KMAN PUBLISHING INSTITUTE

Article history:
Received 12 July 2026
Revised 18 August 2026
Accepted 03 October 2026
Published online 01 November 2026

Journal of Resource Management and Decision Engineering

Volume 5, Issue 6, pp 1-20




# Dynamic Fuzzy Cognitive Mapping of a Model for Strengthening Human Resource Soft Skills in the Iranian National Tax Administration

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A r t i c l e  I n f o

**Article type:**
*Original Research*

**How to cite this article:**
Altafi, S., Hataminasab, S. H., Nayebzadeh, S., & Rahimi Zarchi, M. R. (2026). Dynamic Fuzzy Cognitive Mapping of a Model for Strengthening Human Resource Soft Skills in the Iranian National Tax Administration. *Journal of Resource Management and Decision Engineering*, *5*(6), 1-20.
https://doi.org/10.61838/kman.jrmde.491

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A B S T R A C T

This study aimed to develop and analyze a dynamic fuzzy cognitive map for strengthening human resource soft skills in the Iranian National Tax Administration and to identify the most influential and intervention-sensitive competencies within the resulting causal system. This applied, cross-sectional, expert-based study used Dynamic Fuzzy Cognitive Mapping with nonlinear Hebbian learning. Sixteen experts from the Iranian National Tax Administration and human resource management fields completed a 177-item matrix questionnaire covering the current status of 17 concepts and the direction and intensity of causal relationships among them. The model comprised 12 soft-skill indicators, four higher-order dimensions, and one overall outcome concept. Expert judgments were aggregated into an initial state vector and a 17×17 weighted causal matrix. Dynamic inference was performed using a calibrated hyperbolic tangent threshold function, while nonlinear Hebbian learning updated existing causal weights until system convergence. Network analysis was conducted using indegree, outdegree, and centrality indices. Intervention simulations were also performed by clamping each indicator from 0 to 1, and inter-rater reliability was assessed using Kendall's W, Cronbach's alpha, and ICC. The final network contained 160 nonzero causal links, all positive. Following nonlinear Hebbian learning, 158 links strengthened and the mean causal weight increased from 0.46 to 0.59. The system converged to a stable state, with the overall concept increasing from 0.563 to 0.831. Negotiation showed the highest centrality (14.802), while emotional intelligence had the highest outdegree (8.946). Accountability produced the greatest intervention leverage on the overall concept (effect range = 0.0098), followed by work ethics and professionalism (0.0096), emotional intelligence (0.0092), and adaptability (0.0089). Overall expert agreement was statistically significant, with Kendall's W = 0.576, $\chi^2(159) = 1465.02$, $p < 0.001$, Cronbach's alpha = 0.950, and ICC(2,k) = 0.950. The results indicate that soft skills in the Iranian National Tax Administration form a highly interconnected and reinforcing system, in which emotional intelligence represents the most balanced strategic competency, while accountability and professional ethics provide the strongest direct intervention leverage.

***Keywords:*** *Dynamic Fuzzy Cognitive Mapping; soft skills; human resource development; nonlinear Hebbian learning; tax administration; emotional intelligence.*

## 1. Introduction

Human resource capabilities have become a central determinant of organizational effectiveness as public and private organizations confront rapid technological change, increasing service complexity, digital transformation, artificial intelligence, and growing expectations for accountability, adaptability, and citizen-centered performance. Within this environment, technical competence alone is no longer sufficient for sustained organizational effectiveness. Employees are increasingly expected to communicate effectively, collaborate across functional boundaries, solve complex problems, adapt to change, manage emotions, exercise sound judgment, and demonstrate ethical and accountable behavior. These capacities are generally described as soft skills and are increasingly regarded as complementary to technical or hard skills rather than secondary to them (Espina-Romero et al., 2023; Marin-Zapata et al., 2022; Poláková et al., 2023; Villegas, 2024). The transition toward digitally enabled and human-centered organizations has further intensified the importance of such competencies because automation tends to replace routine tasks while increasing the relative value of capabilities that depend on interpretation, interpersonal interaction, contextual judgment, and adaptive behavior (Goulart et al., 2022; Kubátová et al., 2025; Mohammadi & Mirghaffari, 2026; Turcato et al., 2024).

Despite their increasing importance, soft skills remain conceptually diverse and difficult to delimit. The literature includes communication, teamwork, leadership, emotional intelligence, adaptability, problem solving, critical thinking, negotiation, empathy, self-regulation, creativity, professional ethics, resilience, and related interpersonal and intrapersonal competencies under the broad label of soft skills. This conceptual diversity has generated continuing debates regarding what should properly be included in the construct and how such competencies should be differentiated from personality traits, attitudes, behavioral tendencies, employability capabilities, and contextual professional skills (Fantozzi, Di Luozzo, et al., 2024; Marin-Zapata et al., 2022). Recent attempts to systematize the field have emphasized that soft skills should be understood not as an undifferentiated collection of desirable personal characteristics but as context-sensitive, developable capabilities that influence how employees apply technical knowledge, interact with others, respond to uncertainty, and perform within organizational systems (Colledani et al., 2024; Fantozzi, Martuscelli, et al., 2024; Villegas, 2024). This distinction is particularly important in organizational research because the relevance of a specific soft skill depends on occupational demands, institutional context, technological environment, and the strategic objectives of the organization.

The growing importance of soft skills is especially evident in contemporary employment systems shaped by Industry 4.0, Industry 5.0, and Society 5.0. Digitalization and artificial intelligence have altered both the content of work and the competencies required to perform it. Employees are increasingly expected to combine digital readiness with communication, emotional-social intelligence, adaptability, collaborative problem solving, learning agility, and human-centered decision making (Lubis & Lubis, 2024; Singh & Chouhan, 2023; Turcato et al., 2024). Industry 5.0 perspectives further shift attention from technologically driven efficiency toward human-centeredness, resilience, and sustainable interaction between people and intelligent systems, thereby reinforcing the strategic importance of distinctly human capabilities that cannot be reduced to technical proficiency (Kubátová et al., 2025; Poláková et al., 2023). Research on future workforce requirements similarly indicates that organizations increasingly need employees who can integrate technical knowledge with creativity, judgment, communication, resilience, ethical awareness, and adaptive learning (Ferreira et al., 2023; Vesolovska & Shved, 2024). Consequently, strengthening soft skills has become an essential component of workforce development rather than an optional supplementary training activity.

A substantial body of research has also linked soft skills with individual and organizational outcomes. Soft skills have been associated with improved performance, organizational learning, innovation capability, employability, interpersonal effectiveness, service quality, and the ability of employees to respond constructively to changing workplace demands (Aghababaei, 2023; Awawdeh & Alkshali, 2022; Ghadim Sarbaz, 2022). In government organizations, their importance may be even greater because public employees operate within environments characterized by formal rules, multiple stakeholders, public accountability, legal constraints, and citizen-facing service responsibilities. Communication failures, poor emotional regulation, weak problem-solving capability, inability to negotiate, and limited adaptability can therefore have consequences extending beyond individual job performance to institutional trust and service legitimacy. Accordingly, the development of soft skills has been

identified as an important requirement for the modernization and performance improvement of public organizations (Bostani Rad & Hamidizadeh, 2022; Rostamzadeh Ganji & Afsharinezhad, 2025).

The public sector also presents distinctive conditions that make the identification and development of soft skills more complex than in many private-sector settings. Government employees must frequently balance legal compliance with service responsiveness, procedural consistency with situational judgment, and organizational authority with public trust. This makes competencies such as accountability, integrity, communication, emotional intelligence, adaptability, and problem solving particularly significant. In addition, public-sector organizations undergoing digital transformation must ensure that employees can interpret and use new technologies without weakening interpersonal quality or citizen orientation. The emerging literature on human resource development increasingly emphasizes that soft skills should therefore be embedded within broader empowerment and technology-management strategies rather than treated as isolated training topics (Jafari et al., 2026). Evidence from training-focused research similarly suggests that structured development programs can improve soft-skill capabilities and contribute to better job performance when training content is aligned with actual work demands (Gheybi Takhti, 2025).

These issues are particularly relevant to tax administrations. Tax organizations are not merely technical bureaucracies that calculate liabilities and enforce statutory provisions; they are complex public-service institutions whose effectiveness depends on interactions among employees, taxpayers, managers, digital systems, legal rules, and public expectations. Contemporary tax administration increasingly relies on digital platforms, data-driven processes, automated risk assessment, and electronic service delivery. As a result, tax personnel must combine technical tax knowledge with communication, judgment, adaptability, taxpayer orientation, ethical conduct, and the ability to work effectively in technologically changing environments. Research on tax education has already shown that technological advances affect the competencies required for tax-related learning and practice, reinforcing the need to integrate technical and behavioral dimensions of capability development (Abu Bakar et al., 2023; Agustina & Saragih, 2022). Recent work focused specifically on accounting and taxation similarly highlights the increasing importance of communication, critical thinking, adaptability, teamwork, and other soft competencies alongside technical expertise (Peretiatko, 2025).

The managerial dimension of taxation also reinforces this need. Leading tax departments requires more than numerical expertise, because effective leadership involves communicating complex information, coordinating specialists, negotiating competing priorities, managing stakeholder relationships, and exercising professional judgment under conditions of regulatory and technological change (Ishai, 2024). In public tax organizations, these competencies intersect with the broader objectives of fairness, compliance, institutional credibility, and strategic tax management. Research conducted in the context of the Iranian National Tax Administration has emphasized the importance of organizational and managerial factors in implementing strategic tax management grounded in tax justice (Babaei, 2024). From this perspective, strengthening human resource soft skills can be expected to contribute not only to internal performance but also to the quality of interaction with taxpayers and the broader legitimacy of tax administration.

Behavioral evidence further suggests that the effectiveness of tax administration is influenced by how officials interact with taxpayers and how behavioral principles are incorporated into training and service processes. Behaviorally informed interventions can improve tax compliance by shaping the way tax authorities communicate, design interactions, and respond to taxpayer behavior (Dimitrov et al., 2026). Such findings imply that communication quality, empathy, trust building, accountability, and behavioral awareness are not peripheral competencies in taxation. Rather, they are potentially important components of administrative effectiveness and voluntary compliance. This is particularly important in tax systems seeking to move from a predominantly enforcement-oriented model toward more intelligent, service-oriented, and trust-based forms of administration.

At the same time, the strategic value of soft skills does not arise solely from their direct effects on performance. Soft skills interact with one another in complex ways. Emotional intelligence may improve listening and negotiation; effective communication may strengthen trust; trust may facilitate taxpayer orientation and collaboration; adaptability may support problem solving under changing digital conditions; and professional ethics may reinforce accountability and public confidence. Coaching and developmental relationships can likewise affect employee performance through interconnected behavioral mechanisms

rather than through isolated competencies (Al-Mousawi, 2023). Similarly, sustainability-oriented research suggests that soft skills frequently operate as mutually reinforcing capabilities whose combined influence is more important than the independent contribution of a single skill (Pons et al., 2024). This interdependence implies that soft-skills development should be understood as a system rather than as a collection of separate training modules.

This systemic perspective is also supported by research examining the human factor in complex operational environments. Studies of operations and supply-chain work demonstrate that job tasks increasingly require combinations of communication, coordination, analytical reasoning, adaptability, and decision-making capabilities rather than singular competencies (Fantozzi, Martuscelli, et al., 2024). Broader reviews of human factors similarly emphasize that soft skills, attitudes, and personality-related tendencies often interact in ways that shape workplace behavior and performance (Fantozzi, Di Luozzo, et al., 2024). Such findings are important for public-sector human resource policy because interventions directed at one capability may produce indirect effects on multiple other competencies. A training intervention designed to improve communication, for example, may influence trust, negotiation, collaboration, responsiveness, and service quality simultaneously.

The interaction among soft skills becomes even more salient under conditions of organizational uncertainty and disruption. The COVID-19 pandemic demonstrated that workforce resilience depended not only on technical preparedness but also on adaptability, emotional regulation, communication, and the ability to function under rapidly changing conditions (Vesolovska & Shved, 2024). Likewise, research on emerging workplace competencies emphasizes that future-ready employees must be capable of continuous learning and adjustment rather than relying on static skill sets (Ferreira et al., 2023; Goulart et al., 2022). These developments make it insufficient to identify which soft skills are important; organizations also need to understand how such competencies influence one another, which skills occupy central positions within the competency system, and which interventions are likely to produce the largest system-level effects.

The challenge is therefore partly methodological. Much of the existing literature identifies lists of soft skills, measures their prevalence, or examines linear associations between individual competencies and performance outcomes. Instrument-development research has substantially improved the measurement of multidimensional soft skills in organizational contexts (Colledani et al., 2024), while bibliometric and systematic-review studies have mapped the growing body of research on soft-skills development and training (Espina-Romero et al., 2023; Mohammed & Ozdamli, 2024). However, conventional measurement and regression-oriented approaches are less well suited to representing reciprocal causation, circular influence, nonlinear reinforcement, and dynamic interaction among multiple skills. Where competencies mutually strengthen one another, a purely linear model can obscure feedback structures that may be crucial for intervention design.

This limitation becomes more consequential when the objective is not merely to measure current competency levels but to design a practical model for strengthening them. An intervention priority cannot be determined solely from the current weakness of a skill. A skill may have a low current level but occupy a structurally central position, making it highly consequential for the wider system. Conversely, a skill may be highly connected to other competencies yet have only a weak direct pathway to the overall organizational objective. Similarly, a skill with moderate centrality may have substantial intervention leverage because it lies close to the principal organizational outcome. These distinctions require an analytical framework capable of representing causal direction, varying relationship strength, feedback, indirect influence, and dynamic change.

Fuzzy Cognitive Mapping provides such a framework by representing concepts as nodes and causal influences as directed weighted edges. Its value is particularly evident in organizational settings where knowledge is distributed among experts and causal relationships cannot always be estimated from large longitudinal datasets. The method allows expert knowledge to be translated into a structured causal network and subsequently analyzed in terms of influence, dependence, centrality, and scenario response. A dynamic extension of this approach can go further by allowing the strengths of existing causal relationships to evolve during iterative learning, thereby representing the possibility that interactions among competencies intensify or weaken as the system develops. Such a perspective is especially appropriate for human resource soft skills because these capabilities are not static and independent; they are learned, practiced, reinforced, and transformed through repeated organizational interaction.

The need for a context-sensitive approach is further supported by the fact that soft-skill priorities vary across occupations and institutional environments. Studies in

healthcare have identified distinct combinations of interpersonal, emotional, and professional skills required in nursing contexts (Aghababaei, 2023), while research in specialized technology-oriented employability has shown that soft-skills development must be adapted to the characteristics of particular professional fields (Ijadi, 2025). Research in information technology education similarly confirms that the relative importance of communication, teamwork, problem solving, adaptability, and related competencies changes across technological contexts (Mohammed & Ozdamli, 2024). Accordingly, generic competency lists cannot simply be transferred into tax administration without considering the specific organizational, technological, ethical, and citizen-facing demands of the institution.

The same point applies to emerging artificial-intelligence environments. As AI becomes integrated into organizational processes, technical competence and human capability are becoming more interdependent. Emotional-social intelligence, future-work skills, and adaptive competencies are increasingly viewed as essential complements to AI-based systems (Singh & Chouhan, 2023). Human-centered frameworks for the AI era likewise emphasize that organizations require employees capable of contextual reasoning, responsible decision making, collaboration, and learning alongside technological fluency (Kubátová et al., 2025). Recent research on AI-based employability capabilities further indicates that hard and soft skills should be developed in an integrated manner because the value of technical knowledge increasingly depends on the individual's ability to communicate, adapt, collaborate, and apply knowledge in complex contexts (Mohammadi & Mirghaffari, 2026). These developments are particularly relevant to tax administrations as digitalization and intelligent systems progressively reshape audit, assessment, taxpayer services, information processing, and managerial decision making.

There is consequently a growing need to move from descriptive recognition of soft skills toward analytically grounded prioritization of their interactions and developmental leverage. Research in government organizations has already emphasized the importance of prioritizing soft skills according to their contribution to organizational performance (Rostamzadeh Ganji & Afsharinezhad, 2025). However, prioritization based only on expert rankings or isolated importance scores cannot fully capture the network effects through which one skill alters several others. Similarly, evidence that training can improve soft skills and employee performance does not by itself indicate which capabilities should be targeted first or how interventions will propagate through a broader competency system (Gheybi Takhti, 2025). A dynamic causal representation can address this gap by distinguishing current condition, network influence, structural centrality, and intervention leverage.

Taken together, prior research establishes several important points. Soft skills are increasingly essential under digital, AI-driven, and human-centered work conditions; they are multidimensional and context dependent; they affect organizational performance, innovation, employability, and service quality; and their development is particularly important in public organizations undergoing technological and institutional transformation (Andrés et al., 2023; Awawdeh & Alkshali, 2022; Bostani Rad & Hamidizadeh, 2022; Lubis & Lubis, 2024). At the same time, the literature remains less developed in explaining the dynamic causal structure linking multiple soft skills within a specific public tax administration. Research has not sufficiently clarified which soft skills occupy the most influential positions in such a system, how their causal effects propagate through broader competency dimensions, how nonlinear reinforcement may alter the strength of their relationships, and whether the skills with the greatest network centrality are also those with the greatest intervention leverage.

Therefore, the aim of this study was to develop and analyze a dynamic fuzzy cognitive map of the model for strengthening human resource soft skills in the Iranian National Tax Administration and to identify the most influential and intervention-sensitive competencies within the resulting causal system.

## 2. Methods and Materials

The present study was an applied, cross-sectional, expert-based modeling study conducted using the Dynamic Fuzzy Cognitive Mapping approach to construct and simulate the causal structure underlying the strengthening of human resource soft skills in the Iranian National Tax Administration. Dynamic Fuzzy Cognitive Mapping was selected because the phenomenon under investigation involves multiple interdependent soft-skill concepts whose effects are not necessarily linear or unidirectional. Rather, improvement in one soft skill may reinforce, weaken, or indirectly alter other skills through interconnected causal pathways and feedback loops. Unlike static structural

approaches that represent relationships as fixed links, the dynamic fuzzy cognitive framework allows both the state of the concepts and the strength of causal connections to evolve iteratively until the system reaches a stable configuration. Accordingly, the study sought to represent expert causal knowledge as a directed weighted network and then examine the behavior of that network through iterative inference, nonlinear Hebbian learning, network analysis, and intervention simulation. The conceptual system consisted of 17 concepts arranged in three interconnected levels. At the indicator level, the model included 12 soft-skill concepts: effective verbal and written communication, active listening, taxpayer orientation, negotiation, trust building, problem solving, decision making, analytical thinking, emotional intelligence, adaptability and flexibility, work ethics and professional integrity, and accountability. These concepts were organized under four broader dimensions comprising communication and interpersonal skills, cognitive and problem-solving skills, intrapersonal and self-management skills, and leadership and professional ethics. The overall outcome concept represented the strengthening of human resource soft skills in the Iranian National Tax Administration. The resulting system therefore contained 12 indicator-level concepts, four dimension-level concepts, and one overarching outcome concept.

The study population consisted of experts with sufficient theoretical or practical knowledge of human resource management, organizational development, taxation administration, employee competency development, and organizational decision making. Sixteen experts participated in the study. They included experienced senior and middle managers and specialists from the Iranian National Tax Administration as well as academic experts in human resource management and related management fields. Participants were selected purposively on the basis of professional experience, knowledge of the organizational context, familiarity with human resource issues, and their capacity to make informed judgments regarding causal relationships among the soft-skill concepts. Because Dynamic Fuzzy Cognitive Mapping is an expert-knowledge elicitation method rather than a population-estimation technique, sampling adequacy was determined by the relevance and expertise of the panel rather than by probabilistic sample-size calculations. All 16 experts were treated as equally credible contributors to the group cognitive map. Consequently, each expert was assigned an equal contribution weight of 1/16 in the aggregation of judgments. No expert response was excluded from the analysis because all questionnaires were complete and all responses fell within the predefined measurement ranges.

Data were collected using a structured expert questionnaire specifically designed for Dynamic Fuzzy Cognitive Mapping. The instrument generated two forms of information required for constructing the dynamic model: the initial state of each concept and the direction and intensity of the causal relationships among concepts. The first part of the questionnaire assessed the current status of all 17 concepts. Experts evaluated each concept on a five-level linguistic scale ranging from very poor to excellent. The linguistic categories were transformed into representative values on the interval from 0 to 1, with very poor represented by 0.1, poor by 0.3, moderate by 0.5, good by 0.7, and excellent by 0.9. These values were used to generate the initial state vector of the system. For each concept i, the aggregated initial value was obtained from the expert judgments using the group mean. With equal expert weights, the initial state of concept i was calculated as $\bar{v}_i = \sum(b_j \times v_{ij})$, where $b_j = 1/16$ for every expert and the sum of all expert weights was equal to 1. Here, $v_{ij}$ denotes expert j's assessment of the current state of concept i. The aggregated values formed the initial activation vector used to initiate dynamic inference.

The second part of the questionnaire elicited causal judgments. Experts were asked to evaluate both the direction and strength of influence from one concept to another using a nine-point linguistic scale extending from very strong negative influence to very strong positive influence. The scale was represented numerically as -1.00 for very strong negative, -0.75 for strong negative, -0.50 for moderate negative, -0.25 for weak negative, 0 for no effect, +0.25 for weak positive, +0.50 for moderate positive, +0.75 for strong positive, and +1.00 for very strong positive. Positive weights indicated that an increase in the source concept was expected to increase the target concept, whereas negative values indicated an inverse causal effect. A value of zero indicated the absence of a causal relationship. The questionnaire was organized so that experts assessed the mutual causal relationships among the 12 soft-skill indicators, the effect of each soft-skill indicator on its corresponding dimension, the mutual relationships among the four dimensions, and the effect of each dimension on the overarching soft-skills-strengthening concept. Self-effects were not elicited and the main diagonal of the causal matrix was therefore fixed at zero. The questionnaire contained 177 response cells in total: 17 cells for the current-state vector, 132 cells for directed relationships among the 12 indicators excluding self-

relations, 12 cells for indicator-to-dimension relationships, 12 cells for directed interrelationships among the four dimensions excluding diagonal elements, and four cells for dimension-to-overall-concept relationships.

The causal judgments of the 16 experts were aggregated to construct the initial weighted adjacency matrix. For each permitted directed relationship from concept i to concept j, the aggregated weight was calculated as w_ij = sum(mu_ije)/n, where mu_ije denotes the causal weight assigned by expert e and n = 16. The resulting initial matrix, W_initial, was a 17 × 17 directed weighted matrix in which each element w_ij represented the aggregated direction and intensity of the causal influence of concept i on concept j. Values were restricted to the interval [-1, +1]. The main diagonal was set to zero, and links that were structurally undefined or judged to have no causal effect remained zero. The questionnaire also provided the empirical basis for assessing inter-expert agreement. Because the concepts represented separate causal nodes rather than interchangeable items measuring a single latent construct, conventional internal-consistency logic was not treated as the primary reliability criterion. Instead, reliability was interpreted as the degree to which the expert panel produced a coherent and reproducible pattern of causal judgments. Agreement was therefore examined using the 160 nonzero or substantively assessed causal relations across the 16 experts, supplemented by expert-level diagnostic profiles. The complete dataset contained no missing values and no responses outside the permissible scale.

Data analysis was conducted by constructing the initial state vector and weighted causal matrix and then applying iterative Dynamic Fuzzy Cognitive Mapping with nonlinear Hebbian learning. In the first analytical step, the aggregated current-state values of the 17 concepts were entered as the initial activation vector, v^(0), and the aggregated causal judgments were entered as W_initial. Dynamic inference was then performed iteratively. At each iteration, the activation level of concept i was updated on the basis of its previous state and the weighted influence received from all other concepts. The updating rule was expressed as v_i^(t+1) = f[v_i^(t) + sum(v_j^(t) × w_ji^(t))], for j != i. In this expression, v_i^(t+1) is the activation of concept i at iteration t+1, v_i^(t) is its activation in the preceding iteration, v_j^(t) is the activation of a causally connected concept j, and w_ji^(t) is the current weight of the directed relationship from concept j to concept i. The self-state term was retained in the update function so that the new activation reflected both persistence of the previous condition and accumulated causal stimulation from connected concepts.

A bounded nonlinear threshold function was used to prevent unrestricted growth of activation values during repeated inference. The transformation function was parameterized by a slope coefficient sigma and written as f(x) = tanh(sigma × x). The slope parameter was explicitly calibrated rather than treated as an arbitrary fixed constant. Calibration was conducted to obtain a stable response range in which concept values neither collapsed toward zero nor saturated immediately at their upper bound. Alternative values of sigma were examined and the resulting concept rankings were compared using Spearman rank correlation. A parameter region was considered stable when moderate changes in sigma did not materially alter the ordering of concepts. This sensitivity procedure was used to ensure that substantive conclusions were driven primarily by the causal architecture of the expert-derived network rather than by an unexamined choice of threshold-function parameter.

The defining dynamic feature of the model was the simultaneous adaptation of causal weights through nonlinear Hebbian learning. Rather than retaining the initial expert-derived weights as fixed throughout the simulation, existing causal links were allowed to strengthen or weaken in response to the evolving states of interconnected concepts. At each learning iteration, a nonzero causal weight was updated according to w_ij^(t) = phi × w_ij^(t-1) + lambda(t) × [Delta v_i^(t-1) × Delta v_j^(t-1) + w_ij^(t-1)], provided that the corresponding concept change was nonzero. The decay coefficient phi was set to 0.96. The learning rate was allowed to decline across iterations according to lambda(t) = 0.1 × [1 - t/(1.1p)], where p denotes the planned number of learning steps. The initial learning-rate parameter was therefore bounded at 0.1 and gradually decreased as the system approached stability. A structural constraint was imposed whereby relationships with an initial weight of zero were not created during learning. Accordingly, nonlinear Hebbian learning was permitted to modify only causal links whose existence was supported by expert judgment. This restriction preserved the topology of the expert-derived cognitive map while allowing the intensity of confirmed relationships to evolve dynamically.

System convergence was evaluated throughout the iterative procedure. The model was considered computationally valid only when it converged toward a fixed point rather than continuing to oscillate, diverge, or exhibit irregular behavior. Two complementary convergence criteria were monitored. The first criterion assessed the

Euclidean distance between output concept values and their target values and was represented as F1 = sqrt[sum((DOC_i - T_i)^2)], where DOC_i denotes the current activation of output concept i and T_i represents its target level. The second criterion assessed the magnitude of change in an output concept between consecutive iterations and was expressed as F2 = abs(DOC_i^(k+1) - DOC_i^k). A tolerance of 0.001 was adopted for convergence assessment. Iteration continued until successive state changes fell below the predefined tolerance and the system reached a fixed stable configuration. The resulting activation vector was recorded as v_steady, while the corresponding learned weight matrix was recorded as W_steady. Comparison of W_initial and W_steady was subsequently used to determine which causal relationships were dynamically reinforced, attenuated, or remained comparatively stable as the system evolved.

The final stable network was analyzed using standard Fuzzy Cognitive Map structural indices. For each concept C_i, outdegree was calculated as od(C_i) = sum(abs(w_ij)) and represented the total magnitude of causal influence exerted by that concept on the remainder of the network. Indegree was calculated as id(C_i) = sum(abs(w_ji)) and represented the total magnitude of influence received from other concepts. Total centrality was computed as c(C_i) = od(C_i) + id(C_i). Concepts with od > 0 and id = 0 were interpreted as transmitter or driver concepts, because they primarily propagated causal effects through the network. Concepts with id > 0 and od = 0 were interpreted as receiver concepts, representing outcomes of the system. Concepts with both od > 0 and id > 0 were classified as ordinary or intermediate concepts because they both received and transmitted causal effects. These indices were calculated from the stabilized causal structure so that prioritization reflected the dynamic configuration of the system rather than only its initial expert-specified state.

The behavioral validity and practical interpretability of the model were further evaluated through intervention and scenario simulation. For each of the 12 soft-skill indicators, the initial activation level was manipulated independently while the remaining initial concept values and the stabilized causal structure were held constant. The intervention value was varied from 0 to 1 in increments of 0.1, and the inference process was re-run for each intervention level until convergence. The stable value of the overall concept representing the strengthening of human resource soft skills was recorded after each run. This produced a response trajectory showing how progressive improvement in each individual soft-skill indicator influenced the final system-level outcome. The simulations were used to identify leverage points, nonlinear response patterns, and potential saturation thresholds beyond which additional improvement in a given soft skill generated only limited incremental change in the overall outcome. Sensitivity was also evaluated by comparing the range of change in the stable overall outcome generated by interventions in each indicator. Indicators producing the greatest change in the system-level outcome were interpreted as the most influential intervention levers.

Reliability of the expert-derived causal structure was assessed as inter-rater agreement rather than internal consistency. The principal agreement matrix contained the causal evaluations of 16 experts across the assessed directed relationships. Kendall's coefficient of concordance was calculated to assess the consistency of expert rankings, and the associated chi-square statistic was used to test whether the observed concordance exceeded that expected under the null hypothesis of no systematic agreement. Inter-rater Cronbach's alpha and a two-way random-effects intraclass correlation coefficient based on average-measures agreement were also calculated as complementary indicators of panel-level reliability. These statistics were examined for the full causal matrix and separately for the major structural sections of the cognitive map, including indicator-to-indicator relationships, indicator-to-dimension relationships, inter-dimensional relationships, and dimension-to-overall-concept relationships. Expert-level diagnostics were additionally calculated to identify potentially divergent judgment patterns. For each expert, the mean and within-expert standard deviation of causal ratings, the number of zero-effect judgments, the number of negative causal judgments, and the Spearman correlation between that expert's causal profile and the aggregated group profile were examined. An expert would have been considered potentially atypical if the rank-order correspondence with the group pattern was substantially lower than that of the remaining panel or if within-expert variability was unusually restricted in a manner suggesting mechanically repetitive responding. No questionnaire was removed on these grounds.

Computational analysis was implemented through two complementary procedures. Transparent spreadsheet calculations were used for aggregation of expert judgments, construction and inspection of the initial matrices, calculation of descriptive network indices, and cross-checking of intermediate results. The iterative state-

updating, nonlinear Hebbian learning, convergence assessment, parameter-sensitivity testing, and repeated intervention simulations were implemented computationally because these operations require repeated simultaneous updating of concept states and causal weights. Results produced through overlapping procedures were cross-checked to detect computational inconsistencies. Model credibility was therefore evaluated through convergence to a stable state, inter-expert agreement, examination of individual expert profiles, stability of concept rankings across reasonable threshold-function parameter values, and behavioral sensitivity under controlled interventions. These procedures were intended to ensure that the final dynamic fuzzy cognitive map represented a stable, interpretable, and expert-supported causal model of the strengthening of human resource soft skills in the Iranian National Tax Administration.

## 3. Findings and Results

The Dynamic Fuzzy Cognitive Mapping questionnaire was completed by all 16 experts. Each questionnaire contained 177 response cells, comprising 17 assessments of the current state of the concepts, 132 assessments of reciprocal causal effects among the 12 indicator-level concepts, 12 assessments of the effects of indicators on their corresponding dimensions, 12 assessments of reciprocal effects among the four dimensions, and four assessments of the effects of the dimensions on the overall concept. Accordingly, 2,832 response cells were completed across the 16 questionnaires. Review of the returned questionnaires indicated that there were no missing responses and no values outside the permitted response ranges. Therefore, all 16 questionnaires were retained for analysis without exclusion.

The aggregated causal network contained 160 nonzero directed causal links, indicating that the experts collectively recognized direct causal influence in these concept pairs, whereas the remaining possible relationships were dominated by judgments of no direct effect. An important feature of the resulting network was the complete absence of negative aggregated causal weights. Thus, no inhibitory or counteracting relationship emerged among the soft-skill concepts. The entire network was consequently synergistic, with all established causal relationships operating in a reinforcing direction.

The initial state of each concept was calculated from the equally weighted judgments of the 16 experts. The resulting vector is presented in Table 1.

**Table 1**

*Initial State Vector of the Concepts*

| Code | Concept | Level | Initial state | Category |
|---|---|---|---|---|
| C01 | Effective verbal and written communication | Third | 0.537 | Moderate |
| C02 | Active listening | Third | 0.338 | Poor |
| C08 | Taxpayer orientation | Third | 0.475 | Moderate |
| C09 | Negotiation | Third | 0.388 | Poor |
| C13 | Trust building | Third | 0.388 | Poor |
| C14 | Problem solving | Third | 0.487 | Moderate |
| C15 | Decision making | Third | 0.463 | Moderate |
| C16 | Analytical thinking | Third | 0.738 | Good |
| C26 | Emotional intelligence | Third | 0.375 | Poor |
| C30 | Adaptability and flexibility | Third | 0.500 | Moderate |
| C41 | Work ethics, integrity, and professionalism | Third | 0.662 | Good |
| C43 | Accountability | Third | 0.762 | Good |
| D1 | Communication and interpersonal skills | Second | 0.537 | Moderate |
| D2 | Cognitive and problem-solving skills | Second | 0.713 | Good |
| D3 | Intrapersonal and self-management skills | Second | 0.537 | Moderate |
| D4 | Leadership and professional ethics | Second | 0.700 | Good |
| K | Strengthening human resource soft skills in the Iranian National Tax Administration | First | 0.563 | Moderate |

The initial organizational profile was therefore predominantly moderate. The overall concept had an initial value of 0.563 and was classified as moderate. At the indicator level, accountability had the strongest initial position at 0.762, followed by analytical thinking at 0.738 and work ethics, integrity, and professionalism at 0.662. In contrast, active listening had the weakest initial condition at 0.338, followed by emotional intelligence at 0.375, while

negotiation and trust building both had values of 0.388. A substantively meaningful pattern was therefore evident. Skills characterized by procedural requirements and formal organizational expectations, particularly accountability and ethical conduct, showed comparatively stronger current conditions, whereas interactive and emotional competencies requiring sustained practice and developmental intervention showed weaker initial states.

The causal evaluations of the experts were converted to their corresponding numerical values and averaged across the 16 participants. The resulting initial 17 × 17 weighted adjacency matrix is presented in Table 2. Rows denote the influencing concept and columns denote the affected concept. The average nonzero initial causal weight was 0.46, and the maximum observed weight was 1.00.

**Table 2**

*Initial Weighted Causal Matrix*

| Influencer ↓ / Affected → | C01 | C02 | C08 | C09 | C13 | C14 | C15 | C16 | C26 | C30 | C41 | C43 | D1 | D2 | D3 | D4 | K |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| C01 | 0 | 0.73 | 0.44 | 0.73 | 0.55 | 0.20 | 0.23 | 0.33 | 0.28 | 0.20 | 0.30 | 0.52 | 0.75 | 0 | 0 | 0 | 0 |
| C02 | 0.73 | 0 | 0.47 | 0.70 | 0.69 | 0.23 | 0.31 | 0.28 | 0.59 | 0.25 | 0.20 | 0.22 | 0.75 | 0 | 0 | 0 | 0 |
| C08 | 0.50 | 0.45 | 0 | 0.53 | 0.77 | 0.28 | 0.28 | 0.09 | 0.25 | 0.25 | 0.45 | 0.50 | 0.78 | 0 | 0 | 0 | 0 |
| C09 | 0.55 | 0.55 | 0.55 | 0 | 0.50 | 0.50 | 0.48 | 0.27 | 0.59 | 0.47 | 0.19 | 0.30 | 0.77 | 0 | 0 | 0 | 0 |
| C13 | 0.50 | 0.48 | 0.80 | 0.48 | 0 | 0.23 | 0.23 | 0.05 | 0.23 | 0.27 | 0.36 | 0.56 | 0.73 | 0 | 0 | 0 | 0 |
| C14 | 0.28 | 0.27 | 0.22 | 0.47 | 0.36 | 0 | 0.72 | 0.75 | 0.25 | 0.59 | 0.36 | 0.25 | 0 | 0.75 | 0 | 0 | 0 |
| C15 | 0.17 | 0.30 | 0.25 | 0.53 | 0.25 | 0.75 | 0 | 0.50 | 0.28 | 0.53 | 0.27 | 0.56 | 0 | 0.77 | 0 | 0 | 0 |
| C16 | 0.36 | 0.20 | 0.34 | 0.23 | 0.30 | 0.80 | 0.75 | 0 | 0.05 | 0.20 | 0.23 | 0.30 | 0 | 0.80 | 0 | 0 | 0 |
| C26 | 0.73 | 0.73 | 0.48 | 0.81 | 0.77 | 0.38 | 0.53 | 0.28 | 0 | 0.64 | 0.55 | 0.53 | 0 | 0 | 0.75 | 0 | 0 |
| C30 | 0.58 | 0.28 | 0.41 | 0.55 | 0.25 | 0.44 | 0.48 | 0.31 | 0.44 | 0 | 0.33 | 0.30 | 0 | 0 | 0.72 | 0 | 0 |
| C41 | 0.47 | 0.20 | 0.78 | 0.23 | 0.73 | 0.23 | 0.50 | 0.28 | 0.48 | 0.22 | 0 | 0.75 | 0 | 0 | 0 | 1.00 | 0 |
| C43 | 0.53 | 0.28 | 0.53 | 0.25 | 0.47 | 0.27 | 0.55 | 0.19 | 0.30 | 0.22 | 0.48 | 0 | 0 | 0 | 0 | 0.72 | 0 |
| D1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.48 | 0.52 | 0.44 | 0.70 |
| D2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.45 | 0 | 0.61 | 0.56 | 0.77 |
| D3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.70 | 0.56 | 0 | 0.53 | 0.73 |
| D4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.48 | 0.48 | 0.56 | 0 | 0.97 |
| K | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

The dynamic learning procedure substantially altered the magnitudes of the existing causal relationships while preserving the topology of the expert-derived network. The stabilized weight matrix obtained following nonlinear Hebbian learning is reported in Table 3.

**Table 3**

*Stabilized Weighted Causal Matrix after Nonlinear Hebbian Learning*

| Influencer ↓ / Affected → | C01 | C02 | C08 | C09 | C13 | C14 | C15 | C16 | C26 | C30 | C41 | C43 | D1 | D2 | D3 | D4 | K |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| C01 | 0 | 0.86 | 0.60 | 0.86 | 0.76 | 0.28 | 0.33 | 0.45 | 0.39 | 0.28 | 0.41 | 0.70 | 0.86 | 0 | 0 | 0 | 0 |
| C02 | 0.86 | 0 | 0.65 | 0.86 | 0.86 | 0.33 | 0.44 | 0.38 | 0.82 | 0.35 | 0.28 | 0.30 | 0.86 | 0 | 0 | 0 | 0 |
| C08 | 0.69 | 0.63 | 0 | 0.74 | 0.86 | 0.39 | 0.39 | 0.13 | 0.35 | 0.35 | 0.62 | 0.68 | 0.86 | 0 | 0 | 0 | 0 |
| C09 | 0.76 | 0.76 | 0.76 | 0 | 0.70 | 0.69 | 0.67 | 0.36 | 0.82 | 0.65 | 0.26 | 0.41 | 0.86 | 0 | 0 | 0 | 0 |
| C13 | 0.69 | 0.68 | 0.86 | 0.68 | 0 | 0.33 | 0.33 | 0.06 | 0.33 | 0.37 | 0.49 | 0.77 | 0.86 | 0 | 0 | 0 | 0 |
| C14 | 0.39 | 0.37 | 0.31 | 0.65 | 0.50 | 0 | 0.86 | 0.86 | 0.35 | 0.81 | 0.49 | 0.34 | 0 | 0.86 | 0 | 0 | 0 |
| C15 | 0.24 | 0.42 | 0.35 | 0.74 | 0.36 | 0.86 | 0 | 0.68 | 0.39 | 0.73 | 0.36 | 0.77 | 0 | 0.86 | 0 | 0 | 0 |
| C16 | 0.49 | 0.27 | 0.47 | 0.32 | 0.40 | 0.86 | 0.86 | 0 | 0.06 | 0.28 | 0.32 | 0.41 | 0 | 0.86 | 0 | 0 | 0 |
| C26 | 0.86 | 0.86 | 0.67 | 0.86 | 0.86 | 0.52 | 0.73 | 0.38 | 0 | 0.86 | 0.75 | 0.73 | 0 | 0 | 0.86 | 0 | 0 |
| C30 | 0.79 | 0.39 | 0.56 | 0.75 | 0.35 | 0.60 | 0.67 | 0.43 | 0.60 | 0 | 0.45 | 0.41 | 0 | 0 | 0.86 | 0 | 0 |
| C41 | 0.64 | 0.28 | 0.86 | 0.32 | 0.86 | 0.32 | 0.68 | 0.39 | 0.66 | 0.30 | 0 | 0.86 | 0 | 0 | 0 | 0.86 | 0 |
| C43 | 0.72 | 0.38 | 0.72 | 0.34 | 0.64 | 0.36 | 0.75 | 0.26 | 0.41 | 0.30 | 0.66 | 0 | 0 | 0 | 0 | 0.86 | 0 |
| D1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.66 | 0.70 | 0.60 | 0.86 |
| D2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.62 | 0 | 0.83 | 0.77 | 0.86 |
| D3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.86 | 0.77 | 0 | 0.72 | 0.86 |
| D4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.66 | 0.66 | 0.77 | 0 | 0.86 |
| K | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Comparison of the two matrices indicated that 158 of the 160 initially nonzero causal links increased in magnitude following nonlinear Hebbian learning, whereas only two became weaker. The mean weight of the nonzero relationships increased from 0.46 to 0.59, representing an increase of approximately 28.5%. All links that were initially zero remained zero throughout the learning process. Consequently, the learning algorithm intensified or attenuated only relationships originally supported by the expert panel and did not generate new causal connections. Visual comparison of the initial and stabilized networks likewise showed an increase in the number of strong links after learning, resulting in a more strongly interconnected causal system without alteration of the underlying network topology.

**Figure 1**

*Initial Fuzzy Cognitive Map of the Model for Strengthening Human Resource Soft Skills*

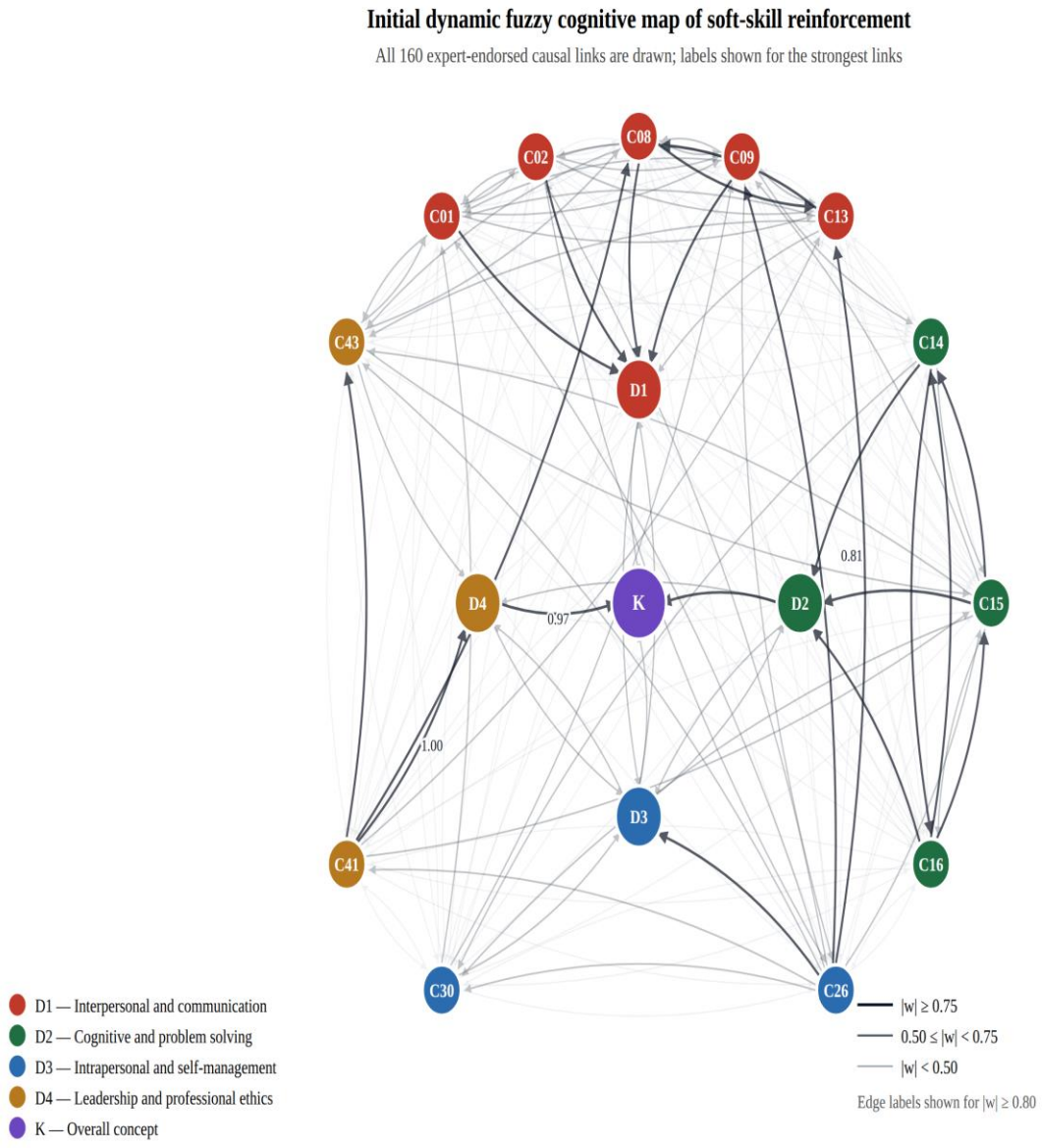
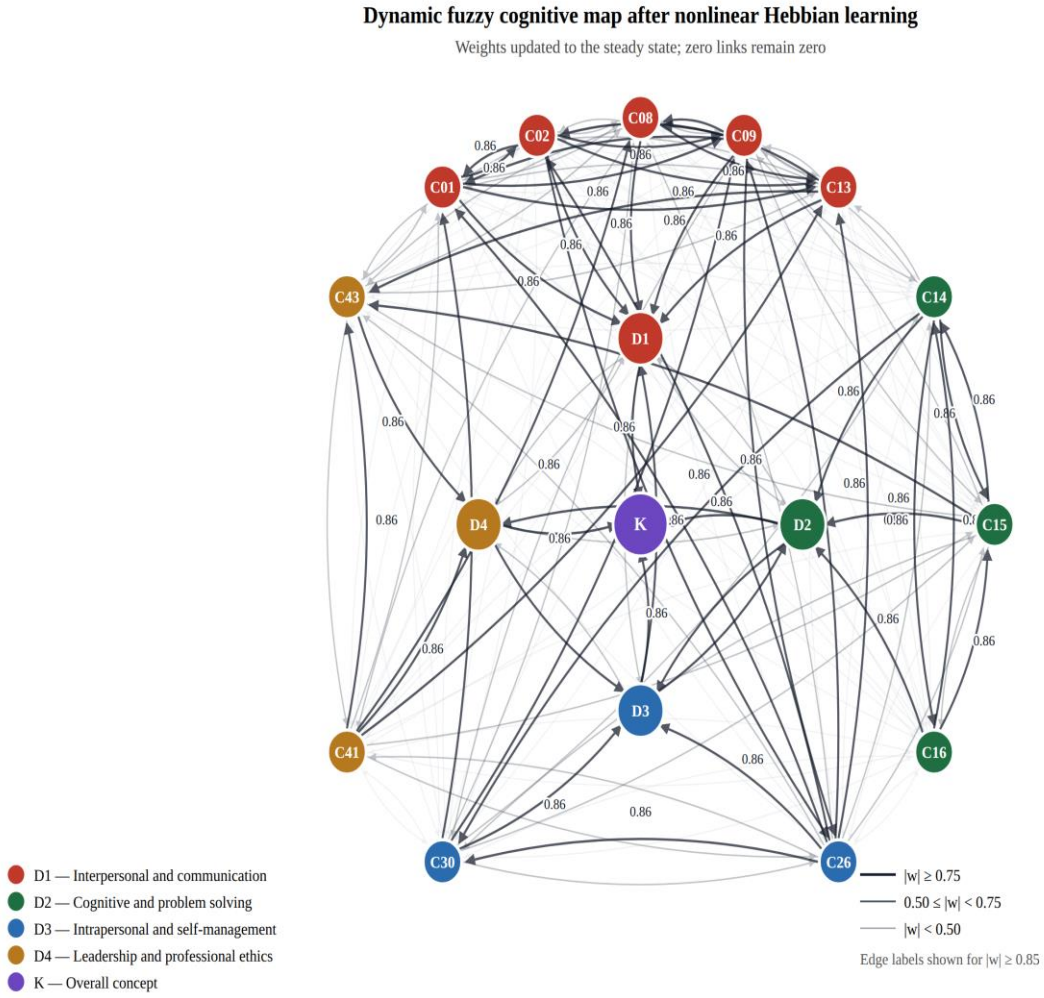


**Figure 2**

*Dynamic Fuzzy Cognitive Map after Nonlinear Hebbian Learning*




Initial inference with the default threshold-function slope of sigma = 1 resulted in almost complete system saturation. Under this specification, the activation values of virtually all concepts converged to 1, and intervention simulations produced essentially no meaningful discrimination among alternative policy scenarios. This occurred because the network was comparatively dense and entirely positive. The mean aggregate incoming influence on each node was approximately 4.35, causing the hyperbolic tangent transformation to operate close to its upper asymptote. The slope parameter was therefore calibrated to obtain a nondegenerate stable state while retaining the complete set of 160 expert-supported relationships. The calibration results are presented in Table 4.

**Table 4**

*Calibration of the Threshold-Function Slope Parameter*

| sigma | Range of steady-state values | Overall concept K | Mean intervention effect on K | Iterations | Rank correlation with baseline |
|---|---|---|---|---|---|
| 0.15 | [0.000, 0.000] | 0.0000 | 0.0934 | 104 | 0.678 |
| 0.20 | [0.316, 0.606] | 0.3155 | 0.1822 | 70 | -0.385 |
| 0.25 | [0.612, 0.870] | 0.6119 | 0.0409 | 30 | 0.965 |
| 0.30 | [0.773, 0.946] | 0.7728 | 0.0151 | 20 | 1.000 |
| 0.35 | [0.863, 0.976] | 0.8633 | 0.0063 | 16 | 1.000 |
| 0.50 | [0.966, 0.997] | 0.9664 | 0.0006 | 10 | 0.986 |
| 1.00 | [1.000, 1.000] | 0.9995 | 0.0000 | 5 | 0.965 |

Values below approximately 0.20 drove the system toward the lower boundary, whereas values of 0.50 and above produced increasing saturation. A stable operating region was observed from approximately sigma = 0.25 to sigma = 0.50. Within this interval, the Spearman rank correlation of intervention rankings relative to the selected baseline ranged from 0.965 to 1.000, indicating that the substantive ordering of the intervention effects was highly stable. A value of sigma = 0.30 was therefore selected as the baseline parameter because it was located near the center of this stable interval and generated a steady-state range of approximately 0.77 to 0.95 without collapsing or saturating the system. Importantly, calibration involved no deletion of causal links; all 160 expert-supported relationships remained active in the model.

Using the calibrated specification, the inference process converged to a stable state after approximately 15 state-update iterations, while the nonlinear Hebbian learning procedure stabilized by approximately the 25th learning step. The stabilized concept values and their differences from the initial conditions are shown in Table 5.

**Table 5**

*Steady-State Values of the Concepts and Changes from the Initial State*

| Code | Concept | Initial state | Steady state | Change | Final category |
|---|---|---|---|---|---|
| C01 | Effective verbal and written communication | 0.537 | 0.9820 | +0.445 | Excellent |
| C02 | Active listening | 0.338 | 0.9642 | +0.627 | Excellent |
| C08 | Taxpayer orientation | 0.475 | 0.9784 | +0.503 | Excellent |
| C09 | Negotiation | 0.388 | 0.9820 | +0.595 | Excellent |
| C13 | Trust building | 0.388 | 0.9822 | +0.595 | Excellent |
| C14 | Problem solving | 0.487 | 0.9548 | +0.467 | Excellent |
| C15 | Decision making | 0.463 | 0.9766 | +0.514 | Excellent |
| C16 | Analytical thinking | 0.738 | 0.9112 | +0.174 | Excellent |
| C26 | Emotional intelligence | 0.375 | 0.9455 | +0.571 | Excellent |
| C30 | Adaptability and flexibility | 0.500 | 0.9477 | +0.448 | Excellent |
| C41 | Work ethics, integrity, and professionalism | 0.662 | 0.9416 | +0.279 | Excellent |
| C43 | Accountability | 0.762 | 0.9721 | +0.210 | Excellent |
| D1 | Communication and interpersonal skills | 0.537 | 0.9719 | +0.434 | Excellent |
| D2 | Cognitive and problem-solving skills | 0.713 | 0.9183 | +0.206 | Excellent |
| D3 | Intrapersonal and self-management skills | 0.537 | 0.8829 | +0.345 | Excellent |
| D4 | Leadership and professional ethics | 0.700 | 0.8698 | +0.170 | Excellent |
| K | Strengthening human resource soft skills in the Iranian National Tax Administration | 0.563 | 0.8309 | +0.268 | Excellent |

All 17 concepts reached the excellent category after stabilization, although meaningful differences remained among them. The overall concept K reached 0.8309 and remained the lowest steady-state value in the network. It was followed by leadership and professional ethics at 0.8698 and intrapersonal and self-management skills at 0.8829. At the indicator level, trust building reached the highest steady-state value at 0.9822, while effective verbal and written communication and negotiation each reached approximately 0.9820. Analytical thinking had the lowest stabilized value among the 12 individual indicators at 0.9112.

The magnitude of change from the initial to steady state was particularly large for skills that were initially weak. Active listening increased from 0.338 to 0.9642, corresponding to the largest increase, +0.627. Negotiation increased from 0.388 to 0.9820, trust building from 0.388 to 0.9822, and emotional intelligence from 0.375 to 0.9455. These findings indicate that the initially weaker status of these competencies did not reflect structurally marginal positions in the causal network. Once the reinforcing causal mechanisms of the network became fully activated, these competencies exhibited substantial potential for improvement. In contrast, the overall concept K showed a smaller increase, from 0.563 to 0.8309, despite substantial improvements at the indicator level. This pattern suggests that conversion of improvements in individual and dimensional soft skills into system-level enhancement constitutes a comparatively restrictive point within the model.

Structural properties of the stabilized network were subsequently examined through outdegree, indegree, and total centrality. The results are reported in Table 6.

**Table 6**

*Network Indices and Structural Classification of the Concepts*

| Rank | Concept | Outdegree | Indegree | Centrality | Type |
|---|---|---|---|---|---|
| 1 | C09 — Negotiation | 7.686 | 7.115 | 14.802 | Intermediate |
| 2 | C26 — Emotional intelligence | 8.946 | 5.191 | 14.137 | Intermediate |
| 3 | C01 — Effective verbal and written communication | 6.786 | 7.138 | 13.924 | Intermediate |
| 4 | C13 — Trust building | 6.451 | 7.144 | 13.595 | Intermediate |
| 5 | C08 — Taxpayer orientation | 6.688 | 6.814 | 13.502 | Intermediate |
| 6 | C15 — Decision making | 6.758 | 6.718 | 13.475 | Intermediate |
| 7 | C02 — Active listening | 6.995 | 5.909 | 12.904 | Intermediate |
| 8 | C43 — Accountability | 6.409 | 6.364 | 12.773 | Intermediate |
| 9 | C14 — Problem solving | 6.798 | 5.554 | 12.352 | Intermediate |
| 10 | C30 — Adaptability and flexibility | 6.856 | 5.276 | 12.132 | Intermediate |
| 11 | C41 — Work ethics, integrity, and professionalism | 7.037 | 5.084 | 12.122 | Intermediate |
| 12 | C16 — Analytical thinking | 5.600 | 4.364 | 9.964 | Intermediate |
| 13 | D1 — Communication and interpersonal skills | 2.823 | 6.447 | 9.270 | Intermediate |
| 14 | D2 — Cognitive and problem-solving skills | 3.076 | 4.672 | 7.748 | Intermediate |
| 15 | D3 — Intrapersonal and self-management skills | 3.214 | 4.025 | 7.239 | Intermediate |
| 16 | D4 — Leadership and professional ethics | 2.947 | 3.809 | 6.757 | Intermediate |
| 17 | K — Strengthening human resource soft skills | 0.000 | 3.447 | 3.447 | Receiver |

The overall concept K was the only pure receiver in the network. Its outdegree was zero and its indegree was 3.447, which was structurally consistent with its role as the final system-level outcome and supported the internal structural validity of the map. The remaining 16 concepts were intermediate nodes because each simultaneously received and transmitted causal influence. The absence of pure transmitter nodes reflects the densely interconnected and cyclical nature of the soft-skills system.

Negotiation ranked first in total centrality with a value of 14.802, followed by emotional intelligence at 14.137 and effective verbal and written communication at 13.924. Emotional intelligence was particularly notable because it had the largest outdegree in the entire network, 8.946, while its indegree was only 5.191. Its influence-to-receptivity profile was therefore more strongly oriented toward exerting effects than that of the other concepts, making emotional intelligence the closest concept to a structural driver despite its formal classification as an intermediate node. Analytical thinking had the lowest total centrality among the indicator-level concepts at 9.964 and was therefore the least interconnected individual soft-skill indicator in the stabilized network.

Intervention analysis was then performed by clamping each indicator at values from 0 to 1 in increments of 0.1 while retaining the remaining system structure unchanged and repeatedly recalculating the steady-state value of the overall concept. Clamping was required because a one-time alteration of the initial value did not permanently affect the eventual fixed point: without continued intervention, the dynamic system returned toward its endogenous equilibrium. The range between K under a zero-level intervention and K under a maximum-level intervention was used as an indicator of intervention leverage. The results are shown in Table 7.

**Table 7**

*Ranking of Intervention Effects on the Steady-State Value of the Overall Concept*

| Rank | Indicator | K at intervention = 0 | K at intervention = 1 | Effect range | Dimension |
|---|---|---|---|---|---|
| 1 | C43 — Accountability | 0.8213 | 0.8311 | 0.0098 | D4 |
| 2 | C41 — Work ethics, integrity, and professionalism | 0.8217 | 0.8313 | 0.0096 | D4 |
| 3 | C26 — Emotional intelligence | 0.8220 | 0.8312 | 0.0092 | D3 |
| 4 | C30 — Adaptability and flexibility | 0.8223 | 0.8312 | 0.0089 | D3 |
| 5 | C15 — Decision making | 0.8239 | 0.8310 | 0.0071 | D2 |
| 6 | C14 — Problem solving | 0.8242 | 0.8311 | 0.0069 | D2 |
| 7 | C16 — Analytical thinking | 0.8251 | 0.8313 | 0.0062 | D2 |

| | | | | | |
|---|---|---|---|---|---|
| 8 | C09 — Negotiation | 0.8279 | 0.8309 | 0.0030 | D1 |
| 9 | C01 — Effective verbal and written communication | 0.8281 | 0.8309 | 0.0028 | D1 |
| 10 | C02 — Active listening | 0.8282 | 0.8309 | 0.0027 | D1 |
| 11 | C08 — Taxpayer orientation | 0.8282 | 0.8309 | 0.0027 | D1 |
| 12 | C13 — Trust building | 0.8282 | 0.8309 | 0.0027 | D1 |

Accountability, work ethics and professionalism, emotional intelligence, and adaptability and flexibility produced the largest intervention effects on the system-level outcome. Their effect ranges extended from 0.0089 to 0.0098. By contrast, trust building, taxpayer orientation, active listening, and effective communication produced intervention ranges of approximately 0.0027 to 0.0028. The leverage associated with the highest-ranked indicator was therefore approximately 3.5 times the leverage associated with the lowest-ranked indicators.

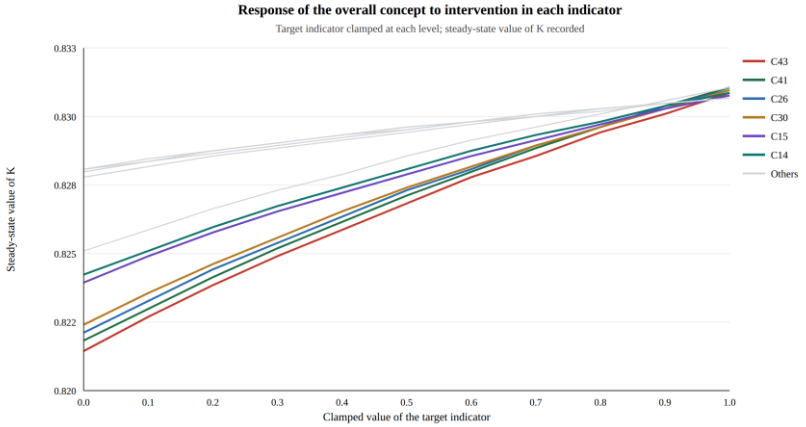
A central finding of the scenario analysis was the divergence between centrality ranking and intervention-leverage ranking. Negotiation and effective communication, which occupied first and third positions in network centrality, ranked only eighth and ninth, respectively, in direct leverage over K. Conversely, accountability and work ethics, which ranked eighth and eleventh in centrality, occupied the first and second positions in intervention leverage. This divergence is attributable to the hierarchical structure of the network. Accountability and work ethics both feed into the leadership and professional ethics dimension, which has a particularly strong direct connection to the overall concept. Their causal paths to K are therefore shorter and experience less attenuation. Negotiation and communication, despite having extensive reciprocal connectivity throughout the indicator network, exert much of their system-level influence through longer pathways.

These findings indicate that high network centrality should not automatically be interpreted as equivalent to intervention priority. If the organizational objective is to maximize short-term improvement in the overall outcome, accountability and work ethics offer the greatest leverage. If the objective is instead to strengthen the general coherence, connectivity, and propagation capacity of the soft-skills network, negotiation and emotional intelligence assume greater importance. Emotional intelligence is particularly significant because it is the only indicator appearing among the top four in both the structural centrality and intervention-leverage rankings. It therefore represents the most balanced candidate for intervention when both local system leverage and broader network influence are considered simultaneously.

The absolute ranges of the intervention effects were nevertheless relatively small. This is attributable to the high density of the network and the hierarchical distance separating third-level indicators from the overall concept. The effect of an individual indicator must first propagate through intermediate dimensions before influencing K, while the wholly positive and highly interconnected structure distributes the total causal influence across numerous reinforcing pathways. Consequently, the intervention results are most appropriately interpreted in relative and rank-order terms rather than as large absolute effect sizes.

**Figure 3**

*Response Curves of the Overall Soft-Skills Concept to Interventions in the Twelve Indicators*



Reliability of the causal judgments was evaluated as inter-rater agreement rather than internal consistency of homogeneous items. Kendall's coefficient of concordance was calculated as $W = 12S / [m^2(n^3 - n) - m\Sigma T]$, with the corresponding chi-square statistic calculated as chi-square = $m(n - 1)W$. Inter-rater Cronbach's alpha, a two-way random-effects intraclass correlation coefficient for average-measures agreement, and the corresponding F statistic were also examined. The results for the complete causal matrix and the different sections of the questionnaire are presented in Table 8.

**Table 8**

*Inter-Expert Reliability Statistics by Questionnaire Section*

| Section | Number of objects, n | Kendall's W | Chi-square | df | p | Cronbach's alpha | ICC(2,k) | F |
|---|---|---|---|---|---|---|---|---|
| All causal relationships | 160 | 0.576 | 1465.02 | 159 | < 0.001 | 0.950 | 0.950 | 19.82 |
| Relationships among indicators | 132 | 0.523 | 1095.82 | 131 | < 0.001 | 0.938 | 0.938 | 16.22 |
| Indicator-to-dimension relationships | 12 | 0.224 | 39.36 | 11 | < 0.001 | 0.748 | 0.756 | 3.97 |
| Relationships among dimensions | 12 | 0.138 | 24.29 | 11 | 0.012 | 0.548 | 0.543 | 2.21 |
| Dimension-to-overall-concept relationships | 4 | 0.414 | 19.89 | 3 | < 0.001 | 0.905 | 0.893 | 10.55 |
| Current-state judgments | 17 | 0.454 | 116.25 | 16 | < 0.001 | 0.920 | 0.921 | 12.54 |

For the full matrix of 160 causal relationships, Kendall's W was 0.576, with chi-square = 1465.02 and 159 degrees of freedom, $p < 0.001$. This result indicated moderate-to-strong concordance and strongly rejected the null hypothesis of nonsystematic expert agreement. Inter-rater Cronbach's alpha was 0.950 and ICC(2,k) was also 0.950, both indicating excellent panel-level reliability. Thus, when considered collectively, the 16 experts formed a highly stable measurement system for extracting the causal structure of the model.

Section-level analysis revealed meaningful heterogeneity in agreement. Kendall's W was 0.523 for relationships among the indicator-level concepts, 0.224 for indicator-to-dimension relationships, 0.138 for relationships among dimensions, 0.414 for relationships from dimensions to the overall concept, and 0.454 for judgments of the current state. The weakest concordance occurred in the inter-dimensional relationship section. Nevertheless, this agreement remained statistically significant, chi-square = 24.29, df = 11, p = 0.012. The lower agreement at this level can be understood in light of the greater conceptual abstraction involved in judging relationships between broad dimensions rather than relationships between concrete soft-skill indicators. In contrast, judgments regarding specific skills or the influence of broad dimensions on the overall outcome showed greater consistency.

Expert-level diagnostic analysis provided no evidence of an outlying judge. Across the 16 experts, mean causal weights ranged narrowly from 0.430 to 0.483, with a group mean of 0.462. Within-expert standard deviations ranged from 0.261 to 0.286, with an average of 0.272. The narrow dispersion of these values indicated that no expert exhibited unusually restricted response variability or mechanically repetitive response behavior. The number of relationships judged to have no effect ranged from 11 to 23, averaging 16.9 per expert, demonstrating normal variation in individual strictness regarding the existence of direct causal links.

The Spearman correlation between each expert's causal profile and the aggregated group profile ranged from 0.696 to 0.803, with a mean of 0.749. Specifically, these correlations were 0.696, 0.731, 0.730, 0.740, 0.750, 0.770, 0.803, 0.768, 0.735, 0.745, 0.781, 0.757, 0.751, 0.757, 0.705, and 0.765 for Experts E1 through E16, respectively. These values indicated that no participant produced a causal pattern sharply divergent from the panel while also showing that individual experts were not simply reproducing an identical response pattern. Mean current-state judgments ranged from 0.488 to 0.582 across the experts, with an overall expert-level mean of 0.539. Expert-specific mean causal weights were 0.477, 0.447, 0.458, 0.483, 0.470, 0.463, 0.461, 0.464, 0.456, 0.464, 0.430, 0.447, 0.481, 0.452, 0.478, and 0.467, while their within-person standard deviations were 0.276, 0.272, 0.268, 0.271, 0.286, 0.263, 0.273, 0.261, 0.278, 0.264, 0.272, 0.265, 0.271, 0.274, 0.278, and 0.283, respectively.

The numbers of no-effect judgments made by Experts E1 through E16 were 19, 18, 17, 14, 20, 13, 18, 11, 17, 14, 23, 19, 14, 21, 15, and 17, respectively. Particularly noteworthy was that the number of negative causal judgments was zero for every one of the 16 experts. Thus, the absence of negative relationships in the aggregated matrix did not result from averaging positive and negative opinions; rather, none of the experts identified any of the modeled causal relationships as inhibitory. This complete agreement reinforces the interpretation of the modeled soft-skills system as a mutually reinforcing structure, while simultaneously indicating that the model contains no balancing or counteracting feedback loops.

Taken together, the results demonstrate a dense, strongly reinforcing, dynamically stable causal architecture. The model moved from a predominantly moderate initial organizational condition toward a high steady-state configuration once the endogenous causal interactions and nonlinear learning mechanism became active. The strongest structural influence was associated with emotional intelligence, whereas negotiation showed the highest total centrality. In contrast, accountability and work ethics exerted the greatest direct intervention leverage on the system-level outcome. The divergence between structural centrality and intervention leverage demonstrates that the most interconnected concept is not necessarily the most effective short-term policy lever. Emotional intelligence represented the most strategically balanced indicator because it simultaneously displayed very high network influence and high intervention leverage. Finally, convergence of the system, stability of rankings across the calibrated parameter range, high panel-level agreement, absence of outlier experts, and preservation of all expert-supported causal links provided convergent evidence for the computational and judgmental stability of the resulting Dynamic Fuzzy Cognitive Map.

## 4. Discussion and Conclusion

The findings of the present study demonstrate that the soft-skills system in the Iranian National Tax Administration is characterized by a dense, highly interconnected, and predominantly reinforcing causal structure. The Dynamic Fuzzy Cognitive Map contained 160 nonzero causal relationships, and none of the aggregated relationships was negative, indicating that the experts perceived the identified soft skills as mutually supportive rather than competing capabilities. Following nonlinear Hebbian learning, 158 of the 160 nonzero relationships were strengthened and the mean causal weight increased from 0.46 to 0.59, representing a 28.5% increase in overall relational intensity. This pattern is consistent with the broader view that soft skills operate as an interconnected capability system rather than as isolated individual attributes. Previous research has similarly emphasized the multidimensional and mutually reinforcing nature of soft skills, particularly where communication, adaptability, emotional intelligence, judgment, teamwork, and problem solving are jointly required for organizational effectiveness (Colledani et al., 2024; Fantozzi, Di Luozzo, et al., 2024; Kubátová et al., 2025; Marin-Zapata et al., 2022). The density of the network therefore suggests that strengthening a particular soft skill is likely to generate indirect effects across several other competencies, which supports a systemic rather than fragmented approach to human resource development.

The initial state vector showed that the organization did not begin from a uniformly weak or strong position. Rather, the overall state of soft skills was moderate, with the general concept obtaining a value of 0.563. Accountability, analytical thinking, and work ethics, integrity, and professionalism had the strongest initial conditions, whereas active listening, emotional intelligence, negotiation, and trust building were among the weakest. This asymmetry is theoretically meaningful. Competencies such as accountability and professional ethics are often embedded in formal administrative structures, rules, performance expectations, and legal responsibilities, whereas emotional and interpersonal skills generally depend more strongly on repeated behavioral practice, developmental feedback, and experiential learning. Research in public organizations has similarly emphasized that formal responsibility and procedural competence may be more institutionally reinforced than relational capabilities, while effective public-sector performance increasingly requires greater investment in communication, adaptability, interpersonal effectiveness, and human-centered behavior (Bostani Rad & Hamidizadeh, 2022; Jafari et al., 2026; Rostamzadeh Ganji & Afsharinezhad, 2025). In tax administration specifically, managerial competence cannot be reduced to technical taxation knowledge because interaction with taxpayers, internal coordination, negotiation, and professional judgment are central to the effectiveness of modern tax organizations (Ishai, 2024; Peretiatko, 2025).

The relatively weak initial status of active listening, negotiation, trust building, and emotional intelligence is particularly important in the context of tax administration.

These competencies are closely related to the quality of interaction between employees and taxpayers and to the manner in which administrative authority is exercised. Contemporary tax administrations increasingly depend on service orientation, behavioral insight, digital communication, and voluntary compliance in addition to traditional enforcement mechanisms. Evidence from taxation-related education and practice indicates that technological transformation alone cannot produce effective tax administration unless personnel possess complementary behavioral and communication competencies (Abu Bakar et al., 2023; Agustina & Saragih, 2022; Dimitrov et al., 2026). The present findings therefore suggest that weaknesses in the interpersonal and emotional domains may represent a significant developmental opportunity, particularly where the organization aims to improve taxpayer engagement and build trust in tax administration.

A major result of the dynamic analysis was that all 17 concepts reached the excellent range after the system stabilized. However, the magnitude of change differed substantially across concepts. Active listening showed the largest increase, from 0.338 to 0.9642, while negotiation, trust building, and emotional intelligence also displayed very large gains. This result indicates that a low initial level should not automatically be interpreted as structural weakness. Some competencies may currently be underdeveloped while simultaneously occupying positions from which they can benefit strongly from the activation of surrounding relationships. This distinction is consistent with research emphasizing that soft skills are developable capabilities rather than fixed personal traits and that structured learning environments, coaching, and organizational reinforcement can substantially improve them (Al-Mousawi, 2023; Gheybi Takhti, 2025; Ijadi, 2025). The large dynamic improvements observed in initially weak skills also align with the wider literature on employability and workforce development, which views communication, adaptability, emotional intelligence, and related competencies as trainable resources capable of responding to organizational intervention (Poláková et al., 2023; Villegas, 2024).

The stabilized system nevertheless revealed an important bottleneck. Although most indicator-level concepts reached values above 0.94, the overall concept of strengthening human resource soft skills stabilized at 0.8309, the lowest value in the network. This suggests that improvement at the level of specific skills does not automatically translate proportionally into system-level organizational improvement. The result can be explained by the hierarchical architecture of the model, in which individual indicators exert their final influence through intermediate dimensions. Such attenuation is consistent with organizational capability perspectives in which individual competencies must be integrated through structures, processes, leadership, and organizational conditions before they generate higher-level outcomes. Research on organizational learning, innovation capability, and performance has similarly suggested that individual competencies create value when they are converted into collective and organizational capabilities (Awawdeh & Alkshali, 2022; Ghadim Sarbaz, 2022). Thus, the relatively lower steady-state value of the overall concept may reflect the difficulty of transforming improved individual behavior into institutionalized organizational capability.

The network analysis provided a more differentiated picture of influence. Negotiation had the highest total centrality, followed by emotional intelligence and effective verbal and written communication. These concepts were therefore the most structurally embedded within the causal network. The result is consistent with the view that communication-centered capabilities occupy foundational positions in modern organizations because they enable coordination, conflict resolution, knowledge transfer, collaboration, and relational trust (Colledani et al., 2024; Marin-Zapata et al., 2022). Negotiation in particular requires the integration of communication, analytical judgment, emotional regulation, listening, and trust-building skills, which helps explain its high structural connectivity. Similar arguments are evident in research on complex professional work, where task performance increasingly depends on combinations of interpersonal and cognitive competencies rather than isolated technical ability (Fantozzi, Martuscelli, et al., 2024; Ferreira et al., 2023).

Emotional intelligence was especially important because it had the highest outdegree in the network, indicating that it exerted the greatest total outgoing influence on other concepts. This suggests that emotional intelligence functions as a near-driver of the soft-skills system, even though it remains formally an intermediate concept because it also receives influence from other nodes. The finding is strongly aligned with previous research describing emotional-social intelligence as a crucial human capability in technologically transformed work environments and as an important complement to artificial intelligence and automation (Singh & Chouhan, 2023). Emotional intelligence may facilitate active listening, adaptability, negotiation, trust building,

communication quality, and interpersonal regulation, which explains why its influence is distributed broadly across the network. The growing emphasis on human-centered capability development in AI-driven workplaces similarly reinforces the importance of emotional, social, and contextual competencies that technological systems cannot independently reproduce (Kubátová et al., 2025; Mohammadi & Mirghaffari, 2026).

The centrality results also showed that analytical thinking had the lowest centrality among the 12 individual indicators, despite having one of the strongest initial states. This finding highlights an important distinction between the current level of a skill and its network significance. A competency may be well developed but relatively less influential in propagating change through the broader system. Analytical thinking is undoubtedly important for technical and professional decision making, but the present network suggests that its effects may be more concentrated within the cognitive and problem-solving dimension than those of broadly relational competencies such as negotiation and emotional intelligence. This interpretation is consistent with research emphasizing that the contemporary labor market increasingly rewards combinations of cognitive, interpersonal, and adaptive capabilities rather than technical-cognitive competence in isolation (Goulart et al., 2022; Poláková et al., 2023; Turcato et al., 2024).

The intervention analysis yielded an even more important practical distinction. Accountability and work ethics, integrity, and professionalism had the greatest direct leverage over the overall concept, followed by emotional intelligence and adaptability. This ranking differed substantially from the centrality ranking. Negotiation, despite having the highest total centrality, ranked only eighth in intervention leverage, while effective communication ranked ninth. Accountability and work ethics, by contrast, ranked first and second in intervention leverage despite occupying lower positions in overall network centrality. This finding demonstrates that structural importance and policy leverage are not equivalent. Centrality measures how extensively a concept is connected within the network, whereas intervention leverage reflects how strongly a controlled change in that concept affects the final outcome through the specific architecture of causal pathways.

The strong leverage of accountability and ethical professionalism is particularly plausible in a tax administration. Tax authorities operate within a domain in which public confidence, fairness, consistency, legal compliance, and institutional legitimacy are central. Ethical conduct and accountability therefore have a short and direct conceptual route to the quality and credibility of tax administration. Research conducted in the context of strategic tax management in the Iranian National Tax Administration has similarly emphasized the importance of justice, institutional conditions, and managerial factors in effective tax administration (Babaei, 2024). In professional tax settings, leadership also requires integrity, judgment, communication, and responsibility beyond numerical or regulatory knowledge (Ishai, 2024). The present findings therefore indicate that interventions targeting accountability and ethical professionalism may produce relatively rapid effects on the overall soft-skills-strengthening outcome because these competencies are closely aligned with the institutional mission of the organization.

Adaptability also ranked highly in intervention leverage, which is consistent with the demands of contemporary digital transformation. Tax administrations increasingly use digital platforms, automated procedures, data analytics, and intelligent systems, requiring employees to adjust continuously to changing processes and technological expectations. Research on Society 5.0, Industry 4.0, and future workforce competencies has consistently identified adaptability, learning capacity, and flexibility as critical capabilities for effective work in technologically evolving environments (Goulart et al., 2022; Lubis & Lubis, 2024; Turcato et al., 2024). Similar evidence from pandemic-related workforce research has shown that resilience and adaptive soft skills become especially important when employees must respond to disruption, uncertainty, and rapidly changing work conditions (Vesolovska & Shved, 2024). The high leverage of adaptability in the present study therefore reflects both the organizational context and broader transformations affecting public administration.

One of the most important findings is that emotional intelligence was the only indicator appearing among the top four in both network centrality and intervention leverage. This dual position makes emotional intelligence a particularly strategic competency. It influences numerous other skills while also producing a comparatively strong direct effect on the overall outcome. From a systems perspective, this means that investment in emotional intelligence may simultaneously strengthen the internal coherence of the soft-skills network and improve the final organizational objective. This finding is consistent with research emphasizing emotional-social intelligence as a central future-work capability in AI-supported human resource systems (Singh & Chouhan, 2023). It also accords

with evidence that human-centered development in increasingly automated workplaces requires employees to retain competencies related to emotion, interpersonal understanding, judgment, and socially intelligent interaction (Kubátová et al., 2025; Mohammadi & Mirghaffari, 2026).

The relatively small absolute intervention effects should also be interpreted carefully. Even the strongest intervention changed the overall concept by less than 0.01 across the full intervention range. This does not indicate that the skills are unimportant. Rather, it reflects the density of the network and the diffusion of influence across many positive pathways. In a highly interconnected system, no single indicator is likely to dominate the overall outcome because numerous other skills simultaneously contribute to the same dimensions and final concept. Similar arguments are implicit in studies that conceptualize soft skills as broad competency portfolios in which organizational outcomes result from combinations rather than isolated characteristics (Espina-Romero et al., 2023; Fantozzi, Di Luozzo, et al., 2024). Consequently, the intervention results are more useful for comparative prioritization than for interpreting absolute effect magnitudes.

The complete absence of negative causal relationships is another noteworthy result. All 16 experts reported zero negative relationships across the modeled links. This implies a shared perception that the selected soft skills operate synergistically and that strengthening one competency does not undermine another. Such a finding is conceptually plausible because the included skills are generally framed as complementary positive capacities. Studies of soft skills in employability, organizational performance, innovation, sustainability, and professional work likewise tend to emphasize complementarity among communication, adaptability, teamwork, responsibility, emotional competence, and problem solving (Awawdeh & Alkshali, 2022; Pons et al., 2024; Villegas, 2024). At the same time, the lack of balancing relationships means that the modeled system contains only reinforcing feedback. This property partially explains the strong increase in steady-state values and the tendency toward saturation under larger threshold-function slopes.

The calibration analysis therefore represented a necessary computational step rather than a cosmetic adjustment. With sigma = 1, the entirely positive and dense network moved rapidly toward complete saturation, eliminating meaningful discrimination among concepts and intervention scenarios. Once the parameter was calibrated to sigma = 0.30, the system generated stable, differentiated outputs, while the rank ordering of intervention effects remained highly consistent throughout the reasonable parameter range from approximately 0.25 to 0.50. This stability strengthens confidence that the substantive conclusions were not artifacts of an arbitrarily selected nonlinear transformation parameter. The dynamic results should therefore be interpreted in terms of relative positions, causal pathways, and comparative intervention priorities rather than as fixed deterministic predictions.

The inter-rater results further support the credibility of the causal structure. Kendall's W for all causal relationships was 0.576, with a highly significant chi-square statistic, while both inter-rater Cronbach's alpha and ICC(2,k) were 0.950. Thus, although the experts were not identical in their judgments, they displayed substantial collective consistency. The relatively lower agreement for relationships among the four broad dimensions is understandable because abstract constructs allow greater interpretive variation than concrete skill-to-skill relationships. Nevertheless, even this section showed statistically significant agreement. The absence of outlier experts and the moderate-to-high correlations between each individual expert profile and the group mean further indicate that the aggregated network was not driven by a small subset of respondents. These results are compatible with the broader methodological logic of expert-based soft-skills research, in which meaningful consensus may coexist with individual variation in judgments about context-sensitive competencies (Aghababaei, 2023; Ijadi, 2025; Rostamzadeh Ganji & Afsharinezhad, 2025).

Overall, the results suggest that soft-skills development in the Iranian National Tax Administration should be understood as a dynamic capability-building process. The most central skills are not necessarily the most powerful short-term intervention points, and the weakest current skills are not necessarily structurally weak. Negotiation and communication contribute heavily to network integration, accountability and professional ethics provide the strongest direct policy leverage, and emotional intelligence occupies the most balanced strategic position across both criteria. This pattern supports the growing view that human resource development in technologically changing organizations should move beyond generic competency lists and adopt integrated, context-sensitive approaches that connect workforce development to organizational systems and strategic outcomes (Jafari et al., 2026; Kubátová et al., 2025). In the tax-administration context, such an approach is especially relevant because technical modernization, taxpayer-centered service, behavioral compliance strategies,

and institutional legitimacy increasingly depend on the quality of human interaction as well as technical capability (Abu Bakar et al., 2023; Dimitrov et al., 2026; Peretiatko, 2025).

The study has several limitations. First, the Dynamic Fuzzy Cognitive Map was constructed from the judgments of 16 experts, and although agreement statistics were strong and no outlier expert was detected, the resulting causal structure remains dependent on the experience and perceptions of this panel. Second, all experts were assigned equal weights, whereas differences in professional experience, organizational position, or domain-specific knowledge could justify alternative weighting schemes. Third, the model was cross-sectional and therefore reflects causal perceptions at a particular point in time rather than their evolution through actual organizational change. Fourth, the complete absence of negative relationships produced a fully reinforcing network and increased the tendency of the dynamic system toward saturation; although parameter calibration addressed the computational consequence of this structure, future empirical observations may reveal balancing, conflicting, or trade-off relationships that were not represented by the expert panel. Fifth, the intervention analysis represents simulated system behavior rather than observed outcomes following real organizational interventions, and its effect sizes should therefore be interpreted comparatively rather than as predictions of exact practical change.

Future studies should replicate the model with larger and more heterogeneous expert panels, including employees from different organizational levels, tax-service units, geographic regions, and specialized functions. Longitudinal designs could repeat the mapping process after training or organizational transformation initiatives to determine whether causal weights and centrality patterns change over time. Future research could also compare equal expert weighting with weighting based on experience, expertise, or organizational role and test the robustness of the resulting intervention priorities. Combining the cognitive map with longitudinal performance indicators, taxpayer satisfaction measures, digital-transformation outcomes, and observed training data would provide a stronger basis for validating the simulated causal relationships. Researchers should also examine alternative activation functions, learning rules, and parameter settings and explicitly investigate whether some soft skills may create trade-offs or nonlinear threshold effects under specific organizational conditions. Comparative studies across tax administrations or other public organizations would further clarify which elements of the network are context-specific and which represent more general patterns of soft-skills development.

For practice, the Iranian National Tax Administration should avoid designing soft-skills programs as isolated training courses with equal emphasis on every competency. Development priorities should instead distinguish between skills that provide direct organizational leverage and skills that strengthen the internal connectivity of the competency system. Accountability and work ethics should receive priority where the objective is rapid improvement in the overall organizational outcome, while negotiation and communication should be emphasized when the objective is to improve coordination and network-wide capability. Emotional intelligence deserves particular attention because it performs strongly on both criteria and can therefore serve as a core element of an integrated development program. Training should combine formal instruction with coaching, behavioral practice, feedback, simulation, and workplace reinforcement, especially for initially weaker competencies such as active listening, negotiation, trust building, and emotional intelligence. Managers should also monitor whether improvements in individual skills are being translated into dimension-level and organization-level capability, because the results indicate that this conversion constitutes an important bottleneck. Finally, soft-skills development should be integrated with digital transformation, managerial evaluation, taxpayer-service improvement, and professional ethics initiatives rather than being managed as a separate human resource activity.

## Authors' Contributions

Authors contributed equally to this article.

## Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

## Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

## Acknowledgments

We would like to express our gratitude to all individuals helped us to do the project.

## Declaration of Interest

The authors report no conflict of interest.

## Funding

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

## Ethics Considerations

In this research, ethical standards including obtaining informed consent, ensuring privacy and confidentiality were considered.

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