Modeling Human Resource Development Based on Employee Maturity Capabilities in Knowledge-Based Companies

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Abstract: The present study aimed to model human resource development based on employee maturity capabilities in knowledge-based companies. In terms of purpose, this research is an applied-developmental study, and based on the data collection method, it is a descriptive study conducted with an exploratory approach within the interpretivist paradigm. The research participants comprised human resource management professors and managers of knowledge-based companies. The sampling method was purposive sampling, and theoretical saturation was achieved after 17 interviews. Data collection was conducted using semi-structured interviews and questionnaires. Qualitative analysis of the expert interviews was performed using thematic qualitative analysis in Maxqda software, and the extracted themes were screened using the fuzzy Delphi method in MatLab software. Finally, the relationships between constructs were identified using structural-interpretive modeling in MicMac software. The research findings indicated that incompatible management is the most fundamental variable in human resource development, influencing people management and capability management. These factors, in turn, affect competency management and transformation, ultimately leading to managerial succession planning based on knowledge. Managerial succession planning impacts training, learning, recruitment, hiring, and retention of human resources. Additionally, research and development influence performance based on the ethical charter and performance management, ultimately leading to human resource development.

Keywords: Human Resource Development, Employee Maturity Capabilities, Knowledge-Based Companies

1. Introduction

In the current knowledge-based economy, small and medium-sized knowledge-based enterprises play a fundamental role in the economic and social development of countries [1]. The success of these companies depends on their human resource capabilities, which can be achieved through human resource development. A comprehensive and strategic plan for improving employee competencies is a key success factor for such companies [2]. Knowledge-based companies have been at the forefront of utilizing knowledge and technology. Enhancing human resources in these companies can have a significant impact on strengthening their knowledge base and overall performance [3]. Empirical evidence from many developed countries and emerging economies shows that these companies have successfully adapted to the challenges posed

by digital transformation through advancements in human resource management [4]. Given the increasing competition among knowledge-based organizations, the managers of these companies can achieve a competitive advantage and sustain their position in the market by focusing on internal organizational development and leveraging human resource capacities [5].

There are various models, approaches, and methods for human resource development. One of the key concepts related to human resource development that has gained significant attention in recent years is employee maturity [6]. Human resource maturity involves investing in employees to enhance their cognitive abilities, metacognitive skills, and professional and communication competencies to maximize their potential (Taghavi et al., 2022). Many contemporary organizations strive to attain higher levels of maturity through the gradual evolution of their processes. A large proportion of organizations have adopted employee maturity models to design roadmaps that enable organizational readiness and development [7]. Employee capability maturity serves as a guide for identifying, designing, and implementing human resource-related processes that continuously improve employee capabilities [8]. The primary goal of employee capability maturity is to enhance human resource competencies, which can be defined as a specific level of knowledge, skills, and expertise required for business operations. Organizations must invest in human resource capabilities that are essential for improving their core competencies [9].

With the increasing complexity of organizational environments, the acceleration of change, intensifying competition, and the growing importance of intangible assets, the role of human resources in all organizational actions has become more prominent. A capable human capital base helps organizations stay up to date by recognizing environmental opportunities and threats, improving learning capabilities, and fostering knowledge sharing [10]. Human resource development, through the enhancement of professional skills and competencies, can lead to business excellence and serves as the foundation for organizational growth and progress. Organizations can facilitate and accelerate the development process by planning, allocating necessary resources, and providing educational opportunities [11].

Available statistics highlight the significance of human resource development. Over the past decade, Iran's labor productivity growth index has been reported at -0.3%, placing Iran 27th among the 30 member countries of the Asian Productivity Organization. Additionally, according to Iran's Sixth Economic, Social, and Cultural Development Plan and Vision Document for 2025, 2.7% of the projected 8% economic growth is expected to be achieved through labor productivity, which shows a significant gap compared to the current situation [12]. In the 13th consecutive Legatum Prosperity Index report, Iran's ranking dropped by six places from the previous year, placing it at 126th among 167 assessed countries. This index evaluates countries based on nine criteria, and despite Iran's favorable status in certain areas such as health and education, it ranks poorly in human capital and labor productivity [13].

The findings of Broustani et al. (2024) emphasize that the implementation of systemic control, strategic objectives, performance improvement, and customer satisfaction can lead to the enhancement and subsequent maturity of human resource processes. According to the findings of Sabzi et al. (2023), the human resource development system comprises components such as development planning and implementation, strategy, training, and strategic evaluation, which contribute to employee empowerment [14]. Nazarian et al. (2023) demonstrated that human resource development, along with organizational and managerial factors, environment, technology infrastructure, and data management, are influential factors in business intelligence maturity [15]. Fathi et al. (2023) identified and analyzed the challenges of human resource development in knowledge-based organizations within four categories:

individual, group, organizational, and environmental [16]. Bahari and Taheri (2023) argue that the human resource development model in knowledge-based companies consists of structural, environmental, cultural, strategic, organizational, technological, planning, recruitment, training, and performance factors [11]. The survey results of Khademi and Sahebkar (2022) indicated that compensation and motivation, training, development and learning environment creation, team-building and participation, performance evaluation management, talent and competency management, and knowledge employee retention and advancement are the most critical functions of human resource development in knowledge-based companies [17]. Seyed Naghavi et al. (2022) emphasized that managers of knowledge-based organizations can gain a comprehensive analysis of human resource development at both individual and organizational levels through human resource development initiatives and optimize their strategies to mitigate associated risks [18]. A review of previous studies and research background indicates that interest in employee maturity capabilities has grown in the country over the past decade, leading to scattered studies on the topic. Prior research has primarily been either review-based or historical analyses using existing models and questionnaires. Therefore, this study adopts an exploratory approach to identify the constructs of a human resource development model based on employee maturity capabilities in knowledge-based companies.

In summary, both theoretical and practical perspectives emphasize the importance of human resource development and knowledge-based growth. Strategic policy documents also highlight these two aspects. The designation of "Knowledge-Based Production and Employment Creation" as the 2022 national slogan underscores the priority of knowledge-based production in the country's economic system and the role of technology development in economic growth and employment generation. According to Article 47 of the Sixth Development Plan, the government is obligated to implement executive measures to expand the market for knowledge-based products, commercialize research and innovation achievements, and strengthen the role of the private and cooperative sectors in this domain. The issue at hand is also critical from a negative perspective, as neglecting employee development and capacity building in a knowledge-based company can lead to significant adverse consequences. As implied by the very name "knowledge-based company," knowledge and intelligence are the foundation of success and progress for such enterprises. A lack of appropriate planning for fostering employee maturity capabilities and utilizing human resource capacities can easily result in the elimination of these companies in the highly competitive, technology-driven, and dynamic knowledge-based business ecosystem. From an academic and research perspective, this issue is equally important, as evidenced by the numerous studies conducted in this area. However, a critical research gap exists: previous studies have typically examined "human resource development" and "employee maturity" as separate topics. There is a lack of applied research that integrates these concepts within the context of knowledge-based companies. Therefore, the present study was conducted to address this research gap. The contribution of this study, both in research and theoretical synergy, lies in its exploratory approach, which draws upon the perspectives of experienced professionals and experts to identify employee maturity capabilities for the development of knowledge-based company employees and to establish a framework for their interrelationships. This study seeks to answer the fundamental question: What is the human resource development model based on employee maturity capabilities in knowledge-based companies?

2. Methodology

This research is based on the interpretivist paradigm and was conducted using an inductive approach. In terms of purpose, it is an applied study aimed at modeling human resource development based on employee maturity

capabilities in knowledge-based companies. Regarding data collection, it is a descriptive study employing an exploratory research design with a qualitative approach.

The research participants included professors, senior managers, and human resource managers in knowledge-based companies involved in human resource development. The selection of participants was based on the five key criteria outlined by Miller et al. (2010): significance, prominence, theoretical knowledge, diversity, and motivation to participate.

A purposive sampling method was used, with the selection criteria for expert practitioners being a minimum of 15 years of management experience in knowledge-based companies and at least a master's degree. Theoretical experts included experienced university professors specializing in human resource development. After each interview, coding and analysis were conducted. Repetition in findings was observed after 14 interviews. To avoid premature saturation, three additional interviews were conducted, and after 17 interviews, it was confirmed that no new themes were emerging. The same experts were consulted for model development to ensure consistency and coherence in the research.

The primary data collection tools were semi-structured interviews and questionnaires. The interviews consisted of six initial questions and were conducted in a semi-structured manner. Subsequently, a fuzzy Delphi questionnaire and a decision matrix-based questionnaire were employed.

The qualitative validity was assessed using the four criteria suggested by Lincoln and Guba: credibility, transferability, confirmability, and dependability, which were evaluated and confirmed by expert reviewers. The reliability of the qualitative section and coding of the interviews was examined using Holsti's method. The interview transcripts were coded in two stages, and the observed agreement percentage (PAO) was calculated.

PAO ranges from 0 (no agreement) to 1 (complete agreement), with a threshold of 0.6 or higher being considered acceptable. In this study, the PAO value was 0.68, indicating satisfactory reliability for the qualitative section. For the structural-interpretive modeling reliability assessment, the intraclass correlation coefficient (ICC) was estimated at 0.86, which falls within the 0.75–0.90 range, signifying an acceptable level of reliability.

The primary method used in the qualitative section was thematic analysis, which was applied to identify the themes of the human resource development model based on employee maturity capabilities in knowledge-based companies. The thematic analysis was conducted using MaxQDA 20 software.

In the second phase, to validate the identified themes, the fuzzy Delphi method was employed using MatLab software. Finally, the model was developed using structural-interpretive modeling in MicMac software.

3. Findings

This study incorporated the perspectives of 17 individuals, including 6 university professors and 11 managers of knowledge-based companies. Regarding gender, 13 participants were male, and 4 were female. In terms of age, 1 participant was under 40 years old, 7 were between 40 and 50 years old, and 9 were 50 years or older. Regarding educational background, 5 participants held a master's degree, while 12 had a doctoral degree. In terms of work experience, 5 participants had between 15 and 20 years of experience, and 12 had more than 20 years of experience.

For the analysis of interview transcripts, the six-step approach proposed by Attride-Stirling (2001) was employed. The first step involved familiarization with the depth and content of the text, achieved by repeatedly reviewing the transcripts and recording initial ideas. To ensure a deep understanding of the content, the researcher engaged in multiple readings of the data while actively searching for meanings and patterns. Following this step, the coding process began. Coding was conducted throughout the entire analysis process. Each new interview was

coded, and the analytical process was repeated with the inclusion of each subsequent interview. The interviews continued until data saturation was reached. The criterion for data saturation was the repetition of extracted codes.

In the open coding stage, 321 codes were identified. Through axial coding, the findings were categorized into 8 overarching themes, 12 organizing themes, and 71 basic themes. The themes of the human resource development model based on employee maturity capabilities in knowledge-based companies are presented in Table 1.

Table 1. Themes of the Human Resource Development Model Based on Employee Maturity Capabilities in Knowledge-Based Companies

Overarching Themes	Organizing Themes	Basic Themes
Development Dimension	Human Resource Development	"Improving job-related skills"; "Enhancing employee capabilities"; "Improving employees' functional efficiency"; "Enhancing job effectiveness"; "Gaining organizational competitive advantage"
Human Resource Capability Maturity Dimension	Initial Level (Incompatible Management)	"Lack of employee awareness of job responsibilities"; "Incompatibility in employee activities"; "Insufficient communication between managers and employees"; "Lack of organizational group cohesion"
	Managed Level (People Management)	"Employee awareness of organizational responsibilities"; "Coordination and communication among employees"; "Employee compensation system"; "Utilization of training methods"
	Defined Level (Competency Management)	"Competency in managerial domain"; "Competency in technical domain"; "Competency in environmental domain"; "Competency in individual domain"; "Meritocracy in personnel appointments"
	Predictable Level (Capability Management)	"Integration and coherence of competencies"; "Specialized employee empowerment"; "Formation of self-managed teams within the organization"; "Coaching and organizational capability management"
	Optimized Level (Transformation Management)	"Employee creativity in assigned tasks"; "Alignment of employees with organizational goals"; "Continuous improvement of organizational capabilities"; "Organizational efficiency and productivity"
Knowledge Dimension	Knowledge-Based Managerial Succession Planning	"Identifying organizational needs related to knowledge management"; "Developing innovative knowledge management strategies"; "Allocating necessary resources for knowledge training and implementation"; "Focusing on specialized and elite internal employees"
Recruitment Dimension	Talent Acquisition, Hiring, and Retention	"Identifying employee strengths and weaknesses"; "Assessing professional skills of human resources"; "Enhancing interaction with managers and colleagues"; "Increasing psychological well-being in the workplace"
Research Dimension	Research and Development	"Identifying development programs and selecting activities"; "Assessing development needs considering organizational goals"; "Defining skill requirements and development objectives"; "Employee accountability for development"; "Monitoring and evaluating individual development progress"
Training Dimension	Training and Learning	"Utilizing modern training methods and up-to-date educational resources"; "Conducting continuous training programs"; "Integrating coaching into key strategies and mission statements"; "Developing a learning-oriented training strategy"
Ethical Dimension	Performance Based on Ethical Charter	"Evaluating employee performance based on ethical charter criteria"; "Maintaining human dignity and ensuring fairness"; "Implementing reward and disciplinary mechanisms to enforce ethical compliance"; "Adhering to ethical principles and Islamic values"
Performance Dimension	Performance Management	"Developing employee performance assessment plans"; "Establishing precise evaluation criteria"; "Implementing modern performance evaluation methods"; "Identifying deviations from work standards"; "Monitoring and assessing employee performance"

To screen and identify the final indicators of the human resource development model based on employee maturity capabilities in knowledge-based companies, the fuzzy Delphi method was used. The experts' opinions on the importance of each indicator were collected using a 7-point fuzzy scale.

Table 2. Seven-Point Fuzzy Scale for Indicator Valuation

Linguistic Variable	Fuzzy Value	Fuzzy Numeric Scale

Completely Unimportant	۱	(0, 0, 0.1)
Very Unimportant	۲	(0, 0.1, 0.3)
Unimportant	۳	(0.1, 0.3, 0.5)
Moderate	۴	(0.3, 0.5, 0.75)
Important	۵	(0.5, 0.75, 0.9)
Very Important	۶	(0.75, 0.9, 1)
Completely Important	۷	(0.9, 1, 1)

First, experts' opinions on the importance of each indicator were collected and fuzzified based on the scale presented in Table 2. Next, the experts' views were aggregated using the fuzzy mean method. For defuzzification, the center of gravity method proposed by Zhang and Tang (1993) was applied.

A defuzzified value greater than 0.7 was considered acceptable, and any indicator scoring below 0.7 was rejected. All indicators scored above the threshold, and none were eliminated. To ensure robustness, an additional Delphi round was conducted. The fuzzy Delphi analysis continued for the remaining indicators in the second round. In this round, no indicators were eliminated, indicating the completion of the Delphi process.

One standard approach for concluding the Delphi process is to compare the mean scores of the first and second rounds. If the difference between the two rounds is below the threshold of 0.2, the survey process is terminated.

Table 3. Difference in Defuzzified Values Between the First and Second Rounds.

Indicator	Fuzzy Round 1	Defuzzified Round 1	Fuzzy Round 2	Defuzzified Round 2	Difference	Result
Improving job-related skills	(0.655,0.825,0.92)	0.8	(0.725,0.87,0.93)	0.842	0.041	Agreement
Enhancing employee capabilities	(0.725,0.875,0.965)	0.855	(0.7,0.86,0.955)	0.838	0.017	Agreement
Improving employees' functional efficiency	(0.685,0.865,0.95)	0.833	(0.675,0.845,0.945)	0.822	0.011	Agreement
Enhancing job effectiveness	(0.67,0.855,0.95)	0.825	(0.69,0.845,0.94)	0.825	0	Agreement
Gaining organizational competitive advantage	(0.63,0.83,0.94)	0.8	(0.655,0.845,0.95)	0.817	0.0169	Agreement
Lack of employee awareness of job responsibilities	(0.67,0.855,0.95)	0.825	(0.655,0.845,0.95)	0.817	0.008	Agreement
Incompatibility in employee activities	(0.775,0.92,0.98)	0.892	(0.735,0.895,0.97)	0.867	0.025	Agreement
Insufficient communication between managers and employees	(0.755,0.905,0.99)	0.883	(0.695,0.85,0.93)	0.825	0.058	Agreement
Lack of organizational group cohesion	(0.745,0.88,0.95)	0.858	(0.68,0.86,0.96)	0.833	0.025	Agreement
Employee awareness of organizational responsibilities	(0.71,0.88,0.96)	0.85	(0.675,0.845,0.945)	0.822	0.028	Agreement
Coordination and communication among employees	(0.655,0.845,0.95)	0.817	(0.825,0.94,0.975)	0.913	0.096	Agreement
Employee compensation system	(0.73,0.89,0.98)	0.867	(0.67,0.855,0.95)	0.825	0.042	Agreement
Utilization of training methods	(0.635,0.82,0.935)	0.797	(0.76,0.91,0.98)	0.883	0.086	Agreement
Managerial competency	(0.65,0.82,0.93)	0.8	(0.675,0.845,0.945)	0.822	0.022	Agreement
Technical competency	(0.68,0.84,0.93)	0.817	(0.665,0.84,0.935)	0.813	0.004	Agreement
Environmental competency	(0.7,0.86,0.955)	0.838	(0.755,0.905,0.99)	0.883	0.045	Agreement
Individual competency	(0.72,0.885,0.97)	0.858	(0.58,0.785,0.925)	0.763	0.095	Agreement
Meritocracy in personnel appointments	(0.735,0.895,0.97)	0.867	(0.735,0.895,0.97)	0.867	0	Agreement
Integration and coherence of competencies	(0.625,0.815,0.925)	0.788	(0.685,0.865,0.95)	0.833	0.045	Agreement
Specialized employee empowerment	(0.655,0.845,0.95)	0.817	(0.595,0.795,0.925)	0.772	0.045	Agreement
Formation of self-managed teams within the organization	(0.63,0.81,0.91)	0.783	(0.76,0.91,0.98)	0.883	0.1	Agreement

Coaching and organizational capability management	(0.71,0.88,0.96)	0.85	(0.67,0.855,0.95)	0.825	0.025	Agreement
Employee creativity in assigned tasks	(0.575,0.775,0.9)	0.75	(0.67,0.855,0.95)	0.825	0.075	Agreement
Alignment of employees with organizational goals	(0.71,0.88,0.96)	0.85	(0.72,0.885,0.97)	0.858	0.008	Agreement
Continuous improvement of organizational capabilities	(0.625,0.825,0.95)	0.8	(0.695,0.85,0.93)	0.825	0.025	Agreement
Organizational efficiency and productivity	(0.64,0.815,0.92)	0.792	(0.695,0.87,0.96)	0.842	0.05	Agreement
Identifying organizational needs related to knowledge management	(0.655,0.845,0.95)	0.817	(0.67,0.835,0.92)	0.808	0.009	Agreement
Developing innovative knowledge management strategies	(0.64,0.815,0.92)	0.792	(0.745,0.9,0.98)	0.875	0.083	Agreement
Allocating necessary resources for knowledge training and implementation	(0.705,0.855,0.94)	0.833	(0.695,0.87,0.96)	0.842	0.009	Agreement
Focusing on specialized and elite internal employees	(0.605,0.815,0.93)	0.783	(0.66,0.835,0.945)	0.813	0.029	Agreement
Identifying employee strengths and weaknesses	(0.745,0.9,0.98)	0.875	(0.655,0.845,0.95)	0.817	0.058	Agreement
Assessing professional skills of human resources	(0.75,0.905,0.97)	0.875	(0.635,0.82,0.935)	0.797	0.078	Agreement
Enhancing interaction with managers and colleagues	(0.715,0.87,0.955)	0.847	(0.68,0.86,0.96)	0.833	0.014	Agreement
Increasing psychological well-being in the workplace	(0.68,0.86,0.96)	0.833	(0.66,0.85,0.94)	0.817	0.016	Agreement
Identifying development programs and selecting activities	(0.745,0.9,0.98)	0.875	(0.67,0.855,0.95)	0.825	0.050	Agreement
Assessing development needs considering organizational goals	(0.625,0.815,0.925)	0.788	(0.53,0.755,0.905)	0.73	0.058	Agreement
Defining skill requirements and development objectives	(0.645,0.84,0.94)	0.808	(0.685,0.865,0.95)	0.833	0.025	Agreement
Employee accountability for development	(0.735,0.875,0.94)	0.85	(0.73,0.88,0.955)	0.855	0.005	Agreement
Monitoring and evaluating individual development progress	(0.75,0.885,0.94)	0.858	(0.72,0.885,0.97)	0.858	0	Agreement
Utilizing modern training methods and up-to-date educational resources	(0.645,0.84,0.94)	0.808	(0.61,0.805,0.925)	0.78	0.028	Agreement
Conducting continuous training programs	(0.75,0.905,0.97)	0.875	(0.675,0.855,0.97)	0.833	0.042	Agreement
Integrating coaching into key strategies and mission statements	(0.605,0.795,0.9)	0.767	(0.63,0.81,0.91)	0.783	0.016	Agreement
Developing a learning-oriented training strategy	(0.645,0.825,0.945)	0.805	(0.69,0.855,0.945)	0.83	0.025	Agreement
Evaluating employee performance based on ethical charter criteria	(0.66,0.835,0.945)	0.813	(0.775,0.92,0.98)	0.892	0.079	Agreement
Maintaining human dignity and ensuring fairness	(0.73,0.88,0.955)	0.855	(0.71,0.88,0.96)	0.85	0.005	Agreement
Implementing reward and disciplinary mechanisms to enforce ethical compliance	(0.76,0.91,0.98)	0.883	(0.625,0.805,0.92)	0.783	0.1	Agreement
Adhering to ethical principles and Islamic values	(0.73,0.89,0.98)	0.867	(0.745,0.9,0.98)	0.875	0.008	Agreement
Developing employee performance assessment plans	(0.605,0.795,0.9)	0.767	(0.665,0.84,0.935)	0.813	0.046	Agreement
Establishing precise evaluation criteria	(0.705,0.875,0.97)	0.85	(0.745,0.89,0.955)	0.863	0.013	Agreement
Implementing modern performance evaluation methods	(0.585,0.78,0.91)	0.758	(0.73,0.89,0.98)	0.867	0.108	Agreement
Identifying deviations from work standards	(0.745,0.9,0.98)	0.875	(0.75,0.905,0.97)	0.875	0	Agreement
Monitoring and assessing employee performance	(0.66,0.85,0.94)	0.817	(0.67,0.855,0.95)	0.825	0.008	Agreement

Based on the results presented in Table 3, it was determined that in all cases, the differences were smaller than 0.2; therefore, the Delphi rounds can be concluded. The next step involves identifying the internal relationships among the identified indicators and presenting the human resource development model based on employee maturity capabilities. For this purpose, the structural-interpretive modeling (ISM) method was employed. The relationships between the overarching constructs are represented using four symbols: V (variable i influences variable j), A (variable j influences variable i), X (a bidirectional relationship exists), and O (no relationship exists) (Habibi & Afridi, 2022). By identifying the relationships among the indicators, the Structural Self-Interaction Matrix (SSIM) was developed, which is presented in Table 4.

Table 4. Structural Self-Interaction Matrix (SSIM) of the Human Resource Development Model Based on Employee Maturity Capabilities

SSIM	C01	C02	C03	C04	C05	C06	C07	C08	C09	C10	C11	C12
Human Resource Development (C01)	-	O	A	A	A	A	A	A	O	A	A	-
Knowledge-Based Managerial Succession Planning (C02)	-	-	O	V	A	A	A	V	V	A	A	O
Performance Based on Ethical Charter (C03)	-	-	-	O	A	A	A	A	A	A	A	X
Training and Learning (C04)	-	-	-	-	A	A	A	X	V	A	A	O
Incompatible Management (C05)	-	-	-	-	-	V	V	V	V	V	V	V
Competency Management (C06)	-	-	-	-	-	-	A	V	V	X	A	V
People Management (C07)	-	-	-	-	-	-	-	V	V	V	X	V
Talent Acquisition, Hiring, and Retention (C08)	-	-	-	-	-	-	-	-	V	A	A	V
Research and Development (C09)	-	-	-	-	-	-	-	-	-	A	A	V
Transformation Management (C10)	-	-	-	-	-	-	-	-	-	-	A	V
Capability Management (C11)	-	-	-	-	-	-	-	-	-	-	-	V
Performance Management (C12)	-	-	-	-	-	-	-	-	-	-	-	-

By converting the Structural Self-Interaction Matrix into a binary (0-1) reachability matrix, the Reachability Matrix (RM) is obtained. In the reachability matrix, the main diagonal elements are set to one. Additionally, secondary relationships must be verified to ensure accuracy. This means that if A leads to B and B leads to C, then A should also lead to C. If secondary relationships are logically required but are missing in the table, the matrix must be corrected to include them (Azar et al., 2021). The final reachability matrix is presented in Table 5.

Table 5. Final Reachability Matrix of the Human Resource Development Model Based on Employee Maturity Capabilities in Knowledge-Based Companies

| TM	C01	C02	C03	C04	C05	C06	C07	C08	C09	C10	C11	C12
Human Resource Development (C01)	1	0	0	0	0	0	0	0	0	0	0	1
Knowledge-Based Managerial Succession Planning (C02)	1*	1	1*	1	0	0	0	1	1	1	0	1*
Performance Based on Ethical Charter (C03)	1	0	1	0	0	0	0	0	0	0	0	1
Training and Learning (C04)	1	1	1*	1	0	0	0	1	1	1	0	1*
Incompatible Management (C05)	1	1	1	1	1	1	1	1	1	1	1	1
Competency Management (C06)	1	1	1	1	0	1	0	1	1	1	0	1
People Management (C07)	1	1	1	1	1	1	1	1	1	1	1	1
Talent Acquisition, Hiring, and Retention (C08)	1	0	1	0	0	0	0	1	1	0	0	1
Research and Development (C09)	1	0	1	0	0	0	0	1	1	0	0	1
Transformation Management (C10)	1*	1	1	1	0	0	0	1	1	1	0	1
Capability Management (C11)	1	1	1	1	1	1	1	1	1	1	1	1
Performance Management (C12)	1	0	0	0	0	0	0	0	0	0	0	1

After constructing the reachability matrix, the next step is to determine relationships and categorize the indicators into hierarchical levels. To achieve this, the "Reachability Set" and "Antecedent Set" must be identified.

For a given variable C_i, the reachability set (outputs or influencing factors) includes the variables that can be reached through C_i. The antecedent set (inputs or influenced factors) consists of variables through which C_i can be reached. These relationships help in structuring the final hierarchical model of human resource development based on employee maturity capabilities.

Table 6. Input and Output Sets for Level Determination

Variables	Output: Influence	Input: Dependency	Intersection
C01	C01	C01, C02, C03, C04, C05, C06, C07, C08, C09, C10, C11, C12	C01
C02	C01, C02, C03, C04, C08, C09, C12	C02, C05, C06, C07, C10, C11	C02
C03	C01, C03, C12	C02, C03, C04, C05, C06, C07, C08, C09, C10, C11, C12	C03, C12
C04	C01, C03, C04, C08, C09, C12	C02, C04, C05, C06, C07, C08, C10, C11	C04, C08
C05	C01, C02, C03, C04, C05, C06, C07, C08, C09, C10, C11, C12	C05	C05
C06	C01, C02, C03, C04, C06, C08, C09, C10, C12	C05, C06, C07, C10, C11	C06, C10
C07	C01, C02, C03, C04, C06, C07, C08, C09, C10, C11, C12	C05, C07, C11	C07, C11
C08	C01, C03, C04, C08, C09, C12	C02, C04, C05, C06, C07, C08, C10, C11	C04, C08
C09	C01, C03, C09, C12	C02, C04, C05, C06, C07, C08, C09, C10, C11	C09
C10	C01, C02, C03, C04, C06, C08, C09, C10, C12	C05, C06, C07, C10, C11	C06, C10
C11	C01, C02, C03, C04, C06, C07, C08, C09, C10, C11, C12	C05, C07, C11	C07, C11
C12	C01, C03, C12	C02, C03, C04, C05, C06, C07, C08, C09, C10, C11, C12	C03, C12

Based on the results of structural-interpretive modeling (ISM), human resource development (C01) is at level 1. The variables performance based on the ethical charter (C03) and performance management (C12) are at level 2. Research and development (C09) is at level 3. Training and learning (C04) and talent acquisition, hiring, and retention (C08) are at level 4. Knowledge-based managerial succession planning (C02) is at level 5. Competency management (C06) and transformation management (C10) are at level 6. People management (C07) and capability management (C11) are at level 7. Finally, incompatible management (C05) is at level 8. The human resource development model based on employee maturity capabilities is illustrated in Figure 1.
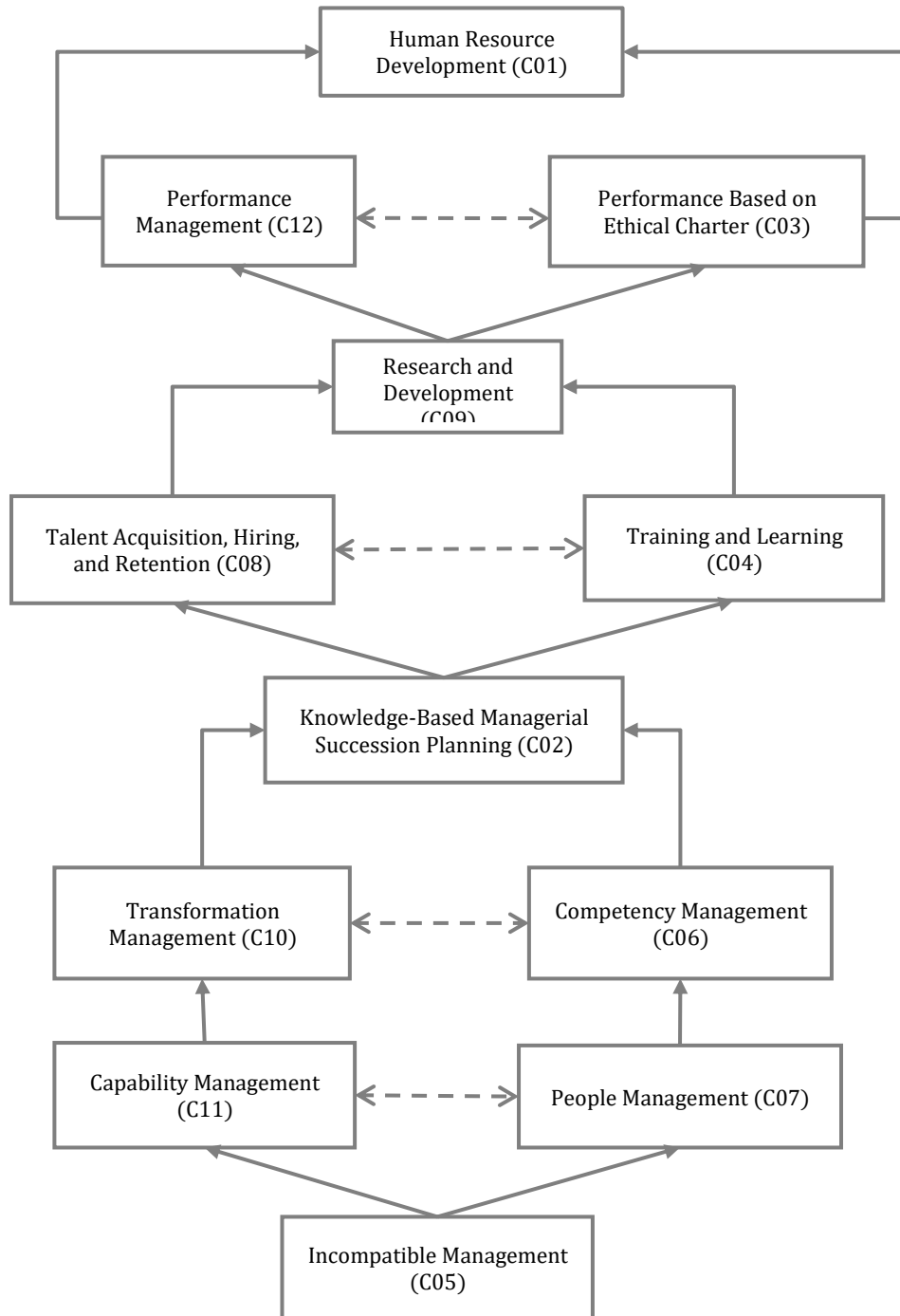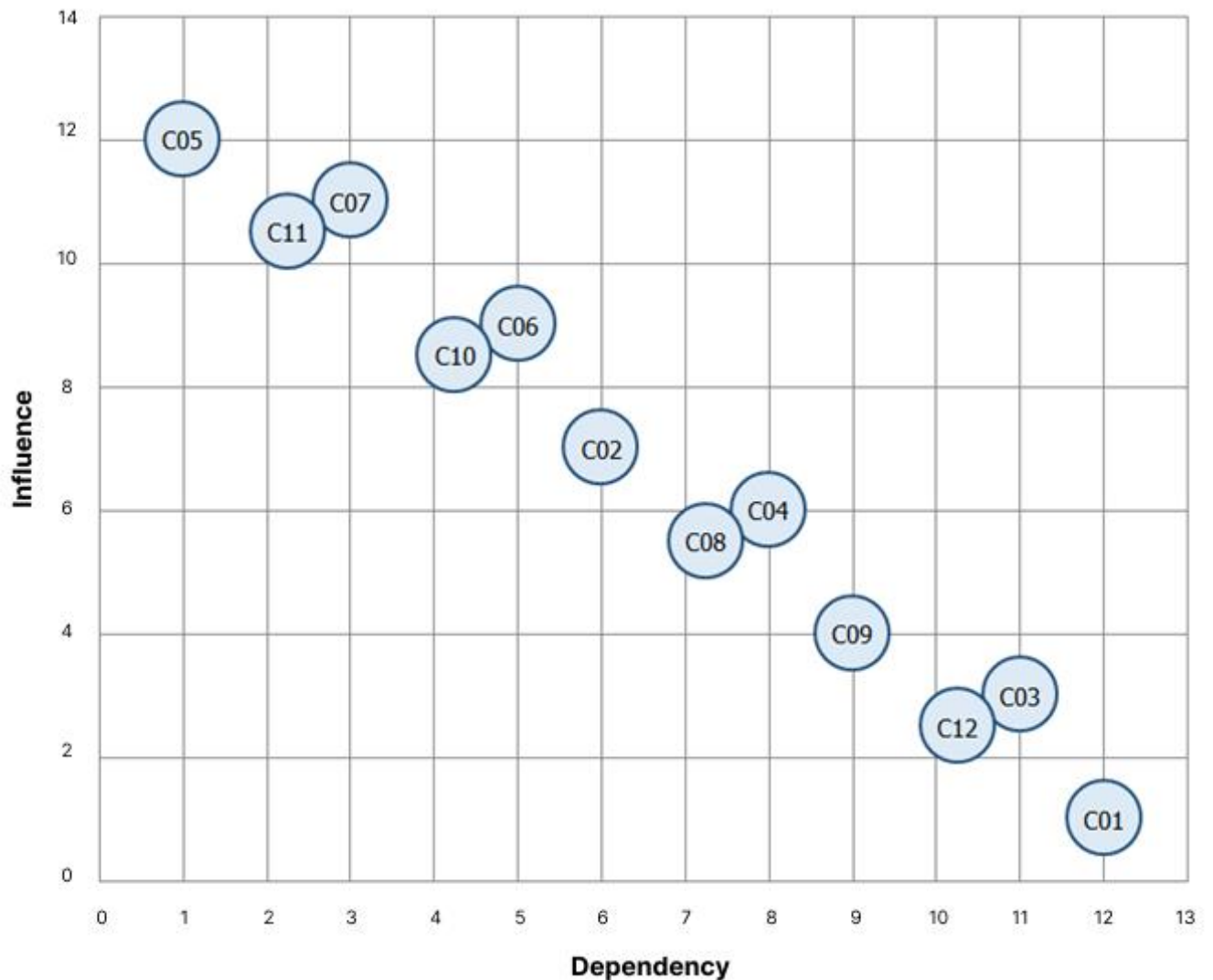
Figure 1. Human Resource Development Model Based on Employee Maturity Capabilities in Knowledge-Based Companies

The input and output sets for each element are used to construct the Influence-Dependence Matrix (MICMAC analysis). The Influence-Dependence Matrix is presented in Table 8. The ISM model effectively illustrates the interrelationships between the criteria and the connections among different levels, providing a clearer decision-making framework for managers. To identify key criteria, the influence and dependency power of each criterion is established through the final reachability matrix.

Table 7. Influence and Dependency Power of the Human Resource Development Model Based on Employee Maturity Capabilities in Knowledge-Based Companies

Research Variables	Dependency Power	Influence Power	Level
Human Resource Development (C01)	12	1	1
Knowledge-Based Managerial Succession Planning (C02)	6	7	5
Performance Based on Ethical Charter (C03)	11	3	2
Training and Learning (C04)	8	6	4
Incompatible Management (C05)	1	12	8
Competency Management (C06)	5	9	6
People Management (C07)	3	11	7
Talent Acquisition, Hiring, and Retention (C08)	8	6	4
Research and Development (C09)	9	4	3
Transformation Management (C10)	5	9	6
Capability Management (C11)	3	11	7
Performance Management (C12)	11	3	2

Figure 2. Influence-Dependence Graph of the Human Resource Development Model Based on Employee Maturity Capabilities

Based on the influence-dependence power diagram, the variables people management (C07), capability management (C11), and incompatible management (C05) have high influence power and low dependency, placing them in the independent variable category. The variables human resource development (C01), performance based on the ethical charter (C03), performance management (C12), and research and development (C09) are classified as

dependent variables. The variables research and development (C09), training and learning (C04), talent acquisition, hiring, and retention (C08), knowledge-based managerial succession planning (C02), competency management (C06), and transformation management (C10) exhibit similar levels of influence and dependency, making them linkage variables. Notably, no variable is located in the autonomous quadrant.

4.   Discussion and Conclusion

This study aimed to model human resource development based on employee maturity capabilities in knowledge-based companies. According to the research model, incompatible management was identified as the most fundamental variable in human resource development, influencing people management and capability management. In this regard, the findings of Sabzi et al. (2023) also indicated that the human resource development system comprises components such as development planning and implementation, strategy, training, and strategic evaluation, all of which lead to employee empowerment [14].

The study further revealed that these factors impact competency and transformation management, ultimately leading to knowledge-based managerial succession planning. The findings of Taghavi et al. (2022) stated that "human resource maturity involves investing in employees to enhance their cognitive abilities, metacognitive skills, and professional and communication competencies to maximize their potential. [19]"

It was also found that knowledge-based managerial succession planning affects training, learning, recruitment, hiring, and retention of human resources. In this regard, the findings of Bahari and Taheri (2023) demonstrated that human resource development in knowledge-based companies involves structural, environmental, cultural, strategic, organizational, technological, planning, recruitment, training, and performance factors. Additionally, the study established that research and development influence performance based on the ethical charter and performance management, ultimately leading to human resource development [11]. The findings of Boroustaei et al. (2024) emphasized that implementing systemic control, strategic objectives, performance improvement, and customer satisfaction can enhance and subsequently mature human resource processes [20].

Based on the research findings, the following practical recommendations are proposed:

Regarding the initial level (incompatible management), it is recommended that employees be familiarized with their job descriptions to foster alignment in their activities. Establishing sufficient communication between managers and employees can also help achieve organizational group cohesion.

For the managed level (people management), it is suggested that raising employees' awareness of their organizational responsibilities will facilitate human resource development. Additionally, improving communication and coordination among employees can reduce interpersonal conflicts. Human resource development can be achieved through an effective compensation system, and the use of training methods such as coaching and mentoring is recommended.

For the defined level (competency management), it is recommended to implement competency frameworks in management and hire skilled managers to enhance technical competency. Identifying aspects of environmental competency is crucial for human resource development and overcoming existing challenges. A critical factor in this domain is individual competency and meritocracy in appointments, both of which significantly contribute to human resource development.

For the predictable level (capability management), it is suggested that strengthening competency integration and cohesion will enhance specialized employee empowerment. The goals of human resource development can be

achieved by establishing self-managed teams within the organization and implementing coaching and organizational capability management programs.

For the optimized level (transformation management), increasing employee creativity in assigned tasks is recommended. Aligning employees with organizational goals will facilitate human resource development. This process relies on continuous improvement of organizational capabilities and enhancing organizational efficiency and productivity.

Regarding knowledge-based managerial succession planning, it is advised that organizations identify their knowledge management needs and develop innovative knowledge management strategies. Managers should allocate the necessary resources for training and knowledge implementation while also focusing on skilled and elite internal employees to streamline the achievement of human resource development objectives.

For talent acquisition, hiring, and retention, it is recommended to first assess employees' strengths and weaknesses. Identifying employees' professional skills is essential for ensuring that each employee is placed in a suitable position. Encouraging employees to improve interactions with managers and colleagues will also enhance workplace psychological well-being, which significantly impacts human resource development.

Regarding research and development, it is recommended to identify development programs, select relevant activities, and assess development needs based on organizational objectives. Determining skill requirements and developmental goals is essential. Employee accountability for development must also be increased, and managers should provide oversight and evaluation to facilitate individual development progress.

For training and learning, it is suggested that managers use modern training methods and up-to-date educational tools while organizing continuous training programs to achieve human resource development objectives. Integrating coaching into key strategies and organizational mission statements is also crucial. Additionally, developing a learning-based training strategy is recommended.

For performance based on the ethical charter, it is suggested that organizations evaluate employee performance according to ethical charter standards while emphasizing human dignity and justice among individuals. Human resource development can be achieved through implementing incentive and disciplinary mechanisms to ensure adherence to ethical guidelines. Furthermore, compliance with ethical principles and Islamic values within the organization plays a crucial role in achieving predefined objectives.

For performance management, it is recommended to plan employee performance evaluations and establish precise assessment indicators while adopting modern performance evaluation methods. Identifying deviations from work standards and continuously monitoring and assessing employee performance is also advised.

By implementing these strategies, achieving human resource development and outcomes such as improved job-related skills, enhanced employee capabilities, increased functional efficiency, greater job effectiveness, and organizational competitive advantage will be well within reach.

To integrate scientific and practical methods with knowledge and applied research, and considering existing limitations, the following research topics are suggested for future studies:

- Conduct conceptual studies on human resource development in knowledge-based companies within the National Iranian Oil Company, using the employee maturity capabilities framework from a theoretical perspective, while also exploring practical implementation methods.
- Investigate the relationship between the mechanisms of human resource development models in knowledge-based companies within the National Iranian Oil Company and the employee maturity capabilities framework from the perspective of employees.

- Compare human resource development models in knowledge-based companies within the National Iranian Oil Company with those in other countries using the employee maturity capabilities framework.
- Prioritize stakeholders of the human resource development model in knowledge-based companies within the National Iranian Oil Company using the employee maturity capabilities framework.
- Examine the antecedents and consequences of the human resource development model in knowledge-based companies within the National Iranian Oil Company using the employee maturity capabilities framework through case studies.
- Identify the prerequisites for implementing and establishing the human resource development model in knowledge-based companies within the National Iranian Oil Company using the employee maturity capabilities framework.
- Conduct a diagnostic analysis of challenges and obstacles in implementing and establishing the human resource development model in knowledge-based companies within the National Iranian Oil Company using the employee maturity capabilities framework.
- Evaluate and prioritize the factors influencing the human resource development model in knowledge-based companies within the National Iranian Oil Company using the employee maturity capabilities framework within the studied or an alternative statistical population.

Authors' Contributions

Authors equally contributed to this article.

Ethical Considerations

All procedures performed in this study were under the ethical standards.

Acknowledgments

Authors thank all participants who participate in this study.

Conflict of Interest

The authors report no conflict of interest.

Funding/Financial Support

According to the authors, this article has no financial support.

References

[1] F. Paimaneh, M. Zayandehroudi, and M. Jalaei, "Identifying and Explaining the Impact of Competitiveness and Knowledge-Based Economy Indicators on the Resilience of Iran's Economy," *Applied Economic Theories,* vol. 11, no. 1, pp. 207-240, 2024.

[2] R. Donnelly and E. Hughes, "The HR ecosystem framework: Examining strategic HRM tensions in knowledge-intensive organizations with boundary-crossing professionals," *Human Resource Management,* vol. 62, no. 1, pp. 79-95, 2023, doi: 10.1002/hrm.22115.

[3] D. Kossyva, G. Theriou, V. Aggelidis, and L. Sarigiannidis, "Retaining talent in knowledge-intensive services: enhancing employee engagement through human resource, knowledge and change management," *Journal of Knowledge Management,* vol. 28, no. 2, pp. 409-439, 2024, doi: 10.1108/JKM-03-2022-0174.

[4]   Y. Hong, K. Shahzad, Y. Jiang, and H. Niaz, "Knowledge-Intensive HRM systems and performance of knowledge-intensive teams: Mediating role of team knowledge processes," *Group & Organization Management,* vol. 48, no. 5, pp. 1430-1466, 2023, doi: 10.1177/10596011211063667.

[5]   L. Yar Ahmadi, M. Arefi, and H. Vahdati, "Examining the Impact of Intra-Organizational Characteristics on Competitive Advantage with the Mediating Role of Entrepreneurial Marketing in Knowledge-Based Organizations," *Productivity Management,* vol. 17, no. 64, pp. 71-92, 2023.

[6]   N. Mirsepasi, *Mirsepasi Human Resource Management Maturity Evaluation Model*. Tehran: Rad Nowandish, 2021.

[7]   L. Wang, Y. Zhou, and G. Zheng, "Linking digital HRM practices with HRM effectiveness: The moderate role of HRM capability maturity from the adaptive structuration perspective," *Sustainability,* vol. 14, no. 2, p. 1003, 2022, doi: 10.3390/su14021003.

[8]   S. Di Luozzo, M. M. Schiraldi, and M. Marino, "Human excellence maturity model: leveraging human resource management to achieve operational excellence," *International Journal of Business Excellence,* vol. 5, no. 3, pp. 130-113, 2021, doi: 10.1504/IJBEX.2021.10043827.

[9]   S. Han, C. Li, W. Feng, Z. Luo, and S. Gupta, "The effect of equipment management capability maturity on manufacturing performance," *Production Planning & Control,* vol. 14, no. 2, pp. 1-16, 2020, doi: 10.1080/09537287.2020.1815246.

[10]   V. Ghorbanizadeh, A. Seyednaghavi, D. Hosseinpour, and A. Nedaei, "A Strategic Development Model for Resources in Government Research Organizations," *Management Research in Iran,* vol. 25, no. 112, pp. 126-149, 2021.

[11]   B. Bahari and M. Taheri, "Designing an E-Human Resource Management Model Based on Knowledge Creation in Knowledge-Based Companies," *Value Creation in Business Management,* vol. 3, no. 1, pp. 106-121, 2023.

[12]   Z. Salgi, H. Vahdati, J. Mousavi, and K. Nazari, "Designing a Lean Human Resources Excellence Model," *Management Research in Iran,* vol. 25, no. 1, pp. 74-93, 2021.

[13]   Legatum, "The Legatum Prosperity Index," 2024. [Online]. Available: https://www.prosperity.com/rankings.

[14]   M. Sabzi, H. Rangriz, and M. Kheyrandish, "A Systemic Model for Human Resource Development in Knowledge-Based Companies with a Qualitative Approach," *Innovation Management in Defense Organizations,* vol. 6, no. 1, pp. 175-204, 2023.

[15]   J. Nazarian, M. H. Ronaghi, M. Ali Mohammadlou, and A. Ebrahimi, "A Framework of Factors Influencing Business Intelligence Maturity," *Smart Business Management Studies,* vol. 12, no. 46, pp. 1-39, 2023.

[16]   N. Fathi, R. Seyedjavadin, and T. Hasangholipour, "Identifying and Analyzing Sociological Challenges of Human Resource Development in Knowledge-Based Organizations," *Cultural Sociology Research,* vol. 14, no. 1, pp. 93-125, 2023.

[17]   M. Khademi and M. Sahebkar, "Presenting a Human Resource Management Model for Knowledge-Based and Innovative Companies," *Management Research in Iran,* vol. 26, no. 117, pp. 70-93, 2022.

[18]   A. Seyed Naghavi, M. Amiri, and M. Ghaffari, "Stagnant Employees in the Oil Industry: Challenges in Training and Human Resource Development," *Organizational Resource Management Research,* vol. 12, no. 54, pp. 152-119, 2022.

[19]   Z. Taghavi, K. Ghahreman, and E. Sharifian, "Examining the Maturity of Human Resources in State Universities of Physical Education with an Emphasis on Future Studies," *Applied Research in Sports Management,* vol. 9, no. 3, pp. 99-108, 2021.

[20]   A. Boroustaei, D. Hosseinpour, A. Seyed Naghavi, and H. Roudsaz, "Identifying Dimensions of Human Resource Management Auditing Based on Process Maturity Using a Synthesis Research Approach," *Applied Educational Leadership,* vol. 5, no. 19, pp. 77-93, 2024.