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Design and Structural Elaboration of a Reskilling Model for Human Resources (Case Study: Public and Private Hospitals in Yazd)

1. Mehdi. Dehghani Tafti : Department of Public Administration, Raf.C., Islamic Azad University, Rafsanjan, Iran
2. Amin. Nikpour*: Department of Public Administration, Ke.C., Islamic Azad University, Kerman, Iran
3. Malikeh. Beheshtifar : Department of Public Administration, Raf.C., Islamic Azad University, Rafsanjan, Iran

*corresponding author's email: kermani123456@iau.ac.ir

ABSTRACT

In a context where work environments are undergoing rapid and continuous transformation, reliance on traditional skills and past knowledge is no longer adequate for addressing complex and multidimensional organizational needs. To survive and maintain competitiveness, organizations are compelled to invest in the reskilling of their human resources. The purpose of this study is to design and structurally elaborate a human-resources reskilling model. The methodological approach is an exploratory mixed-methods design, employing thematic analysis in the qualitative phase and structural equation modeling in the quantitative phase. The qualitative findings include 92 basic themes, 25 organizing themes, and 7 global themes such as the macro-policy system of reskilling, technology-driven cognitive mapping of reskilling, the schema of strategic human-resource actions, skill-based resilience building, operational competitiveness, evolutionary development of the reskilling system, and employees' psychological empowerment. The quantitative findings indicated that the macro-policy system of reskilling constitutes a central and foundational construct with the greatest effect on the schema of strategic human-resource actions. The construct of the strategic human-resource actions schema functions as the operational core of the model, linking macro-level policies to the operational level, and demonstrates a positive and significant relationship with three constructs: technology-driven cognitive mapping, operational competitiveness, and skill-based resilience building. Moreover, the two final constructs of the model—evolutionary development of the reskilling system and employees' psychological empowerment—exhibited desirable levels of model fit, indicating that the reskilling system becomes effective when policymaking, technology, resilience, and human resources converge in an integrated manner to shape the trajectory of growth and self-correction in the health-care system. Ultimately, it can be argued that hospital system management must shift its policymaking perspective on reskilling and view it through a transformational lens in practice, thereby enabling a deeper linkage between service delivery and learning among human resources. Furthermore, instead of temporary or incremental upskilling, managers should pursue the long-term development of an architectural, skill- and knowledge-based structure. Such an approach reduces instrumental views of skills and replaces them with a capital-investment orientation.

Keywords: Reskilling, Upskilling, Skill Gap, Health-Care System.

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Introduction

Reskilling and upskilling have moved from being discretionary human resource initiatives to becoming strategic necessities in the context of the Fourth Industrial Revolution (4IR), rapid digitization, and pervasive artificial intelligence (AI) across sectors (1-3). Automation, data-driven decision making, and platform-based work arrangements are transforming job designs, competency requirements, and the stability of professional identities, forcing organizations to rethink how they develop and redeploy human capital over the life course of employment (4, 5). These transformations are particularly acute in knowledge-intensive and safety-critical settings such as health care, where technological change intersects directly with population health, patient safety, and equity in access to services (6, 7). Against this backdrop, reskilling is increasingly framed not merely as an educational intervention, but as a systemic governance issue that links national competitiveness, social protection, and organizational agility (8, 9).

Global evidence suggests that the pace of technology adoption and AI diffusion is outstripping existing skill-formation systems, generating persistent and widening skill gaps in both advanced and emerging economies (10, 11). Dynamic panel analyses show that AI-related productivity gains are accompanied by risks of technological unemployment and job polarization, particularly in high-tech economies that lack robust active labour-market and training policies (12). Within organizations, the rapid restructuring of work processes, the introduction of robotics and digital platforms, and the redesign of professional roles can disrupt workers' sense of competence and identity, amplifying resistance to change unless accompanied by purposeful reskilling strategies (4, 13). These pressures are reflected in calls for integrated approaches to training course planning, hierarchical scheduling of multi-skilled employees, and strategic workforce planning that jointly consider production efficiency and developmental trajectories of workers' capabilities (14, 15).

Health-care systems represent a particularly salient case of the reskilling challenge. The World Health Organization anticipates substantial shortages and maldistribution of health workers by 2030, threatening progress toward universal health coverage and widening inequities between and within countries (6). At the same time, hospitals and primary-care systems are under pressure to adopt digital health records, telemedicine, robotic process automation, and AI-enabled diagnostic tools, all of which reconfigure the skills required of clinicians, managers, and support staff (7, 16). Scoping reviews of intersectoral collaboration for health workforce education emphasize that recruitment and retention strategies must be tightly coupled with opportunities for continuous learning, career progression, and skill renewal in order to remain effective in a volatile environment (17, 18). In this context, reskilling is not merely a response to individual competence deficits, but a core mechanism for sustaining system resilience and service quality under conditions of demographic change, epidemiological transition, and financial constraint (19, 20).

Concurrent developments in AI and digitalization have further intensified the urgency of reskilling. Conceptual and empirical work highlights how AI can function as both a disruptive force—automating routine tasks and reshaping occupational structures—and an enabling infrastructure for scalable, personalized learning experiences (3, 21). AI-driven skilling platforms, micro-credentialing systems, and adaptive learning pathways are being deployed to support large-scale reskilling and upskilling initiatives across industries, including health care (16, 22). However, such initiatives require complementary governance frameworks that safeguard human-centred learning, ethical use of data, and equitable access to opportunities, particularly for workers at risk of skill obsolescence or marginalization in the digital labour economy (1, 5). Global reviews of reskilling and upskilling initiatives in the age of AI underscore that fragmented, short-term training projects rarely deliver sustainable outcomes unless embedded in coherent systems of workforce planning, competency management, and organizational change (9, 23).

The literature on strategic human resource management increasingly positions reskilling and upskilling as central levers for "future-proofing" workforces and enhancing organizational agility. HR scholars and practitioners argue that reskilling must be integrated with talent management, job redesign, and competency mapping, rather than treated as isolated training events (24, 25). Empirical analyses in construction, services, and manufacturing show that organizations that proactively map skill gaps, align training investments with strategic priorities, and leverage innovative HR technologies are better positioned to respond to disruptive shocks and seize emerging opportunities (26-28). In service marketing and hospitality, strategic workforce reskilling is linked to the development of soft skills, sustainability competences, and customer-experience capabilities that are not easily automated and hence provide durable competitive advantage (29, 30). Concurrently, qualitative and quantitative studies document how job redesign, reskilling, and upskilling shape organizational agility by enabling employees to flexibly assume new roles, collaborate across functional boundaries, and adapt to rapidly shifting customer and stakeholder expectations (31, 32).

From a macro-structural perspective, governments and international organizations have begun to articulate national and regional strategies for reskilling as part of broader competitiveness and inclusion agendas. The European competitiveness strategy, for instance, highlights human capital development and workforce skill transformation as prerequisites for long-term productivity, technological sovereignty, and green transition (8). Scenario analyses for basic digital upskilling and reskilling in Romania demonstrate that failing to close foundational skill gaps risks entrenching regional disparities and limiting the diffusion of digital public services (33). In Gulf and Asian contexts, national frameworks for AI skills and adult learning are being deployed to "future-proof" careers and reduce the vulnerability of citizens to technological displacement, with special attention to mid-career workers and those employed in small and medium-sized enterprises (32, 34). These strategies complement organizational-level initiatives by creating enabling environments for lifelong learning, credential portability, and cross-sectoral mobility.

Yet, research also shows that the impacts of reskilling efforts are uneven across worker groups and employment arrangements. Studies on the gig economy document both positive and negative consequences of upskilling and reskilling, noting that while competency development can enhance earning potential and job satisfaction, structural constraints, precarious contracts, and algorithmic control systems often limit gig workers' capacity to translate new skills into secure career trajectories (35, 36). Similar patterns are observed in distributed and hybrid workforces, where HR's ability to optimize models of remote and on-site work depends on proactive investments in digital skills, e-leadership, and novel forms of collaboration (18, 37). Evidence from construction and the built environment indicates that training needs assessments, context-sensitive curricula, and industry–academia partnerships are necessary to ensure that reskilling initiatives align with the practical realities of workplaces and technological infrastructures (20, 26).

Within the health sector specifically, upskilling and reskilling have been investigated in relation to emergency medicine, nursing, and health professional education more broadly. Cross-sectional surveys in emergency medicine highlight persistent knowledge and skill gaps that require systematic approaches to lifelong training, retraining, reskilling, and upskilling, especially as new technologies, protocols, and population-health challenges emerge (38). Reviews of upskilling in the health-care sector underscore the need for robust educational ecosystems that combine formal training, simulation-based learning, and blended approaches to practical skill acquisition, thereby maintaining clinical competence while accommodating work pressures (19, 39). The COVID-19 pandemic further revealed how rapid reskilling initiatives—often delivered under crisis conditions—can open pathways into entrepreneurship, foster optimism, and reshape perceptions of labour-market opportunities, while simultaneously exposing structural barriers related to access, digital divides, and support systems (40). These insights point to the importance of designing reskilling systems that are both agile and equitable, capable of responding to acute shocks without reinforcing existing inequalities.

In the Iranian and broader regional context, scholars have begun to conceptualize reskilling as a multi-level challenge encompassing sectoral clusters, military organizations, and emerging industries. Studies on skills training roadmaps for conscript personnel in the armed forces, for example, emphasize the necessity of structured curricula, competency-based assessment, and alignment with long-term career development inside and outside the military (41). Research on human-resource skills models for industrial clusters, such as the plastics industry, likewise stresses the need for integrated approaches that connect technical training with innovation capacity, inter-organizational collaboration, and regional development strategies (42). In the automotive industry, skills-training models oriented toward organizational innovation reveal how targeted competencies in creativity, problem solving, and teamwork can catalyse technological upgrading and competitive performance (43). These sectoral insights underscore the importance of context-sensitive models that take into account the specific technologies, regulatory frameworks, and labour-market dynamics of each field.

At the micro-organizational level, research on managerial unlearning, reverse mentoring, and e-leadership in Iranian organizations highlights the psychological and cultural dimensions of reskilling processes. Managerial unlearning is identified as a critical antecedent of skills enhancement in the digital transformation era, as entrenched assumptions and legacy practices often inhibit the adoption of new technologies and work methods (44). Reverse mentoring in start-ups has been shown to bridge skill gaps by allowing younger, digitally proficient employees to support senior managers' learning, thereby reshaping power dynamics and promoting a culture of continuous improvement (45). E-leadership studies point to the importance of communication, digital literacy, and change-management competencies for leaders who must orchestrate geographically and technologically distributed teams (37). Together, this body of work suggests that any reskilling model must incorporate mechanisms for unlearning, intergenerational knowledge exchange, and leadership development, in addition to technical training.

Global reviews and conceptual frameworks on skill-gap management provide further guidance for the design of comprehensive reskilling architectures. The "skill bridge" perspective conceptualizes skill-gap management as an ongoing process of diagnosis, intervention, and evaluation that spans education systems, labour markets, and organizational practices (10). Syntheses of digital skill gaps in the global workforce propose multi-layered frameworks that integrate individual capabilities, organizational resources, and policy instruments to promote inclusive digital transitions (33, 46). Studies on AI for workforce development, reverse mentoring, and AI-based competency mapping suggest that leveraging data analytics and intelligent systems can enhance the precision of training needs assessment, personalize learning pathways, and monitor the effectiveness of interventions over time (22, 27). However, these benefits are contingent upon robust ethical governance and participatory design that foreground worker agency and well-being (3, 31).

For human resource professionals, the convergence of these trends translates into a mandate to place reskilling and upskilling at the centre of workforce strategies. Strategic HR reviews emphasize that HR must move beyond transactional training administration toward orchestrating holistic reskilling ecosystems that cut across organizational boundaries and time horizons (24, 25). Practical guidance for building future-fit workforces highlights the need to articulate clear skill taxonomies, map current and future roles, and design learning journeys that blend formal education, on-the-job learning, mentoring, and digital platforms (34, 47). Comparative analyses of teaching modalities show that blended and online approaches, when carefully designed, can match or surpass face-to-face instruction in supporting practical skill acquisition, thereby offering flexible routes for reskilling busy professionals (39). Collectively, this literature suggests that effective reskilling architectures must be simultaneously strategic, evidence-based, technologically enabled, and human-centred.

Despite the growing global evidence base, there remains a paucity of contextually grounded models that integrate governance, technology, strategic HR actions, resilience, operational competitiveness, and psychological empowerment into a coherent framework for reskilling in hospital systems, particularly in middle-income countries facing simultaneous demographic, epidemiological, and fiscal pressures (6, 38). Few studies have systematically examined how macro-level policymaking for reskilling interacts with technology-driven cognitive mapping, strategic human-resource action schemas, and skill-based resilience building to shape the evolution and effectiveness of reskilling systems within health-care organizations (14, 48). Even fewer have explored how such systemic configurations influence the psychological empowerment of employees, their readiness to engage in continuous learning, and their capacity to sustain high-quality clinical and administrative performance under conditions of turbulence (13, 15, 49). Addressing this gap requires empirically validated models that capture the multidimensional nature of human-resource reskilling in health-care settings and provide actionable guidance for policymakers, hospital managers, and HR professionals (9, 23, 47).

Accordingly, building upon international and national evidence on skill gaps, reskilling architectures, and health workforce challenges, the present study seeks to design and structurally validate a comprehensive model of human-resource reskilling for public and private hospitals, integrating macro-level policymaking, technology-driven cognitive mapping, strategic HR actions, skill-based resilience, operational competitiveness, system evolution, and psychological empowerment of employees; therefore, the aim of the present study is to design and structurally explain a human-resource reskilling model for hospital systems.

Methods and Materials

This study is applied in terms of purpose and is considered descriptive in nature. The objective of the present research is to design and structurally elaborate a human-resources reskilling model in public and private hospitals in the city of Yazd. The research strategy in the qualitative phase was thematic analysis aimed at discovering the thematic network, and for evaluating the research model, path analysis and the structural equation modeling (SEM) test were employed. Semi-structured interviews were used to collect qualitative data. A purposive judgmental sampling method was also adopted.

In the qualitative sampling process, criteria such as prior research activity (books, organizational and applied projects, scientific lectures, conferences, domestic and international articles, and supervision of doctoral dissertations and master's theses) related to human-resource development, employee training, skill-development programs, learning and the learning organization, knowledge management, and similar areas were used purposively to select academic experts. With respect to selecting organizational experts (including hospital managers, heads, and deputy directors), the most important criterion was job experience in human-resource management, support, or administrative management (at least 5 years). Interviews continued until theoretical saturation was achieved. On average, each interview lasted 40 minutes depending on the richness of its content, and because theoretical saturation was reached after 12 interviews, the interview process was concluded, and the researcher considered the number of completed interviews sufficient. The researcher then proceeded to coding and categorization based on the thematic analysis technique in initial textual concepts, basic themes, organizing themes, and global themes. Table (1) presents the characteristics of the experts.

Table 1. Characteristics of Experts

Row	Gender	Age	Education	Specialization	Job Position
1	Male	41	PhD	Business Management	Deputy for Research and Technology
2	Male	47	PhD	Entrepreneurship Management	Deputy for Support Services
3	Male	50	PhD	Organizational Behavior Management	Faculty Member
4	Female	39	PhD	Human Resource Management	Faculty Member
5	Male	35	PhD	Business Administration	Deputy for Management Development and Resources
6	Female	49	PhD	Public Administration – Human Resources	Faculty Member
7	Male	43	PhD	Business Management	Deputy for Education
8	Male	48	PhD	Public Administration – Policy Making	Faculty Member
9	Male	45	PhD	Business Management – Human Resources	Deputy for Human Capital
10	Male	50	PhD	Business Management	Deputy for Research
11	Female	44	PhD	Public Administration	Faculty Member
12	Male	41	PhD	Public Administration	Faculty Member

To ensure validity, content validity was assessed using two indicators: CVR, the Content Validity Ratio proposed by Lawshe (1975), and CVI, the Content Validity Index. The overall CVR was estimated as 0.782 and the overall CVI as 3.314. Because the CVR exceeded the threshold of 0.75 with the participation of 8 experts, it can be stated that the research findings were confirmed by experts from the perspective of CVR. Furthermore, the CVI index, due to exceeding the average level (= 3), also confirmed the consensus among expert evaluations.

To calculate interview reliability using the test–retest method, four interviews were selected from the conducted interviews and each was recoded by the researcher with a 20-day interval. The test–retest reliability was calculated as 93.22 percent, indicating the dependability of the researcher's coding process. For calculating inter-coder reliability, two coders (the researcher and another qualitative researcher) independently performed the coding. For this purpose, a doctoral student in management familiar with the coding process was asked to participate in the coding, and the final inter-coder reliability was deemed acceptable at 83.26 percent.

The quantitative research population consisted of employees of public and private hospitals in the city of Yazd. The population size was estimated to be 11,030 employees. Using Cochran's formula, the sample size was calculated as 371. Given the specialized nature of the research topic and the policy-oriented nature of the questionnaire (strategic, planning, managerial, and educational aspects), the questionnaire was purposively distributed among managers, deputy directors, supervisors, and senior organizational decision makers. These groups are cognitively qualified, have access to organizational information, and play roles in adopting and implementing reskilling policies; therefore, they are appropriate representatives for responding to the research questions. Sampling was deliberately performed to ensure that the data reflected the perspectives of actual decision makers in the reskilling process.

Accordingly, based on the estimated sample size and using non-probability quota sampling, 310 questionnaires were distributed in public hospitals (Shahid Sadoughi, Shohada-ye Mehrab (Burn and Trauma), Seyyed Reza Shah

Vali, Shahid Rahnemoun (Farrokhi), Shohada-ye Kargar, Bahman, Afshar) and 61 questionnaires in private hospitals (Dr. Mojibian, Madar, Mortaz, Seyyed al-Shohada). To collect quantitative data, a 76-item researcher-developed questionnaire using a five-point Likert scale was employed based on the qualitative findings. For assessing questionnaire reliability, Cronbach's alpha was used, and the KMO test was employed to assess sampling adequacy and construct validity. For analyzing quantitative data, the structural equation modeling test in SMART PLS 3 was utilized. The PLS data-analysis algorithm consists of three sections: measurement-model indices, structural-model indices, and the overall model fit criterion (GOF).

Findings and Results

In the initial analysis of the interview transcripts, a total of 649 concepts or initial codes were extracted. These initial concepts formed the foundation of the thematic-analysis process. Through in-depth examination of the initial concepts, 399 concepts with semantic similarities were identified and categorized into 92 basic themes. At the intermediate level of theme analysis, which pertains to organizing themes and reflects the implicit meanings of the primary assumptions derived from the basic themes—providing the necessary groundwork for mapping the thematic network—25 organizing themes were identified through categorization of the basic themes. Finally, at the highest level of thematic analysis, 7 global themes, representing the principal analytical metaphors of the study, were obtained. Table (2) presents the basic, organizing, and global themes.

Table 2. Overall Structure of the Data

Basic Themes	Organizing Themes	Global Themes
Strategic enforcement of human-resource reskilling; data-driven policymaking in reskilling; national macro-orientation in reskilling programs; establishment of a national reskilling governance headquarters; members of the national reskilling headquarters; duties of the national reskilling headquarters; linking governance and operational levels in reskilling plans	Designing a reskilling governance system	Macro-level reskilling policymaking system
Developing an employee skill map; creating a skill-information repository; enhancing security and confidentiality of the skill database; implementing skill-tiering; operationalizing reskilling programs; pilot implementation and gradual redesign of programs	Regulatory structuring of the operational map for reskilling	
Flexible revision of the educational system structure; adaptive reforms in the education system; obligatory redesign of human-resource structures; alignment of reskilling programs with HR policies	Policy-induced activation of HR education	
Expanding educational equity in underprivileged regions; improving regional access to education; establishing regional shared reskilling centers	Regional macro-level educational equity	
Future-oriented investment; anticipatory skill-planning in the health-care system	Development-oriented foresight	
Technological influence on health-care occupations; structural redesign aligned with digital transformation; job substitutability due to technological change	Technology-driven job-system redesign	Technology-driven cognitive mapping of reskilling
Providing technology-based job training; growth of e-learning; expansion of electronic learning; enhancing employees' contemporary knowledge literacy; strengthening employees' digital literacy	Development of digital-based educational infrastructures	
Expanding coaching roles; blended-learning delivery; accessibility of reskilling programs	Development of new reskilling capacities	
Job-skill needs assessment; reducing skill gaps	Feasibility of skill growth	Strategic human-resource action schema
Necessity of soft-skill development; basic-skill training for different groups; reskilling of frontline staff; reskilling of experienced staff; specialized training for specific jobs; reskilling of mid-skilled occupations	Comprehensive enforcement of learning capability	
Embedding distinguished job incentives; valuing reskilling in career advancement; preventing rising turnover; alignment of reskilling and career-path development	Strategic alignment of career pathways	
Preference-based learning; personalized learning; development of blended learning; structuring training frameworks; employee involvement in program content design; organizational support for employee learning	Employee-centered learning	

Preparation for new job opportunities; policies for maintaining and enhancing current and new skills	Development of opportunity-oriented job capacity	
Establishing skill-effectiveness evaluation systems; continuous evaluation of reskilling programs; ongoing environmental scanning for educational planning	Continuous functionalist evaluation	
Balanced distribution of job responsibilities; managing labor supply and demand in the health-care system; preparing the workforce for crises	Resilient management of responsibility-driven functions	Skill-based resilience building
Gradual impact of skill obsolescence; essential qualitative shifts in skills and work methods; weakened employee adaptability to change; risk of workforce aging	Skill-avoidance contingencies	
Cross-sectoral synergy in the health-care system; strengthening labor-union participation	Development of inter-organizational collaborations	Operational competitiveness
Attracting governmental financial support; attracting strategic private-sector participation; optimizing cost management; organizational resource support for reskilling programs; designing a strategic inter-organizational financing model; economic justification of reskilling programs	Strengthening economic levers	
Improving the quality of health-care services; providing desirable clinical performance; enhancing job-educational productivity	Improvement of service-delivery and clinical performance	Evolutionary reskilling-system development
Employee learning participation; collaborative employee dynamism; strengthening internal organizational communication; reinforcing collective experiences	Learning-driven interaction	
Enhancing decision-making skills; developing informational skills; strengthening analytical and evaluative capacity	Multi-purpose skill enhancement	
Identifying skill needs; developing multi-skilled staff; workforce management during crises; improving external responsiveness	Agile skill-system management	
Employee psychological readiness and well-being; reducing job stress and anxiety; reducing job depression	Employee psychological well-being	Psychological empowerment of employees
Internal motivation; increasing employee self-efficacy	Job-based self-motivation	
Strengthening sense of organizational belonging; increasing organizational commitment	Organizational loyalty	

The paradigmatic model of the study is presented in Figure (1).

Macro-Level Reskilling Policymaking System: This category refers to the formation of an architectural macro-governance structure that transforms reskilling from dispersed educational activities into a coherent public-policy framework. At this level, the concept of a “macro-level policymaking system” is defined as a structure that regulates relationships based on skill standardization, analytical data, and educational equity. According to the findings, three core pillars of this system include the national reskilling headquarters, the national skill-information repository, and a comprehensive system of continuous evaluation of reskilling courses. This category reflects the notion of data-driven governance, wherein policymaking relies on evidence and real analyses rather than temporary or situational decisions.

Strategic Human-Resource Action Schema: This category concerns the set of strategic actions and orientations that the health-care system adopts to operationalize the objectives related to human-resource reskilling policies. This comprehensive category highlights the design of an integrated, gradual strategic pathway for skill development based on the logic of strategic human-resource management. Through this strategic perspective, human-resource reskilling acquires broader capacity-building implications within the macro-policy structure of the health-care system and can itself be regarded as a roadmap for human-capital transformation.

Technology-Driven Cognitive Mapping of Reskilling: Technology-driven cognitive mapping of reskilling is conceptualized as a cognitive framework aimed at institutionalizing the idea that digital, data-driven, and analytical skills are no longer supplementary but instead lie at the core of occupational competencies and serve as foundational elements in the structure of reskilling. It signals a paradigm shift from traditional transmission-based training to interactive learning grounded in experience, simulation, and the application of artificial-intelligence capabilities. The ultimate purpose of technology-driven cognitive mapping is to build and strengthen cognitive foundations within reskilling mechanisms, under the premise that any element capable of functional relevance can be incorporated into reskilling mechanisms as a teachable and learnable component.

Operational Competitiveness: This category pertains to enhancing operational capacity and capability in the work environment. The health-care system must therefore define a strategic level of action in relation to this construct. Achieving operational competitiveness requires both internal and external organizational prerequisites to support operations and increase the maneuverability of the health-care system. Internally, linking human-resource reskilling initiatives with operations management is one of the primary sources of organizational support, which, in addition to expanding the operational domain, enhances trust and confidence, enabling the health-care system to function with greater assurance in its environment.

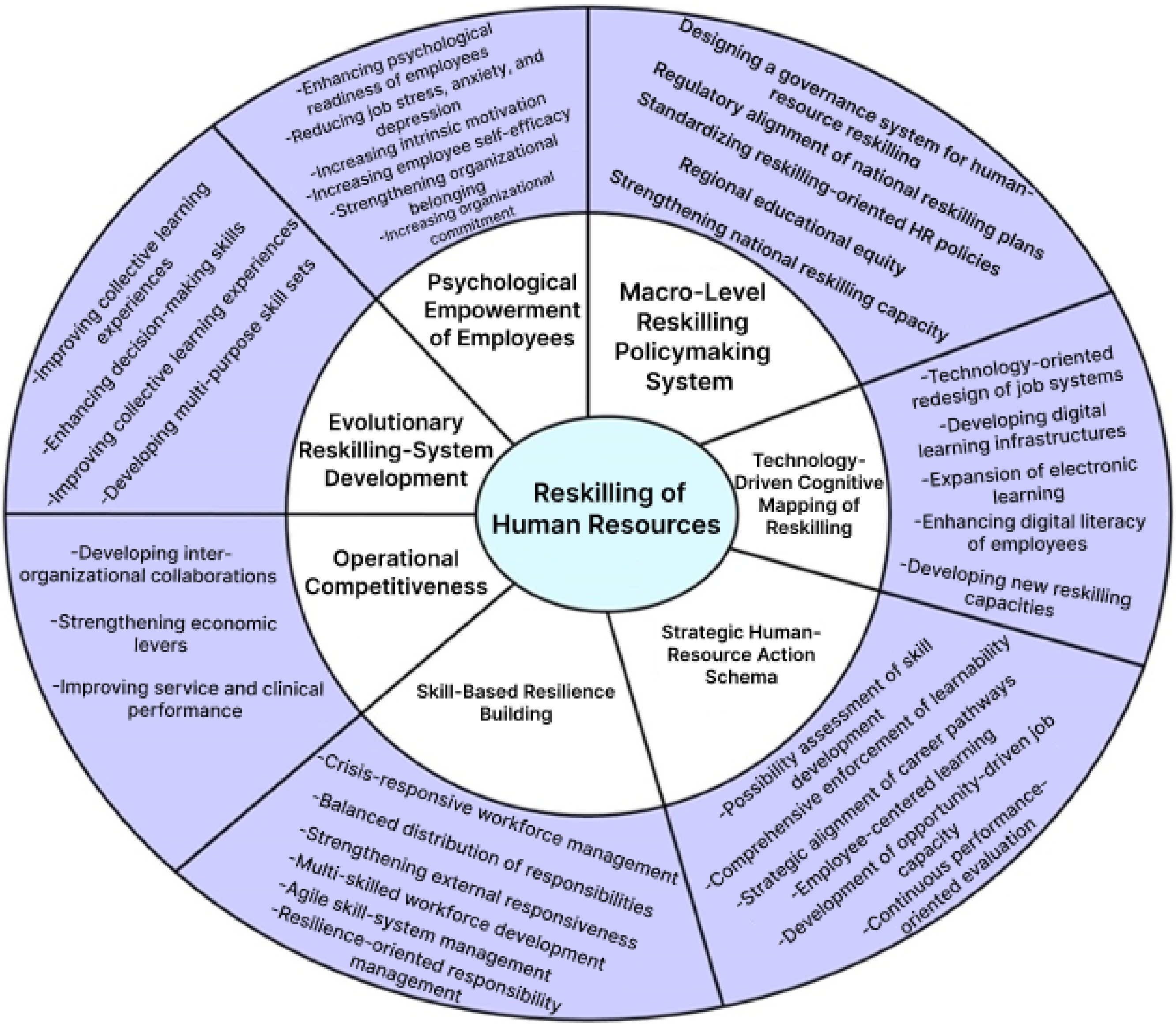

Figure 1. Human-Resource Reskilling Model in the National Health-Care System

Skill-Based Resilience Building: This category refers to a strategic policy in human resource management within the health-care system, aimed at creating organizational response capability through systematic resilience orientation in reskilling programs. Skill-based resilience building, as a pioneering managerial mechanism, emphasizes the creation and development of a skill framework that enables the health-care system to continue functioning in its vital operations without interruption under conditions of crisis, pandemics, or structural disruptions. This category underscores that resilience in the health system is not necessarily an individual or psychological trait of employees, but rather an organizational and rule-governed capability that emerges through purposeful planning in skill-based programs.

Evolutionary Reskilling-System Development: This category refers to the final level of maturity and dynamism of the reskilling system in the health-care sector. At this level, the processes of learning, skill enhancement, and performance improvement operate not only intermittently but as a continuous and self-reinforcing cycle. Evolutionary reskilling-system development represents a stage in which reskilling transcends a mere educational action or temporary intervention and becomes a permanent infrastructure for skill transformation. In this sense, the reskilling system is conceived as a dynamic and learning entity that, through improving service and clinical performance, developing multi-purpose skills, and creating agility in the workforce, strengthens its adaptive and competitive capacity in changing environments.

Psychological Empowerment of Employees: This category concerns the reinforcement of the most internal motivational, cognitive, and emotional layers of employees for acquiring new skills. At this level, psychological empowerment is conceived as a process through which purposeful and participatory learning enhances employees' sense of meaning, competence, self-efficacy, and organizational belonging, transforming them from a state of passivity and mere compliance into informed, committed, and motivated actors. By virtue of psychological empowerment and in the light of reskilling policies, employees feel that the organization values their growth and learning. This feeling not only reduces job stress, anxiety, and depression but also increases organizational loyalty and commitment in the long term. Psychological empowerment is, in fact, the human dimension of reskilling policy that ensures that skill transformation is aligned with employees' cognitive and motivational transformation.

In the quantitative phase, the researcher proceeded to validate the qualitative model. For this purpose, the paradigmatic model designed in Figure (1) was presented in the form of Figure (2) as the structural model, with the aim of conducting structural equation modeling (SEM). It should be noted that the hypotheses were not formulated on the basis of a prior theoretical framework, but instead were developed inductively from the theory-building process and paradigmatic model derived from data analysis. In other words, the aim of the research was not to test predetermined hypotheses, but to translate the discovered conceptual relationships into testable propositions for validating the paradigmatic model. Put differently, the hypotheses in this study resulted from a theoretical hypothesis-building process that was extracted from themes and intra-model relationships. Accordingly, SEM in this research was employed as the phase of validating the emergent theory, and the hypotheses merely represent the relationships among themes in the paradigmatic model. For this reason, the research process was grounded not in hypothesis construction based on prior theories, but in hypothesis-building based on theory emerging from the data.

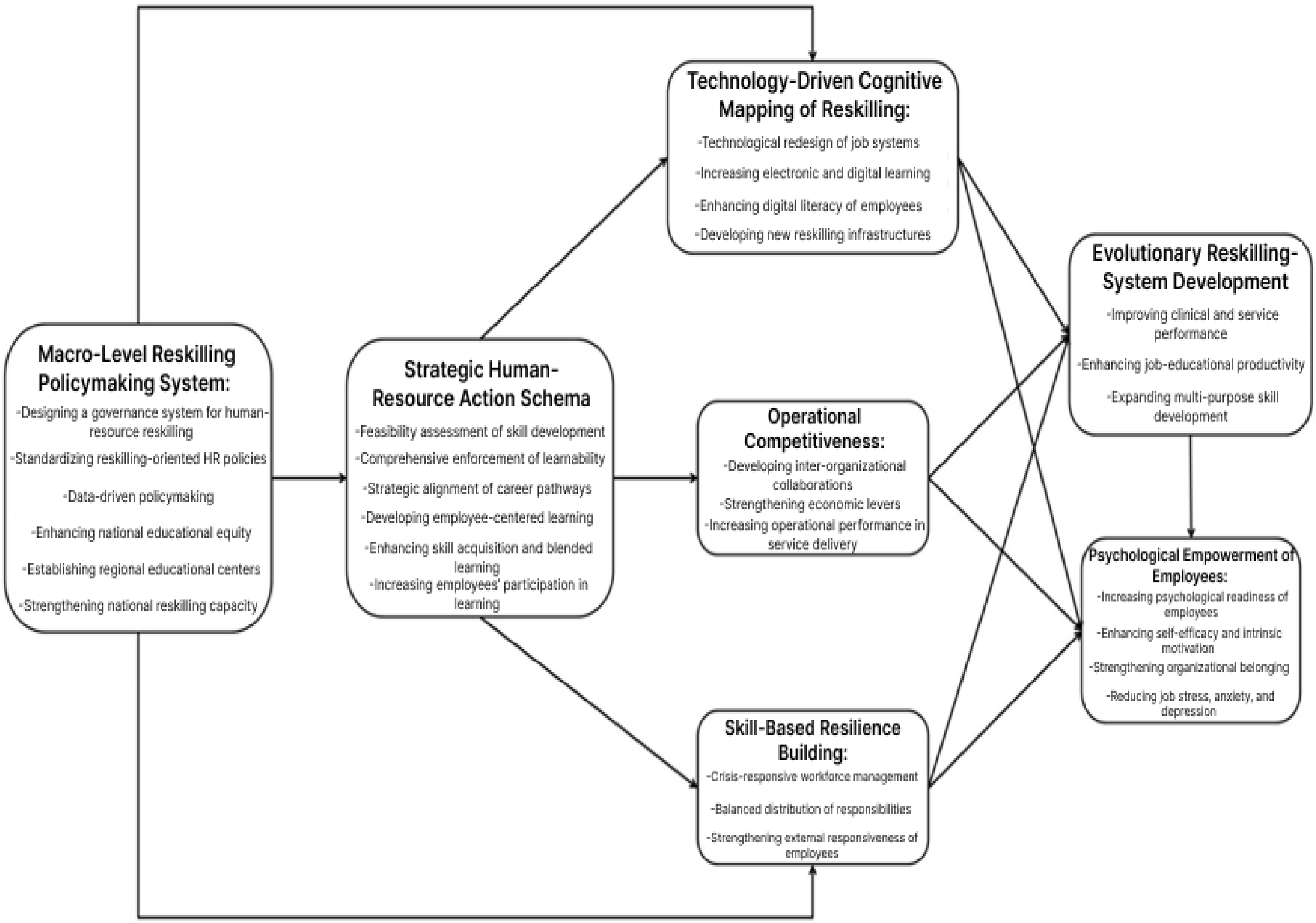

Figure 2. Structural Model of the Study

Furthermore, based on the relationships identified among the categories, 13 hypotheses were formulated for examination.

In the measurement component of the PLS approach, five criteria were addressed in Table (4): convergent validity (AVE), discriminant validity (DV), composite reliability (CR), Cronbach's alpha for the constructs, and the rho_A index (homogeneous reliability).

Table 3. Results of Measurement Criteria for the Structural Model of the Study

Variable	Convergent Validity / AVE	Discriminant Validity / DV	Cronbach's Alpha	rho_A Index	Composite Reliability / CR
Macro-Level Reskilling Policymaking System	0.521	0.722	0.921	0.930	0.933
Strategic Human-Resource Action Schema	0.535	0.731	0.918	0.922	0.931
Technology-Driven Cognitive Mapping of Reskilling	0.552	0.743	0.884	0.890	0.908
Operational Competitiveness	0.563	0.750	0.845	0.849	0.885
Skill-Based Resilience Building	0.512	0.716	0.770	0.786	0.834
Evolutionary Reskilling-System Development	0.570	0.755	0.914	0.923	0.929
Psychological Empowerment of Employees	0.546	0.739	0.835	0.844	0.878

Regarding convergent validity (AVE), as the findings indicate, all values are above 0.50. The highest coefficient pertains to evolutionary reskilling-system development (0.570). To calculate discriminant validity (DV), the AVE values must be placed under the radical and their square root taken. The resulting values represent discriminant validity (DV). The acceptable threshold for DV is 0.70, and according to the results in the table, discriminant validity for all constructs is confirmed because all values exceed 0.70. Composite reliability (CR), similar to Cronbach's alpha, should be greater than 0.70, and this criterion is also met for all constructs. The rho_A index, known as homogeneous reliability, in fact balances Cronbach's alpha and composite reliability. Specifically, Cronbach's alpha indicates reliability thresholds for constructs, whereas composite reliability is a more flexible statistic; rho_A, positioned between them, provides a more refined view of reliability closer to the true reliability of constructs. According to the findings, for all constructs, values increase from Cronbach's alpha to composite reliability, and all coefficients exceed 0.70, indicating confirmation of construct reliability across all three statistics. In the structural component, four statistics are reported: path coefficients (beta), coefficients of determination (R^2), significance coefficients (Z-value), and predictive relevance coefficients (Q^2).

With respect to model validation, the findings indicate the effect of the macro-level reskilling policymaking system on its dependent constructs, namely the strategic human-resource action schema with a path coefficient of 0.815, technology-driven cognitive mapping of reskilling with a path coefficient of 0.274, and skill-based resilience building with a path coefficient of 0.359, among which the relationship with the strategic human-resource action schema exhibits the highest path coefficient. This statistic means that the strategic human-resource action schema constitutes a central and determining construct in human-resource reskilling within the health-care system. That is, while the health-care system must first design a reskilling policy and policymaking structure for human resources at the governance level, it must also necessarily establish a strategic schema of required actions and interventions to operationalize and concretize human-resource reskilling policy. Although the macro-level reskilling policymaking system also affects the two variables of technology-driven cognitive mapping of reskilling and skill-based resilience building, the findings show that when the health-care system views reskilling issues and details through the lens of the strategic human-resource action schema, the path coefficients increase. For example, the direct relationship between the macro-level reskilling policymaking system and technology-driven cognitive mapping of reskling is 0.274, but when the strategic human-resource action schema enters the relationship, this coefficient increases, and the indirect effect of the macro-level reskilling policymaking system on technology-driven cognitive mapping equals 0.465, highlighting the determining and central role of the strategic human-resource action schema in the reskilling model of the health-care system's human resources. This indirect coefficient for skill-based resilience building equals 0.373, demonstrating in both cases the enhancing role of the strategic human-resource action schema in increasing the strength of effects.

The findings also show that the strategic human-resource action schema affects each of its three directly related variables: technology-driven cognitive mapping of reskilling with a path coefficient of 0.571, operational competitiveness with a path coefficient of 0.684, and skill-based resilience building with a path coefficient of 0.458. Although the path coefficient is higher in relation to operational competitiveness than for the two other constructs, the coefficient of determination (R^2) for technology-driven cognitive mapping of reskilling, with a value of 0.656, indicates a high level of model fit for this variable. In addition, the model fit for skill-based resilience building, with an R^2 of 0.607, is also greater than that of operational competitiveness.

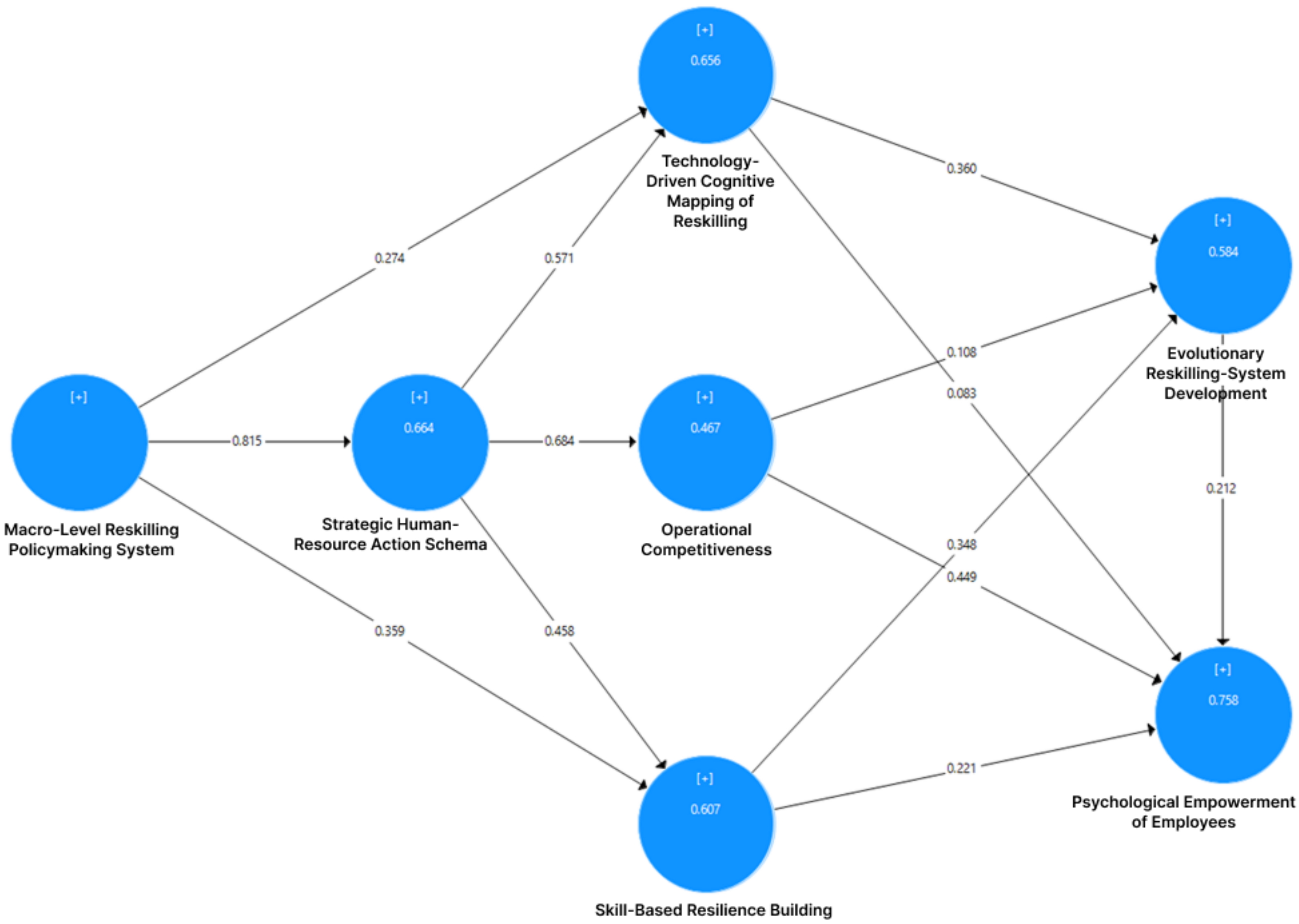

Figure 3. Research Model in Terms of Beta Coefficients and Coefficients of Determination (R^2)

The reason for this lies in the fact that the two constructs of the macro-level reskilling policymaking system and the strategic human-resource action schema simultaneously affect the constructs of technology-driven cognitive mapping of reskilling and skill-based resilience building, and therefore exhibit higher levels of model fit. This indicates that these four constructs are inherently in interaction with one another and underscore the importance of intra-model relationships in the structure of human-resource reskilling in the health-care system. In other words, these findings suggest that the four constructs of the macro-level reskilling policymaking system, the strategic human-resource action schema, technology-driven cognitive mapping of reskilling, and skill-based resilience building can be regarded as foundational elements in the human-resource reskilling model of the health-care system, and that, based on their values, one can determine which construct is antecedent to another.

Furthermore, the findings showed that the two final dependent constructs of the model, namely evolutionary reskilling-system development and psychological empowerment of employees, based on the coefficients of determination (0.584 and 0.758), achieved desirable levels of fit in the studied context. Regarding the constructs affecting these two dependent variables, technology-driven cognitive mapping of reskilling had a stronger effect on evolutionary reskilling-system development, with a path coefficient of 0.360. Operational competitiveness had a stronger effect on psychological empowerment of employees, with a path coefficient of 0.449, and finally, skill-based resilience building showed a stronger effect in its interaction with evolutionary reskilling-system development, with a path coefficient of 0.348. These findings emphasize that evolutionary reskilling-system development can be considered a critical link in the human-resource reskilling chain within the health-care system. It essentially functions as a representational and concretizing construct for reskilling programs and actions in the health-care system and, through feedback-based evaluations of these programs and actions, can determine the extent to which programmatic and project objectives have been realized and what reforms and adjustments need to be implemented.

Table (4) presents the structural criteria (coefficients of determination and predictive relevance/Q^2).

Table 4. Structural Criteria (R^2 and Q^2)

Dependent Construct	Coefficient of Determination (R^2)	Level of Fit	Q^2 Coefficient	Level of Fit
Strategic Human-Resource Action Schema	0.664	Medium	0.330	Medium
Technology-Driven Cognitive Mapping of Reskilling	0.656	Medium	0.329	Medium
Operational Competitiveness	0.467	Medium	0.230	Medium
Skill-Based Resilience Building	0.607	Medium	0.239	Medium
Evolutionary Reskilling-System Development	0.584	Medium	0.303	Medium
Psychological Empowerment of Employees	0.758	Strong	0.378	Strong

The difference between the coefficients of determination and Q^2 is that the coefficients of determination (R^2) refer to the context that has been studied and indicate the extent to which the construct is explained within that same organizational setting, whereas the Q^2 coefficients pertain to other organizational contexts. That is, if this conceptual model, with the same relationships, or a portion of this model, or a single construct, were to be examined in another organizational setting, Q^2 indicates the extent to which one can expect that construct to retain its explanatory power in the new context. As shown in Table (5), the highest coefficient of determination and Q^2 belong to the construct of psychological empowerment of employees, with values of 0.758 and 0.378, respectively, both reflecting a strong level of fit in these two statistics. The final statistic concerns the overall structural model fit, known as GOF. To estimate the final model fit, the following two values are multiplied under the radical, and the resulting value represents the model's goodness of fit:

(0.543 average shared variance; 0.623 average coefficient of determination/R^2)

$$GOF = \sqrt{(0.543 \times 0.623)} = 0.459$$

The value of 0.459 for the GOF statistic indicates strong model fit (greater than 0.36) for the structural model of the study.

The final conclusion regarding the quantitative-phase hypotheses is presented in Table (5).

Table 5. Final Results of the Hypotheses

Hypothesis	Beta	P-value	Z Coefficient	Result
First hypothesis: The macro-level reskilling policymaking system affects the strategic HR action schema.	0.815	0.000	56.099	Hypothesis confirmed
Second hypothesis: The macro-level reskilling policymaking system affects technology-driven cognitive mapping of reskilling.	0.274	0.000	5.331	Hypothesis confirmed
Third hypothesis: The macro-level reskilling policymaking system affects skill-based resilience building.	0.359	0.000	6.710	Hypothesis confirmed
Fourth hypothesis: The strategic human-resource action schema affects technology-driven cognitive mapping of reskilling.	0.571	0.000	12.450	Hypothesis confirmed
Fifth hypothesis: The strategic human-resource action schema affects operational competitiveness.	0.684	0.000	28.988	Hypothesis confirmed
Sixth hypothesis: The strategic human-resource action schema affects skill-based resilience building.	0.458	0.000	8.960	Hypothesis confirmed
Seventh hypothesis: Technology-driven cognitive mapping of reskilling affects evolutionary reskilling-system development.	0.360	0.000	6.517	Hypothesis confirmed
Eighth hypothesis: Technology-driven cognitive mapping of reskilling affects psychological empowerment of employees.	0.083	0.091	1.695	Hypothesis not confirmed

Ninth hypothesis: Operational competitiveness affects evolutionary reskilling-system development.	0.108	0.036	2.102	Hypothesis confirmed
Tenth hypothesis: Operational competitiveness affects psychological empowerment of employees.	0.449	0.000	10.600	Hypothesis confirmed
Eleventh hypothesis: Skill-based resilience building affects evolutionary reskilling-system development.	0.348	0.000	5.409	Hypothesis confirmed
Twelfth hypothesis: Skill-based resilience building affects psychological empowerment of employees.	0.221	0.000	4.033	Hypothesis confirmed
Thirteenth hypothesis: Evolutionary reskilling-system development affects psychological empowerment of employees.	0.212	0.000	4.907	Hypothesis confirmed

Discussion and Conclusion

The purpose of this study was to conceptualize, operationalize, and empirically validate a structural model of human-resource reskilling in the healthcare sector, demonstrating how macro-level policy structures, strategic HR action schemas, technological reskilling cognition, operational competitiveness, skill-based resilience, system evolutionary maturity, and psychological empowerment collectively interact to shape a coherent and future-ready workforce. The results of the structural model indicated that the macro-policy system of reskilling is the most powerful antecedent across the model, exerting direct effects on strategic HR action planning, technology-driven reskilling cognition, and skill-resilience formation. This finding emphasizes that reskilling in healthcare is fundamentally a governance-driven capability rather than a series of isolated training interventions. The importance of system-wide policy coherence is widely supported in contemporary reskilling literature, which argues that skill transformation in the Fourth Industrial Revolution is primarily shaped by policy steering, regulatory alignment, and institutional readiness (5, 14, 26). Scholars have increasingly highlighted that high-skill ecosystems emerge only when macro-level directives provide clear incentives, structural clarity, and strategic coordination for organizations to redesign learning pathways and invest in workforce transformation (1, 9). The strong direct effect (β = 0.815) of macro-policy on the strategic action schema in this study aligns with international evidence showing that structured HR strategies—when aligned with institutional policy—can trigger systemic workforce adaptation and mitigate the consequences of skill obsolescence in high-complexity sectors such as healthcare (6, 11).

A central finding concerns the mediating power of the strategic HR action schema, which significantly influenced technology-driven reskilling cognition, operational competitiveness, and skill-resilience formation. This indicates that even when macro-policies exist, they become meaningful only when implemented through deliberate strategic HR programs that translate policy into localized action, skill-mapping, competency frameworks, and opportunities for experiential learning. This mechanism is consistent with global studies showing that organizations that adopt structured HR planning—incorporating digital competency frameworks, talent road-mapping, and multi-skilling pathways—are more likely to achieve effective organizational transformation under Industry 4.0 and AI-enabled environments (13, 15, 28). In the context of healthcare, where knowledge is rapidly advancing and technological disruption is continuous, strategic HR action becomes the operational anchor that enables staff to adapt quickly and reliably (19, 25). The magnitude of direct effects observed in this study (β ranging from 0.458 to 0.684) reinforces the notion that strategy-led HR reskilling architectures significantly influence both workforce capability formation and operational outcomes.

The strong positive effect of the strategic action schema on operational competitiveness (β = 0.684) highlights the importance of aligning workforce skill initiatives with operational objectives and performance improvement pathways. Numerous studies have confirmed that reskilling interventions are most effective when they directly address organizational performance metrics, care quality indicators, and service innovation needs (17, 38, 49).

Operational competitiveness in healthcare increasingly depends on the ability of staff to integrate digital solutions, adapt to AI-supported clinical processes, and collaborate in agile care environments (21, 22, 34). The present results therefore add empirical evidence to the strategic management literature, indicating that workforce reskilling is not merely a developmental activity but a strategic lever that enhances operational efficiency, adaptability, and evidence-based decision-making.

The study also identified technological reskilling cognition as a significant predictor of the evolutionary maturity of the reskilling system (β = 0.360), indicating that organizations must cultivate a workforce capable of interacting meaningfully with emerging technologies and digital infrastructures. This finding is aligned with international research showing that technological literacy, digital readiness, and AI-integration skills are central to developing adaptive workplaces that sustain continuous improvement and self-reinforcing learning cycles (2, 23, 33). Technological cognition is not merely a technical dimension but a cognitive-behavioral capacity that enables employees to reinterpret tasks, adopt new workflows, and internalize digital transformation as part of their professional identity (4, 16). The model's findings strengthen the theoretical claim that digital reskilling is foundational to achieving system-level transformation in healthcare and that cognitive alignment with technology is essential for sustainable improvement.

Furthermore, skill-resilience demonstrated significant direct effects on evolutionary system maturity (β = 0.348) and psychological empowerment (β = 0.221). These effects indicate that resilience is not only a stress-buffering mechanism but also a skill-formation capability that enhances adaptability, emotional readiness, and workforce engagement in reskilling contexts. Growing evidence supports this conceptualization, showing that resilient employees exhibit greater flexibility, higher learning retention, and faster adaptation to digitally mediated tasks (29, 36, 46). In healthcare settings, where unpredictability is inherent, resilience-oriented reskilling strategies enhance employees' psychological safety, motivation, and role clarity, thereby strengthening retention and professional satisfaction (30, 48). By demonstrating that resilience contributes significantly to both system maturity and empowerment, this study empirically validates the emerging theoretical view that skill-resilience is a core meta-competency for workforce transformation in uncertain environments.

One of the most meaningful findings is that psychological empowerment—an essential outcome variable—was most strongly predicted by operational competitiveness (β = 0.449). This suggests that empowerment is not solely an internal psychological state but is influenced by structural and performance-related conditions. When employees perceive that their skills translate into meaningful contributions to service quality, operational efficiency, and patient outcomes, their sense of meaning, competence, and impact increases. This relationship is consistent with international healthcare research emphasizing that empowerment is significantly enhanced when workers actively participate in organizational innovation, decision-making, and performance improvement initiatives (6, 18, 40). Additionally, as new technologies and digital workflows reshape task identities, empowerment becomes crucial for maintaining engagement and reducing resistance to change (12, 31). The empirical support for this relationship situates empowerment as a downstream outcome of strategically aligned, performance-oriented reskilling systems.

Interestingly, the direct effect of technological reskilling cognition on psychological empowerment was not significant (β = 0.083, $p > 0.05$). This indicates that technological understanding alone does not guarantee empowerment unless accompanied by meaningful strategic structures, performance alignment, and supportive organizational climates. This finding is reflected in recent research showing that technology adoption without sufficient organizational scaffolding can increase stress, role ambiguity, and cognitive overload among healthcare workers (37, 39, 44). The lack of significance strengthens the argument that empowerment arises from holistic system maturity rather than isolated cognitive awareness of technological change.

The findings further revealed that the evolutionary maturity of the reskilling system significantly influences psychological empowerment ($\beta = 0.212$), underscoring that when reskilling becomes embedded in the organizational culture—as a continuous, self-reinforcing process—employees internalize learning as an integral part of their professional identity. Global literature strongly supports this mechanism, highlighting that organizations with high learning maturity—characterized by continuous feedback, developmental pathways, and supportive learning environments—foster greater employee autonomy, confidence, and commitment (7, 24, 47). This study therefore contributes empirical validation to the notion of reskilling maturity as an organizational psychological resource.

The combined results of the model, including high R^2 values for empowerment (0.758) and system maturity (0.584), indicate that the structural model is both theoretically coherent and empirically robust. The GOF index of 0.459 further confirms strong overall model fit. Comparatively, similar models of workforce transformation in AI-driven or healthcare environments have reported moderate explanatory power, often constrained by incomplete integration of psychological and organizational variables (27, 42, 43). The present study's higher explanatory values suggest that integrating policy governance, strategic action, technological cognition, resilience, competitiveness, and psychological empowerment provides a more comprehensive and systemically aligned understanding of workforce transformation.

This study is limited by its cross-sectional design, which restricts causal inference and prevents longitudinal assessment of how reskilling systems evolve over time. The sample was drawn from healthcare organizations within a single geographic region, which may limit generalizability to other institutional or cultural contexts. Data relied on self-reported perceptions, which may introduce bias related to participant expectations, organizational culture, or social desirability. Furthermore, while the structural model incorporates multiple dimensions of reskilling, additional environmental, technological, or behavioral variables may further enrich explanatory power.

Future studies should employ longitudinal or mixed-methods designs to capture the dynamic evolution of reskilling maturity and its long-term impact on workforce adaptation and patient outcomes. Comparative studies across regions, countries, or healthcare sectors could provide broader insights into contextual moderators of reskilling effectiveness. Researchers may also explore the role of AI-driven personalization in reskilling systems, the influence of interprofessional collaboration on learning transfer, or the impact of leadership styles on psychological empowerment during digital transformation.

Healthcare organizations should prioritize integrated reskilling strategies that align policy, strategic HR action, and operational performance systems. Leaders should cultivate a culture of continuous learning, emphasize resilience-building initiatives, and ensure that technological training is paired with supportive organizational structures. Investing in digital competency frameworks, performance-linked development pathways, and empowerment-oriented management practices will enable healthcare institutions to sustain adaptability and workforce engagement in an era of rapid technological and environmental change.

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Authors' Contributions

All authors equally contributed to this study.

Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

All ethical principles were adheried in conducting and writing this article.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

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