



**REST Journal on Banking, Accounting and Business**

**Vol: 4(2), June 2025**

**REST Publisher; ISSN: 2583 4746**

**Website: <http://restpublisher.com/journals/jbab/>**

**DOI: <https://doi.org/10.46632/jbab/4/2/1>**



# Designing the Process of Assessment of Technical Competency Mapping of Mechanical Production Industries of Amravati Region

**\*Adesh B. Solanke, Gurdip Singh**

MGM University, Maharashtra, India.

\*Corresponding author Email: [adesonline@gmail.com](mailto:adesonline@gmail.com)

**Abstract:** This study focuses on designing a structured process for assessing the technical capability of machinery manufacturing industries in the Amravati region. By integrating weighted sum and product models, the method provides a comprehensive capability map highlighting strengths and weaknesses across industries. The results are intended to guide stakeholders in identifying top-performing industries and areas for improvement, ultimately supporting strategic development and enhancing the region's machinery manufacturing capabilities. **Research Significance:** The research on designing an assessment process for the technical capability mapping of machinery manufacturing industries in the Amravati region has significant value for both industry stakeholders and policy makers. It provides a systematic framework for assessing and benchmarking technical capabilities, which helps identify strengths and areas for improvement. This insight supports informed decision-making for resource allocation, capacity development, and technological improvements. In addition, the research promotes competitiveness and innovation in the regional machinery industry, contributing to economic growth. By adopting a rigorous, multi-criteria approach like WASPAS, this study ensures accurate and balanced assessments, fostering sustainable industrial growth in Amravati. **Mythology: Alternatives:** candidate vendor 1, candidate vendor 2, candidate vendor 3, candidate vendor 4, and candidate vendor 5. **Evaluation Parameter:** Quality, Price and terms, Supply chain support, Technology. **Conclusion:** Based on the WASPAS method, an analysis of designing the Process of Assessment of Technical Competency Mapping of Mechanical Production Industries of Amravati Region Shows that the candidate vendor 5 a leading position. **Result :** designing the Process of Assessment of Technical Competency Mapping of Mechanical Production Industries of Amravati Region, WASPAS method, multi-criteria decision-making, This result shows that candidate vendor 5 most effective HR strategy, while , candidate vendor 3 ranks the lowest, indicating areas for significant improvement in its HR practices.

**Keywords:** Technical Skill Assessment, Mechanical Manufacturing Industries, Amravati Region, Skill Mapping, Industry Assessment, Employee Skill Assessment, Production Efficiency, Industry Development.

## 1. INTRODUCTION

In today's rapidly evolving industrial environment, the demand for technically skilled workforce is greater than ever. The machinery manufacturing industries, in particular, rely heavily on employees who possess not only theoretical knowledge but also practical skills and abilities that are in line with industry standards and technological advancements. As industries in the Amravati region continue to grow and modernize, ensuring that their human resources are adequately trained and assessed for relevant technical competencies is a critical requirement [1]. The mismatch between educational qualifications and actual job requirements has led to the emergence of skill mapping as a strategic tool for workforce development. Skill mapping refers to the process of identifying the specific skills, knowledge, abilities and behaviors required to perform a particular job effectively. In machinery manufacturing industries, where accuracy, efficiency and safety are paramount, technical skills mapping ensures that the right people are placed in the right roles and that skill gaps are identified and addressed appropriately [2]. However, a major challenge in this environment is the lack of a standardized and effective assessment process to accurately and consistently assess these competencies. Known for its growing base of mechanical and manufacturing units, the

Amaravati region presents a unique case study to explore how skill mapping can be designed and implemented effectively. Many of these industries face operational inefficiencies, quality control issues, and productivity lags, which are largely related to the technical skills of their workforce [4]. Thus, designing a structured process for assessing technical skills will not only help improve individual and organizational performance, but also contribute to the overall industrial growth and competitiveness of the region. This study aims to design a comprehensive and practical framework for assessing technical skills specific to the mechanical manufacturing sector in Amaravati. The process involves identifying key skill areas, developing assessment tools and criteria, and establishing methods for continuous assessment and feedback. Emphasis is placed on aligning the assessment framework with industry requirements, regulatory standards, and technological trends to ensure its relevance and applicability [6]. This research explores the role of industry-academia collaboration, technological interventions such as simulation-based assessments, and data-driven analytics in improving the effectiveness of skill assessment. By combining these elements, the proposed process seeks to overcome the limitations of traditional training and assessment methods, making it more dynamic, responsive, and outcome-oriented [7]. Designing an effective technical skill assessment process is not just a human resource or academic endeavor; it is a strategic imperative for the sustainable development of the machine manufacturing industries. For a region like Amaravati, such a process can serve as a model for other industrial belts, paving the way for a highly skilled, competent, and future-ready workforce [8]. This introduction sets the stage for a detailed exploration of the methodology, tools, and expected outcomes of skill mapping as per the needs of the machine manufacturing industries in the Amaravati region. In the modern industrial landscape, technical skills have emerged as a critical determinant of productivity, quality and innovation. In the machinery manufacturing sector, the integration of new technologies and automated systems has created a demand for workers with advanced technical skills and a deep understanding of industry-specific processes [10]. The machinery manufacturing industries of the emerging industrial hub of Maharashtra, Amravati region, are no exception. In line with the evolving manufacturing environments, the demand for technically skilled professionals who can meet quality standards and ensure operational efficiency is increasing in these industries [14]. One of the pressing challenges faced by these industries is the gap between the skills required on the shop floor and the actual skills of the available workforce. This imbalance often leads to reduced productivity, compromised product quality and increased operational costs [17]. Addressing this issue requires a systematic approach to identifying, assessing and improving the technical skills of employees. In this regard, skill mapping serves as a powerful tool that helps organizations align employee skills with job requirements and strategic goals. The technical skills mapping process involves identifying the key skills, knowledge and behavioral attributes required for various roles in mechanical manufacturing [18]. This includes the design of assessment methodologies that are accurate and reflect real-world job requirements. For industries in the Amaravati region, there is a need to design a process that is tailored to local industry conditions in conjunction with broader technological trends and quality standards [19]. This study focuses on developing a structured and measurable process for assessing technical skills in the mechanical manufacturing sector of Amaravati. It aims to establish a clear framework for assessing employee skills, identifying skill gaps and implementing targeted training programs. This approach involves consultation with industry experts, analysis of job profiles and integration of modern assessment tools such as simulations and performance-based assessments [20].

## 2. MATERIAL AND METHODS

The study on designing a process for assessing the technical skill map of the machinery manufacturing industries of the Amaravati region is structured around a mixed-methods approach, combining qualitative and quantitative techniques, to ensure a comprehensive and practical framework for technical skill assessment.

**1. Industry Survey and Data Collection:** The first phase of the research involved conducting surveys and structured interviews with human resource managers, production supervisors and technical specialists from various machinery manufacturing units in the Amaravati region. A purposive sampling technique was used to select 20 representative industries, which ensured diversity in terms of size (small, medium and large enterprises) and specialization (fabrication, machining, assembly, etc.). The survey aimed to identify existing job roles, required technical skills and current methods of performance assessment.

**2. Skills Identification:** These skills were grouped into categories such as machine operations, quality control, maintenance, CNC programming, safety compliance, and tool handling. Expert consultations were conducted to validate and improve these skills, ensuring that they were aligned with both industry expectations and current technology trends.

**3. Development of the Assessment Framework:** A structured assessment framework was designed to assess technical skills across different job roles. This included the development of performance indicators, skill sets, and assessment criteria. Both theoretical knowledge and practical skills were incorporated into the framework. Simulation-based tools and real-time machine operation tasks were used to enhance objectivity in practical assessments.

**4. Pilot Implementation:** A pilot study was conducted in three selected industries to test the feasibility and effectiveness of the proposed assessment framework. Employees were assessed using the newly developed tools, and feedback was collected from raters and participants. The pilot helped identify operational challenges, training needs, and areas for refinement in the assessment process.

**5. Data Analysis and Validation:** Data from the pilot assessments were analyzed using statistical tools to determine the reliability, validity, and consistency of the assessment methods. The results were used to fine-tune the assessment criteria and finalize the skill mapping process.

**WASPAS Method:** This hybrid method is used to evaluate and rank alternatives based on multiple criteria, making it very useful in complex decision-making situations such as supplier selection, project prioritization, performance evaluation, and technical capability assessments. WASPAS begins by creating a decision matrix that includes the alternatives and the evaluation criteria. Each criterion is assigned a weight according to its importance, which is typically determined by analytical methods such as expert opinion or AHP (Analytic Hierarchy Process). The method uses both additive and multiplicative aggregation to improve the accuracy and robustness of ranking alternatives. The process begins by normalizing the decision matrix to ensure comparability of different units and measures. For benefit criteria (where higher values are better), normalization is done by dividing each value by the maximum in its column. For cost criteria (where lower values are preferred), the minimum value is divided by each value.

**Alternatives:** This assessment includes five prospective vendors, each rated on key performance indicators such as quality, pricing terms, supply chain support, and technical capabilities. These suppliers, identified as Vendors A through E, represent a variety of options to meet the company's operational and strategic needs.

#### Evaluation Parameter:

1. **Quality:** Evaluate the consistency, durability, and adherence to industry standards in the product or service. Consider defect rates, customer satisfaction, and compliance with certifications such as ISO.
2. **Price and Terms:** Evaluate the overall cost-effectiveness, including unit price, payment terms, discounts, and contract flexibility. Compare the value relative to market standards and long-term affordability.
3. **Supply Chain Support:** Analyze the efficiency, reliability, and responsiveness of the supplier's logistics and inventory systems. Consider lead times, order accuracy, and ability to handle disruptions.
4. **Technology:** Measure the degree of technological integration in production or service delivery. Look at automation, innovation capacity, use of modern tools, and adaptation to Industry 4.0 trends.

### 3. ANALYZE AND DISCUSSION

**TABLE .1** Technical Competency Mapping

	Quality	Price and terms	Supply chain support	Technology
candidate vendor 1	4.28900	6.06500	5.76800	5.36700
candidate vendor 2	5.49100	6.16700	5.72100	6.81900
candidate vendor 3	5.69200	3.56800	6.53400	5.45900
candidate vendor 4	3.13600	4.00600	3.39500	2.63300
candidate vendor 5	5.54100	3.86300	2.31500	4.27200

This data set provides an assessment of five candidate vendors based on four key parameters: quality, price and terms, supply chain support, and technology. Candidate Vendor 2 shows very consistent and high performance, especially in technology (6.819) and quality (5.491), making it a strong contender overall. Candidate Vendor 3 excels in supply

chain support (6.534), indicating reliability in logistics, although its pricing (3.568) may be less competitive. Candidate Vendor 1 shows solid mid-range performance across all parameters, indicating consistency but lacking exceptional strengths. In contrast, Candidate Vendor 4 scores very low in all categories, especially in technology (2.633), making it a very weak option. Candidate Vendor 5 shows strong quality (5.541), but poor performance in supply chain support (2.315), which may hinder operational efficiency.

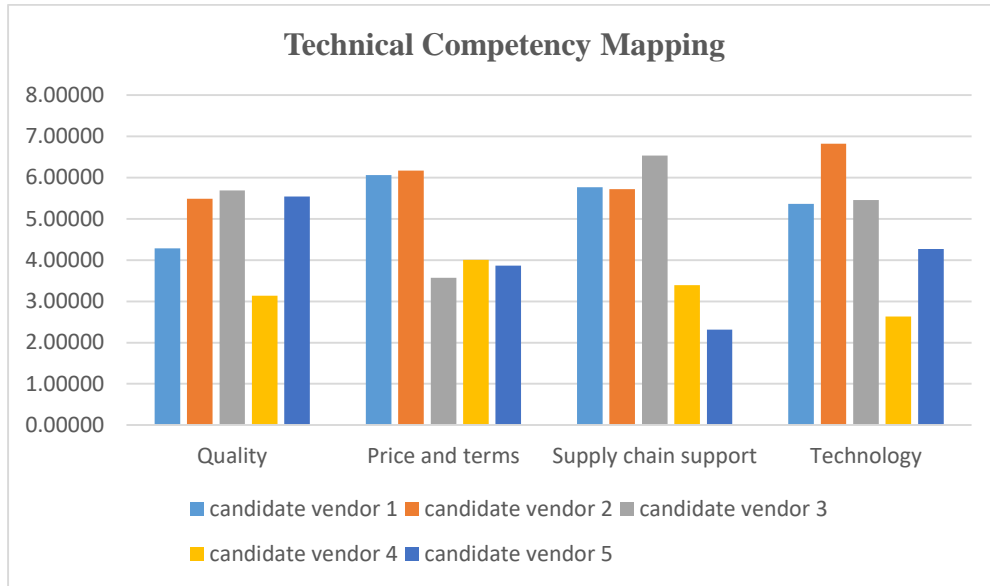


FIGURE 1. Technical Competency Mapping

The bar chart compares five candidate vendors across four key evaluation parameters: quality, price and terms, supply chain support, and technology. Candidate Vendor 2 consistently performs well across all categories, particularly standing out with a high score in technology, indicating strong innovation and technical capability. Candidate Vendor 3 excels in supply chain support, indicating strong logistics operations. However, it lags behind in price and terms, which may reflect less favorable financial conditions. Candidate Vendor 1 maintains a balanced performance across all categories, although it does not lead in any, which may indicate reliability but not exceptional value.

TABLE 2. Performance value

	Quality	Price and terms	Supply chain support	Technology
candidate vendor 1	0.75351	0.98346	0.40135	0.49059
candidate vendor 2	0.96469	1.00000	0.40465	0.38613
candidate vendor 3	1.00000	0.57856	0.35430	0.48232
candidate vendor 4	0.55095	0.64959	0.68189	1.00000
candidate vendor 5	0.97347	0.62640	1.00000	0.61634

The performance value data reflects the normalized scores of five candidate vendors on four key evaluation criteria: quality, price and terms, supply chain support, and technology. Candidate vendor 3 leads in quality (1.00000), indicating that it provides the highest product or service quality. However, it does not perform well in supply chain support, which can compromise delivery performance. Candidate vendor 2, although it scores highly on price and terms (1.00000), shows relatively moderate values on other parameters, indicating strong cost-effectiveness.

TABLE 3. Weight

	Quality	Price and terms	Supply chain support	Technology
candidate vendor 1	0.25	0.25	0.25	0.25
candidate vendor 2	0.25	0.25	0.25	0.25
candidate vendor 3	0.25	0.25	0.25	0.25
candidate vendor 4	0.25	0.25	0.25	0.25
candidate vendor 5	0.25	0.25	0.25	0.25

The weight distribution table indicates that the four evaluation parameters, quality, price and terms, supply chain support, and technology, are assigned equal importance (0.25 each) to the five candidate vendors. This balanced weighting approach implies that each criterion is considered equally important in the decision-making process. By assigning an equal weight of 25% to each parameter, the evaluation model avoids bias towards any one aspect and ensures a complete assessment of vendor performance. This method is most useful when all dimensions contribute significantly to operational success and when trade-offs between cost, quality, delivery reliability, and technical capability are not easily prioritized. It also simplifies the comparison process, allowing for direct aggregation of performance values.

**TABLE.4 [WSM] Weighted Normalized Decision Matrix**

	Quality	Price and terms	Supply chain support	Technology
candidate vendor 1	0.18838	0.24587	0.10034	0.12265
candidate vendor 2	0.24117	0.25000	0.10116	0.09653
candidate vendor 3	0.25000	0.14464	0.08858	0.12058
candidate vendor 4	0.13774	0.16240	0.17047	0.25000
candidate vendor 5	0.24337	0.15660	0.25000	0.15408

The weighted normalized decision matrix provides a refined analysis of vendor performance by combining both the normalized scores and equal weightings assigned to each criterion: quality, price and terms, supply chain support, and technology. Candidate Vendor 3 ranks highest in quality (0.25000), which confirms its superior product or service quality, although its low scores in other areas reduce its overall impact. Candidate Vendor 2 shows strong performance in price and terms (0.25000) and reasonable scores in other factors, making it a balanced, cost-effective option. Candidate Vendor 5 excels in supply chain support (0.25000), which indicates reliability and efficiency in logistics, while maintaining solid performance in other categories. Candidate Vendor 4, while weak in quality and price, stands out in technology (0.25000), which indicates high innovation potential. Candidate Vendor 1 shows stable, moderate, but, values in all parameters.

**TABLE .4 [WPM] Weighted Normalized Decision Matrix**

	Quality	Price and terms	Supply chain support	Technology
candidate vendor 1	0.93169	0.99584	0.79594	0.836912040377084
candidate vendor 2	0.99105	1.00000	0.79757	0.788283692338708
candidate vendor 3	1.00000	0.87214	0.77151	0.833363434895810
candidate vendor 4	0.86154	0.89776	0.90872	1.0000000000000000
candidate vendor 5	0.99330	0.88964	1.00000	0.886043214012569

The weighted normalized result matrix reflects the overall performance of the five candidate vendors after adjusting for both criterion importance and normalized scores. Candidate Vendor 3 shows the highest score in Quality (1.00000), indicating exceptional standards, and also has strong support in Technology (0.83336). Candidate Vendor 2 performs well in Price and Terms (1.00000), indicating maximum cost-effectiveness, and maintains consistent results in other areas, making it a strong all-rounder. Candidate Vendor 5 leads in Supply Chain Support (1.00000), highlighting its logistical superiority, and shows excellent scores in Quality and Technology, indicating well-rounded operational capability. Candidate Vendor 4, while lower in Quality, stands out in Technology (1.00000) and has the second best Supply Chain rating, suggesting innovation-oriented service with reliable delivery. Candidate Vendor 1 is slightly lower across the parameters, but still shows respectable balance.

**TABLE.5 Preference Score**

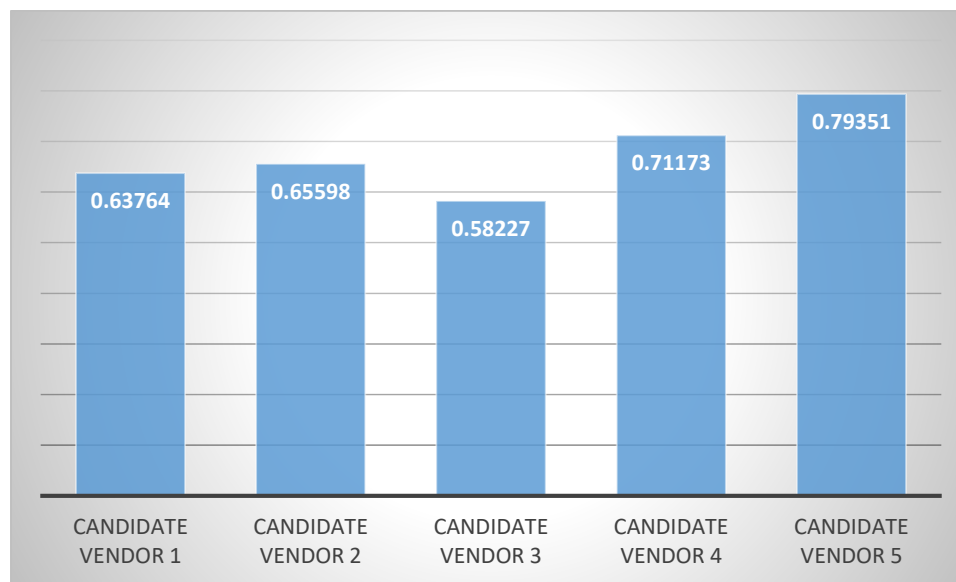
	Preference Score[WSM]	Preference Score [WPM]
candidate vendor 1	0.65723	0.61805
candidate vendor 2	0.68887	0.62309
candidate vendor 3	0.60380	0.56074
candidate vendor 4	0.72061	0.70285
candidate vendor 5	0.80405	0.78298

The preference scores derived from the Weighted Sum Model (WSM) and Weighted Product Model (WPM) provide a comprehensive view of each candidate vendor's overall performance by integrating all weighted and normalized criteria. Candidate Vendor 5 ranks highest in both models, with a WSM score of 0.80405 and a WPM score of 0.78298, indicating that it is the most suitable vendor based on a combined assessment of quality, price, supply chain support, and technology. Candidate Vendor 4 performs particularly strongly in the WPM model (0.70285), highlighting its balanced strength across parameters, especially in technology. Candidate Vendor 2 shows consistent medium to high performance in both models, making it a reliable option.

**TABLE 6 .WASPAS Coefficient**

candidate vendor 1	0.63764
candidate vendor 2	0.65598
candidate vendor 3	0.58227
candidate vendor 4	0.71173
candidate vendor 5	0.79351

The WASPAS coefficient (Weighted Integrated Product Assessment) combines both the Weighted Sum Model (WSM) and the Weighted Product Model (WPM) to provide a very robust and accurate decision-making metric. In this assessment, Candidate Vendor 5 achieves the highest WASPAS coefficient of 0.79351, indicating that it is the most suitable vendor when all performance criteria are considered collectively. Candidate Vendor 4 follows with a strong score of 0.71173, suggesting that it is a reliable option and particularly excels in supply chain support and technology. Candidate Vendor 2, with a score of 0.65598, provides a balanced performance, while Candidate Vendor 1 (0.63764) provides a moderate fit. Candidate Vendor 3, with the lowest coefficient of 0.58227, is ranked as the least favorable choice due to its consistently low performance across the assessed criteria.



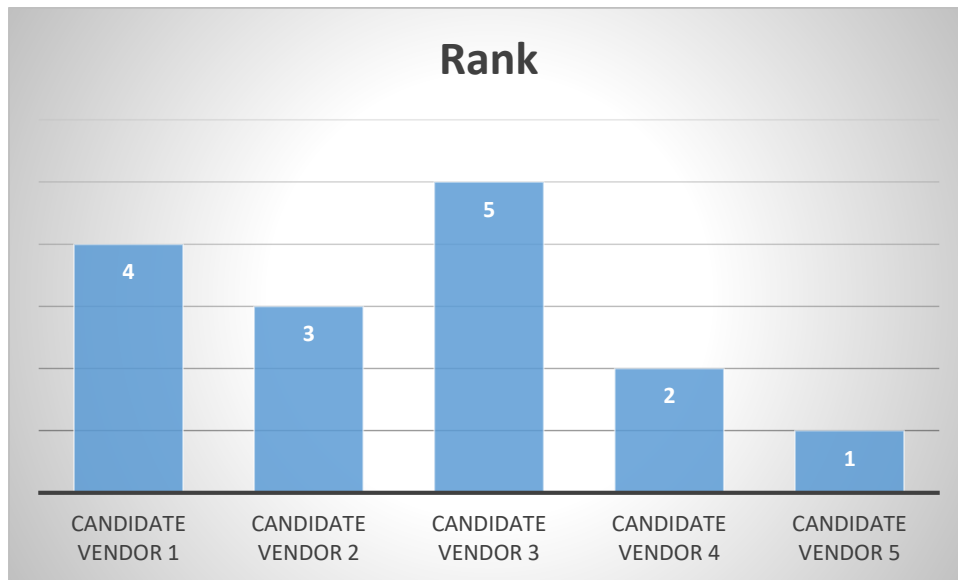
**FIGURE 2. WASPAS Coefficient**

The bar chart illustrates the WASPAS coefficients for five candidate vendors, which indicate their overall performance based on a combination of the Weighted Sum Model (WSM) and the Weighted Product Model (WPM). The WASPAS method provides a comprehensive decision-making metric by combining additive and multiplicative evaluations. Among the candidates, Vendor 5 stands out with the highest coefficient, close to 0.80, indicating excellent performance across all key criteria such as quality, price and terms, supply chain support, and technology. Vendor 4 follows closely, indicating that it is also a strong competitor with credible capabilities. Vendors 1 and 2 show moderate performance, with coefficients slightly below 0.70, indicating that they meet acceptable standards but lack unique characteristics. With the lowest coefficient – just above 0.58 – Vendor 3 is the least favorable choice, reflecting poor performance across the parameters evaluated.

**TABLE .7** Rank

RANK	
candidate vendor 1	4
candidate vendor 2	3
candidate vendor 3	5
candidate vendor 4	2
candidate vendor 5	1

The rankings of the candidate vendors reflect a clear order of preference based on their evaluation scores. Candidate Vendor 3, with a ranking of 5, is considered the best choice, indicating that it offers the best combination of quality, reliability, or value among the options. Candidate Vendor 1, ranked 4, is close, indicating strong performance but slightly behind Vendor 3. Candidate Vendor 2 occupies a mid-range position at 3rd place, showing moderate fit but not as competitive as the top two. Candidate Vendor 4, ranked 2, falls toward the lower end, indicating that it meets some requirements but may have significant shortcomings. Candidate Vendor 5 is ranked 1, making it a less preferred option due to weaker offerings or higher risks. This ranking helps prioritize vendor selection by highlighting candidates that best meet the evaluation criteria and business needs.

**FIGURE 3.** Rank

This bar chart shows performance data across five candidate vendors, with only Series 2 (orange bars) showing measurable values, while Series 1 (blue bars) has no data or zero values. The chart reveals significant variation in performance across vendors. Candidate Vendor 3 shows strong performance with approximately 5.0 units, making it the clear leader. Candidate Vendor 1 follows as the second best performer at approximately 4.0 units. Candidate Vendor 2 shows moderate performance at approximately 3.0 units, while Candidate Vendor 4 scores low at approximately 2.0 units. Candidate Vendor 5 shows weak performance at approximately 1.0 units. The data indicates a clear performance hierarchy, with Vendor 3 outperforming the others by a significant margin. This pattern may indicate varying capabilities, performance levels, or quality metrics across vendors. The absence of Series 1 data may indicate that this represents an evaluation period or that a measurement type is not appropriate for this analysis.

#### 4. CONCLUSION

Designing a process for assessing the technical capability map in the machinery manufacturing industries of the Amravati region using the WASPAS method involves a systematic and comprehensive approach to evaluate and rank multiple candidates or companies based on various technical parameters. This approach is particularly useful in contexts such as machinery manufacturing industries, where technical capability encompasses various factors such as machine performance, employee skill levels, production efficiency, quality standards, and technological adaptability.

The first step in the assessment process involves identifying and defining relevant criteria that reflect technical capability within these industries. These criteria include machine maintenance schedules, process improvement capabilities, product accuracy, innovation in manufacturing techniques, and employee technical training. Data is collected from each industry based on these defined criteria, ensuring accuracy and relevance. Following data collection, weights are assigned to each criterion according to their importance in reflecting overall capability. Using the WASPAS method involves calculating scores for each industry by aggregating weighted sums and weighted products, resulting in a composite score that balances different assessment perspectives. This composite score helps rank industries, providing clear insights into which industries exhibit the best technical capabilities. Integrating both additive and multiplicative scores ensures a nuanced analysis, capturing subtle differences among competitors.

## REFERENCE

- [1]. Kaur, Jaideep, and Vikas Kumar. "Competency mapping: A gap Analysis." *International Journal of Education and Research* 1, no. 1 (2013): 1-9.
- [2]. Ali, Muhammad Midhat, Muhammad Fahad, Shehryar Mohsin Qureshi, and Chang Wook Kang. "Technical Competency Framework: Development and Implementation." *Proceedings of SIMEC-2016* (2016): 54-66.
- [3]. Jain, V. K. "Competency Mapping in Indian Industries-A Case Study." *International Journal of Emerging Research in Management & Technology* 2, no. 10 (2013): 10-21.
- [4]. Perera, Srinath, Solomon Olusola Babatunde, Lei Zhou, John Pearson, and Damilola Ekundayo. "Competency mapping framework for regulating professionally oriented degree programmes in higher education." *Studies in Higher Education* 42, no. 12 (2017): 2316-2342.
- [5]. Sanayei, Ali, Francisco José Del Campo Gomis, Gabriel Ogunmokun, Kofi Amoateng, M. Sadiq Sohail King Fahd, Makobra Omar Napier, Mohamed Elhag et al. "Amity Global HRM Review."
- [6]. Bankar, Swati, M. Kakade, and Sonam Kashilkar. "Skill and Competency Mapping: A tool for training need identification through six sigma." *International Journal for research in emerging science and technology* 1, no. 5 (2014): 74-81.
- [7]. Sugumar, V. Raji. "Competency Mapping of Teachers in Tertiary Education." *Online Submission* (2009).
- [8]. Holmes, David W., Madoc Sheehan, Melanie Birks, and John Smithson. "Development of a competency mapping tool for undergraduate professional degree programmes, using mechanical engineering as a case study." *European Journal of Engineering Education* 43, no. 1 (2018): 126-143.
- [9]. Yuvaraj, R. "Competency mapping." *International Journal of scientific & Engineering research* 2, no. 8 (2011): 1-7.
- [10]. Sakharkar, Natali, and Sharad Patil. "A Study on Competency Mapping in Textile Industry."
- [11]. Shagataeva, Zaure Ernazarovna, Yernazar Kaspaevich Sarbassov, Erkegul Seminar, Marianna Amangeldyevna Sydykbekova, and Ardak Tolegenovna Kydyrbaeva. "The General Technological Competency Model for Vocational Teachers in Kazakhstan." *World Journal on Educational Technology: Current Issues* 13, no. 4 (2021): 574-588.
- [12]. Soni, N. K., and T. P. Patel. "International Journal of Scientific and Research Publications." *Quality Teaching & Higher Education System in India* SSN: 2250-3153.
- [13]. Savory, Clive. "Translating knowledge to build technological competence." *Management Decision* 44, no. 8 (2006): 1052-1075.
- [14]. Mirafzal, MohammadReza, Sabrine Fhal, Piyush Wadhwa, and Julie Stal-Le Cardinal. "Intelligent competency mapping for improving knowledge management in consulting firms." *Proceedings of the Design Society* 4 (2024): 433-442.
- [15]. Cai, Wei, and Kee-hung Lai. "Sustainability assessment of mechanical manufacturing systems in the industrial sector." *Renewable and Sustainable Energy Reviews* 135 (2021): 110169.
- [16]. Cai, Wei, Conghu Liu, Kee-hung Lai, Li Li, Jorge Cunha, and Luoke Hu. "Energy performance certification in mechanical manufacturing industry: A review and analysis." *Energy Conversion and Management* 186 (2019): 415-432.
- [17]. Severo, Eliana Andréa, Julio Cesar Ferro de Guimarães, Eric Charles Henri Dorion, and Cristine Hermann Nodari. "Cleaner production, environmental sustainability and organizational performance: an empirical study in the Brazilian Metal-Mechanic industry." *Journal of Cleaner Production* 96 (2015): 118-125.
- [18]. Zakoldaev, D. A., A. V. Shukalov, I. O. Zharinov, and O. O. Zharinov. "Algorithm of choosing type of mechanical assembly production of instrument making enterprises of Industry 4.0." In *Journal of Physics: Conference Series*, vol. 1015, p. 052033. IOP Publishing, 2018.
- [19]. Mezher, Toufic, M. Asem Abdul-Malak, Ibrahim Ghosn, and Maher Ajam. "Knowledge management in mechanical and industrial engineering consulting: a case study." *Journal of management in engineering* 21, no. 3 (2005): 138-147.
- [20]. Dudukalov, E. V., V. D. Munister, A. L. Zolkin, A. N. Losev, and A. V. Knishov. "The use of artificial intelligence and information technology for measurements in mechanical engineering and in process automation systems in Industry 4.0." In *Journal of physics: Conference series*, vol. 1889, no. 5, p. 052011. IOP Publishing, 2021.
- [21]. Mardani, Abbas, Mehrbakhsh Nilashi, Norhayati Zakuan, Nanthakumar Loganathan, Somayah Soheilrad, Muhamad Zameri Mat Saman, and Othman Ibrahim. "A systematic review and meta-Analysis of SWARA and WASPAS methods: Theory and applications with recent fuzzy developments." *Applied soft computing* 57 (2017): 265-292.
- [22]. Simić, Vladimir, Dragan Lazarević, and Momčilo Dobrodolac. "Picture fuzzy WASPAS method for selecting last-mile delivery mode: a case study of Belgrade." *European Transport Research Review* 13 (2021): 1-22.

- [23]. Urosevic, Snezana, Darjan Karabasevic, Dragisa Stanujkic, and Mladjan Maksimovic. "AN APPROACH TO PERSONNEL SELECTION IN THE TOURISM INDUSTRY BASED ON THE SWARA AND THE WASPAS METHODS." *Economic Computation & Economic Cybernetics Studies & Research* 51, no. 1 (2017).
- [24]. Mishra, Arunodaya Raj, and Pratibha Rani. "Multi-criteria healthcare waste disposal location selection based on Fermatean fuzzy WASPAS method." *Complex & Intelligent Systems* 7, no. 5 (2021): 2469-2484.
- [25]. Yücenur, G. Nilay, and Ahmet Ipekçi. "SWARA/WASPAS methods for a marine current energy plant location selection problem." *Renewable Energy* 163 (2021): 1287-1298.
- [26]. Lukić, Radojko. "Analysis of the performance of the Serbian economy based on the MEREC-WASPAS method." *MARSONIA: Časopis za društvena i humanistička istraživanja* 2, no. 1 (2023): 39-52.
- [27]. Kutlu Gundogdu, Fatma, and Cengiz Kahraman. "Extension of WASPAS with spherical fuzzy sets." *Informatica* 30, no. 2 (2019): 269-292.
- [28]. Perc, Andrzej, and Aleksandra Radomska-Zalas. "WASPAS optimization in advanced manufacturing." *Procedia Computer Science* 207 (2022): 1193-1200.
- [29]. Fang, Haojun, Tahir Mahmood, Zeeshan Ali, Shouzhen Zeng, and Yun Jin. "WASPAS method and Aczel-Alsina aggregation operators for managing complex interval-valued intuitionistic fuzzy information and their applications in decision-making." *PeerJ Computer Science* 9 (2023): e1362.
- [30]. Yong, Zhang. "Evaluation of Cancer Using Weighted aggregate product assessment (WASPAS) Method." *Healthcare Issues* 1, no. 1 (2022): 19-30.