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Role of Quality Management success factors for enhancing the performance of SMEs of Northern India-An Empirical Investigation

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Abstract

Total Quality Management is a management approach of enhancing processes by reducing defects in operations. This study attempts to access the significant barriers, benefits and initiatives of TQM approach using interpretive structural modeling (ISM), options field methodology (OFM), options profile methodology (OPM), analytic hierarchy process (AHP) and Fuzzy Set Theory (FST). Results of investigation demonstrated that all the barriers of TQM approach affect the performance of manufacturing SMEs. TQM approach significantly aimed at improving the performance of manufacturing operations of SMEs. TQM approach through effective process planning of manufacturing operations aimed at improving the performance of SMEs. Moreover Structural Modeling shows significant relationship between enablers of TQM approach in improving firm performance.

Keywords: *TQM, Lean Manufacturing, Manufacturing Strategy, Questionnaire, Structural Equation Modeling.*

1. Introduction

Improving customer service, making operation faster, more operation and reduction in costs are challenges faced by manufacturers today. To meet these challenges many companies in India searching to improve their ability to compete globally. Wastage during production process is rapidly growing day by day in industries. This is because of change in taste of the customer. This will lead to increase in production costs. There are different techniques of waste reduction and performance enhancement like Just In Time (JIT), Total Quality Management (TQM), Total Productive Maintenance (TPM), Continuous Improvement etc. (Gautam et al.). Manufacturing Industries are under increasingly diverse and mounting pressures due to more sophisticated markets, changing customer choice and global competition. The market for products is becoming increasingly international (Dangayach and Deshmukh, 2003). They must understand how changes in their competitive environment are unfolding. Industries should actively look for opportunities to exploit their strategic abilities, adapt and seek improvements in every area of the business, building on awareness and understanding of current strategies and successes. Accordingly, measures of modern quality management aiming for sustainable success do not only mean to avoid the delivery of defective products to the customer but seek to establish maximum efficiency in the performance of all processes of the company. With such optimized procedures, products of high quality can be provided with minimum effort of time and costs. Global competition has increased during the past few decades, since the quality of goods is determined by customers thus customers are the only factor that can create competition among organizations. Further, this makes factories to focus more on quality. Nowadays, gaining competition has become a matter of knowing customers' needs and wants. In fact, customers have become the starting point rather than the end point in any successful business. Manufacturing organizations in order to survive need to create new management based on total quality management (TQM) (Dale and McQuater, 1998).Black and Porter (1996) conducted a study to determine the TQM critical success factors using members of the European Foundation for Quality Management. The Authors determined that TQM critical success factors were: people and customer management, supplier partnerships, communication of improvement information, customer satisfaction orientation, external interface management, strategic quality management, teamwork structures for improvement, operational quality planning, quality improvement measurement systems, and corporate quality culture. Sohal and Terziovski (2000) discussed the trends in adoption of quality management practices in Australian manufacturing industry and highlight some of the barriers to the adoption of such factors that are considered to be critical to adoption of TQM in Australian manufacturing. The longitudinal quantitative and qualitative results show that TQM is largely implemented in manufacturing function with little progress in other functional areas. Based on the results of surveys and the case study research, numerous factors critical to success are identified that includes positive attitude towards quality, leadership education and training, Integrating the voice of the customer and the supplier, and developing appropriate performance indicators and rewards. It is concluded that there is no single best approach to implementing the TQM philosophy. Motwani (2001) found seven critical success factors for TQM implementation after examining six empirical studies. He recommended that attention should be given mostly to these five constructs: top management commitment, employee training and empowerment, quality measurement and benchmarking, process management, and customer involvement and satisfaction. According to Tsang and Antony (2001), 11 critical success factors for the successful implementation of TQM in the UK service sector are: customer focus, continuous improvement, teamwork and involvement, top management commitment and recognition, training and development, quality systems and policies, supervisory leadership, communication within the company, supplier relationship and supplier management, measurement and feedback, and cultural change in employees' behaviors and attitudes. Walsh et al. (2002) examined the practices of total quality management philosophy within companies operating in Ireland. The main objective of the study is to establish whether or not, TQM philosophy is suitable for adoption by organizations. The study is quantitative in nature and is based on the findings of two research questionnaire. Data from the research indicated that TQM activities are practiced throughout Irish Industry. Many organizations have adopted TQM activities for the long term. It is concluded that TQM philosophy is suitable for adoption by organizations operating in Ireland and that a TQM approach offers these organizations as a platform for developing strategies that guarantee competitiveness and success. Tahla (2004) defined TQM philosophy as management technique focused on customer relations. All the members of TQM organization strive to systematically manage the improvement of the organization through the ongoing participation of all employees in the manufacturing industry; product quality has become a key factor in determining a firm's success or failure in the global market place. Today's competitive market, in almost every category of product and services, is characterized by accelerating change, innovation and massive amount of new information. Most organizations that have been successful with their quality improvement efforts have adopted an integrated approach commonly referred to as TQM. Bhat and Rajashekhar (2009) identified the barriers of total quality management (TQM) implementation, in order to make them known to the managers of Indian industries. In order to achieve this objective, an extensive literature review has been carried out to understand the barriers to TQM implementation. This was followed by a survey of quality award winning industries in India. A total of 41 completed questionnaires were received and the overall response rate was 31 percent. The findings of this survey suggest that the most important TQM barriers in Indian industry are: "no benchmarking of other company's practices" and "employees are resistant to change". Factor analysis of the 21 potential barriers to TQM implementation revealed the following five underlying constructs including lack of customer orientation, lack of planning for quality, lack of total involvement, lack of management commitment, and lack of resources. The findings based on this empirical research present a solution to the difficulties faced by the managers while implementing TQM effectively in their industries.

2. Research Methodology

The study has been carried out in Indian manufacturing SMEs that have successfully implemented TQM methodology. The objective of the study is to investigate the contributions of TQM initiatives towards realization of manufacturing benefits. The study involves investigation of barriers in successful TQM approach in the manufacturing enterprises. The approach has been directed towards justification of implementing TQM initiatives for its support to manufacturing organization. The methodology employed in the present study has been depicted in Figure 1.

To ensure the relevance and effectiveness of the questions to manufacturing industry, the questionnaire has been pre-tested on a representative sample of industry.

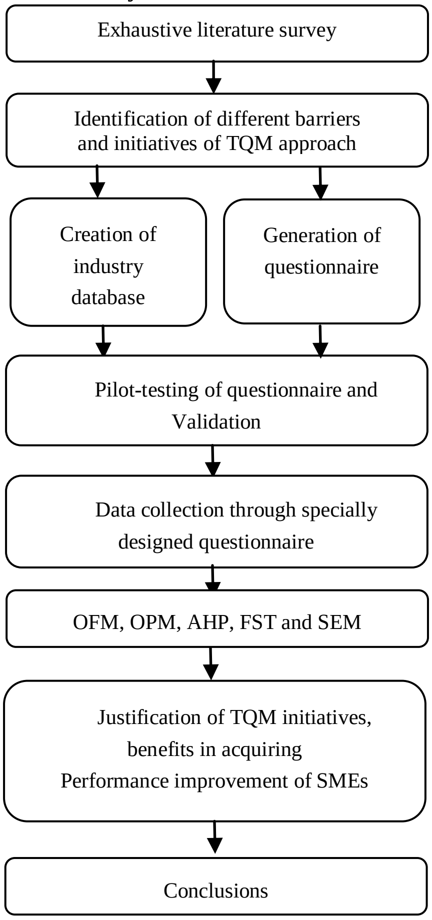

Figure 1: Methodology employed for the study

. The suggestions from peers, consultants, TQM councillors, senior executives from industries and academicians have been incorporated to make the questionnaire relevant to the purpose and bring out key outcomes as a result of strategic TQM implementation. The final structured questionnaire has been sent to 250 manufacturing organizations randomly selected from among the membership of the confederation of Indian Industry (CII) and Directorate of Industries. The Questionnaire has been sent to the companies via post, along with a cover letter and pre-paid reply envelope. Various efforts, for examples follow-up telephone calls and faxes as well as personal connections have been employed to encourage respondents to complete and return the questionnaires. The TQM questionnaire serves the purpose of revealing exploits of Indian entrepreneurs with TQM barriers and highlights the contributions of TQM initiatives realizing the firm performance and objectives. In this study, a reasonably large number of manufacturing organizations (101 organizations representing high response rate) have been extensively surveyed. The four point likert scale have been employed in the survey (Barriers on 1=Not at all important, 2=Neutral, 3=Important, 4=Most Important; Benefits on 1=Nominal Gain, 2=Reasonable Gain, 3=High Gain, 4=Extremely high Gain; Initiatives on 1=Disagree, 2-Neutral, 3=Agree, 4=Strongly Agree).

2.1 Respondent Characteristics and Types of Organization Surveyed

The breakdown of responses and types of product manufactured by the organizations is shown in Table 1.

Table 1 Breakdown of responses by the organizations

Type of Company	Small Scale(53)	Medium Scale(48)
	53/101= 52.48%	48/101= 47.52%
Type of Products Manufactured		
Auto Parts	43/101 = 42.58%	
Cycle Parts	17/101 = 16.83%	
Casting Components	3/101 = 2.97%	
Multi Products	9/101 = 8.91%	
Tubes, Rods, pipes, bars, rolled products	14/101 = 13.86%	
Machine Tools	2/101 = 1.98%	
Sheet Metal Components	5/101 = 4.95%	
Fasteners	4/101 = 3.96%	
Hand Tools	4/101 = 3.96%	

Most of the respondents to 'Questionnaire' belonged to the top brass of management executives that included several Managing Directors, Partners, Proprietors, Managers of Different Departments, Senior Engineers, Engineers, Management Representatives, Heads of different Departments, secretaries etc. The responses thus received have been compiled and analyzed critically to ascertain the performance of the Indian Industry regarding various TQM related initiatives. The study employs various modeling tools for extracting significant factors contributing effectively towards realization of manufacturing performance.

2.2 Interpretive Structural Modeling

For analysing the criteria a contextual relationship of "leads to" is chosen. This means that one criterion leads to another. Based on this contextual relationship, a SSIM has been developed. To obtain consensus, the SSIM was sent to five experts. Based on their responses, the SSIM has been modified as shown in Table 2 For analyzing the factors in developing SSIM, the following four legends have been used to denote the direction of relationship between barriers (i and j): O - Factor i and j are unrelated; X - Factor i and j will help to achieve or exceed each other; Y - Factor i will help to achieve or exceed barrier j; and Z - Factor j will help to achieve or exceed barrier i.

Table 2: Distribution of samples and respondent rate of industries.

City	Sample Size	Number of industries respond	(% of total)
Ludhiana	75	19	40%
Jalandhar	33	11	40%
Phagwara	32	9	40%
Total	140	39	

2.2 Selection of parameters

After studying previous research works, Brainstorming and Industrial & academicians experts improvise, 09 parameters (new technology) were selected which effect the casting process and 06 defects were identified which affect the quality and productivity of casted products

2.3 Design of questionnaire

A pilot survey study was done with the help of industry professionals and researchers to inspect the content validity of the questionnaire. The 5-point Likert scale was applied to gather the data.

2.4 Data Collection

The final questionnaire was sent randomly to 140 auto parts manufacturing Industries. The gentle follow up, and personal visit to few Industries was also made to collect the data. Most of the respondent's position belongs to the upper level of administration that comprised executives, general managers, directors etc. The surveys having incomplete information and more than one response from an industry were dropped and finally, the survey involved, a total of 39 questionnaires collected from different auto parts manufacturing Industries. The response rate was 29 %, Out of these 19, 11 and 09 from Ludhiana, Jalandhar, and Phagwara respectively.

2.5 Testing of normality

The normality of collected data should be checked, before an investigation of data to examine distribution pattern of data (Kuo et al., 2009). skewness and kurtosis values are used to check the normality of data, the acceptable range of univariate skewness <3 and kurtosis <10 (Hair et al., 2010). The values of skewness and kurtosis of all collected data fell within the adequate range

2.6 Design Validation

Cronbach's alpha test was applied to 39 industries. The acceptable range of Cronbach's alpha coefficient for the valid questionnaires should be in the range of 0.7-1. In the present work, this range was 0.785, which was acceptable. SPSS 20 software was used to validate the current data.

3. Data Analysis and Discussions

3.1 Type of Industries

Table 3 shows the type of Auto parts industries in Ludhiana. 36 percent industries were small scale industries and 31 percent industries were medium scale.

Table 3: Type of industries

Industry type	Percentage of Industries
Micro Scale	31
Small Scale	33
Medium Scale	36

3.2 Number of Employees

Table 4 displays the number of personnel employed in enterprises. Out of total 69 percent industries having less than 300 employees and 8 percent have more than 1500 employees.

Table 4: Employees working in industries

Number of Employee	Percentage of Industries
<300	69
301-800	20
800-1500	3
>1500	8

3.3 Market Channel

Table 5 shows about the Market channel of various industries out of total 77% supply products in local market and 23 % export the products.

Table 5: Market Channel

Market Channel	Percentage of Industries
Domestic	77
Export	23

3.4 ISO-9000 certified

Table 6 shows Majority of the industry have quality conscious and have quality certification. Out of total 89% industries have ISO certification and 11 % don't have.

Table 6: ISO certification

ISO-9000 certified	Percentage of Industries
Yes	89
No	11

3.5 Awareness in Casting/Foundry Technology

Figure 2 shows about the awareness in Casting/Foundry Technology. Likert scale was used for checking the awareness level in Casting/Foundry Technology achieved by industries ranging from not at all as 1 to a large extent as 5.

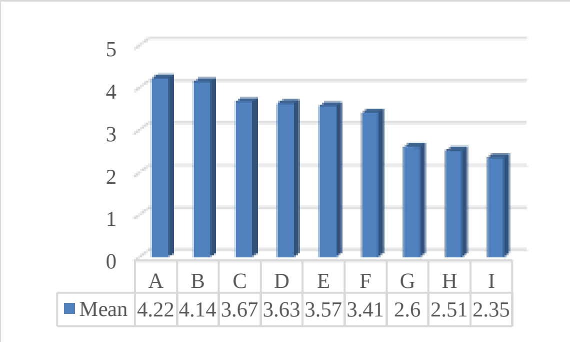

Fig.2 Awareness in Casting/Foundry Technology

On the basis of these findings the parameters can be ranked in Table 7 according to their importance. It shows that majority of MSMEs are aware of Indian Standard for casting materials (ferrous & Nonferrous) and less aware of Standardization of open tolerances.

Table 7: Ranking of awareness level Casting/Foundry technology

Code	Casting/Foundry	Mean
A	Indian Standard for casting materials (ferrous & Nonferrous)	4.22
B	Testing of sand and mould	4.14
C	Spectrometric of control of casting	3.67
D	Microstructure of control of casting	3.63
E	Temperature control of molten metal at the ladle level	3.57
F	Mechanical testing of casting	3.41
G	Furnaces temperature controlled	2.60
H	Centrifugal casting technology for nonferrous casting	2.51
I	Standardization of open tolerances	2.35

3.6 Defects in the casting

Figure 3 shows about casting which causes rejection in casted products. Likert scale was used for checking the rejection level in Casting/Foundry Technology achieved by industries ranging from 1-5 percent as 1 to 20-25 percent as 5.

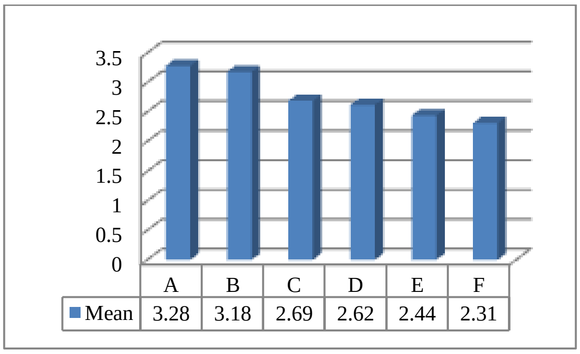

Fig. 3 Defects in the casting

On the basis of these findings the parameters can be ranked in Table 8 according to their importance. Major defects faced by MSMEs are blow holes/pinholes and less occurred defect are defects on parting line.

Table 8: Defects in the casting

Code	Casting/Foundry	Mean
A	Blow holes/pinholes	3.28
B	Chilled surface	3.18
C	Surface finish	2.69
D	Defects on parting line	2.62
E	Hardness	2.44
F	Shrinkages	2.31

3.7 Significant difference in the level of technology awareness and defects occurred in the casting

For finding the significance difference between and within group's One way ANOVA test was used. Three hypothesis were set for checking the awareness level of technology between MSMEs, Which the given below:

Ho = There is no significance variance of technology awareness between MSMEs.

H1 = There is significance variance of technology awareness between MSMEs.

H2 = There is significance variance of occurrence of casting defects among MSMEs.

Ho will be accepted if the significance value is larger than .05 and H_1 and H_2 will be accepted if the significance value is less than .05.

3.8 Significant difference in the level of technology awareness in MSMEs

ANOVA test shows the significant parameters for Casting/Foundry Technology Awareness. Out of the 9 technology attributes 5 were showed significant difference in the level of awareness. These are 1. Furnaces temperature controlled, 2. Temperature control of molten metal at the ladle level, 3. Standardization of open tolerances, 4. Microstructure of control of casting, 5. Centrifugal casting technology for nonferrous casting.

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3.9 Significant difference in the defects occurred in the MSMEs

All the parameters are Significant for Casting/Foundry defects.

3.10 Student Newmann keuls[ab] Test

After finding the significant factors, Student Newmann Keuls test was applied to find that where the significance difference arises. Only on significant factors this test was applied. The subset columns shows the average values of enterprises. If all the values are in same column it represents that there is no statistically variance if the values are in different columns then there is statistically variance between them. The value of a (harmonic mean) for casting is 12.949 Value of b = Group sizes are not identical and harmonic mean of size is used.

3.11 Comparison of casting technology awareness

This test was applied to the 5 casting/foundry technology attribute to see the level of awareness in the MSMEs. Lowermost average value is signified on topmost of the table while utmost at bottommost of the table. First of all applied in the temperature controlled furnaces whose results are shown in table 9.

Table 9: Result of temperature controlled furnaces

Type	N	Subset for alpha = 0.05	
		1	2
Micro-Scale	12	1.88	
Small-Scale	13	2.25	
Medium-Scale	14		3.00

Medium scale enterprises have maximum awareness of temperature controlled furnaces with average value 3.00 however micro scale enterprises have minimum awareness with average 1.88. Similarly same examination was applied to other significant elements. The mean values of all the factors are shown in figure 4.

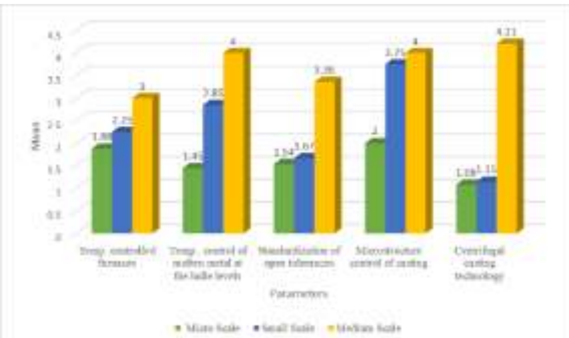

Fig.4 Comparison of casting technology awareness

Figure 4 shows the following results:

1. Most common awareness in micro scale industries are Microstructure control of casting with mean value 2.00, Temp. controlled furnaces with mean value 1.88 and Standardization of open tolerances with mean 1.54.
2. Most common awareness in small scale industries are Microstructure control of casting with mean value 3.75, Temp. control of molten metal at the ladle levels with mean value 2.85 and Temp. controlled furnaces with mean value 2.25.
3. Most common awareness in medium scale industries are Centrifugal casting technology with mean value 4.21, Temp. control of molten metal at the ladle levels with mean value 4.00 and Microstructure control of casting with mean value 4.00.

3.12 Comparison of casting defects

Comparison of defects faced in the casted products by industries, from the Student Newmann Test is shown figure 5.

Fig.5. Comparison of casting defects faced by Industries

From the figure 5 following three results were observed:

1. Most common defects in casting process faced by micro scale industries are chilled surface with mean value 4.25, blow holes/pin holes with mean value 4.17 and parting line with mean 3.70.
2. Most common defects in casting process faced by small scale industries are blow holes/pin holes with mean value 3.54, chilled surface with mean value 3.40 and surface finish with mean value 3.38.
3. Most common defects in casting process faced medium scale industries are parting line with mean value 1.79, chilled surface with mean value 1.69 and hardness with mean value 1.64.

4. Conclusions

India is in the process of improving its economy through its prosperous MSMEs. These enterprises need to introduce new technologies in their industry processes, especially in their manufacturing activities. The current research findings can also contribute to the development of MSMEs casting technology awareness in other developing countries. This study introduces the new age and explores the casting technology awareness levels and defects faced by MSMEs of northern India.

Majority of the Casting/Foundry industries are aware of Indian Standard for casting materials (ferrous & Nonferrous).

Most common defect faced by industries are blow holes/pin holes in the casted products.

Awareness about Casting/Foundry technology by MSME’s are:

Micro scale: Microstructure control of casting, Temperature controlled furnaces and Standardization of open tolerances.

Small scale: Microstructure control of casting, Temperature control of molten metal at the ladle levels and Temperature controlled furnaces.

Medium scale: Centrifugal casting technology, Temperature control of molten metal at the ladle levels and Microstructure control of casting.

Defects faced by MSME’s are:

Micro scale: Chilled surface, blow holes/pin holes and parting line.

Small scale: Blow holes/pin holes, chilled surface and surface finish.

Medium scale: Parting line, chilled surface and hardness.

The main drawback of this study derives from the different types of requirements for new technology awareness. Future research should expand this study to other type of manufacturing technology like forging, machining, heat treatment etc. Finally, MSME atmospheres may vary through different nations. Thus, future research should make cross-country relationships to improve the generalizability of this study.

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