TO STUDY THE IMPACT OF MODERN MANAGEMENT TOOLS ON THE PRODUCTIVITY OF BIMETAL BEARING LTD

A Project Report

Submitted

By

S.MOHAN

Reg.No.1120400055

Under the guidance of

R.VINAYAGA SUNDARAM

Associate Professor

In partial fulfillment of the requirements

for the award of the degree

of

MASTER OF BUSINESS ADMIISTRATION

Department of Management Studies

Kumaraguru College of Technology

(An autonomous institution affiliated to Anna University, Coimbatore)

Coimbatore -641 049

September, 2012

Certified that this project report titled **"TO STUDY THE IMPACT OF MODERN MANAGEMENT TOOLS ON THE PRODUCTIVITY OF BIMETAL BEARING LTD"** is the bonafide work of **Mr. S.Mohan, 11MBA085,** who carried out the project under my supervision. Certified further, that to the best of my knowledge the work reported herein does not form part of any other project report or dissertation on the basis which a degree or award was conferred on an earlier occasion on this or any other candidate.

Faculty Guide	Director
(R. Vinayaga Sundaram)	**Dr. Vijila Kennedy**
Associate Professor	**KCTBS**
KCTBS	

Submitted for the project viva-voce examination held on ____________________________

Internal Examiner   External Examiner

DECLARATION

I hereby declare that this project report entitled "**TO STUDY THE IMPACT OF MODERN MANAGEMENT TOOLS ON THE PRODUCTIVITY OF BIMETAL BEARING LTD, COIMBATORE**" has been undertaken for academic purpose submitted to Anna University in partial fulfillment of the requirements for the award of the degree of Master of Business Administration. The project report is the record of the original work done by me under the guidance of **Mr. R. VINAYAGA SUNDARAM, Associate Professor** during the academic year 2012-2013.

I, also declare hereby, that the information given in this report is correct to best of my knowledge and belief.

Date: Signature

Place: Coimbatore   S.Mohan

ACKNOWLEDGEMENT

I express my sincere gratitude to our beloved chairman **Arutchelvar Dr. N. Mahalingam** and Management for the prime guiding spirit of Kumaraguru College of Technology.

I take this opportunity to extend my sincere thanks and indebtedness to **Dr. Vijila Kennedy,** Director, KCT Business School, for her remarkable guidance.

It gives pleasure to express my sense of gratitude to my Guide **Mr. R. Vinayaga Sundaram,** Assistant Professor, KCT Business School, for his guidance, support and constant source of inspiration during this project.

I thank **Mr. . Muralitharan**, Production manager, Bimetal Bearing Ltd, Coimbatore plant for his valuable support and guidance throughout my project.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

SYNOPSIS

The bearing industry is one of the key sectors that is closely related with the engineering field. The number of engineering industries has increased rapidly in the past decade. Most of the engineering sectors use bearing for their core operation. Therefore the need to improve the production of the bearings and delivering it in a good quality has become essential. Improving the production indicated that there should be increase in the productivity. Productivity is a measure of the efficiency of production. Productivity is a ratio of production output to what is required to produce it (inputs). The measure of productivity is defined as a total output per one unit of a total input.

The study aims at identifying the impact and comparing the productivity of Bimetal Bearing Limited over the time period of 2008 to 2011. This study deals with the measuring of productivity in terms of output/year. The study also compares various factors that directly and indirectly affect the productivity such as lead time, idle time, accidents, defects, etc.

CHAPTER 1

INTRODUCTION

1.1. INTRODUCTION TO THE STUDY:

Productivity is a measure of the efficiency of production. Productivity is a ratio of production output to what is required to produce it (inputs). The measure of productivity is defined as a total output per one unit of a total input. Measuring productivity is done to estimate the performance of the company and the ability of it to earn profit.

In general the productivity in a manufacturing plant is measured in many ways. The following are the few ways of measuring productivity:

- Output/worker
- Output/day
- Output/machine
- Unit cost (total cost/total output)

The study aims at identifying the impact and comparing the productivity of Bimetal Bearing Limited over the time period of 2008 to 2011. This study deals with the measuring of productivity in terms of output/year.

1.2. INTRODUCTION TO THE BEARING INDUSTRY:

The bearing industry has evolved since the time of industrial revolution. The Indian bearing industry has grown steadily in the past years. Bearing industry has a greater impact on the automobile industry all over the world. Improvement in the technology like high speed engines and machines, robotics, etc has led to an increase in the demand for the bearings. The Indian bearing industries manufacture over 500 varieties of bearings.

The bearing Industry in India can be divided into three segments; the organized sector, comprising 12 leading manufacturers, located at Rajasthan, Gujarat, Maharashtra, Andhra Pradesh, Karnataka, Tamil Nadu, West Bengal

and Jharkhand primarily cater to the OEM Segment which are predominantly automotive, Railway and other Industrial users. The use of the bearings depends upon the original equipment manufacturer (OEM) market and the replacement market. The former market accounts for 60 % of the total demand and the remaining demand is accounted towards the later market.

The unorganized sector includes the small scale manufacturers and manufacturers of spurious bearings. The unorganized sector contributes to about 18% of the total Industry turn over. The unorganized sector players have a strong regional presence and mainly cater to the needs of the replacement markets. The Indian bearing Industry is estimated at Rs. 100 billion. The domestic Industry caters to the 74 % of total demand for common varieties & sizes. The organized sector units contribute around 53% of the Industry sales. The imports are about 26% of the total demand of the industry, while about 18% import comes through official channels. There are also estimated 8% illegal imports. Legal imports generally represent the specialized / super precision bearings not manufactured in India. Illegal imports generally represent the entry of spurious imports of bearings. The legal imports are about Rs.1 8.00 billion while the spurious imports are about Rs. 8.00 billion. The small scale units manufacturing bearing are mainly concentrated in Rajasthan and Gujarat having 15 and 50 units respectively. The bearing manufacturing units are also present in Delhi, Punjab, and Maharashtra. The state of Rajasthan has major concentration of about 100 bearing components manufacturing units with 1000 to 1200 Vendors carrying out turning job work.

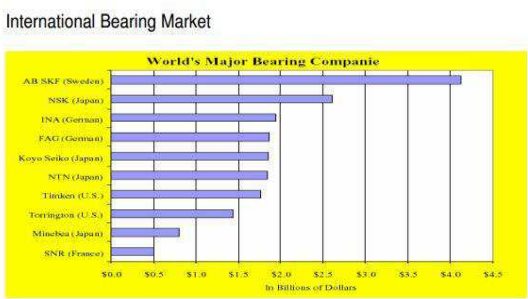
There are substantial No. of component manufacturing units in Gujarat, Maharashtra, West Bengal and Punjab also. The bearing component manufacturing units are the vendors of organized sector, and unorganized sector bearing manufacturing units for supply of inner and outer races, balls, rollers, cages, seals, retainers & rivets. These components are also exported to Europe, United States of America and other global customers.

There are about 450 to 500 number of spurious bearing assembling units situated in the State of Punjab, Delhi and Gujarat, eating the market of

organized & unorganized sector players. A number of global bearing manufacturers have established their units in India through joint ventures or 100% ownership and more are expected to follow suit. The Big player of bearing sector is present in U.S.A, Russia, Japan, China and Eastern Europe. Some of leading bearing manufacturer are:

1. NSK Japan
2. NTN Japan
3. KOYA Seiko Japan
4. FAG Germany
5. SKF Sweden
6. NRB France
7. Timken USA

Fig1.1. International bearing market



1.2.1. Global collaboration:

All the manufacturers in the organised sector have entered into collaboration agreements for supply of complete process know how as well as supply of major manufacturing machinery. The collaboration agreements are still valid and the industry gets all assistance for process, know-how product development, customer development, tool design, production control techniques etc from them. Most of the big player is having either technical or financial Collaboration with leading Auto Manufacturer. International Collaboration gives Access to best technology in the world. The Indian Bearing Industry, especially the companies having technical and financial collaboration with Global player is expected to garner higher price in export market.

Table1.1. Table displaying the bearing companies in India that have foreign collaboration:

Sl.no	Company	Collaboration
1.	SKF Bearings, India	SKF Sweden
2.	FAG Bearing India	FAG, Germany
3.	NRB Bearings	Nadella, France
4.	ABC Bearing Ltd	NSK Japan
5.	TIMKEN India	TIMKEN USA
6.	Bimetal Bearing Ltd	Clevite Corporation USA

7.	Gabriel India	Suspension Italy

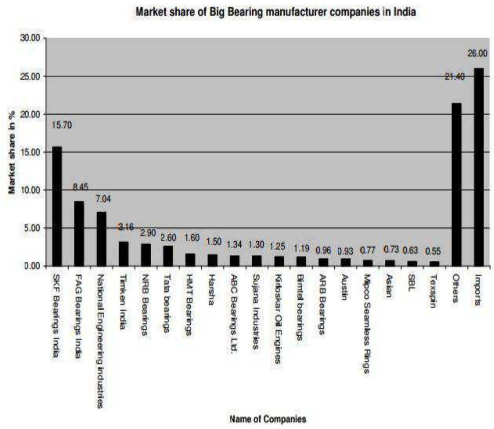
In view of the growing industrial and automobile sector, the growth in this industry is going to be substantial. The requirement of bearings increasing day by day in India in both the OEM and replacement market and increasing number of small manufacturing industries developing in Jaipur (Rajasthan) Rajkot and Surrender Nagar (Gujarat) and Punjab have come up in unorganized sector. These industries are manufacturing from complete bearings to components and supplying to leading players.

The following are the major manufacturers of bearings in India:

1. Associated Bearing Company Ltd., Pune (Maharashtra)
2. Asian Bearings Company Ltd., Hosur (Karnataka)
3. Karnataka Ball Bearing Corporation Ltd., Mysore (Karnataka)
4. Bimetal Bearings Ltd., Hosur (Karnataka)
5. HMT Ltd., Hyderabad (Andhra Pradesh)
6. Tata Iron and Steel Company Ltd., (Bearings Division) Kharagpur (West Bengal)
7. Shriram Bearings Ltd., Ranchi (Bihar)
8. National Engineering Industries Ltd., Jaipur (Rajasthan)
9. FAG Precision Bearings Ltd., Vadodara (Gujarat)
10. Antifriction Bearing Company Ltd. Bharuch (Gujarat) Lonavala (Maharashtra)
11. Union Bearings Manufacturing Co., Porbunder (Gujarat)
12. Needle Roller Bearing Co. Ltd., Thana/Jalna (Maharashtra)
13. Shriram Needle Industries Ltd., Ranchi (Bihar)
14. Deepak Insulated Cables Ltd., Mysore (Karnataka) (Needle Bearings Division)
15. Austin Engg Company Limited Junagadh, Gujarat13
16. Karnataka Ball Bearing Co Ltd., Mysore

17. Mysore Kirloskar Ltd, Harihar (Karnataka)
18. Needle Roller Bearings Ltd, Thane
19. Needle Roller Bearings Ltd., Waluj
20. SKF India Limited, Chinchwad, Pune
21. SKF India Limited, Bommasandra, Bangalore
22. Timken India Limited, Jamshedpur
23. ZKL Bearings India Pvt. Ltd.,
24. NTN (India) Limited

Fig1.2. Major Manufacturers of bearing in India



The Indian bearing industry manufactures the following types of bearings:

1. Ball bearings
2. Cylindrical roller bearings
3. Taper roller bearings
4. Spherical roller bearings
5. Needle roller bearings
6. Magnetic bearings

The following are the few areas where these bearings are utilized:

1. Automobiles
2. Engines
3. Trains
4. Earth movers
5. Pumps
6. Machine tools
7. Textile
8. Electric fans
9. Motors
10. Steel plants
11. Sugar mills
12. Paper mills
13. Power plants

The Government of India has set up bearings cluster for development of unorganized segment in Small and Medium sector and understands the market and quality linkage and makes them competitive and prepares them with the best benchmarking practices in the sector. The future of the bearing industry is bright in India as the automobile companies have started expansion and modernisation. Also to add is the entrance of many foreign car makers in India in the past decade. Moreover India is poised to emerge as the largest manufacturer of cars at the end of 2050.

1.3. INTRODUCTION TO BEARING:

The Bearing is a machine element used in rotating parts of virtually every machine. Bearing permit smooth low friction rotary or linear movement between two surfaces. It employs either a sliding or a rolling action. Bearing can be broadly classified into two segments:

- Bimetal bearings
- Antifriction bearings

Bimetal bearings (also known as engine bearings) are primarily used in engines of automobiles or machines. The bearings are meant to reduce the friction between the moving parts of the engine crankshaft or crank shaft or associated support surfaces.

Antifriction Bearings include Ball Bearings and Roller Bearings. Roller bearings can further be subdivided into tapered roller. Cylindrical roller, Needle roller, thrust bearings and other special application bearings. The main components of an antifriction bearing are the inner race (ring), the other race (ring) the rolling elements, cages (retainers) and seals. The following are the major types of bearing:

a. Ball bearing
b. Cylindrical roller bearing
c. Taper roller bearing
d. Needle roller bearing

1.4. INTRODUCTION TO BIMETAL BEARING LTD (BBL)

Bimetal Bearing Ltd (BBL) is a leading manufacturer of engine bearings, bushings, thrust washers in India. It belongs to the Amalgamation group of companies which was started in the year 1961 in collaboration with Clevite Corporation, USA and Repco Ltd, Australia. The Amalgamations group is one of India s leading engineering conglomerate. BBL and Daiso, Japan entered a joint venture partnership to establish a facility for history. Bimetal Bearing Ltd is represented with the brand name “BIMITE”. BBL is denoted by “BIMETAL” in NSE and its BSE code is “505186”.

BBL holds the following facts with it:

- 70% market share in India.
- Leader in engine bearing manufacturing in India.
- Modern testing facility.
- In-house integrated manufacturing facilities from alloy powder and bimetallic strips to bearing shells.

Some of the other engineering companies under the group are:

- Simpson & co – manufactures diesel engines,
- Amco batteries – manufactures automotive batteries,
- Mable India pistons – manufactures pistons,
- Tractors & farm equipment ltd – manufactures tractors, etc.

BBL has 3 plants at present, one located in Hosur and the other in Coimbatore. It also has a regional office in Chennai. The Coimbatore plant manufactures:

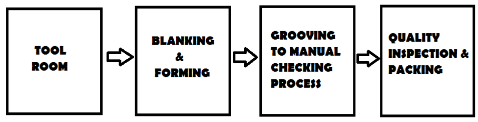
- Engine bearings
- Bushings
- Thrust washers
- Alloy powder and bimetallic strips

The bearings and other components produced by the company are used in passenger cars, MUV’s, LCV’s, tractors, industrial engines and in two wheelers.

1.4.1. The process:

1.4.1.1. The process flow chart:

Fig 1.3 The process flow chart



THE PROCESS INVOLVED IN BIMETAL BEARING LTD

1. Blanking and forming
2. Chamfering
3. Grooving
4. Piercing
5. Notching
6. Buffing
7. Broaching
8. Measuring
   a. Automatic measuring
   b. Manual measuring
9. Boring
10. Manual checking
11. Packing

The process chart and the raw material shown here may vary depending upon the customer needs.

1.4.1.2. Blanking operation:

- The raw material is in the form of thin sheets and is loaded manually into the set-up which then rolls the sheet into the blanking machine.
- The blanking machine cuts the sheets according to the pre-set measurement.
- The output of this process serves as the output for forming operation.

1.4.1.3. Forming operation:

- The metal strips are then formed into the required shape by using the die and press.
- This produces a U shaped material.

1.4.1.4. Chamfering operation:

- The corners of the U shaped material are chamfered and then the material passes through a series of operation according to the output requirements.
- The finished component is then measured and checked and sent finally for packing.
- The rejected components are reworked if the defects are minor or else it becomes scrap item.

1.4.2. The set – up:

- There are 3 lines in the company.
- Operates for 3 shifts at present.

1.4.3. Key Customers to BBL:

- Hyundai motors India ltd.
- Tata cummins,
- Simpson,
- Maruti gypsy,
- Bajaj auto ltd,
- HM,
- Greaves.

1.5. SCOPE OF THE STUDY:

- The outcome of the study can be utilised for identifying the key areas of improvement like inventory management, lead time reduction, etc.
- The study may lead to prove the importance of implementing the modern tools in the field of production management

CHAPTER 2

LITERATURE REVIEW

[1] **David N. Card** (2006) says that in an era of tight budgets and increased outsourcing, getting a good measure of an organization's productivity is a persistent management concern. Unfortunately, experience shows that no single productivity measure applies in all situations for all purposes. Instead, organizations must craft productivity measures appropriate to their processes and information needs. This article discusses the key considerations for defining an effective productivity measure. It also explores the relationship between quality and productivity. It does not advocate any specific productivity measure as a general solution.

[2] **Jennifer A. Farris** (2006) says the research presents results from a multi-site field study of 51 Kaizen event teams in six manufacturing organizations. Although Kaizen events have been growing in popularity since the mid-1990s, to date, there has been no systematic empirical research on the determinants of Kaizen event effectiveness. To address this need, a theory-driven model of event effectiveness is developed, drawn from extant Kaizen event practitioner articles and related literature on projects and teams. This model relates Kaizen event outcomes to hypothesized key input factors and hypothesized key process factors. In addition, process factors are hypothesized to partially mediate the relationship between input factors and outcomes. Following sociotechnical systems (STS) theory, both technical and social (human resource) aspects of Kaizen event performance are measured. Relationship between outcomes, process factors and input factors are analysed

[1] David N. Card - The Challenge of Productivity Measurement, Pacific Northwest Software Quality Conference, 2006

[2] Jennifer A. Farris - An Empirical Investigation of Kaizen Event Effectiveness: Outcomes and Critical Success Factors, Virginia Polytechnic Institute and State University, 2006

through regression, using generalized estimating equations (GEE) to account for potential correlation in residuals within organizations.

The research found a significant positive correlation between the two social system outcomes (attitude toward Kaizen events and employee gains in problem-solving knowledge, skills and attitudes). In addition, the research found significant positive correlations between the social system outcomes and one technical system outcome (team member perceptions of the impact of the Kaizen event on the target work area). However, none of the three technical system outcomes (employee perceptions of event impact, facilitator ratings of event success and actual percentage of team goals achieved) were significantly correlated.

[3] **Rallabandi Srinivasu** (2009) says that the Statistical Process Control (SPC) methods have been widely recognized as effective approaches for process monitoring and diagnosis. Statistical process control provides use of the statistical principals and techniques at every stage of the production. Statistical Process Control (SPC) aims to control quality characteristics on the methods, machine, products, equipment's both for the company and operators with magnificent seven. Some simple techniques like the "seven basic quality control (QC) tools" provide a very valuable and cost effective way to meet these objectives. However, to make them successful as cost effective and problem solving tools, strong commitment from top management is required. Statistical process control (SPC) is one of the important tools in quality control (QC). In order to survive in a competitive market, improving quality and productivity of product or process is a must for any company.

[3] Rallabandi Srinivasu - Utility of quality control tools and statistical process control to improve the productivity and quality in an industry, International Journal of Reviews in Computing, 2009

[4] **William Gullickson** (1995) says that this article discusses the measurement of multifactor productivity for manufacturing and analyses growth trends within the sector. Through the years, a wide variety of productivity statistics have appeared in the literature, distinguished by the concepts underlying the measurement of output, the methods of aggregation, and the inputs included for analysis. Recent additions of "superlative" indexes of gross domestic product (GDP) by industry to the U.S. National Income and Product Accounts, prepared by the Bureau of Economic Analysis, U.S. Department of Commerce, have enhanced available alternatives for measuring manufacturing productivity. Planned changes in the way BLS measures manufacturing productivity are also discussed. Multifactor productivity growth trends are then examined for the overall manufacturing sector and for 19 two-digit SIC manufacturing subsectors. In particular, early post-war and more recent productivity growth trends are compared. When this comparison was last discussed in 1992, data were available through 1988, covering a period of rapid growth following emergence from the 1982 recession. Because of this growth, multifactor productivity growth seemed to have regained much of its early post-war momentum. It is now possible to examine recent trends more comprehensively because the extended series cover the 1990 business cycle peak, the brief recession that followed in 1991, and a recovery period in 1992. These trends indicate that the productivity growth rates of the early post-war period were not entirely regained during the 1980's.

[4] William Gullickson - Measure productivity growth in US manufacturing industry, Monthly Labour Review, July 1995

[5] **Kanthi M.N. Muthiah** (2006) says that globalisation is posing several challenges to the manufacturing sector. Design and operation of manufacturing systems are of great economic importance. Factory performance remains unpredictable in spite of the considerable literature on manufacturing productivity improvement, and the long history of manufacturing as there is no widespread agreement on how best be performed (Gershwin, 2000). Productivity measurement and improvement goes hand in hand, because one cannot improve what one cannot measure. The review of literature on manufacturing system productivity measurement and improvement has been summarised under four categories; they are Operations Research- (OR-) based methods, system analysis-based methods, continuous improvement methods and performance metrics-based methods. A survey of commercial tools available to measure manufacturing system performance is also performed. The review indicates that quantitative metrics for measuring factory level productivity and for performing factory level diagnostics (bottleneck detection, hidden capacity identification) are lacking. To address this gap, a factory level effectiveness metrics-based productivity measurement and diagnostic methodology is proposed.

[6] **Patrick Taggart (2009)** says that in recent years companies have made increased use of Lean Manufacturing audits to measure the degree of Lean Manufacturing implementation within their organizations. Thereafter, a gap analysis highlights areas for improvement, which leads to increased Operational Performance. This approach may be flawed. The audit may measure Lean Manufacturing characteristics that are not beneficial or the Lean Manufacturing audit may be inaccurate due to auditor bias or inadequate scope. The result is frustration and a lack of belief in the effectiveness of Lean Manufacturing as a

[5] Kanthi M.N. Muthiah - A review of literature on manufacturing systems productivity measurement and improvement, Int. J. Industrial and Systems Engineering, Vol. 1, No. 4, 2006

[6] The effectiveness of lean manufacturing audits in driving improvements in operational performance, University of the Witwatersrand, Johannesburg, 2009

competitive strategy. This study tests the hypothesis that "Lean Manufacturing audits drive improvements in Operational Performance." A sample company comprising sixty four organizations operating in a job shop and Batch operations management environment is used as a case study. The organizations manufacture and service high value added products for heavy industry. The Lean Manufacturing audit developed to assess the effectiveness of Lean Manufacturing audits in driving Operational Performance uses Lean Manufacturing characteristics commonly used in previous research. These characteristics include policy deployment, standardized work, visual management and housekeeping, quick changeover techniques, total preventative maintenance, continuous improvement, error proofing, cultural awareness, material control and level production. Commonly used Operational Performance measures such as On-Time-Delivery, Inventory turns and Direct Labour Utilization are used to assess Operational Performance. A range of independent auditors were used to gather data on the extent of implementation of Lean Manufacturing and Operational Performance measures.

Structural Equation Modelling is used to relate the results of the Lean Manufacturing audits to Operational Performance. This is the first known paper to use Structural Equation Modelling in measuring the extent of implementation of Lean Manufacturing to Operational Performance. Lean Manufacturing audit results have a significant correlation to Operational Performance but with a high degree of variation in Operational Performance not accounted for by the results of the Lean Manufacturing audit. This variation is caused by the inadequate scope of the audit relative to Operational Performance measures as well as auditor bias. Lean Manufacturing audits are effective in driving improvements in Operational Performance provided that the scope of the audit is expanded to include office functions, supplier networks and customer and branch distribution networks. A recommended audit framework is suggested in this research. A large scale study of a number of different companies should be conducted to verify the results of this research using the audit framework developed.

CHAPTER 3

RESEARCH METHODOLOGY

Research may be defined as the search for knowledge through an objective and scientific method of finding solution of problem. Research methodology is a way to systematically solve the research problem. It includes the various steps that are generally adopted by a researcher in studying problem along with the logic behind them. Following research design had been adopted during the research.

RESEARCH DESIGN:

Research design can be defined as the arrangement of conditions for the collection and analysis of data in a manner that aims to combine relevance in research purpose with economy in procedure. It constitutes the blue print for the collection, measurement and analysis of the data. The research design is a collection of the following steps:

- To decide the objective and subjective of the research
- To determine the most suitable method of research
- To determine the sources of data
- To decide the appropriate research instrument for data collection
- To determine the suitable sampling design and sampling size
- To conduct the field survey for data collection
- To prepare the research report

3.1. TYPE OF RESEARCH:

The project is based on qualitative research. Quantitative research aims to measure the quantity or amount and compares it with past records and tries to project for future period. In social sciences, "quantitative research refers to the systematic empirical investigation of quantitative properties and phenomena and their relationships". Quantitative research involves the use of structured

questions, where the response options have been pre-determined. Quantitative research is used to compare with past data.

3.2. OBJECTIVE OF THE SYUDY:

3.2.1. Primary objective:

- To study the impact of modern management tools on the productivity of Bimetal Bearing Limited and to compare the productivity over the past four years.

3.2.2. Secondary objective:

- To compare the inventory level.
- To compare the idle time of the machines.
- To suggest ideas to improve the productivity.

3.3. DATA AND SOURCE OF DATA:

The data collected for the study is primary data that was directly collected from the company.

3.4. TIME PERIOD:

The study was carried out for a span of 6 weeks and the data was gathered in a weeks' time and analysis was carried out for the next 2 weeks.

3.5. STATISTICAL TOOL USED:

- Pie charts
- Bar graphs
- Scatter diagram
- Percentage analysis

3.6. LIMITATION OF THE STUDY:

- The study was carried out for a shorter period of time, so further in depth analysis couldn't be made.

- The study was carried out considering only 2 modern production tools – lean manufacturing and kaizen.
- The data for exact customers couldn't be gathered to find the in depth impact of the production tools on the individual customers.
- Comparison of the productivity before and after the implementation of the modern tools couldn't be done due to the lack of data before the year 2008.
- The data for different years are average of 12 months.

CHAPTER 4

ANALYSIS AND INTERPRETATION

Table 4.1.1: Table showing the annual output for consecutive years

Sl.no	Year	Annual output (units)	Percentage
1.	2008	1006000	21.58 %
2.	2009	1102000	23.64 %
3.	2010	1203200	25.81 %
4.	2011	1350000	28.96 %

TOTAL = 46, 61,200 units 100 %

Fig 4.1.1: Bar graph showing the overall production in terms of % for consecutive years

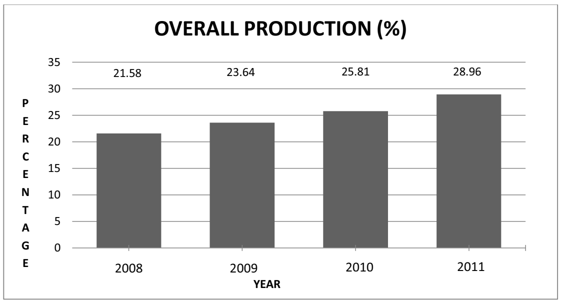
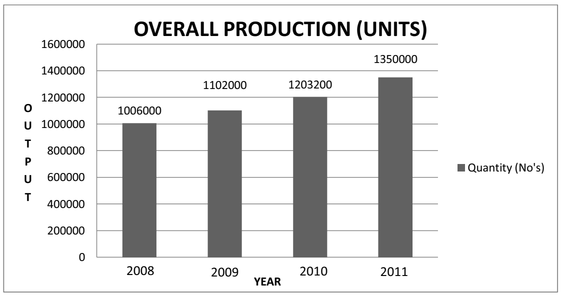


Fig 4.1.2: Bar graph showing the total production for consecutive years



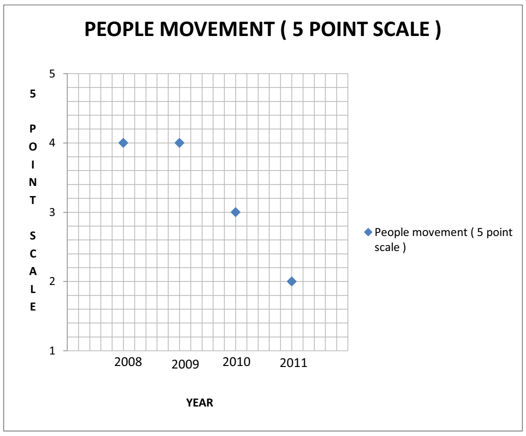
Interpretation:

- Total number of units is in the increasing margin which shows that the productivity of the company is growing and the company is focusing on continuous improvement.
- The maximum output (28.96 %) is in the year 2011 when compared to all the other years.
- It can be predicted that the output for the year 2012 will be higher than that of the year 2011. Again this is a positive indicator for continuous improvement.

Table 4.1.2: Table showing the measurement of people movement (in terms of 5 point scale) inside the plant during consecutive years

Sl.no	Year	People movement (5 point scale)
1.	2008	4
2.	2009	4
3.	2010	3
4.	2011	2

Fig: 4.1.3: People movement inside the plant for consecutive years



Interpretation:

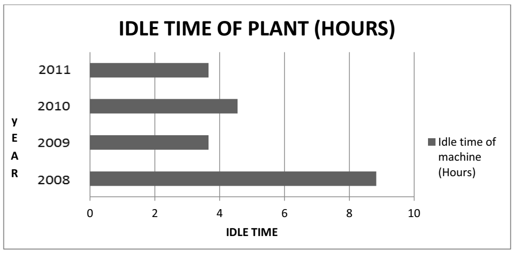
- It is clear that the movement of people within the plant was at the same level during the period 2008 and 2009.
- But the movement of people got reduced comparatively for the next two years (i.e., during 2010 and 2011).

Table 4.1.3: Table showing the total idle time of the plant for consecutive years

Sl.no	Year	Idle time (hours)	Percentage
1.	2008	8.83	42.72 %
2.	2009	3.65	17.64 %
3.	2010	4.55	22.00 %
4.	2011	3.65	17.64 %

TOTAL = 20.68 hours 100%

Fig 4.1.4: Idle time of the plant in hours for consecutive years



Interpretation:

- The idle time of the plant has reduced to a huge extend from the year 2008 to 2011.
- Idle time for the year 2009 and 2011 are almost the same.
- Reduction in the idle time is one of the major factors that leads to increase productivity.
- It can be correlated that the reduction in the idle time in the year 2011 may have led to the increased productivity.

Table 4.1.4: Table showing the inventory level for consecutive years

Sl.no	Year	Inventory (units)
1.	2008	5,88,000
2.	2009	4,58,000
3.	2010	4,06,000
4.	2011	4,12,000

TOTAL = 18, 64, 000 units

Fig 4.1.5: Inventory level maintained in the company for consecutive years (in terms of %)

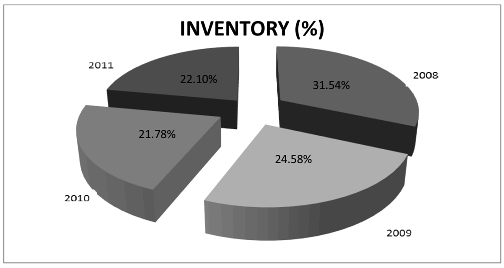
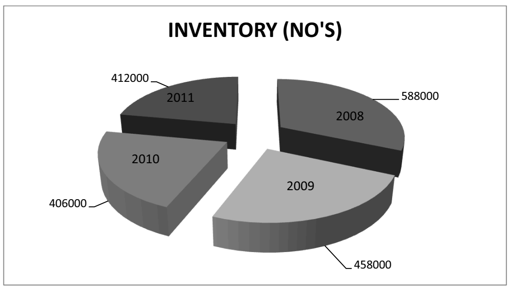


Fig 4.1.6: Inventory level maintained in the company for consecutive years (in terms of units)



Interpretation:

- It is clear that inventory level has been minimized to certain extend year on year basis.
- The inventory level for the year 2011 has been on the rising margin when compared with 2010.

Table 4.1.5: Table showing the defective components produced during consecutive years

Sl.no	Year	Actual output (units)	Defective output (units)
1.	2008	10,06,000	19,617
2.	2009	11,02,000	19,174
3.	2010	12,03,200	14,799
4.	2011	13,50,000	15,120

TOTAL = 4,66,1200 units 68, 710 units

Fig 4.1.7: Comparison between actual output and defective output

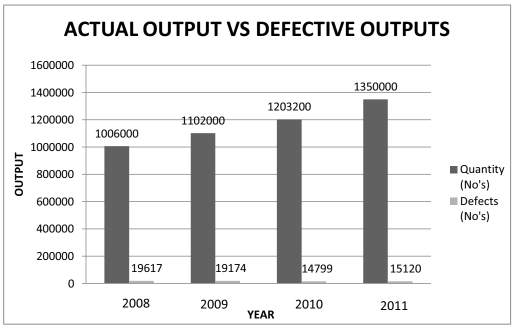
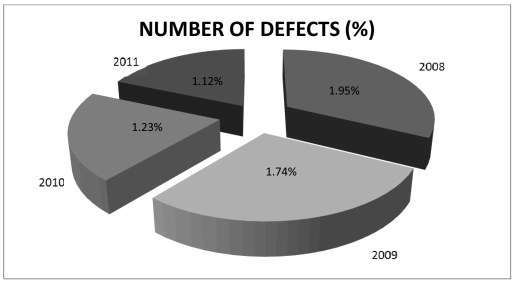


Fig 4.1.8: Number of defects in terms of % of the total output for a year



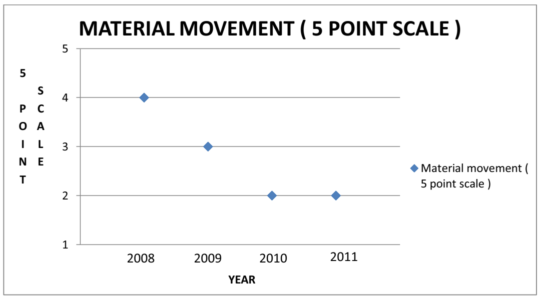
Interpretation:

- More defective components were produced during the year 2008 (1.95 %) in terms of % and the number is minimum during the year 2011 (1.12 %).
- Reduction in the defects indicates that the company is trying to avoid waste and also focuses on continuous improvement.

Table 4.1.6: Table showing measurement of material movement within the plant

Sl.no	Year	Material movement (5 point scale)
1.	2008	4
2.	2009	3
3.	2010	2
4.	2011	2

Fig 4.1.9: Material movement within the plant (in terms of 5 point scale)



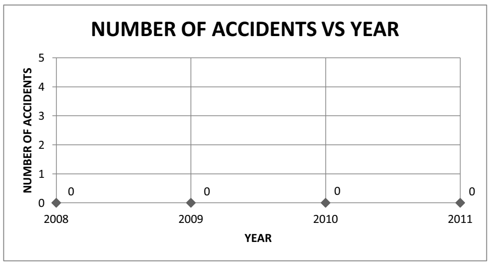
Interpretation:

- The unwanted movement of material within the plant as well as outside the plant has been on the dropping note.
- The graph indicates that the level of movement of material is the same for the last 2 years i.e. during the year 2010 and 2011.

Table 4.1.7: Table showing the number of accidents during consecutive years

Sl.no	Year	Number of accidents
1.	2008	0
2.	2009	0
3.	2010	0
4.	2011	0

Fig 4.2.0: Number of accidents occurred during consecutive years



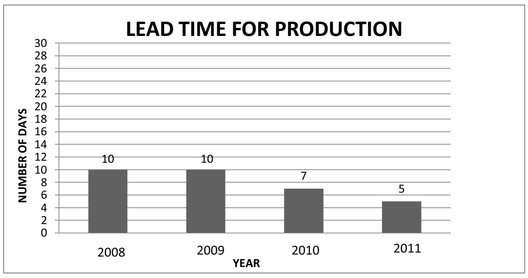
Interpretation:

- The accident level remains zero throughout the four years which is a good indication for the level of safety in which the plant operates.

Table 4.1.8: Table showing the lead time for producing the bearings

Sl.no	Year	Lead time (days)
1.	2008	10
2.	2009	10
3.	2010	7
4.	2011	5

Fig 4.2.1: Lead time for production for consecutive years



Interpretation:

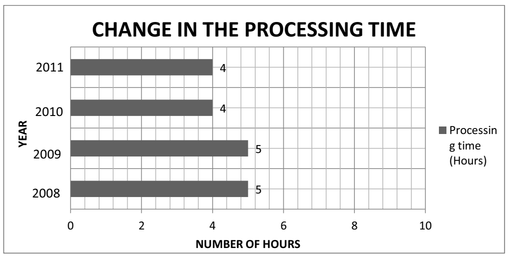
- There has been a change in lead time from the year 2008 to 2011.
- The lead time remains the same for the year 2008 and 2009.
- But it has reduced consistently during the year 2010 (7 days) and 2011 (5 days).

Table 4.1.9: Table showing the average processing time for a batch during consecutive years

Sl.no	Year	Processing time (hours)
1.	2008	5

2.	2009	5
3.	2010	4
4.	2011	4

Fig 4.2.2: Processing time difference for consecutive years



Interpretation:

- The processing time during the year 2008 and 2009 are the same which has led to the reduced productivity when compared to the years 2010 and 2011.

CHAPTER 5
FINDINGS AND SUGGESTIONS

5.1. FINDINGS:

- The overall productivity has increased from 21.58 % during 2008 to 28.96 % during 2011.
- The productivity is continuously increasing i.e. 21.58 % in 2008, 23.64 % in 2009, 25.81 % in 2010 and 28.96 % in 2011.
- The idle time of the plant has been reduced to 17.64 % (2011) from 42.72 % (2008).
- Inventory level was on the declining side from 2008 to 2010. But during the year 2011 the inventory level has been increased from 4, 06, 000 units to 4, 12, 000 units.
- The number of defective components produced has been reducing over the past four years i.e. from 1.95 % in 2008, 1.74 % in 2009, 1.23 % in 2011 and 1.12 % in 2011.
- Movement of material within the plant has reduced from high (2008) to low (2011) with respect to the 5 point scale.
- Movement of people within the plant has reduced from high (2008) to low (2011) with respect to the 5 point scale.
- Accident level has remained constant for all the four years respectively.
- Lead time for production has reduced from 10 days during 2008 to 5 days during 2011.
- The processing time has come down to 4 hours per batch (2011) from 5 hours per batch (2008).

5.2. SUGGESTIONS:

- The inventory level may be maintained at suitable level depending upon the market demand.
- The company may upgrade to 6 sigma level from 4 sigma level to reduce the variation in the products.

- Number of defects may be reduced by adopting modernisation techniques like automation.
- People movement and material movement can be reduced further if the 5 S is fully adopted.

5.3. CONCLUSION:

Conclusion drawn from the study is that the modern production tools have a positive impact on the company. Productivity of the company is on the rising margin over the past four years. The company is focused on continuous improvement and also increasing the productivity further with maximum minimisation of unwanted waste and time.

5.4. SCOPE FOR FUTURE STUDY:

The study can be carried out for individual customers to find out the statistics of each of the customer.

BIBLIOGRAPHY

- C R Kothari, “Research methodology Methods and Techniques”, Wishwa Prakashan, New Delhi, Second Edition, 2001.
- Juran, “Six sigma green belt course material”, Part-1, Pune.
- R.Paneerselvam, Production and Operations management, Second edition, 2005.

Web references:

1. http://www.bimite.co.in
2. http://content.indiainfoline.com/wc/archives/sect/bear.pdf
3. www.bsahome.org
4. http://sisijaipur.gov.in
5. http://uva.ulb.ac.be/cit_courseware/research/chapter6.htm
6. http://www.scribd.com/doc/54686711/124/Percentage-Analysis
7. http://en.wikipedia.org/wiki/Quantitative_research
8. http://scholar.lib.vt.edu/theses/available/etd-12292006-131435/unrestricted/farris_etd.pdf
9. http://wiredspace.wits.ac.za/bitstream/handle/10539/8731/P.Taggart%20-%20MSc%20Report.pdf?sequence=1
10. http://tweakyourbiz.com/growth/2010/10/07/12-ways-to-improve-productivity-at-the-workplace/
11. http://www.lmsi.ca/kaizen.htm

Appendix

DATA COLLECTION FORM

1. **Lean manufacturing:**

Sl.no	Variables	2008	2009	2010	2011
1.	Quantity produced	Average per month 10,06,000 (2008)	Average per month 11,02,000	Average per month 12,03,200	Average per month 13,50,000 (2012)
2.	People movement	High	High	Normal	Low
3.	Idle time of machines	Average per month 1.57 %	Average per month 0.65%	Average per month 0.81%	Average per month 0.65%
4.	Inventory level	Average per month 5.88 Lacks	Average per month 4.58 Lacks	Average per month 4.06 Lacks	Average per month 4.12 Lacks
5.	Defects	Average per month 1.95%	Average per month 1.74%	Average per month 1.23%	Average per month 1.12%
6.	Material movement	High	Normal	Low	Low

2. **Kaizen:**

Sl.no	Variables	2008	2009	2010	2011
1.	Accident level	Nil	Nil	Nil	Nil
2.	Lead time	Average per month 10 days	Average per month 10 days	Average per month 7 days	Average per month 5 days
3.	Defects	Average per month 1.95%	Average per month 1.74%	Average per month 1.23%	Average per month 1.12%
4.	Processing time	Average per batch 5 Hours	Average per batch 5 Hours	Average per batch 4 Hours	Average per batch 4 Hours
5.	Number of shifts	3 Shifts	3 Shifts	3 Shifts	3 Shifts

TO STUDY THE IMPACT OF MODERN MANAGEMENT TOOLS ON THE PRODUCTIVITY OF BIMETAL BEARING LTD

A Project Report

Submitted

By

S.MOHAN

Reg.No.1120400055

Under the guidance of

R.VINAYAGA SUNDARAM

Associate Professor

In partial fulfillment of the requirements

for the award of the degree

of

MASTER OF BUSINESS ADMIISTRATION

Department of Management Studies

Kumaraguru College of Technology

(An autonomous institution affiliated to Anna University, Coimbatore)

Coimbatore -641 049

September, 2012

Certified that this project report titled **"TO STUDY THE IMPACT OF MODERN MANAGEMENT TOOLS ON THE PRODUCTIVITY OF BIMETAL BEARING LTD"** is the bonafide work of **Mr. S.Mohan, 11MBA085,** who carried out the project under my supervision. Certified further, that to the best of my knowledge the work reported herein does not form part of any other project report or dissertation on the basis which a degree or award was conferred on an earlier occasion on this or any other candidate.

Faculty Guide

(R. Vinayaga Sundaram)
Associate Professor
KCTBS

Director

Dr. Vijila Kennedy
KCTBS

Submitted for the project viva-voce examination held on ____________________________

Internal Examiner

External Examiner

DECLARATION

I hereby declare that this project report entitled "**TO STUDY THE IMPACT OF MODERN MANAGEMENT TOOLS ON THE PRODUCTIVITY OF BIMETAL BEARING LTD, COIMBATORE**" has been undertaken for academic purpose submitted to Anna University in partial fulfillment of the requirements for the award of the degree of Master of Business Administration. The project report is the record of the original work done by me under the guidance of **Mr. R. VINAYAGA SUNDARAM, Associate Professor** during the academic year 2012-2013.

I, also declare hereby, that the information given in this report is correct to best of my knowledge and belief.

Date:

Signature

Place: Coimbatore

S.Mohan

ACKNOWLEDGEMENT

I express my sincere gratitude to our beloved chairman **Arutchelvar Dr. N. Mahalingam** and Management for the prime guiding spirit of Kumaraguru College of Technology.

I take this opportunity to extend my sincere thanks and indebtedness to **Dr. Vijila Kennedy,** Director, KCT Business School, for her remarkable guidance.

It gives pleasure to express my sense of gratitude to my Guide **Mr. R. Vinayaga Sundaram,** Assistant Professor, KCT Business School, for his guidance, support and constant source of inspiration during this project.

I thank **Mr. . Muralitharan**, Production manager, Bimetal Bearing Ltd, Coimbatore plant for his valuable support and guidance throughout my project.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

SYNOPSIS

The bearing industry is one of the key sectors that is closely related with the engineering field. The number of engineering industries has increased rapidly in the past decade. Most of the engineering sectors use bearing for their core operation. Therefore the need to improve the production of the bearings and delivering it in a good quality has become essential. Improving the production indicated that there should be increase in the productivity. Productivity is a measure of the efficiency of production. Productivity is a ratio of production output to what is required to produce it (inputs). The measure of productivity is defined as a total output per one unit of a total input.

The study aims at identifying the impact and comparing the productivity of Bimetal Bearing Limited over the time period of 2008 to 2011. This study deals with the measuring of productivity in terms of output/year. The study also compares various factors that directly and indirectly affect the productivity such as lead time, idle time, accidents, defects, etc.

CHAPTER 1

INTRODUCTION

1.1. INTRODUCTION TO THE STUDY:

Productivity is a measure of the efficiency of production. Productivity is a ratio of production output to what is required to produce it (inputs). The measure of productivity is defined as a total output per one unit of a total input. Measuring productivity is done to estimate the performance of the company and the ability of it to earn profit.

In general the productivity in a manufacturing plant is measured in many ways. The following are the few ways of measuring productivity:

- Output/worker
- Output/day
- Output/machine
- Unit cost (total cost/total output)

The study aims at identifying the impact and comparing the productivity of Bimetal Bearing Limited over the time period of 2008 to 2011. This study deals with the measuring of productivity in terms of output/year.

1.2. INTRODUCTION TO THE BEARING INDUSTRY:

The bearing industry has evolved since the time of industrial revolution. The Indian bearing industry has grown steadily in the past years. Bearing industry has a greater impact on the automobile industry all over the world. Improvement in the technology like high speed engines and machines, robotics, etc has led to an increase in the demand for the bearings. The Indian bearing industries manufacture over 500 varieties of bearings.

The bearing Industry in India can be divided into three segments; the organized sector, comprising 12 leading manufacturers, located at Rajasthan, Gujarat, Maharashtra, Andhra Pradesh, Karnataka, Tamil Nadu, West Bengal

and Jharkhand primarily cater to the OEM Segment which are predominantly automotive, Railway and other Industrial users. The use of the bearings depends upon the original equipment manufacturer (OEM) market and the replacement market. The former market accounts for 60 % of the total demand and the remaining demand is accounted towards the later market.

The unorganized sector includes the small scale manufacturers and manufacturers of spurious bearings. The unorganized sector contributes to about 18% of the total Industry turn over. The unorganized sector players have a strong regional presence and mainly cater to the needs of the replacement markets. The Indian bearing Industry is estimated at Rs. 100 billion. The domestic Industry caters to the 74 % of total demand for common varieties & sizes. The organized sector units contribute around 53% of the Industry sales. The imports are about 26% of the total demand of the industry, while about 18% import comes through official channels. There are also estimated 8% illegal imports. Legal imports generally represent the specialized / super precision bearings not manufactured in India. Illegal imports generally represent the entry of spurious imports of bearings. The legal imports are about Rs.1 8.00 billion while the spurious imports are about Rs. 8.00 billion. The small scale units manufacturing bearing are mainly concentrated in Rajasthan and Gujarat having 15 and 50 units respectively. The bearing manufacturing units are also present in Delhi, Punjab, and Maharashtra. The state of Rajasthan has major concentration of about 100 bearing components manufacturing units with 1000 to 1200 Vendors carrying out turning job work.

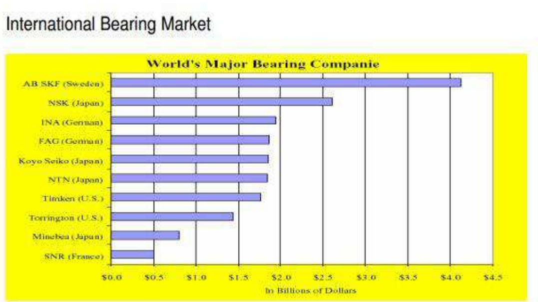
There are substantial No. of component manufacturing units in Gujarat, Maharashtra, West Bengal and Punjab also. The bearing component manufacturing units are the vendors of organized sector, and unorganized sector bearing manufacturing units for supply of inner and outer races, balls, rollers, cages, seals, retainers & rivets. These components are also exported to Europe, United States of America and other global customers.

There are about 450 to 500 number of spurious bearing assembling units situated in the State of Punjab, Delhi and Gujarat, eating the market of

organized & unorganized sector players. A number of global bearing manufacturers have established their units in India through joint ventures or 100% ownership and more are expected to follow suit. The Big player of bearing sector is present in U.S.A, Russia, Japan, China and Eastern Europe. Some of leading bearing manufacturer are:

1. NSK Japan
2. NTN Japan
3. KOYA Seiko Japan
4. FAG Germany
5. SKF Sweden
6. NRB France
7. Timken USA

Fig1.1. International bearing market



1.2.1. Global collaboration:

All the manufacturers in the organised sector have entered into collaboration agreements for supply of complete process know how as well as supply of major manufacturing machinery. The collaboration agreements are still valid and the industry gets all assistance for process, know-how product development, customer development, tool design, production control techniques etc from them. Most of the big player is having either technical or financial Collaboration with leading Auto Manufacturer. International Collaboration gives Access to best technology in the world. The Indian Bearing Industry, especially the companies having technical and financial collaboration with Global player is expected to garner higher price in export market.

Table1.1. Table displaying the bearing companies in India that have foreign collaboration:

Sl.no	Company	Collaboration
1.	SKF Bearings, India	SKF Sweden
2.	FAG Bearing India	FAG, Germany
3.	NRB Bearings	Nadella, France
4.	ABC Bearing Ltd	NSK Japan
5.	TIMKEN India	TIMKEN USA
6.	Bimetal Bearing Ltd	Clevite Corporation USA

7.	Gabriel India	Suspension Italy

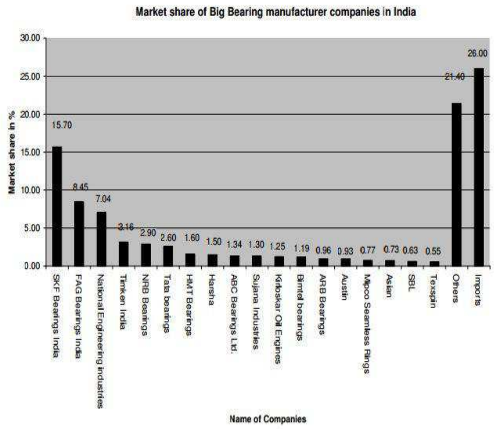
In view of the growing industrial and automobile sector, the growth in this industry is going to be substantial. The requirement of bearings increasing day by day in India in both the OEM and replacement market and increasing number of small manufacturing industries developing in Jaipur (Rajasthan) Rajkot and Surrender Nagar (Gujarat) and Punjab have come up in unorganized sector. These industries are manufacturing from complete bearings to components and supplying to leading players.

The following are the major manufacturers of bearings in India:

1. Associated Bearing Company Ltd., Pune (Maharashtra)
2. Asian Bearings Company Ltd., Hosur (Karnataka)
3. Karnataka Ball Bearing Corporation Ltd., Mysore (Karnataka)
4. Bimetal Bearings Ltd., Hosur (Karnataka)
5. HMT Ltd., Hyderabad (Andhra Pradesh)
6. Tata Iron and Steel Company Ltd., (Bearings Division) Kharagpur (West Bengal)
7. Shriram Bearings Ltd., Ranchi (Bihar)
8. National Engineering Industries Ltd., Jaipur (Rajasthan)
9. FAG Precision Bearings Ltd., Vadodara (Gujarat)
10. Antifriction Bearing Company Ltd. Bharuch (Gujarat) Lonavala (Maharashtra)
11. Union Bearings Manufacturing Co., Porbunder (Gujarat)
12. Needle Roller Bearing Co. Ltd., Thana/Jalna (Maharashtra)
13. Shriram Needle Industries Ltd., Ranchi (Bihar)
14. Deepak Insulated Cables Ltd., Mysore (Karnataka) (Needle Bearings Division)
15. Austin Engg Company Limited Junagadh, Gujarat13
16. Karnataka Ball Bearing Co Ltd., Mysore

17. Mysore Kirloskar Ltd, Harihar (Karnataka)
18. Needle Roller Bearings Ltd, Thane
19. Needle Roller Bearings Ltd., Waluj
20. SKF India Limited, Chinchwad, Pune
21. SKF India Limited, Bommasandra, Bangalore
22. Timken India Limited, Jamshedpur
23. ZKL Bearings India Pvt. Ltd.,
24. NTN (India) Limited

Fig1.2. Major Manufacturers of bearing in India



The Indian bearing industry manufactures the following types of bearings:

1. Ball bearings
2. Cylindrical roller bearings
3. Taper roller bearings
4. Spherical roller bearings
5. Needle roller bearings
6. Magnetic bearings

The following are the few areas where these bearings are utilized:

1. Automobiles
2. Engines
3. Trains
4. Earth movers
5. Pumps
6. Machine tools
7. Textile
8. Electric fans
9. Motors
10. Steel plants
11. Sugar mills
12. Paper mills
13. Power plants

The Government of India has set up bearings cluster for development of unorganized segment in Small and Medium sector and understands the market and quality linkage and makes them competitive and prepares them with the best benchmarking practices in the sector. The future of the bearing industry is bright in India as the automobile companies have started expansion and modernisation. Also to add is the entrance of many foreign car makers in India in the past decade. Moreover India is poised to emerge as the largest manufacturer of cars at the end of 2050.

1.3. INTRODUCTION TO BEARING:

The Bearing is a machine element used in rotating parts of virtually every machine. Bearing permit smooth low friction rotary or linear movement between two surfaces. It employs either a sliding or a rolling action. Bearing can be broadly classified into two segments:

- Bimetal bearings
- Antifriction bearings

Bimetal bearings (also known as engine bearings) are primarily used in engines of automobiles or machines. The bearings are meant to reduce the friction between the moving parts of the engine crankshaft or crank shaft or associated support surfaces.

Antifriction Bearings include Ball Bearings and Roller Bearings. Roller bearings can further be subdivided into tapered roller. Cylindrical roller, Needle roller, thrust bearings and other special application bearings. The main components of an antifriction bearing are the inner race (ring), the other race (ring) the rolling elements, cages (retainers) and seals. The following are the major types of bearing:

a. Ball bearing
b. Cylindrical roller bearing
c. Taper roller bearing
d. Needle roller bearing

1.4. INTRODUCTION TO BIMETAL BEARING LTD (BBL)

Bimetal Bearing Ltd (BBL) is a leading manufacturer of engine bearings, bushings, thrust washers in India. It belongs to the Amalgamation group of companies which was started in the year 1961 in collaboration with Clevite Corporation, USA and Repco Ltd, Australia. The Amalgamations group is one of India s leading engineering conglomerate. BBL and Daiso, Japan entered a joint venture partnership to establish a facility for history. Bimetal Bearing Ltd is represented with the brand name "BIMITE". BBL is denoted by "BIMETAL" in NSE and its BSE code is "505186".

BBL holds the following facts with it:

- 70% market share in India.
- Leader in engine bearing manufacturing in India.
- Modern testing facility.
- In-house integrated manufacturing facilities from alloy powder and bimetallic strips to bearing shells.

Some of the other engineering companies under the group are:

- Simpson & co – manufactures diesel engines,
- Amco batteries – manufactures automotive batteries,
- Mable India pistons – manufactures pistons,
- Tractors & farm equipment ltd – manufactures tractors, etc.

BBL has 3 plants at present, one located in Hosur and the other in Coimbatore. It also has a regional office in Chennai. The Coimbatore plant manufactures:

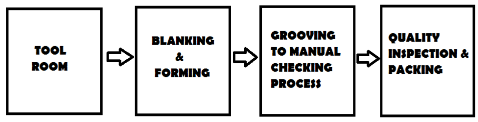
- Engine bearings
- Bushings
- Thrust washers
- Alloy powder and bimetallic strips

The bearings and other components produced by the company are used in passenger cars, MUV's, LCV's, tractors, industrial engines and in two wheelers.

1.4.1. The process:

1.4.1.1. The process flow chart:

Fig 1.3 The process flow chart



THE PROCESS INVOLVED IN BIMETAL BEARING LTD

1. Blanking and forming
2. Chamfering
3. Grooving
4. Piercing
5. Notching
6. Buffing
7. Broaching
8. Measuring
    a. Automatic measuring
    b. Manual measuring
9. Boring
10. Manual checking
11. Packing

The process chart and the raw material shown here may vary depending upon the customer needs.

1.4.1.2. Blanking operation:

- The raw material is in the form of thin sheets and is loaded manually into the set-up which then rolls the sheet into the blanking machine.
- The blanking machine cuts the sheets according to the pre-set measurement.
- The output of this process serves as the output for forming operation.

1.4.1.3. Forming operation:

- The metal strips are then formed into the required shape by using the die and press.
- This produces a U shaped material.

1.4.1.4. Chamfering operation:

- The corners of the U shaped material are chamfered and then the material passes through a series of operation according to the output requirements.
- The finished component is then measured and checked and sent finally for packing.
- The rejected components are reworked if the defects are minor or else it becomes scrap item.

1.4.2. The set – up:

- There are 3 lines in the company.
- Operates for 3 shifts at present.

1.4.3. Key Customers to BBL:

- Hyundai motors India ltd.
- Tata cummins,
- Simpson,
- Maruti gypsy,
- Bajaj auto ltd,
- HM,
- Greaves.

1.5. SCOPE OF THE STUDY:

- The outcome of the study can be utilised for identifying the key areas of improvement like inventory management, lead time reduction, etc.
- The study may lead to prove the importance of implementing the modern tools in the field of production management

CHAPTER 2

LITERATURE REVIEW

[1] **David N. Card** (2006) says that in an era of tight budgets and increased outsourcing, getting a good measure of an organization's productivity is a persistent management concern. Unfortunately, experience shows that no single productivity measure applies in all situations for all purposes. Instead, organizations must craft productivity measures appropriate to their processes and information needs. This article discusses the key considerations for defining an effective productivity measure. It also explores the relationship between quality and productivity. It does not advocate any specific productivity measure as a general solution.

[2] **Jennifer A. Farris** (2006) says the research presents results from a multi-site field study of 51 Kaizen event teams in six manufacturing organizations. Although Kaizen events have been growing in popularity since the mid-1990s, to date, there has been no systematic empirical research on the determinants of Kaizen event effectiveness. To address this need, a theory-driven model of event effectiveness is developed, drawn from extant Kaizen event practitioner articles and related literature on projects and teams. This model relates Kaizen event outcomes to hypothesized key input factors and hypothesized key process factors. In addition, process factors are hypothesized to partially mediate the relationship between input factors and outcomes. Following sociotechnical systems (STS) theory, both technical and social (human resource) aspects of Kaizen event performance are measured. Relationship between outcomes, process factors and input factors are analysed

[1] David N. Card - The Challenge of Productivity Measurement, Pacific Northwest Software Quality Conference, 2006

[2] Jennifer A. Farris - An Empirical Investigation of Kaizen Event Effectiveness: Outcomes and Critical Success Factors, Virginia Polytechnic Institute and State University, 2006

through regression, using generalized estimating equations (GEE) to account for potential correlation in residuals within organizations.

The research found a significant positive correlation between the two social system outcomes (attitude toward Kaizen events and employee gains in problem-solving knowledge, skills and attitudes). In addition, the research found significant positive correlations between the social system outcomes and one technical system outcome (team member perceptions of the impact of the Kaizen event on the target work area). However, none of the three technical system outcomes (employee perceptions of event impact, facilitator ratings of event success and actual percentage of team goals achieved) were significantly correlated.

[3] **Rallabandi Srinivasu** (2009) says that the Statistical Process Control (SPC) methods have been widely recognized as effective approaches for process monitoring and diagnosis. Statistical process control provides use of the statistical principals and techniques at every stage of the production. Statistical Process Control (SPC) aims to control quality characteristics on the methods, machine, products, equipment's both for the company and operators with magnificent seven. Some simple techniques like the "seven basic quality control (QC) tools" provide a very valuable and cost effective way to meet these objectives. However, to make them successful as cost effective and problem solving tools, strong commitment from top management is required. Statistical process control (SPC) is one of the important tools in quality control (QC). In order to survive in a competitive market, improving quality and productivity of product or process is a must for any company.

[3] Rallabandi Srinivasu - Utility of quality control tools and statistical process control to improve the productivity and quality in an industry, International Journal of Reviews in Computing, 2009

[4] **William Gullickson** (1995) says that this article discusses the measurement of multifactor productivity for manufacturing and analyses growth trends within the sector. Through the years, a wide variety of productivity statistics have appeared in the literature, distinguished by the concepts underlying the measurement of output, the methods of aggregation, and the inputs included for analysis. Recent additions of "superlative" indexes of gross domestic product (GDP) by industry to the U.S. National Income and Product Accounts, prepared by the Bureau of Economic Analysis, U.S. Department of Commerce, have enhanced available alternatives for measuring manufacturing productivity. Planned changes in the way BLS measures manufacturing productivity are also discussed. Multifactor productivity growth trends are then examined for the overall manufacturing sector and for 19 two-digit SIC manufacturing subsectors. In particular, early post-war and more recent productivity growth trends are compared. When this comparison was last discussed in 1992, data were available through 1988, covering a period of rapid growth following emergence from the 1982 recession. Because of this growth, multifactor productivity growth seemed to have regained much of its early post-war momentum. It is now possible to examine recent trends more comprehensively because the extended series cover the 1990 business cycle peak, the brief recession that followed in 1991, and a recovery period in 1992. These trends indicate that the productivity growth rates of the early post-war period were not entirely regained during the 1980's.

[4] William Gullickson - Measure productivity growth in US manufacturing industry, Monthly Labour Review, July 1995

[5] **Kanthi M.N. Muthiah** (2006) says that globalisation is posing several challenges to the manufacturing sector. Design and operation of manufacturing systems are of great economic importance. Factory performance remains unpredictable in spite of the considerable literature on manufacturing productivity improvement, and the long history of manufacturing as there is no widespread agreement on how best be performed (Gershwin, 2000). Productivity measurement and improvement goes hand in hand, because one cannot improve what one cannot measure. The review of literature on manufacturing system productivity measurement and improvement has been summarised under four categories; they are Operations Research- (OR-) based methods, system analysis-based methods, continuous improvement methods and performance metrics-based methods. A survey of commercial tools available to measure manufacturing system performance is also performed. The review indicates that quantitative metrics for measuring factory level productivity and for performing factory level diagnostics (bottleneck detection, hidden capacity identification) are lacking. To address this gap, a factory level effectiveness metrics-based productivity measurement and diagnostic methodology is proposed.

[6] **Patrick Taggart (2009)** says that in recent years companies have made increased use of Lean Manufacturing audits to measure the degree of Lean Manufacturing implementation within their organizations. Thereafter, a gap analysis highlights areas for improvement, which leads to increased Operational Performance. This approach may be flawed. The audit may measure Lean Manufacturing characteristics that are not beneficial or the Lean Manufacturing audit may be inaccurate due to auditor bias or inadequate scope. The result is frustration and a lack of belief in the effectiveness of Lean Manufacturing as a

[5] Kanthi M.N. Muthiah - A review of literature on manufacturing systems productivity measurement and improvement, Int. J. Industrial and Systems Engineering, Vol. 1, No. 4, 2006

[6] The effectiveness of lean manufacturing audits in driving improvements in operational performance, University of the Witwatersrand, Johannesburg, 2009

competitive strategy. This study tests the hypothesis that "Lean Manufacturing audits drive improvements in Operational Performance." A sample company comprising sixty four organizations operating in a job shop and Batch operations management environment is used as a case study. The organizations manufacture and service high value added products for heavy industry. The Lean Manufacturing audit developed to assess the effectiveness of Lean Manufacturing audits in driving Operational Performance uses Lean Manufacturing characteristics commonly used in previous research. These characteristics include policy deployment, standardized work, visual management and housekeeping, quick changeover techniques, total preventative maintenance, continuous improvement, error proofing, cultural awareness, material control and level production. Commonly used Operational Performance measures such as On-Time-Delivery, Inventory turns and Direct Labour Utilization are used to assess Operational Performance. A range of independent auditors were used to gather data on the extent of implementation of Lean Manufacturing and Operational Performance measures.

Structural Equation Modelling is used to relate the results of the Lean Manufacturing audits to Operational Performance. This is the first known paper to use Structural Equation Modelling in measuring the extent of implementation of Lean Manufacturing to Operational Performance. Lean Manufacturing audit results have a significant correlation to Operational Performance but with a high degree of variation in Operational Performance not accounted for by the results of the Lean Manufacturing audit. This variation is caused by the inadequate scope of the audit relative to Operational Performance measures as well as auditor bias. Lean Manufacturing audits are effective in driving improvements in Operational Performance provided that the scope of the audit is expanded to include office functions, supplier networks and customer and branch distribution networks. A recommended audit framework is suggested in this research. A large scale study of a number of different companies should be conducted to verify the results of this research using the audit framework developed.

CHAPTER 3

RESEARCH METHODOLOGY

Research may be defined as the search for knowledge through an objective and scientific method of finding solution of problem. Research methodology is a way to systematically solve the research problem. It includes the various steps that are generally adopted by a researcher in studying problem along with the logic behind them. Following research design had been adopted during the research.

RESEARCH DESIGN:

Research design can be defined as the arrangement of conditions for the collection and analysis of data in a manner that aims to combine relevance in research purpose with economy in procedure. It constitutes the blue print for the collection, measurement and analysis of the data. The research design is a collection of the following steps:

- To decide the objective and subjective of the research
- To determine the most suitable method of research
- To determine the sources of data
- To decide the appropriate research instrument for data collection
- To determine the suitable sampling design and sampling size
- To conduct the field survey for data collection
- To prepare the research report

3.1. TYPE OF RESEARCH:

The project is based on qualitative research. Quantitative research aims to measure the quantity or amount and compares it with past records and tries to project for future period. In social sciences, "quantitative research refers to the systematic empirical investigation of quantitative properties and phenomena and their relationships". Quantitative research involves the use of structured

questions, where the response options have been pre-determined. Quantitative research is used to compare with past data.

3.2. OBJECTIVE OF THE SYUDY:

3.2.1. Primary objective:

- To study the impact of modern management tools on the productivity of Bimetal Bearing Limited and to compare the productivity over the past four years.

3.2.2. Secondary objective:

- To compare the inventory level.
- To compare the idle time of the machines.
- To suggest ideas to improve the productivity.

3.3. DATA AND SOURCE OF DATA:

The data collected for the study is primary data that was directly collected from the company.

3.4. TIME PERIOD:

The study was carried out for a span of 6 weeks and the data was gathered in a weeks' time and analysis was carried out for the next 2 weeks.

3.5. STATISTICAL TOOL USED:

- Pie charts
- Bar graphs
- Scatter diagram
- Percentage analysis

3.6. LIMITATION OF THE STUDY:

- The study was carried out for a shorter period of time, so further in depth analysis couldn't be made.

- The study was carried out considering only 2 modern production tools – lean manufacturing and kaizen.
- The data for exact customers couldn't be gathered to find the in depth impact of the production tools on the individual customers.
- Comparison of the productivity before and after the implementation of the modern tools couldn't be done due to the lack of data before the year 2008.
- The data for different years are average of 12 months.

CHAPTER 4

ANALYSIS AND INTERPRETATION

Table 4.1.1: Table showing the annual output for consecutive years

Sl.no	Year	Annual output (units)	Percentage
1.	2008	1006000	21.58 %
2.	2009	1102000	23.64 %
3.	2010	1203200	25.81 %
4.	2011	1350000	28.96 %

TOTAL = 46, 61,200 units 100 %

Fig 4.1.1: Bar graph showing the overall production in terms of % for consecutive years

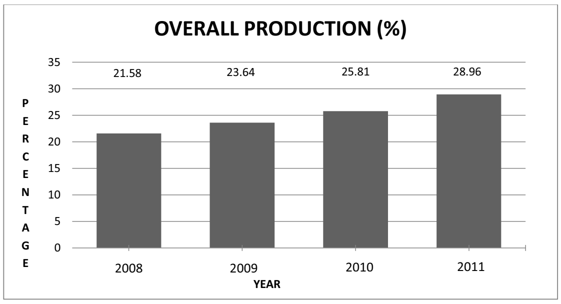
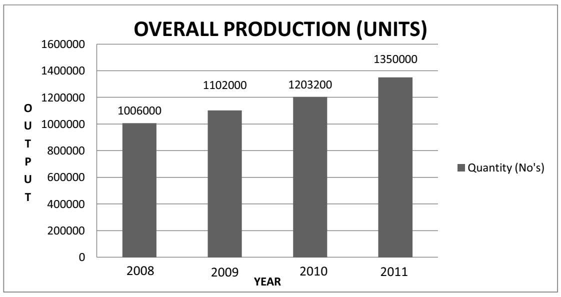


Fig 4.1.2: Bar graph showing the total production for consecutive years



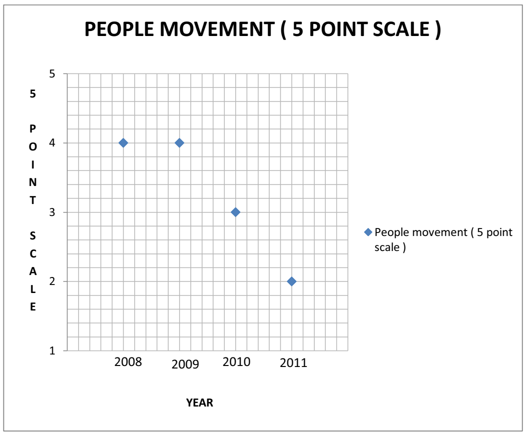
Interpretation:

- Total number of units is in the increasing margin which shows that the productivity of the company is growing and the company is focusing on continuous improvement.
- The maximum output (28.96 %) is in the year 2011 when compared to all the other years.
- It can be predicted that the output for the year 2012 will be higher than that of the year 2011. Again this is a positive indicator for continuous improvement.

Table 4.1.2: Table showing the measurement of people movement (in terms of 5 point scale) inside the plant during consecutive years

Sl.no	Year	People movement (5 point scale)
1.	2008	4
2.	2009	4
3.	2010	3
4.	2011	2

Fig: 4.1.3: People movement inside the plant for consecutive years



Interpretation:

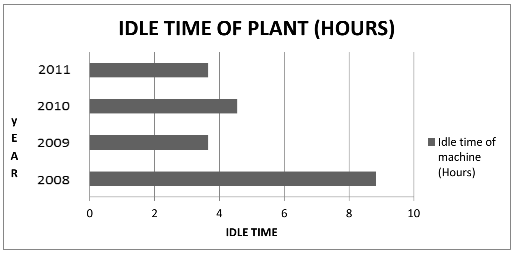
- It is clear that the movement of people within the plant was at the same level during the period 2008 and 2009.
- But the movement of people got reduced comparatively for the next two years (i.e., during 2010 and 2011).

Table 4.1.3: Table showing the total idle time of the plant for consecutive years

Sl.no	Year	Idle time (hours)	Percentage
1.	2008	8.83	42.72 %
2.	2009	3.65	17.64 %
3.	2010	4.55	22.00 %
4.	2011	3.65	17.64 %

TOTAL = 20.68 hours 100%

Fig 4.1.4: Idle time of the plant in hours for consecutive years



Interpretation:

- The idle time of the plant has reduced to a huge extend from the year 2008 to 2011.
- Idle time for the year 2009 and 2011 are almost the same.
- Reduction in the idle time is one of the major factors that leads to increase productivity.
- It can be correlated that the reduction in the idle time in the year 2011 may have led to the increased productivity.

Table 4.1.4: Table showing the inventory level for consecutive years

Sl.no	Year	Inventory (units)
1.	2008	5,88,000
2.	2009	4,58,000
3.	2010	4,06,000
4.	2011	4,12,000

TOTAL = 18, 64, 000 units

Fig 4.1.5: Inventory level maintained in the company for consecutive years (in terms of %)

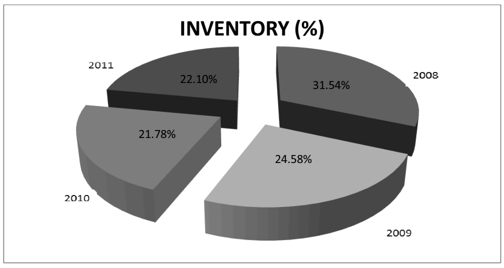
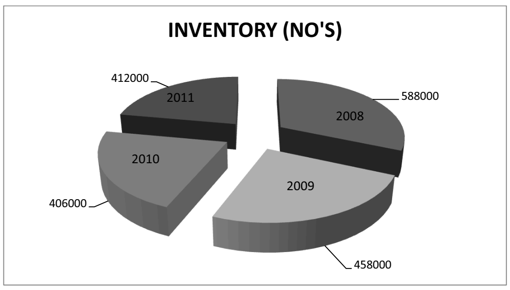


Fig 4.1.6: Inventory level maintained in the company for consecutive years (in terms of units)



Interpretation:

- It is clear that inventory level has been minimized to certain extend year on year basis.
- The inventory level for the year 2011 has been on the rising margin when compared with 2010.

Table 4.1.5: Table showing the defective components produced during consecutive years

Sl.no	Year	Actual output (units)	Defective output (units)
1.	2008	10,06,000	19,617
2.	2009	11,02,000	19,174
3.	2010	12,03,200	14,799
4.	2011	13,50,000	15,120

TOTAL = 4,66,1200 units 68, 710 units

Fig 4.1.7: Comparison between actual output and defective output

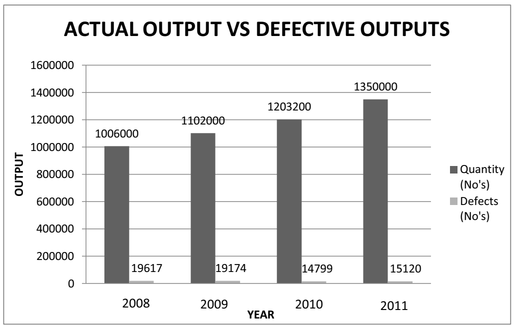
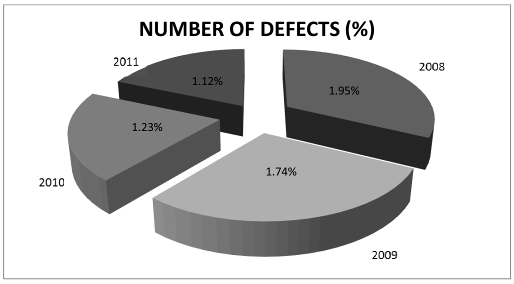


Fig 4.1.8: Number of defects in terms of % of the total output for a year



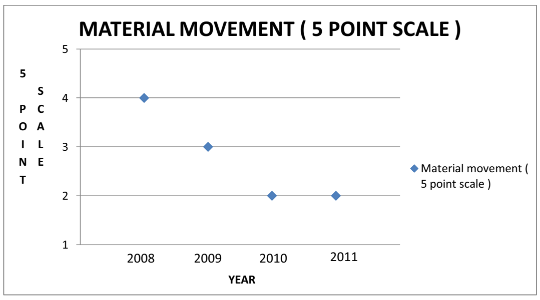
Interpretation:

- More defective components were produced during the year 2008 (1.95 %) in terms of % and the number is minimum during the year 2011 (1.12 %).
- Reduction in the defects indicates that the company is trying to avoid waste and also focuses on continuous improvement.

Table 4.1.6: Table showing measurement of material movement within the plant

Sl.no	Year	Material movement (5 point scale)
1.	2008	4
2.	2009	3
3.	2010	2
4.	2011	2

Fig 4.1.9: Material movement within the plant (in terms of 5 point scale)



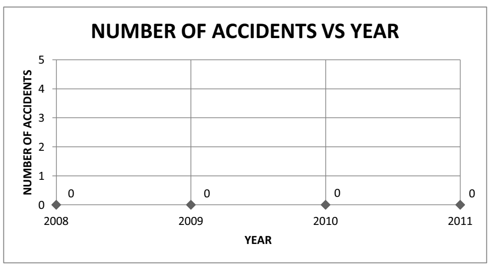
Interpretation:

- The unwanted movement of material within the plant as well as outside the plant has been on the dropping note.
- The graph indicates that the level of movement of material is the same for the last 2 years i.e. during the year 2010 and 2011.

Table 4.1.7: Table showing the number of accidents during consecutive years

Sl.no	Year	Number of accidents
1.	2008	0
2.	2009	0
3.	2010	0
4.	2011	0

Fig 4.2.0: Number of accidents occurred during consecutive years



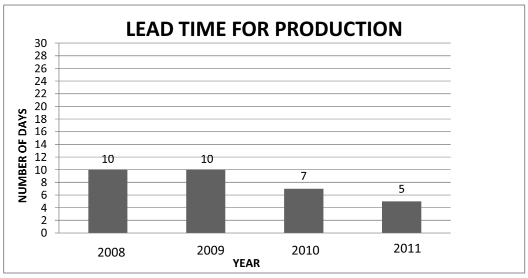
Interpretation:

- The accident level remains zero throughout the four years which is a good indication for the level of safety in which the plant operates.

Table 4.1.8: Table showing the lead time for producing the bearings

Sl.no	Year	Lead time (days)
1.	2008	10
2.	2009	10
3.	2010	7
4.	2011	5

Fig 4.2.1: Lead time for production for consecutive years



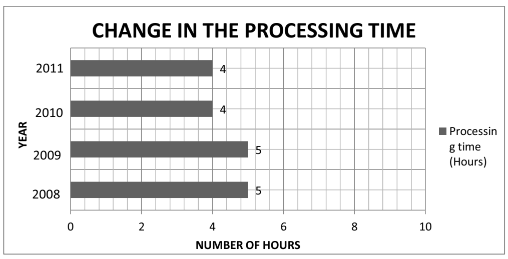
Interpretation:

- There has been a change in lead time from the year 2008 to 2011.
- The lead time remains the same for the year 2008 and 2009.
- But it has reduced consistently during the year 2010 (7 days) and 2011 (5 days).

Table 4.1.9: Table showing the average processing time for a batch during consecutive years

Sl.no	Year	Processing time (hours)
1.	2008	5
2.	2009	5
3.	2010	4
4.	2011	4

Fig 4.2.2: Processing time difference for consecutive years



Interpretation:

- The processing time during the year 2008 and 2009 are the same which has led to the reduced productivity when compared to the years 2010 and 2011.

CHAPTER 5

FINDINGS AND SUGGESTIONS

5.1. FINDINGS:

- The overall productivity has increased from 21.58 % during 2008 to 28.96 % during 2011.
- The productivity is continuously increasing i.e. 21.58 % in 2008, 23.64 % in 2009, 25.81 % in 2010 and 28.96 % in 2011.
- The idle time of the plant has been reduced to 17.64 % (2011) from 42.72 % (2008).
- Inventory level was on the declining side from 2008 to 2010. But during the year 2011 the inventory level has been increased from 4, 06, 000 units to 4, 12, 000 units.
- The number of defective components produced has been reducing over the past four years i.e. from 1.95 % in 2008, 1.74 % in 2009, 1.23 % in 2011 and 1.12 % in 2011.
- Movement of material within the plant has reduced from high (2008) to low (2011) with respect to the 5 point scale.
- Movement of people within the plant has reduced from high (2008) to low (2011) with respect to the 5 point scale.
- Accident level has remained constant for all the four years respectively.
- Lead time for production has reduced from 10 days during 2008 to 5 days during 2011.
- The processing time has come down to 4 hours per batch (2011) from 5 hours per batch (2008).

5.2. SUGGESTIONS:

- The inventory level may be maintained at suitable level depending upon the market demand.
- The company may upgrade to 6 sigma level from 4 sigma level to reduce the variation in the products.

- Number of defects may be reduced by adopting modernisation techniques like automation.
- People movement and material movement can be reduced further if the 5 S is fully adopted.

5.3. CONCLUSION:

Conclusion drawn from the study is that the modern production tools have a positive impact on the company. Productivity of the company is on the rising margin over the past four years. The company is focused on continuous improvement and also increasing the productivity further with maximum minimisation of unwanted waste and time.

5.4. SCOPE FOR FUTURE STUDY:

The study can be carried out for individual customers to find out the statistics of each of the customer.

BIBLIOGRAPHY

- C R Kothari, "Research methodology Methods and Techniques", Wishwa Prakashan, New Delhi, Second Edition, 2001.
- Juran, "Six sigma green belt course material", Part-1, Pune.
- R.Paneerselvam, Production and Operations management, Second edition, 2005.

Web references:

1. http://www.bimite.co.in
2. http://content.indiainfoline.com/wc/archives/sect/bear.pdf
3. www.bsahome.org
4. http://sisijaipur.gov.in
5. http://uva.ulb.ac.be/cit_courseware/research/chapter6.htm
6. http://www.scribd.com/doc/54686711/124/Percentage-Analysis
7. http://en.wikipedia.org/wiki/Quantitative_research
8. http://scholar.lib.vt.edu/theses/available/etd-12292006-131435/unrestricted/farris_etd.pdf
9. http://wiredspace.wits.ac.za/bitstream/handle/10539/8731/P.Taggart%20-%20MSc%20Report.pdf?sequence=1
10. http://tweakyourbiz.com/growth/2010/10/07/12-ways-to-improve-productivity-at-the-workplace/
11. http://www.lmsi.ca/kaizen.htm

Appendix

DATA COLLECTION FORM

1. **Lean manufacturing:**

Sl.no	Variables	2008	2009	2010	2011
1.	Quantity produced	Average per month 10,06,000 (2008)	Average per month 11,02,000	Average per month 12,03,200	Average per month 13,50,000 (2012)
2.	People movement	High	High	Normal	Low
3.	Idle time of machines	Average per month 1.57 %	Average per month 0.65%	Average per month 0.81%	Average per month 0.65%
4.	Inventory level	Average per month 5.88 Lacks	Average per month 4.58 Lacks	Average per month 4.06 Lacks	Average per month 4.12 Lacks
5.	Defects	Average per month 1.95%	Average per month 1.74%	Average per month 1.23%	Average per month 1.12%
6.	Material movement	High	Normal	Low	Low

2. **Kaizen:**

Sl.no	Variables	2008	2009	2010	2011
1.	Accident level	Nil	Nil	Nil	Nil
2.	Lead time	Average per month 10 days	Average per month 10 days	Average per month 7 days	Average per month 5 days
3.	Defects	Average per month 1.95%	Average per month 1.74%	Average per month 1.23%	Average per month 1.12%
4.	Processing time	Average per batch 5 Hours	Average per batch 5 Hours	Average per batch 4 Hours	Average per batch 4 Hours
5.	Number of shifts	3 Shifts	3 Shifts	3 Shifts	3 Shifts