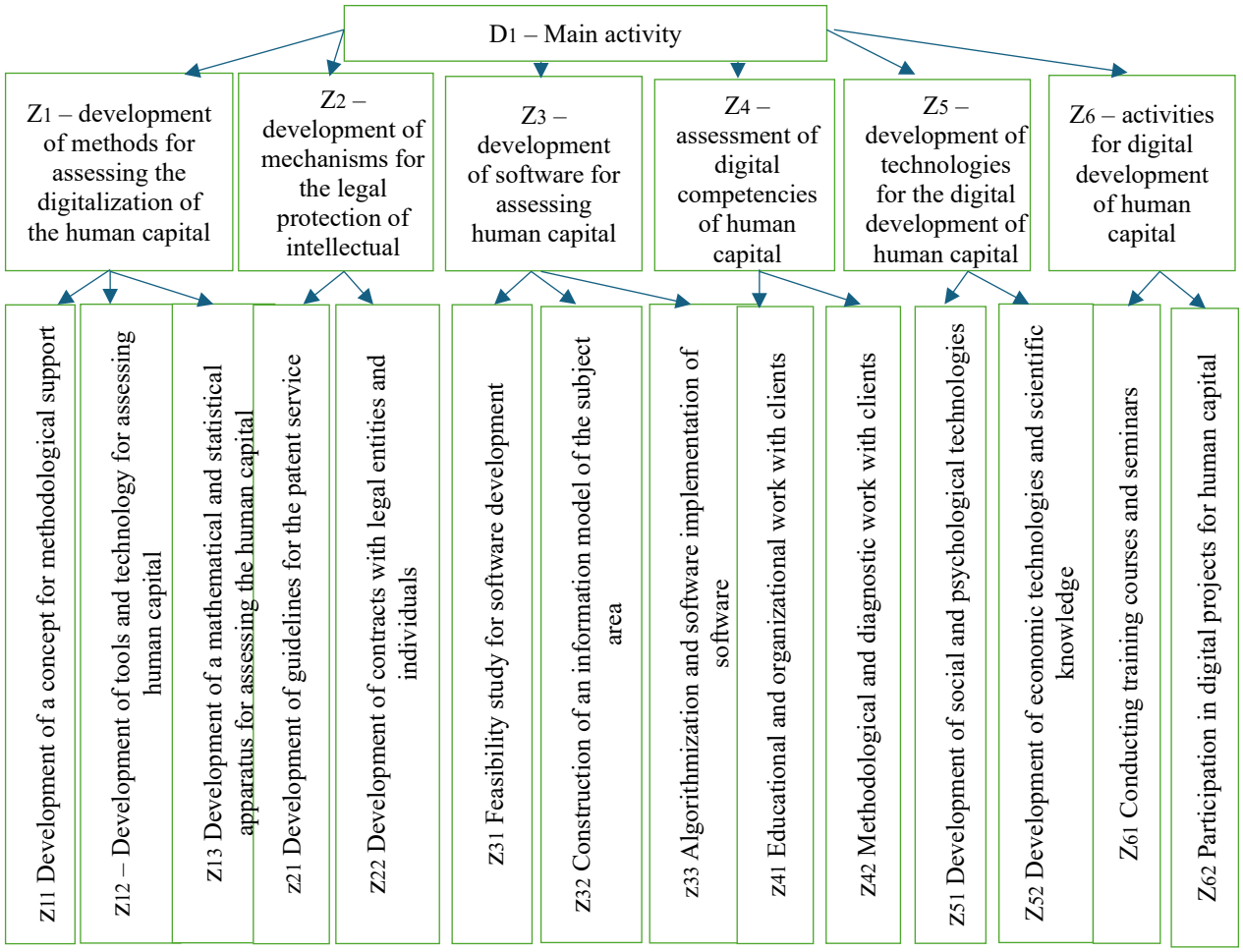

Fig. 3. Specification of target objectives for the activities of the integrated digital human capital development process at an enterprise

Note: compiled by the authors

G3 is the organizational structure of the integrated digital human capital development management process at an enterprise, reflecting the subordination relationships between positions.

This allows for the creation of conditions for the formation of a unified internal information space with defined communication, project, and process links.

The organizational structure of the integrated digital human capital development management process at an enterprise is shown in Fig. 4.

A programmer and a digital talent developer provide software and hardware support for the procedures for assessing, developing, and designing human capital. A coaching psychologist and a sociologist-psychologist assess the human capital development of the enterprise's employees. A research teacher and digital talent analyst conduct research on the formation and development of human capital. Design

This combination of linear-functional and matrix organizational structures allows for more flexible and effective use of human capital assessment and development activities in the direction of digitalization.

The sixth stage, "Information system design and automation", involves the creation and automation of an information system for the integrated digital human capital development management process at an enterprise.

An information system is defined as an organizationally organized set of data arrays and digital technologies for storing, searching, distributing, transmitting, and providing information.

The design of the information structure of the integrated digital human capital development management process at an enterprise includes the following subprocesses: design of organizational measures; engineering and technical design of the system and application software installation; engineering and software design; and software and analytical design.

The sixth stage, "Software development" involves the development of a software system for assessing the enterprise's human capital. This system will enable the following: a) input and storage of information about employees and ongoing digital projects; b) determination

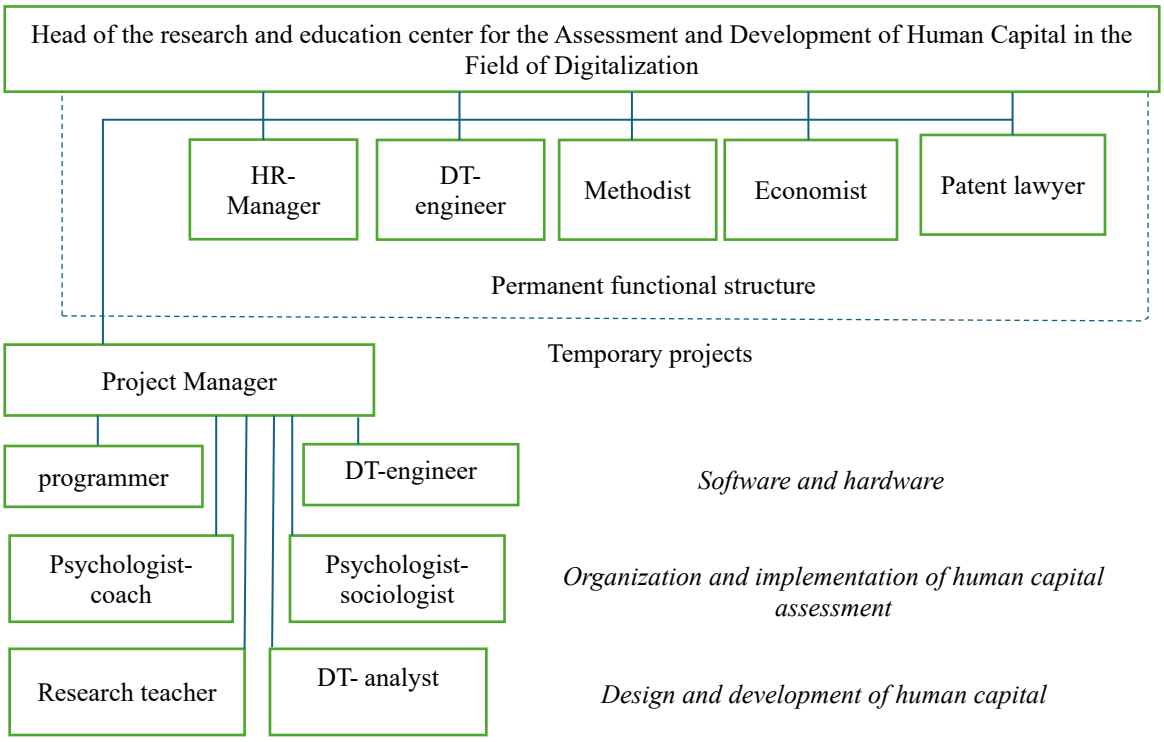

Fig. 4. Organizational structure of the integrated digital human capital development management process at an enterprise

Note: compiled by the authors

of indicators characterizing the level of the enterprise's digital potential; c) analysis of the dynamics of the level of digital potential; d) assessment of the effectiveness of investments in human capital. f) Forecasting the development of human capital for the company's employees.

Further work on the use of the management information system will be aimed at automating activities in the following areas:

1. Administrative guidance for assessing and developing human capital in the direction of digitalization, including: the process of providing reliable information on financial status; monitoring the activities of structural divisions; clear coordination of primary, support, auxiliary, and management activities.

2. Operational activities, including: the process of organizing and conducting the assessment and development of human capital for enterprise employees; processing the obtained results and creating corresponding databases; entering and monitoring orders for the assessment and development of human capital for the company's employees.

3. Management activities, including: developing and populating a data array; entering and analyzing statistics on work performed; information support for effective human capital management.

Conclusions. The study's results have both theoretical and practical significance, providing a foundation for improving scientific and methodological tools for assessing, developing, and nurturing human capital in the context of digital transformation. Implementing the proposed mechanism for comprehensive management of digital human capital development at enterprises, based on an integrative approach, will improve the efficiency of human resource management, accelerate digitalization processes, and ensure their long-term competitiveness in the new economic reality.

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