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Structural Modeling and Multi-Aggregation Priority Assessment of Workplace Incivility Determinants in the Healthcare Sector

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ABSTRACT

Workplace incivility is a pressing concern that affects both work and non-work life as well as productivity. This paper aims to identify the key determinants of workplace incivility and their contextual hierarchical relationships in the healthcare sector. The current work focuses on nurses. It derives the determinants through a structured literature review using multiple theoretical lenses. The identified determinants are ratified through expert consultation. The contextual relationships are identified using the ISM (Interpretive Structural Modeling) and MICMAC analysis. This paper develops a new expert opinion and consensus-based criteria weighting method known as Multi Aggregation based Priority Assessment (MAPA). This method is used to measure the relative priorities of the determinants of workplace incivility. A group of 32 decision makers participated in the evaluation process. The analysis identifies social norms, a culture of silence and blaming, social identity discrepancies, and policy gaps as the main driving factors. ISM-MICMAC-based results are consistent with the prioritization derived through MAPA, showing that the ordering of determinants remains stable while still capturing behavioral differences. The findings highlight the need for systemic interventions grounded in policy enforcement, leadership accountability, and organizational culture, rather than isolated behavioral corrections. This paper is a distinguished contribution to developing a hybrid framework for assessing and prioritizing structural relationships to address workplace incivility in the healthcare sector. This paper proposes MAPA as a new criterion weighting method. MAPA is the first of its kind that integrates five distinct aggregation operators in group decision-making problems.

1. Introduction

Imagine the life of a nurse whose day begins in an overcrowded hospital room, with long hours ahead and important chores to do. Before the day even progresses, the nurse is faced with a derogatory comment from a senior, retorts from the patient's relatives indicating impatience, and disregard from other colleagues, small but non-stop indications of disrespect. This daily occurrence

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points to workplace incivility, a subtle yet largely invisible and socially accepted menace in the healthcare context [1-4].

Based on a global survey, 86% of care workers have been discriminated against, harassed, and subjected to violence. More than one quarter of the care workers suffer harassment once every month, while more than one out of six experience violence each week. Two-thirds of the victims are women [5]. Based on reports and studies, this phenomenon, based on data till late 2025, shows an acute level of workplace violence and uncivil behavior towards healthcare professionals in India, ranging between about 60% and above 80% [6].

Incivility at the workplace has been a growing issue in the healthcare sector. The problem is more critical for nurses who work in high-stress jobs [1,7]. Incivility is shaped by several multi-level elements beyond simple interpersonal interactions, as indicated by contemporary research [8,9]. Numerous studies have examined the consequences and Determinants of incivility. Prior studies have identified the influence of several determinants on workplace incivility, including leadership styles, work pressure, organizational culture, and demographic variables [10-12].

However, the causal relationships among various determinants in the healthcare space have not been sufficiently examined. For example, broader social values influence organizational structures, which in turn affect the actions of teams and individuals. Social norms and cultural variables, for example, are some critical contributors to incivility [13-14]. Tolerance for incivility is moderated by organizational environments and leadership [15-16]. Workplace stressors linked to technostress and reduced social interaction caused by excessive reliance on digital technologies significantly contribute to uncivilized behavior at work [17-18].

These forms of ill treatment and incivility are associated with adverse psychological outcomes, which include burnout, emotional exhaustion, and job dissatisfaction [19-21]. Eventually, it affects the service quality [3,4,22], enhances the turnover intentions of the healthcare professionals, dampens collaboration among healthcare professionals, hampers interpersonal communication, and affects patient safety [23,24]. The need to counter workplace incivility is, therefore, undeniable. Workplace civility ensures the physical and psychological well-being of employees, promotes accountability, and improves overall organizational performance [25,26].

Nevertheless, an important gap in the literature remains in the modeling and prioritization of the determinants of incivility. Most previous research has relied on methods like regression and structural equation modeling. While these approaches are useful, they have limitations in capturing causation and interdependence [27-28]. Moreover, decision-making methods applied in similar fields are subject to several issues, namely inconsistencies in pairwise comparisons and rank-reversal sensitivity [29]. The identification and structuring of determinants in prior research are also inconsistent, as various criteria are employed [8-9]. Furthermore, there is a general tendency for existing research to ignore technology-based antecedents altogether in favor of more traditional organizational and social ones [30].

Motivated by the aforementioned shortcomings, the current study employs a data-driven, hybrid research methodology to identify and explore the determinants of workplace incivility among nurses. In this context, the methodology employs Interpretive Structural Modeling (ISM) [31] and MICMAC (Matrice d'Impacts Croisés Multiplication Appliquée à un Classement) analysis. The ISM technique provides a means to uncover hierarchical relationships among determinants, in which higher-level antecedents affect lower-level factors [31]. Furthermore, MICMAC analysis (developed by J. C. Duperrin and M. Godet between 1972 and 1974) classifies these factors according to their driving and dependence powers, enabling judgments about their systemic significance [32]. As an additional technique to complement ISM and MICMAC analyses, this paper proposes an innovative hybrid approach for criteria weighting and ranking, namely Multi Aggregation based Priority Assessment

(MAPA). This method uniquely combines five different aggregation operators to consolidate expert opinions, determine criteria weights, and rank them. It integrates five widely used weighted aggregation operators that capture different aspects, such as linear averaging, nonlinear interaction, multiplicative combination, and ordering.

In this context, this paper aims for the following research objectives:

- RO1: To conceptualize the multi-dimensional structure of the determinants of workplace incivility within the healthcare industry, focusing on nurses.
- RO2: To explore the causal linkages and hierarchical associations between various determinants.
- RO3: To categorize these determinants depending on driving and dependency power.
- RO4: To rank the significance and priority of these determinants.

The aforesaid research objectives are centered on the following research questions:

- RQ1: What are the significant determinants of workplace incivility in healthcare?
- RQ2: What are the causal linkages between these determinants?
- RQ3: Who are the main drivers, and who are the dependent outcomes?
- RQ4: How can a robust scientific framework be developed to prioritize these determinants for intervention purposes?

The present study makes contributions from both theoretical and methodological perspectives.

- Firstly, theoretically, the research develops existing knowledge by constructing an inclusive, integrated multi-level framework that accounts for the hierarchical and complex characteristics of incivility determinants, in light of the fragmentation evident in past studies [8,33].
- Secondly, this paper presents a multi-theoretic introspection of the determinants of workplace incivility in the healthcare sector.
- Third, the conceptual model proposed in this paper considers socially, technologically, organizationally, and individually relevant aspects, aligning with the dynamic changes in the healthcare industry [17,30].
- Fourth, from a methodological standpoint, this research presents an innovative analytical framework that combines ISM, MICMAC, and MAPA for the identification of causal relationships along with priorities.
- Lastly, this paper is the first to develop the MAPA framework. It presents a new meta-aggregation approach that combines multiple aggregation methods using entropy-based weights. The method incorporates the weighted power mean operator and a non-consensus penalty to integrate diverse decision aggregators and mitigate the shortcomings of a specific approach. Hence, it is a hybrid approach that enhances the flexibility and reliability of the decision-making process.

The remnant of this paper is constructed as follows. Section 2 outlines various determinants derived from theoretical contributions. Section 3 describes the data collection and methodological steps. Section 4 highlights key findings and shows the validation and sensitivity analysis. Section 5 discusses the findings and highlights various research implications and future directions. The paper is concluded in Section 6.

2. Determinants of Workplace Incivility

2.1. Theoretical Foundation

On theoretical grounds, workplace incivility in the healthcare sector can be accounted for through a holistic, multi-theoretical approach that encompasses emotions, relationships, structures, and technology. First, affective event theory (AET) suggests that workplace events elicit emotional reactions in employees, which in turn lead to specific behavioral outcomes [34]. This theory indicates

that constant exposure to rudeness and disrespect, in the form of behavior, will result in persistent incivility at the workplace. In addition to AET, the ongoing work draws on multiple other theories. Social Exchange Theory (SET) states that workers will respond to negative actions with equal force [35]. Social dominance theory (SDT) explains that power systems establish which workers face discrimination through their organized structure [36]. Social identity theory (SIT) describes how people form social groups based on their work, gender identity, and social class membership [37-38]. Job Demands-Resources (JD-R) theory demonstrates that employees experience stress and burnout because they must handle excessive job demands while their available resources remain insufficient [39]. The digital health systems of modern health care facilities create technostress when users face information overload and must stay connected while losing personal interaction, leading to new behavioral problems that increase workplace incivility [40].

2.2. Description of the Determinants (Factors) Influencing Workplace Incivility

Workplace incivility is an intricate, multi-layered phenomenon with distinct dimensions that lead to uncivil behavior emerging through connections across macro, meso, and micro systems. The interdependencies among elements create an incivility loop that generates self-perpetuating incivility problems [41-43]. Workplace incivility in healthcare organizations arises from several interconnected societal, organizational, technological, and individual factors. Social norms of incivility, which result in unequal treatment and workplace incivilities going unreported, develop through societal determinants, including gender bias, social norm bias, a culture of silence and blame, and social disadvantage and weak policy enforcement [1,13,26,44]. The organizational-level determinants include workplace resource pressures, organizational culture, and respect and power abuse, resource deficiencies, work stress, skill deficiencies, and poor leadership practices, which create work environments that generate interpersonal conflicts that result in workplace incivilities [10-11,45].

From a collective perspective, dysfunctional group dynamics and office politics contribute to heightened relational conflict and decreased trust [33,46]. The technological dimension includes three components that reduce the need for human interaction, create technostress, and provide insufficient support for technology use, resulting in problems for people who need to interact with others and manage their feelings [17-18]. Individual behavior patterns, which include inappropriate actions, stress responses, and vulnerability, shape how people perceive workplace communication [19,47]. The research study presents a comprehensive framework that identifies the key factors leading to workplace incivility. Table 1 presents factors that contribute to workplace incivility. For a detailed description, consult Table A1 (Appendix A).

Table 1

List of determinants of workplace incivility

S/L	Factor (Determinants)	Theory	Related Studies
<i>Macro-level</i>			
A1	Gender and social norm bias	SDT	[13],[44]
A2	Silence culture and the blame game	SET	[1],[14],[26]
A3	Social identity disadvantage	SIT	[4],[47], [44]
A4	Lack of structured Policy and enforcement	SET	[1], [9], [25]
<i>Meso-level (organizational)</i>			
A5	Workplace resource constraints	JD-R	[21],[45]
A6	Workplace culture and respect	SET	[11]
A7	Misuse of power and inequality	SDT	[16],[33],[46]
A8	Lack of staff and infrastructure	JD-R	[3], [22]

Table 1

Continued

S/L	Factor (Determinants)	Theory	Related Studies
<i>Meso-level (organizational)</i>			
A9	Work pressure	JD-R	[10], [19]
A10	Skill and communication gaps	AET	[8], [2]
A11	Negative leadership style	SET	[10],[11], [16]
<i>Collective (Workgroup Level)</i>			
A12	Lack of a healthy team culture	SET	[33], [24]
A13	Workplace politics and favoritism	SET	[14], [46]
<i>Technological (Mechanical) Level</i>			
A14	Lack of human touch (Technology divide)	AET	[30], [18]
A15	Techno stress at work	JD-R	[17]
A16	Lack of technology support and training	JD-R	[18], [30]
<i>Individual (Entity) Level</i>			
A17	Unpleasant peer behavior	AET	[7], [28]
A18	Emotional stress and poor control	AET/ JD-R	[19], [20]
A19	Self-vulnerability to incivility	SIT	[47], [4]

3. Methodology

3.1 Data Collection

This study is based on the opinions of experienced professionals in different fields (both industrial and academic). Firstly, a few senior professionals were contacted directly. We took their valuable opinions in finalizing the determinants. We used snowball sampling to purposively identify the experienced professionals. The rationale was to include professionals from related areas (e.g., healthcare, social work, psychology, people management, legal and governance) in both public and private sector organizations. We considered a minimum of ten years of experience in the concerned areas. Finally, after proper screening and discussions with targeted respondents, 32 such experts were identified. Prior studies provided no specifications regarding the minimum sample size or the ideal sampling process. [48] acknowledged that eight experts are sufficient and that judgment sampling has been applied. Thus, the considered sample size is sufficient to proceed with the study. Two steps were undertaken to collect data from these selected experts. The first step was to inform the experts about the entire process before collecting data. The second step ensured that everything was kept confidential and that all expert input was used solely for research purposes. The experts were circulated with the questionnaire, and their evaluations of various criteria were sought. Table 2 exhibits the respondents' profiles.

Table 2

Profile of the experts

Experience	Frequency	Education	Frequency	Functional expertise	Frequency
20 years and above	6	Doctoral	9	Patient care	15
15 to 20 years	14	Post Graduation	18	Healthcare administration	6
10 to 15 years	12	Under Graduation	5	Sociology	3
				Government/ policy	3
				People management	5
Total	32	Total	32	Total	32

3.2. ISM-MICMAC Framework

ISM examines the causal interrelationships among variables in the problem through structural mapping, in which the relationships are depicted as directed graphs (digraphs). The digraph displays

the vertices and edges, while the experts determine the sequence and direction of the edges based on their contextual analysis. ISM helps identify indirect relations by applying the mathematical property of transitivity to rule out unintended relationships. As such, the ISM approach facilitates the interpretation and simplification of complicated relational structures [31].

ISM process includes several steps. The determinants relevant to the research question are first identified. Expert opinions are then obtained regarding the contextual relationships among the identified determinants. Based on these views, Structural Self-Interaction Matrix (SSIM) is constructed. The initial reachability matrix (IRM) is then developed. The transitivity rule is applied to obtain the final reachability matrix (FRM). Finally, level partitioning is carried out and a digraph is formed.

MICMAC analysis is conducted to understand the interrelationship between the selected determinants. As a result, four categories of variables, including independent, dependent, linkage, and autonomous, are categorized depending on their driving power (indicating the degree to which a particular barrier impacts other elements) and dependence power (illustrating the number of other barriers influencing a specific element) [48].

3.3. MAPA Method

This method determines criteria weights using five different aggregation operators.

Step 1. Formation of the expert-rated criteria evaluation matrix (CEM). Suppose there are $j = 1, 2, \dots, k$ experts who evaluated $i = 1, 2, \dots, n$ criteria. Then, e_{ij} is the evaluated importance value of

the i^{th} criterion by j^{th} expert. The CEM is then constructed as $E = \begin{pmatrix} e_{11} & \cdots & e_{1k} \\ \vdots & \ddots & \vdots \\ e_{n1} & \cdots & e_{nk} \end{pmatrix}$

Suppose, ϖ_j is the priority weight of the j^{th} expert.

Step 2. Obtain the priority score (PS) of each criterion using various operators.

Step 2a. Einstein Weighted Arithmetic Average (EWAA) operator. PS value using EWAA operator is obtained as follows [49]:

$$S_i^E = EWAA\{e_{i1}, e_{i2}, \dots, e_{ik}\}$$

$$= \sum_{j=1}^k e_{ij} \frac{\prod_{j=1}^k (1 + f(e_{ij}))^{\varpi_j} - \prod_{j=1}^k (1 - f(e_{ij}))^{\varpi_j}}{\prod_{j=1}^k (1 + f(e_{ij}))^{\varpi_j} + \prod_{j=1}^k (1 - f(e_{ij}))^{\varpi_j}} \quad (1)$$

Where:

$$f(e_{ij}) = \frac{e_{ij}}{\sum_{j=1}^n e_{ij}} \quad (2)$$

Step 2b. Hybrid weighted arithmetical averaging (HWAA). PS value using HWAA operator is obtained as follows [50-51].

$$S_i^H = HWAA\{e_{i1}, e_{i2}, \dots, e_{ik}\}$$

$$= \sum_{j=1}^k e_{ij} \frac{\prod_{j=1}^k (1 + (\zeta - 1) f(e_{ij}))^{\varpi_j} - \prod_{j=1}^k (1 - f(e_{ij}))^{\varpi_j}}{\prod_{j=1}^k (1 + (\zeta - 1) f(e_{ij}))^{\varpi_j} + (\zeta - 1) \prod_{j=1}^k (1 - f(e_{ij}))^{\varpi_j}} \quad (3)$$

Where $\zeta > 0$ is the parameter of HWAA operator.

Step 2c. WFA operator. PS value using WFA operator is given by the following equation [52]:

$$S_i^F = WFA(e_{i1}, e_{i2}, \dots, e_{ik}) \\ = \left(1 - \log_{\lambda} \left(1 + \prod_{j=1}^k \left((\lambda)^{1-\zeta_{ij}} - 1 \right)^{\varpi_j} \right) \right) \quad (4)$$

where:

$$\zeta_{ij} = \frac{e_{ij}}{\sum_{i=1}^n e_{ij}} \quad (5)$$

$\lambda > 1$ is the parameter of WFA.

Step 2d. Ordered weighted averaging (OWA) operator. PS value using OWA operator is obtained as follows [51]:

$$S_i^{WA} = OWA(e_{i1}, e_{i2}, \dots, e_{ik}) = \sum_{j=1}^k \varpi_k e_{ij} \quad (6)$$

Step 2e. Ordered weighted geometric (OWG) operator. PS value using OWG operator is obtained as follows [51]:

$$S_i^{WG} = OWG(e_{i1}, e_{i2}, \dots, e_{ik}) = \prod_{j=1}^k (e_{ij})^{\varpi_k} \quad (7)$$

Step 3. Obtain the weights of the individual operators. This step is carried out in the following sequence.

Step 3a. Normalization of the operator-centric PS values. The normalization is done as follows.

$$y_i^{(g)} = \frac{S_i^{(g)}}{\sum_{i=1}^n S_i^{(g)}} \quad (8)$$

In Eq. (8), “g” denotes a specific aggregation operator (g = 1 indicates EWAA, g = 2 indicates HWAA, g = 3 means WFA, g = 4 means OWA, and g = 5 indicates OWG).

Step 3b. Obtain the weights of the individual aggregation operator. This is done by using Entropy method [53]. The calculation is demonstrated below. First, the entropy of an individual aggregation operator is determined as follows.

$$\mathcal{E}_g = -\frac{1}{\ln(n)} \sum_{i=1}^n y_i^{(g)} \ln(y_i^{(g)}) \quad (9)$$

Then, the divergence of the operator is derived as follows.

$$\mathcal{D}_g = 1 - \mathcal{E}_g \quad (10)$$

Finally, the weight of each operator is determined by Eq. 11.

$$\omega_g = \frac{\mathcal{D}_g}{\sum_{g=1}^5 \mathcal{D}_g}; \omega_g > 0, \sum \omega_g = 1 \quad (11)$$

Step 4. Obtain the overall priority score (OPS) of each criterion. This step is the core advantage of this method.

Step 4a. Aggregation of PS values. MAPA method uses the weighted power mean (Hölder mean) [54] to aggregate PS values obtained by using five distinct aggregation operators. The weighted power mean of PS values is given by Eq. (12).

$$\phi_i = \left(\sum_{g=1}^g \omega_g \left(S_i^{(g)} \right)^\theta \right)^{\frac{1}{\theta}} \quad (12)$$

In Eq. (12), the parameter θ indicates the behavioral attitude of the decision maker and introduces flexibility in the decision-making. Table 3 provides the interpretation of various values of θ .

Table 3

Interpretation of various values of the behavioral attitude parameter

θ value	Operator	Interpretation	Attitude
$\theta = 1$	Weighted arithmetic mean Weighted geometric mean	Standard linear integration of values	Neutral
$\theta \rightarrow 0$	$\lim_{\theta \rightarrow 0} (\phi_i) = \prod_{g=1}^g \left(S_i^{(g)} \right)^{\omega_g}$	Multiplicative and balanced aggregation and strict towards zero contribution	Neutral (Conservative)
$\theta = -1$	Weighted harmonic mean	Sensitivity towards lower values	Pessimism
$\theta \rightarrow -\infty$	Weighted min operator	Strong inclination towards lower values	Strong pessimism
$\theta \rightarrow +\infty$	Weighted max operator	Strong inclination towards higher values	Strong optimism

In general, $\theta > 0$ indicates an optimistic aggregation. It amplifies the higher PS values. Alternatives that perform well on some criteria are favored. An increase in θ leads to an increase in ϕ_i . Hence, the efficient operators are rewarded. When an operator obtains a high rating in any of EWAA, HWAA, WFA, OWA, or OWG, the overall score improves. On the other hand, $\theta < 0$ is a strict consensus driven attitude. When all operators need to agree on the importance of a specific criterion, these values are suitable.

Step 4b. Obtain the penalty score. The MAPA method introduces a penalty term to penalize divergence from the consensus of opinions. We define the penalty for disagreement. The disagreement penalty term is defined as follows.

$$\mathcal{L}_i = \tau \times \sigma_i \quad (13)$$

Where:

τ is the disagreement penalty coefficient. By selecting an appropriate value of τ the decision maker controls the effect of inter-operator disagreement on OPS. $S_i^{(g)} \in (0,1]$ as they are based on experts' opinions using the five-point Likert scale.

The value σ_i is obtained by calculating the standard deviation of the weighted PS values of each criterion across the aggregation operators. The weighted PS value is given by

$$S_i^{*(g)} = \omega_g S_i^{(g)} \quad (14)$$

Essentially, Eq. (14) computes the extent to which the aggregation operators disagree about the criterion i .

The value of σ_i indicates the noise level. It shows the amount of disagreement among the aggregating functions about the significance of a specific criterion. Hence, it indicates the worst-case scenario, i.e., the most contested criterion. On the other hand, ϕ_i indicates the signal strength, the superiority of the concerned criterion over the others, as opined by the experts. The term $\mathcal{L}_i$ measures the penalty for each criterion.

If τ is large then, the aggregated PS value of the weakest criterion is comparable with the maximum disagreement. Hence, it reflects a relatively stable model with a mild penalty. On the other

hand, if $\tau \rightarrow 0$ (i.e., small) then, disagreement subdues the overall attractiveness of the criterion. Hence, a high penalty should be imposed.

Step 4c. Obtain OPS values of the criteria. OPS value is finally derived as follows.

$$\mathbb{S}_i = \phi_i - \mathcal{L}_i = \left(\sum_{g=1}^g \omega_g \left(S_i^{(g)} \right)^\theta \right)^{\frac{1}{\theta}} - \tau \sigma_i \quad (15)$$

Decision rule: A higher $\mathbb{S}_i$ indicates the higher priority of the corresponding criterion.

Step 5. Calculate the final weights of the criteria. This is obtained by using Eq. (16).

$$w_i = \frac{\mathbb{S}_i}{\sum_{i=1}^n \mathbb{S}_i}; w_i > 0, \sum w_i = 1 \quad (16)$$

Step 6. Determine the critical threshold value for the disagreement penalty coefficient. The MAPA method also calculates critical threshold (CT) value for τ as follows.

$$\Omega = \frac{1}{\text{Max}_i \left(\frac{\sigma_i}{\phi_i} \right)} \quad (17)$$

Essentially, the CT value signifies the tolerance for disagreement. This is the maximum penalty the model can tolerate while maintaining OPS > 0. For a meaningful weight calculation using the MAPA method, the following conditions must be satisfied.

$$\mathbb{S}_i > 0 \Rightarrow (\phi_i - \tau \sigma_i) > 0 \quad \forall i = 1, 2, \dots, n$$

$$\Rightarrow \phi_i > \tau \sigma_i \Rightarrow \tau \frac{\sigma_i}{\phi_i} < 1 \Rightarrow \tau < \left(\frac{1}{\frac{\sigma_i}{\phi_i}} \right) \quad \forall i = 1, 2, \dots, n \quad (18)$$

Given that this condition must be satisfied concurrently with all criteria, the limiting condition is determined by CT value. The decision maker must set the value of τ given this limiting condition, i.e., $\tau < \Omega$. In other words, $\tau \in [0, \Omega)$.

A higher value of CT indicates that the criteria performed well, irrespective of the disagreements over the aggregation operators and dissension among the decision makers.

In this context, the ratio $\left(\frac{\tau}{\Omega} \right)$ plays a crucial role. The value of $\left(\frac{\tau}{\Omega} \right) \rightarrow 0$ indicates that the decision maker has not utilized the tolerance level appropriately, i.e., a mild penalty has been imposed. On the other hand, a very high value of $\left(\frac{\tau}{\Omega} \right) \rightarrow 1$ indicates that the model approaches the limiting condition and is aggressive.

Step 7. Stability assessment of the result. This step is integral to MAPA method, making it advantageous to use. The stability is assessed in two steps.

Step 7a. Determination of local stability index (LSI). This step assesses criterion-wise stability. LSI value for the i^{th} criterion is obtained as follows.

$$\hat{\lambda}_i = \frac{\phi_i}{\phi_i + \sigma_i}; \hat{\lambda}_i \in [0, 1] \quad (19)$$

$\hat{\lambda}_i \rightarrow 1$ indicates that the signal strength of the i^{th} criterion dominates the disagreement among the aggregation operators. Hence, the criterion exhibits stability irrespective of the choice of the

aggregation methods. On the other hand, $\hat{\lambda}_i \rightarrow 0$ is an indication of the fragility or instability of the criterion score. If $\sigma_i \rightarrow 0$ that implies $\hat{\lambda}_i \rightarrow 1$.

Step 7b. Determination of global stability index (GSI). GSI value evaluates the model stability. It is calculated by averaging the LSI values as follows.

$$\Xi = \frac{1}{n} \sum_{i=1}^n \hat{\lambda}_i = \frac{1}{n} \sum_{i=1}^n \left(\frac{\phi_i}{\phi_i + \sigma_i} \right) \quad (20)$$

GSI reflects reliability of MAPA method for criteria weighting. Given the diversity of aggregation operators and the subjectivity of expert evaluations, a GSI value greater than 0.8 indicates considerable model stability. A value of GSI lies between 0.6 and 0.8, which may be considered satisfactory.

Step 8. Calculate model endurance index (MEI). MEI value indicates ability of the model to withstand the imposed penalty. It is defined as follows.

$$\mathcal{E} = \frac{\text{Min}_i(\phi_i - \tau\sigma_i)}{\text{Min}_i(\phi_i)} \quad (21)$$

MEI=1 means that there is no penalty for any criterion, and all criteria have their entire OPS value equal to their entire ϕ value. MEI=0.70 means that, even after the penalty is applied, only 70% of the value of the most penalized criterion remains, implying that 30% is deducted due to inter-operatory disagreement. The closer the MEI value is to zero, the closer the model approaches breakdown at the chosen τ level.

3.4. Methodological Advantages of MAPA

The MAPA method offers several advantages:

- i. The MAPA model enhances expert decision-making by using a multi-level aggregation approach that integrates multiple aggregation operations rather than relying on a single operator. Unlike other expert decision-making methods like Criteria Importance Assessment (CIMAS) [55], FulLEX [56], and others that rely on a single operator, MAPA uses multiple operators, including EWAA, HWAA, WFA, OWA, and OWG.
- ii. Each of the five aggregation operators used in MAPA has complementary qualities that enable different types of consensus processes to be captured within a group decision-making context. The EWAA operator enables compensation of experts' opinions, but the HWAA function introduces a parameter that controls the agreement process. The WFA function enables interpolation between conjunction and disjunction. The OWA function uses rank-based weights to capture attitudes, whereas the OWG accounts for extreme or near-zero scores during evaluation.
- iii. The five operators were chosen since they cover all possible paradigms for aggregating information in MCDM based on linear averaging, non-linear interaction, multiplicative combination, and ordering. In this way, MAPA considers both value-oriented and position-based information that other approaches (CIMAS or FulLEX) ignore. However, it may be noted that there are several other aggregation operators of similar types to cover the whole spectrum.
- iv. It incorporates structured diversity so as to minimize the personal bias introduced by each operator. The entropy-based weighting technique further helps ensure that only operators that carry informational significance contribute to the final solution, thereby managing complexity. The selection of five is a perfect compromise between being rich

- and being concise. In MAPA, meta-aggregation between heterogeneous operators benefits from diversity.
- v. It simultaneously accounts for compensatory, non-compensatory, and attitudinal behaviours. This is achieved through objective weighting to determine each operator's discrimination power.
 - vi. In addition, MAPA incorporates a general power mean fusion method based on a consensus penalty, allowing flexible modeling of the attitude of the decision makers while simultaneously penalizing any inconsistency among operators.
 - vii. Unlike traditional approaches that ignore the uncertainty inherent in the aggregation process, MAPA integrates adaptability of behavior, efficiency of information, and sensitivity to consensus into a single coherent mathematical model.
 - viii. The MAPA method has embedded stability and reliability diagnosis mechanisms. Unlike conventional approaches, MAPA incorporates the Local Stability Index (LSI), Global Stability Index (GSI), and Model Endurance Index (MEI) into its framework. Such an embedding enables concurrent testing of both result stability and model validity without requiring any separate verification tool. The implementation of CT introduces an instrument that enables the regulation of the maximum possible disagreement.

Table A2 presents a brief comparison of some recent and popular group decision-making methods for criteria weighting. Figure 1 depicts the research methodology framework.

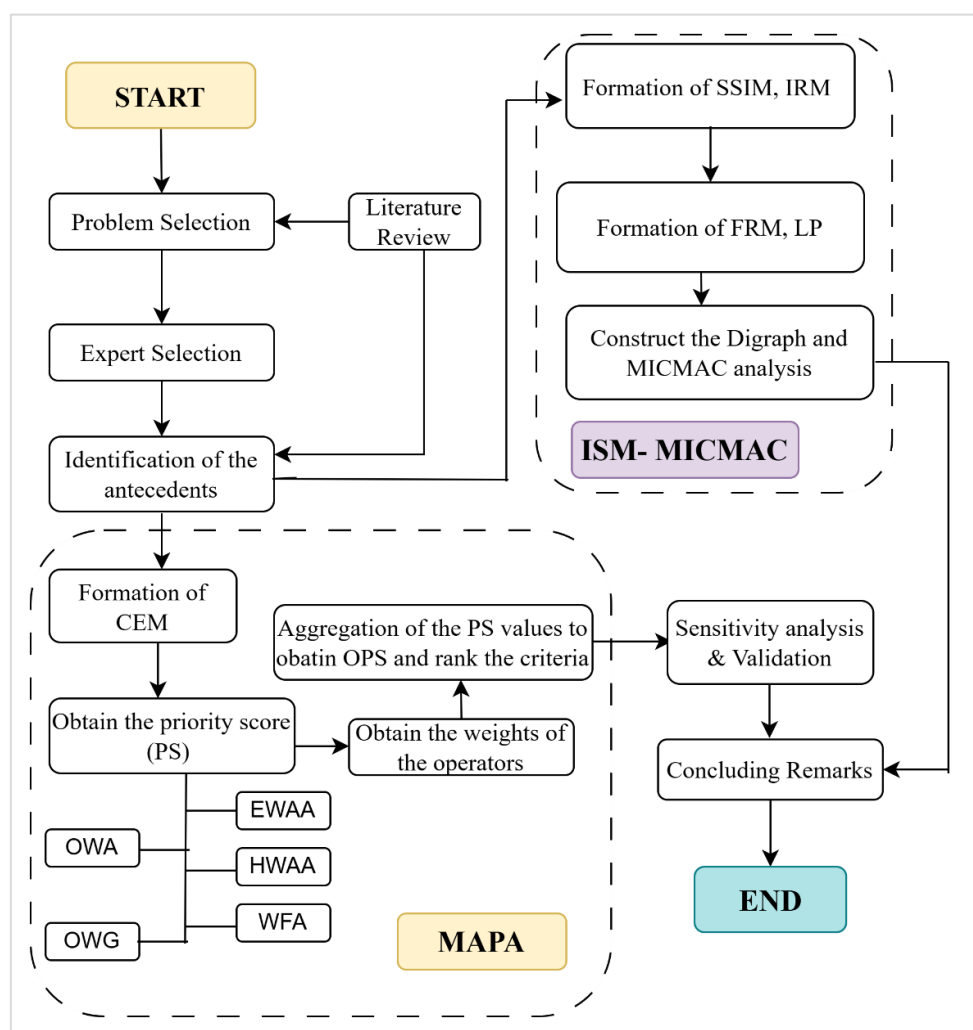


Fig. 1. Flowchart of the methodological framework

4. Findings

The data analysis is carried out in two phases: ISM/MICMAC (delving into the interrelationship among various determinants) and MAPA (which determines the priority of the determinants). In the following subsections, we report key findings from the data analysis.

4.1. Causal Relationships: Results of ISM

ISM analysis is carried out through several sequential steps [57-59] as described below. Smart ISM software tool [58] is used to conduct the analysis. First, SSIM is formulated. The opinions of twelve senior experts are collected, and a consensus is reached through deliberation to establish the contextual relationships among the various determinants (Table 4).

IRM is then constructed, as presented in Table A3, followed by FRM shown in Table A4. Next, the antecedent variables, representing determinants of workplace incivility, are partitioned into hierarchical levels and classified accordingly. This process is completed through three iterations. The reachability set for a specific determinant encompasses the determinant itself and any other determinants it can affect (as shown in FRM by a cell that displays either 1 or 1* in the relevant row). The antecedent set includes the determinant itself together with all other determinants that can affect it (their presence being shown through cells that display 1 or 1* in the respective column). The intersection set is obtained by identifying the common elements between the reachability and antecedent sets. The highest level of the hierarchy is a determinant whose reachability set equals its intersection set. The process of determining the complete hierarchical structure starts by identifying primary determinants, then other determinants, until all levels of the hierarchy are established. The result of the level partitioning of various determinants is displayed in Table 5.

Table 4
Contextual relationships among the determinants (SSIM)

Deter minants	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A17	A18	A19
A1		X	X	X	V	V	V	V	V	V	V	V	V	V	O	O	V	V	V
A2			X	X	V	V	V	V	V	V	V	V	V	V	O	O	V	V	V
A3				X	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V
A4					V	V	V	V	V	V	V	V	V	V	V	V	V	V	V
A5						X	X	X	X	V	X	V	X	V	V	V	V	V	V
A6							X	X	X	V	X	X	X	V	V	V	V	V	V
A7								X	X	V	X	V	X	V	V	V	V	V	V
A8									X	V	X	V	V	V	V	V	V	V	V
A9										V	X	V	V	V	V	V	V	V	V
A10											V	X	O	V	V	V	V	V	V
A11												X	X	V	V	V	V	V	V
A12													X	V	V	V	V	V	V
A13															V	V	V	V	V
A14																X	X	X	X
A15																	X	X	X
A16																		X	X
A17																			X
A18																			
A19																			

Meaning of the symbols used in the formulation of SSIM:

V: Indication that the row variable influences the corresponding column variable

A: Indication that the column variable influences the corresponding row variable

X: Indicates the bidirectional mutual influence of the row and column variables on each other

O: Indication of non-existent relationship among the variables

Table 5
Level partitioning of the determinants of workplace incivility

Determinant	Reachability Set	Antecedent Set	Intersection Set	Level
1	1, 2, 3, 4,	1, 2, 3, 4,	1, 2, 3, 4,	3
2	1, 2, 3, 4,	1, 2, 3, 4,	1, 2, 3, 4,	3
3	1, 2, 3, 4,	1, 2, 3, 4,	1, 2, 3, 4,	3
4	1, 2, 3, 4,	1, 2, 3, 4,	1, 2, 3, 4,	3
5	5, 6, 7, 8, 9, 10, 11, 12, 13,	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13,	5, 6, 7, 8, 9, 10, 11, 12, 13,	2
6	5, 6, 7, 8, 9, 10, 11, 12, 13,	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13,	5, 6, 7, 8, 9, 10, 11, 12, 13,	2
7	5, 6, 7, 8, 9, 10, 11, 12, 13,	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13,	5, 6, 7, 8, 9, 10, 11, 12, 13,	2
8	5, 6, 7, 8, 9, 10, 11, 12, 13,	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13,	5, 6, 7, 8, 9, 10, 11, 12, 13,	2
9	5, 6, 7, 8, 9, 10, 11, 12, 13,	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13,	5, 6, 7, 8, 9, 10, 11, 12, 13,	2
10	5, 6, 7, 8, 9, 10, 11, 12, 13,	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13,	5, 6, 7, 8, 9, 10, 11, 12, 13,	2
11	5, 6, 7, 8, 9, 10, 11, 12, 13,	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13,	5, 6, 7, 8, 9, 10, 11, 12, 13,	2
12	5, 6, 7, 8, 9, 10, 11, 12, 13,	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13,	5, 6, 7, 8, 9, 10, 11, 12, 13,	2
13	5, 6, 7, 8, 9, 10, 11, 12, 13,	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13,	5, 6, 7, 8, 9, 10, 11, 12, 13,	2
14	14, 15, 16, 17, 18, 19,	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19,	14, 15, 16, 17, 18, 19,	1
15	14, 15, 16, 17, 18, 19,	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19,	14, 15, 16, 17, 18, 19,	1
16	14, 15, 16, 17, 18, 19,	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19,	14, 15, 16, 17, 18, 19,	1
17	14, 15, 16, 17, 18, 19,	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19,	14, 15, 16, 17, 18, 19,	1
18	14, 15, 16, 17, 18, 19,	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19,	14, 15, 16, 17, 18, 19,	1
19	14, 15, 16, 17, 18, 19,	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19,	14, 15, 16, 17, 18, 19,	1

The final reachability matrix (Table A4) and partitioning result (Table 5) are used to construct the initial ISM model (Figure A1). After removing transitivity from the initial ISM model (Digraph), we construct the final model (Digraph), displayed in Figure 2.

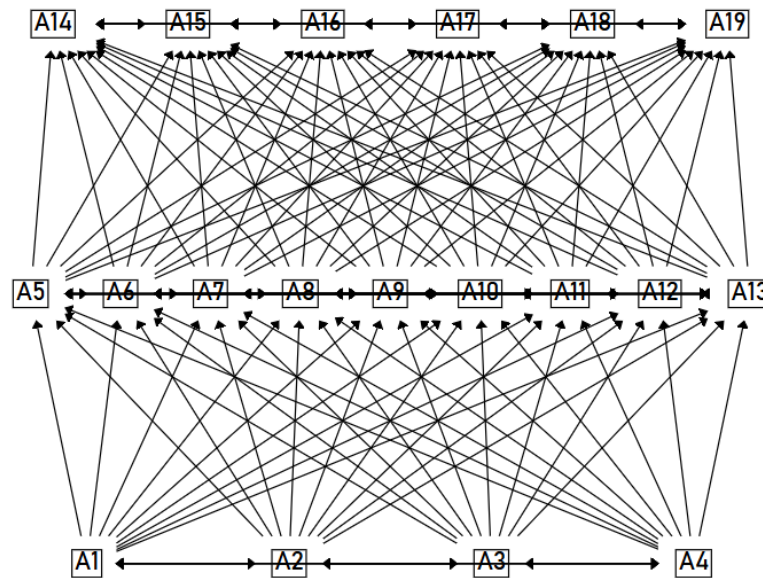


Fig. 2. The final ISM model (Digraph)

4.2. MICMAC Analysis

MICMAC analysis is used to understand how the selected antecedents influence one another. The variables are grouped into independent, dependent, linkage, and autonomous categories based on driving power and dependence power. Driving power shows how strongly a factor affects others, whereas dependence power shows how much a factor is influenced by others [48]. Figure 3 displays the result of the MICMAC analysis.

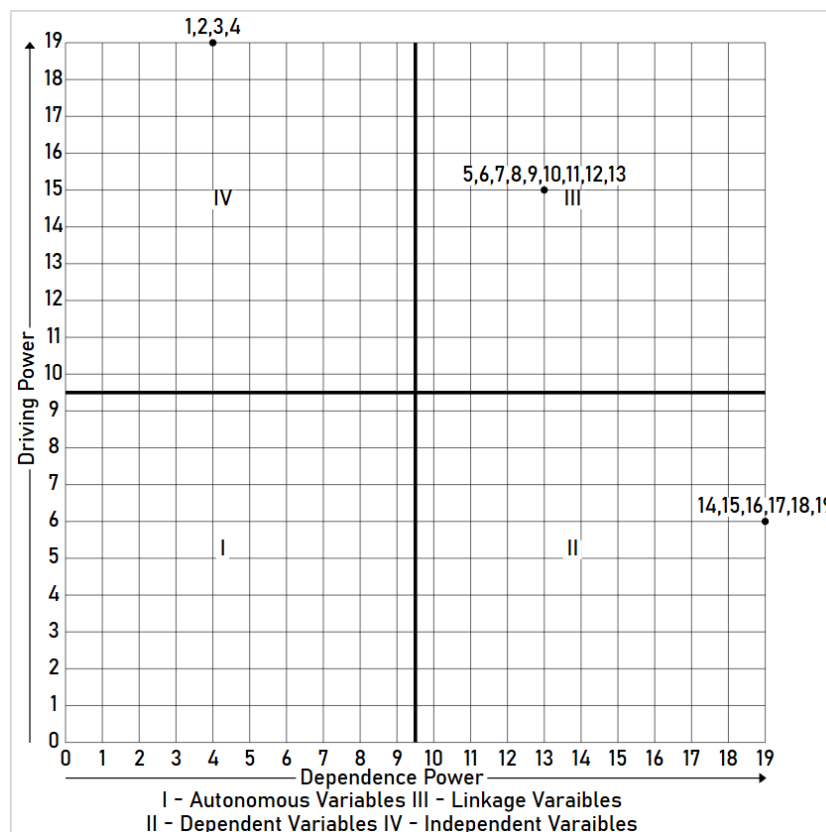


Fig. 3. Plotting of antecedents (MICMAC analysis)

Figure 3 indicates that A1, A2, A3, and A4 act as independent variables (quadrant IV) that drive the other determinant variables. The determinants A14-A19 act as dependent variables with equal emphasis. Finally, A5-A13 are plotted in the linkage quadrant. The MICMAC analysis reflects the final ISM model and level partitioning results.

4.3. Findings of MAPA

The next step is to derive the weights of the determinants to prioritize them. To this end, first, we collect the ratings of the determinants by the experts (Table A5). We then apply the aggregation operators (EWAA, HWAA, WFA, OWA, and OWG) to aggregate the ratings to obtain the PS values of all determinants. We assume that all experts are equally important. We believe that the current problem is an experiential issue. Thus, everyone's rating is equally important. Therefore, the weight of any decision maker is calculated as $(1/32)$. Further, for balanced aggregation, we set $\zeta = 1$, $\lambda = 2$, $\theta = 1$, and $\tau = 1$ in the initial case. Table 6 summarizes the aggregation results (i.e., calculated PS values).

Table 6

Calculated PS values of the determinants

Determinant (Factor)	PS values				
	EWAA	HWAA	WFA	OWA	OWG
A1	4.7188	4.7194	0.0671	4.7188	4.6958
A2	4.5938	4.5946	0.0654	4.5938	4.5667
A3	4.5001	4.5009	0.064	4.5000	4.4721
A4	4.4063	4.4074	0.0626	4.4063	4.3707
A5	4.2501	4.2514	0.0603	4.2500	4.2040
A6	4.3438	4.3448	0.0618	4.3438	4.3102
A7	4.0626	4.0645	0.0577	4.0625	3.9993
A8	4.0001	4.0023	0.0568	4.0000	3.9280
A9	3.9064	3.9081	0.0554	3.9063	3.8403
A10	3.6564	3.6581	0.052	3.6563	3.5895
A11	3.9688	3.9704	0.0563	3.9688	3.9165
A12	3.4689	3.4717	0.0493	3.4688	3.3805
A13	3.4376	3.4392	0.0488	3.4375	3.3830
A14	3.0626	3.0645	0.0436	3.0625	2.9987
A15	2.9689	2.9716	0.0422	2.9688	2.8811
A16	2.9376	2.9399	0.0417	2.9375	2.8610
A17	2.7502	2.7526	0.039	2.7500	2.6712
A18	2.7189	2.7214	0.0387	2.7188	2.6376
A19	2.6565	2.6595	0.0377	2.6563	2.5485

The next task is to find out the priority weights of the operators. Using the entropy method, we determine the weights of the individual operators (Table 7).

Table 7

Calculated weights of the aggregation operators

Operator	EWAA	HWAA	WFA	OWA	OWG
Entropy	0.9943	0.9943	0.9943	0.9943	0.9937
Divergence	0.0057	0.0057	0.0057	0.0057	0.0063
Op. weight	0.1962	0.1957	0.1965	0.1962	0.2154

PS values (ϕ) are then aggregated, and the penalty value for each criterion is determined. In this process, disagreement across operators (σ) is measured, followed by the computation of penalty

values. OPS values are then derived. Using these OPS values, the weights of all criteria are calculated. The detailed computation of the criteria weights is presented in Table 8.

Table 8
Calculation of OPS values and weights of the criteria

Antecedent (Factor)	ϕ	σ	Penalty	OPS	Rank	Weight
A1	3.8000	0.4192	0.4192	3.3809	1	0.0672
A2	3.6984	0.4079	0.4079	3.2905	2	0.0654
A3	3.6226	0.3995	0.3995	3.2231	3	0.0641
A4	3.5454	0.3910	0.3910	3.1545	4	0.0627
A5	3.4172	0.3767	0.3767	3.0405	6	0.0604
A6	3.4955	0.3855	0.3855	3.1100	5	0.0618
A7	3.2625	0.3595	0.3595	2.9029	7	0.0577
A8	3.2102	0.3537	0.3537	2.8566	8	0.0568
A9	3.1359	0.3455	0.3455	2.7903	10	0.0555
A10	2.9341	0.3233	0.3233	2.6109	11	0.0519
A11	3.1892	0.3515	0.3515	2.8376	9	0.0564
A12	2.7785	0.3059	0.3059	2.4726	12	0.0492
A13	2.7604	0.3042	0.3042	2.4562	13	0.0488
A14	2.4560	0.2705	0.2705	2.1855	14	0.0434
A15	2.3755	0.2615	0.2615	2.1140	15	0.0420
A16	2.3526	0.2590	0.2590	2.0936	16	0.0416
A17	2.2009	0.2423	0.2423	1.9586	17	0.0389
A18	2.1753	0.2394	0.2394	1.9358	18	0.0385
A19	2.1193	0.2331	0.2331	1.8861	19	0.0375
					GSI	0.901
					MEI	0.890

The CT value is then calculated for setting up the upper limit of the coefficient τ . We find the maximum value of $\sigma/\phi = 0.11$. Hence, $\Omega = \frac{1}{0.11} = 9.07 \Rightarrow \tau \in [0, 9.07)$. The initial value of τ is set to 1 for ease of calculation and a considerable reduction in the penalty.

4.4. Validation: Comparison of the MAPA methods with other MCDM models

LSI values for each criterion range from 0.9007 to 0.9009, indicating a stable OPS calculation. The GSI value is 0.901, while the MEI value is 0.890, reflecting the strong resilience of the MAPA model. To check the reliability and generalizability of the determinant rankings based on the calculated weights, the results are compared with those obtained from Defining Interrelationships Between Ranked criteria II (DIBR-II), Level Based Weight Assessment (LBWA), FullEX, MAX-C, Pivot Pairwise Relative Criteria Importance Assessment (PIPRECIA), Step-wise Weight Assessment Ratio Analysis (SWARA), Comparisons Between Ranked Criteria (COBRAC), Full Consistency Method (FUCOM), and CIMAS-M methods. The comparison of several established MCDM models provides multiple perspectives for evaluating a set of alternatives and criteria using a specific method [60-62]. It is found that most of the other models produce rankings of the determinants similar to MAPA method (Figure 4). Spearman's rank correlation test reveals that the other models maintain a statistically significant and high rank correlation coefficient with the MAPA method (Table 9)

Table 9

Result of the Spearman rank correlation test among various methods

Method	Spearman rank correlation coefficients								
	DIBR-II	LBWA	FullEX	MAX-C	PIPRECIA	SWARA	COBRAC	FUCOM	CIMAS-M
MAPA	1.000	1.000	1.000	0.944	0.996	0.993	1.000	1.000	0.958

(All coefficients are significant at the 0.05 level, two-tailed)

The Kruskal-Wallis H test is performed to examine whether statistically significant differences exist in the calculated criteria weights for the 19 determinants across the 10 methods, including MAPA. A Python-based analysis on the Google Colab platform yields an H value of 1.6545 with 9 degrees of freedom and a p value of 0.995830, which is greater than 0.05. The effect sizes are also computed, with $\eta^2 = -0.0408$ and $\epsilon^2 = 0.0088$, both indicating negligible effects. It is therefore concluded that no significant differences exist in the calculated weights of the determinants across the methods. Accordingly, MAPA is considered reliable. The detailed results of the Kruskal-Wallis H test are presented in Figure 5.

4.5. Sensitivity Analysis: MAPA

The MAPA method uses several parameters and coefficients. Besides, it handles five distinct aggregating operators. Hence, it is imperative to examine how variations in these parameters and coefficients affect the weight calculation, as recommended by several researchers [63,64]. Also, it is worthwhile to assess the effect of variations in the priority weights of individual aggregate operators on the MAPA method's outcome. Figures 6-8 display the effects on the final ranking, OPS values, and model stability.

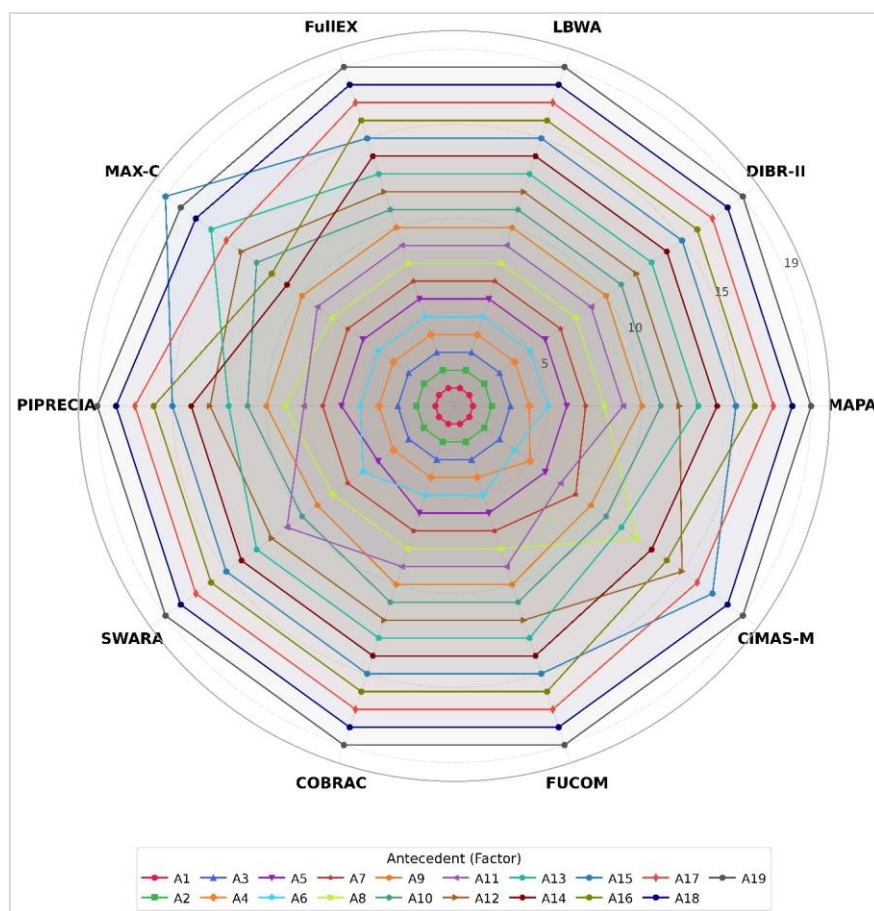


Fig. 4. Ranking of the determinants by various MCDM methods (including the MAPA method)

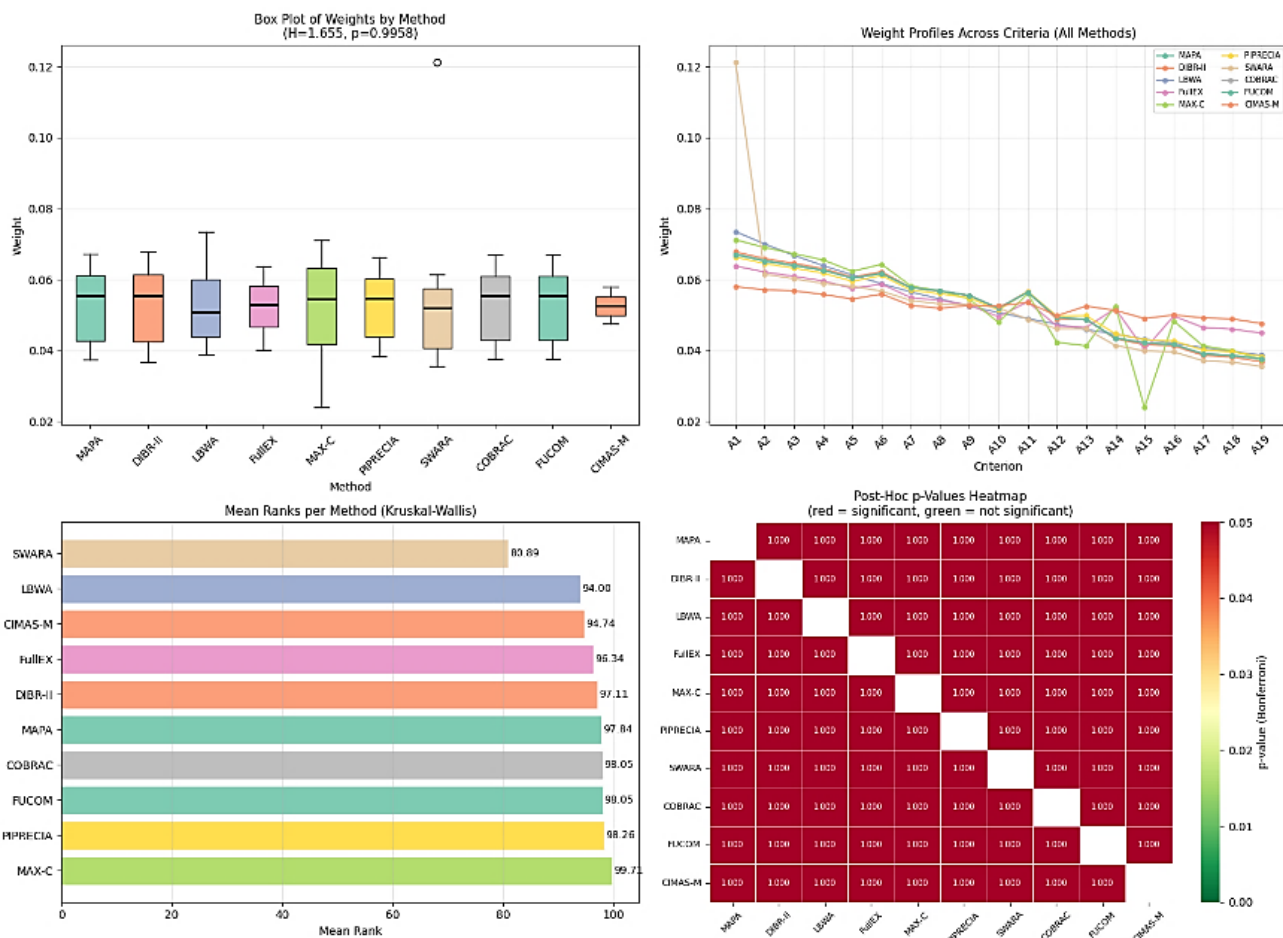


Fig. 5. Results of the Kruskal-Wallis's test

It is observed that despite variations in ζ, λ, θ and τ values there has not been any change in the ranking order of the determinants (Figure 6). To further understand the results, OPS values are visualized under different conditions using heatmaps (Figure 7). The results do not show any major irregularities. Figure 8 reflects that the GSI and MEI are indifferent of changes in ζ and λ . The continuous increase in θ value results into an increase in GSI and MEI. The coefficient τ does not have any impact on GSI. However, reasonably MEI decreases as more penalty are imposed (increasing τ values). The decline in MEI value is observed at a steep rate after $\tau = 2.0$ (Figure 8).

The variations in the priority weights of the different aggregation operators show a non-significant impact on the overall ranking of the determinants (Figure 9). We developed nine experimental cases by reducing the highest calculated weight ($w = 0.215$ of OWG operator) by 10% and adjusting the reduced amount proportionately with the others. We find that there is a similar declining effect on GSI and MEI values (Figure 10).

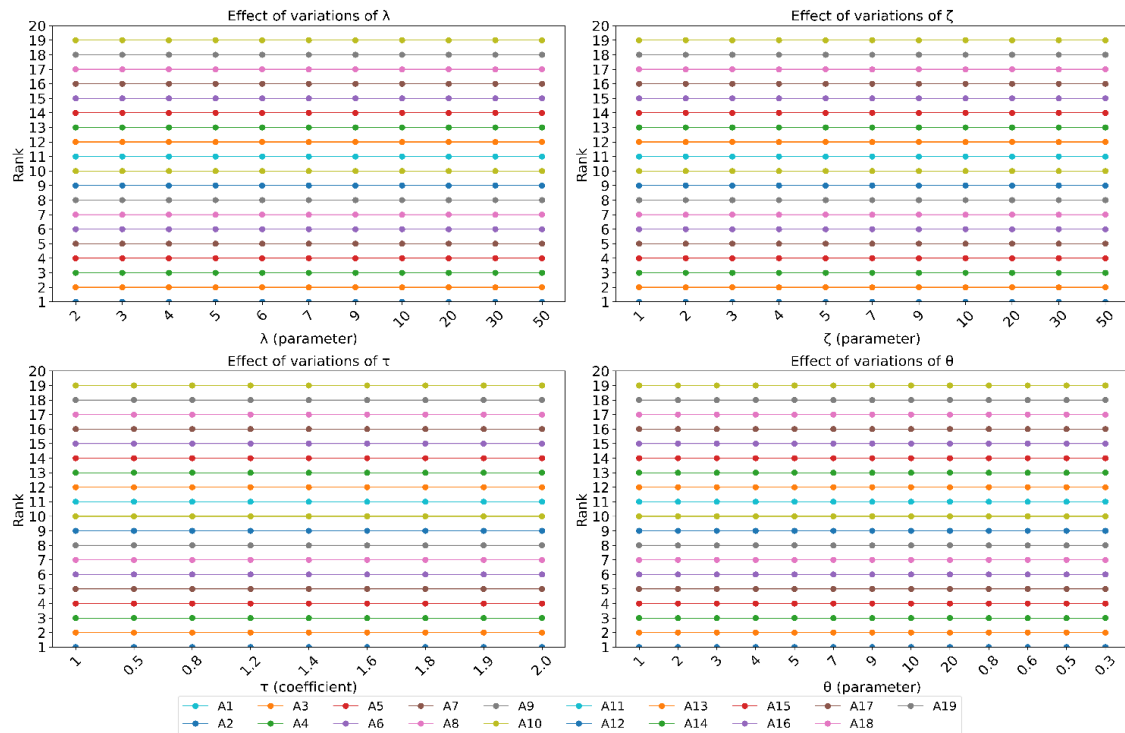


Fig. 6. Effect of variations in parameters and coefficients on the ranking of the determinants

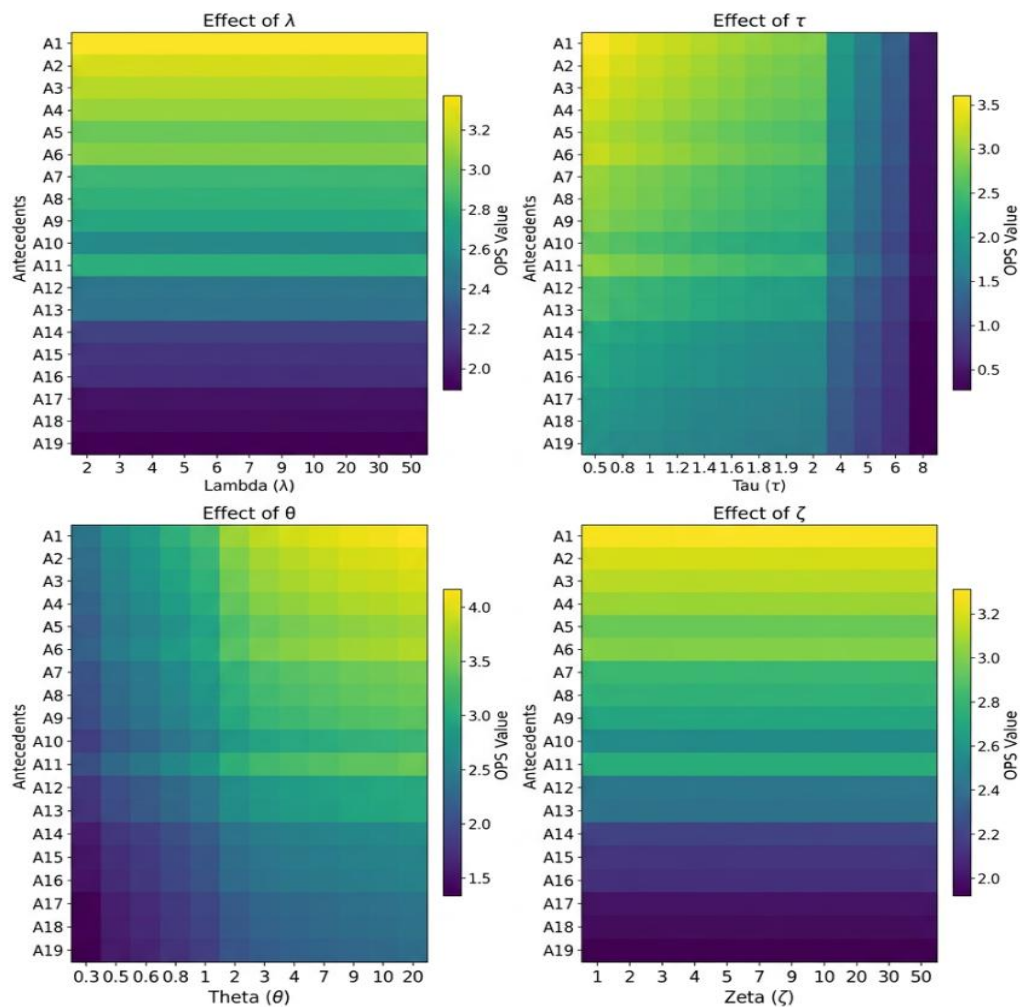


Fig. 7. Effect of variations in parameters and coefficients on the OPS values of the determinants

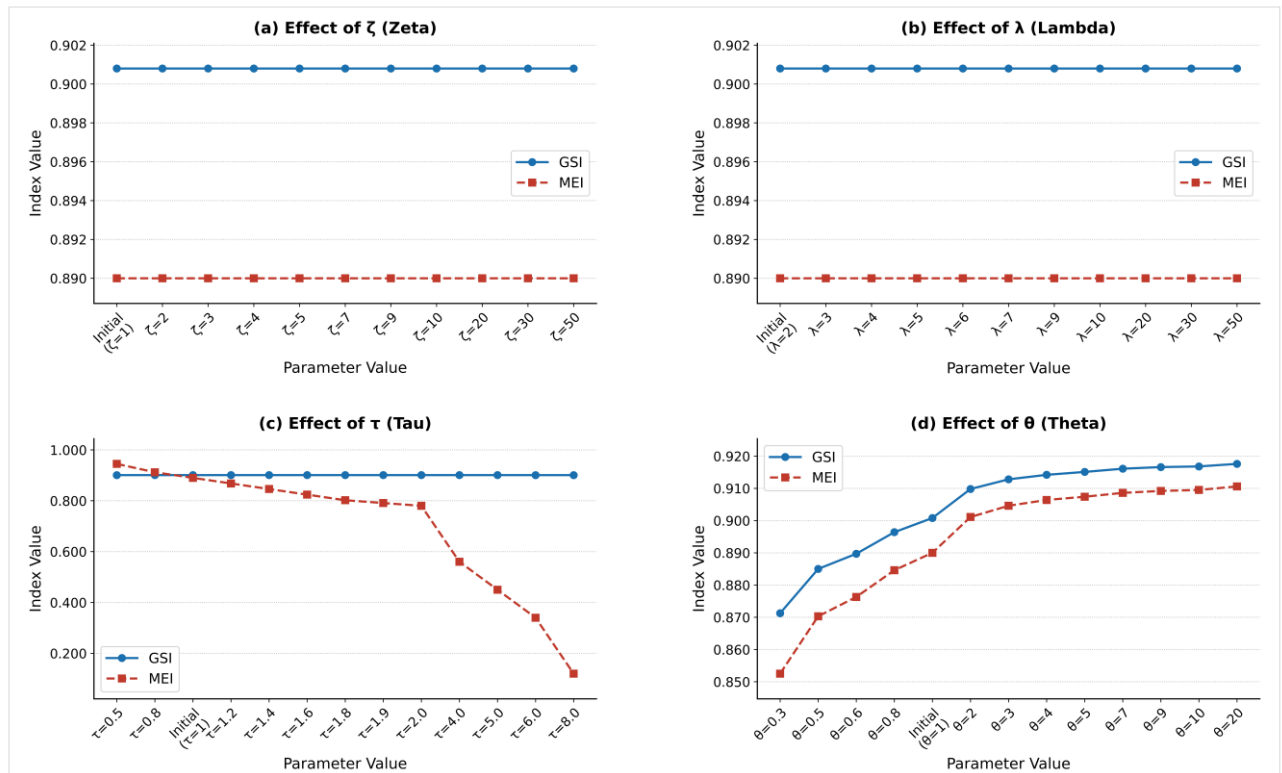


Fig. 8. Effect of variations in parameters and coefficients on model stability and endurance

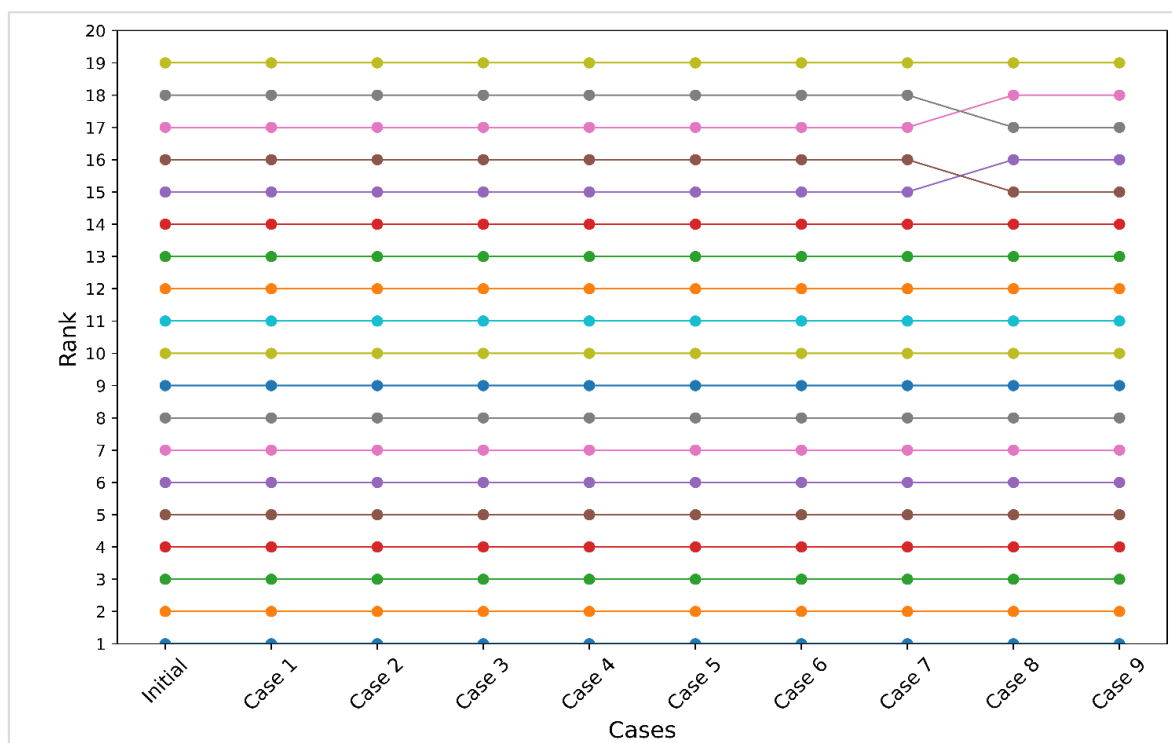


Fig. 9. Effect of changes in priority of the aggregation operators on the ranking

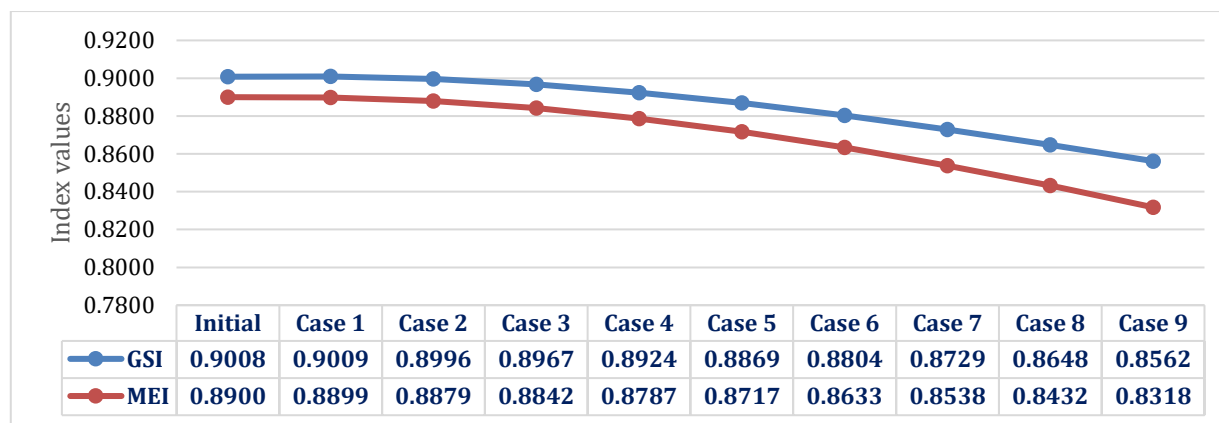


Fig. 10. Effect of changes in priority of the aggregation operators on GSI and MEI

5. Discussion

The empirical and methodological findings of this study support the conceptualization of workplace incivility in health care as a multi-level, systemic phenomenon, rather than an isolated, individual-level behavioral problem. In an effort to capture the linkages and span across levels, the ISM results suggest a clear hierarchical structure of macro-level determinants (A1-A4) of incivility in health care, including gender and social norm bias, silence culture, and weak policy enforcement, that catalyzes organizational and individual outcomes. These results also corroborate earlier theoretical discussions that incivility is rooted in a broader socio-cultural system [1,65-68] and the “spiral effect” proposed by Andersson and Pearson [7], in which incivility carries over across levels.

The MICMAC analysis further supports the aforesaid findings by demonstrating that macro factors function as independent drivers, whereas individual-level determinants (A14-A19) exhibit strong dependency relationships. Recent studies have found that emotional exhaustion, vulnerability, and behavioral responses result from structural and organizational stressors in the workplace [19-20,69,70]. The system functions with strong feedback loops because A5-A13 linkage variables, which include leadership style, workplace culture, and work pressure, create a system in which organizational practices interact with incivility behavior. The study supports the Job Demands-Resources (JD-R) framework by showing how organizational climate and leadership practices mediate the influence of these factors on uncivil behavior [10-11,71].

MAPA method provides detailed insights into the relative importance of various determinants. It simultaneously uses multiple aggregation methods and applies penalties for operator disagreement in the results. MAPA method also enables to analyze the strength of consensus while studying variations in behavior across different operators. In fact, MAPA addresses the existing problems of rank instability and aggregation bias identified by precedent researchers [27]. The implementation of entropy-weighted operators, together with stability indices like GSI, LSI, and MEI, ensures that the resulting priorities maintain both statistical validity and practical value for decision-making. This system becomes essential for complex social systems that require expert judgment in healthcare, as it must assess diverse contexts and personal perspectives.

The study results demonstrate that interventions that focus solely on changing individual behavior will not succeed until organizations implement necessary measures to control organizational culture and leadership responsibility. The healthcare sector should implement systemic changes together with governance systems that are based on organizational culture, according to recent research findings [8,23]. The study contributes to the existing literature by examining technological factors that affect workplace interaction, as digitalization continues to transform professional environments [17-18].

5.1. Research Implications

The current research leaves several managerial, social, and policy implications. From a managerial standpoint, the results suggest that workplace incivility cannot be addressed through isolated efforts (e.g., behavioral training). To instill a civilized culture at the workplace in the healthcare sector, leaders must remain accountable and committed to building a de-stress environment through workload management and resource optimization. The results indicate that organizational and structural issues are paramount. Transparent, assertive communication and structured, unbiased grievance-redressal measures can mitigate workplace incivility.

From a social perspective, this study reveals the prevailing effects of social norms, gender biases, and a silent culture that continue to reinforce the normalization of incivility in healthcare settings. A more holistic approach is required, including socio-cultural reforms and initiatives to break the culture of silence. There is a need for greater awareness, psychological safety, and respect for diversity to challenge the status quo and normalize a culture of respect.

From a policy-making perspective, this study highlights the immediate need for robust policy frameworks and their enforcement. A lack of policy enforcement and accountability was identified as an underlying cause of incivility. There is a need for stronger anti-incivility policies, reporting mechanisms, and monitoring and enforcement mechanisms. Integration of these with digital health policies and workforce well-being can contribute to the long-term sustainability of a humane and healthy healthcare ecosystem.

5.2. Research Limitations and Future Scopes

The current research addresses a topical issue and develops a comprehensive approach to examine the interrelationships among the various determinants of workplace incivility. It also measures the magnitude of importance of these determinants in the eyes of decision makers. Nevertheless, the current work has apparent limitations that highlight several avenues for further extension.

- i. First, the current study is heavily dependent on experts or decision-makers. In this study, the sample size is limited to 32 respondents. Given the complex nature of the healthcare industry and the intricacy of the problem, this sample size may not be adequate. Future work may incorporate responses from a large sample of respondents while ensuring participation across all levels of seniority. In this regard, a multi-group analysis may be designed to discern responses from nurses (in a dedicated group), doctors, and experts (e.g., sociologists, psychologists, and others).
- ii. Second, the paper deals with a behavioral issue. Hence, a mixed study combining qualitative and quantitative responses would be more in-depth and convincing. There is a possibility of a triangulation study to relate the ISM findings with longitudinal behavioral responses to understand the real-time incivility dynamics in healthcare.
- iii. Third, workplace incivility originates on both the patient and the staff/supervisor ends. Hence, it is important to analyze them separately. Also, there is a need to observe the moderating effects of organizational culture, cynicism, and work alienation on the relationship between incivility and the outcomes, like turnover intention and enrichment of quality of work life. The impact of technology has not been studied in-depth in the current study. There is also a need to investigate how socio-cultural norms, power distance, collectivism, and digital maturity influence workplace incivility.
- iv. Fourth, it focuses on the determinants of incivility. However, how these determinants cause incivility and ultimately lead to various risk factors remains unanswered in this work. Future research can address this issue and prioritize the risk factors.

- v. Fifth, the ISM-MICMAC framework overlooks weak, nonlinear, or contextual relationships, including techno-stress or leadership behavior that can have threshold effects. There is a need to extend the framework to fuzzy digraphs or probabilistic causal networks to examine how relationship strength and associated uncertainty affect the hierarchy of incivility drivers.
- vi. Sixth, methodologically, the MAPA method can be further extended by developing an adaptive penalty function, specifically relevant to the socio-behavioral decision-making problem. Moreover, this method can be extended to handle imprecise data under uncertainty using fuzzy, rough, and grey numbers.
- vii. This work presents a scientific methodology to address workplace incivility through structural analysis and prioritization of determinants.

6. Conclusion

A multi-level framework is developed in this paper to model the structural relationships among the determinants of workplace incivility in healthcare, with a focus on nurses, and to prioritize variables based on the opinions of 32 respondents. The determinants are identified through a structured approach drawing on multiple theories, past studies, and expert views. The contextual hierarchical relationships are established through ISM-MICMAC analysis. A new priority assessment method, MAPA, has been developed to determine the weights of the determinants in a group decision-making setup. The analysis reveals deep-rooted drivers like social norms, policy gaps, and organizational culture. The MAPA method demonstrates robustness by accounting for opinion consensus, disagreement, and behavioral flexibility, thereby supporting the findings of the ISM-MICMAC analysis. This work presents a data-driven approach to formulate interventions to address workplace incivility affecting healthcare personnel.

Appendix A

Table A1

Brief descriptions of the factors (determinants) influencing workplace incivility

S/L	Factor (Determinant)	Description
<i>Macro-level</i>		
A1	Gender and social norm bias	This dimension indicates the degree to which societal norms and cultural beliefs foster discrimination based on gender, caste, and identity. This aspect highlights how stereotypes, domineering attitudes, and the hierarchy of the social order encourage uncivil conduct and insensitivity to incivility in the workplace.
A2	Silence culture and the blame game	This is an environment, socially and organizationally, in which people are afraid or reluctant to report incivility for various reasons, including fear. This environment includes elements such as victim-blaming, ignoring misbehavior, and discouraging open dialogue, all of which allow incivility to thrive.
A3	Social identity disadvantage	This factor refers to the probability of experiencing incivility because of one's identity, such as gender, age, caste, or religion. This concept is based on the reality that systemic forms of identity-based inequality and discrimination lead to unequal probabilities of being treated uncivilly.
A4	Lack of structured Policy and enforcement	This element is an indicator of the weakness of policies and systems within institutions that would curb incidences of incivility in the workplace. The absence of regulatory systems, rule enforcement, and an accountability system contributes to this problem.

Table A1

Continued

S/L	Factor (Determinant)	Description
<i>Meso-level (organizational)</i>		
A5	Workplace resource constraints	This factor addresses the strain associated with increased population pressure and limited resources. Environmental and geographical constraints increase workload, which in turn heightens stress and reduces patience, resulting in conflict.
A6	Workplace culture and respect	This element encompasses the common organizational beliefs about mutual respect and acceptable behavior. This can be a toxic organizational culture, favoritism, a lack of encouragement, or inappropriate actions within the organization that affect relationships among employees.
A7	Misuse of power and inequality	It describes how people use their position and abuse their power. It is used in cases where those in high positions abuse their power, causing others to fear them and be treated unprofessionally. This results in their inability to complain.
A8	Lack of staff and infrastructure	This factor encompasses deficiencies in manpower, infrastructure, and necessary facilities within the work environment. Overcrowding, inadequate security measures, and poor support systems create an environment conducive to stress and frustration, thereby increasing the likelihood of such behavior.
A9	Work pressure	It embodies the strain associated with work overload, long working hours, and challenging shift work systems. This construct describes how job strain leads to exhaustion and frustration, which make an individual more likely to be less civil towards their colleagues during workplace exchanges.
A10	Skill and communication gaps	It involves issues related to professional incompetence, such as communication challenges, inexperience, and workplace mistakes. Such issues usually result in confusion, frustration, and conflict, which can easily turn into incivility among co-workers, patients, and other individuals.
A11	Negative leadership style	This construct is characterized by authoritarian leadership styles that are unsupportive and unjust. This is evidenced by coercive decision-making, a lack of cooperation, and inadequate managerial support, thereby creating stressful work environments that model bad behavior and spread incivility throughout the organization.
<i>Collective (Workgroup Level)</i>		
A12	Lack of a healthy team culture	This is an element of negative team dynamics, such as conflict, distrust, uncooperativeness, and a lack of collegiality. This element demonstrates how tense interpersonal relations among team members create an environment characterized by incivility.
A13	Workplace politics and favoritism	It describes the presence of internal political dynamics, favoritism, and self-interested activities within the organization. It indicates that inequalities in opportunities and lobbying, and biases in decision-making, will undermine trust and fairness, leading to conflicts among people.
<i>Technological</i>		
A14	Lack of human touch (Technology divide)	This aspect indicates reduced interaction resulting from reliance on digital technology. The limitation of personal interaction causes a lack of empathy and misunderstanding, leading to a lack of personal interaction in communication.
A15	Techno stress at work	This construct refers to stress arising from overreliance on digital technology, including information overload, multitasking, and constant connectivity. The idea here is that such stress causes a loss of emotional control, leading to frustration and increasing the chances of incivility at work.
A16	Lack of technology support and training	This is related to the inability of organizational members to learn, understand, and receive technical assistance with using technological devices. This arises because technology is forcibly adopted by people who fail to receive sufficient guidance and assistance.

Table A1

Continued

S/L	Factor (Determinant)	Description
<i>Individual Level</i>		
A17	Unpleasant peer behavior	This construct captures the behavioral tendencies that increase the likelihood that individuals will behave in an uncivil manner. Such inclinations are associated with factors such as a negative attitude, poor interpersonal skills, and situational stress.
A18	Emotional Stress and Poor Control	This variable is concerned with the failure to control emotions owing to stress or anxiety. This is because a lack of control over emotions results in impulsive behavior, misinterpretation of circumstances, and an increased tendency towards incivility in the workplace. It indicates individual differences in the form of lower status, less experience, minority status, or high-role interactions, which expose employees to uncivil behavior.
A19	Self-vulnerability to incivility	This construct demonstrates how some employees are more vulnerable than others to victimization due to organizational structures.

Table A2

Comparison of group decision-making methods for criteria weighting

Feature	Method						
	MAPA	CIMAS	FullEX	FUCOM	DIBR-II	BWM	SWARA
Use of multiple aggregation operators	✓	X	X	X	X	X	X
Meta-aggregation (aggregation of aggregators)	✓	X	X	X	X	X	X
Initial criteria sorting	X	X	X	✓	✓	X	✓
Reference criteria selection	X	X	X	X	X	✓	X
Pairwise comparison of criteria	X	X	X	✓	✓	✓	✓
Behavioral attitude consideration	✓	X	X	X	X	X	X
Expert reputation consideration	X	✓	✓	X	X	X	✓
Consensus achievement focus	✓	✓	✓	X	✓	X	✓
Inherent consistency check	X	X	X	✓	X	✓	X
Embedded stability assessment	✓	X	X	X	X	X	X
Reliability calculation	✓	✓	✓	X	✓	X	✓
Penalization of inconsistency	✓	X	X	X	X	X	X
Computational complexity	Moderate	Low	Low	Low	Low	Moderate	Low

(Criteria Importance Assessment (CIMAS) [55], FullEX [56], Full Consistency Method (FUCOM) [29], Defining Interrelationships Between Ranked Criteria II (DIBR-II) [71])

Table A3

The initial reachability matrix

De t.	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A17	A18	A19	Driving power
A1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	17
A2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	17
A3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	19
A4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	19
A5	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	15
A6	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	15
A7	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	15

Table A3
Continued

Det.	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A17	A18	A19	Driving power
A8	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	15
A9	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	15
A10	0	0	0	0	0	0	0	0	0	1	1	1	0	1	1	1	1	1	1	9
A11	0	0	0	0	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	14
A12	0	0	0	0	0	1	0	0	0	1	1	1	1	1	1	1	1	1	1	11
A13	0	0	0	0	1	1	1	0	0	0	1	1	1	1	1	1	1	1	1	12
A14	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	6
A15	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	6
A16	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	6
A17	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	6
A18	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	6
A19	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	6
Dependence power	4	4	4	4	11	12	11	10	10	11	13	13	12	19	17	17	19	19	19	

Rule: Assign "1" to the cell (i, j) contains "V" or "X". The counterpart, i.e., the (j, i) cell will be assigned with "0" (corresponding to "V") or "1" (corresponding to "X"). Assign "0" to the cell (i, j) contains "A" or "O". The counterpart, i.e., the (j, i) cell will be assigned with "1" (corresponding to "A") or "0" (corresponding to "O")

Table A4
The final reachability matrix

Det.	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A17	A18	A19	Driving power
A1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1*	1*	1	1	1	19
A2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1*	1*	1	1	1	19
A3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	19
A4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	19
A5	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	15
A6	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	15
A7	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	15
A8	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	15
A9	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	15
A10	0	0	0	0	1*	1*	1*	1*	1*	1	1	1	1*	1	1	1	1	1	1	15
A11	0	0	0	0	1	1	1	1	1	1*	1	1	1	1	1	1	1	1	1	15
A12	0	0	0	0	1*	1	1*	1*	1*	1	1	1	1	1	1	1	1	1	1	15
A13	0	0	0	0	1	1	1	1*	1*	1*	1	1	1	1	1	1	1	1	1	15
A14	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	6
A15	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	6
A16	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	6
A17	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	6
A18	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	6
A19	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	6
Dependence power	4	4	4	4	13	13	13	13	13	13	13	13	13	19	19	19	19	19	19	

Rule: Apply the transitivity property. If A_i influences A_j and A_j influences A_k ; then A_i indirectly influences A_k . Replace the corresponding cell value "0" with 1* to indicate that there exists an indirect relationship. In case there is no direct or indirect relationship, let the value "0" remain.

Table A5

Evaluation of the determinants of workplace incivility by experts

Det.	Experts' evaluation of the determinants															
	E-1	E-2	E-3	E-4	E-5	E-6	E-7	E-8	E-9	E-10	E-11	E-12	E-13	E-14	E-15	E-16
A1	5	5	5	5	5	5	5	5	4	5	4	5	5	5	5	4
A2	5	4	5	4	5	5	5	5	5	4	4	4	4	5	5	4
A3	4	5	4	5	4	5	5	5	5	5	5	4	4	5	5	5
A4	4	5	4	4	5	4	5	3	4	5	5	4	4	4	5	5
A5	4	4	5	4	4	4	5	5	4	4	4	5	5	4	5	4
A6	4	4	5	5	5	4	4	4	5	5	5	5	4	4	4	4
A7	4	3	4	3	3	5	4	4	5	4	4	4	3	4	4	4
A8	5	3	4	4	5	4	4	3	4	5	4	4	4	3	4	5
A9	4	4	5	4	4	4	4	4	4	5	4	4	4	4	4	4
A10	4	4	3	3	4	4	4	4	4	2	4	3	2	4	4	4
A11	5	4	4	4	4	5	4	3	3	4	5	4	4	4	4	4
A12	3	3	4	3	2	5	2	4	3	4	3	4	5	4	3	5
A13	3	4	4	3	2	4	3	4	3	3	3	3	3	4	3	3
A14	3	4	3	3	4	3	2	2	3	3	4	3	4	2	2	3
A15	3	2	3	2	4	3	3	3	3	3	3	4	3	3	3	2
A16	3	2	2	3	2	3	4	3	4	4	2	3	3	3	2	3
A17	2	2	3	3	3	2	3	2	3	2	2	3	2	4	3	2
A18	2	2	3	3	3	2	2	4	3	3	3	4	4	2	2	2
A19	4	3	3	2	2	1	3	4	2	4	3	2	3	3	4	3

Det.	Experts' evaluation of the determinants															
	E-17	E-18	E-19	E-20	E-21	E-22	E-23	E-24	E-25	E-26	E-27	E-28	E-29	E-30	E-31	E-32
A1	5	5	4	4	5	5	5	4	4	5	4	5	5	5	4	5
A2	5	4	4	5	5	5	4	4	5	5	5	5	4	4	5	5
A3	5	5	4	5	4	4	4	4	4	5	4	4	4	5	4	4
A4	4	4	5	4	4	4	5	4	5	4	4	5	4	5	5	5
A5	4	3	4	5	3	4	5	4	3	4	5	4	4	4	5	5
A6	5	4	5	5	4	4	3	4	4	5	4	4	4	5	4	4
A7	4	4	4	5	3	5	3	5	4	4	4	3	5	5	5	5
A8	4	5	3	5	4	3	4	5	4	3	3	4	3	3	5	5
A9	3	3	4	3	4	4	5	2	5	3	3	3	5	4	4	4
A10	4	4	4	3	3	4	4	4	3	5	3	3	4	4	4	4
A11	5	3	3	4	3	4	4	3	4	3	5	4	4	4	4	5
A12	4	4	3	3	3	3	3	4	3	3	3	4	5	3	3	3
A13	3	4	4	3	3	4	4	3	4	3	4	3	5	4	3	4
A14	3	3	2	3	3	4	3	3	3	3	3	4	4	3	3	3
A15	2	4	4	3	3	3	5	4	3	2	2	3	3	2	3	2
A16	2	3	3	2	4	3	3	3	3	2	3	3	3	4	4	3
A17	3	2	3	4	2	2	3	3	3	2	3	4	3	4	3	3
A18	2	3	3	2	2	2	3	3	4	3	3	3	2	3	3	2
A19	3	3	2	3	2	2	3	2	2	2	3	3	2	3	2	2

(5: Strongly agree; 4: Agree; 3: Neutral; 2: Disagree; 1: Strongly disagree)

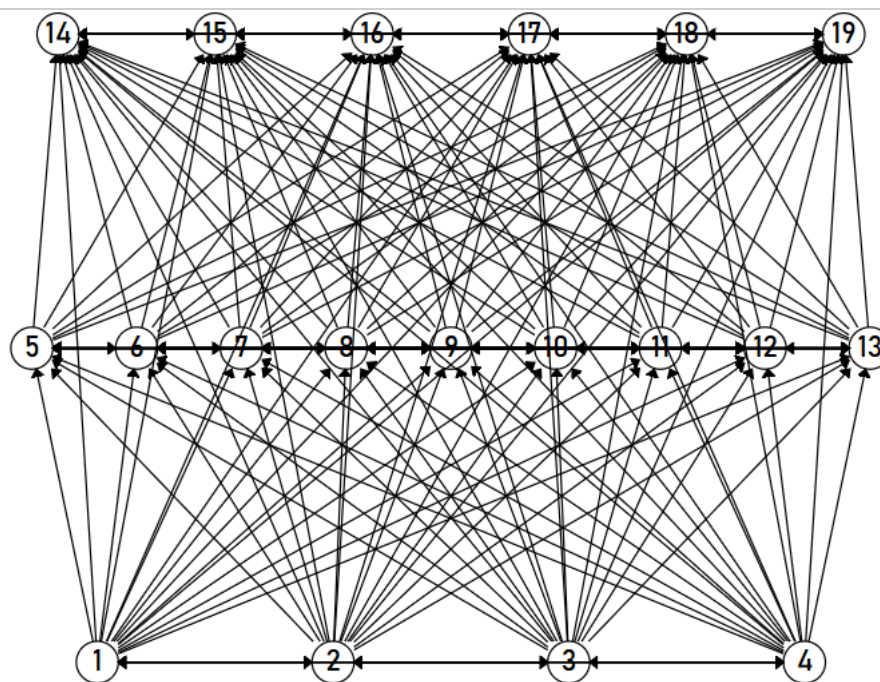


Fig. A1. The initial ISM model

Note: Unidirectional arrows indicate one-way relationships between the respective determinants. The bidirectional arrows represent mutual influence

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Conflicts of Interest

The authors declare no conflicts of interest.

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