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LEAN APPRAISEMENT OF STUFF PROVIDER'S ORGANIZATIONS UNDER TWMCCR BASED PRACTICE-METRICS BY USING AHP WITH TOPSIS APPROACH

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Abstract*-An 2nd layer TWMCCR based practice-metrics hierarchical appraisement model is proposed. The proposed model dealt with identified six practices and twenty seven interrelated metrics for measuring the performance of stuff provider's organizations s under lean practice-metrics. The lean strategy based TCMBC practice-metrics hierarchical appraisement model undertook fuzzy information of DMs. In order to compute the performance scores of stuff provider's organizations, fuzzy-AHP (Analytic Hierarchy Process) is utilized to compute weight against six momentous practices, while TOPSIS (Technique for Order of Preference by Similarity to Ideal Solution- multi-objective optimization) approach is implemented on model to robustly evaluate score and making potential decision.*

Keywords: Lean practice-metrics, Model, Subjective Information (SI), Multi-Criteria Group Decision Making Process (MCGDMP), Benchmarking.

I. MCDM DECISION MAKING

MCDM (Multi Criteria Decision Making) has aim to find optimal choice under several (conflicting) criterion, which are to be achieved simultaneously. The characteristics of MCDM are a set of (conflicting) objectives, having non constraints. Therefore, it is naturally associated with the technique of mathematical programming for dealing with optimization problems. However, it can be seen that two main difficulties involving the trade-off and the scale problems complicate the MCDM situations through the mathematical programming model.

II. LEAN MANUFACTURING

Lean manufacturing is a management thinking derived typically from the Toyota Production System (TPS) and recognized as 'lean' only in the 1990s. TPS is well known for its heart on reduction of the original Toyota seven wastes to get better overall purchaser worth. Lean Manufacturing (LM) is fundamentally a production practice that believes on the expenditure of resources for any goal other than the making of worth for the end users to be wasteful and thus an aim for removal. LM spotlight on price reduction by reducing non-value-added activities in order that several advantages can be obtained such as elimination of waste, increased business occasions and more competitive organizations. LM can be accepted where there is a stable demand and to ensure a level schedule. The term 'lean manufacturing', which first appeared in 1990, when it was used to refer to the removal of waste in the production process, has been proclaimed as the production system of the 21st century.

III. LEAN PERFORMANCE MEASUREMENT STRATEGY

The Lean strategy is an approach to nonstop upgrading technologies / approaches / paths towards reducing the unworthily added activities or waste. Lean idea originated in the 21st century and approximately ran over most of the manufacturing firm.

IV. LEAN PERFORMANCE MEASUREMENT (LPM)

It is worldwide well knew that Lean Performance Measurement offers an occasion to manufacturing sector/unit/firm to achieve their organization objectives. During the journey of 19 to 20 century, it observed that, on one hand market demands tremendously altered into the demand of customized goods because of several factors; new technique, vast technologies and high elimination of non-productive machine tools. On other hand, market actuated the firms to maintain their effectual practice-metrics by elimination the non-productive action of production and ongoing processes. Therefore, the firm is working under lean strategy or not, is assessed by materializing the firm efficiency cum effectiveness called Lean Performance Measurement (LPM) Sharifi and Zhang (2001), Arbos (2002). Garvin (1993) discovered rough set hypothesis to examine the relations among managerial attributes, dealer development program involvement features, and performance outcomes. The performance outcomes focused on green and business dimensions. Govindan et al. 92013) shown that lean manufacturing principles for operations management. He developed a model to accurately define and operational the lean production idea. The model stood for a conceptualization of lean manufacturing as made of a most excellent practice or characterizations of different areas of the corporations.

V. TOPSIS METHOD

The hybrid method was first proposed by Hwang and Yoon (1981), Hwang et al. (1993). It is based on the concept of Positive Ideal Solution (PIS) as well as Negative Ideal Solution (Anti-Ideal Solution) (NIS). The PIS is a solution that minimizes the cost criteria and maximizes the benefit criteria; whereas, the NIS maximizes the cost criteria and minimizes the benefit criteria. The so-called benefit criteria are those whose maximum values are proffered; whilst, the cost criteria are those whose minimum values are desired. The best alternative is the one, which is placed at closest to the PIS and farthest distance from the NIS.

Let $E=\{e_1,e_2,...,e_q\}$ be the set of decision-makers in the group decision making process. $A=\{A_1,A_2,...,A_m\}$ be the set of alternatives, and $C=\{C_1,C_2,...,C_n\}$ be the set of criteria-attributes. Suppose that $\tilde{\tilde{a}}_{ijk}=(a_{ijk1},a_{ijk2},a_{ijk3})$ is the attribute value given by decision maker e_k, where $\tilde{\tilde{a}}_{ijk}$ is a trapezoidal fuzzy number for the alternative A_i with respect to the attribute C_j.

Evaluation of rating from 2nd to 1st level:

$$\mathbf{R}=(r_{ij})_{m\times n}=\frac{r_{i1}+r_{i2}+r_{i3}+r_{i4}+r_{i5}+r_{i6}.....r_{in}}{C_n} \quad .....(1)$$

$$\mathbf{R}=(r_{ij})_{m\times n}=\begin{array}{c} \\ f_1 \\ f_2 \\ \vdots \\ f_m \end{array}\begin{array}{c} \begin{array}{cccc} c_1 & c_2 & \cdots & c_n \end{array} \\ \begin{bmatrix} r_{11} & r_{12} & \cdots & r_{1n} \\ r_{21} & r_{22} & \ldots & r_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ r_{m1} & r_{m2} & \ldots & r_{mn} \end{bmatrix} \end{array}$$

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Normalize the decision matrix $X = (x_{ij})_{mn}$ using the following equation:

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{j=1}^{n} x^2_{ij}}}, \quad i = 1,2,3,.......m,, \quad j = 1,2,3,.......n$$

………………………..…..(2)

Here r_{ij} is the normalized criterion rating. The normalization method mentioned above is to preserve the property that the range of a normalized trapezoidal fuzzy number $\tilde{r}_{ij}$ belongs to the closed interval $[0,1]$.

$$\tilde{\mathbf{R}} = (\tilde{r}_{ij})_{m\times n} = \begin{array}{c} \\ f_1 \\ f_2 \\ \vdots \\ f_m \end{array} \begin{array}{c} \begin{array}{cccc} c_1 & c_2 & \cdots & c_n \end{array} \\ \begin{bmatrix} x'_{11} & x'_{12} & \cdots & x'_{1n} \\ x'_{21} & x'_{22} & \cdots & x'_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ x'_{m1} & x'_{m2} & \cdots & x'_{mn} \end{bmatrix} \end{array}$$

Let $W = (w_{1,}\ w_{2,..........}, w_n)$ be the relative weight vector about the criteria, evaluated by fuzzy APH satisfying $\sum_{j=1}^{n} w_j = 1$.

Calculate the weighted normalized decision matrix $v = (v_{ij})_{mn}$ ……....(3)

$$\mathbf{R} = (r_{ij})_{m\times n} = \begin{array}{c} \\ f_1 \\ f_2 \\ \vdots \\ f_m \end{array} \begin{array}{c} \begin{array}{cccc} c_1 & c_2 & \cdots & c_n \end{array} \\ \begin{bmatrix} r_{11} & r_{12} & \cdots & r_{1n} \\ r_{21} & r_{22} & \cdots & r_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ r_{m1} & r_{m2} & \cdots & r_{mn} \end{bmatrix} \end{array}$$

$$\times \begin{array}{c} \\ f_1 \\ f_2 \\ \vdots \\ f_m \end{array} \begin{array}{c} \begin{array}{cccc} c_1 & c_2 & \cdots & c_n \end{array} \\ \begin{bmatrix} x'_{11} & x'_{12} & \cdots & x'_{1n} \\ x'_{21} & x'_{22} & \cdots & x'_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ x'_{m1} & x'_{m2} & \cdots & x'_{mn} \end{bmatrix} \end{array}$$

$$\tilde{\mathbf{V}} = (\tilde{v}_{ij})_{m\times n} = \begin{array}{c} \\ f_1 \\ f_2 \\ \vdots \\ f_m \end{array} \begin{array}{c} \begin{array}{cccc} x_1 & x_2 & \cdots & x_n \end{array} \\ \begin{bmatrix} \tilde{v}_{11} & \tilde{v}_{12} & \cdots & \tilde{v}_{1n} \\ \tilde{v}_{21} & \tilde{v}_{22} & \cdots & \tilde{v}_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ \tilde{v}_{m1} & \tilde{v}_{m2} & \cdots & \tilde{v}_{mn} \end{bmatrix} \end{array}$$

Then, the decision matrix $v = (v_{ij})_{mn}$ can be transformed into the normalized fuzzy decision matrix:

Determine the PIS and NIS by:

$$A^* = \{v_1{}^*,.........., v_n{}^*.\} = \left\{ (\max_i v_{ij} \left(j \in \Omega_b \right], (\min_i v_{ij} \left(j \in \Omega_c \right] \right\}_j$$

………...(4)

$$A^- = \{v_1{}^-,.........., v_n{}^-.\} = \left\{ (\min_i v_{ij} \left(j \in \Omega_b \right], (\max v_{ij} \left(j \in \Omega_c \right] \right\}_j$$

…………………………………..(5)

Here Ω_b and Ω_c are the sets of benefit criteria and cost criteria, respectively.

Calculate the Euclidean distances of each alternative from the PIS and the NIS, respectively

$$D^*{}_i = \sqrt{\sum_{j=1}^{n} (v_{ij} - v^*)^2{}_{ij}}, \quad i = 1,2,3,.......m \quad ………..................................……(24)$$

$$D^-{}_i = \sqrt{\sum_{j=1}^{n} (v_{ij} - v^*)^2{}_{ij}}, \quad i = 1,2,3,.......m \quad ………$$

…...............................…….............(6)

Calculate the relative closeness of each alternative with respect to the ideal solution. The relative closeness of the alternative A_i with respect to A^* is defined by:

$$RC_i = \frac{D_i^-}{D_i{}^* + D_i^-}, \quad i = 1,2,3,.......m………....$$

..........................…...............…..(7)

Rank the alternatives according to their relative closeness to the ideal solution. The bigger the RC_i, the better the alternative A_i is. The best alternative is the one which is having the greatest relative closeness to the ideal solution.

VI. EMPIRICAL RESEARCH

The Lean-TWMCCR based practice-metrics hierarchical structural evaluation model has core objective to evaluate the best stuff provider's organizations amongst feasible alternatives in accordance with comparative analysis is shown in Table. 1. To evaluate result, a committee of five highly experience decision makers, has been formed from units of manufacturing industry. Fuzzy APH is applied, which revealed the results: [0.084171, 0.14683, 0.137025, 0.240021, 0.203531, 0.188566]. Calculated λ_{max}=7.21 by using Equa. 18 (considered M=6). Then, the consistency (for CI =1.24) has been checked by using Equation 19, depicted 0.1025. Later, using the concept of trapezoidal fuzzy numbers in fuzzy set theory, the linguistic variables, shown in Table. 2, used by team of same decision makers to assign ratings against for stuff provider's organizations s firm A_1, A_2 and A_3 have aggregated by fuzzy rules, and then, defuzzification is carried out on aggregated ratings, shown in Tables 3-5 for 2nd level. Addition is carried out by equation 1 to get 1st level rating is shown in Tables 3-5, for stuff provider's organizations s firm A_1, A_2 and A_3. Then, normalization is carried out by using Equ. 2 for bring value in the interval of 0 to 1 excluding transforming non-beneficial criterion into beneficial criterion and constructed the weighted normalized matrix by using Eq. 3. TOPSIS is applied on the data available of Table 6. The positive and negative ideal solution is calculated by Equ. 4 and measure of separation from Positive and Negative ideal solution is calculated by using Equ. 5-6. shown in Table. 6-7. The coefficient is calculated by Equ. 7, shown in Table. 7.

Table: 1. Lean-TWMCCR based practice-metrics hierarchical structural evaluation model

Fuzzy based TWMCC hierarchical structural model	Technological involvement, (C_1)	Systematic process control, ($C_{1,1}$)
		Utility of TQM tools, ($C_{1,2}$)
		Maintenance of machine tools, ($C_{1,3}$)
		Reduction of unwanted cost via approaches, ($C_{1,4}$)
		Recognition and prioritization of significant machine tools, ($C_{1,5}$)
	Work force leanness,(C_2)	Flexible labor force for adaptation of new advanced technologies, ($C_{2,1}$)
		Multi-skilled workers, ($C_{2,2}$)
		Strong employee courage and cooperation, ($C_{2,3}$)
		Employee empowerment, ($C_{2,4}$)
		Group efforts of employees, ($C_{2,5}$)
	Manufacturing management, (C_3)	Enhancement in working culture, ($C_{3,1}$)
		JIT delivery to clients, ($C_{3,2}$)
		Optimization of processing sequence and flow in shop floor, ($C_{3,3}$)
		Overall production waste reduction, ($C_{3,4}$)
	Collaborative planning, (C_4)	Stuff planning, ($C_{4,1}$)
		Collaborative manufacturing planning, ($C_{4,2}$)
		Stuff provider's organizations planning, ($C_{4,3}$)
		Supply planning, ($C_{4,4}$)
	Customer service	Purchaser satisfaction, ($C_{5,1}$)
		Delivery reliability, ($C_{5,2}$)

	performance,, (C_5)	Responsiveness, ($C_{5,3}$)
		Orders fill capacity, ($C_{5,4}$)
		Agility, ($C_{5,5}$)
	Resource utilization, (C_6)	Planning of capital, ($C_{6,1}$)
		Optimized deployment of tools,(C_{62})
		Retrofitting of machine tools, (C_{63})
		Scheduled actions on production assets, (C_{64})

Table: 2. Aggregated fuzzy appropriateness rating

Linguistic Term (Appropriateness Rating)	Corresponding Fuzzy Numbers
Absolutely Poor (AP)	(0, 0, 0, 0; 1.00)
Very Poor (VP)	(0, 0, 0.2, 0.7; 1.00)
Poor (P)	(0.4, 0.1, 0.8, 0.23; 1.00)
Medium Poor (MP)	(1.7, 2.2, 3.6, 4.2; 1.00)
Fair (F)	(3.2, 4.1, 5.8, 6.5; 1.00)
Medium Good (MG)	(5.8, 6.3, 8.0, 8.6; 1.00)
Good (G)	(7.2, 7.8, 9.2, 9.7; 1.00)
Very Good (VG)	(9.3, 9.8, 10.0, 10.0; 1.00)
Absolutely Good (AG)	(10.0, 10.0, 10.0, 10.0; 1.00)

Table.3 Appropriateness rating against subjective Lean assessment metrics for A_1

Lean assessment metrics	Appropriateness rating against individual 2^{nd} level evaluation metrics					AFR	Crisp value
	DM1	DM2	DM3	DM4	DM5		
($C_{1,1}$)	G	MP	F	F	MP	(3.800,4.800,5.400,6.400)	5.1
($C_{1,2}$)	G	G	VG	G	VG	(7.800,8.800,9.400,10.00)	8.98
($C_{1,3}$)	VG	VG	VG	G	G	(8.200,9.200,9.600,10.00)	9.22
($C_{1,4}$)	VG	G	VG	VG	VG	(8.600,9.600,9.800,10.00)	9.45
($C_{1,5}$)	VG	MG	G	G	G	(7.000,8.000,8.800,9.600)	8.34
($C_{2,1}$)	MG	F	G	MG	VG	(6.000,7.000,7.600,8.400)	7.24
($C_{2,2}$)	F	G	MG	F	G	(5.400,6.400,7.000,8.000)	6.7
($C_{2,3}$)	F	G	G	G	F	(5.800,6.800,7.400,8.400)	7.1
($C_{2,4}$)	F	G	G	G	G	(6.400,7.400,8.200,9.200)	7.8
($C_{2,5}$)	G	MG	F	VG	MG	(6.000,7.000,7.600,8.400)	7.24
($C_{3,1}$)	MG	F	G	MG	VG	(6.000,7.000,7.600,8.400)	7.24
($C_{3,2}$)	F	G	MG	F	G	(5.400,6.400,7.000,8.000)	6.7
($C_{3,3}$)	F	G	G	G	F	(5.800,6.800,7.400,8.400)	7.1
($C_{3,4}$)	F	G	G	G	G	(6.400,7.400,8.200,9.200)	7.8
($C_{4,1}$)	G	MG	F	VG	MG	(6.000,7.000,7.600,8.400)	7.24
($C_{4,2}$)	VG	VG	G	G	G	(7.800,8.800,9.400,10.00)	8.98
($C_{4,3}$)	MG	VG	G	F	G	(6.400,7.400,8.000,8.800)	7.64
($C_{4,4}$)	G	VG	MG	VG	VG	(7.800,8.800,9.200,9.600)	8.82

($C_{5,1}$)	MG	G	MG	G	VG	(6.600,7.600,8.400,9.200)	7.94
($C_{5,2}$)	F	VG	F	MP	VG	(5.600,6.600,6.800,7.400)	6.57
($C_{5,3}$)	VG	VG	G	G	G	(7.800,8.800,9.400,10.00)	8.98
($C_{5,4}$)	MG	VG	G	F	G	(6.400,7.400,8.000,8.800)	7.64
($C_{5,5}$)	G	VG	MG	VG	VG	(7.800,8.800,9.200,9.600)	8.82
($C_{6,1}$)	MG	G	MG	G	VG	(6.600,7.600,8.400,9.200)	7.94
(C_{62})	F	VG	F	MP	VG	(5.600,6.600,6.800,7.400)	6.57
(C_{63})	MG	F	G	MG	VG	(6.000,7.000,7.600,8.400)	7.24
(C_{64})	F	G	MG	F	G	(5.400,6.400,7.000,8.000)	6.7

Table.4 Appropriateness rating against subjective Lean assessment metrics for A_2

Lean assessment metrics	Appropriateness rating against individual 2^{nd} level evaluation metrics					AFR	Crisp value
	DM1	DM2	DM3	DM4	DM5		
($C_{1,1}$)	G	MG	MG	MG	G	(5.800,6.800,7.800,8.800)	7.3
($C_{1,2}$)	VG	MG	MG	MG	MG	(5.800,6.800,7.600,8.400)	7.14
($C_{1,3}$)	G	MP	MG	MP	G	(4.600,5.600,6.600,7.600)	6.1
($C_{1,4}$)	VG	G	MG	VG	VG	(7.800,8.800,9.200,9.600)	8.82
($C_{1,5}$)	F	G	G	MP	MP	(4.400,5.400,6.200,7.200)	5.8
($C_{2,1}$)	MG	F	G	MG	VG	(6.000,7.000,7.600,8.400)	7.24
($C_{2,2}$)	F	G	MG	F	G	(5.400,6.400,7.000,8.000)	6.7
($C_{2,3}$)	F	G	G	G	F	(5.800,6.800,7.400,8.400)	7.1
($C_{2,4}$)	F	G	G	G	G	(6.400,7.400,8.200,9.200)	7.8
($C_{2,5}$)	G	MG	F	VG	MG	(6.000,7.000,7.600,8.400)	7.24
($C_{3,1}$)	G	MP	F	F	MP	(3.800,4.800,5.400,6.400)	5.1
($C_{3,2}$)	G	G	VG	G	VG	(7.800,8.800,9.400,10.00)	8.98
($C_{3,3}$)	VG	VG	VG	G	G	(8.200,9.200,9.600,10.00)	9.22
($C_{3,4}$)	VG	G	VG	VG	VG	(8.600,9.600,9.800,10.00)	9.45
($C_{4,1}$)	VG	MG	G	G	G	(7.000,8.000,8.800,9.600)	8.34
($C_{4,2}$)	MG	F	G	MG	VG	(6.000,7.000,7.600,8.400)	7.24
($C_{4,3}$)	F	G	MG	F	G	(5.400,6.400,7.000,8.000)	6.7
($C_{4,4}$)	F	G	G	G	F	(5.800,6.800,7.400,8.400)	7.1
($C_{5,1}$)	F	G	G	G	G	(6.400,7.400,8.200,9.200)	7.8
($C_{5,2}$)	G	MG	F	VG	MG	(6.000,7.000,7.600,8.400)	7.24
($C_{5,3}$)	VG	G	MG	VG	VG	(7.800,8.800,9.200,9.600)	8.82
($C_{5,4}$)	F	G	G	MP	MP	(4.400,5.400,6.200,7.200)	5.8
($C_{5,5}$)	MG	F	G	MG	VG	(6.000,7.000,7.600,8.400)	7.24
($C_{6,1}$)	F	G	MG	F	G	(5.400,6.400,7.000,8.000)	6.7
(C_{62})	F	G	G	G	F	(5.800,6.800,7.400,8.400)	7.1
(C_{63})	F	G	G	G	G	(6.400,7.400,8.200,9.200)	7.8
(C_{64})	G	MG	F	VG	MG	(6.000,7.000,7.600,8.400)	7.24

Table.5 Appropriateness rating against subjective Lean assessment metrics for A_3

Lean assessment metrics	Appropriateness rating against individual 2nd level evaluation metrics					AFR	Crisp value
	DM1	DM2	DM3	DM4	DM5		
($C_{1,1}$)	G	G	VG	VG	G	(7.800,8.800,9.400,10.00)	8.98
($C_{1,2}$)	MG	VG	MG	VG	MG	(6.600,7.600,8.200,8.800)	7.78
($C_{1,3}$)	MG	VG	MG	G	VG	(7.000,8.000,8.600,9.200)	8.18
($C_{1,4}$)	G	G	F	MG	MG	(5.600,6.600,7.400,8.400)	7
($C_{1,5}$)	G	G	MG	VG	MG	(6.600,7.600,8.400,9.200)	7.94
($C_{2,1}$)	MG	F	G	MG	VG	(6.000,7.000,7.600,8.400)	7.24
($C_{2,2}$)	F	G	MG	F	G	(5.400,6.400,7.000,8.000)	6.7
($C_{2,3}$)	F	G	G	G	F	(5.800,6.800,7.400,8.400)	7.1
($C_{2,4}$)	F	G	G	G	G	(6.400,7.400,8.200,9.200)	7.8
($C_{2,5}$)	G	MG	F	VG	MG	(6.000,7.000,7.600,8.400)	7.24
($C_{3,1}$)	G	MP	F	F	MP	(3.800,4.800,5.400,6.400)	5.1
($C_{3,2}$)	G	G	VG	G	VG	(7.800,8.800,9.400,10.00)	8.98
($C_{3,3}$)	VG	VG	VG	G	G	(8.200,9.200,9.600,10.00)	9.22
($C_{3,4}$)	VG	G	VG	VG	VG	(8.600,9.600,9.800,10.00)	9.45
($C_{4,1}$)	VG	MG	G	G	G	(7.000,8.000,8.800,9.600)	8.34
($C_{4,2}$)	MG	F	G	MG	VG	(6.000,7.000,7.600,8.400)	7.24
($C_{4,3}$)	F	G	MG	F	G	(5.400,6.400,7.000,8.000)	6.7
($C_{4,4}$)	F	G	G	G	F	(5.800,6.800,7.400,8.400)	7.1
($C_{5,1}$)	F	G	G	G	G	(6.400,7.400,8.200,9.200)	7.8
($C_{5,2}$)	G	G	VG	VG	G	(7.800,8.800,9.400,10.00)	8.98
($C_{5,3}$)	MG	VG	MG	VG	MG	(6.600,7.600,8.200,8.800)	7.78
($C_{5,4}$)	MG	VG	MG	G	VG	(7.000,8.000,8.600,9.200)	8.18
($C_{5,5}$)	G	G	F	MG	MG	(5.600,6.600,7.400,8.400)	7
($C_{6,1}$)	F	G	MG	F	G	(5.400,6.400,7.000,8.000)	6.7
(C_{62})	F	G	G	G	F	(5.800,6.800,7.400,8.400)	7.1
(C_{63})	G	G	VG	VG	G	(7.800,8.800,9.400,10.00)	8.98
(C_{64})	MG	VG	MG	VG	MG	(6.600,7.600,8.200,8.800)	7.78

Table.6 Weighted Normalized and Positive ideal solution

C_j	A_1	A_2	A_3
Technological involvement, (C_1)	0.0368	0.0326	0.0355
Work force leanness,(C_2)	0.0564	0.0584	0.0560
Manufacturing management,(C_3)	0.0526	0.0619	0.0593
Collaborative planning, (C_4)	0.1044	0.0972	0.0931
Customer service performance,(C_5)	0.0866	0.0828	0.0855
Resource utilization, (C_6)	0.0714	0.0750	0.0761

Table.7. Weighted Normalized and Positive ideal solution

C_j	A_1	A_2	A_3
Technological involvement, (C_1)	0.0368	0.0326	0.0355
Work force leanness,(C_2)	0.0564	0.0584	0.0560
Manufacturing management,(C_3)	0.0526	0.0619	0.0593
Collaborative planning, (C_4)	0.1044	0.0972	0.0931
Customer service performance,(C_5)	0.0866	0.0828	0.0855
Resource utilization, (C_6)	0.0714	0.0750	0.0761

Table.8 Preferences of stuff provider's organizations under Lean-TWMCCR based practice-metrics by using TOPSIS

A_i	A_1	A_2	A_3
TOPSIS			
D_i^-	0.09418186	0.099987	0.092011
D_i*	0.104680173	0.087312	0.078673
Cc_i	**0.474**	**0.534**	**0.539**
Preference orders	3	2	1

VII. CONCLUSIONS

Lean performance measurement problems are inherently compound problems with multi-layered internal connecting activities. Recently, the globalization market has brought new defies to the business owners. Market is continuously fragmenting, customers' demands, which also required fast service from manufacturing firm. Delay in scheduled production does not make the reputation of companies ill well, but beak the relationship of manufacturing firm quite long time. The result shown that A_3 alternative is the best. Fig.1 shown the preference of stuff provider's organizations by using TOPSIS.

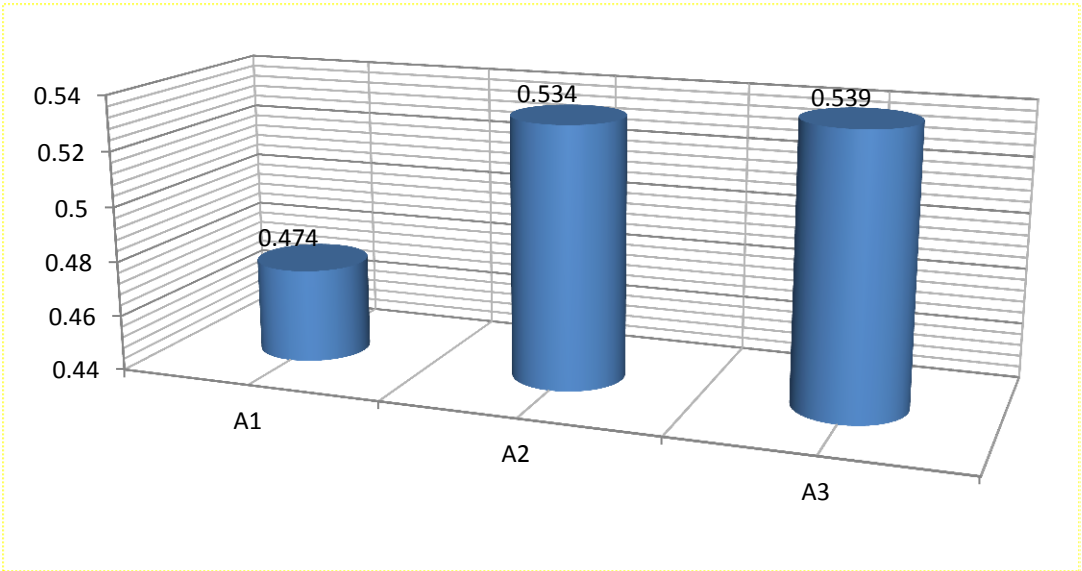

Fig.1. Preference of stuff provider's organizations by using TOPSIS

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