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Presentation of an Organizational Ethics Model Based on Society 5.0 in Municipalities

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ABSTRACT

In the digital age and the technological transformations of Society 5.0, municipalities, as key institutions in urban governance, face new challenges in organizational ethics. This study was conducted with the aim of presenting an organizational ethics model based on Society 5.0 in the municipalities of West Azerbaijan, East Azerbaijan, Ardabil, and Zanjan provinces. The research method was designed in a mixed (qualitative–quantitative) form. In the qualitative section, based on the results obtained from the meta-synthesis approach and the systematic review of the existing literature, the dimensions and components of organizational ethics grounded in the requirements of Society 5.0 were identified. Then, the findings were screened and validated using experts' opinions through the fuzzy Delphi method. To analyze causal relationships and prioritize the dimensions, the combined DEMATEL-ANP (DANP) model was applied. The DEMATEL method was used to distinguish cause (influential) and effect (influenced) dimensions, while the ANP (Analytic Network Process) method was used to assign weights and prioritize the criteria, and the conceptual model was presented. Data were collected through questionnaires with input from seven experts in the fields of urban management, organizational ethics, and Society 5.0, and analyzed using MATLAB and Excel software. The findings showed that criteria such as ethical leadership, corporate social responsibility, and social justice have the highest importance within the framework of organizational ethics in municipalities. Moreover, dimensions such as governance and ethics-oriented digital innovation, as well as workplace ethics and organizational culture, were identified as causal influencing factors, whereas dimensions such as citizen participation and inter-organizational cooperation were categorized as effect factors. The results of the study provide a systematic framework for understanding the interactions and hierarchies of organizational ethics dimensions in the context of the smart society and can serve as a scientific–practical basis for policymaking, planning, and improving the performance of municipalities in the path toward sustainable and human-centered development in Society 5.0.

Keywords: Organizational ethics; Society 5.0; DEMATEL technique; Analytic Network Process technique; Municipalities

Introduction

Municipalities today operate at the epicenter of complex value trade-offs: they must safeguard the public interest, accelerate digital transformation, and cultivate an ethical culture that can withstand heightened scrutiny from citizens, regulators, and algorithmic systems alike. The Society 5.0 vision sharpened this challenge by shifting the axis of innovation from technology-centric efficiency to human-centric problem-solving in "super-smart" socio-technical systems, where cyber–physical infrastructures are expected to create inclusive, dignified, and sustainable urban life [1-3]. This orientation reframes municipal ethics from a compliance function to a strategic capability that permeates design, data governance, service delivery, and inter-organizational collaboration across public–private ecosystems [4-6]. Yet translating these aspirations into operational guidance remains difficult: local governments must reconcile political mandates, budget constraints, legacy processes, and evolving community expectations while managing the moral hazards of platformized services and data-driven decision-making [7-9].

A growing body of scholarship highlights ethical leadership as the keystone of this transition, not merely as an individual virtue but as a system property that structures norms, incentives, and routines. Studies in public administration show that leadership behaviors signaling fairness, integrity, and open communication correlate with stronger ethics climates, clearer accountability lines, and better service outcomes in local governments [10-12]. Complementary research connects virtue-based approaches and empowerment dynamics with the risk of "over-empowerment," cautioning that unleashing teams without guardrails can erode responsibility diffusion and ethical deliberation; the remedy is value-explicit governance that balances autonomy with purpose, stewardship, and stakeholder respect [13, 14]. In municipal contexts, where discretionary street-level decisions are frequent, such leadership must institutionalize dialogic accountability—inviting contestability, dissent, and learning—rather than relying solely on codes or punitive controls [4, 7].

The Society 5.0 lens also recasts citizen participation: digital tools enable co-production, yet they may widen inequalities if design neglects accessibility, data justice, and cultural fit. Human-centered, inclusive design approaches emphasize accessibility for older adults and marginalized groups, leveraging assistive and ambient technologies to foster belonging and agency in digital communities [15, 16]. Educational systems play a parallel role by cultivating digital and ethical competencies needed for human-centric innovation, a point underscored by analyses of Society 5.0's educational underpinnings and the ethical formation embedded in curricular and civic learning initiatives [17-19]. Extending this argument to universities, models of human-centered sustainable campuses demonstrate how governance, curriculum, and campus operations can align to socialize future municipal leaders in sustainability, participation, and care ethics [20]. Together, these literatures imply that municipal ethics cannot be separated from a jurisdiction's learning architecture and participatory infrastructures.

Digital transformation magnifies both opportunities and ethical exposure. Research on government digitalization links ethical leadership to dynamic capabilities—sensing, seizing, and reconfiguring—to ensure that data platforms, AI tools, and process automation serve public values rather than eclipse them [9]. The Society 5.0 agenda further demands cross-functional "design-in-law" mindsets in which legal norms are made legible, embedded, and usable in everyday services, decreasing discretional opacity and strengthening rights-conscious design [16]. Concurrently, human-centered AI approaches emphasize transparency, explainability, and stakeholder participation as conditions for legitimacy and sustainable development alignment, placing municipal data governance at the heart of ethics practice [2]. For municipalities experimenting with Construction 5.0 and resilient, sustainable infrastructure, a similar logic holds: technology enablers must be integrated with human-centricity and ethical risk management to avoid techno-solutionism and rebound effects [6]. Hence, governance capabilities—policy coherence, role clarity, inter-departmental learning, and boundary-spanning partnerships—are as critical as technical prowess [3, 5].

At the organizational level, ethics must diffuse beyond codes into management systems that align vision, measurement, and routines. Studies on pervasive ethics describe processes by which ethics becomes "lived" across strategy, HR, procurement, and service design—supported by training, open dialogue, and embedded reflection practices [14]. Municipalities that formalize ethics management as an integral system—linking leadership, evaluation, reporting, and community interface—can reduce fragmentation and strengthen trust [21]. Empirical investigations of ethics culture frameworks in local governments offer practical diagnostics—clarifying norms, leadership signals, peer reinforcement, and procedural justice—as precursors to improved performance and legitimacy [7, 8]. In parallel, sector-specific research on accounting judgements and marketing ethics underscores how professional norms and market pressures shape ethical sensitivity, suggesting that municipal financial reporting, public communications, and digital engagement demand tailored safeguards against rationalization and moral disengagement [22, 23].

Capacity building remains a persistent constraint. Municipal employees face competing expectations, politicized environments, and ambiguous policy signals. Evidence from ethics programs in ministries and municipal contexts indicates that culturally grounded frameworks—whether Islamic-inspired ethics architectures or rural-development-oriented evaluation models—can resonate with frontline staff and bridge the rhetoric–practice gap when coupled with transparent performance systems and participatory oversight [24, 25]. Comparative work on government ethics similarly stresses the basics—rule of law, merit systems, and integrity mechanisms—while warning that formalistic controls without cultural change may yield compliance theater rather than integrity [26, 27]. Trust and coordination in local government relations—both with citizens and inter-organizational partners—are fragile assets that depend on fairness in procedures, reliability in commitments, and reciprocity norms cultivated over time [28]. Scholarship on interpersonal citizenship behaviors in the public sector adds that micro-ethics—respect, support, and discretionary helping—mediate between leadership signals and collective performance, making “everyday ethics” a strategic lever [10].

The external environment compounds these internal demands. SMEs and contractors partnering with municipalities confront Industry 4.0 disruptions—cybersecurity risks, interoperability challenges, workforce reskilling needs—that spill over into municipal supply chains and service ecosystems [29]. Without ethical criteria for vendor selection, data sharing, and algorithmic accountability, governments risk value capture by vendors and erosion of public trust. Literature on humanists in Society 5.0 and interdisciplinary approaches warns that technical rationality alone cannot adjudicate contested values; pluralist, humanities-informed deliberation is necessary to navigate competing goods and harms in smart-city projects [30]. Likewise, ethical decision-making theories remind managers to balance utilitarian, deontological, and virtue considerations when facing globalized pressures, time scarcity, and information asymmetries—conditions typical of municipal crisis response and procurement [31]. In many jurisdictions, service-delivery pressures and political volatility can tempt short-cuts; case evidence from municipalities links ethical leadership deficits to service failures, while strengthening ethics correlates with improved responsiveness and citizen satisfaction [12, 26, 32].

Culture and education are durable pathways for institutionalizing ethics. Research on ethics education in Society 5.0 contexts points to curriculum that integrates digital literacy, sustainability, and moral reasoning, producing professionals capable of negotiating AI-mediated dilemmas and socio-technical complexity [17, 18]. Law-in-design initiatives propose approachable legal models that translate abstract rules into practical artifacts for users and implementers, which can help municipalities make transparency and accountability tangible in service journeys [16]. At the same time, global and comparative perspectives in Islamic civilization studies and human-centered university governance remind us that values pluralism and cultural narratives shape how ethical frameworks are interpreted and enacted locally—an essential insight for multi-ethnic cities and diverse stakeholder coalitions [19, 20]. When combined with governance structures that reward ethical behavior and sanction misconduct, these cultural investments create a reinforcing loop between values, capabilities, and outcomes [8, 11].

Operationalizing this agenda requires instruments that link vision to measurement and continuous improvement. Ethics evaluation models tailored to public organizations—featuring indicators for leadership, transparency, stakeholder engagement, fairness, and social responsibility—offer a scaffold for diagnosis, benchmarking, and learning [21, 25]. In municipalities moving toward Society 5.0, such models should be extended to include digital ethics (e.g., data governance, algorithmic impact, cybersecurity), co-production quality (e.g., inclusion, representativeness), and ecological stewardship (e.g., climate resilience, circularity) [1, 5, 6]. Emerging work on ethical leadership in digital transformation underscores the need to couple these metrics with dynamic capabilities—scan risks, experiment safely, pivot based on feedback—so ethics becomes adaptive rather than static [9]. Moreover, public-sector studies of ethics culture caution against “checkbox” approaches; leaders must routinely revisit dilemmas, recognize gray zones, and integrate citizen voice to prevent ritualism and value drift [4, 8].

In this study, we synthesize these streams to propose and empirically prioritize a Society 5.0–aligned organizational ethics model for municipalities. Building blocks include ethical leadership that shapes climate and behavior [10, 11, 33, 34], transparency and accountability that enable trust and coordination [27, 28], social justice commitments that center vulnerable populations in digital services [2, 4], and workplace ethics that embed fairness and care into daily routines [14, 35]. The model further integrates sustainability obligations and inter-organizational cooperation critical to smart-city ecosystems [5, 6], while recognizing that municipal ethics cultures emerge from iterative learning, virtue cultivation, and context-sensitive frameworks rather than one-size-fits-all prescriptions [13, 24]. Finally, comparative public-sector evidence and regional analyses of moral foundations among municipal employees underscore that legitimacy, performance, and ethics are mutually reinforcing—when supported by coherent governance and human-centric design [7, 26, 30, 36].

By drawing together insights from organizational ethics, public administration, digital governance, education, and sustainability, the present research addresses a pressing gap: municipalities need an actionable, prioritized roadmap that aligns ethical leadership, culture, and digital innovation with Society 5.0’s human-centric promise.

Methodology

This study was conducted with the aim of presenting an organizational ethics model within the framework of Society 5.0 in municipalities, using a mixed qualitative–quantitative approach. The applied methodological model consisted of two main phases: a qualitative phase for extracting and validating the dimensions and components of organizational ethics, and a quantitative phase for structural analysis, determining causal relationships, and final weighting of the criteria. In the qualitative section, the meta-synthesis method was employed to systematically review domestic and international scientific literature and extract key concepts of organizational ethics consistent with the requirements of Society 5.0. Subsequently, using the Fuzzy Delphi Method, the findings were validated, and a comprehensive conceptual framework of organizational ethics in municipalities was developed. This phase led to the identification of 13 main dimensions and 46 key components in the field of organizational ethics in municipalities, which were then used in the quantitative phase.

In the quantitative phase, a combination of DEMATEL and ANP (DANP model) was applied to analyze causal relationships and determine structural priorities among the identified components. Specifically, DEMATEL was first used to determine cause–effect relationships among the components and to map their network structure. Then, based on the results obtained from DEMATEL, the ANP method was employed to calculate the final weights of the dimensions and to provide a more precise prioritization of the components, which ultimately led to the presentation of the conceptual model. Data were collected via questionnaires from seven experts in the fields of urban management, organizational ethics, and Society 5.0, and the analysis was carried out using MATLAB 2024 and Excel 2024 software. This research approach provided a systematic framework for understanding the interactions and hierarchies of organizational ethics dimensions in municipalities, contributed to the advancement of both theoretical and practical insights in urban management within the context of the smart society, and produced findings that can serve as a scientific and practical basis for policymaking, planning, and improving the performance of municipalities in the path toward smart and human-centered development in Society 5.0.

- **Objective:** Extracting the dimensions and components of organizational ethics based on Society 5.0.
- **Method:** Systematic review of research literature (meta-synthesis) and validation through the Fuzzy Delphi Method.
- **Output:** A list of validated components to be used as inputs in subsequent stages.
- **Result:** The implementation of meta-synthesis and the Fuzzy Delphi Method led to the extraction and final validation of the following dimensions and components.

The DEMATEL method (Decision Making Trial and Evaluation Laboratory) is one of the multi-criteria decision-making techniques designed to analyze the structural cause–effect relationships among the factors of a complex system. This method was first developed by the Battelle Memorial Institute in the 1970s to address complex and interdisciplinary problems.

In DEMATEL, using experts' opinions and pairwise comparison matrices, the degree of influence and dependence of each factor on the others is determined. Then, through normalization and matrix calculations, a network of relationships among the factors is constructed, in which the factors are classified into two categories: causal (cause) and effect. This analysis helps decision-makers identify the key influential factors and place greater focus on them in policymaking and planning.

The Analytic Network Process (ANP) is an advanced multi-criteria decision-making technique designed to prioritize options or factors in complex problems with internal relationships and interdependencies among the criteria. Unlike the Analytic Hierarchy Process (AHP), which assumes independence among criteria, ANP considers a network structure of interactions in which criteria can influence one another and even their sub-criteria. In this method, a network of elements (criteria and sub-criteria) is first designed, and then pairwise comparisons between them are conducted to determine the relative priority of each element. Afterwards, a supermatrix is constructed to combine the weights and interactions, and finally, by converting the supermatrix into the limit supermatrix, the final weight of each option or criterion is extracted. In summary, ANP is a powerful tool for decision-making in real-world conditions with complex, circular, and interactive relationships among factors.

In multi-criteria decision-making approaches, the DEMATEL technique serves as a powerful tool for identifying the structure of cause–effect relationships among variables. This method can specify which variables are influential (causal), which are influenced (effect), and which are linking variables that simultaneously play the role of sender and receiver of information. In other words, DEMATEL maps out the network of interactions among different dimensions and quantitatively presents the degree of influence each factor exerts on the others. Integrating DEMATEL with the Analytic Network Process (ANP) provides a significant advantage in managerial analyses by allowing the final prioritization of criteria under conditions of interdependency among them. In this integration, DEMATEL first generates the total influence matrix, which depicts the network structure and intensity of effects among criteria and sub-criteria. Then, this structure is transferred as input to the ANP model, where the final weights of the criteria are calculated based on the identified interdependencies and relative importance. Functionally, DEMATEL is limited to mapping cause–effect relationships and cannot independently determine the final weights of criteria, while ANP assumes a predefined network structure of relationships. By combining the two methods, DEMATEL produces the total influence matrix, which then serves as the foundation for constructing the supermatrix in ANP. Finally, the ultimate weights of the criteria are computed, considering their interdependencies and relative importance. This synergy between DEMATEL and ANP offers a precise, comprehensive, and structured analysis of the relationships among factors and guides the decision-making process based on data and the real interactions between variables.

Findings and Results

Based on the degree of influence of each component on the other components (0: no influence, 1: low, 2: medium, 3: high, 4: very high).

After identifying the dimensions and components, a pairwise comparison questionnaire was prepared in which each dimension was compared with the others. In this questionnaire, respondents were asked to specify the degree of influence of each dimension on another dimension using a numerical scale from 0 to 4.

The experts of this study are individuals specialized in organizational ethics and urban management (municipalities). This group included municipal managers, professionals in the field of professional ethics, and university faculty members. The number of experts in this study was determined to be 7. Based on methodological studies, for applying the DEMATEL technique, at least 5 to 10 experts are considered suitable to achieve sufficient validity and consensus in the data. Therefore, the selection of 7 experts in this study was made according to the framework proposed by scientific sources and with the aim of balancing data quality with data manageability.

Table 1

Characteristics of the Expert Panel in the Field of Municipalities, Organizational Ethics, and Society 5.0 Using the DEMATEL and ANP Methods

No.	Teaching or Executive Experience	Educational Qualification	Academic Membership / Executive Background
1	27 years of executive and teaching experience	PhD in Technology Management	Faculty member of the Industrial Management Organization, former CEO of the Industrial Management Organization
2	23 years of teaching in management	PhD in Public Administration	Faculty member, Islamic Azad University
3	20 years of teaching experience	PhD in Public Administration	Faculty member, Jahad-e-Daneshgahi
4	25 years of teaching and research experience	PhD in Public Administration	Faculty member, Islamic Azad University
5	35 years of executive experience	PhD in Public Administration	Former head of the Organization of Municipalities and Rural Affairs
6	30 years of executive experience	PhD in Management	Deputy of Urban Services, Municipality
7	18 years of research and executive experience	PhD in Urban Planning	Municipal researcher, mayor’s consultant

Collection of expert opinions: The prepared questionnaires were physically delivered to the experts and relevant specialists so that they could provide their opinions on the degree of influence of each criterion on the others.

Aggregating opinions and constructing the final direct-relation matrix.

To obtain a comprehensive matrix representing the opinions of all experts, the arithmetic mean of their responses was calculated. After collecting the responses for each cell of the matrix, the average of the experts’ responses was computed.

Table 2

Aggregation of Expert Opinions and Formation of the Final Direct-Relation Matrix

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	Row Sum
C1	0.00	3.50	3.40	1.50	2.90	2.60	3.40	1.20	3.00	0.60	1.60	0.50	0.70	24.90
C2	0.60	0.00	3.01	0.70	1.20	1.80	3.50	1.20	0.80	0.50	3.50	0.30	0.20	17.31
C3	3.20	3.00	0.00	1.30	2.80	2.60	3.60	1.00	3.20	1.10	3.20	0.90	0.50	26.40
C4	0.30	3.20	1.10	0.00	1.30	1.30	1.50	1.70	2.00	0.74	1.80	0.90	0.10	15.94
C5	3.00	3.10	2.70	2.40	0.00	2.66	2.90	2.90	1.70	0.13	1.60	3.30	0.70	27.09
C6	3.40	3.40	2.86	3.10	2.80	0.00	2.90	2.70	3.30	0.54	2.30	0.20	0.10	27.60
C7	1.20	0.40	0.30	0.20	0.40	0.70	0.00	0.60	1.20	0.43	1.30	0.30	0.25	7.28
C8	0.20	1.20	0.40	0.33	0.40	0.44	0.56	0.00	0.91	0.47	0.98	0.25	0.67	6.81
C9	0.90	1.40	1.40	0.45	0.67	0.35	0.67	0.48	0.00	0.39	0.81	0.86	0.79	9.17
C10	1.10	0.90	2.01	0.93	0.98	0.83	1.04	1.06	1.45	0.00	1.69	1.89	1.97	15.85
C11	1.20	0.40	0.34	0.11	0.14	1.20	0.91	0.19	0.40	0.16	0.00	0.73	0.71	6.49
C12	0.20	0.30	0.40	1.80	0.50	0.30	0.40	0.33	0.49	0.24	0.59	0.00	3.20	8.75
C13	0.70	1.60	0.76	0.56	0.72	0.86	0.63	1.54	0.89	0.31	1.00	3.40	0.00	12.97
Col Sum	16.00	22.40	18.68	13.38	14.81	15.64	22.01	14.90	19.34	5.61	20.37	13.53	9.89	27.60

Formula for normalizing the direct-relation matrix in the DEMATEL method (Gabus & Fontela, 1976):

$$\max\left(\max_{i}\sum_{j=1}^{n} x_{ij},\ \max_{j}\sum_{i=1}^{n} x_{j}\right) = s$$

Where xij represents the degree of influence of criterion i on criterion j, and s is the maximum of the row sum or column sum of the matrix. Then, the normalized matrix is calculated from the relation X = 1/s, in which all values fall within the range between 0 and 1.

Table 3

Normalized Direct-Relation Matrix

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13
C1	0.0000	0.1268	0.1232	0.0543	0.1051	0.0942	0.1232	0.0435	0.1087	0.0217	0.0580	0.0181	0.0254
C2	0.0217	0.0000	0.1091	0.0254	0.0435	0.0652	0.1268	0.0435	0.0290	0.0181	0.1268	0.0109	0.0072
C3	0.1159	0.1087	0.0000	0.0471	0.1014	0.0942	0.1304	0.0362	0.1159	0.0399	0.1159	0.0326	0.0181
C4	0.0109	0.1159	0.0399	0.0000	0.0471	0.0471	0.0543	0.0616	0.0725	0.0268	0.0652	0.0326	0.0036
C5	0.1087	0.1123	0.0978	0.0870	0.0000	0.0964	0.1051	0.1051	0.0616	0.0047	0.0580	0.1196	0.0254
C6	0.1232	0.1232	0.1036	0.1123	0.1014	0.0000	0.1051	0.0978	0.1196	0.0196	0.0833	0.0072	0.0036
C7	0.0435	0.0145	0.0109	0.0072	0.0145	0.0254	0.0000	0.0217	0.0435	0.0156	0.0471	0.0109	0.0091
C8	0.0072	0.0435	0.0145	0.0120	0.0145	0.0159	0.0203	0.0000	0.0330	0.0170	0.0355	0.0091	0.0243
C9	0.0326	0.0507	0.0507	0.0163	0.0243	0.0127	0.0241	0.0174	0.0000	0.0141	0.0293	0.0312	0.0286
C10	0.0399	0.0326	0.0728	0.0337	0.0355	0.0301	0.0377	0.0384	0.0525	0.0000	0.0612	0.0685	0.0714
C11	0.0435	0.0145	0.0123	0.0040	0.0051	0.0435	0.0330	0.0069	0.0145	0.0058	0.0000	0.0264	0.0257
C12	0.0072	0.0109	0.0145	0.0652	0.0181	0.0109	0.0145	0.0120	0.0178	0.0087	0.0214	0.0000	0.1159
C13	0.0254	0.0580	0.0275	0.0203	0.0261	0.0312	0.0228	0.0558	0.0322	0.0112	0.0362	0.1232	0.0000

The total-relation matrix is computed from the relation: T = N × (I − N)^−1. In this relation, I is the identity matrix.

The total-relation matrix (T) reflects the sum of direct and indirect effects among the criteria and reveals a comprehensive structure of the system's causal interactions. This matrix is obtained by aggregating the normalized matrix (N) and its successive powers until convergence is reached. In the calculation process, the identity matrix (I) is first subtracted from the normalized matrix, and then the inverse of the difference (I − N) is computed. The result of this operation is finally multiplied by the normalized matrix, and the total-relation matrix is derived as follows: T = N × (I − N)^−1.

For the above computation to be valid, the matrix (I − N) must have certain properties: first, the matrix in question must be square (that is, it must have an equal number of rows and columns), and second, its determinant must be nonzero; otherwise, it is not possible to compute the inverse and the process will face a computational dead end. Satisfying these conditions ensures that the results obtained for T present an accurate and valid picture of causal relationships and interactions among the criteria (Gabus & Fontela, 1972).

Table 4.

Total-Relation Matrix (T)

T	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	D
C1	0.1132	0.2596	0.2365	0.1345	0.1963	0.1946	0.2690	0.1347	0.2270	0.0591	0.1935	0.0893	0.0723	2.1795
C2	0.0980	0.0883	0.1744	0.0761	0.1040	0.1309	0.2165	0.0989	0.1102	0.0426	0.2080	0.0551	0.0392	1.4420
C3	0.2189	0.2434	0.1264	0.1288	0.1929	0.1954	0.2747	0.1280	0.2337	0.0751	0.2437	0.1036	0.0697	2.2343
C4	0.0724	0.1864	0.1087	0.0462	0.0982	0.1045	0.1388	0.1112	0.1369	0.0477	0.1433	0.0717	0.0351	1.3012
C5	0.2076	0.2491	0.2129	0.1682	0.1009	0.1959	0.2512	0.1912	0.1861	0.0444	0.1930	0.1804	0.0815	2.2623
C6	0.2285	0.2696	0.2282	0.1903	0.1998	0.1158	0.2626	0.1897	0.2460	0.0603	0.2246	0.0818	0.0553	2.3525
C7	0.0712	0.0533	0.0451	0.0299	0.0413	0.0533	0.0404	0.0456	0.0762	0.0254	0.0809	0.0306	0.0245	0.6177
C8	0.0330	0.0742	0.0438	0.0309	0.0366	0.0407	0.0557	0.0221	0.0603	0.0258	0.0682	0.0284	0.0373	0.5569
C9	0.0703	0.0992	0.0923	0.0460	0.0595	0.0522	0.0793	0.0498	0.0448	0.0279	0.0790	0.0582	0.0486	0.8072
C10	0.0995	0.1120	0.1350	0.0808	0.0896	0.0889	0.1189	0.0892	0.1209	0.0219	0.1346	0.1137	0.1050	1.3100
C11	0.0707	0.0525	0.0453	0.0280	0.0330	0.0690	0.0716	0.0318	0.0488	0.0157	0.0348	0.0446	0.0399	0.5857
C12	0.0362	0.0555	0.0473	0.0868	0.0451	0.0411	0.0543	0.0427	0.0532	0.0201	0.0600	0.0329	0.1296	0.7047
C13	0.0678	0.1136	0.0774	0.0594	0.0659	0.0736	0.0845	0.0929	0.0824	0.0275	0.0932	0.1513	0.0334	1.0229
R	1.3873	1.8569	1.5734	1.1058	1.2628	1.3559	1.9175	1.2279	1.6264	0.4936	1.7567	1.0416	0.7713	

- Determining indices of influence and being influenced.
- Calculating the degree of influence and susceptibility of each component (D + R and D − R).
- Determining the threshold.
- Plotting the causal diagram.
- DEMATEL output: identifying causal (influencing) and effect (influenced) components.

For each dimension, the influence index (D) (row sums of the total-relation matrix) and the susceptibility index (R) (column sums of the total-relation matrix) were calculated.

Table 5.

Degree of Influence and Susceptibility of Each Component (D + R and D − R) and Cause/Effect Factors

Type	D (Influence Index)	R (Susceptibility Index)	X-Axis (D + R)	Y-Axis (D − R)	Dimension	Code
Influential	2.1795	1.3873	3.5668	0.7922	Ethical Leadership	C1
Influenced	1.4420	1.8569	3.2989	−0.4148	Transparency and Accountability	C2
Influential	2.2343	1.5734	3.8077	0.6610	Social Justice	C3
Influential	1.3012	1.1058	2.4070	0.1954	Governance and Ethics-Oriented Digital Innovation	C4
Influential	2.2623	1.2628	3.5252	0.9995	Workplace Ethics and Organizational Culture	C5
Influential	2.3525	1.3559	3.7083	0.9966	Corporate Social Responsibility	C6
Influenced	0.6177	1.9175	2.5353	−1.2998	Citizen Participation	C7
Influenced	0.5569	1.2279	1.7848	−0.6709	Inter-Organizational Cooperation	C8
Influenced	0.8072	1.6264	2.4336	−0.8192	Ethics in Public Policy-Making	C9
Influential	1.3100	0.4936	1.8036	0.8164	Sustainable Development and Environmental Protection	C10
Influenced	0.5857	1.7567	2.3424	−1.1710	Development of Human Resources and Employee Well-being	C11
Influenced	0.7047	1.0416	1.7464	−0.3369	Digital Agility	C12
Influential	1.0229	0.7713	1.7943	0.2516	Smart Process Reengineering	C13

- Causal: C4, C5, C10, C13.
- Bridging: C1, C2, C3, C6 (both D and R are above the mean).
- Effect: C7, C8, C9, C11, C12.

Figure 1.

Diagram of relationships among dimensions with an influence threshold greater than 0.10 derived from the total influence matrix.

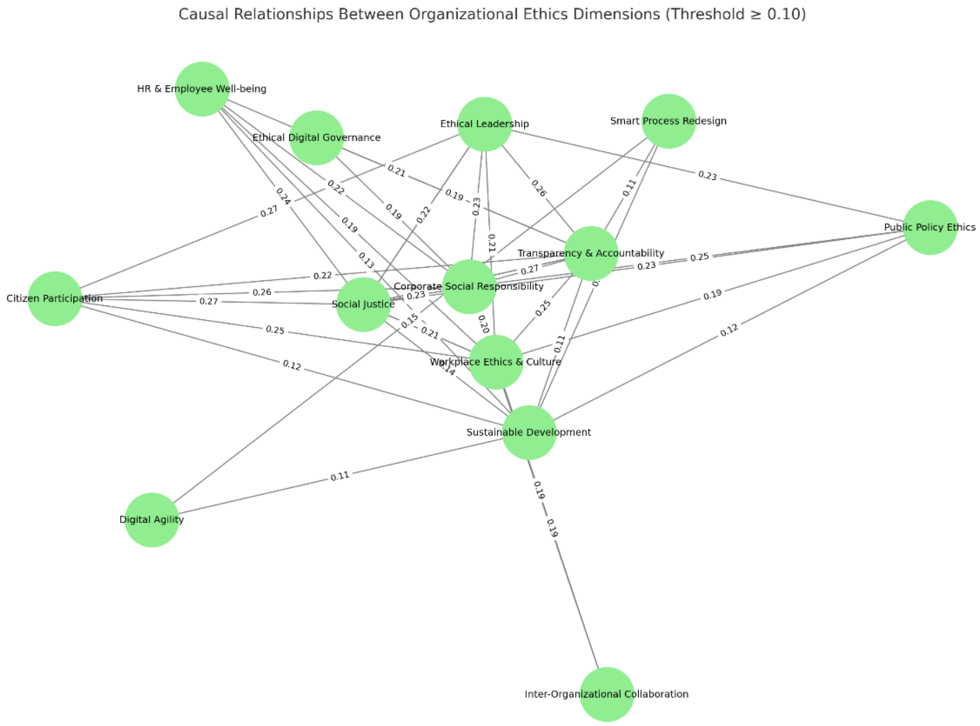
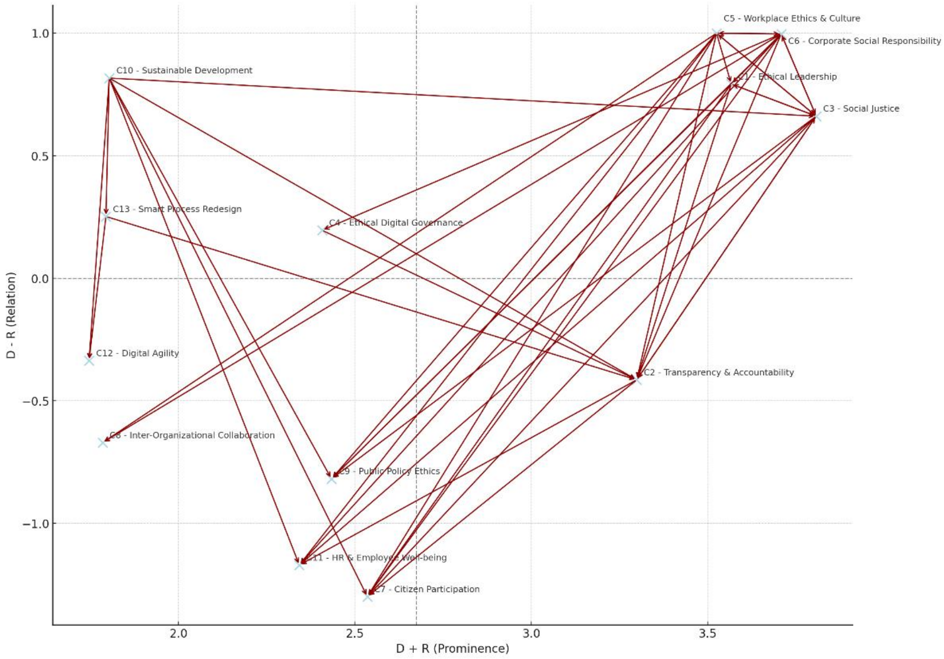


Figure 2.

Causal–effect diagram.



In this study, the DEMATEL model variables were classified into three groups based on the influence (D) and susceptibility (R) indices: causal variables include C4, C5, C10, and C13, with positive D − R and greater influence than susceptibility, acting as sources of change and driving factors. Effect variables include C7, C8, C9, C11, and C12, with negative D − R, which are more influenced by other variables than they influence others and thus appear as system outcomes. In contrast, bridging variables—namely C1, C2, C3, and C6—have D and R values above the mean (1.33), indicating high interaction both as receivers and senders. Due to their dual position, this group of variables typically shows unstable and sensitive behavior.

Causal relationships among these dimensions were extracted from the total influence matrix (T) with an influence threshold of 0.10, and based on that, the two-dimensional DEMATEL diagram was plotted. In this diagram, the horizontal axis (D − R) denotes the causal or effect role, and the vertical axis (D + R) represents the intensity of the systematic interaction of each dimension, ultimately providing a clear structure of relationships among organizational ethics components in the context of Society 5.0.

Step one: extracting clusters.

Dividing the criteria into logical clusters based on their causal relationships using matrix (T).

How to divide the criteria into two groups:

In DEMATEL:

• Each criterion has an influence index (D) and a susceptibility index (R).

• By computing D − R, the role of each criterion can be determined:

Table 6.

Method for Determining Clusters

Cluster	Criteria	Count	Condition
Causal	C4, C5, C10, C13	4	D − R > 0 and R < 1.33
Effect	C7, C8, C9, C11, C12	5	D − R < 0
Bridging	C1, C2, C3, C6	4	D > 1.33 and R > 1.33

Wij: the submatrix of T that shows how the criteria of cluster j affect the criteria of cluster i. These values are taken directly from matrix T (without numerical modification).

Table 7.

General Structure of the Clustered Supermatrix

W=	W_{11}	W_{12}	W_{13}
	W_{21}	W_{22}	W_{23}
	W_{31}	W_{32}	W_{33}

Table 8.

Clustered Supermatrix

W11

	C1	C2	C3	C6
C1	0.1132	0.2596	0.2365	0.1946
C2	0.0980	0.0883	0.1744	0.1309
C3	0.2189	0.2434	0.1264	0.1954
C6	0.2285	0.2696	0.2282	0.1158

W12

	C4	C5	C10	C13
C1	0.1345	0.1963	0.0591	0.0723

C2	0.0761	0.1040	0.0426	0.0392
C3	0.1288	0.1929	0.0751	0.0697
C6	0.1903	0.1998	0.0603	0.0553

W13

	C7	C8	C9	C11	C12
C1	0.2690	0.1347	0.2270	0.1935	0.0893
C2	0.2165	0.0989	0.1102	0.2080	0.0551
C3	0.2747	0.1280	0.2337	0.2437	0.1036
C6	0.2626	0.1897	0.2460	0.2246	0.0818

W21

	C1	C2	C3	C6
C4	0.0724	0.1864	0.1087	0.1045
C5	0.2076	0.2491	0.2129	0.1959
C10	0.0995	0.1120	0.1350	0.0889
C13	0.0678	0.1136	0.0774	0.0736

W22

	C4	C5	C10	C13
C4	0.0462	0.0982	0.0477	0.0351
C5	0.1682	0.1009	0.0444	0.0815
C10	0.0808	0.0896	0.0219	0.1050
C13	0.0594	0.0659	0.0275	0.0334

W23

	C7	C8	C9	C11	C12
C4	0.1388	0.1112	0.1369	0.1433	0.0717
C5	0.2512	0.1912	0.1861	0.1930	0.1804
C10	0.1189	0.0892	0.1209	0.1346	0.1137
C13	0.0845	0.0929	0.0824	0.0932	0.1513

W31

	C1	C2	C3	C6
C7	0.0712	0.0533	0.0451	0.0533
C8	0.0330	0.0742	0.0438	0.0407
C9	0.0703	0.0992	0.0923	0.0522
C11	0.0707	0.0525	0.0453	0.0690
C12	0.0362	0.0555	0.0473	0.0411

W32

	C4	C5	C10	C13
C7	0.0299	0.0413	0.0254	0.0245
C8	0.0309	0.0366	0.0258	0.0373
C9	0.0460	0.0595	0.0279	0.0486
C11	0.0280	0.0330	0.0157	0.0399
C12	0.0868	0.0451	0.0201	0.1296

W33

	C7	C8	C9	C11	C12
C7	0.0404	0.0456	0.0762	0.0809	0.0306
C8	0.0557	0.0221	0.0603	0.0682	0.0284
C9	0.0793	0.0498	0.0448	0.0790	0.0582
C11	0.0716	0.0318	0.0488	0.0348	0.0446
C12	0.0543	0.0427	0.0532	0.0600	0.0329

Within-cluster comparisons

• For each cluster, the elements inside it are compared with one another.

Between-cluster comparisons

• Based on the network structure (from DEMATEL), it is determined which cluster affects which other cluster.

• Then, the relative importance of one cluster in influencing another is evaluated using Saaty’s scale.

These blocks are now ready to be combined into a 13 × 13 matrix.

Table 9.

Unweighted Supermatrix

	C1	C2	C3	C6	C4	C5	C10	C13	C7	C8	C9	C11	C12
C1	0.113	0.260	0.237	0.195	0.135	0.196	0.059	0.072	0.269	0.135	0.227	0.194	0.089
C2	0.098	0.088	0.174	0.131	0.076	0.104	0.043	0.039	0.217	0.099	0.110	0.208	0.055
C3	0.219	0.243	0.126	0.195	0.129	0.193	0.075	0.070	0.275	0.128	0.234	0.244	0.104
C6	0.229	0.270	0.228	0.116	0.190	0.200	0.060	0.055	0.263	0.190	0.246	0.225	0.082
C4	0.072	0.186	0.109	0.105	0.046	0.098	0.048	0.035	0.139	0.111	0.137	0.143	0.072
C5	0.208	0.249	0.213	0.196	0.168	0.101	0.044	0.082	0.251	0.191	0.186	0.193	0.180
C10	0.100	0.112	0.135	0.089	0.081	0.090	0.022	0.105	0.119	0.089	0.121	0.135	0.114
C13	0.068	0.114	0.077	0.074	0.059	0.066	0.028	0.033	0.085	0.093	0.082	0.093	0.151
C7	0.071	0.053	0.045	0.053	0.030	0.041	0.025	0.025	0.040	0.046	0.076	0.081	0.031
C8	0.033	0.074	0.044	0.041	0.031	0.037	0.026	0.037	0.056	0.022	0.060	0.068	0.028
C9	0.070	0.099	0.092	0.052	0.046	0.060	0.028	0.049	0.079	0.050	0.045	0.079	0.058
C11	0.071	0.053	0.045	0.069	0.028	0.033	0.016	0.040	0.072	0.032	0.049	0.035	0.045
C12	0.036	0.056	0.047	0.041	0.087	0.045	0.020	0.130	0.054	0.043	0.053	0.060	0.033

Formula for computing the global weight (Tzeng & Huang, 2011; Tzeng, Chiang, & Li, 2007):

$$w_i = \frac{D_i + R_i}{\sum_{=1}^{n} (D_i + R_i)}$$

Table 10.

Computing the Global Weight

	D+R	Global Weight (Wi)
C1	3.5668	0.1026
C2	3.2989	0.0949
C3	3.8077	0.1096
C4	2.4070	0.0693
C5	3.5252	0.1014
C6	3.7083	0.1067
C7	2.5353	0.0729
C8	1.7848	0.0514
C9	2.4336	0.0700
C10	1.8036	0.0519
C11	2.3424	0.0674
C12	1.7464	0.0502
C13	1.7943	0.0516
	34.7542	

Weights relative to their clusters:

C1 C2 C3 C6 C4 C5 C10 C13 C7 C8 C9 C11 C12

Cluster weight—Bridging: 14.382 (WEIGHT 0.414)

Cluster weight—Causal: 9.530 (WEIGHT 0.274)

Cluster weight—Effect: 10.842 (WEIGHT 0.312)

SUM WEIGHT SUM WEIGHT SUM WEIGHT

Table 11.

Cluster Global-Weight Multiplication (Cluster-by-Cluster)

	0.414	0.274	0.312
	C1	C2	C3
C1	0.1132	0.2596	0.2365
C2	0.0980	0.0883	0.1744

C3	0.2189	0.2434	0.1264
C6	0.2285	0.2696	0.2282
C4	0.0724	0.1864	0.1087
C5	0.2076	0.2491	0.2129
C10	0.0995	0.1120	0.1350
C13	0.0678	0.1136	0.0774
C7	0.0712	0.0533	0.0451
C8	0.0330	0.0742	0.0438
C9	0.0703	0.0992	0.0923
C11	0.0707	0.0525	0.0453
C12	0.0362	0.0555	0.0473

Table 12.

Weighted Supermatrix

	C1	C2	C3	C6	C4	C5	C10	C13	C7	C8	C9	C11	C12
C1	0.047	0.107	0.098	0.081	0.037	0.054	0.016	0.020	0.084	0.042	0.071	0.060	0.028
C2	0.041	0.037	0.072	0.054	0.021	0.029	0.012	0.011	0.068	0.031	0.034	0.065	0.017
C3	0.091	0.101	0.052	0.081	0.035	0.053	0.021	0.019	0.086	0.040	0.073	0.076	0.032
C6	0.095	0.112	0.094	0.048	0.052	0.055	0.017	0.015	0.082	0.059	0.077	0.070	0.026
C4	0.030	0.077	0.045	0.043	0.013	0.027	0.013	0.010	0.043	0.035	0.043	0.045	0.022
C5	0.086	0.103	0.088	0.081	0.046	0.028	0.012	0.022	0.078	0.060	0.058	0.060	0.056
C10	0.041	0.046	0.056	0.037	0.022	0.025	0.006	0.029	0.037	0.028	0.038	0.042	0.035
C13	0.028	0.047	0.032	0.030	0.016	0.018	0.008	0.009	0.026	0.029	0.026	0.029	0.047
C7	0.029	0.022	0.019	0.022	0.008	0.011	0.007	0.007	0.013	0.014	0.024	0.025	0.010
C8	0.014	0.031	0.018	0.017	0.008	0.010	0.007	0.010	0.017	0.007	0.019	0.021	0.009
C9	0.029	0.041	0.038	0.022	0.013	0.016	0.008	0.013	0.025	0.016	0.014	0.025	0.018
C11	0.029	0.022	0.019	0.029	0.008	0.009	0.004	0.011	0.022	0.010	0.015	0.011	0.014
C12	0.015	0.023	0.020	0.017	0.024	0.012	0.006	0.036	0.017	0.013	0.017	0.019	0.010

To convert the weighted supermatrix into the limit supermatrix, this matrix was raised to higher powers (for example, W^k as k approaches infinity) until a steady (limit) state was reached. In practice, this is done by repeatedly multiplying the matrix by itself until the columns converge and no longer change.

Table 13.

Limit Supermatrix

	C1	C2	C3	C6	C4	C5	C10	C13	C7	C8	C9	C11	C12
C1	0.1862	0.1204	0.1785	0.1823	0.0987	0.1701	0.0752	0.0678	0.0421	0.0331	0.0519	0.0378	0.0359
C2	0.1862	0.1204	0.1785	0.1823	0.0987	0.1701	0.0752	0.0678	0.0421	0.0331	0.0519	0.0378	0.0359
C3	0.1862	0.1204	0.1785	0.1823	0.0987	0.1701	0.0752	0.0678	0.0421	0.0331	0.0519	0.0378	0.0359
C6	0.1862	0.1204	0.1785	0.1823	0.0987	0.1701	0.0752	0.0678	0.0421	0.0331	0.0519	0.0378	0.0359
C4	0.1862	0.1204	0.1785	0.1823	0.0987	0.1701	0.0752	0.0678	0.0421	0.0331	0.0519	0.0378	0.0359
C5	0.1862	0.1204	0.1785	0.1823	0.0987	0.1701	0.0752	0.0678	0.0421	0.0331	0.0519	0.0378	0.0359
C10	0.1862	0.1204	0.1785	0.1823	0.0987	0.1701	0.0752	0.0678	0.0421	0.0331	0.0519	0.0378	0.0359
C13	0.1862	0.1204	0.1785	0.1823	0.0987	0.1701	0.0752	0.0678	0.0421	0.0331	0.0519	0.0378	0.0359
C7	0.1862	0.1204	0.1785	0.1823	0.0987	0.1701	0.0752	0.0678	0.0421	0.0331	0.0519	0.0378	0.0359
C8	0.1862	0.1204	0.1785	0.1823	0.0987	0.1701	0.0752	0.0678	0.0421	0.0331	0.0519	0.0378	0.0359
C9	0.1862	0.1204	0.1785	0.1823	0.0987	0.1701	0.0752	0.0678	0.0421	0.0331	0.0519	0.0378	0.0359
C11	0.1862	0.1204	0.1785	0.1823	0.0987	0.1701	0.0752	0.0678	0.0421	0.0331	0.0519	0.0378	0.0359
C12	0.1862	0.1204	0.1785	0.1823	0.0987	0.1701	0.0752	0.0678	0.0421	0.0331	0.0519	0.0378	0.0359

Table 14.

Extracting the Final Priority Vector from the Limit Supermatrix

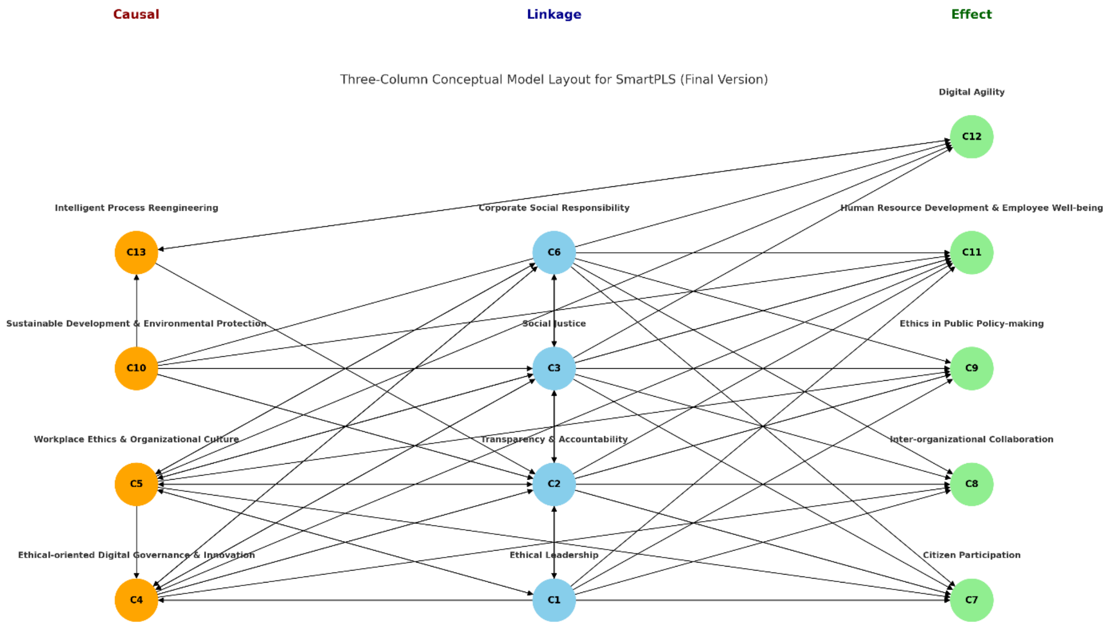
Dimension (Code)	Final Importance	Final Ranking
Ethical Leadership (C1)	0.1862	1
Transparency and Accountability (C2)	0.1204	5
Social Justice (C3)	0.1785	3
Corporate Social Responsibility (C6)	0.1823	2
Governance and Ethics-Oriented Digital Innovation (C4)	0.0987	6

Workplace Ethics and Organizational Culture (C5)	0.1701	4
Sustainable Development and Environmental Protection (C10)	0.0752	7
Smart Process Reengineering (C13)	0.0678	8
Citizen Participation (C7)	0.0421	10
Inter-Organizational Cooperation (C8)	0.0331	12
Ethics in Public Policy-Making (C9)	0.0519	9
Development of Human Resources and Employee Well-being (C11)	0.0378	11
Digital Agility (C12)	0.0359	13

C1 < C6 < C3 < C5 < C2 < C4 < C10 < C13 < C9 < C7 < C11 < C12 < C8

Figure 3.

Final conceptual model.



Discussion and Conclusion

The present study set out to develop and prioritize a Society 5.0–aligned organizational ethics model for municipalities. The quantitative results placed ethical leadership (C1), corporate social responsibility (C6), social justice (C3), and workplace ethics and organizational culture (C5) at the top of the final ANP ranking, while DEMATEL classified governance and ethics-oriented digital innovation (C4), workplace ethics and organizational culture (C5), sustainable development and environmental protection (C10), and smart process reengineering (C13) as causal drivers. Citizen participation (C7), inter-organizational cooperation (C8), ethics in public policy-making (C9), human-resource development and employee well-being (C11), and digital agility (C12) behaved primarily as effects, whereas ethical leadership (C1), transparency and accountability (C2), social justice (C3), and corporate social responsibility (C6) emerged as high-interaction "bridging" variables (D and R above mean). Taken together, these patterns suggest that municipalities will gain the most leverage by investing upstream in leadership, culture, governance mechanisms, and digitally enabled, ethics-by-design processes, which in turn propagate improvements in participation, collaboration, and policy ethics.

The prominence of ethical leadership at the top of the final weights and among the bridging nodes is consistent with public-sector studies showing that leadership behaviors—fairness, integrity, and open communication—shape ethics climate and downstream service outcomes [10, 11]. That leadership functions as a structural signal is further supported by evidence linking ethical leaders to dynamic capabilities in government digital transformation, enabling organizations to sense and reconfigure in ways that preserve public values amid technological change [9]. Our results also resonate with research cautioning that empowerment without virtue-based guardrails can drift into “over-empowerment,” weakening responsibility diffusion and ethical deliberation; the high weight for leadership therefore underscores the need to embed clear normative frames and accountability practices alongside autonomy [13]. In municipal settings, empirical analyses connect leadership tone and ethics culture to measurable performance gains, aligning with the causal role we observed for culture-centric and governance dimensions [7, 8, 12].

The elevation of corporate social responsibility and social justice indicates that a Society 5.0 ethics architecture is irreducibly human-centric and stakeholder-oriented. The Society 5.0 literature frames innovation as a means to inclusive well-being in super-smart socio-technical systems, balancing Industry 4.0 efficiencies with societal needs and resilience [1, 3]. Our findings are congruent with human-centered AI perspectives arguing that transparency, explainability, and participatory governance are prerequisites for legitimacy and sustainable development alignment [2]. In practice, this translates to CSR portfolios that extend beyond philanthropy into data ethics, equity in algorithmic service delivery, and environmental stewardship—areas that our model captures through the causal salience of sustainable development and environmental protection (C10) and the strong weights on justice and responsibility [4, 6]. Such results are compatible with municipal ethics evaluation research and rural-development-oriented frameworks that prioritize fairness, inclusion, and community accountability [25].

The causal role of governance and ethics-oriented digital innovation (C4) and smart process reengineering (C13) suggests that ethics must be designed into digital workflows rather than appended ex post. This aligns with studies arguing for “design-in-law” approaches—making legal norms legible and usable within everyday service experiences—as well as human-centric digital communities for older adults and other groups often excluded from digital government [15, 16]. In our model, these governance-technology linkages act as upstream levers: improving them increases the probability that downstream components—participation, inter-organizational cooperation, and policy ethics—will improve via clearer roles, traceability, and trustworthy data practices [5, 27]. The finding that digital agility (C12) manifests as an effect rather than a cause is theoretically coherent: agility emerges when governance, leadership, and culture already provide ethical clarity and learning routines, a view echoed by dynamic capability scholarship in the public sector [9, 14].

Workplace ethics and organizational culture (C5) was both highly weighted and causally influential, underscoring that ethics must become “lived” through routines—recruitment, training, performance appraisal, procurement, and reflective practice—rather than static codes. Prior work explains how pervasive ethics arises when organizations create dialogic spaces, measurement systems, and reinforcement mechanisms that scaffold everyday judgment [14]. Our results also align with qualitative studies proposing culturally grounded ethics frameworks—such as Islamic-inspired models—capable of resonating with frontline staff in ministries and municipal bodies; culture functions as a channel translating abstract principles into action [24]. Evidence from accounting and marketing ethics confirms that professional subcultures can drift under market or political pressures, strengthening the case for continuous ethics education and value-explicit guidelines in municipal finance and communications [22, 23].

The classification of citizen participation (C7), inter-organizational cooperation (C8), and ethics in public policy-making (C9) as effects is instructive. Participation quality and collaborative capacity improve when upstream conditions—leadership signals, transparent processes, equitable policies, and rights-conscious digital design—are in place. Comparative work on trust and coordination with local governments emphasizes that fair procedures and reliable commitments foster durable cooperation, mirroring our model's structure [28]. Public-sector ethics studies similarly suggest that codes and formal controls, absent culture and leadership, risk compliance theater; our demotion of these components to the effect category reflects the need to address causes first [8, 26, 27]. Educational and cultural infrastructures also matter: by institutionalizing ethics and digital literacies—through school systems, universities, and civic learning—jurisdictions prepare future staff and citizens to co-produce responsibly in Society 5.0 [17-20].

An important contextual insight arises from the ecosystem interface with Industry 4.0. Municipal supply chains and service partnerships increasingly involve SMEs grappling with interoperability, cybersecurity, and workforce reskilling; absent explicit ethical criteria for vendor selection and data governance, municipalities risk vendor capture and diminished public trust [29, 31]. Our model's causal emphasis on governance, sustainability, and process design provides a countermeasure: embed procurement ethics, algorithmic accountability, and environmental standards into the architecture of digital services and contracts [1, 6]. Interdisciplinary perspectives further warn that technical rationality alone cannot adjudicate value conflicts in smart-city projects; pluralist, humanities-informed deliberation should be institutionalized to navigate competing goods and harms [30].

From a human-resource standpoint, our classification of development of human resources and employee well-being (C11) as an effect suggests that learning, well-being, and ethical comportment are products of system conditions—leadership, culture, governance, and justice—rather than isolated training programs. This is compatible with moral-foundations work among municipal employees and with research on interpersonal citizenship behaviors in the public sector, which show that micro-ethics (respect, support, discretionary helping) mediates the influence of leadership and culture on performance [10, 36]. Ethics management in municipalities, accordingly, should be approached as an integral system linking leadership development, climate diagnostics, and external accountability [21]. Our findings also align with evidence that ethics education and leadership development are necessary complements to structural reforms, not substitutes [4, 33, 34].

Finally, our framework coheres with the broader transformation narratives of Society 5.0 and Construction 5.0, which integrate sustainability, resilience, and human-centricity with technological advancement in urban systems [5, 6]. By identifying which dimensions are causal, bridging, or effect, our results convert those narratives into actionable priorities. They indicate that municipalities should (1) set the tone through ethical leadership and culture, (2) encode ethics into governance and digital process design, and (3) measure CSR, justice, and sustainability as core outcomes—knowing that participation, collaboration, policy ethics, HR development, and agility will rise as consequences when the causal architecture is strengthened [7, 8, 11, 14, 32].

This study relied on the judgments of a relatively small expert panel to structure causal relations and derive priorities; although methodologically acceptable for DEMATEL–ANP applications, such panels may not fully capture the diversity of municipal contexts and stakeholder perspectives. The model was operationalized at a single point in time; because ethics climates and digital ecosystems evolve, causal salience and weights may shift with policy changes, leadership transitions, or technological adoption cycles. Our indicators emphasized organizational levers; while citizen experience and equity outcomes are implicitly reflected, we did not directly measure them. Finally, we focused on internal municipal systems and did not systematically analyze legal, fiscal, and political constraints that often condition ethical capacity in practice.

Future work should broaden stakeholder involvement by incorporating citizens, frontline service users, vendors, and civic technologists into causal mapping to stress-test the model against lived experience. Longitudinal and multi-city studies could track how weights and roles change across electoral cycles, crises, or major digital deployments. Mixed-methods designs that join DEMATEL–ANP with field experiments or realist evaluation would help identify context–mechanism–outcome patterns. Extending measurement to include equity, accessibility, and environmental performance outcomes would strengthen external validity. Finally, comparative research across legal regimes and fiscal capacities could reveal how enabling conditions modulate the effectiveness of ethical governance interventions.

Start with tone-from-the-top: invest in ethical leadership development and embed values into performance management and recruitment. Build ethics into process architecture by codifying transparency, explainability, and audit trails in all digital workflows and contracts. Establish a municipal ethics dashboard that tracks leadership signals, culture health, CSR, justice, and sustainability, with public reporting to reinforce trust. Create dialogic spaces—ethics rounds, design reviews, and citizen juries—to surface dilemmas early and normalize learning. Align procurement with ethics by setting vendor standards for data protection, accessibility, and environmental impact. Prioritize capacity building for middle managers and street-level staff through scenario-based training. Finally, treat participation and inter-organizational cooperation as outcomes of good governance: stabilize the causal core, and then scale co-production initiatives to deepen legitimacy and resilience.

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Authors' Contributions

All authors equally contributed to this study.

Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants. Written consent was obtained from all participants in the study.

Transparency of Data

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

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