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COMPARING AND DESCRIBING THE RANKING OF PERFORMANCE MEASURES IN IMPLEMENTING JIT

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ABSTRACT: *The growing intensity of competition in today's global marketplaces is the most significant issue that businesses, particularly manufacturers, must contend with today. Meeting the rapidly increasing expectations of customers, improving operating efficiency, raising quality standards, and substantially lowering costs are some of the challenges that manufacturers are now dealing with. The majority of firms are on the lookout for innovative methods that will improve their capacity to compete on a global scale. The just-in-time (JIT) production method is one such approach that has captivated the attention of many firms in this era of globalization and globalization. The tangible benefit of just-in-time delivery is the achievement of stringent productivity and quality requirements. While the adoption of just-in-time (JIT) in big businesses may be very effective, MSMEs are still in the process of being established. The use of the Just-in-Time (JIT) concept in micro, small, and medium-sized businesses (MSMEs) in India usually presents a number of challenges. JIT, its advantages and components, as well as their viability in Indian MSMEs, have all been investigated. The application of the JIT concept in small and medium-sized enterprises (SMEs) is the subject of this article. A Multi Criteria Decision Model (MCDM) with Weighted Aggregated Sum Product Assessment (WASPAS) is presented in this paper to support the rationale of Just-in-Time (JIT) for Indian MSMEs businesses. The WASPAS model was used to compute the ranking of performance indicators, which was done with the help of the MATLAB program.*

1. INTRODUCTION

Manufacturing has been on the lookout for processes that may provide greater advantages, higher performance, and better quality, shorter cycle times, reduced waste, smoother operation, and lower operating costs[1] in this age of globalization. Following World War II, the Japanese manufacturing industry was hampered by a scarcity of raw materials, financial resources, and skilled labor. Eiji Toyoda and Taiichi Ohno of Toyota Motor Corporation in Japan developed the concept of Just in Time Manufacturing (JIT) or Toyota Production System (TPS) in the United States in order to optimize and make efficient use of available resources[2] in order to optimize and make efficient use of available resources. The waste reduction component of this idea was described as any amount of resources spent on a completed product that does not provide any value to the client. For the purposes of this definition, JIT refers to the creation of products and services when they are most required, i.e., when they are most needed. It reduces waste of resources and time by optimizing the use of personnel and the layout of the factory floor, allowing for more output at a reduced cost [3].

JIT deployment in big companies may be very appropriate and effective [4, while MSMEs are still in the early stages of development [5]. Today, a significant number of companies around the globe are attempting to use JIT in order to remain competitive. Nowadays, the performance of an organization is very essential, and the best performance may be obtained by using JIT [6] [7], which stands for Just in Time. It is essential to assess the business that has applied the key success criteria that have been identified by JIT. As a result, it is a challenge involving many criteria decision making (MCDM). The multiple attribute decision making technique (MADM) may be helpful in situations when numerous and distinct decision-making or selection issues must be resolved at the same time. When dealing with decision and planning issues that include many criteria, multiple criteria decision making (MCDM) is the term used to refer to the structure and resolution of such problems. The goal is to provide assistance to decision-makers who are confronted with such issues. In general, there is no optimum answer for these issues, and it is essential to distinguish the options based on the preferences of the decision maker [8]. MADM is an applied method to problem solving that includes the selection of a limited number of alternatives from a large number of possible solutions. In this function, you may specify how the attribute information should be processed in order to arrive at a selection. Using a just-in-time (JIT) system, the goal is to continually reduce waste across all processes and operations. As a result, this study intends to investigate the selection and categorization of performance indicators and their components in connection to the applicability of successful implementation of JIT in Indian MSMEs [9] [10] [11].

2. METHODOLOGY AND DATA ANALYSIS

2.1 Steps of the Process

- According to the results of the literature survey [11, 12], critical success criteria and performance indicators were identified.
- In order to offer consistent input data, a 5-point Likert scale has been used in the questionnaires to collect responses.
- An equal amount of weight is provided to all components, and the WASPAS MCDM MODEL is applied to the data received from various MSMEs utilizing a questionnaire that has been developed.
- Using MATLAB, the WASPAS MODEL was able to determine the ranking of JIT execution performance metrics..

Table 1. Performance Indicators and JIT Elements

PERFORMANCE INDICATORS(PI)	Abbreviation	JIT ELEMENTS(JE)	Abbreviation	JIT ELEMENTS (JE)	Abbreviation
Productivity	PRO	Top Management Commitment	TMC	Jidoka (Autonomation)	JID
Waste Reduction	WR	JIT Purchasing	JP	Pull Production System	PPS
Product Quality Improvement	PQI	Supplier Network	SN	Total Quality Management	TQM
Capacity Utilization	CU	Lot Size	LS	Total Preventive Maintenance	TPM
Profit	PRF	Kanban	KNB	Vendor Lead Time	VLT
Operations Efficiency	OE	Flexible Manufacturing system	FMS		

The WASPAS technique is used to evaluate the ranking of the seven Performance indicators based on twelve JIT elements. On the basis of the questionnaire prepared, the data are collected and simplified as shown in Table 2.

Table 2. Average Data Matrix

PERFORMANCE INDICATORS	JIT ELEMENTS											
	TMC	JP	SN	LS	KNB	FMS	STD	JID	PPS	TQM	TPM	VLT
PRO	3.26	3.21	3.05	2.16	3.74	4.16	4.10	3.95	3.21	4.11	3.74	2.16
WR	2.32	4.70	3.53	4.00	3.16	3.21	3.95	3.26	4.05	3.42	3.21	2.84
PQI	3.68	3.00	2.79	2.21	2.84	4.05	4.16	3.75	2.95	4.84	3.37	2.05
CU	2.11	2.58	1.84	1.42	3.74	4.53	4.16	4.21	3.05	3.58	4.47	2.16
PRF	4.70	4.63	4.47	4.16	2.95	3.70	4.11	3.74	4.21	4.00	3.80	2.95
OE	3.00	3.16	2.84	2.05	3.47	3.95	4.05	3.37	3.37	3.79	4.05	2.90
LTR	3.53	4.84	4.79	4.47	2.53	1.79	2.79	1.68	3.74	3.26	2.05	4.74

3. RESULTS AND DISCUSSIONS

Different techniques are suggested as part of the theory of the utility of multiple characteristics for the decision-making of numerous criteria, which is a subset of the theory of the usefulness of multiple attributes. The weighted sum and weighted product models (WSM and WPM) are two of the approaches that have been developed and are well-known and generally accepted. The WASPAS technique, which use an aggregate of WSM and WPM to enhance the accuracy of WSM and WPM, has

been suggested to improve the precision of WSM and WPM [13]. The model that has been created is capable of resolving the justification of JIT manufacturing systems for Indian SMEs, as well as assisting in the development of a decision support system for the effective application of the JIT philosophy in SMEs. In general, consider the following scenario: a given MCDM issue is described in terms of m options and n selection criteria. If w j indicates the relative importance (weight) of the criteria and y_{ij} represents the performance value of option I when it is assessed in terms of criterion j, we get the following equation:If $Max_i\, y_{ij}$ value is preferable

$$\bar{y}_{ij} = \frac{y_{ij}}{y_j^{Max}} \quad (1)$$

Or $Min_i\, y_{ij}$ value is preferable

$$\bar{y}_{ij} = \frac{y_j^{Min}}{y_{ij}} \quad (2)$$

Table 3. Linear Normalize Average Data Matrix

PI	JE											
	TMC	JP	SN	LS	KNB	FMS	STD	JID	PPS	TQM	TPM	VLT
PRO	0.6936	0.6632	0.6367	0.4832	1.0000	0.9183	0.9855	0.9382	0.7624	0.8491	0.8366	0.4557
WR	0.4936	0.9710	0.7369	0.8948	0.8449	0.7086	0.9495	0.7743	0.9620	0.7066	0.7181	0.5992
PQI	0.7830	0.6198	0.5825	0.4944	0.7594	0.8940	1.0000	0.8907	0.7007	1.0000	0.7539	0.4325
CU	0.4489	0.5331	0.3841	0.3177	1.0000	1.0000	1.0000	1.0000	0.7245	0.7397	1.0000	0.4557
PRF	1.0000	0.9566	0.9332	0.9307	0.7888	0.8168	0.9880	0.8884	1.0000	0.8265	0.8501	0.6224
OE	0.6383	0.6529	0.5929	0.4586	0.9278	0.8720	0.9736	0.8005	0.8005	0.7831	0.9060	0.6118
LTR	0.7511	1.0000	1.0000	1.0000	0.6765	0.3951	0.6707	0.3991	0.8884	0.6736	0.4586	1.0000

Table 4. Weighted Linear Normalized Average Data Matrix

PI	JE											
	TMC	JP	SN	LS	KNB	FMS	STD	JID	PPS	TQM	TPM	VLT
PRO	0.05780	0.05527	0.05306	0.04027	0.08333	0.07652	0.08213	0.07818	0.06354	0.07076	0.06972	0.03797
WR	0.04113	0.08091	0.06141	0.07456	0.07041	0.05905	0.07912	0.06452	0.08016	0.05888	0.05984	0.04994
PQI	0.06525	0.05165	0.04854	0.04120	0.06328	0.07450	0.08333	0.07422	0.05839	0.08333	0.06282	0.03604
CU	0.03741	0.04442	0.03201	0.02647	0.08333	0.08333	0.08333	0.08333	0.06037	0.06164	0.08333	0.03797
PRF	0.08333	0.07971	0.07776	0.07755	0.06573	0.06806	0.08233	0.07403	0.08333	0.06887	0.07084	0.05186
OE	0.05319	0.05440	0.04941	0.03822	0.07731	0.07266	0.08113	0.06671	0.06671	0.06526	0.07550	0.05098
LTR	0.06259	0.08333	0.08333	0.08333	0.05637	0.03292	0.05589	0.03326	0.07403	0.05613	0.03821	0.08333

$$R_i^{WSM} = \sum_{j=1}^{n} \bar{y}_{ij} \times w_j \quad (3)$$

Table 5. Preference score using equation 3 (WSM)

Performance Indicators	PRO	WR	PQI	CU	PRF	OE	LTR
Preference Score	0.76858	0.77998	0.74257	0.71697	0.88344	0.75149	0.74274

$$R_i^{WPM} = \prod_{j=1}^{n} \bar{y}_{ij}^{w_j} \quad (4)$$

Table 6. Preference score using equation 4 (WPM)

Performance Indicators	PRO	WR	PQI	CU	PRF	OE	LTR
Preference Score	0.74593	0.76583	0.71969	0.66236	0.87643	0.73492	0.70370

$$R_i = \alpha \cdot R_i^{WSM} + (1-\alpha) R_i^{WPM}, \qquad \alpha = 0, \ldots\ldots, 1 \quad (5)$$

Value of α taken is 0.5 in equation 5

Table 7. Ranking of Performance indicators using equation 5 (WASPAS=WSM+WPM)

Performance Indicators	PRO	WR	PQI	CU	PRF	OE	LTR
Preference Score	0.75725	0.7729	0.73113	0.68967	0.87993	0.7432	0.72322
Ranking	3	2	5	7	1	4	6

Above matrix shows the ranking of Performance Indicators based on several criteria which would be beneficial in developing a decision support system for successful implementation of JIT in MSMEs [14] [15].

4. CONCLUSIONS

Different techniques are suggested as part of the theory of the utility of multiple characteristics for the decision-making of numerous criteria, which is a subset of the theory of the usefulness of multiple attributes. The weighted sum and weighted product models (WSM and WPM) are two of the approaches that have been developed and are well-known and generally accepted. The WASPAS technique, which use an aggregate of WSM and WPM to enhance the accuracy of WSM and WPM, has been suggested to improve the precision of WSM and WPM [13]. The model that has been created is capable of resolving the justification of JIT manufacturing systems for Indian SMEs, as well as assisting in the development of a decision support system for the effective application of the JIT philosophy in SMEs. In general, consider the following scenario: a given MCDM issue is described in terms of m options and n selection criteria. If w j indicates the relative importance (weight) of the criteria and y ij represents the performance value of option I when it is assessed in terms of criterion j, we get the following equation:

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