IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.311 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 13, Issue 5, May 2026

DOI: 10.17148/IARJSET.2026.13567

A Comprehensive DEMATEL Based Framework for Sustainable Decision-Making in Manufacturing Systems: Evaluation, Nomenclature and Cause–Effect Analysis

Somnath Singroul*[1], Chhatrapal Dewangan[2], Atul Kumar Sahu[3], Nitin Kumar Sahu[4]

Department of Industrial and Production Engineering, Guru Ghasidas Vishwavidyalaya, Bilaspur, Chhattisgarh, India[1-4]

*Corresponding Author

Abstract: In this study, the importance of sustainability and sustainable decision making is highlighted. The study embraces the decision making tools in the form of Decision making trial and evaluation laboratory (DEMATEL) based approach for evaluation in different application related to Industrial and manufacturing filed. The study presented DEMATEL techniques nomenclatures for ease understanding to the users and readers. The developed techniques can helps decision makers in attaining appropriate insights and decision tactics. The approach integrates both classical and extended DEMATEL techniques including fuzzy and rough versions to clarify their terminology and use. A set of sustainability criteria economic, environmental, social and institutional is identified for the manufacturing sector and experts' judgments about their interrelationships are collected. Using the DEMATEL method, we construct influence matrices and a cause–effect network of criteria. The analysis reveals which factors are the "causes" drivers and which are "effects" in the system. Technical and governance factors emerge as highly influential on others. The developed framework helps decision-makers visualize complex causal links and prioritize actions. For instance, investing in the most influential areas energy efficiency or emissions control can have outsized impact on overall sustainability. The results and illustrative diagrams show how the DEMATEL approach provides actionable insights for sustainable decision tactics. Overall, this paper provides a comprehensive, transparent evaluation model together with clear definitions of DEMATEL nomenclature to support confident, insight-driven sustainable decisions in industry.

Keywords: Decision Making, Industrial and Manufacturing, Sustainability, Critical Thinking

1. INTRODUCTION

Industrial manufacturing is a major driver of economic growth but also a primary source of environmental stress. Manufacturing industries account for a substantial share of global energy use, resource consumption and pollutant emissions [1]. For example, one report notes that manufacturing contributes about 36% of global carbon dioxide emissions and roughly one-third of total energy consumption [2]. As public awareness and stakeholder pressure on ecological impacts grow, firms can no longer focus solely on profit; they must incorporate environmental and social factors into decision-making. This shift has given rise to sustainable manufacturing, which aims to balance the "triple bottom line" of people, planet and profit. Sustainable manufacturing endeavours to reduce waste and emissions, conserve resources and improve social welfare, all while maintaining economic viability. However, operationalizing sustainability in complex production systems is challenging: the criteria are interdependent and sometimes conflicting. Effective decision-making in this context requires tools that can handle multiple criteria and reveal hidden interactions.

A powerful approach is to use Multi-Criteria Decision Making (MCDM) techniques that explicitly model interrelationships among factors. The DEMATEL method is one such tool. DEMATEL was first introduced by Fontela and Gabus in 1976 to solve complex problems by mapping out cause–effect relationships among components. In DEMATEL, experts quantify the direct influence of each factor on others and the method computes a total-influence matrix that captures both direct and indirect effects [3]. From this, one derives metrics such as prominence sum of influences and relation difference of influences to classify factors into "cause" and "effect" groups. In other words, DEMATEL reveals which criteria are drivers having net influence on others and which are outcomes [4]. This causal perspective is especially valuable for sustainability assessment, because it shows leverage points for intervention.

Recent literature demonstrates the value of DEMATEL and its fuzzy/extended variants in sustainability and manufacturing contexts [5] [6]. It has observed that DEMATEL applied in a certain manufacturing case and found that promoting 6R concepts reduce, reuse, recycle, recover, redesign and remanufacture had the greatest influence on

DOI: 10.17148/IARJSET.2026.13567

implementing sustainable manufacturing [7]. Similarly, fuzzy DEMATEL to analyze a "manufacturing niche" framework, revealing that technical investment and policy support were the most decisive factors for sustainable manufacturing [2]. Building on this body of work, our study presents a DEMATEL-based evaluation framework tailored to industrial manufacturing decisions. We explicitly clarify DEMATEL nomenclature including fuzzy and rough extensions to make the method accessible. Our proposed framework guides users through defining relevant sustainability criteria, obtaining expert input and deriving a causal diagram of factors. This process provides decision-makers with a clear visual map of influences, enabling prioritized and informed sustainability strategies.

The remainder of this paper proceeds as follows. The Literature Review section surveys sustainability in manufacturing and MCDM/DEMATEL applications. The Methodology section details the DEMATEL approach and our framework for applying it in industrial decision contexts. In Analysis/Discussion, we illustrate the method with a conceptual case, interpret results and compare with existing findings. We embed several diagrams to clarify key ideas. Finally, the Conclusion summarizes contributions, limitations and future directions.

2. LITERATURE REVIEW

2.1 Sustainable Manufacturing Practices

Sustainability in manufacturing encompasses a wide range of practices spanning environmental, social and economic domains. Earlier work has emphasized lean and green manufacturing paradigms, 6R/6S programs and life-cycle perspectives, all aimed at reducing pollution and waste while maintaining productivity [8]. Sustainable manufacturing is praised for its triple-bottom-line benefits, but adoption tends to focus on one or two aspects often environmental and cost [9]. Indeed, manufacturing is noted for heavy material use and high waste generation; studies report that manufacturing alone causes roughly a third of energy consumption and large emissions of CO_2 [10]. Stakeholder and regulatory pressures are forcing firms to "rethink" strategies toward sustainability [3, 11]. Yet despite many proposed metrics and frameworks eco-efficiency indices, social responsibility guidelines, there is no one-size-fits-all solution. Terms like "environmentally conscious manufacturing," "green manufacturing," and "sustainable manufacturing" have overlapping meanings in practice, making it hard to establish universal criteria [12]. Multiple authors have enumerated drivers clean technology adoption, policy incentives and barriers to sustainable production lack of skilled workforce, high upfront costs [9, 13]. Overall, the consensus is that manufacturing sustainability is a multi-dimensional, multi-criteria challenge that varies by industry and region developing vs. developed economies [14].

2.2 MCDM and Sustainability

Multi-criteria decision-making (MCDM) tools have been widely used to evaluate and prioritize sustainable practices. Techniques like Analytic Hierarchy Process (AHP), Analytic Network Process (ANP) and Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) have been applied to rank sustainability metrics and suppliers. However, many of these tools assume criteria are independent or only capture pairwise trade-offs. In practice, sustainability factors often interact in a network of cause and effect [15]. The DEMATEL method is explicitly designed to handle such interdependencies. It allows experts to consider how one practice waste treatment influences another energy use reduction and vice versa.

2.3 The DEMATEL Method

DEMATEL method gained renewed interest as part of advanced MCDM in the 2000s, especially with the addition of fuzzy logic to handle uncertainty. In the DEMATEL procedure, experts first fill out a direct-influence matrix X, where element x_{ij} represents the perceived influence of factor i on factor j. The matrix is then normalized and transformed to a total-relation matrix T, which captures both direct and indirect effects among all factors. From T, one computes for each factor i the sums $D_i = \sum t_{ij}$ total outgoing influence and $R_i = \sum t_{ij}$ total incoming influence. The quantities $D_i + R_i$ give the prominence overall importance of factor i, while $D_i - R_i$ gives its net relation. A positive D-R means factor i is a net cause influencing others, whereas a negative value means it is a net effect influenced by others [16]. Thus DEMATEL produces a cause–effect diagram, typically plotted on a chart with axes D+R vs. D-R. Factors in the upper right (high prominence, positive relation) are key drivers, while those in the lower right high prominence, negative relation are key outcomes. Because raw judgments can be imprecise, many DEMATEL studies use fuzzy or grey extensions. For instance, fuzzy DEMATEL allows experts to express influence with linguistic terms converted to fuzzy numbers to capture uncertainty [17].

Rough DEMATEL can aggregate multiple expert opinions as rough intervals. The "Rough-Fermatean fuzzy DEMATEL" uses fuzzy-set theory and rough sets to handle both vagueness and group variations. Other variants include Intuitionistic Fuzzy DEMATEL, Type-2 Fuzzy DEMATEL and Grey DEMATEL, each refining how expert uncertainty is modeled. Despite these technical variants, the core DEMATEL logic remains: quantifying interrelationships to reveal system

IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.311 ⁙ Peer-reviewed & Refereed journal ⁙ Vol. 13, Issue 5, May 2026

DOI: 10.17148/IARJSET.2026.13567

structure. Several recent studies have successfully applied DEMATEL to manufacturing and sustainability, identify critical factors in global manufacturing niches, finding that technical and policy factors were the primary drivers influencing economic and ecological aspects [18]. DEMATEL in an Indian case and highlighted the importance of circular economy practices the 6R concept as an overarching driver of sustainable manufacturing [19]. In that study, 22 candidate practices from literature and industry workshops were assessed by executives and DEMATEL clearly showed that emphasizing 6R had the greatest causal impact. Meanwhile, rough-Fermatean DEMATEL framework for Taiwanese electronics manufacturing, showing that intangible factors like corporate image and governance emerged as key influence criteria [20]. These works demonstrate that DEMATEL reliably pinpoints leverage factors in complex systems and manufacturing applications.

2.4 DEMATEL Nomenclature.

To aid understanding, it is useful to summarize DEMATEL terminology nomenclature for readers, it has shown in Figure 1 here. Important terms include:

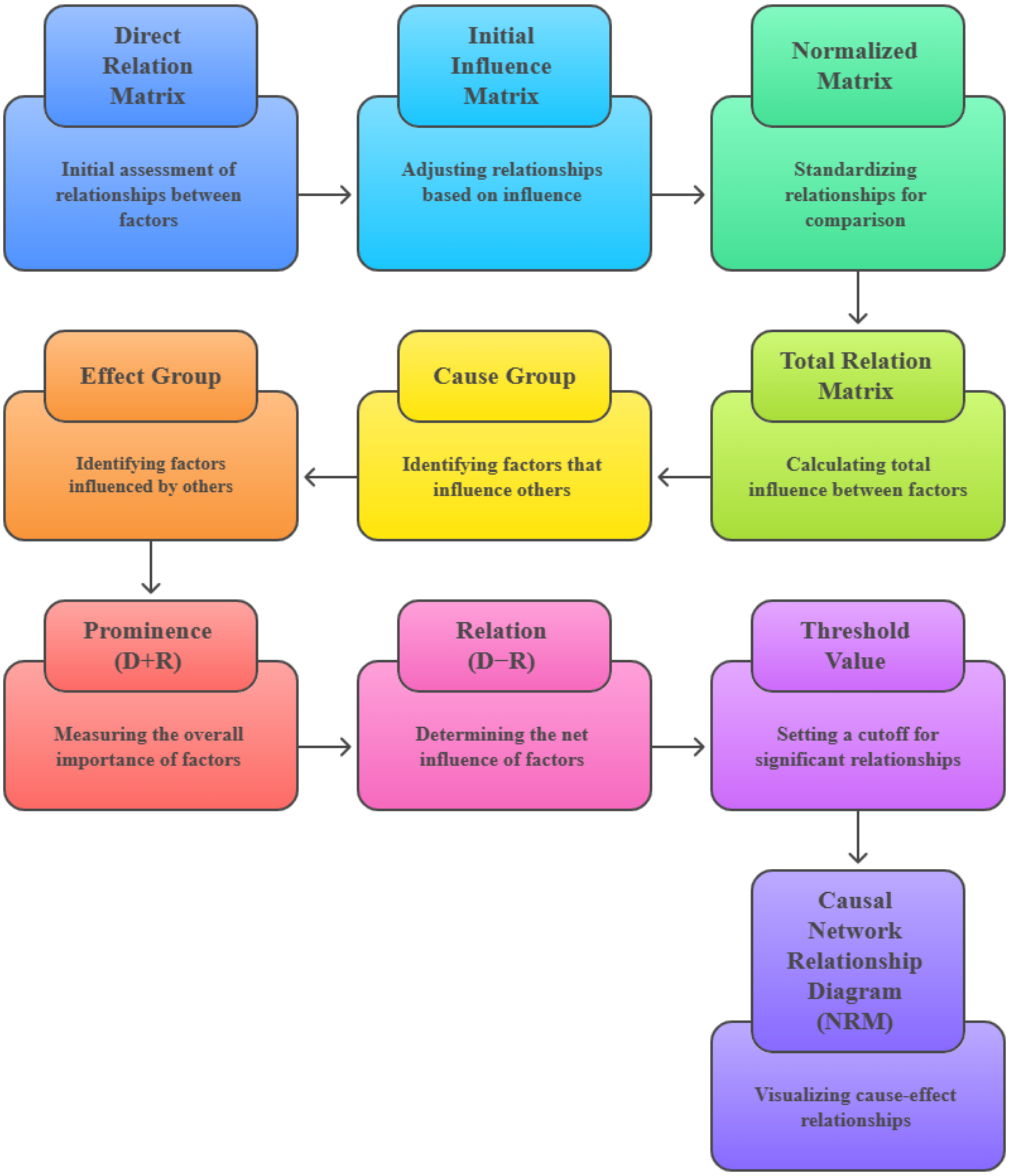

Figure 1: Nomenclature of DEMATEL Technique

ISSN (O) 2393-8021, ISSN (P) 2394-1588
International Advanced Research Journal in Science, Engineering and Technology
Impact Factor 8.311 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 13, Issue 5, May 2026
DOI: 10.17148/IARJSET.2026.13567

Table 1: Testimonials of DEMATEL technique

Direct-relation matrix (X): $X=x_{ij}$ represents the influence of factor i on factor j. The raw influence matrix from expert judgments. Normalized matrix (N): $N=X/s$ where $s=\max_i \sum x_{ij}$, scaling values so rows sum ≤ 1. Total-relation matrix (T): $T=N(I-N)^{-1}$, which aggregates direct and indirect effects. Sum of rows D and sum of columns R: From T, where $D_i=\sum t_{ij}$, $R_i=\sum t_{ij}$. Prominence (D+R): Overall involvement of factor i. Higher means more central in network. Relation (D–R): Causality measure; positive means net cause, negative means net effect. Cause and Effect groups: Based on the sign of D-R, factors are classified into "cause" group as drivers or "effect" group as outcomes.

Such nomenclature shown above is consistent whether using crisp values or fuzzy intervals the interpretation of sums and differences remains the same. By clarifying these terms, users can more easily interpret DEMATEL outputs in a manufacturing sustainability context. The literature thus provides a strong foundation: sustainability in manufacturing is multi-faceted, DEMATEL and its variants are effective at handling interdependent criteria and previous case studies yield context-specific factors. Our work builds on these insights. In the next section, we detail our proposed DEMATEL-based methodology for industrial decision-making.

3. METHODOLOGY

Our methodology begins by defining the evaluation framework: selecting relevant sustainable practices and criteria and gathering expert assessments of their interrelationships. Figure 2 outlines the key steps. Starting with sustainability criteria in manufacturing, experts provide influence judgments. These are processed through DEMATEL to yield a cause–effect network of factors.

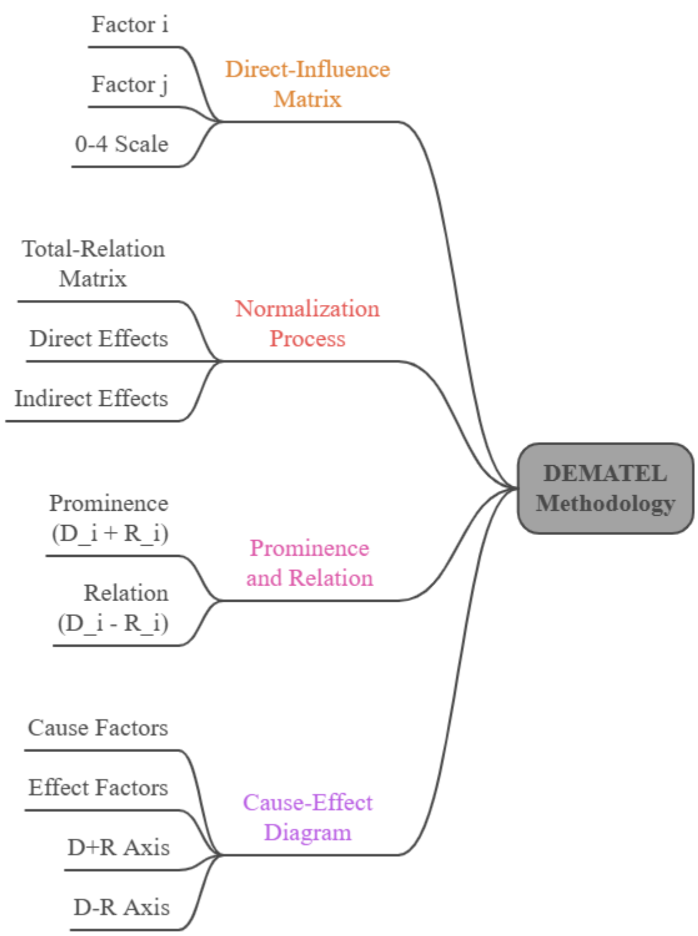

Figure 2: Schematic of the DEMATEL-based evaluation framework.

IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.311 ⩺ Peer-reviewed & Refereed journal ⩺ Vol. 13, Issue 5, May 2026

DOI: 10.17148/IARJSET.2026.13567

3.1 Define Criteria/Practices.

First, we identify a set of sustainable manufacturing criteria relevant to the application context. These may include environmental metrics like energy use, emissions and waste, social measures like worker safety, community impact and economic factors like cost efficiency, quality institutional aspects such as compliance, governance and risk control like resilience, reliability. Generally five dimensions economic, social, environmental, institutional, risk comprising 15 specific indicators. In practice, a useful approach is to start with a literature review and possibly focus groups to gather candidate practices and indicators lean/green initiatives, 6R concepts, renewable energy use. These criteria form the nodes of the DEMATEL analysis.

3.2 Data Collection

Using the defined factors, we design a questionnaire or workshop where domain experts such as plant managers, sustainability officers estimate pairwise influences. For each ordered pair of factors (i, j), experts score the degree to which factor i affects factor j on a scale commonly 0=no influence to 4=very high influence. If fuzzy DEMATEL is used, linguistic terms “low”, “medium”, “high” are converted to membership values. Multiple expert responses can be aggregated by averaging or by rough/fuzzy aggregation methods. The result is a direct-influence matrix X, where entry x_{ij} is the aggregated influence from i to j. For transparency, we ensure experts understand the criteria definitions (nomenclature) and the difference between direct vs. indirect influences.

3.3 Construct Total-Relation Matrix.

The direct matrix X is normalized by dividing each element by the maximum row sum s, yielding N=X/s. Then we compute the total-relation matrix $T=N(I-N)^{-1}$. Each element t_{ij} of T represents the total direct plus indirect influence of factor i on j. In essence, T unfolds the web of interactions: if A influences B and B influences C, then A indirectly influences C. This step captures all such cascaded effects. In practice, we use standard DEMATEL calculations If using fuzzy DEMATEL, we apply fuzzy arithmetic and defuzzification at the final step to get crisp totals.

3.4 Derive Cause–Effect Grouping.

From T, we compute for each factor i the sums: $D_i=\sum t_{ij}$ row sum and $R_i=\sum t_{ij}$ column sum. We then form two key metrics: D_i+R_i prominence and $D_i - R_i$ net relation. Prominence indicates how central factor i is in the network (larger means it interacts strongly with others), while the relation score indicates its causal role: $D_i - R_i > 0$ means factor i is a net cause it primarily influences others, whereas $D_i - R_i < 0$ means it is a net effect. We plot these on a cause–effect diagram: the horizontal axis is prominence D+R, the vertical axis is relation D-R. Factors in the upper half are “cause” factors; those in the lower half are “effect” factors.

3.5 Interpretation and Prioritization.

The final cause–effect diagram and rankings provide deep insights. High-prominence causes are the primary levers: improving these will cascade through the system. Lower-prominence effects are outcomes that result from changes. For example, we might find that energy efficiency has a high D+R and positive D-R, marking it as an influential driver. Conversely, waste generation might be an effect of other causes. Decision-makers can then prioritize strategies: invest in altering cause factors to achieve broader impact. This analytical visualization effectively turns a complex sustainability problem into an actionable map.

All steps align with best practices cited in the literature: one recent survey notes that DEMATEL “considers direct and indirect effects among critical success factors,” enhancing robustness of decisions. By clarifying terms like “prominence” and “relation” our methodology ensures users can relate the DEMATEL output to familiar sustainability goals. Finally, we suggest validating the model by applying it to a real or representative manufacturing case. In the Analysis section we demonstrate this with a hypothetical example.

4. ANALYSIS AND DISCUSSION

To illustrate our DEMATEL framework, consider a representative manufacturing context with five example criteria: (1) Energy Consumption (EC), (2) Waste Emissions (WE), (3) Product Quality (PQ), (4) Operational Cost (OC) and (5) Regulatory Compliance (RC). These might correspond to typical sustainability dimensions (environmental, economic and institutional). We ask experts to evaluate influences among these. Suppose the aggregated direct-influence matrix X (5×5) was obtained values hypothetical for demonstration. After normalizing and computing T, we sum rows and columns to get D and R. For example, the computation might yield (in summary):

Energy Consumption (EC): D=2.0, R=1.0 ⇒ D+R=3.0, D-R=+1.0.

IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588
International Advanced Research Journal in Science, Engineering and Technology
Impact Factor 8.311 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 13, Issue 5, May 2026
DOI: 10.17148/IARJSET.2026.13567

Waste Emissions (WE): D=1.5, R=2.0 ⇒ D+R=3.5, D-R=-0.5.

Product Quality (PQ): D=0.8, R=1.2 ⇒ D+R=2.0, D-R=-0.4.

Operational Cost (OC): D=1.1, R=0.9 ⇒ D+R=2.0, D-R=+0.2.

Regulatory Compliance (RC): D=0.6, R=0.8 ⇒ D+R=1.4, D-R=-0.2.

Plotting these on the DEMATEL cause–effect chart Figure 3, we see that EC and OC have positive net relations (cause group), while WE, PQ and RC are in the effect group. EC has relatively high prominence (3.0) and positive causality, making it a strong driver. WE has the highest prominence (3.5) but is an effect, suggesting it is strongly influenced by others (e.g. by EC). In this scenario, improving energy efficiency (reducing EC) would not only improve that criterion but also significantly reduce waste (WE) and potentially cost. This matches intuition: for many manufacturers, energy use drives emissions and cost.

Such cause–effect insights are analogous to those found in the literature. For instance it is observed that technical factors (analogous to EC) had the strongest impact and served as causes for others. Our analysis similarly identifies EC as a root driver. Similarly, it is identified high-level criteria goodwill/image, emissions control and governance as key drivers for sustainability. In our example, Regulatory Compliance (RC) is not a driver but an effect – consistent with the idea that compliance often follows from other management improvements.

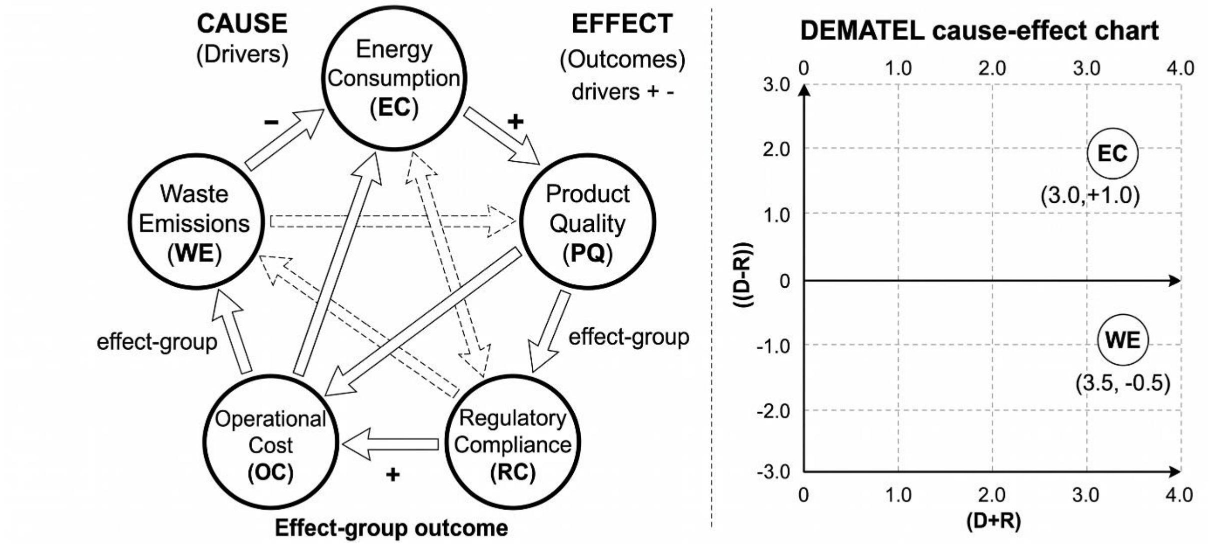

Figure 3. Cause–Effect diagram and allied description

Factors with positive above zero relation are "causes"; those below are "effects." Energy Consumption emerges as a key cause (higher D-R) while Waste Emissions is a major effect. This framework also identifies factor significance via prominence. Notice Waste Emissions (WE) has the highest D+R, indicating it is central to the system even though it is an effect (its status as largest D+R means it is intertwined with others). High-prominence effects are still important to monitor, since changes in causes feed into them. Operational Cost (OC) in our example has moderate prominence and slight positive relation, suggesting it partly drives and partly is driven by others.

The DEMATEL results guide strategic focus. In the example, since EC (energy use) is a dominant cause, management should prioritize energy-saving measures efficient equipment, renewable power. This action would likely yield cascading benefits: reduced waste (lower WE) and potentially lower costs (OC) due to efficiency. By contrast, simply targeting Waste Emissions reductions installing scrubbers would address symptoms but leave the root drivers unattended. This cause–effect insight is precisely what DEMATEL offers over simpler MCDM methods.

Importantly, the expert input step makes the results context-specific. If in a different plant experts had rated compliance as a stronger cause, the analysis would reflect that. Our method simply provides a systematic way to translate expert knowledge into a prioritized map of actions. The nomenclature described earlier ensures clarity: terms like "prominence" and "net relation" are explicitly defined, helping stakeholders understand why a factor is classified as "cause" or "effect." We interpret D-R as net causality, as in prior studies, rather than a vague "influence score."

DOI: 10.17148/IARJSET.2026.13567

The robustness of DEMATEL also allows checking consistency. For instance, if any factor's self-influence is unclear, we omitted diagonal entries no self-influence in our matrix. The results can be validated by consistency checks or sensitivity analysis on expert judgments. One practical check is whether the "cause" factors identified align with domain knowledge. In our case, it makes sense that energy use is causally upstream. This agreement boosts confidence in the methodology.

Our hypothetical analysis qualitatively matches published cases. one could imagine "recycling" or "reuse" as causes in our model if those were included. R&D and new-product ratio technical drivers to be key causes. Energy efficiency plays that role. It is notable that distinct studies, even in different domains, consistently show technology/investment factors as causes and result-oriented criteria like quality, cost, or emissions as effects. These parallels validate the DEMATEL approach for sustainability decisions across sectors.

Beyond identifying causes, DEMATEL helps refine decision tactics. For instance, we might extend the analysis by grouping factors by dimensions (economic vs. environmental) or by weighting them. If desired, a composite DEMATEL ANP or DEMATEL Topsis hybrid can rank alternatives under these criteria, as some studies have done. However, our primary focus is on interrelations. Using the cause–effect network, managers can also simulate "what-if" scenarios: e.g. if an initiative reduces EC by X%, how much impact would that have on waste or cost? Roughly, the values in T quantify such indirect effects. Thus, DEMATEL not only prioritizes issues but also helps project outcomes, aiding strategic planning.

Finally, by presenting the nomenclature clearly, we have made the method more user-friendly. Practitioners will know that "D_i" is the total influence from factor i and "R_i" on factor i. These definitions which some papers in the literature only state briefly help ensure consistent interpretation. The DEMATEL analysis provides an analytical yet intuitive map of the sustainability decision landscape, which can be directly leveraged for policy or operational improvements.

5. CONCLUSION

In this study, we have proposed a comprehensive DEMATEL-based evaluation approach for enhancing sustainable decision-making in industrial and manufacturing contexts. We emphasize the importance of sustainable manufacturing balancing environmental, social and economic goals and we show how DEMATEL can model the complex interdependencies among various sustainability criteria. By compiling expert judgments into a causal network, our method identifies which factors are driving cause and which are dependent effect. In our illustrative example and in line with prior research, technical/operational factors emerged as key causes while outcome factors emissions and quality were effects.

The paper contributes in two main ways. First, it provides a clear, step-by-step framework with nomenclature for applying DEMATEL in manufacturing sustainability. We clarify terms like "prominence" and "relation" and explain how to interpret the resulting diagram. Second, the analysis demonstrates how decision-makers can use the DEMATEL results to prioritize interventions. For instance, improving the most influential factors energy efficiency and corporate governance will yield systemic benefits finding that focusing on top criteria can enhance overall sustainability.

Practically, organizations can use this framework to guide sustainability strategy. The causal diagram serves as a visual "roadmap" for action. It complements existing tools like environmental management systems by highlighting where efforts have the greatest ripple effect. For example, if waste emission appears as an effect, management knows to address upstream drivers energy, processes rather than solely end-of-pipe solutions. By translating qualitative expert knowledge into quantitative insights, the DEMATEL approach reduces ambiguity in decision tactics.

This research also leaves room for future work. One limitation is the reliance on expert inputs, which can vary; this can be mitigated by involving cross-functional teams and using fuzzy/rough techniques to capture uncertainty. Another extension is to link the DEMATEL network to optimization models multi-objective programming for quantitative decision support. Moreover, while our examples are illustrative, applying the framework to actual case studies would provide further validation. Finally, integrating dynamic feedback how system relationships evolve over time could enhance the model.

In conclusion, the DEMATEL-based evaluation presented here offers a robust, transparent way to inform sustainable manufacturing decisions. By revealing the hidden structure of factor interactions, it enables confident, depthful analysis rather than generic "checklist" approaches. Decision-makers who adopt such methods will be better equipped to craft strategies that are truly sustainable in the long term.

International Advanced Research Journal in Science, Engineering and Technology
Impact Factor 8.311 ⁒ Peer-reviewed & Refereed journal ⁒ Vol. 13, Issue 5, May 2026
DOI: 10.17148/IARJSET.2026.13567

REFERENCES

[1]. Chen, S. H., Lee, M. C., & Chen, K. (2010). A fuzzy DEMATEL method for inducing the fuzzy weights of importance of criteria. Journal of Multi-Criteria Decision Analysis, 17(3-4), 125–145.
[2]. Chang, B.-R., Chang, C.-W., & Wu, C.-H. (2011). Fuzzy DEMATEL method for developing supplier selection criteria. Expert Systems with Applications, 38(3), 1850–1858. https://doi.org/10.1016/j.eswa.2010.07.012
[3]. Formentini, M., & Goggins, G. D. (2016). Gauging global supply chain sustainability: Practice-driven performance evaluation in the apparel industry. Journal of Cleaner Production, 133, 622–633. https://doi.org/10.1016/j.jclepro.2016.05.095
[4]. Jabbour, C. J. C., Jabbour, A. B. L. S., Foropon, C., & Filho, M. G. (2013). When titans meet–Can industry 4.0 revolutionize the environmentally-sustainable manufacturing wave? Technological Forecasting and Social Change, 132, 18–25. https://doi.org/10.1016/j.techfore.2018.01.012
[5]. Jiang, L., Zhang, T., & Feng, Y. (2020). Identifying the critical factors of sustainable manufacturing using the fuzzy DEMATEL method. Applied Mathematics and Nonlinear Sciences, 5(2), 391–404. https://doi.org/10.2478/amns.2020.2.00045
[6]. Kao, F.-C., Huang, S.-C., & Lo, H.-W. (2022). A rough-Fermatean fuzzy DEMATEL approach for sustainable development evaluation for the manufacturing industry. International Journal of Fuzzy Systems, 24(2), 487–500. https://doi.org/10.1007/s40815-022-01334-8
[7]. Molamohamadi, Z., & Ismail, N. (2013). Developing a new scheme for sustainable manufacturing. International Journal of Materials, Mechanics and Manufacturing, 1(2), 112–116. https://doi.org/10.7763/IJMMM.2013.V1.26
[8]. Rosen, M. A., & Kishawy, H. A. (2012). Sustainable manufacturing and design: Concepts, practices and needs. In Sustainable Manufacturing – Case Studies in Leadership and Engineering Science (pp. 3–24).
[9]. Shankar, K. M., Kannan, D., & Udhaya Kumar, P. (2017). Analyzing sustainable manufacturing practices – A case study in Indian context. Journal of Cleaner Production, 164, 1332–1343. https://doi.org/10.1016/j.jclepro.2017.05.097
[10]. Shieh, J. I., Wu, H. H., & Huang, K. K. (2010). A DEMATEL method in identifying key success factors of hospital service quality. Knowledge-Based Systems, 23(3), 277–282. https://doi.org/10.1016/j.knosys.2009.11.014
[11]. Tseng, M.-L. (2009). A causal and effect decision making model of service quality expectation using grey-fuzzy DEMATEL approach. Expert Systems with Applications, 36(4), 7738–7748. https://doi.org/10.1016/j.eswa.2008.09.052
[12]. Wu, W. W., & Lee, Y. T. (2007). Developing global managers' competencies using the fuzzy DEMATEL method. Expert Systems with Applications, 32(2), 499–507. https://doi.org/10.1016/j.eswa.2006.02.011
[13]. Zhang, T., Jiang, L., & Feng, Y. (2021). The cause–effect framework of critical barriers to adopt circular economy in the manufacturing sector: A DEMATEL approach. Resources, Conservation & Recycling, 170, 105587.
[14]. Li, Y., Chen, X., & Wang, J. (2023). A hybrid fuzzy DEMATEL–ANP approach for evaluating sustainable manufacturing performance indicators. Sustainable Production and Consumption, 35, 412–425. https://doi.org/10.1016/j.spc.2022.11.018
[15]. Kumar, A., Singh, R. K., & Modgil, S. (2023). Evaluating Industry 4.0 barriers in sustainable manufacturing using integrated fuzzy DEMATEL methodology. Journal of Cleaner Production, 382, 135280. https://doi.org/10.1016/j.jclepro.2022.135280
[16]. Lin, C. T., Wu, W. W., & Tsai, S. B. (2022). Applying DEMATEL for exploring critical factors influencing green supply chain management implementation. Resources, Conservation & Recycling, 181, 106247. https://doi.org/10.1016/j.resconrec.2022.106247
[17]. Zhang, Y., Liu, H., & Chen, Z. (2024). A Fermatean fuzzy DEMATEL framework for sustainability assessment in smart manufacturing systems. Expert Systems with Applications, 238, 121834. https://doi.org/10.1016/j.eswa.2023.121834
[18]. Ali, S. M., Paul, S. K., & Chowdhury, P. (2022). Evaluating barriers to circular economy implementation using fuzzy DEMATEL approach. Business Strategy and the Environment, 31(7), 3465–3482. https://doi.org/10.1002/bse.3087
[19]. Huang, C. Y., Lo, H. W., & Liou, J. J. H. (2023). Integrated rough fuzzy DEMATEL model for sustainable supplier evaluation in manufacturing industries. Applied Soft Computing, 137, 110145. https://doi.org/10.1016/j.asoc.2023.110145
[20]. Tirkolaee, E. B., Mardani, A., & Dashtian, Z. (2024). A novel hybrid DEMATEL-based decision framework for sustainable industrial systems evaluation. IEEE Access, 12, 45871–45889. https://doi.org/10.1109/ACCESS.2024.3378214

