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Evaluate The Venturi Effect at a Constant Height By Using (MOORA) Method

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ABSTRACT

The Venturi Effect is a well-known principle in fluid dynamics, describing the behavior of fluids as they flow through a constricted pipe or tube at a constant height. The Venturi Effect is based on the conservation of mass and Bernoulli's principle. When a fluid, such as a gas or liquid, flows through a constricted section of a pipe or tube, its velocity increases, while its pressure decreases. This phenomenon occurs due to the conservation of mass, which dictates that the mass flow rate remains constant along the pipe. Therefore, as the cross-sectional area of the pipe decreases, the fluid must accelerate to maintain the same mass flow rate. This increase in fluid velocity results in a decrease in pressure, as described by Bernoulli's principle. Research significance: The Venturi Effect is a critical component of fluid mechanics. It helps scientists and engineers understand how fluids behave in various situations, from pipe flows to aircraft design, and even the human circulatory system. Understanding this phenomenon is essential for making accurate predictions and solving complex fluid dynamics problems. Venturi Effect is widely used in engineering and industry. It plays a crucial role in applications like the design of nozzles, carburetors, and flow meters. Engineers and researchers use it to optimize the efficiency and performance of various fluid systems, including in aviation, automotive, and manufacturing. Method: A new optimization technique, MOORA, is introduced as an innovative approach with flexibility and a range of unique options. This systematic method involves creating a matrix of potential responses and suggests optimal strategies by considering the employed rates. It is well-established and provides a comprehensive solution. In contrast, the reference point method, another multi-objective optimization technique, was considered for comparison. Following various competitions, it was concluded that MOORA outperformed other methods and proved to be the most effective approach.Result: From the result venturi has first rank whereas multiphase has lowest rank

1. INTRODUCTION

Height plays a crucial role in the variation of air pressure in Earth's atmosphere. As altitude increases, the pressure decreases due to the decreasing density of air molecules in the atmosphere. This phenomenon can be attributed to the weight of the air column above a specific point. At higher elevations, there is less air above, resulting in lower pressure, while at lower elevations, the greater weight of the air column leads to higher pressure. Understanding this relationship is essential in meteorology and aviation, as it affects weather patterns and flight operations [1] Wind tunnel tests provide a physical model to assess airflow patterns and pressures, helping refine the roof's shape. Concurrently, CFD analysis complements these experiments, offering precise numerical simulations to optimize design parameters, ensuring the roof's ability to channel and harness natural ventilation effectively. This comprehensive approach ensures that the final roof

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design maximizes airflow efficiency and enhances the overall building's ventilation system [2] In this case; the study used computational simulations to analyze airflow patterns between buildings positioned at right angles to each other. The results revealed that, under certain conditions, a Venturi effect does indeed occur, leading to increased wind speeds and potential implications for natural ventilation, energy efficiency, and urban planning in such urban environments [3] The Venturi effect in passage ventilation between two non-parallel buildings refers to the principle that governs the airflow between structures when they are not aligned. When wind passes through this constricted space, it accelerates due to reduced pressure, drawing air from the surroundings. This effect enhances the exchange of air and can be harnessed for natural ventilation in urban environments. By utilizing the Venturi effect, designers can improve air quality and reduce the reliance on mechanical systems for airflow; making it a valuable concept in sustainable building design and urban planning [4] the performance of flow meters at low Reynolds numbers can significantly affect their accuracy and reliability in measuring fluid flow. In such conditions, where the flow is characterized by low velocities and a high degree of fluid viscosity, various flow meters, including Venturi tubes, standard concentric orifice plates, V-cones, and wedge flow meters, may exhibit different discharge coefficient behaviors. Venturi tubes are known for their high accuracy and stable discharge coefficients even at low Reynolds numbers. They maintain a consistent discharge coefficient due to their smooth converging and diverging sections, which minimize flow disturbances and pressure losses. Standard concentric orifice plates, on the other hand, tend to have a lower discharge coefficient performance at low Reynolds numbers because they create more turbulence and energy losses in the flow-cones and wedge flow meters are designed to improve the discharge coefficient performance in various flow conditions, including low Reynolds numbers. V-cones, with their unique shape, can provide better accuracy than orifice plates, even at lower Reynolds numbers, thanks to reduced flow disturbances. Wedge flow meters also offer good performance in low Reynolds number flows due to their specialized design that minimizes pressure loss and turbulence [5] To evaluate the Venturi device's impact on gas well production, one can employ a systematic approach. First, install the Venturi device in the wellbore and record production data before and after its implementation. Monitor key parameters such as gas flow rates, pressure differentials, and wellhead pressures. Compare the data to assess any improvements or declines in production efficiency, enabling informed decisions regarding the Venturi device's effectiveness in enhancing gas well performance [6] the height of the building can create turbulence and alter wind patterns, affecting wind speed. A wider building can create wind shadows and reduce mean wind speed, while the size of the building relative to its surroundings can also impact wind flow. The approaching flow profile, whether it's laminar or turbulent, significantly influences how wind interacts with the building; further influencing mean wind speed [7] The Venturi principle finds valuable applications in water aeration systems, where it enhances dissolved oxygen levels in aquatic environments. In this context, a Venturi device accelerates water flow through a constricted area, creating a low-pressure zone that draws in and mixes air with the water. This process efficiently oxygenates the water, benefiting fish tanks, aquaculture, and wastewater treatment, promoting healthier aquatic ecosystems and improved water quality [8]

2. MATERIALS AND METHODS

Alternative parameters: Efficiency, Pressure Drop, Cost, Environmental Impact. Evaluation parameters: V-Cone, Multiphase, venture, Wedge, Orifice. Efficiency: Efficiency is often associated with effectiveness, which involves achieving desired outcomes, but efficiency specifically focuses on optimizing the use of resources in the process. Pressure Drop: Pressure drop refers to the decrease in pressure that occurs as a fluid (liquid or gas) flows through a system, such as pipes, valves, fittings, or other components. It is a critical factor in the design and operation of fluid systems, as pressure drop can impact the performance, efficiency, and safety of the system. Cost: Cost refers to the amount of resources, usually expressed in terms of money, time, or effort, required to produce, acquire, or achieve something. It is a fundamental concept in economics, business, and everyday decision-making. Costs can be categorized in various ways, and understanding them is crucial for making informed choices and managing resources effectively. Environmental Impact: This impact can be both positive and negative, influencing ecosystems, biodiversity, air and water quality, climate, and various other environmental factors. Assessing environmental impact is a critical component of environmental management and sustainable development practices. Multiphase: Multiphase refers to a system or process involving the simultaneous presence of multiple phases of matter. In the context of fluid dynamics, it commonly refers to systems where two or more phases (gas, liquid, or solid) coexist. The most common multiphase systems involve the mixture of gas and liquid phases, such as gas-liquid flows in pipelines or oil and gas reservoirs. Multiphase systems can exhibit complex behaviors, as the interactions between different phases influence the overall behavior of the system. In the oil and gas industry, for example, the production and transportation of hydrocarbons often involve multiphase flow, where oil, gas, and water coexist in pipelines. Understanding and accurately predicting the behavior of multiphase flows are crucial for designing and operating systems in various engineering applications. Wedge: In meteorology, a "wedge" is a type of cold air mass that wedges itself between two warmer air masses, often leading to specific weather conditions. Orifice: An "orifice" refers to an opening, hole, or passage, typically in a body or a surface. It can be natural, like the opening of a tube or a cavity in an organism, or artificial, such as an opening created for specific purposes, like the nozzle of a pipe or a valve. The term is commonly used in various fields, including anatomy, engineering, fluid dynamics, and mechanics, to describe a passage through which fluids, gases, or other substances can flow or be transferred. MOORA: Moora has been successfully employed for optimization purposes. The second characteristic of MOORA involves utilizing dimensionless numbers as the fundamental basis. Additionally, the analysis sheds light on the disparities in well-being among Lithuania's ten counties, considering all objectives. Notably, the affluent districts starkly contrast with the less fortunate ones. Addressing the migration of workers to the Vilnius district is crucial, as it directly influences income. The approach of automatic redistribution is deemed unacceptable, with the recommendation being the emergence of commercialization and industrialization in specific locations (9). Concrete multi-objective optimization is highlighted, emphasizing the simultaneous improvement of the system within constraints or when faced with conflicting attributes. Optimal decisions are crucial in various areas, including product design and multi-goal optimization. Commercial transactions often involve a balance between competing interests, such as increasing sales while reducing product prices, enhancing performance while minimizing automotive fuel consumption, and reducing weight despite potential challenges (10).MOORA stands out among other Multiple Criteria Decision Making (MCDM) approaches for several reasons. Firstly, it introduces a novel MCTM technique that was developed with a clear understanding of the limitations associated with more traditional methods. This makes MOORA a highly practical choice. Secondly, the processing time required by MOORA, as documented in the MCDM literature, is notably efficient. Lastly, MOORA is advantageous due to its minimal setup requirements, as indicated in the literature, saving time and providing consistent results [11].The MOORA tool serves as a decision-support system for the selection of college students eligible for scholarships, aimed at enhancing academic performance. The institution employs MOORA as a versatile decision-making tool capable of addressing a wide array of situations. By utilizing this machine selection technique, scholarship candidates can be efficiently chosen, leading to improved educational outcomes and providing support to deserving students in need [12].MOORA is highly praised for its effectiveness. It is a green multi-criteria selection method that comprehensively explores possibilities, considering high heterogeneity and various relevant factors. The technique is particularly valuable in effectively resolving complex decision-making challenges, often yielding grades that rigorously weigh both positive and negative criteria. Certain decisions made using the MOORA technique are recognized and awarded based on its effectiveness [13].MOORA is a method of multi-objective optimization. Some people use a variety of features and tactics to progress and improve simultaneously. MOORA is about trying new things. An effective approach strategy. Constraint [14] MOORA, or multiple criteria or multiple features, refers to multi-goal optimization based mostly on ratio analysis. Optimization is an upgrade process that takes into account two or more disputed attributes at the same time (notes). This timed provides a wide range of tools for decision-making in the disputed and complex environment of the supply chain. Examples include selecting the warehouse location, supplier, product, and procedure design. MOORA can be used when the best options are required. [15]

3. RESULT AND DISCUSSION

TABLE 1. Evaluate the Venturi Effect at a Constant Height

Type	Efficiency (%)	Pressure Drop	Cost ($)	Environmental Impact
V-Cone	88	1.4	9000	73
Multiphase	86	1.3	8500	93
Venturi	90	1.5	10000	25
Wedge	91	1.6	11000	84
Orifice	85	1.2	8000	52

Table 1 shows Embedded Intelligent real time systems Alternative: Efficiency, Pressure Drop, Cost, and Environmental Impact. Evaluation preference: V-Cone, Multiphase, venture, Wedge, Orifice.Use this table.

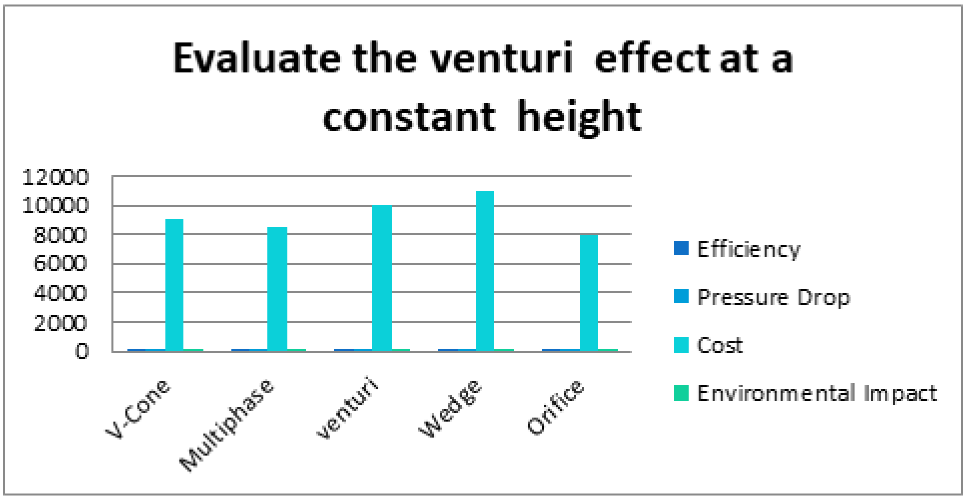

FIGURE 1. Evaluate the Venturi Effect at a constant height.

Figure 1 show chart titled “Evaluate the Venturi Effect at a Constant Height” compares five flow measurement devices—V-Cone, Multiphase, Venturi, Wedge, and Orifice—based on efficiency, pressure drop, cost, and environmental impact. The comparison shows noticeable differences in performance and operational characteristics among the devices.In terms of efficiency, the Venturi and Wedge meters demonstrate relatively higher values, indicating better capability in maintaining accurate and stable flow measurement under constant height conditions. The V-Cone and Multiphase meters show moderate efficiency, while the Orifice meter appears slightly lower in comparison.

TABLE 2. Table 2: Divide & Sum

7744.0000	1.9600	81000000.0000	5329.0000
7396.0000	1.6900	72250000.0000	8649.0000
8100.0000	2.2500	100000000.0000	625.0000
8281.0000	2.5600	121000000.0000	7056.0000
7225.0000	1.4400	64000000.0000	2704.0000
38746.0000	9.9000	438250000.0000	24363.0000

Table 2 titled “Divide & Sum” presents four numerical columns with five individual observations and a final row showing the totals of each column. The first column contains values ranging from 7,225.0000 to 8,281.0000, with a total sum of 38,746.0000. These figures appear relatively consistent, indicating limited variation among the observations. The second column includes smaller decimal values between 1.4400 and 2.5600, summing to 9.9000. This suggests that the second variable has a narrow range and steady distribution across the dataset. The third column contains very large numbers, from 64,000,000.0000 to 121,000,000.0000, producing a total of 438,250,000.0000. These values dominate the table in magnitude, indicating that this variable carries the greatest numerical weight. The fourth column ranges from 625.0000 to

8,649.0000, with a total of 24,363.0000, showing moderate variability compared to the first two columns.

TABLE 3. Table 3: Normalized Data

	Efficiency	Pressure Drop	Cost	Environmental Impact
1	0.4471	0.4449	0.4299	0.4677
2	0.4369	0.4132	0.4060	0.5958
3	0.4572	0.4767	0.4777	0.1602
4	0.4623	0.5085	0.5255	0.5382
5	0.4318	0.3814	0.3821	0.3331

$$X_{n1} = \frac{X_1}{\sqrt{X_1^2 + X_2^2 + X_3^2 + \cdots}} \tag{1}$$

Table 3 presents the normalized data for four evaluation criteria: Efficiency, Pressure Drop, Cost, and Environmental Impact. Normalization scales the original values into a comparable range, typically between 0 and 1, allowing fair comparison across different units and magnitudes. From the table, Efficiency values range from 0.4318 to 0.4623. The fourth observation (0.4623) shows the highest normalized efficiency, while the fifth (0.4318) is the lowest. The variation is small, indicating that efficiency differences among the alternatives are relatively moderate. For Pressure Drop, values vary between 0.3814 and 0.5085. The fourth observation again records the highest value (0.5085), suggesting comparatively greater pressure drop under normalized conditions, while the fifth observation shows the lowest (0.3814), indicating better performance in minimizing pressure loss.

TABLE 4. Weighted Normalized Decision Matrix

Alternative	**Criterion 1**	**Criterion 2**	**Criterion 3**	**Criterion 4**
Alternative 1	0.1118	0.1112	0.1075	0.1169
Alternative 2	0.1092	0.1033	0.1015	0.1490
Alternative 3	0.1143	0.1192	0.1194	0.0400
Alternative 4	0.1156	0.1271	0.1314	0.1345
Alternative 5	0.1080	0.0953	0.0955	0.0833

Table 4 presents the Weighted Normalized Decision Matrix, which is derived by multiplying each normalized value by its respective criterion weight. This matrix reflects the relative importance of each criterion—Efficiency, Pressure Drop, Cost, and Environmental Impact—in the overall evaluation process. The weighted values help in identifying the most suitable alternative using multi-criteria decision-making methods such as TOPSIS.From the table, the fourth alternative shows comparatively higher weighted scores in Efficiency (0.1156), Pressure Drop (0.1271), and Cost (0.1314), indicating strong performance in these criteria after considering their assigned weights. However, its Environmental Impact value (0.1345) is also relatively high, which may be unfavorable if environmental impact is considered a cost criterion.The third alternative performs well in Efficiency (0.1143) and Pressure Drop (0.1192), but its Environmental Impact score (0.0400) is significantly lower than the others, suggesting better environmental performance if lower values are preferred.

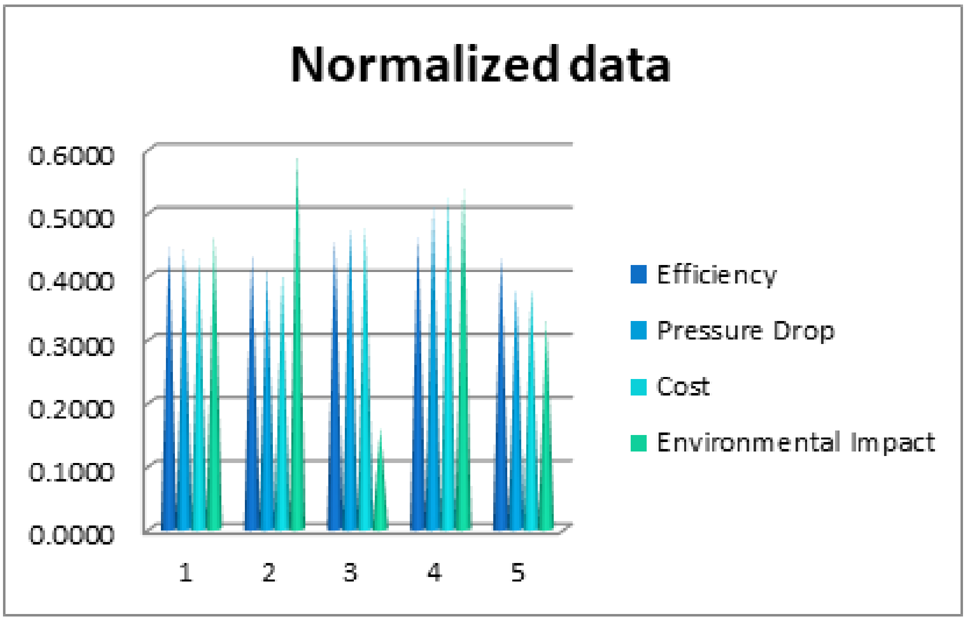

FIGURE 2. Normalized data

Figure 2 show The chart titled "Normalized Data" presents a comparative visualization of five alternatives evaluated across four criteria: Efficiency, Pressure Drop, Cost, and Environmental Impact. Since the data is normalized, all values fall within a similar scale (approximately 0 to 0.6), allowing for fair comparison among criteria that originally had different units and magnitudes. From the graph, Efficiency values appear relatively consistent across all five alternatives, showing only slight variation. This indicates that none of the options significantly outperforms the others in terms of efficiency. Pressure Drop values show moderate fluctuation, with one alternative displaying a noticeably higher value, suggesting comparatively greater resistance or energy loss in that case.

TABLE 5. Table 5: Assessment Value & Rank

Type	Assessment Value	Rank
V-Cone	-0.0014	3
Multiphase	-0.0379	5
Venturi	0.0740	1
Wedge	-0.0232	4
Orifice	0.0245	2

$$\text{Assessment Value} = \sum (X_{wn1} + X_{wn2} - X_{wn3}) \tag{3}$$

Table 5 shows the Assessment value& Rank value used. Assessment value for V-Cone -0.0014, Multiphase -0.0379, venturi 0.0740, Wedge -0.0232, Orifice 0.0245, the final rank of this paper, the v- cone is in 3rd rank, orifice is in 2nd rank, wedge is in 4th rank, multiphase is in 5th rank, and the venture is in 1st rank.

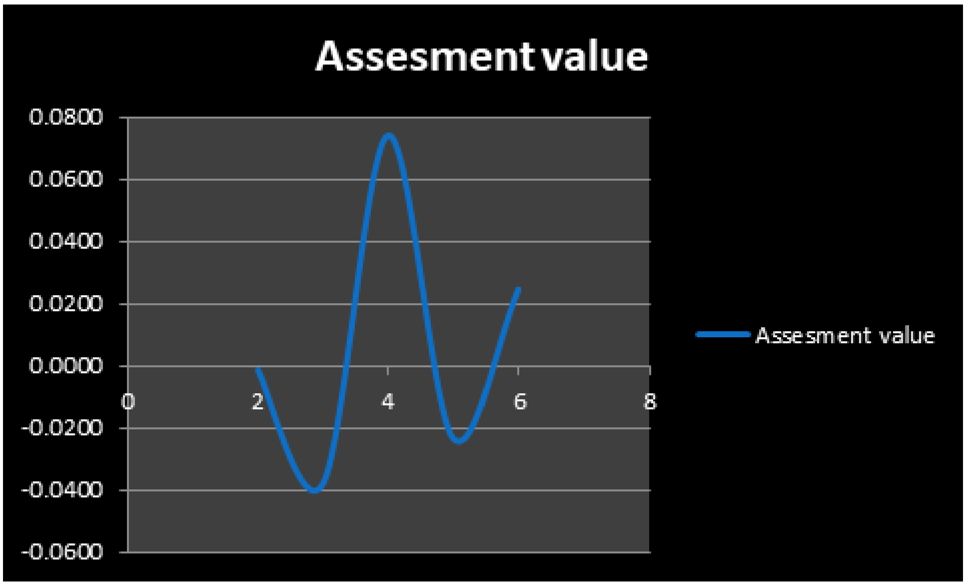

FIGURE 3. Assessment value

Figure 3 show Assessment Value" illustrates the comparative performance scores of five flow measurement devices based on the calculated assessment values. The vertical axis ranges approximately from –0.06 to 0.08, while the horizontal axis represents the different alternatives. The graph clearly shows variation in performance among the options.One alternative exhibits the highest positive assessment value, around 0.074, indicating it is the most preferred option according to the evaluation criteria. A higher positive value suggests stronger overall performance after considering efficiency, pressure drop, cost, and environmental impact. Another alternative shows a moderately positive value (around 0.025), ranking second in performance.Two alternatives fall into the negative range, with one reaching approximately –0.038, representing the lowest score among all options. Negative values indicate comparatively weaker overall performance when weighted criteria are applied. Another alternative shows a slightly negative value near zero, suggesting moderate but less competitive performance.

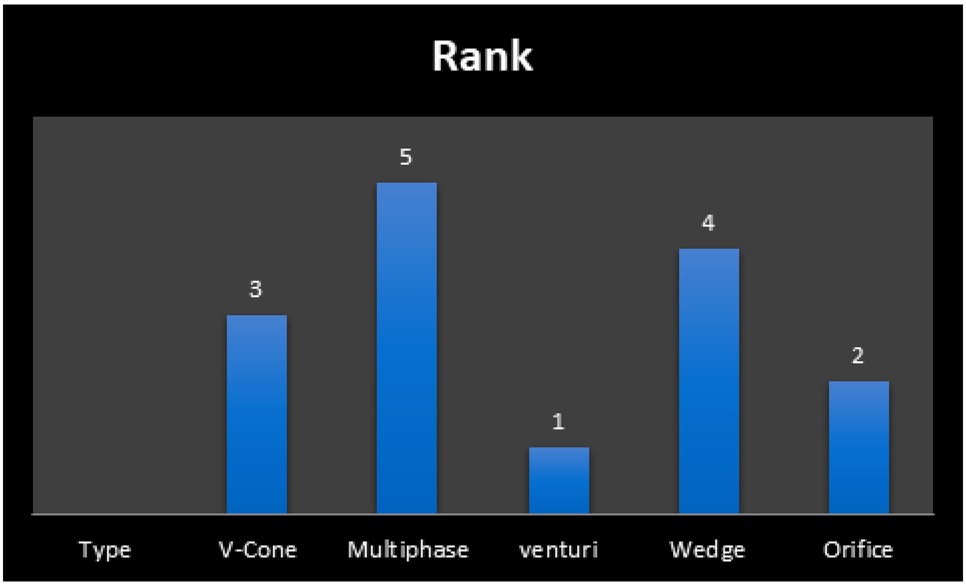

FIGURE 4. Rank

Figure 4 presents the final ranking of five flow measurement devices: V-Cone, Multiphase, Venturi, Wedge, and Orifice. The ranking is based on their overall assessment values derived from multiple evaluation criteria such as efficiency, pressure drop, cost, and environmental impact.From the chart, the Venturi meter achieves Rank 1, indicating it is the best-performing alternative among the five options. This suggests that Venturi provides the most balanced and favorable performance when all criteria are considered together. The Orifice meter is placed in Rank 2, showing strong overall performance but slightly lower than Venturi. The V-Cone meter holds Rank 3, representing moderate performance compared to the top two alternatives. The Wedge meter is positioned at Rank 4, indicating relatively lower overall suitability. Finally, the Multiphase meter receives Rank 5, making it the least preferred option under the given evaluation framework.

4. CONCLUSION

The dynamic relationship between business strategy, human resource systems, and organizational performance is crucial. A well-aligned business strategy that integrates with effective human resource systems can enhance employee skills, motivation, and adaptability. This synergy, in turn, directly impacts organizational performance. Whether it's adopting a customer-centric approach, embracing technological advancements, or navigating regulatory changes, a strategic and flexible human resource framework ensures the workforce is equipped to execute the business strategy. The Spanish banking sector's success lies in the strategic integration of these elements, fostering resilience, innovation, and sustained organizational performance amidst the evolving financial landscape

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