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"6S" IMPLEMENTATION LEVEL IN MANUFACTURING - MSME INDUSTRIES

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Abstract

Manufacturing is the making of goods by hand or by a machine that is intended to be sold to customers. Items used in manufacturing may be raw materials or component parts of a larger product. Typically, manufacturing takes place on a huge production line using equipment and experienced labour. Business is the development of adapting unfinished things from raw materials or pieces using tools, labour, machinery, and chemical processing. In order to achieve planned objectives and goals, operation is the development that converts approaches and plans into actions. As critical as, if not more so strategy is the execution of strategic plan. The manufacturing sector is regarded as crucial to both social and economic advancement. They help modernize agriculture and reduce people's heavy reliance on farming by supplying jobs in the secondary and tertiary industries profits. The manufacturing industry is critical to a country's overall, and especially economic development. A country's financial asset is resolute by its manufacturing sector. The primary tenet that guides public sector productions and joint sector imaginations in India is that productions exertion to combat poverty and redundancy. By establishing businesses in familial and retrograde areas, they reduce regional inequities.

Key Words: MSME, Manufacturing, Stages, Implementation.

1. Introduction

According to a report by the United Nations (2018), micro, small and medium-scale enterprises (MSMEs) globally account for nearly 90% of firms and substantially contribute to the world's economy. However, MSMEs are continuously dared by various questions related to eminence, productivity, distribution, and elasticity Yadav (2019). Manufacturing is a production business and its primary objective is to adapt raw resources into quality goods that have value in the marketplace and as a result, generated profit Foston et al (1991) Factors such as system effectiveness, invention eminence, and reliability, productivity and lower cost, and efficient and effective management techniques contributing to increasing that profit.

Types of 6 S

- Sorting
- Set in order
- Shine
- Standardization
- Sustain
- Safety

FIGURE - 1: "6 S" IN MANUFACTURING INDUSTRIES

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Meaning of 6 S

- SORT - Throw away all unserviceable and left-over material from the factory
- SET IN ORDER- Everything is in its appropriate place for swift access
- SHINE/CLEANLINESS-Maintain the workplace neat and clean
- STANDARDISATION - Constantly keep order at the workplace and make it habitual
- SUSTAIN- Practice 5S daily
- SAFETY- Use all safety equipment and maintain them in a good manner

Sort

The goal of Sort is to distinguish between objects that are required for work and objects which are not required for work. The workspace should be cleared of any items that are no longer required or in use. Some may be completely trashed, some may be placed nearby for convenient retrieval, and placed in a disposition area for further review. It keeps the workplace clean and efficient for receiving and searching for items and reduces the duration of the operation.

Set in Order

Set in order means managing all the items in a proper way and place at the workplace for quicker access and use. Make sure products can be identified by giving them the proper tags. Every working strategy has a particular type of order. After determining it, correct it.

Shine

The office is kept neat and clean through routine cleaning. When using a light source, a workshop, and cleaning supplies, proper cleaning procedures are followed. Operators need to be aware of their personal upkeep and cleanliness.

Standardisation

Standards should be developed and implemented in the workshop. In order to keep the office tidy and prepared, the administration should deliver personnel with clear instructions and productive habits. This can be attained by giving graphic notices and defining workers' responsibilities on a regular basis.

Sustain

The main objective of sustaining is to set up a clean environment and keep it that way permanently. This raises employee awareness and improves quality. Additionally, it improves worker relations and communication.

Safety

The main step of the 6'S method is safety. Ensure that all necessary safety supplies, such as first aid kits, personal protective equipment, and fire extinguishers, are available at the workplace. All safety equipment should be regularly maintained in the workplace.

2. Review of Literature and Research Gap

2.1 SIX "S" Methods

Cuaand McKone et al (2001) investigate of execution of performsCua et al (2006) on manufacturing performance. Michael and Yasin (1997) management and service behaviors, which is a direct result of

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virtualization, Nagorny (2012) transformed the mechatronics / production layout into an automatic collaborative network, Mostafa et al (2013) framework with thorough four employment segments.
Effective methods and equipment for implementing lean manufacturing in the Iranian manufacturing sector Zahraee (2016) Implementing lean manufacturing is less effective with a decreased inventory. The 6S method aims to increase the effectiveness and safety of all organizational processes. Dhounchak (2017) The 6S method leads in improved quality, decreased waste and expense, increased efficiency, improved safety, and a more sustainable production approach is Kishawy (2018) implementation of 6S with an Jewalikar & Shelke (2017) safer working conditions with increased productivity and building the image of MSMEs to customers.

A new consideration of revolution proposes that Micro Small and Medium Enterprises performance a energetic role in the invention (Lee et al., 2016).Innovation is an essential aspect to attain benefits in sustainable competition Khurana (2019) strengthens the assimilation of sustainability with the invention of Indian manufacturing MSMEs as these organizations. Tortorella (2017) implementation phase of slender industrial and level of digital implementation, Antony, Vinodh, and Gijo (2017) barriers to implementing LMPs.

Zangiacomi et al (2019) support companies in understanding which are the most important issues to be addressed when facing the adoption of digital and innovative technologies. Huang et al (2019) beneficial for the sectors involved with micro, small, and medium enterprises. Process implementation is the strategic method for assisting a company to embrace new practices. In fact (2021), businesses introduce new procedures for a variety of purposes, such as streamlining work, increasing productivity, minimising errors, or fostering business expansion. This is done to ascertain the relationship between the use of alphanumerical technologies and various production environments as well as company sizes. Buer (2021) Three characteristics of digitization are highlighted in order to offer crucial insights for planning future research projects to help behind-the-curve environments in their digital transformation. Khurana (2021) due to their distinctive capability of adapting novel ideas into innovations and thus building profitable enterprises. Sahu (2021) new insights to MSME managers, policymakers, régimes, and consultants for empathetic the performance of MSME employees toward the adoption of LMPs in their enterprises, implementation of the organization by business enterprises with orientation to Nandhini and Palanivelu et al (2022) MSMEs and to assess its usefulness.

2.2 stages of a Manufacturing Implementation

Ashford (1994) application to accomplish Rachuri et al (2010) workable industrial approach is speckled grounded on the operation difficulty level of Sudarsan et al (2010) business and quality practices and viewpoints Hokomaet al (2008) improved management commitments in the implementation process and took full responsibility to encourage and motivate. Investigate involvement, research methodology, Bhamu and Sangwan et al (2014) type of industry, tools/ techniques / methodology used, and various characteristics of Lean Management.

To develop a (Sundar, Balaji, and Kumar, et al (2014)) highly effective and safer work environment in the organization. 6S methodology is to establish all developments. Dhounchak & Khatak (2017). The work place 6S methodology is a commonly implemented performance of lean principles in Brazil, Cezar Lucato and Araujo Calarge et al (2014) An innovative method to ascertain how a set of 11 factors can influence successful lean implementation sustainable manufacturing approach identified by Kishawy (2018) merchandise, method, and structure scales, obtain a relationship between the

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consistency of the DMAIC phase Purba et al (2021) to surge the sigma in efficiency upgrading and engineering sustainability.

2.3 Research Gap

Industrial is not only quality administration system ethics Dhounchak (2017) but also require continuous improvement in the quality management and safety of workers in the plant. Improve its processes Upadhye et al (2010) and align them to the requirements of its customers. Hence, the present study is thru in the framework of India. Finally, there are no studies on the current topic, particularly in the implementation of 6 S Levels in Manufacturing in Chennai.

3. Objectives

I. To explore the types of manufacturing methods and Stages, Benefitsof Manufacturing Implementation in MSME industries.
II. To investigate the Advantages of using the 6S Methods and Skills for Manufacturing employees.

4. Research Methodology

The data was collected from Chennai manufacturing MSMEs industries. A total of 1989 employees worked in 117 different MSMEs. A total of 324 employees showed interest in the survey. The data was collected following a random sampling technique and different numbers of employees from each MSME were allowed to participate in the survey. The survey was offered in web-linked form. Consequently, this study data set was sufficient for statistical data analysis and drawing inferences. Descriptive research has been implemented in the study. Type of data collection was primary data collection was collected through a questionnaire (survey method); the secondary data was collected from websites, journals, and publications. A random sampling technique has been adopted for the research. The structured questionnaire has been constructed on the basis of earlier studies, Stages of Manufacturing Implementation,Benefits of Manufacturing implementation, types of manufacturing methods, Advantages of using the 6S Method, and Skill. The survey method has been employed for conducting this study and data have been gathered from respondents randomly in Chennai through a structured questionnaire it has distributed among 180 respondents. The research model is shown in Figure - 1.

5 Findings and Results

5.1 Descriptive Analysis

Table - 1 Represents the Demographic outline of the respondents, the results explain gender is male working is 58 percent, the maximum working age category people are 19-29 years of people are 28 percent, and her average qualification is Post Graduate 40 percent. Working experience is 1 – 5 years 39%. Assistant Managers / Team Leaders are more collaborative throughout the data collection. 11-25 employees are 35 working in the MSME organizations. Single people are working in MSME companies.

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Table - 1: Characteristics of Respondents

Category	Frequency	Percent
Gender of the Respondents		
Male	104	57.8
Female	76	42.2
Age (Years)		
19-29	51	28.3
30-39	43	23.9
40-49	45	25.0
50-60	12	6.7
Above 60	29	16.1
Designation		
Senior manager	26	14.4
Manager	27	15.0
Assistant Manager / Team Leader	60	33.3
Senior Executive / Executive	33	18.3
Fresher / Trainee	34	18.9
Education Qualification		
Diploma	44	24.4
Graduate	49	27.2
Post Graduate	72	40.0
Others	15	8.3
Year of Experience		
> 1 Year	35	19.4
1 to 5 Years	70	38.9
6 to 10 Years	38	21.1
11 to 15 Years	12	6.7
Above15 Years	25	13.9
Category	**Frequency**	**Percent**
Employees are Working		
Below 10 employees	19	10.6
11-25 employees	63	35.0
26 -50 employees	13	7.2
51 -100 employees	11	6.1
Above 101 employees	74	41.1
Marital Status		
Single	96	53.3
Married	84	46.7
Stages of Manufacturing Implementation		
Planning and Preparation	60	33.3
Configuration/Implementation	71	39.4
Go-live/Post Go-live	49	27.2

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5.2 Rank

Table - 2: Rank the Types of Manufacturing

Types of Manufacturing	Mean	SD	RANK
Repetitive Manufacturing	4.50	1.096	II
Discrete Manufacturing	3.99	1.430	VI
Job Shop Manufacturing	4.41	1.024	III
Process (Continuous) Manufacturing	4.53	.874	I
Process (Batch) Manufacturing	4.23	1.009	V
3D Printing	4.26	1.031	IV
Total	**25.92**	**6.464**	

Table – 2 Represents the rank of the types of manufacturing in MSME industries, First rank represents Process (Continuous) Manufacturing, Second rank is Repetitive Manufacturing mean value of 4.50. The final rank of the accused is Discrete Manufacturing.

5.3 Correlation

Benefits of process implementation in manufacturing

B1 - Improve the quality of output
B2 - Increase efficiency
B3 - Aids compliance and transparency
B4 - Ensure scalability
B5 - Foster improvement
B6 - Easier monitoring of performance
Significant- Sig. (2-tailed)

Table - 3: Correlations

Correlations							
		B1	B2	B3	B4	B5	B6
B1	Pearson Correlation	1					
	Significant						
B2	Pearson Correlation	.601**	1				
	Significant	**.000**					
B3	Pearson Correlation	-.135	-.014	1			
	Significant	.071	.848				
B4	Pearson Correlation	-.126	-.248**	.020	1		
	Significant	.093	**.001**	.789			
B5	Pearson Correlation	-.003	-.009	.075	.013	1	
	Significant	.973	.900	.318	.860		
B6	Pearson Correlation	-.203**	-.239**	.112	-.170*	-.016	1
	Significant	**.006**	**.001**	.133	**.023**	.830	

Table - 3 represents the benefits of process enactment in trade industries, quality of output, increasing efficiency, aiding compliance, and transparency, Ensuring scalability, fostering improvement, and Easier monitoring of performance. Need to foster improvement in benefits of process implementation in manufacturing.

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5.4 Factor Analysis

Advantages of Using the 6s Method

Table - 4.1: KMO and Bartlett's test

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.560
Bartlett's Test of Sphericity	Approx. Chi-square	283.018
	DF	120
	Significant	**.000**

Table 4.1 demonstrations that the KMO value of 0.560, indicates that the degree of common variance among the variable is moderately high, therefore factor analysis can be shown.

Table 4.2: Communalities

Communalities		
	Initial	Extraction
Reduction in material handling cost and manufacturing cost	1.000	.617
Neat and Clean workplace	1.000	.607
Easy to find tool and use	1.000	.487
Easy to access the all-equipment organization	1.000	.556
Saves process time	1.000	.555
All things are in well-organized order	1.000	.498
Increase productivity of plant	1.000	.624
Increase the quality of products	1.000	.536
Intensification safe work environment	1.000	.575
Improve communication between employees	1.000	.631
Increase work speed at the workplace	1.000	.562
Increase worker's performance	1.000	.448
Reduces chances of an accident at the workplace	1.000	.469
Minimizes equipment and tools breakdowns at the workplace	1.000	.584
Reduces wastage in the plant	1.000	.648
Reduces tool changing time	1.000	.779
Extraction Method: Principal Component Analysis.		

Table - 4.2 Explicates the alteration of the 16 variables ranging from .448 to .779. It shows that the 16 variables exhibit a considerable variance from 44 percent to 77 percent. Hence it is decided that these entire 16 variables are capable of segmenting themselves with respect to the merits of consuming the 6S Method.

Table - 4.3: Total Variance Explained

Total Variance Explained									
C	Initial Eigen Values			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1.984	12.402	12.402	1.984	12.402	12.402	1.699	10.619	10.619
2	1.859	11.621	24.023	1.859	11.621	24.023	1.650	10.310	20.929
3	1.542	9.635	33.658	1.542	9.635	33.658	1.545	9.657	30.586
4	1.349	8.432	42.089	1.349	8.432	42.089	1.538	9.615	40.201
5	1.279	7.994	50.084	1.279	7.994	50.084	1.395	8.721	48.922
6	1.162	7.264	57.348	1.162	7.264	57.348	1.348	8.426	57.348
Extraction Method: Principal Component Analysis									

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As could see from table 4.3 Eigen values are greater than six factors. From this one, it is confirmed that the sixteen variables are grouped into six factors. The rotated sum of squared loading should be greater than 44 percent. The six variables were reduced into three predominant factors with the individual variance of 10.619, 20.929, 30.586, 40.201, 48.922, and 57.348. It is also found that the total variance of the sixteen variables is originated to be 57.348 percent which is less than the benchmark value of 77 percent. Moreover, it confirms that the factor segment is the meaningful one.

Table - 4.4 Rotated Component Matrix

Rotated Component Matrix[a]						
	Component					
	1	2	3	4	5	6
Easy to find tool and use	.670					
All things are in well-organized order	.666					
Easy to access the all-equipment organization		.714				
Intensification safe work environment		.597				
Improve communication between employees		.547				
Neat and Clean workplace			-.743			
Saves process time			-.556			
Increase the quality of products			.516			
Increase productivity of plant			.516			
Reduction in material handling cost and manufacturing cost				.761		
Minimizes equipment and tools breakdowns at the workplace				.665		
Reduces chances of an accident at the workplace					.608	
Increase worker's performance					.595	
Reduces wastage in the plant					-.578	
Reduces tool changing time						.869
Increase work speed at the workplace						.574
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.						
a. Rotation converged in 16 iterations.						

Table - 4.4 shows the factor loadings of six factors extracted through factor analysis. The first characteristic encompasses two sub-factors; Easy to find tools and use, all things are in well-organized order. The first factor is named "Use of Administration". The second factor contains three sub-factors; Ease of to access the all-equipment organization, Intensification safe work environment, and Improved communication between employees. Hence, it is named the "Employee factor". The third factor contains three sub-factors; they are a neat and clean workplace, saves process time, and Increases the quality of products. The third factor is named "workplace safety". The fourth factor contains two sub-factors; Reduction in material handling cost and manufacturing costs, and minimizing equipment and tools breakdowns at the workplace. Hence it is named "Equipment handling". The fifth factor contains two sub-factors; Reduces chances of an accident at the workplace increase worker performance, and

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Reduces wastage in the plant. Later it is named "Worker Performance". The sixth factor contains two sub-factors; Reduces tool changing time, and Increase work speed at the workplace. Henceforth it is called "Speed Factor".

5. Two-Step Cluster

Table - 5.1 Auto-Clustering

Auto-Clustering				
Number of Clusters	Schwarz's Bayesian Criterion (BIC)	BIC Change[a]	Ratio of BIC Changes[b]	Ratio of Distance Measures[c]
1	2152.302			
2	2068.967	-83.335	1.000	1.187
3	2021.697	-47.270	.567	1.641
4	2049.717	28.020	-.336	1.075
5	2085.943	36.226	-.435	1.313
6	2148.224	62.281	-.747	1.047
7	2214.214	65.990	-.792	1.288
8	2297.966	83.753	-1.005	1.043
9	2384.265	86.299	-1.036	1.136
10	2477.659	93.394	-1.121	1.123
11	2576.740	99.081	-1.189	1.019
12	2676.669	99.929	-1.199	1.038
13	2778.273	101.604	-1.219	1.206
14	2887.373	109.100	-1.309	1.104
15	2999.896	112.523	-1.350	1.048

a. The changes are from the preceding quantity of clusters in the table.
b. The ratios of changes are compared to the modification for the two-cluster solution.
c. The ratios of distance procedures are based on the current number of clusters against the previous number of clusters.

Table - 5.2 Cluster Distribution

Cluster Distribution				
		N	% of Combined	% of Total
Cluster	1	90	50.0%	50.0%
	2	60	33.3%	33.3%
	3	30	16.7%	16.7%
	Combined	180	100.0%	100.0%
Total		180		100.0%

The cluster distribution table displays the incidence of each cluster. Of the 180 total cases,5 was excepted from the scrutiny due to missing values on one or more of the variables. Of the 180 cases assigned to clusters, 90 were assigned to the first cluster, 60 to the second, and 30 to the third.

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Table - 5.3 Centroids

	Cluster	Mean	SD
Strong Communication	1	4.37	.905
	2	4.33	.877
	3	4.60	.563
Critical Thinking	1	4.39	1.024
	2	4.03	1.473
	3	3.27	1.552
Analytical Skills	1	4.38	1.001
	2	4.40	.867
	3	4.67	.479
Team Skills and Tolerance	1	4.02	1.438
	2	3.62	1.342
	3	3.20	1.243
STEM Skills	1	4.16	1.141
	2	3.92	.907
	3	3.17	1.234
Mechanical and Technical Skills	1	4.30	.930
	2	4.60	.764
	3	4.80	.407
	Cluster	**Mean**	**SD**
Flexibility	1	4.62	.488
	2	4.43	.593
	3	1.83	.874
A knack for Solving Big Problems	1	4.26	.801
	2	4.32	.725
	3	3.73	1.202
Be Multilingual	1	4.83	.375
	2	3.95	1.080
	3	4.30	.915
Attention to Detail and Manual Acuity	1	4.62	.488
	2	4.43	.593
	3	1.83	.874
Aptitude for Interest in Technology	1	4.26	.801
	2	4.32	.725
	3	3.73	1.202
Dependable	1	4.83	.375
	2	3.95	1.080
	3	4.30	.915
Cross-Training	1	4.30	1.054
	2	4.42	.809
	3	4.63	.615

Table - 5.4 Stages of Manufacturing Implementation

		Stages of Manufacturing					
		Planning and Preparation		Configuration/Implementation		Go-live/Post Go-live	
		Frequency	Percent	Frequency	Percent	Frequency	Percent
Cluster	1	44	73.3%	46	64.8%	0	0.0%
	2	9	15.0%	2	2.8%	49	100.0%
	3	7	11.7%	23	32.4%	0	0.0%
	C	60	100.0%	71	100.0%	49	100.0%

C- Combined

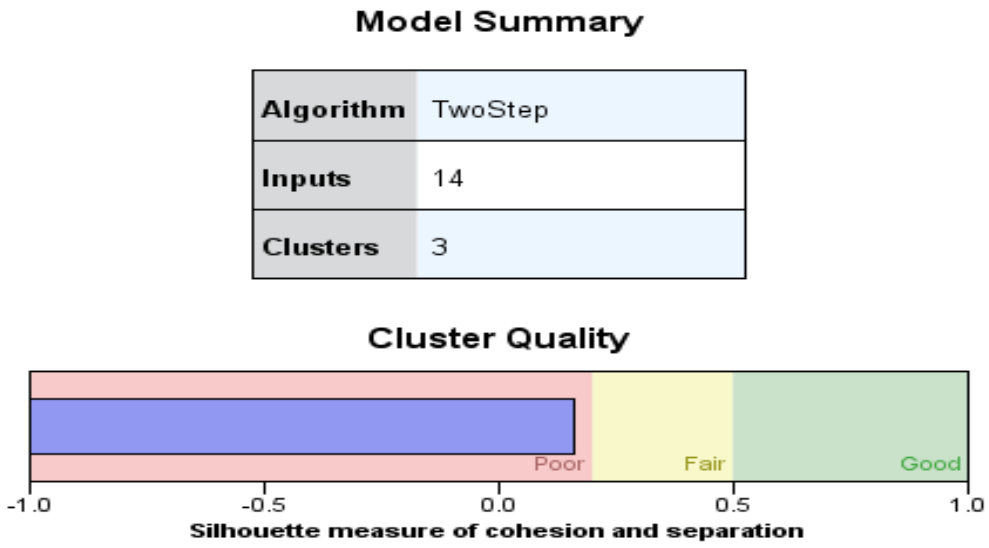

Figure - 1: Cluster Quality

Using the Two-Step Cluster Analysis procedure, have separated the stages of manufacturing implementation into three fairly broad categories. Planning and Preparation, Configuration / Implementation, Go-live / Post Go-live.

6. Suggestions and Conclusion

6S implementation is very useful and beneficial for a manufacturing company. Training is the 5 s key to success Samuel (1999) without proper training, the employees have not captured the 6S implementation properly and the manufacturing sector will perform a foremost role in driving growth. Internet of Things, expertise nowadays has the ability to renovate industry and make shrewd shops of the Future. 6S repetition is seen as a real technique that can advance housekeeping, environmental performance, health, and safety standards in the workplace. 6S practice and the reason given by them is the amount of time and money that would be required to implement the proposed activities in the 6S.

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