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ASSESSMENT OF THE IMPLEMENTATION OF VARIOUS CONTINUOUS IMPROVEMENT APPROACHES IN SME'S OF PUNJAB

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ABSTRACT

Continuous improvement strategies are the recognized way of making small incremental improvements in the manufacturing processes. Manufacturing organizations are implementing such strategies to enhance the performance of their manufacturing operations. Modern manufacturing system is still lacking in good technical and managerial skills required for implementing different continuous improvement strategies and are facing difficulties in implementing such strategies. This study attempts to assess the level of difficulties in implementing different continuous improvement strategies in SMEs (small to medium enterprises) of Punjab. Results indicated that the manufacturing enterprises are facing most difficulties in implementing strategies of total quality management and are facing least difficulties in implementing total productive maintenance strategies.

Keywords: *Continuous Improvement, Total Quality Management and Total Productive Maintenance.*

1. Introduction

Continuous improvement is a quality control term originated from Japan in 1950s and become popular worldwide. The term came from Gemba Kaizen in Japanese meaning "continuous improvement and perfection" [1]. Cua et al. [2] emphasized on Total Quality Management (TQM), Just-in-Time (JIT) and Total Productive Maintenance (TPM) and investigated the implementation and impact of these manufacturing programs in isolation. It has been found that there is evidence supporting the compatibility of the practices in these programs and that manufacturing performance is associated with the level of implementation of both socially- and technically-oriented practices of the three programs. Seth and Tripath [3] studied the strategic implications of TQM and TPM in an Indian manufacturing set-up and to detail literature reviews to highlight gap areas. To examine the relationship between factors influencing the implementation of TQM and TPM and business performance for the following three approaches in an Indian context: TQM alone; TPM alone; bothTQM and TPM together. This is done to extract significant factors for the above three approaches.

Malik and YeZhuang [4] performed a survey in 105 Spanish and 50 Pakistani companies to analyze the outcome of continuous improvement practices carried out in these industries. Twelve continuous improvement tools have been investigated. Result shows that Spanish industries utilize these tools more than Pakistani industries. Spanish industries are comparatively more experienced and advanced from Pakistani industries. Tseng et al. [5] investigated the effects of continuous improvement and cleaner production on the operational performance. A total of 223 responses have been obtained after the distribution of questionnaire. The direct and indirect influences of independent variables on dependent variables are tested by SEM (structural equation modeling) technique. Continuous improvement plays a significant role in cleaner production implementation.

Kikuchi et al. [6] aimed at applying OEE (Overall Equipment Effectiveness) method to cost reduction by using KAIZEN technique in a semiconductor industry. The consumption of gases and chemicals (GAC) for a specific process is very high. Two different methods of OCE (Overall Consumable Effectiveness) technique are adopted to reduce the consumption of gases and chemicals (GAC) for 12 items. Result indicates a cost reduction of 7% annually for GAC usage. Ahuja and Khamba [7] presented a review of literature on Total Productive Maintenance (TPM) and overview of TPM implementation practices adopted by the manufacturing organizations. The authors also highligted the important issues in Total Productive Maintenance ranging from maintenance techniques, framework of TPM, overall equipment effectiveness (OEE), TPM implementation practices, barriers and success factors in TPM implementation,

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etc. The contributions of strategic TPM programmes towards improving manufacturing competencies of the organizations have been highlighted in the paper. Chandrasekaran et al. [8] applied KAIZEN technique to solve the 'part mismatch problem' problems in automobile assembly production line. The various benefits that have been observed after implementing KAIZEN include elimination of major functional problem, reduction in quality rejections, and elimination of rework processes.

Singh and Khamba [9] have find out the extent of use of various advanced manufacturing technologies like Just in Time Manufacturing, CNC etc. in northern part of India's mechanical manufacturing industry. It has been found that CAD and NC/CNC/DNC machines are being used widely in design and fabrication related advanced manufacturing technologies respectively.

Modern manufacturing organizations are focusing towards increased profitability by improving the manufacturing system processes using management techniques like continuous improvement. These organizations are still lacking in technological and managerial skills required for identifying and implementing small incremental improvements in their manufacturing processes and there exist a level of difficulties in implementing different continuous improvement strategies. This paper investigates the level of difficulties of eight (8) CI strategies including Supplier Development, Process (JIT), People (Total Involvement), Total Quality Management, System (Support Core Work), Leadership, Total Productive Maintenance and Customer Relationship and also on the basis of sub-strategies of CI approach.

2. Research Design

2.1 Research methodology

The Research methodology used for the research work in the steps given below:

Step 1: Preparation of Questionnaire
Step 2: Pilot testing of Questionnaire
Step 3: Filling of Questionnaire
Step 4: Creation of Industry Database
Step 5: Statistical Analysis
Step 6: Results
Step 7: Conclusions

For this survey, a questionnaire has been designed which consists of two different section, first section consists of questions related to general organizational information, name and designation of respondent, Types of products manufactured, whether they are applying CI strategies or not. The measurement of other sections is done on five point Likert scale i.e. level of importance is determined on the scale (1=Not at all difficult, 2=least difficult, 3=Not so difficult, 4=Very difficult, 5=Most difficult. A total of 38 questions have been included in the questionnaire. The survey instrument is pre-tested for content validity and clarity by two experienced researchers and managers of an Industry. This process yielded a survey instrument that was judged to exhibit high content validity.

2.2 Data collection

The final structure questionnaire has been sent to 120 manufacturing organizations randomly selected from Punjab Industrial Directory. The Questionnaire has been sent to the companies via post, along with a cover letter and pre-paid reply envelope. A total of 45 responses have been obtained after the distribution of questionnaire to different manufacturing enterprises, representing a response rate of 37.5%. Survey suggests that 53% of the total manufacturing enterprises surveyed are applying continuous improvement strategies and 47% are not applying these strategies. Different types of manufacturing organizations have been surveyed based on the product manufactured including auto parts (58.33%), cycle parts (25%) and cold rolled products (16.67%). The majority of respondents of organizations include Management Representatives (20.8%), Managers (33.3%), Assistant Managers (8.4%), Senior Engineers (20.8%), and Engineers (16.7%).

3. Results and Discussions

3.1 Reliability analysis

Table 1: The Value of Cronbach Alpha

CI Strategies	Cronbach Alpha
Supplier Development	0.764
Process (Just in Time)	0.872
People (Total Involvement)	0.907
Total Quality Management	0.752
System (Support Core Work)	0.715
Leadership	0.868
Total Productive Maintenance	0.813
Customer Relationship	0.902

The reliability of all the constructs meets Terziovski's, [10] recommended standard (Cronbach Alpha $\geq$ 0.70) for early stage research as shown in Table1.

3.2 Analysis of eight (08) CI strategies

Sample size for this survey is 24. For small sample sizes, *t* distribution is applicable. For the analysis of data, student *t*-test has been applied. Analysis is done on the basis of eight (8) CI strategies and also on the basis of sub- strategies of CI. The level of difficulties has been calculated on the value of mean and the level of significance has been tested on basis of *t*-test. Table 2 shows the results of the student *t*- test for the eight (8) CI strategies.

Table 2: Results of the Student *t*- test for the Eight (08) CI Strategies

CI strategies	Mean	S.D	*t*-Statistics	Hypothesized Mean(μ)
Supplier Development	3.393939	0.926	1.973**	
Process (Just in Time)	2.945455	1.04	-0.263*	
People (Total Involvement)	2.857143	0.952	-0.724*	3.0042
Total Quality Management	3.409091	1.175	1.615*	
System (Support Core Work)	2.852273	0.977	-0.729*	
Leadership	2.924242	1.071	-0.350*	
Total Productive Maintenance	2.787879	0.968	-1.047*	
Customer Relationship	2.863636	0.978	-0.673*	

*Significant at 5% level *t*n-1(0.05) =1.72
**Significant at 1% level, *t*n-1(0.01) =2.52, ***Not Significant

3.3 Results of the Findings 1

The strategy "Total Quality Management" is rated most difficult (Mean=3.40909) and "Total Productive Maintenance" is rated least difficult (Mean=2.787879). The descending order of their difficulties follows Total Quality Management (Mean=3.409091), Supplier Development (Mean=3.393939), Process (Just in Time) (Mean=2.945455), Leadership (Mean=2.924242), Customer Relationship (Mean=2.863636), People (Total Involvement) (Mean=2.857143), System (Support Core Work) (Mean=2.852273), Total Productive Maintenance (Mean=2.78787).

3.4 Analysis of sub-strategies of CI

Table 3 shows the result of student *t*-test applied for different strategies in terms of eight (08) main CI strategies.

3.5 Discussion of the finding 2

The sub-strategy "Value Analysis" is rated most difficult (Mean=3.59) and "Total Cost Management" is rated least difficult (Mean=3.09) in terms of Supplier Development; strategy "Process Flow Analysis" is rated most difficult (Mean=3.045) and "Cell Formation" is rated least difficult (Mean=2.863) in terms of Process (Just In Time); strategy "Team based Improvement" is rated most difficult (Mean=3.136) and "Internal training and Monitoring" and "Self Discipline" are rated least difficult (Mean= 2.636) in terms of People (Total Involvement); strategy "5-S" is rated most difficult (Mean=3.5) and "Failure Mode Effect Analysis" is rated least difficult (Mean=2.636) in terms of TQM (Total Quality Management); strategy "Total Cost Management" is rated most difficult (Mean=3.227) and "Process Flow Mapping" is rated least difficult (Mean=2.590) in terms of System (Support Core Work); strategy "Policy Deployment" is rated most difficult (Mean=3.045455), and strategy "Vision Alignment and Direction" is rated least difficult (Mean=2.818) in terms of Leadership; strategy "Preventive Maintenance" is rated most difficult (Mean=2.818) and strategy "Minor Stoppage Elimination" is rated least difficult (Mean=2.272) in terms of Total Productive Maintenance (TPM); strategy "Customer Quality, Cost, Delivery Analysis" is rated more difficult (Mean=2.954) than strategy "Quality Function Deployment" (Mean=2.772) in terms of Customer relationship.

4. Conclusions

Results of investigation demonstrate that the manufacturing enterprises in Punjab are facing most difficulties mostly in implementing management approach centered on Quality (TQM). These enterprises are facing least difficulties in managing the financial outcomes of all the activities, in terms of Supplier Development; Checking the step-by-step flow of a process by tracking the flow of material is most difficult and grouping of the products having similarities in their design and manufacturing is least difficult in terms of Process (Just In Time); manufacturing organizations are facing most difficulties in making improvements on the

collective team effort basis and are facing least difficulties in giving team training to the employees and

Table 3: Results of Student t-test

Strategies	Sub-Strategies	Mean	S.D	*t*-Statistics	Hypothe-sized Mean(μ)
Supplier Development	Total Cost Mgt	3.09	0.97	-1.463*	3.393
	Value Stream Analysis	3.5	0.74	0.672*	
	Value Analysis	3.59	1.00	0.916*	
Process (Just in Time)	Process Flow Analysis	3.045	1.09	0.43*	2.945
	Cycle Time Reduction	2.954	0.99	0.042*	
	Material and Information Flow	2.954	1.09	0.039*	
	Theory of Constraints	2.909	0.97	-0.175*	
	Cell Formation	2.863	1.16	-0.328*	
People (Total Involvement)	Principles of KAIZEN	3.045	0.99	0.884*	2.857
	Internal Training and Monitoring	2.636	0.95	-1.086*	
	Self-Discipline	2.636	0.95	-1.086*	
	Suggestion System	2.772	0.97	-0.407*	
	Manager Development	2.818	0.90	-0.201*	
	Small Group Activities	2.954	0.89	-0.508*	
	Team based Improvement	3.136	0.99	1.322*	
Total Quality Management (TQM)	5S	3.5	1.26	0.337*	3.409
	Error Proofing	3.408	0.85	-0.055*	
	Analysis Six Sigma	4.181	1.00	3.601***	
	Failure Mode Effect Analysis (FMEA)	3.318	1.12	-0.377*	
	Casual Analysis	2.636	1.13	-3.191***	
System (Support Core Work)	Support and Administration	2.727	0.70	-0.834*	2.852
	KAIZEN				
	Process Flow Mapping	2.590	0.95	-1.278*	
	Total Cost Management	3.227	1.15	1.526*	
	Finance	2.863	1.13	0.053*	
Leadership	Vision Alignment and Direction	2.818	1.13	-0.436*	2.924
	Policy Deployment	3.045	0.99	0.569*	
	Recognition	2.909	1.10	-0.064*	
Total Productive Maintenance	Preventive Maintenance	2.818	1.05	0.135*	2.787
	Equipment Restoration	2.772	0.97	-0.073*	
	Minor Stoppage Elimination	2.272	0.92	-0.077*	
Customer Relationship	Quality Function Deployment	2.772	0.92	-0.462*	2.863
	Customer Quality, Cost, Delivery Analysis (QCD)	2.954	1.04	0.407*	

*****Significant at 5% level, *t*n-1(0.05) =1.72, ***Not Significant,
**Significant at 1% level, tn-1(0.01) =2.52

maintaining self-discipline in terms of Process (Just in time); managing control on 5-S activities is most difficult and determining the potential modes of failure is least difficult in terms of Total Quality Management; manufacturing organizations are facing difficulties mostly in managing the financial outcomes of activities or managing all types of costs and Elimination of the workplace waste, inconsistencies and irrationalities by preparing flow charts is least difficult in terms of System (support core work); effective deployment of policy goals in the organization is most difficult and aligning the workforce with the continuous improvement activities and communicating a vision and

clear goals of achieving continuous improvement is least difficult in terms of Leadership; manufacturing organizations are facing difficulties mostly in preventing failures before it occurs and elimination of minor stoppages occurring at time to time are least difficult in terms of Total Productive Maintenance; and manufacturing organizations are facing most difficulties in developing the key performance indicators through continuous feedback from the customer and are facing least difficulties in translating the customer requirements at the design stages of the product in terms of Customer Relationship.

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