Barriers Analysis for Total Production Maintenance Implementation in Small & Medium Scale Industry Using Interpretive Structural Modeling

Veerendra Kumar[1], Dheeraj Dave[2]
[1]*Pg Scholar TIET, Jabalpur*
[2]*Asst. Prof. TIET Jabalpur*

***Abstract*- The idea of this research is come in mind because of central and state governments are mainly focus on MSMEs to solve the unemployment problems of the country and it's also clearly seen from the current scenario schemes of Madhya Pradesh government that the MSMEs are now playing very big role in economy. In Madhya Pradesh SMEs are very rapidly growing but at the same time number of startup at this level are not compete to the current big brand of the same manufacturing and production stream. Hence in this work Total Productive Maintenance tool implementation in SMEs are preferred for sustainable growth and development of SMEs. TPM is used because most of the SMEs are suffered by maintenance and idle of machines issues due to poor planning of maintenance process in the plant. Hence significance of this research is very important for SMEs in current rapid changing technology world for sustainable development of SMEs and also provides a safe environment for working and competition.**

***Index Terms*- Small & medium scale industry, total productive maintenance and interpretive structural modeling.**

1. INTRODUCTION

Numbers of studies have been done on small & medium scale industries (SMI) are financially and problems face by them as found from literature survey and expert assistance but no studies has been concern with priorities the barriers which help the entrepreneur. Small scale industries have played a significant role in all the developed economies primarily for the economic growth, job creation and poverty reduction in the State. The government has a huge responsibility to provide a business friendly environment and most importantly to encourage entrepreneurs. A large part of any state's economic growth depends upon the condition of business environment and its commitment to medium and small scale industries. The Government of Madhya Pradesh since the last decade has been very supportive of inclusive growth through special focus on MSMEs (MSME vision document Madhya Pradesh 01 October 2016).

It is with this view that an assessment of growth, development and working of small scale industries in the specific region is attempted in this research study. However, before entering into an analytical study of this project, it is necessary to examine the concept of Small scale industry as it has come to be, today, in Madhya Pradesh.

2. OBJECTIVES

The main objectives of the present study are:

The main objectives of this research work are as follows:-

1. To get the main barriers those are mainly affected the implementation of TPM in SMEs of Jabalpur region.
2. With the help of brainstorming and interview session select the exact barriers relevant to SMEs of Jabalpur for thesis work.
3. How to priorities the barriers and there weightage?

3. RESEARCH METHODOLOGY

In order to overcome gap mentioned in literature review and in previous section a brief study was carried out and analyze the barriers in the implementation of TPM in SMEs and using the interpretive structure modeling tool is used to priorities the barriers by taking there weightages.

Literature view of various journals and interview with various entrepreneur lots of barriers are found those are severely affecting the sustainable development of SMEs but there is no work found in which barriers are priorities according to their weightages. Therefore in this research work to achieve the above written goals ISM tool is utilized and applied on barriers select by interview with experts and entrepreneurs.

LIMITATION OF STUDY:

In this thesis Jabalpur district is consider hence this research work can't be exactly fit to other state of country. Second these barriers broadly connected conventional main area hence it's not necessary that these barriers concern to all kind of industry. ISM methodology is given in details has it can be easily utilize by any industry, therefore this work can be useful for all kind of industries but at the time of barriers selection procedure, experts should be consider from relevant SMEs.

4. SMALL & MEDIUM SCALE INDUSTRIES

In the recent years, Indian economy has changed substantially. Market forces have begun to dictate investment flows across the industrial sectors. Accelerating investments in industrial development for economic growth is one of the major focus areas for Madhya Pradesh. Today, Madhya Pradesh is one of the fastest growing states in India, backed by an impressive annual growth rate of 10.98% during 2015-16. Rapidly growing state offers immense business opportunities across sectors. In Madhya Pradesh, investors have better options in terms of project location, infrastructure, incentives and other facilities. At present the state has prospective investment proposals of more than US$ 104 billion under various stages of consideration [2].

This study mainly concern with the Jabalpur district because Jabalpur has a variety of industries largely based in mineral substances of economic value found in the district, although the ready-made garments industry is a substantial portion of production in Jabalpur. MSME classification in Madhya Pradesh:

TABLE : MANUFACTURING SECTOR	
Enterprises	Investment in plant & machinery
Micro	Less than Rs 25 lakhs
Small	Over Rs 25 lakhs but not exceeding Rs 5 Crores
Medium	Over 5 Crores but less than Rs 10 Crores

TABLE : SERVICE SECTOR	
Enterprises	Investment in Equipments
Micro	Less than Rs 10 lakhs
Small	Over Rs 10 lakhs but not exceeding Rs 2 Crores
Medium	Over Rs 2 Crores but not exceeding Rs 5 Crores

In Jabalpur district mainly 17 types of industries are working. Under which 1861 units are running and cover investment around 158.07 Crores hence provide job to 1387 people (Source: - DTIC, JABALPUR).

5. PROBLEM IDENTIFICATION

Based on literature review and expert assistance there have eleven barriers identified for implementation of TPM in small & medium scale industry. These barriers are explained in the following sub-sections.

1. Lack of training and education
2. Lack of motivation
3. Employee resistance
4. Cultural resistance
5. Failure to allow sufficient time for the evolution
6. Poor relation between production and maintenance department
7. Lack of communication
8. Financial constraints
9. Lack of understanding and knowledge of TPM
10. Lack of skilled equipment operators
11. Lack of leadership from top executives

After literature survey, below given the research paper in which issues concern to small & medium scale industry are discussed:

S. No	Author	Paper Work On
1	Improving operations performance in a small company: a case study A. Gunasekaran, L. Forker and B. Kobu.International Journal of Operations & Production Management, Vol. 20 No. 3, 2000, pp. 316-335.	Finally, implementation issues associated with productivity improvement strategies in a small company are discussed.
2	Problems of Small Scale Industries in India Sangita G.Patil1, Dr.	In this paper examine the growth and performance small

	P.T.Chaudhari2 1Research Scholar and Assistant Professor, North Maharashtra University, Jalgaon, INDIA.Volume-4, Issue-2, April-2014, ISSN No.: 2250-0758 International Journal of Engineering and Management Research.	scale industries and To analyse the problems of small scale industries.
3	Research perspective for small scale industries in India Yogender, Ranbir Singh.International Journal of Latest Research in Science and Technology ISSN (Online):2278-5299 Volume 1, Issue 1 : Page No. 70-75, May-June(2012)	In this research paper Frameworks and approaches have been developed that guide people in making decisions about manufacturing system. This paper reviews all such study of small scale industries.
4	Supply chain performance measurement frameworkfor small and medium scale enterprises. Jitesh Thakkar,Arun Kanda,S.G. Deshmukh,Mechanical Engineering Department, A.D. Patel Institute of Technology, Vitthal Udyognagar, India..An International Journal Vol. 16 No. 5, 2009 pp. 702-723q Emerald Group Publishing Limited 1463-5771 DOI 10.1108/14635770910987878	In this paper is to propose an integrated supply chain performance measurement framework for the case of small and medium scale enterprises (SMEs) using set of qualitative and quantitative insights gained during the case study research.
5	Benchmarking: Small and Medium Enterprises Across the Globe, Meghana Ayyagari Thorsten Beck Asli Demirguc-Kunt,Small Business Economics (2007) 29:415–434 Springer 2007 DOI 10.1007/s11187-006-9002-5	This paper analyzes the relationship between the relative size of the small and medium enterprise (SME) Sector and the business environment in 76 countries. The paper first describes a new and unique cross-country database that presents consistent and comparable information on the contribution of the SME sector to total employment in manufacturing and GDP across different countries.
6	Small-Scale Industry and Cleaner Production Strategies JOS FRIJNS,BAS VAN VLIET.World Development Vol. 27, No. 6, pp. 967±983, 1999 Elsevier Science Ltd All rights reserved. Printed in Great Britain 0305-750X/99/$.	To introduce cleaner production methods successfully, the small-scale sector needs support, such as technical and ®nancial incentives, from policy organizations and nongovernmental organizations. This requires better coordination of policy e€ orts and organization of small-scale enterprises, in particular because environmental improvements could be induced within enhanced industrial interactions.
7	SMALL SCALE INDUSTRY: AN ENGINE OF GROWTH RAM SINGH*; DR. O P VERMA**; DR. BIMAL ANJUM..ZENITH International Journal of Business Economics & Management Research Vol.2 Issue 5, May 2012, ISSN 2249 8826.	This paper analyze the performance of Small scale industry in India and focus on policy changes which have opened new opportunities for this sector. Technology development and strengthening of financial infrastructure is needed to boost SSI and thus growth target can be achieved.
8	Small and medium-size enterprises: Access to finance as a growth constraint Thorsten Beck *, Asli Demirguc-Kunt..T. Beck, A. Demirguc-Kunt / Journal of Banking & Finance 30 (2006) 2931–2943	This paper presents recent research on access to finance by small and medium-size enterprises(SMEs). SMEs form a large part of private sector in many developed and developing countries. While cross-country research sheds doubt on a causal link between SMEs and economic development, there is substantial evidence that small firms face larger growth constraints and have less access to formal sources of external finance, potentially explaining the lack of SMEs' contribution to growth.

6. ISM APPLIED TO BARRIERS IMPLEMENT OF TPM IN SMALL & MEDIUM SCALE INDUSTRY

The ISM is basically giving the explanation as judgment of the selected areas for the research decides whether and how the variables are related. ISM generally has following steps [12]. The ISM procedure can be described briefly as encompassing the following steps:

- Step 1:- Variables influence the system are listed; in our research work barriers to implement TPM in SMI's have been identified as variables.
- Step 2:- Variables found in step 1, contextual relationship among the variables with respect to which pairs of variables are examined.
- Step 3:- A Structural Self-Interaction Matrix (SSIM) is produced for variables, which shows pair wise relationship along with variables of the system for consideration.
- Step 4:- A reachability matrix is generate from the SSIM and the matrix is checked for transitivity. The transitivity states that if variable A is drive to variable B and variable B is drive to variable C, then variable A is necessarily drive to variable C.
- Step 5:- The reachability matrix found in Step 4 is segregated into diverse levels.
- Step 6:- Based on the appropriate relationships in the reachability matrix, a digraph is drawn and the transitive links are removed.
- Step 7:- The final directed graph is converted into an Interpretive Structural Model by replacing variable nodes with statements.

6.1. STRUCTURAL SELF-INTERACTION MATRIX (SSIM)

Barrier Number		Barrier Number									
	Barrier Description	11	10	9	8	7	6	5	4	3	2
1	Lack of training and education	A	A	V	A	V	V	O	A	A	A
2	Lack of motivation	A	V	X	A	A	V	V	V	V	X
3	Employee resistance	A	A	A	A	V	A	V	X	X	A
4	Cultural resistance	A	O	V	O	A	V	V	X	X	A
5	Failure to allow sufficient time for the evolution	A	V	V	O	O	A	X	A	A	O
6	Poor relation between production and maintenance department	A	A	A	O	A	X	A	A	A	O
7	Lack of communication	X	O	X	O	X	V	O	V	V	A
8	Financial constraints	V	V	O	X	O	O	V	O	V	V
9	Lack of understanding and knowledge of TPM	O	O	X	A	O	O	V	A	V	X
10	Lack of skilled equipment operators	A	X	O	A	O	V	X	O	V	O
11	Lack of leadership from top executives	X	O	V	A	V	V	O	O	V	V

6.3. LEVEL PARTITIONS

From the final reachability matrix, the reachability and antecedent set for each barrier is establish. The reachability set include the barriers having unit digit of binary in row of IRM and the other elements which it may help achieve, whereas the antecedent set consider the barriers having unit digit of binary from column itself and the other elements which may help in achieving it. After getting the reachability and antecedent set, the iteration process is start. In

iteration process the barriers for which the reachability and the antecedent set are common are put in the intersection sets. With the help of intersection the same occupy the top level in the ISM hierarchy. For same occupy case reachability set first consider those having very less common occupy. The top-level element in the hierarchy would not help achieve any other element above its own level. Once the top-level element is identified, it is separated out from the other elements. Then, the same process is repeated to find out the elements in the next level. This process is continued until the level of each element is found. These levels help in building the diagraph and the final model [11].

Iteration summary given below:

Criterion Number	Reachability Set	Antecedent Set	Intersection	Level	Iteration Number
6	1,6	1,2,4,6,7,10,11	1,6	I	Iteration I
5	5,9,10	2,3,4,5,8,9,10	5,9,10	II	Iteration II
1	1,6,7,9	1,2,3,6,7,9	1,6,7,9	III	Iteration III
10	3,5,6,10	2,5,8,10	5,10	III	Iteration III
3	1,3,4,5,7	2,3,4,7,8,9,10,11	3,4,7	IV	Iteration IV
4	3,4,5,6,9	2,3,4,7,8	3,4	IV	Iteration IV
9	1,2,3,5,9	1,2,4,5,7,9,11	1,2,5,9	IV	Iteration IV
11	2,3,6,7,9,11	7,8,11	7,11	V	Iteration V
7	1,3,4,6,7,9,11	1,3,7,11	1,3,7,11	VI	Iteration VI
8	2,3,4,5,8,10,11	8	8	VI	Iteration VI
2	1,2,3,4,5,6,9,10	2,8,9,11	2,9	VII	Iteration VII

6.4. MICMAC ANALYSIS

Cross-impact matrix multiplication applied to classification is abbreviated as MICMAC. The aim of MICMAC examination is to check up the driving power and dependence power of factors. MICMAC concept is based on multiplication properties of matrices. According to this concept is to find out essential barriers that drive the system in various areas. These regions have been divided into four group's i.e. autonomous factors, linkage factors, dependent and independent factors.

		INDEPENDENT VARIABLES					LINKAGE VARIBLES					
DRIVING POWER	11											
	10											
	9											
	8				B2							
	7	B8			B7							
	6			B11								
	5							B4, B9	B3			
	4				B10		B1					
	3							B5				
	2							B6				
	1											
		1	2	3	4	5	6	7	8	9	10	11
		AUTONOMOUS VARIABLES					DEPENDENT VARIABLES					
		DEPENDENCE POWER										

7. CONCLUSION

The result of this thesis was to recognizing the drivers and barriers to implement Total productive maintenance in SMEs. The research work follows the problem statement and after achieving the goal by using ISM methodology help to concluded the thesis. By using ISM 07 levels achieved for 11 barriers and at the same time the driving power of all barriers received. These driving power help that the "poor relation between production and maintenance department" is the main barriers to focus on the implementation of TPM in SMEs first. At the same time also shows the interrelation between them; for example "lack of skill operator" and lack of training and education" are drive to each other. These results are mathematically received therefore entrepreneurs can confidently used it.

This research work is very valuable for SMEs because by using TPM process maintenance issue will not suffer them and at the same time implementation process become easier for them.

The foremost finding was that while implementation of TPM in SMSI helps both entrepreneur & state government to save the startup as well as save the economy and solve the unemployment issues.

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