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Evaluation and Selection of Lot Sizing Techniques using SAW Approach for Indian Automobile Industries

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Abstract

Inventory management is a vital for any automotive industry. It involves selection of right ordering policy and lot sizing policy. Selectionof lot sizing techniques depends upon different interdependent criteria. Right lot sizing techniques influences productivity and profitably of any organization. The work has employed SAW technique to evaluate and rank the lot sizing technique for Indian Automotive Industries.

1. INTRODUCTION

The automobile industry is the globally largest production (Suthikarnnarunai, 2008). Growing automobiles demand has emerged India as most automobile manufacturing hub. The global competition has forced automobile producer to redesign the supply chain to meet customer ever-changing demand. The inventory policy includes ordering policy along with lot sizing. The automotive industry deals with the high volume. Lot size determination is ever-changing vital problems as it is depending upon the different interdependent criteria.

The work has used four lot sizing techniques Classical Economic Order Quantity (EOQ), Economic Order Quantity-Fixed Unit Price, Minimum Order Quantity (MOQ) and Lot for Lot (LFL) technique which are most extensively employed in Indian Automotive industry as per the personnel involved in lot sizing selection directly or indirectly.

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This research work has developed a methodology for ranking of various lot sizing techniques based on interdepended criterion employing. The purchase personnel involved in lot size determination assign all the criteria a cardinal values. In this paper, Simple Additive Weighting (SAW) Technique has been employed for a multi criteria decision making lot sizing technique selection. Lot sizing selection criteria are defined in Section 2. Section 3 presents the developed methodology for ranking of lot sizing techniques. Section 4 exhibits the example while conclusion is summarized finally.

2. RESEARCH METHODOLOGY

Lot Sizing Technique selection depends upon mutually interdependent criterion. Therefore, this problem belongs to Multi Criteria Decision Making (MCDM). Gandhi and Agrawal (1994), Holt (1998), Garg et al. (2007 and 2011), Upadhyay et al. (2013), Kumar and Garg (2010), Gupta et al. (2014), Kumar et al. (2014), Gupta (2016) have employed different MCDM approaches to solve different engineering problems. It is required for Automotive industries to optimize the lot size selection to minimize the total production cost. Lot sizing technique selection methodology comprises of lot sizing technique selection criteria, respondent sample base, formation of model with appropriate procedure, analysis and synthesis. The decision hierarchy is presented in following figure.

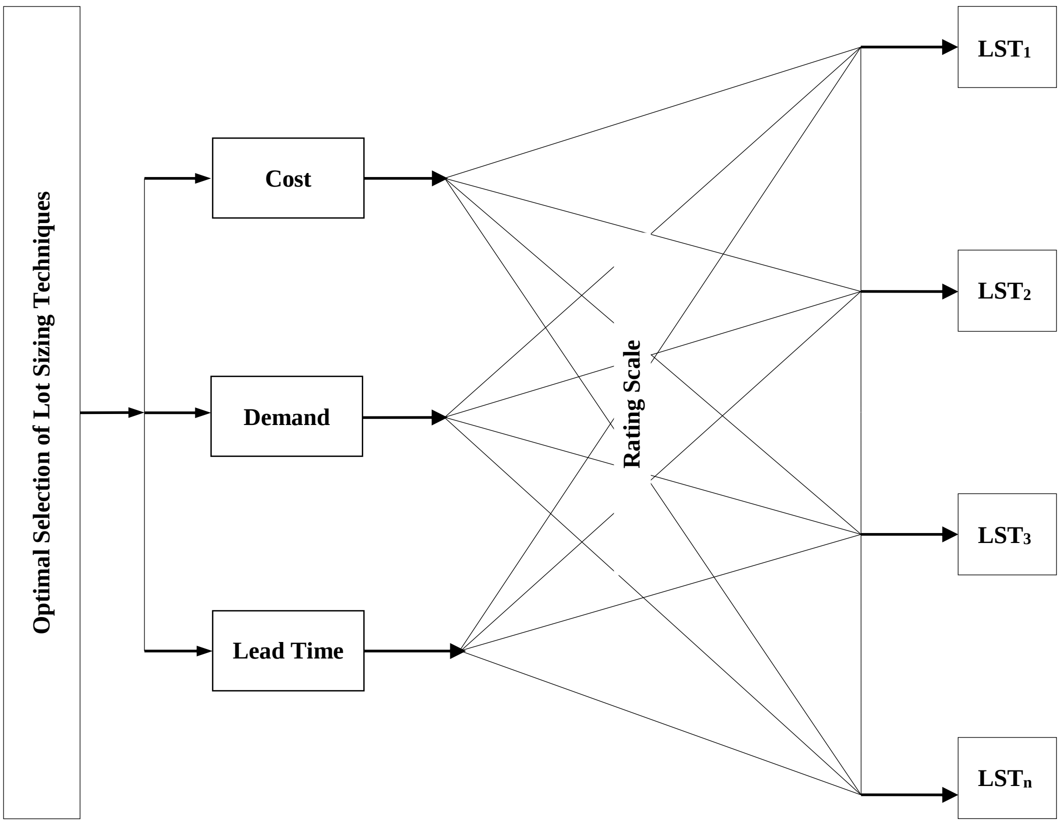

Fig 1. Decision Hierarchy for Lot Sizing Technique Selection Model

The various steps of decision hierarchy for lot sizing technique selection model are as follows:

- The first level of the hierarchy is to determine the 'goal'. In this part of the work, the goal is to optimize the selection of lot sizing technique for an automotive industry.
- The second and third levels include lot sizing technique selection criteria/sub-criteria for Indian automotive industry, which are identified form literature.
- The forth level is related to the rating scale. Experts have assigned rating of inventory policies.
- In fifth level includes the selection of lot sizing technique based on the lot-sizing techniques criteria and sub-criteria for Indian automotive industry, which are identified form literature.

2.1 Simple Additive Weighting(SAW) Technique

This research work presents SAW Additive method for ranking of Lot sizing techniques. Experts assigned weights to each criterion such that sum of each criteria are equal to one. Different Lot sizing techniques are representing as follows:

$$\begin{bmatrix} A_{11} & A_{11} & \cdots & A_{1j} \\ A_{21} & A_{21} & \cdots & A_{1j} \\ \vdots & \vdots & \ddots & \vdots \\ A_{i1} & A_{31} & \cdots & A_{1j} \end{bmatrix}$$

Following Equation is used to calculate composite score:

$$C_i = \sum_{j=1}^{n} W_j A_{ij}$$

Where i = 1, 2, 3,…., n alternative lot sizing techniques,

j = 1, 2, 3,…., n lot sizing techniques selection criteria,

W_j= weights of j selection criteria,

A_{ij}= rating of i lot sizing techniques for j selection criteria,

C_i=Composite Score for lot sizing techniques

The lot sizing technique having highest value of C_i is assigned rank #1. Rank #2 is assigned to the alternate having less value and so on.

2.2 Selection Criterion

The list of criteria proposed and used for developing of various lot sizing techniques is summarized and presented in Table 1.

Table 1: Lot Sizing Technique Selection Criteria used by Various Researchers

Criterion / Author	Year	Back-Ordering Cost	Demand	Demand (Deterministic)	Demand (Stochastic)	Holding Cost	Lead Time	Lead Time (Procurement)	Lead Time (Vendor)	Lead Time (Transportation)	Ordering Cost	Penalty Cost/Shortage Cost	Transportation Cost	Unit Cost
Tersine et al.	1992		√			√		√				√	√	√
Gunasekaran et al.	1993		√									√		√
Zhuang	1994		√			√								√
Chiu	1995					√	√	√			√	√		
Wee	1995			√		√					√	√		√
Chiang and Gutierrez	1996		√			√						√		
Dohi et al.	1997					√		√				√		
Shinn	1997		√			√					√	√		√
Andijani and Al-Dajani	1998					√								√
Schultz and Johansen	1999	√				√					√			
Heijden	2000					√		√						
Garget al.	2001		√			√					√	√		
Tekin et al.	2001		√			√					√			
Mahadevan et al.	2003					√					√			
Axsater	2003	√			√	√	√		√	√		√		
Ghalebsaz-Jeddi et al.	2004					√						√		√
Yang	2004			√		√					√			√
Yang and Wee	2006					√					√			√
Chen and Kang	2007		√			√					√			√
Huang et al.	2010			√		√		√				√		√
Pishvae and Torabi	2010		√											√
Thangam and Uthayakumar	2010	√				√						√	√	
Glock	2011			√		√						√		
Li and Ryan	2012					√							√	√
Hartmut and Sahling	2013	√	√			√	√							
Moussawi-Haidar and Jaber	2013		√			√					√			√
Ouyang et al.	2013		√			√					√		√	

Lot sizing technique selection system for an Indian automobile industry requires selection criteria. Criteria proposed by different authors is summarized as follows:

1. Cost (C_1)
2. Demand (C_2)
3. Lead Time (C_3)

3. ILLUSTRATED EXAMPLE

Following example demonstrates the procedure for ranking of lot sizing techniques as given in section 2. Rating for each lot sizing techniques (LSTs) against criteria and criteria weights are given in Table 2 and 3.

Table 2: Rating for Each Criteria

Lot Sizing Techniques	**(Cost) C_1**	**(Demand)**	**(Lead Time)**
Lot Sizing Techniques	0.425	0.455	0.605
Lot Sizing Techniques	0.3125	0.530	0.590
Lot Sizing Techniques	0.805	0.7225	0.305
Lot Sizing Techniques	0.305	0.425	0.575

Table 3. Weights of Each Criterion

Criteria	**(Cost)**	**(Demand)**	**(Lead Time) C_3**
Weights	0.496	0.327	0.1762

Composite score is determined using eq. 1 and presented in following table:

Table 4. Weights and Rating of Lot Sizing Techniques

Lot Sizing Techniques	**(Cost) C_1**	**(Demand) C_2**	**(Lead Time)**
EOQ - Fixed Unit Price	0.2108	0.148785	0.106601
Classical EOQ	0.1550	0.17331	0.103958
LFL	0.3993	0.2362575	0.053741
MOQ	0.1513	0.138975	0.101315

Weighted Sum Matrix: -

Table 4. Composite Score and Ranks of Ordering Policies

Lot Sizing Techniques	**Composite Distance**	**Rank**
EOQ - Fixed Unit Price	0.4662	2
Classical EOQ	0.4323	3
LFL	0.6893	1
MOQ	0.3916	4

Table 5 presents the composite score for each lot sizing techniques. Lot sizing Techniques “Lot For Lot” having highest composite score 0.6993 is ranked as #1 and lot sizing techniques “Economic Order Quantity - Fixed Unit Price” having lesser value is ranked #2 and so on.

4. CONCLUSION

In this research work, a user friendly methodology based on SAW technique which hitherto not employed in the literature has been developed to rank lot sizing techniques based on the selection criterion. The aim of this work is reduce intricacy in selection problems. This model assists the user to employ the different lot sizing technique for dynamics selection criteria.

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