

Modeling and Analysis of Productivity Issues in Automotive Sector Manufacturing Companies: Survey

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ABSTRACT

It is well known that entry of multinational automakers and economic reforms promoted development of automotive industry in recent years and increased competition in the form of wide variety of product. To succeed under such competitive environment, companies are enforced to adopt efficient ways for their operations. Industries are trying hard to increase value of their products by improving productivity. Present study assesses the status of Productivity related issues through an extensive survey conducted among the automotive sector manufacturing companies. Statistical analysis of the survey responses indicating the usefulness of the findings to the firms in regard of Productivity Improvement Techniques implementation is also presented. In all 154 valid responses have been obtained and in reliability analysis of responses, Cronbach's alpha values between 0.711 and 0.887 are obtained. It is clear from the statistics that productivity awareness is highest for Top Manager and that of supporting staff is least, hence supporting staff need to be trained. Analysis also represents Customer Satisfaction; Employee satisfaction and Marketing Management play a vital role for productivity improvement in industries. Crosstab analysis of Top Manager with Marketing Management, have indicated that almost 40% companies have applied Marketing management as a tool for productivity improvement.

Keywords: automotive industry, customer satisfaction, productivity improvement, statistical analysis, survey

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INTRODUCTION

Manufacturing companies all around the world are facing tremendous competition in terms of improved quality of products and better service [1]. Automotive sector manufacturing companies are also sailing in same boat of global competition. In this situation, companies are bound to improve productivity to survive in challenging global market. In 1990s industries around the world added the capacity in response to increased demand which translated into increased competition [2]. And it forced companies to reduce costs of product and services by improving productivity. Productivity is the key to success and growth in every industry. Some

researchers note that growth in productivity is the only plausible route to increase the standard of living and is therefore a measure of welfare [3]. The relevance of growth is less meaningful if it has not affected productivity and hence the standard of living. Essentially the focus is on enhancing productivity to meet the competition on relevant cost, quality and flexibility issues.

Automotive sector manufacturing companies play a key role in both developed and developing economies [4]. India is no exception and automotive sector occupy a prominent position in planned development of economy.

Increasing competition due to globalization has pushed this sector to grapple with the changing needs of their customers. According to Society of Automotive Manufacturers (SIAM), India emerged as Asia's fourth largest exporter of automobiles, behind Japan, South Korea and Thailand. The growth trend was for Two Wheelers- 32.31%, Commercial Vehicle -19.10% and Passenger Cars grew by - 19.10%. Hyundai remained the top

exporter in fiscal 2015. The automobile industry in India saw a growth in sales of 13.11% for the February 2016 compared to same month last year. The market has ultimately recognized car demand in India and hence, it is manufactured accordingly. Market Sales Trend of Cars in India are represented in Figure 1 (source:www.team-bhp.com), which indicate that Maruti Suzuki is having highest sales.

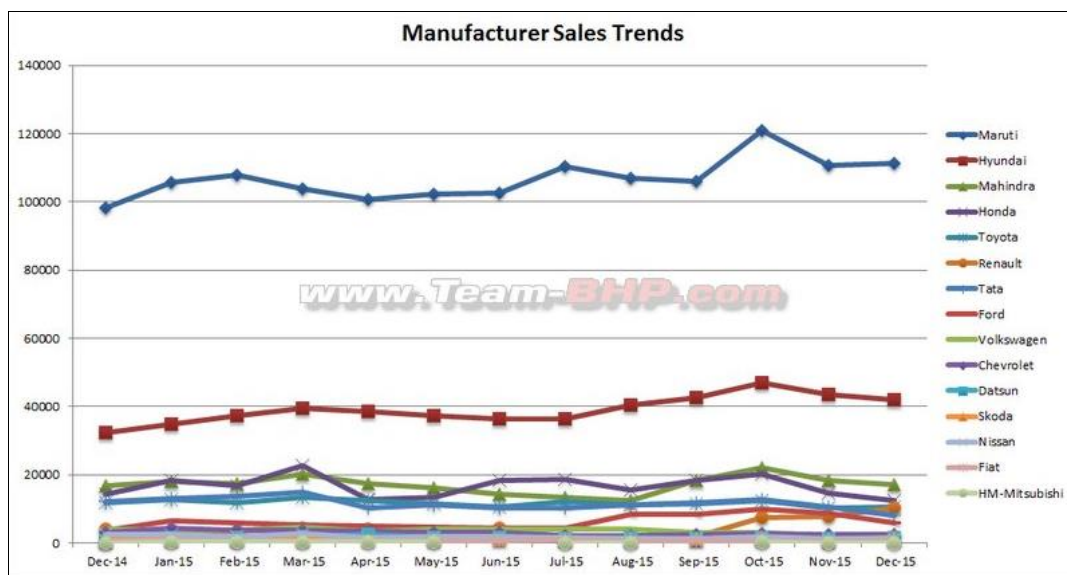


Fig. 1. Market sales trend of cars in India (source: www.team-bhp.com).

Literature specify that automotive manufacturing companies are fairly developed one, involve considerable investments in research and development, this sector is seen as an indicator of the economic progress of the country and most significantly facing huge competitions from foreign industry. In industrial perspective, automotive sector manufacturing companies play a major role in economy. Hence this sector is taken up for present study. To sustain their role in economic development, they need to analyse their existing productivity improvement strategies and adopt all means improve productivity. For the research survey questionnaire shall be framed and administered in companies,

responses shall be analysed statistically to give suitable recommendations useful for these industries. The research is focusing on following issues:

- Productivity awareness status of workforce in industries
- Existing productivity measurement technique implemented in industries
- Productivity improvement practices in industries
- Factors affecting productivity in industries

With the help of surveys and statistical modelling, research had analysed how the implementation factors and productivity are associated. The survey questionnaire contains 3 sections. Section 'I' contains

questions, pertaining to Company Information and section 'II' is related to assessment of Existing Productivity Improvement techniques and productivity measurement practices followed in the industry. Section 'III' contains questions related to main factors affecting productivity. After conducting the survey statistical analysis has been done in SPSS (version 20). Findings are of use for manufacturing industry to respond

proactively to emerging challenges posed by an increasingly complex, interdependent and changing world.

PRODUCTIVITY MEASUREMENT AND IMPROVEMENT: LITERATURE REVIEW

Productivity is generally defined as the relationship between input and output [5].

$$\text{Productivity(P)} = \text{Output(O)} / \text{Input(I)}$$

Table 1. *Conceptual analysis of studies for productivity improvement techniques.*

Concept	Authors
Study examines the methods to deal with "productivity" and "performance", indicating that terms used in these fields are often vaguely defined and poorly understood.	Tangen [2]
This Edition of Operations Management features the latest concepts and applications without losing focus on the core concepts.	Stevenson [4]
This study establishes that till 1980s knowledge about testing grounds of productivity as TFP was limited.	Balakrishnan and Pushpangadan [16]
To listen to many economists and policymakers, discuss the economics of growth it would be easy to be confused by the terms: competitiveness and productivity.	Atkinson [17]
The paper computes the TFP growth of Indian manufacturing for both formal and informal sectors from 1994-95 to 2005-06.	Kathuria et. al. [18]
"The single greatest challenge facing managers in the developed countries of the world is to raise the productivity of knowledge and service workers," writes Drucker.	Drucker [19]
The Doctoral thesis explained productivity improvement as a Method to Support Performance Improvement in Industrial Operations.	Grunberg [20]
Productivity Improvement in Ethiopian Garment Industry through Efficient Maintenance Management is described in this Master thesis.	Miskir [21]
Productivity, quality and flexibility are critical measures of manufacturing performance for justifying the investment in integrated manufacturing and production systems. The research quantified and incorporated these three measures.	Young and Park [22]
The paper outlines a framework for productivity analysis which enables both partial and total input productivities to be identified in terms of money values and their real (volume) and unit value (terms-off trade) components.	Bennett et. al. [23]
In this paper, the details of the sensitivity analysis of the factors considered in the Ray-Sahu model of productivity measurement for multi-product manufacturing firms have been provided.	Ray and Sahu [24]
The main focus of this paper is on integrating various functional groups of a manufacturing organization and highlighting the role of new manufacturing concepts and technologies in such integrations.	Gunasekaran et. al. [25]
The economic measure (productivity) and the technical measure (transformation factor) have been used to design a new bottling line in practice.	Ad J. de Ron [26]
In this paper researcher have proposed a general definition of the concept of flexibility and analyse its relationship with the productivity concept departing from a basic economic-theoretic point of view.	Robert W. Grubbstrm, Jan Olhager [27]
This paper explores value efficiency in competitive manufacturing industries. The emphasis and viewpoint is industrial strategy.	Eero Eloranta, Jan Holmstrijm [28]
This research attempts to: define and measure the concept of fit as it, applies to operations strategy; show how fit leads to better performance and investigate the inter relationship between fit, business strategy, productivity, and performance.	Smith and Reece [29]
This paper focuses on gaining insight into the impact of TQM on the business performance of the service sector. The study yields clear evidence that TQM implementation improved business performance in the service sector of Singapore.	Shaukat et. al. [30]

This paper surveys and evaluates recent empirical work addressing the question of <i>why</i> businesses differ in their measured productivity levels.	Chad Syverson [31]
Key performance indicators are found to affect the productivity of manufacturing organizations, but quality and productivity plays main part in establishing Total Quality Model (TQM).	Syed et. al. [32]
This study provides a basis on how policies can be designed for enhancing the total factor productivity growth of the informal sector.	Indrajit Bairagya [33]
In this paper detailed implementation of TPM in the cold rolling plant is discussed.	Dogra et.al. [34]
The purpose of this paper is to examine the relationship between management education, the performance of German engineering enterprises and the strategic knowledge status of the executives running those enterprises.	Robert et.al. [35]
The production dice game is a powerful learning exercise focusing on the impact of variability and dependency on throughput and work-in-process inventory of flow lines.	Marc et.al. [36]
Thus, the purpose of this work is to propose improvement areas in the industry to improve its productivity by analysing the problems associated with it.	Parthiban and Raju [37]
Effective utilization of workforce is a primary objective for any manufacturing organization is no exception to this. In-fact, considering the significant environmental and safety risks associated, it becomes imperative to deploy the right number of associates in the plant and at appropriate locations.	Gupta and Chandrawat [38]
This paper presents conceptual analysis of the six most common used lean principles in their manufacturing and applicability to service context for different types of services.	Carlborg, et.al. [39]
Primary aim of our project is to improve the productivity and the reduction in job manufacturing cost. Our project is basically study based project.	Priti Mandwe [40]
This paper reviews the broad contours of total factor productivity (TFP) growth in the U.S. economy since 1870, highlighting the contribution of various technological innovations to the growth of different sectors of the economy. Also notes the correlation between TFP growth and improvements in general health and well-being.	Robert Shackleton [41]
The objectives of this paper are to study and evaluate processes of the case organization, to find out current sigma level and finally to improve existing sigma level through productivity improvement.	Kabir et al. [42]
The purpose of this paper is to examine the extent of total quality management (TQM) practices implemented in Palestinian hospitals and their relationship to organizational performance using the Malcolm Baldrige National Quality Award criteria.	Sabella et al. [43]

Research studies carried out so far indicated that productivity improvement play key role in survival of the industry. Some of the reasons for not using productivity improvement in industries include shortage of human and capital resources, lack of strategic planning, misconception of the benefits and an overall technical orientation [6-15]. Traditional mindset does not allow industrialists to invest their resources much in productivity improvement techniques. There are several other reasons which encouraged our interest towards this study in automotive sector manufacturing industry, these are:

- The high number of manufacturing industry in this sector

- Absence of clear strategic expectation
- Non-holistic thinking of managers about productivity related issues

In the light of above facts, it can be concluded that there are ample chances of carrying out a study in this field.

RESEARCH METHODOLOGY

This study is covering both primary and secondary data. Primary data are collected by distributing questionnaire to the officers and employees of the industry under study and secondary data from various journals, articles, websites, dissertation and thesis pertaining to the subject under study. Case studies and survey remain one of the best ways to make sure that researchers are making valid observations and contributions to the body of operations

management knowledge [44]. Case-based research represents the intersection of theory, structure and events [45]. Mathematical modelling has proved to be

a scientific approach that attempts to ground theoretical concepts in reality [44]. Flow chart of the research methodology is shown in Figure 2.

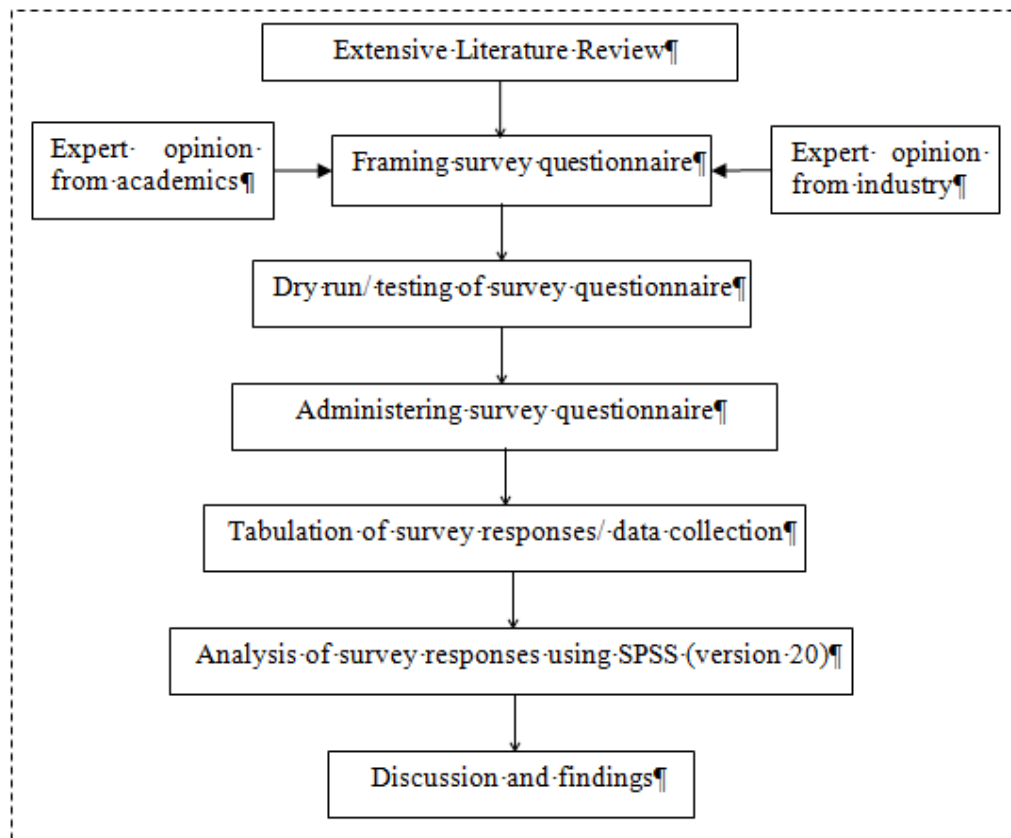


Fig. 2. Research methodology.

Based on the literature, survey questionnaire was designed [46–49]. The questionnaire has been developed on a five-point Likert scale. Various issues related to productivity measurement and improvement has been incorporated relevant to automotive sector manufacturing companies. The questionnaire contained 3 sections. To assess content validity a “dry run” was made and few questionnaires were administered to three leading practitioners, one academicians and two consultants. Based on their suggestions present form has been evolved and final questionnaire was sent to 400 companies. After phone calls, personal visits, e-mail, reminders and re-reminders, 154 filled responses have been received, which gives 38.5%

response rate. In our survey majority of respondents were of CEO or Works Manager level and thus appropriate for research questions. To reduce sampling error, a random sample of 400 companies was drawn and response rate was higher than 20% which is considered to be adequate as suggested in literature [50]. Research methodology is represented in the flow chart shown in the Figure 2.

After conducting the survey statistical analysis has been done in SPSS (version 20). Findings are of use for manufacturing industry to respond proactively to emerging challenges posed by an increasingly complex, interdependent and changing world.

OBSERVATIONS AND ANALYSIS

In the present study Automotive sector manufacturing firms are mapped to assess Productivity related issues. The statistical analysis of survey responses is enumerated in following section. The analysis includes evaluating Cronbach's Alpha for reliability analysis, item wise statistics for evaluating mean and standard deviation, cross tab analysis and t-test for various parameters of the survey. Cronbach's alpha is calculated for each scale, as recommended for empirical research in production and operations management [50]. Cronbach's alpha values range between 0.711 to 0.887 which are more than 0.7, and considered adequate for exploratory work.

Productivity Awareness Status of Workforce in Industries

Figure 3 presents statistics for workforce productivity awareness. Workforce including Top Manager, Middle Manager, Lower Manager, Operators and Supporting Staffs are taken for assessment of awareness. While querying the respondents about awareness about the

productivity awareness of their workforce, they were asked questions, measuring awareness on a five-point Likert scale (1 = no awareness, 5 = full awareness). All the 154 valid survey responses were considered for the analysis. The surveys studied the respondent's perceptions about the extent of awareness about productivity among workforce. It is clear from the statistics that overall mean for productivity awareness is highest (4.68) for Top Manager. For rest of the workforce the mean lies in the range of 3.21 to 3.86. Data indicates that Top manager is more aware for productivity improvement in the industry than to other workforces. Top manager's awareness causes the enhancement of productivity by motivating and training other employees working in the industry. Supporting staff and operators are comparatively less aware about productivity improvement and need to be trained for the same. Supporting staff and operators, as normally observed, are concern only about production and production based financial incentives.

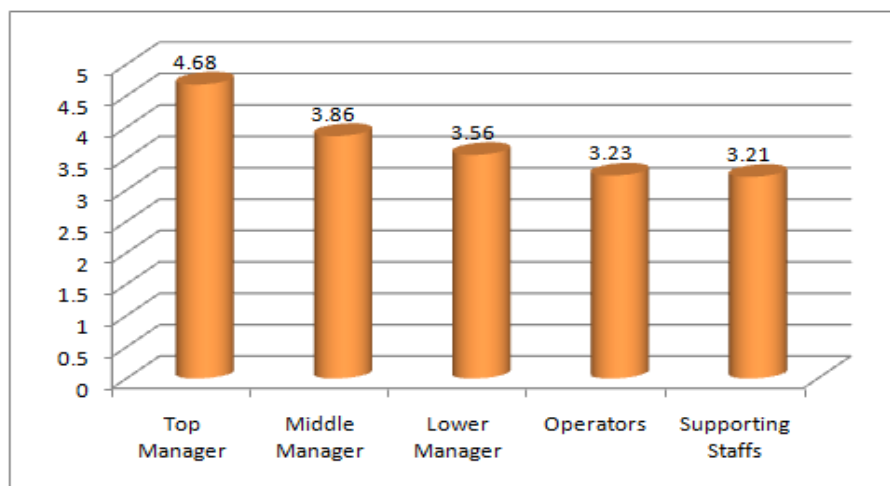


Fig. 3. Workforce productivity awareness.

Productivity Measurement Technique Implementation in Industries

Figure 4 presents statistics for productivity measurement technique implementation. The productivity measurement techniques include the value of output with respect to

value of man hours, capital, material input, miscellaneous inputs, total input, customer satisfaction, etc. It is observed from figure that overall mean for productivity measurement technique.

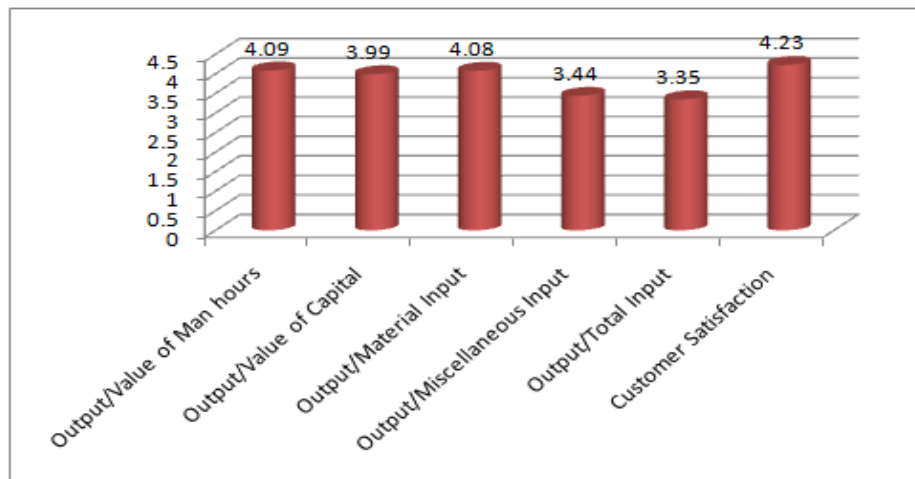


Fig. 4. Productivity measurement technique implementation.

implementation is highest (4.23) for Customer Satisfaction. For rest of the techniques the mean lies in the range of 3.35 to 4.09. These data indicate that Customer Satisfaction, both internal and external, is more important among productivity measurement techniques implementation in the industry than to other techniques. As evident from the data that many companies have recognized that there is a direct link between customer satisfaction and productivity. In fact, many problems related to productivity improvement can be attributed to lack of customer satisfaction aspect. During informal interview with respondents it was also observed that in this aspect more emphasis is given to internal customer satisfaction, since the object has to move

through various shop floors or machining centres, the satisfactory machining from previous shop/centre is very important for next one.

Productivity Improvement Practices in Industries

Figure 5 presents statistics for productivity improvement practices in industries. The productivity improvement practices include education level, skills, absentees, lead time, internal transport, employee satisfaction, etc. It is clear from the statistics that overall mean for productivity improvement practices is highest (4.42) for employee satisfaction, thus employee satisfaction is taken as most important parameter for the productivity improvement.

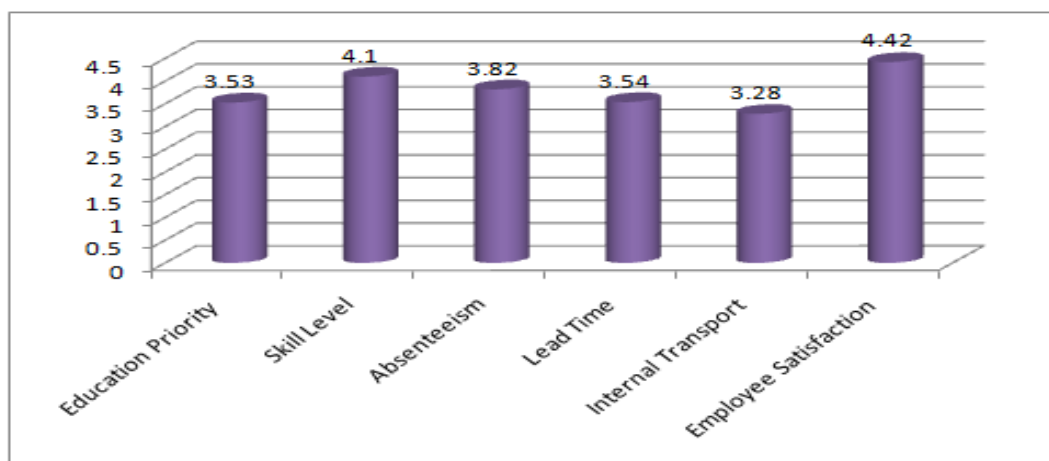


Fig. 5. Productivity improvement practices in industries.

practices than other practices. From the inferences of the analysis it is clear that many industries are of the opinion that a satisfied employee has a better productivity and can be a good asset for industry. In the interviews with respondents it was observed that for improving productivity industries are trying to satisfy their employees by the way of better work environment, financial incentives, etc.

Factors Affecting Productivity in Industries

Figure 6 presents statistics for factors affecting Productivity in industries. In the survey thirty main factors that affect productivity like: Computer application, Computer Aided Process Planning,

Computer Aided Design, Computer Aided Manufacturing, Group Technology, etc. were included. It is evident from the statistics that overall mean for Marketing Management is highest (3.98) and Job Safety is second highest (3.80), thus Marketing Management and Job Safety play a vital role among factors that affect productivity of industry. In the interviews, companies indicated that the marketing teams who directly deal or provide the services to the customers are more important. The role played by them is very crucial from business point of view. When they meet and provide the service to customer then their behaviour, competencies, promptness, initiatives to handle the customers and motivation affect the services offered.

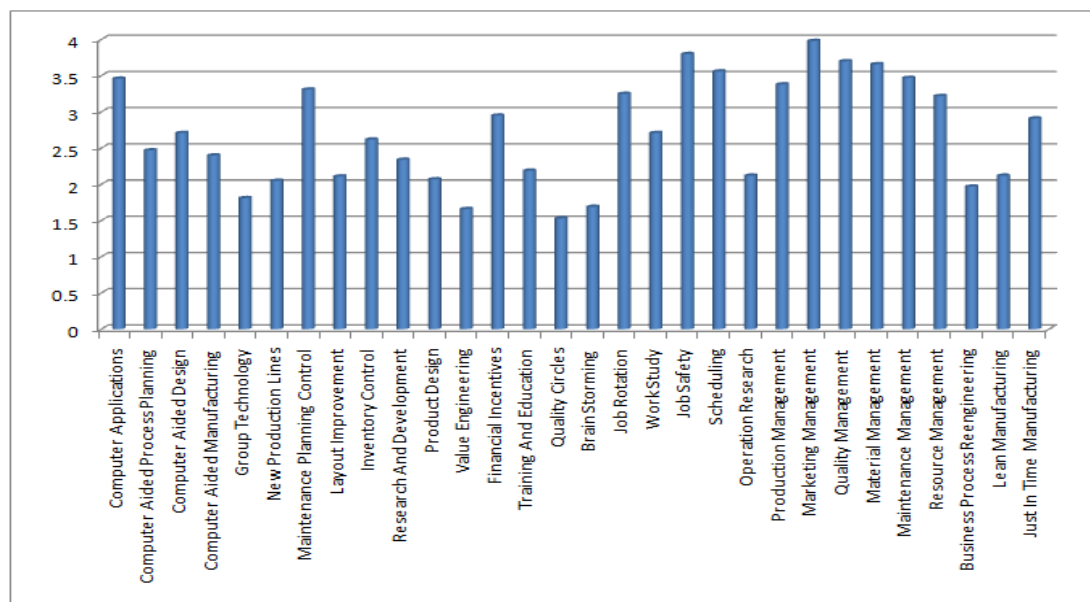


Fig. 6. Factors affecting productivity in industries.

Crosstab Analysis of Top Manager with Marketing Management

Crosstab or cross tabulation or correlation is the basic technique for examining relationship between two variables. Figure 7 presents crosstab analysis of top manager with marketing management. It is clear from the table that 96 (62% approx) companies have indicated that their top managers have applied and having a good/full understanding of marketing

management as productivity improvement tool in the industries. Crosstab between top manager and marketing management is also depicted in the bar chart shown in Figure 8. It can also be concluded from the analysis that top management understands that importance of marketing management as the process by which companies create customer interest in goods or services, and remain profitable thereby improving overall productivity.

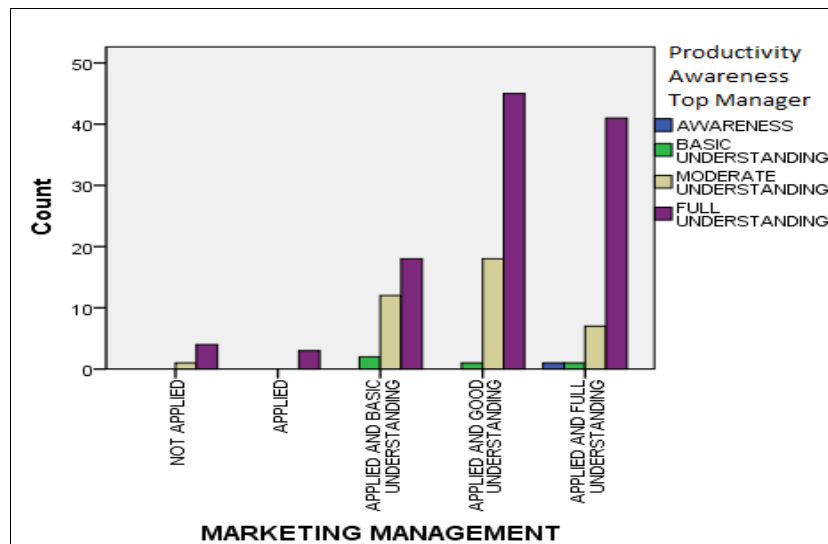


Fig. 7. Crosstab between top manager v/s marketing management.

Table 2. One-sample t test for productivity improvement techniques.

	Test value = 1					
	t	Df	Sig. (2-tailed)	Mean difference	95% Confidence interval of the difference	
					Lower	Upper
Computer Applications	24.577	153	.000	2.461	2.26	2.66
Computer Aided Process Planning	13.130	153	.000	1.468	1.25	1.69
Computer Aided Design	15.362	153	.000	1.714	1.49	1.93
Computer Aided Manufacturing	11.693	153	.000	1.403	1.17	1.64
Group Technology	8.567	153	.000	.805	.62	.99
New Production Lines	11.666	153	.000	1.052	.87	1.23
Maintenance Planning Control	23.929	153	.000	2.305	2.11	2.50
Layout Improvement	12.460	153	.000	1.110	.93	1.29
Inventory Control	15.050	153	.000	1.623	1.41	1.84
Research and Development	11.112	153	.000	1.344	1.11	1.58
Product Design	9.588	153	.000	1.071	.85	1.29
Value Engineering	6.669	153	.000	.662	.47	.86
Financial Incentives	20.655	153	.000	1.948	1.76	2.13
Training and Education	10.621	153	.000	1.195	.97	1.42
Quality Circles	4.612	153	.000	.526	.30	.75
Brain Storming	7.986	153	.000	.688	.52	.86
Job Rotation	24.471	153	.000	2.247	2.07	2.43
Work Study	15.856	153	.000	1.714	1.50	1.93
Job Safety	35.706	153	.000	2.799	2.64	2.95
Scheduling	26.974	153	.000	2.558	2.37	2.75
Operation Research	11.023	153	.000	1.117	.92	1.32
Production Management	26.103	153	.000	2.383	2.20	2.56
Marketing Management	38.813	153	.000	2.981	2.83	3.13
Quality Management	37.811	153	.000	2.701	2.56	2.84
Material Management	34.003	153	.000	2.662	2.51	2.82
Maintenance Management	29.800	153	.000	2.474	2.31	2.64
Resource Management	24.570	153	.000	2.221	2.04	2.40
Business Process Reengineering	9.574	153	.000	.974	.77	1.18
Lean Manufacturing	10.600	153	.000	1.123	.91	1.33
Just in Time Manufacturing	16.466	153	.000	1.909	1.68	2.14

In the view of some top managers, marketing management start with a marketing plan – identifying the customer and their needs and wants. Since the essence of business is fulfilling a need it is an important to know exact need of the customer. Then to decide, how best to reach those customers who have that need. According to managers, an obvious advantage of marketing is the promotion of the business and getting attention of target customer across a wide ranging or specific market.

T-Test Analysis of Factors Affecting Productivity

Table 2 gives one-sample t test for productivity improvement techniques, it

reveals statistically reliable ratio of the difference between sample mean and given number to the standard error of the mean, since the standard error of the mean measures the variability of sample mean, the smaller the standard error of the mean, more likely that sample mean is close to true mean. In the table t value for marketing management is highest, indicating highest effect of it on Productivity improvement techniques. And the value of significance (2-tailed) comes out to be 0.00 which is less than 0.05, hence statistical analysis for the survey is significant and true mean value is different from test value (=1).

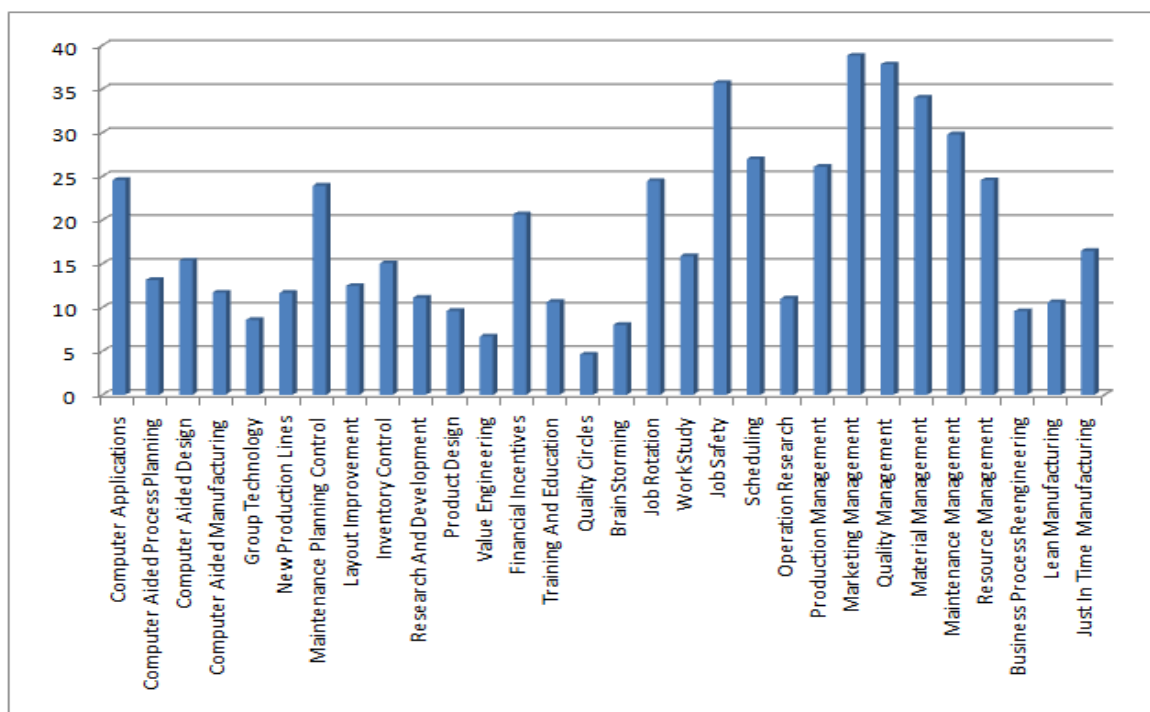


Fig. 8. t-Values for factors affecting productivity.

CONCLUDING REMARKS AND DIRECTIONS FOR FUTURE RESEARCH

The key to successful implementation of productivity improvement is to focus on producing measurable results. A more productive industry is ultimately a more profitable. In our study we have tried to map automotive sector manufacturing

industries in various productivity improvement related issues based on frameworks of productivity awareness status of workforce; productivity measurement technique used by the industry; existing productivity improvement techniques in industry; and factors affecting productivity in the industry (Figure 9).

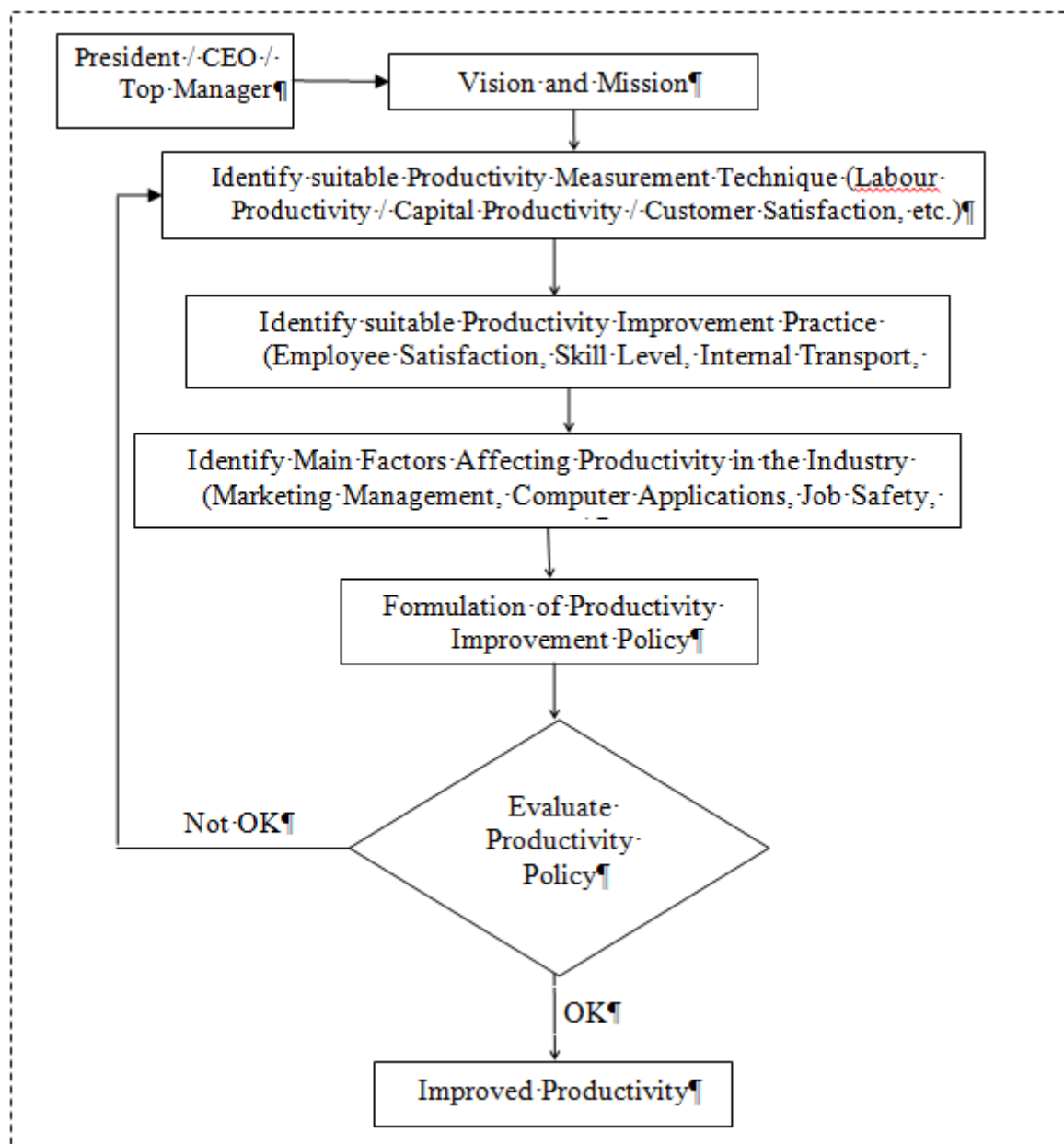


Fig. 9. Framework for productivity improvement.

In our study an attempt is made to study Productivity improvement techniques followed in automotive sector manufacturing industries. Survey questionnaire has been used to capture the information from 154 different companies with a response rate of 39.19% of the total 400 contacted companies. This survey is able to provide a fairly accurate overview of Productivity related issues in automotive sector manufacturing companies. First the Cronbach's alpha is calculated for each parameter to check

reliability or internal consistency. Second, based on the answers from the respondents of survey t-test in SPSS has been conducted. Results of analysis concerning the Productivity awareness status of workforce indicate that in most of the industry's top management is having awareness and good understanding of productivity related issues. In regard of productivity measurement technique implementation, Customer Satisfaction is having highest priority. Further for productivity improvement practices,

employee satisfaction is considered important. It is also evident from the statistics that Marketing Management is paid highest concern among factors that affect productivity of industry.

Based on the findings of the survey and experience gained through case studies, a framework, shown in Figure 9, for productivity improvement in automotive sector manufacturing companies is proposed. President/CEO/Top Manager sets Vision and Mission of the company in view of overall corporate policy. In line with vision/mission suitable productivity measurement technique; among labour productivity, material productivity, capital productivity, miscellaneous productivity, total productivity, customer satisfaction, etc. is identified. In second step suitable Productivity Improvement Practice is identified. Then in third step main factor affecting productivity are identified. In present survey, factors like: computer application, computer aided design, material management, work study, marketing management, just in time manufacturing, etc. were considered. Productivity Improvement Policy is framed after these three steps. The policy framed, is evaluated and modifications are done if required. In present study customer satisfaction came out to be on top priority among productivity measurement techniques, employee satisfaction comes out to be on top in productivity improvement practices, and Marketing management is preferred among various factors affecting productivity for automotive sector manufacturing companies. Although in case studies one company working in the field of designing and manufacturing polymer products, shown Computer applications and CAD as important factor affecting productivity, yet it may be written that Marketing management, Job satisfaction, Computer applications and CAD are few factors among other which are dominating in automotive sector manufacturing companies. Once a suitable

policy is framed for a particular industry, it can be evaluated via productivity measurement or improvements obtained after applying policy.

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