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Performance Evaluation of an Automated Material Handling System for a Wafer Fab Using MOORA Method

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Abstract*: In this paper, we introduce two systems: Variants as Open Queue Network (OQN) Creation, and Automated Storage and Retrieval Systems (AS/RS). To assess their performance, we utilize a performance analyzer named MPA, which is commonly employed for analyzing OQNs. In our analysis, we employ the AVS/RS tool to swiftly evaluate different configurations. Through our experimentation, we demonstrate that MPA outperforms simulation methods for efficiently evaluating the performance of these systems. We provide experimental results to support this conclusion. The AMHS layout is uniquely configured, incorporating features Turntables, turnouts and high speed express lanes etc. The assumptions underlying the simulation model were verified using real-world data sets. Behavioral analysis was conducted, primarily focusing on intertribal times. It was assumed that intermediate points were accessible for all stockers. The distribution of stacker behavior followed basic patterns, with interatrial times predominantly exhibiting exponential or Weibull distributions. Cognitive automation refers to the use of computerized systems that mimic human cognitive functions to provide relevant information and reduce the workload for operators. This type of automation aims to streamline processes by handling tasks that require human-like decision-making, problem-solving, and learning. It can analyze data, interpret patterns, make predictions, and even interact with users in a more intelligent and human-like manner. This document originates from Memorial Hospital (GMH) in Greenville, South Carolina, USA, focusing on research utilizing data to explore the implementation of Automated Guided Vehicle Systems (AGVS) within discrete flow systems. These AGVS systems utilize both unidirectional and bidirectional guide routes networks. The article primarily centers on two key objectives. Firstly, it introduces a mathematical optimization technique aimed at enhancing material flow efficiency. Secondly, it proposes a modeling approach to address the challenges associated with implementing AGVS within discrete flow systems A 300-inch wafer fabrication facility can be designed using a general model that considers the dimensions of Automated Material Handling System (AMHS) solutions to support decision-making. This model utilizes ratio analysis and dimensionless metrics to assess various options. The Multiple Objective Optimization by Method of Ratio Analysis (MOORA) employed for objective measurement, ensuring that contractor bias does not influence decisions. This method categorically ranks different solutions based on their performance in meeting specific criteria. In the typical progression of a manufacturing system, various components such as product design, facility placement, facility layout, suppliers, materials, and technology need to be carefully considered and implemented at appropriate stages to ensure efficiency. Ultimately, assessing the performance of the machinery can be effectively accomplished using the MOORA method. To validate this approach, a test scenario was devised for verification purposes. Process data is ranked first, whereas inventory management data is ranked lowest.*

Keywords: *Equipment performance metrics, Inventory management data, Process data, Maintenance records and Efficiency and throughput metrics***.**

1. INTRODUCTION

This paper investigates Micro-transport systems, which are part of Material Handling Systems (MHSs). Despite their significant size, MHSs have unique and intricate designs. They encounter various challenges throughout their operation. Analytical models of MHSs must account for stochastic components, which are thoroughly explored in this study [1]. Items are not kept in the warehouse, even temporarily. Instead, at the warehouse entrance, order takers manage stock, utilizing materials stored on-site or arriving via trucks. They promptly dispatch cartons directly or arrange for customers to collect items from trays. Additionally, they consolidate orders as necessary. These two groups collectively utilize 40% of the warehouse's overall space, with less than 6% currently occupied while the remaining portion, exceeding 0%, is designated for reservation. Typically, these reserved areas are characterized by high density, featuring narrow aisles for storage purposes [2]. The surge in semiconductor fabrication necessitates heightened cleanliness standards and efficient part handling. Automation Material handling and control is important. The Automated Material Handling System (AMHS) aims to enhance overall manufacturing performance by shortening production cycles and maximizing equipment utilization. Its focus lies in streamlining material delivery throughout the manufacturing process, thus driving progress in efficiency [3]. In material handling systems, the utilization of Computer Numerical Control (CNC) technology is indispensable due to increasing demands and evolving manufacturing requirements, resulting in diverse production variables. This technology plays a crucial role in supporting operators by providing a wealth of information. In complex automation setups, operators are tasked with physical duties, yet there is a wealth of available data. Therefore, emphasis should be placed on activities such as monitoring, decision-making, and cognitive tasks like control [4]. The majority of operations, around 80%, within the healthcare system pertain to food trays, paraphernalia related to IT equipment, laboratory supplies, logs, linens, and support services such as laundry. These operations are primarily focused on internal logistics. As outlined in a white paper, a staggering 95% of the costs within the healthcare system's supply chain are allocated towards internal logistics expenditures, predominantly on administration [5]. When embarking on the implementation of a new Flexible Manufacturing System (FMS) or reconfiguring an existing system, such as in reverse design scenarios, several challenges often arise, particularly in the realm of introducing new equipment. These challenges necessitate a focus on AGVS (Automated Guided Vehicle Systems) layout design, as well as broader facility design considerations for manufacturing systems [6]. The analysis of capabilities within a factory is necessary for system design, as it contributes essential input. However, it encompasses assessing skills, tool quantities, transportation, and overall storage capacity within the factory, all of which can significantly influence performance. It's important to acknowledge that overlooking these factors could have detrimental effects [7]. Fixed Queue Networks, Event-Graphs, and state-change mappings, akin to Petri nets and discrete-event simulation, are methodologies used for describing a variety of models, particularly in systems such as manufacturing. These approaches are crucial for designing and analyzing systems at various stages of development. They offer a structured framework for creating new models or refining existing ones. Additionally, they serve as a foundation for tutorial presentations on modeling methodologies, particularly in the context of manufacturing systems [8]. The focus on productivity enhancement is evident in the increased volume production resulting from improvements. Currently, there is significant interest in automatic methods, particularly in systems where automation is pivotal, such as in the design of material handling systems. This paper outlines the development of an automated material handling system for a sheet metal shop with eleven machines. [9]. Achieving optimal productivity and dependability requires the implementation of a system that activates when certain benchmarks are met. This system ensures that all resources operate efficiently and are managed effectively. The focus lies on developing automated machinery and seamlessly integrating it into production processes. This involves overseeing and synchronizing operations while also being adaptable and intelligent enough to accommodate increasingly automated setups. Extensive research has been dedicated to this objective [10]. The distribution system serves the purpose of efficiently transferring materials, ensuring they are delivered to their designated locations promptly. Inadequate ATV tables contribute to delays in container handling processes, hindering the timely transfer of items to their intended destinations [11]. The various methods explored encompass dispatching and scheduling techniques, alongside simulation software, without establishing clear distinctions between them. Consequently, this integration poses challenges for shop-floor control, making it arduous to repurpose the software and resulting in the development of iterative algorithms [12]. Furthermore, as regulations continue to evolve, companies are increasingly compelled to devise methods for reducing carbon emissions without sacrificing service quality. This necessity has sparked heightened interest in addressing these challenges across both industrial and academic settings. Automated solutions spanning various levels are being considered in studying such issues [13]. In semiconductor manufacturing, the demand for ultraclean environments is on the rise, particularly in expanding areas. To meet this need, automated material handling systems (AMHS) are essential for effective control. These systems play a crucial role in reducing production cycle times, enhancing equipment utilization, and ultimately improving overall fabrication efficiency. The primary goal of implementing AMHS is to streamline processes and ensure a more efficient production flow within the semiconductor manufacturing organization [14]. Efficient utilization of material handling equipment is crucial, particularly when considering its potential impact on non-value-added aspects of production. Yet, its introduction

Timing and excessive utilization must be carefully managed within a production setting. When implemented appropriately, these tools can diminish work content and ultimately enhance productivity [15].

2. MATERIALS AND METHOD

Equipment performance metrics: The Equipment Utilization Rate (EUR) A basic key performance indicator (KPI) for businesses, reflecting the usage of equipment. It hinges on factors such as the extent of equipment usage, the duration of idle time, and measures dwell time. A high EUR signifies efficient asset management, correlating with higher revenue generation.

Inventory management data: Inventory management, a key aspect of supply chain operations, involves overseeing the flow of goods from manufacturers to warehouses and ultimately to outlets. Its primary focus is on efficiently tracking and managing cargo from its origin to its destination. The goal of inventory management is to ensure that the right products are available at the right time and at the right places to effectively meet demand.

Process data: Creating a straightforward visual representation of vast stock data is achievable through an Exchange Stock Trading Software. Similarly, an e-commerce enterprise employs customer data to suggest products based on their search history. Meanwhile, a digital marketing firm utilizes demographic information for planning location-specific campaigns.

Maintenance records: Keeping track of the maintenance history of your equipment is essential. This documentation serves as a record of your machine's upkeep, aiding in monitoring its overall health. When necessary, scheduling inspections ensures timely maintenance, guaranteeing that your device remains safe to operate while also optimizing its performance.

Efficiency and throughput metrics: Assessing performance through Metrics of Effectiveness (MOEs) involves evaluating specific conditions or meeting objectives to gauge the capability of an organization or individual. It involves measuring performance to determine if the necessary steps are being taken to achieve desired outcomes.

Performance Metrics: KPIs are intricately tied to business goals, providing a focused lens through which to measure success. Simultaneously, metrics offer specific measurements that gauge the outcomes of individual activities. Together, they provide a comprehensive framework for assessing performance and driving progress towards overarching targets.

Cost Analysis: Cost analysis, commonly known as cost-benefit analysis, refers to the evaluation of expenses and potential gains stemming from a project. It involves calculating the total revenue and benefits associated with the completion of the project and then subtracting the costs incurred. Essentially, it's a method used to determine the profitability of a project by comparing its estimated costs to the financial benefits it is expected to generate.

Safety Assessment: In essence, security or risk assessment involves identifying potential harmful situations, processes, and elements within a workspace. It provides a comprehensive understanding of the workspace environment. Once identified, the focus shifts to analyzing and evaluating the likelihood and severity of security risks.

Scalability: Scaling in business refers to the capacity to meet growing demand from other companies. As production volume rises, unit costs tend to decrease, allowing for wider profit margins and increased efficiency within the economy. A business that can scale effectively stands to gain significant advantages.

MOORA Method: Construction projects are intricate endeavors that span over extended periods, often characterized by their uniqueness, which can be attributed to evolving environmental conditions. They represent ambitious initiatives with distinctive attributes. As these projects grow in complexity, assessing the contractor's performance becomes increasingly crucial [16]. Marketing decisions are frequently encountered during each stage Product life cycle. Similarly, the overarching concept of production extends across the entirety of the cycle. During the initial phase of production, emphasis is placed on selecting the product and its design, as well as establishing the necessary manufacturing facilities, all of which are imperative responsibilities for the manufacturer [17]. Ratio analysis (MOORA) is employed in this context to assess the optimal performance of plastic injection machine maintenance, introduces a multi-objective optimization method for development this planned document [18]. The MOORA method, also known as multi-objective optimization by ratio analysis, a technique utilized in multi-criteria or multi attribute optimization. It's particularly useful in various production environments for tackling complex decision-making challenges. In such scenarios, where multiple objectives are subject to certain constraints or conflicting requirements, MOORA enables the simultaneous enhancement of these objectives [19]. Fuzzy AHP and Fuzzy MOORA techniques, designed for evaluating complex decision-making scenarios, were employed across seven distinct domains and assessed against ten criteria in the survey findings. Among the prominent areas of preference were Technology, identified alongside Finance and Information/Software as significant determinants [20]. When choosing the MOORA method for tests, there is a selection phase involved. This method encompasses various types that are interconnected with barriers, involving two or more aspects. It employs a value-centric approach aimed at maximizing benefits [21]. This paper focuses on the automation of gas metal arc (GMA) welding and multi-response optimization. The objective is to devise a problem-solving approach to improve the width and height of beads as well as the hardness of the weldment. The chosen response variables are then optimized through data analysis. The method of entropy measurement is employed to forecast the individual response weights. Subsequently, an enhanced optimization approach based on MOORA and Taguchi methodology is utilized. The confirmation test validates the results obtained [22]. The implementation of paraphrasing methods can be quite challenging and complex due to the need for a deep understanding of mathematics. This complexity is particularly relevant in the context of fleet management, where decision-makers face various problems that need solutions. Hence, there's a demand for a straightforward, rational, and systematic approach to address these issues effectively. To cater to the needs of decision-makers, the MOORA method is chosen, which includes both reference point and multi-MOORA modes [23]. The MOORA method is used in many real-world scenarios, involving practitioners and decision-makers, and has gained notable traction among researchers. The authors This research paper aims to provide a summary of its applications and impact. However, despite its widespread use, A comprehensive literature review on the MOORA method, encompassing its various applications and nuances, is currently lacking. This article serves as a thorough exploration, offering an extensive overview and utilization of the MOORA method. It establishes a reference database for its integration and practical use. Furthermore, it conducts a formal examination of MOORA's effectiveness within uncertain settings, building upon and analyzing prior research in this domain [24]. Subjected to various test conditions from different specimens or samples, the ideal model or approach for listing purposes is exemplified by the MOORA method. Renowned for its simplicity, MOORA enables consideration of personal characteristics and delivers direct results, making it particularly valuable when traditional methods cannot be applied [25]. However, there has been limited exploration into the application of MOORA in relation to the advanced machining process. Therefore, this study delves into assessing the AWJ (Abrasive Water Jet) Machinability of Jute/Polyester Composites using MOORA, particularly focusing on the impact of laminate thickness [26]. To assist in this decision-making procedure, there exist several methods for multi-objective optimization. One such approach is Multi-Objective Optimization by Ratio Analysis (MOORA). This technique is known for its simplicity and mathematical ease of use in addressing multiple objectives simultaneously [27]. Various techniques are employed across industries to manufacture sheet metal products, including spinning, electromagnetic forming, hot stamping, deep drawing and hydroforming. Among these methods, sheet hydroforming provides final cups with precise dimensions and excellent surface quality [28].

3. ANALYSIS AND DISCUSSION

TABLE 1. Automated material handling systems

	Performance Metrics	Cost Analysis	Safety Assessment	Scalability
Equipment performance metrics	42.30	181.10	69.50	98.52
Inventory management data	11.25	159.26	81.45	88.93
Process data	32.69	183.25	13.80	10.10
Maintenance records	13.08	128.28	45.87	40.20
Efficiency and throughput metrics	56.89	146.32	65.45	18.89

Table 1 shows the Multi-Objective Optimization based on ratio Analysis and Automated material handling systems. Equipment performance metrics, Inventory management data, Process data, Maintenance records and Efficiency and throughput metrics. Performance Metrics, Cost Analysis, Safety Assessment and Scalability.

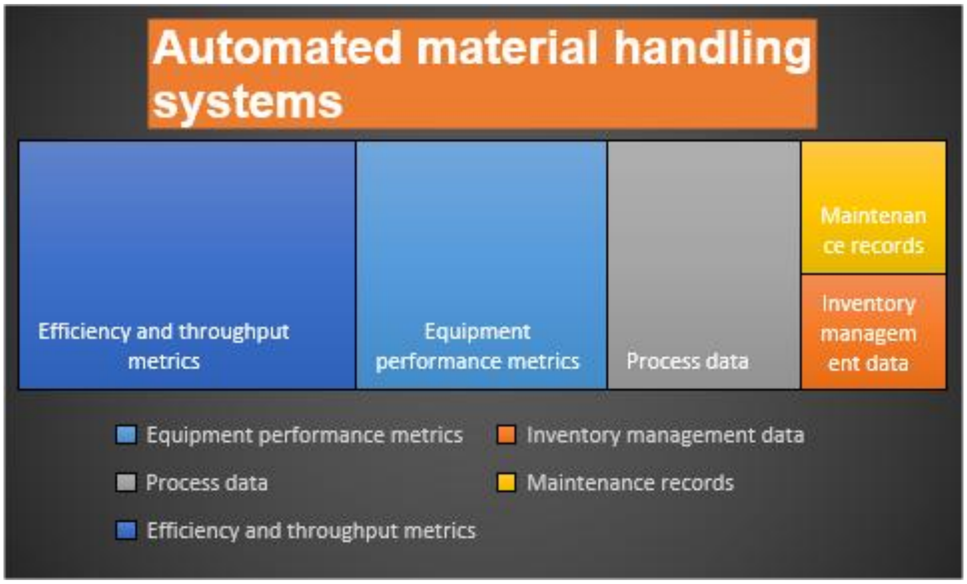

FIGURE 1. Automated material handling systems

Performance and performance metrics from Figure 1 and Table 1 show the highest value for performance metrics and inventory management data shows the lowest value. Process data shows the highest value for cost analysis and maintenance records shows the lowest value. Inventory management data shows a high value for safety assessment and process data shows a low value. Equipment performance metrics scaling and process data show low value.

TABLE 2. Normalized Data

	Performance Metrics	Cost Analysis	Safety Assessment	Scalability
Equipment performance metrics	0.5291	0.5030	0.5174	0.7021
Inventory management data	0.1407	0.4424	0.6064	0.6338
Process data	0.4089	0.5090	0.1027	0.0720
Maintenance records	0.1636	0.3563	0.3415	0.2865
Efficiency and throughput metrics	0.7116	0.4064	0.4873	0.1346

$$X_{n1} = \frac{X1}{\sqrt{((X1)^2+(X2)^2+(X3)^2 \ldots)}} \quad (1).$$

Table 2 shows the various Normalized Data High values of Equipment performance metrics, Inventory management data, Process data, Maintenance records and Efficiency and throughput metrics. Performance Metrics, Cost Analysis, Safety Assessment and Scalability. Normalized value is obtained by using the formula (1). Table 3 shows Weightages used for the analysis. We take same weights for all the parameters for the analysis

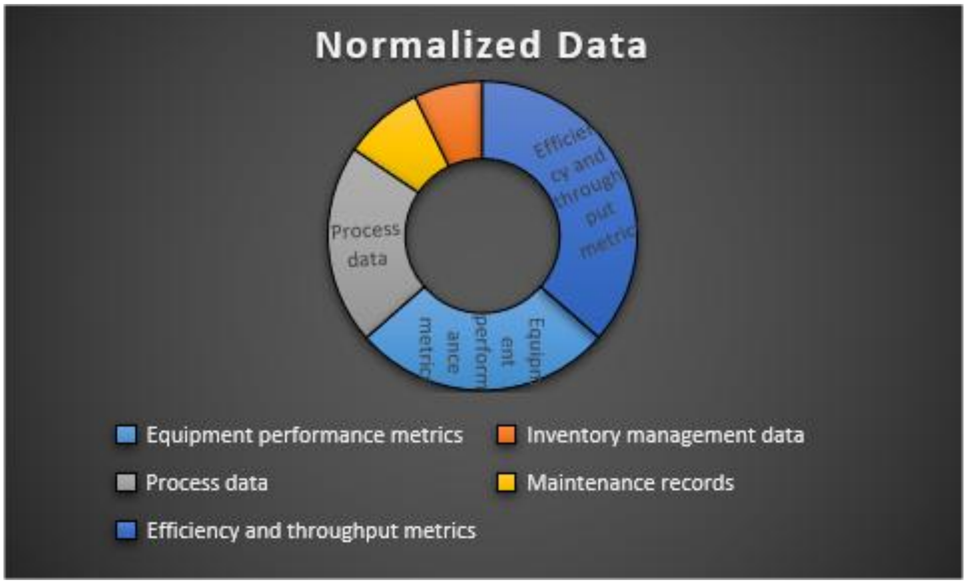

FIGURE 2. Normalized Data

Figure 2 shows the Normalized Data Automated material handling systems. Equipment performance metrics, Inventory management data, Process data, Maintenance records and Efficiency and throughput metrics. Performance Metrics, Cost Analysis, Safety Assessment and Scalability.

TABLE 3. Weightages

Weight			
0.25	0.25	0.25	0.25
0.25	0.25	0.25	0.25
0.25	0.25	0.25	0.25
0.25	0.25	0.25	0.25
0.25	0.25	0.25	0.25

$$\boldsymbol{X_{wnormal1}} = X_{n1} \times w_1(2).$$

TABLE 4. Weighted Normalized Decision Matrix

	Weighted normalized decision matrix			
Equipment performance metrics	0.1323	0.1258	0.1294	0.1755
Inventory management data	0.0352	0.1106	0.1516	0.1584
Process data	0.1022	0.1273	0.0257	0.0180
Maintenance records	0.0409	0.0891	0.0854	0.0716
Efficiency and	0.1779	0.1016	0.1218	0.0337

throughput metrics				

Table 4, 5 shows the final result multi-objective optimization based on ratio analysis Automated material handling systems. The weighted default result is calculated using the matrix formula (2). In Assessment value, Process data is having is Higher Value and Inventory management data is having Lower value formula (3).

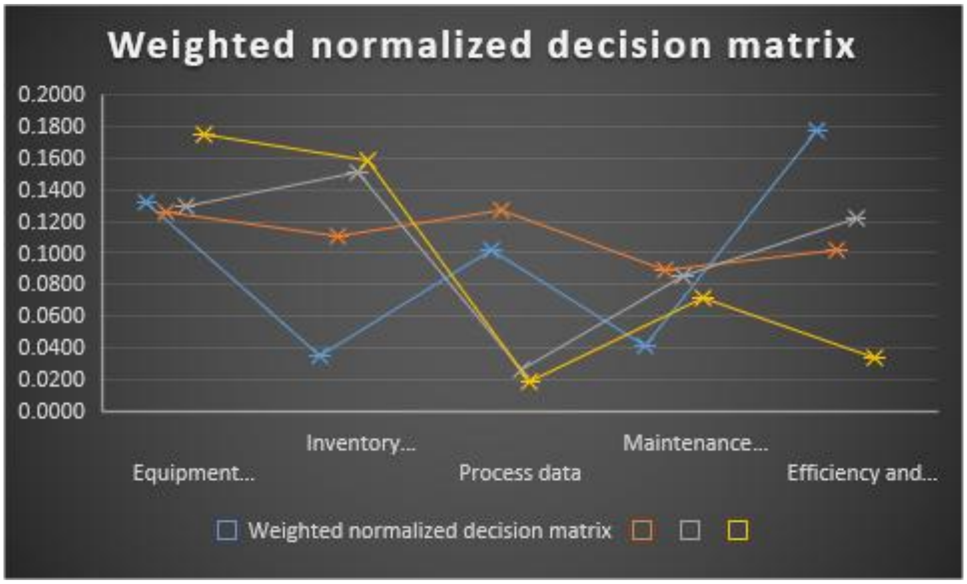

FIGURE 3. Weighted normalized decision matrix

Figure 3 and Table 4, 5 shows the final result multi-objective optimization based on ratio analysis Automated material handling systems. The weighted default result is calculated using the matrix formula (2). In Assessment value, Process data is having is Higher Value and Inventory management data is having Lower value formula (3).

TABLE 5. MOORA Analysis and Result

	Assessment value	**Rank**
Equipment performance metrics	-0.0469	**4**
Inventory management data	-0.1643	**5**
Process data	0.1858	**1**
Maintenance records	-0.0270	**3**
Efficiency and throughput metrics	0.1240	**2**

$$\text{Assesment value} = \sum X_{wn1} + X_{wn2} - X_{wn3} \qquad (3).$$

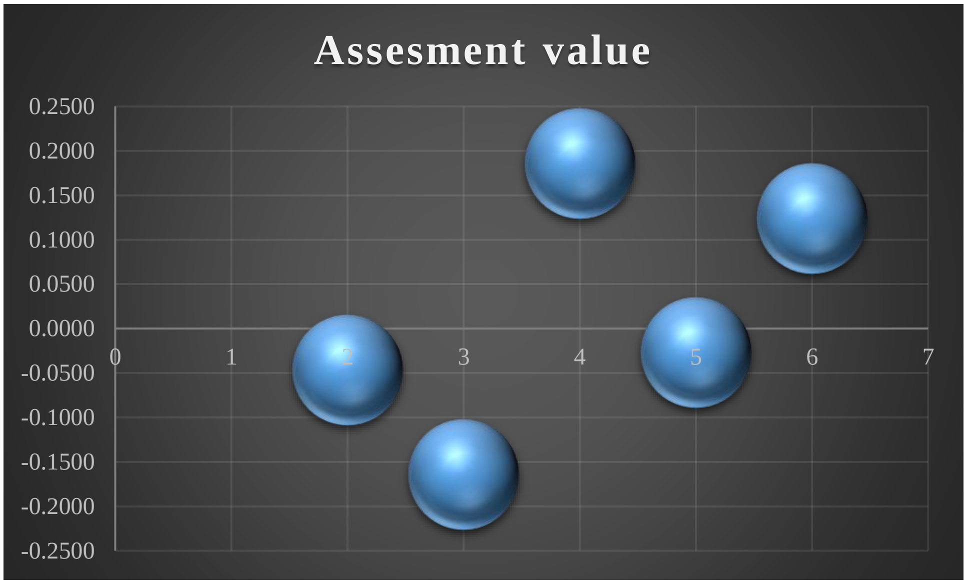

FIGURE 4. Assessment value

Figure 4 Shows the MOORA method using the analysis Assessment value for Process data is having is Higher Value and Inventory management data is having Lower value.

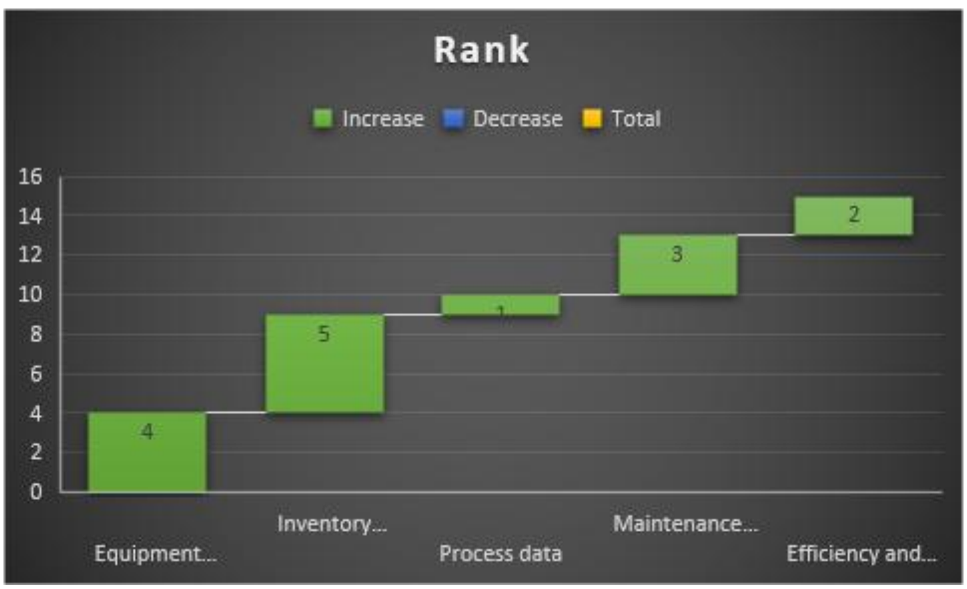

FIGURE 5. Shown the Rank

Figure 5 Shows the Ranking of Automated material handling systems. Process data is got the first rank whereas is the Inventory management data is having the Lowest rank.

4. CONCLUSION

Despite their significant size, MHSs have unique and intricate designs. They encounter various challenges throughout their operation. Instead, at the warehouse entrance, order takers manage stock, utilizing materials stored on-site or arriving via trucks. They promptly dispatch cartons directly or arrange for customers to collect items from trays.

Additionally, they consolidate orders as necessary. The Automated Material Handling System (AMHS) aims to enhance overall manufacturing performance by shortening production cycles and maximizing equipment utilization. Its focus lies in streamlining material delivery throughout the manufacturing process, thus driving progress in efficiency. The majority of operations, around 80%, within the healthcare system pertain to food trays, paraphernalia related to IT equipment, laboratory supplies, logs, linens, and support services such as laundry. These operations are primarily focused on internal logistics. As outlined in a white paper, a staggering 95% of the costs within the healthcare system's supply chain are allocated towards internal logistics expenditures, predominantly on administration. Currently, there is significant interest in automatic methods, particularly in systems where automation is pivotal, such as in the design of material handling systems. This paper outlines the development of an automated material handling system for a sheet metal shop comprising eleven machines. Marketing decisions are frequently encountered during each stage of the product life cycle. Similarly, the overarching concept of production extends across the entirety of the cycle. During the initial phase of production, emphasis is placed on selecting the product and its design, as well as establishing the necessary manufacturing facilities, all of which are imperative responsibilities for the manufacturer. Subsequently, an enhanced optimization approach based on MOORA and Taguchi methodology is utilized. The confirmation test validates the results obtained. To assist in this decision-making procedure, there exist several methods for multi-objective optimization. One such approach is the Multi-Objective Optimization by Ratio Analysis. This technique is known for its simplicity and mathematical ease of use in addressing multiple objectives simultaneously.

REFERENCES

[1]. Johnson, M. Eric, and Margaret L. Brandeau. "Stochastic modeling for automated material handling system design and control." Transportation science 30, no. 4 (1996): 330-350.

[2]. Heragu, Sunderesh S., Xiao Cai, Ananth Krishnamurthy, and Charles J. Malmborg. "Analytical models for analysis of automated warehouse material handling systems." International Journal of Production Research 49, no. 22 (2011): 6833-6861.

[3]. Manikandan, G., and S. Srinivasan. "An efficient algorithm for mining spatially co-located moving objects." *American Journal of Applied Sciences* 10, no. 3 (2013): 195-208.

[4]. Krishnamaneni, R., A. N. Murthy, and S. Sen. "Quantitative analysis of disease dynamics in machine learning models for diabetes prediction." *International Journal of Computer Science and Engineering Research and Development (IJCSERD)* 12, no. 1 (2022): 10-20.

[5]. Banerjee, Deepak, Vinay Kukreja, Vandana Sharma, Vishal Jain, and Shanmugasundaram Hariharan. "Automated Diagnosis of Marigold Leaf Diseases using a Hybrid CNN-SVM Model." In *2023 8th International Conference on Communication and Electronics Systems (ICCES)*, pp. 901-906. IEEE, 2023.

[6]. Wang, F. K., and J. T. Lin. "Performance evaluation of an automated material handling system for a wafer fab." Robotics and Computer-Integrated Manufacturing 20, no. 2 (2004): 91-100.

[7]. Choe, Pilsung, Jeffrey D. Tew, and Songzhen Tong. "Effect of cognitive automation in a material handling system on manufacturing flexibility." International Journal of Production Economics 170 (2015): 891-899.

[8]. Bhosekar, Amogh, Tuğçe Işık, Sandra Ekşioğlu, Kade Gilstrap, and Robert Allen. "Simulation-optimization of automated material handling systems in a healthcare facility." IISE Transactions on Healthcare Systems Engineering 11, no. 4 (2021): 316-337.

[9]. Gourgand, Michel, Xiao-Chao Sun, and N. Tchernev. "Choice of the guide path layout for an AGV based material handling system." In Proceedings 1995 INRIA/IEEE Symposium on Emerging Technologies and Factory Automation. ETFA'95, vol. 2, pp. 475-483. IEEE, 1995.

[10]. Schulz, Mathias, Timothy D. Stanley, Bernhard Renelt, and Roland Sturm. "Simulation based decision support for future 300 mm automated material handling." In 2000 Winter Simulation Conference Proceedings (Cat. No. 00CH37165), vol. 2, pp. 1518-1522. IEEE, 2000.

[11]. Bhuyan, Hemanta Kumar, Vinayakumar Ravi, and M. Srikanth Yadav. "Multi-objective optimization-based privacy in data mining." *Cluster computing* 25, no. 6 (2022): 4275-4287.

[12]. Chaudhari, Sachin Vasant, M. Dhipa, Shahnawaz Ayoub, B. Gayathri, M. Siva, and V. Banupriya. "Modified Aquila optimization based route planning model for unmanned aerial vehicles networks." In *2022 international conference on automation, computing and renewable systems (ICACRS)*, pp. 370-375. IEEE, 2022.

[13]. Bel, Gérard, and Didier Dubois. "A unified setting for various models of automated material flow and production systems." Computers in industry 6, no. 4 (1985): 227-235.

[14]. Hutchinson, G. K. "The design of an automated material handling system for a job shop." Computers in industry 4, no. 2 (1983): 139-145.

[15]. Shin, Dongmin, Richard A. Wysk, and Ling Rothrock. "An investigation of a human material handler on part flow in automated manufacturing systems." IEEE Transactions on Systems, Man, and Cybernetics-Part A: Systems and Humans 36, no. 1 (2005): 123-135.

[16]. Rahman, Humyun Fuad, and Izabela Nielsen. "Scheduling automated transport vehicles for material distribution systems." Applied Soft Computing 82 (2019): 105552.

[17]. Raju, D. Naveen, Hariharan Shanmugasundaram, and R. Sasikumar. "Fuzzy segmentation and black widow–based optimal SVM for skin disease classification." *Medical & biological engineering & computing* 59, no. 10 (2021): 2019-2035.

[18]. Kakulavaram, Sridhar. "Artificial Intelligence-Driven Frameworks for Enhanced Risk Management in Life Insurance." *Journal of Computational Analysis and Applications* 33, no. 8 (2024).

[19]. Kanumarlapudi, P. K. "Improving Data Market Implementation Using Gray Relational Analysis in Decentralized Environments." Journal of Artificial intelligence and Machine Learning 2, no. 1 (2024): 1-7.

[20]. Praveen Kumar Kanumarlapudi, "Enhancing Generative AI Shopping Assistants through Advanced Multi-Attribute Decision Making Technique." *Journal of Artificial Intelligence and Machine Learning*, 3(2), (2025): 1-7. DOI: 10.55124/jaim.v3i2.267.

[21]. Bhuvaneswari, G., and G. Manikandan. "A smart speed governor device for vehicle using IoT." *Webology* 19, no. 2 (2022).

[22]. Kumar, KRN Kiran, and K. Bhavani. "Folded spined cube: new topology in interconnection networks." In *2022 6th International Conference on Computing Methodologies and Communication (ICCMC)*, pp. 314-319. IEEE, 2022.

[23]. Sen, Souptik, Ramesh Krishnamaneni, and Ashwin Narasimha Murthy. "THE ROLE OF MACHINE LEARNING IN ENHANCING SLEEP STAGE DETECTION ACCURACY WITH SINGLE-CHANNEL EEG." (2021).

[24]. Driessel, Rene, and Lars Monch. "Simulation framework for complex manufacturing systems with automated material handling." In 2007 Winter, Simulation Conference, pp. 1713-1721. IEEE, 2007.

[25]. Bhuyan, Hemanta Kumar, A. Vijayaraj, and Vinayakumar Ravi. "Diagnosis system for cancer disease using a single setting approach." *Multimedia Tools and Applications* 82, no. 30 (2023): 46241-46267.

[26]. Gayathri, B. "Gray wolf optimisation based energy efficient green cloud computing." *Journal of Algebraic Statistics* 13, no. 1 (2022): 932-940.

[27]. Peram, S. R. "Automated Label Detection and Recommendation System Using Deep Convolution Neural Networks and SPSS-Based Evaluation." *International Journal of Computer Science and Data Engineering* 1, no. 2 (2024): 258.

[28]. Fang, Zhou, and Jianfeng Mao. "Energy-efficient elevating transfer vehicle routing for automated multi-level material handling systems." IEEE transactions on automation science and engineering 17, no. 3 (2019): 1107-1123.

[29]. Lin, J. T., Fu-Kwun Wang, and Ping-Yung Yen. "Simulation analysis of dispatching rules for an automated interbay material handling system in wafer fab." International Journal of Production Research 39, no. 6 (2001): 1221-1238.

[30]. Farayibi, Peter Kayode, Taiwo Ebenezer Abioye, and Olagoke Zephaniah Ayodeji. "Development of an automated mechanical lift for material handling purposes." African Journal of Science, Technology, Innovation and Development 12, no. 5 (2020): 561-569.

[31]. Brauers, Willem Karel M. "Multi-objective contractor's ranking by applying the MOORA method." Journal of Business Economics and management 4 (2008): 245-255.

[32]. Attri, Rajesh, and Sandeep Grover. "Decision making over the production system life cycle: MOORA method." International Journal of System Assurance Engineering and Management 5 (2014): 320-328.

[33]. Pérez-Domínguez, Luis, KY Sánchez Mojica, LC Ovalles Pabón, and MC Cordero Diáz. "Application of the MOORA method for the evaluation of the industrial maintenance system." In Journal of Physics: Conference Series, vol. 1126, no. 1, p. 012018. IOP Publishing, 2018.

[34]. Bhuyan, Hemanta Kumar, A. Vijayaraj, and Vinayakumar Ravi. "Development of secrete images in image transferring system." *Multimedia Tools and Applications* 82, no. 5 (2023): 7529-7552.

[35]. Polepaka, Sanjeeva, B. Gayathri, Shahnawaz Ayoub, Himanshu Sharma, Yudhveer Singh Moudgil, and S. Kannan. "Privacy Preserving Encryption with Optimal Key Generation Technique on Deduplication for Cloud Computing Environment." In *2022 International Conference on Automation, Computing and Renewable Systems (ICACRS)*, pp. 464-470. IEEE, 2022.

[36]. Kakulavaram, Sridhar. "Life Insurance Customer Prediction and Sustainbility Analysis Using Machine Learning Techniques." *International Journal of Intelligent Systems and Applications in Engineering* 10 (2022).

[37]. Peram, S. R. "Advanced Network Traffic Visualization and Anomaly Detection Using PCA-MDS Integration and Histogram Gradient Boosting Regression." *Journal of Artificial Intelligence and Machine Learning* 1, no. 3 (2023): 281.

[38]. Abhang, Laxman B., Mohd Iqbal, and M. Hameedullah. "Optimization of machining process parameters using moora method." In Defect and Diffusion Forum, vol. 402, pp. 81-89. Trans Tech Publications Ltd, 2020.

[39]. Gürbüz, Feyza, and Gizem Erdinç. "Selecting the best hotel using the Fuzzy-Moora method with a new combined weight approach." In 2018 2nd International Symposium on Multidisciplinary Studies and Innovative Technologies (ISMSIT), pp. 1-8. IEEE, 2018.

[40]. Mohan, VakaMurali, MalliKarjuna Reddy, and KRN Kiron Kumar. "A New Approach to Optical Networks Security: Attack-Aware Routing and Wavelength Assignment." In *IJCA Special Issues on "2nd National Conference-Computing, Communication and Sensor Network" CCSN*. 2011.

[41]. Krishnamaneni, Mr Ramesh, and A. N. Murthy. "Advancing Drug Dealing Detection Using Neural Embedding and Nearest Neighbour Searching Techniques." *International Journal on Recent and Innovation Trends in Computing and Communication* 9, no. 7 (2021): 19-23.
[42]. Umamehaswari, Muthukrishanan, Muthukrishnan Ramprasath, and Shanmugasundaram Hariharan. "Improved question answering system by semantic refomulation." In *2012 Fourth International Conference on Advanced Computing (ICoAC)*, pp. 1-4. IEEE, 2012.
[43]. Manurung, Samuel Van Basten, Fati Gratianus Nafiri Larosa, Indra M. Sarkis Simamora, Asaziduhu Gea, Emma Rosinta Simarmata, and Alfonsus Situmorang. "Decision support system of best teacher selection using method moora and saw." In 2019 International Conference of Computer Science and Information Technology (ICoSNIKOM), pp. 1-6. IEEE, 2019.
[44]. Liang, Zong-Liang, Tae-Jong Yun, Won-Bin Oh, Bo-Ram Lee, and Ill-Soo Kim. "A study on MOORA-based Taguchi method for optimization in automated GMA welding process." Materials Today: Proceedings 22 (2020): 1778-1785.
[45]. Rane, Santosh B., Prathamesh Ramkrishana Potdar, and Suraj Rane. "Data-driven fleet management using MOORA: a perspective of risk management." Journal of Modelling in Management 16, no. 1 (2021): 310-338.
[46]. Pérez-Domínguez, Luis, Alejandro Alvarado-Iniesta, Iván Rodríguez-Borbón, and Osslan Vergara-Villegas. "Intuitionistic fuzzy MOORA for supplier selection." Dyna 82, no. 191 (2015): 34-41.
[47]. Gurumurthy, Hemanth, Suresha Bheemappa, Rudramuni Chidanandappa, and Pradhyumna Bhat. "Optimization of bio-based liquid transformer insulator using MOORA method." Electric Power Components and Systems 48, no. 12-13 (2020): 1401-1409.
[48]. Bhuyan, Hemanta Kumar, and Narendra Kumar Kamila. "Privacy preserving sub-feature selection based on fuzzy probabilities." *Cluster computing* 17, no. 4 (2014): 1383-1399.
[49]. Kalirasu, S., N. Rajini, S. Rajesh, JT Winowlin Jappes, and K. Karuppasamy. "AWJM Performance of jute/polyester composite using MOORA and analytical models." Materials and manufacturing processes 32, no. 15 (2017): 1730-1739.
[50]. Paul, T. R., A. Saha, H. Majumder, V. Dey, and P. Dutta. "Multi-objective optimization of some correlated process parameters in EDM of Inconel 800 using a hybrid approach." Journal of the Brazilian Society of Mechanical Sciences and Engineering 41 (2019): 1-11.
[51]. Murthy, Ashwin Narasimha, Souptik Sen, and Ramesh Krishnamaneni. "The role of supervised learning in enhancing diagnostic accuracy of neurodegenerative diseases." *International Journal of Advanced Research in Engineering and Technology (IJARET)* 11, no. 8 (2020): 1063-1076.
[52]. Ravindhar, N. V., Hariharan Shanmugasundaram Anand, and Godfrey Winster Ragavendran. "Intelligent diagnosis of cardiac disease prediction using machine learning." *Int. J. Innov. Technol. Explor. Eng* 8, no. 11 (2019): 1417-1421.
[53]. Chandrasekar Raja, M. Ramachandran, Vimala Saravanan, Manjulaselvam, "Improving Fault-Tolerance in Nano-Computing Circuits Through Design Optimization Using the Electric Method", REST Journal on Data Analytics and Artificial Intelligence, 4(2), June 2025, 94-108.
[54]. Modanloo, Vahid, Ali Doniavi, and Rezgar Hasanzadeh. "Application of multi criteria decision making methods to select sheet hydroforming process parameters." Decision Science Letters 5, no. 3 (2016): 349-360.
[55]. Manikandan, G., and S. Srinivasan. "Mining spatially co-located objects from vehicle moving data." *Eur. J. of Sci. Res* 68, no. 3 (2012).
[56]. Rani, Dr V. Vasudha, D. Vasavi, and K. Kumar. "Significance of multilayer perceptron model for early detection of diabetes over ml methods." *J. Univ. Shanghai Sci. Technol* 23, no. 08 (2021): 148-160.
[57]. Banerjee, Deepak, Vinay Kukreja, Shanmugasundaram Hariharan, Vishal Jain, and Soumi Dutta. "Cnn-svm model for accurate detection of bacterial diseases in cucumber leaves." In *2023 Third International Conference on Secure Cyber Computing and Communication (ICSCCC)*, pp. 7-12. IEEE, 2023.
[58]. Bhuyan, Hemanta Kumar, M. Saikiran, Murchhana Tripathy, and Vinayakumar Ravi. "Wide-ranging approach-based feature selection for classification." *Multimedia Tools and Applications* 82, no. 15 (2023): 23277-23304.