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The role of integrated approach in decision making and performance evaluation: critical insights for attaining sustainability

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Abstract: In present study, the role of an integrated approach in decision-making and performance evaluation is presented. Here, critical insights for attaining sustainability are presented from the perspective of the development and growth of existing frameworks used by the organizations. The fishbone diagram is presented and critical insights are discussed from the frame of lean manufacturing and sustainable development. The study can help practitioners in evaluating criteria-based decision-making methods within organizations. This study presented eight steps of the decision-making process and also discussed ten different Multi criteria decion making method (MCDM). The study can be used to deal with multiple problems in the application area of selection, monitoring, defining, recording, and developing system characteristics. The study embraced its dimensions in presenting the theoretical foundation related to decision-making under the edges of industrial, manufacturing, and societal problems.

Keywords: Decision Making, Critical Insights, Evaluation, Integrated Approach, Sustainability

I. INTRODUCTION

Every day, people must make judgments in a variety of difficult and demanding circumstances. Rather than being decided at random, management decisions are deliberate and well-reasoned. Making the right choice is essential before making any decisions. This decision is supported by relevant evidence and yields the intended results. The decision is a process rather than a snap decision (Mulyono et al., 2021). The decision itself is important, but most people just remember how it turned out. Decision-making is required to determine an existing problem and then look for some of the best alternatives available that can satisfy the identified problem. Every alternative may have certain advantages and disadvantages that should be carefully evaluated before selecting one (Taherdoost & Mitra Madanchian, 2023).

Therefore, collecting information and assessing the advantages and disadvantages of any option are crucial. An effective decision generally aids in bridging the gaps between ideals and realities and aids in determining the path from the design process beginning to execution and termination (Asadabadi et al., 2019). If people encounter a predicament in various facets of their lives, it is also beneficial to think about reasonable restrictions and ideal circumstances. Making decisions is a crucial managerial task that takes precedence over other facets, such as organizing and directing employees (Malleeswaran & Uthayakumar, 2022). In addition, decision-making is arguably the most prevalent and somewhat unstructured form of problem-solving, despite being an essential ability in the more intricate and unstructured forms. For instance, making decisions and solving problems is essential in design and policy (Madanchian & Taherdoost, 2023).

Sustainability creates and maintains the conditions under which humans and nature can exist in productive harmony, that permit fulfilling the social, economic and other requirements of present and future generations (Hariyani et al., 2022)**.** In the manufacturing sectors, sustainability aims to create manufactured products that use processes and practices that maximize profits, minimize negative environmental impacts, conserve natural resources and energy, and are safe for employees, consumers, and communities (Beyer, 2022; Kineber et al., 2023). This study presented the following two objectives (OBJ):

OBJ1: To deal with multiple problems in the application area of selection, monitoring, defining, recording, and developing system characteristics.

OBJ2: To embrace dimensions in presenting the theoretical foundation related to decision-making under the edges of industrial, manufacturing, and societal problems.

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II. LITERATURE REVIEW

2.1 Decision-making process:

Making decisions begins with a point and ends with a conclusion. A procedure comprising multiple steps and particular tactics to complete each step is followed to make a decision. Decision-makers benefit from this process by understanding what they must do at each stage and why. Many decision-making procedures are suggested by different authors according to the objectives they have (Nutt, 2008). But a widely recognized general decision-making process is broken down into the following eight processes (Taherdoost & Mitra Madanchian, 2023), which are also illustrated in Figure 1:

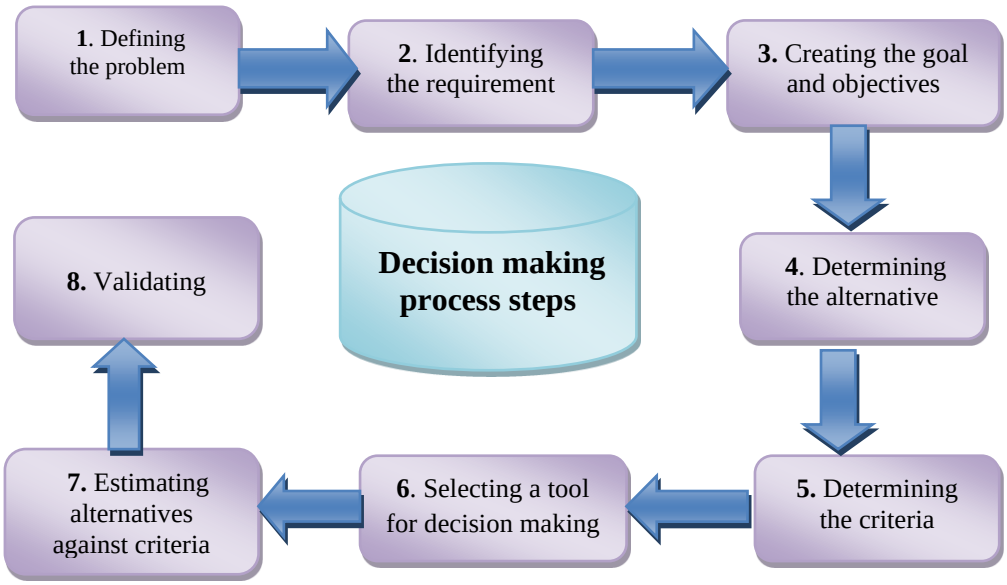

Figure 1. Decision-making process steps

1) Defining the problem: Identifying the primary causes, problems, constraints, interfaces, and boundaries is part of this process. Here, the issue should be stated concisely, clearly, and unambiguously while taking the desired and initial conditions into account (Taherdoost & Mitra Madanchian, 2023).

2) Identifying the requirement: The problem needs to satisfy these requirements. These are the quantitative forms of the group of workable solutions when considering mathematical form. Mathematics is used to model current alternatives and their results, present and explain options, and evaluate and improve the quality of data in the face of ambiguity (de Oliveira et al., 2023).

3) Creating the goal and objectives: The objectives exceed the required minimum values. A goal is a comprehensive statement of the ideals and objectives. By claiming that the objective is the aim, one can differentiate the objective in mathematics from the requirement, which is a restriction (Schoemaker & Russo, 2021.).

4) Determining the alternative: Alternatives use a variety of strategies to help alter the starting conditions to the intended ones. These options should all satisfy the criteria. There may be an infinite or finite number of options. If there are only a limited number of options, each one should be examined to determine whether it satisfies the requirements and to identify the ones that are impractical and ought to be removed (Nutt, 2008).

5) Determining the criteria: The purpose of criteria is to distinguish between the options and are based on aims. The degree to which the alternatives can accomplish the objectives is assessed using these criteria. There should be at least one criterion created for each objective. On the other hand, several criteria may be produced for complex objectives (Taherdoost & Mitra Madanchian, 2023).

6) Selecting a tool for decision-making: There are many different decision-making tools accessible, but to select the best one, one must take into account several factors, including the goals and the specifics of the problem. Complex approaches, for instance, are appropriate for complex decision-making situations (Panpatte & Takale, 2019.).

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7) Estimating alternatives against criteria: To obtain the right decision-making approach, this stage is an essential input of data. Depending on the criterion, the evaluation may be subjective or objective. While the subjective evaluation is judgmental, the objective evaluation takes into account a well-understood measurement scale, like money. The alternatives are ranked according to the evaluation results obtained using the decision-making tool chosen in the preceding steps. The most promising subsets would then be selected (Mulyono et al., 2021).

8) Validating: In this phase, the terms selected in the previous step should be verified in light of the decision's requirements-making issue to ensure that the tool for decision-making was not misused (Taherdoost & Mitra Madanchian, 2023).

III. CASE DISCUSSION

Lean Manufacturing and Management in Organizations

Samuel et al. (2021) presented the use of lean and quality technologies for ongoing, non-automated improvements in the electronic repair sector. To eliminate the bottlenecks compromising quality and production, two tiers of the repair bay procedure were selected. In summary, Lean Manufacturing's implementation led to continuous improvement and made it easier for human workers to increase the quality of their repair processes.

Banga et al., (2020) investigated how to improve productivity through the use of lean tools in the manufacturing industry. Research is focused on offering workable substitutes to shorten the cycle time and, as a result, boost the output of a batch production system in a company that manufactures sheet metal parts. In this study, simulation serves as the primary tool for testing the system with a range of viable options. Following the simulation's outcomes, an analysis of the degree to which a goal was achieved using the different approaches used has been offered.

Mostafa et al. (2013) has given a framework of lean manufacturing and how to implement it in different manufacturing industries. A framework to get around some of the restrictions has been proposed. The suggested framework comprises four distinct implementation phases and is built as a project-based framework. Each phase is given a set of suggested appropriate activities and decision-making tools. The suggested framework is still at the conceptual stage, nevertheless. For it to be validated, more implementation is needed.

IV. THE INTEGRATED APPROACH THAT CAN BE USED

Since there is just one person who makes decisions, that person is in charge of the procedure. Collective affairs cases are not typically the issue at hand. But in this case, the individual decision-maker who may be the CEO or head of the company, for instance, can affect the fate of the entire group (Asad Abadi et al., 2019). Participatory decision-making, opportunity cost calculation, non-scientific approaches (such as draw cards, coin tossing, tarot cards, astrology, and obedience to authority), preference trees, pros and cons analysis, and others are some of the primary individual decision-making procedures (Mulyono et al., 2021). The methods used to address decision-making issues involving many criteria are known as MCDM difficulties. Making decisions becomes more difficult when there are several variables to take into account. Complex scenarios including multiple choices for decision-making are referred to as multi-criteria decision-making (Mulyono et al., 2021).

It is a useful tool when there are several options to think about. Therefore, every criterion, whether qualitative or quantitative, is examined to ascertain whether it would improve or worsen the result. Several MCDM techniques are available, including, the analytical hierarchal process (AHP), technology for order performance by similarity to the optimal solution (TOPSIS), the analytical network process (ANP), VIKOR Method, Grey Relational Analysis (GRA), Best Worst Method (BWM), Entropy Weightage Method (EWM), Decision Making Trial and Evaluation Laboratory (DEMATEL), Interpretive Structural Modeling (ISM), and Simple Multi-Attribute Rating Technique (SMART) Figure 2 (Nutt, 2008; Rezaei, 2015; Taherdoost & Mitra Madanchian, 2023; Taherdoost & Mohebi, 2024; Thakkar, 2021).

The use aforesaid two or more two decision-making methods will create an integrated approach to choosing decisions more accurately and effectively. Additionally, a number of the MCDM methods listed in Table 1 are conducted by specialized decision support software.

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Table 1. Different multi-criteria decision-making method (MCDM)

SN.	Different MCDM method	Definitions	References
1.	Analytic Hierarchy Process (AHP)	a systematic technique for arranging and comprehending complicated problems that are grounded in mathematics and psychology.	(Asadabadi et al., 2019)
2.	Technique for Order Preference by Similarity to Ideal Solution (TOPSIS)	Under the fundamental idea, the best answer is the one that is nearest to the positive ideal solution.	(Madanchian & Taherdoost, 2023)
3.	Analytic Network Process (ANP)	It is a more comprehensive version of the MCDM tool AHP.	(Taherdoost & Madanchian, 2023)
4.	VIKOR Method	Lots of variables are optimized, and a compromise solution is found.	(Mardani et al., 2016)
5.	Grey Relational Analysis (GRA)	A method for determining the degree of Gray relations and the extent to which the main behavior of the system influences the overall picture or the degree to which the system elements influence each other.	(Gawkhare, 2019)
6.	Best Worst Method (BWM)	To evaluate a set of criteria for choosing a group of alternatives.	(Rezaei, 2015)
7.	Entropy Weightage Method (EWM)	EWM is a popular weighting technique that evaluates decision-making value dispersion.	(Qu et al., 2022)
8.	Decision Making Trial and Evaluation Laboratory (DEMATEL)	By taking into account the opinions of experts, it has been able to resolve numerous worldwide difficult problems in the fields of science, politics, and economics.	(Thakkar, 2021)
9.	Interpretive Structural Modeling (ISM)	This computer-based method assists teams in producing graphical depictions of intricate systems.	(Raut et al., 2018)
10.	Simple Multi-Attribute Rating Technique (SMART)	It is an approach to decision-making that helps to evaluate a group of choices according to certain regulations.	(Taherdoost & Mohebi, 2024)

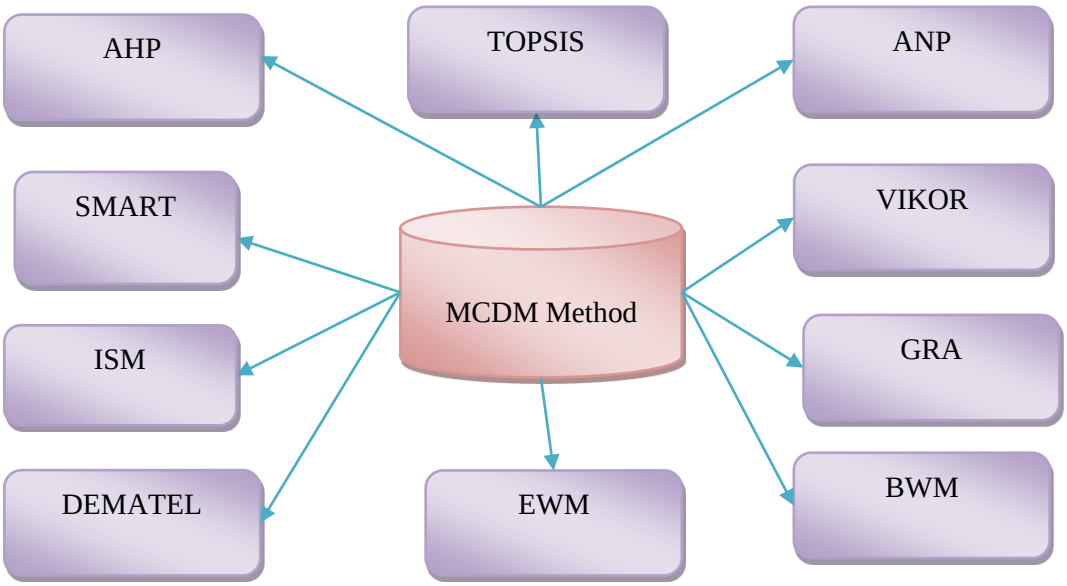

Figure 2: Different Multi-criteria decision-making methods

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V. DISCUSSIONS

This study presented a general description of decision-making with a management perspective to explain, what is decision making, and what the role is at the time to make effective decisions in the manufacturing industry. Defined sustainability and discussed its aim to create manufactured products that use processes and practices that maximize profits, minimize negative environmental impacts, conserve natural resources and energy, and are safe for employees, consumers, and the community. This study discussed eight steps of the decision-making process and also listed ten different multi-criteria decision-making methods AHP, TOPSIS, ANP, VIKOR, GRA, BWM, EWM, DEMATEL, ISM, and SMART. This study also discussed a case study of lean manufacturing and management that defined the effective decision-making method that will help the systematic implementation of the lean manufacturing framework.

VI. CONCLUSIONS

To improve the overall quality of decisions in manufacturing organizations, decision-making is crucial. Advanced technologies like artificial intelligence and machine learning can be integrated to enhance decision-making processes by offering predictive analytics and data-driven insights, which empowers enterprises to make better-informed and efficient choices. The evaluation of each MCDM technique, tool, and updated version, together with its advantages and disadvantages and applications, maybe the main subject of future research. A more comprehensive understanding of the multiple studies of decision-making processes will be possible according to the discussions that have been provided. The study can help practitioners in evaluating criteria-based decision-making methods within organizations.

REFERENCES

[1]. Asadabadi, M. R., Chang, E., & Saberi, M. (2019). Are MCDM methods useful? A critical review of Analytic Hierarchy Process (AHP) and Analytic Network Process (ANP). *Cogent Engineering*, *6*(1). https://doi.org/10.1080/23311916.2019.1623153

[2]. Banga, H. K., Kumar, R., Kumar, P., Purohit, A., Kumar, H., & Singh, K. (2020). Productivity improvement in manufacturing industry by lean tool. *Materials Today: Proceedings*, *28*, 1788–1794. https://doi.org/10.1016/j.matpr.2020.05.195

[3]. Beyer, K. (2022). Barriers to innovative activity of enterprises in the sustain development in times of crisis. *Procedia Computer Science*, *207*, 3134–3142. https://doi.org/10.1016/j.procs.2022.09.372

[4]. de Oliveira, M. S., Steffen, V., de Francisco, A. C., & Trojan, F. (2023). Integrated data envelopment analysis, multi-criteria decision making, and cluster analysis methods: Trends and perspectives. In *Decision Analytics Journal* (Vol. 8). Elsevier Inc. https://doi.org/10.1016/j.dajour.2023.100271

[5]. Gawkhare, M. (2019). *GREY RELATION ANALYSIS METHODOLOGY AND ITS APPLICATION*. https://doi.org/10.5281/zenodo.2578088

[6]. Hariyani, D., Mishra, S., Sharma, M. K., & Hariyani, P. (2022). Organizational barriers to the sustainable manufacturing system: A literature review. In *Environmental Challenges* (Vol. 9). Elsevier B.V. https://doi.org/10.1016/j.envc.2022.100606

[7]. Kineber, A. F., Singh, A. K., Fazeli, A., Mohandes, S. R., Cheung, C., Arashpour, M., Ejohwomu, O., & Zayed, T. (2023). Modelling the relationship between digital twins implementation barriers and sustainability pillars: Insights from building and construction sector. *Sustainable Cities and Society*, *99*. https://doi.org/10.1016/j.scs.2023.104930

[8]. Madanchian, M., & Taherdoost, H. (2023). A comprehensive guide to the TOPSIS method for multi-criteria decision making. *Sustainable Social Development*, *1*(1). https://doi.org/10.54517/ssd.v1i1.2220

[9]. Malleeswaran, B., & Uthayakumar, R. (2022). A sustainable pharmaceutical supply chain model for household energy consumption and expiration cost under decision making approach. In *Cleaner Engineering and Technology* (Vol. 11). Elsevier Ltd. https://doi.org/10.1016/j.clet.2022.100568

[10]. Mardani, A., Zavadskas, E. K., Govindan, K., Senin, A. A., & Jusoh, A. (2016). VIKOR technique: A systematic review of the state of the art literature on methodologies and applications. In *Sustainability (Switzerland)* (Vol. 8, Issue 1). MDPI. https://doi.org/10.3390/su8010037

[11]. Mostafa, S., Dumrak, J., & Soltan, H. (2013). A framework for lean manufacturing implementation. *Production and Manufacturing Research*, *1*(1), 44–64. https://doi.org/10.1080/21693277.2013.862159

[12]. Mulyono, H., Purba, N., Hadian, A., Syamsuri, A. R., & Hasibuan, M. Z. (2021). *Decision-Making Culture in Organizations*.

[13]. Nutt, P. C. (2008). *Investigating the Success of Decision Making Processes*.

[14]. Panpatte, S., & Takale, V. D. (n.d.). *To Study the Decision Making Process in an Organization for its Effectiveness*. www.theijbmt.com

DOI: 10.17148/IJIREEICE.2024.121001

[15]. Qu, W., Li, J., Song, W., Li, X., Zhao, Y., Dong, H., Wang, Y., Zhao, Q., & Qi, Y. (2022). Entropy-Weight-Method-Based Integrated Models for Short-Term Intersection Traffic Flow Prediction. *Entropy*, *24*(7). https://doi.org/10.3390/e24070849

[16]. Raut, R., Narkhede, B. E., Gardas, B. B., & Luong, H. T. (2018). An ISM approach for the barrier analysis in implementing sustainable practices: The Indian oil and gas sector. *Benchmarking*, *25*(4), 1245–1271. https://doi.org/10.1108/BIJ-05-2016-0073

[17]. Rezaei, J. (2015). Best-worst multi-criteria decision-making method. *Omega (United Kingdom)*, *53*, 49–57. https://doi.org/10.1016/j.omega.2014.11.009

[18]. Samuel, R., Rajesh, M., Rajanna, S., & Franklin, E. (2021). Implementation of lean manufacturing with the notion of quality improvement in electronics repair industry. *Materials Today: Proceedings*, *47*, 2253–2257. https://doi.org/10.1016/j.matpr.2021.04.200

[19]. Schoemaker, P. J. H., & Russo, J. E. (n.d.). decision-making. In *The Palgrave Encyclopedia of Strategic Management*. Palgrave Macmillan. https://doi.org/10.1057/9781137294678.0160

[20]. Taherdoost, H., & Madanchian, M. (2023). Analytic Network Process (ANP) Method: A Comprehensive Review of Applications, Advantages, and Limitations. *Journal of Data Science and Intelligent Systems*, *1*(1), 12–18. https://doi.org/10.47852/bonviewjdsis3202885

[21]. Taherdoost, H., & Mitra Madanchian. (2023). Decision Making: Models, Processes, Techniques. *Cloud Computing and Data Science*, 1–14. https://doi.org/10.37256/ccds.5120233284

[22]. Taherdoost, H., & Mohebi, A. (2024). Using SMART Method for Multi-Criteria Decision Making: Applications, Advantages and Limitations. *Archives of Advanced Engineering Science*. https://doi.org/10.47852/bonviewaaes42022765

[23]. Thakkar, J. J. (2021). Decision-Making Trial and Evaluation Laboratory (DEMATEL). In *Studies in Systems, Decision and Control* (Vol. 336, pp. 139–159). Springer Science and Business Media Deutschland GmbH. https://doi.org/10.1007/978-981-33-4745-8_9

