



COMPARISON STUDY BETWEEN CONVENTIONAL AND NON-CONVENTIONAL
FOUNDRIES WITH RESPECT TO NEW TECHNOLOGY ON PRODUCTIVITY



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A PROJECT REPORT

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BONAFIDE CERTIFICATE

Certified that this project report titled "comparison study between conventional and non-conventional foundries with respect to new technology on productivity" is the bonafide work of **Mr. Jayakumar M, Reg no: 1120400040** 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 of which a degree or award was conferred on an earlier occasion on this or any other candidate.

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DECLARATION

I affirm that the project work titled "comparison study between conventional and non-conventional foundries with respect to new technology on productivity" being submitted in partial fulfilment for the award of Master of Business Administration is the original work carried out by me. It has not found the party other project work submitted for award of any degree or diploma, either in this or any other university.

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I certify that the declaration made above by the candidate is true.

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SYNOPSIS

Nowadays most of the manufacturing industries are modernised. In this study the companies are selected based on conventional sampling, i.e. one from each of the conventional and non- conventional company.

The ultimate aim of this study is to analyse the importance of modern technologies in foundries based on their productivity. The study is also focuses on the importance of new technology within the non-conventional foundry and also the comparison study between the two companies.

This study will be helpful to analyse and compare the company with their competitors and if they have some new successful technology they can adapt it from their competitors. The study also finds that the company can increase their productivity, quality and reduce their waste.

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CHAPTER 1

INTRODUCTION

1.1 ABOUT THE STUDY

The Indian Foundry industry produces approx **7 Million MT of castings** employing estimated 500,000 persons directly & another 1.5 million indirectly. The growth of foundry industry is very important for inclusive growth, other engineering sectors & the overall Indian Economy.

Coimbatore cluster

Apart from the local pump industry, Coimbatore cluster focuses on customers from textile and automobile industries also. The fortunes of small-scale foundries in Coimbatore fluctuate with that of the pump industry. Coimbatore foundries have more export opportunities to tap with growth in the end user segment. Coimbatore foundry cluster has about 620 units and most of them are small-scale. They produce 40,000 to 45,000 tons of castings a month. The proposal of this study is to explain the production process inside the foundries and the importance of modern technologies in foundries and study of the technology which is implemented in the foundry. This paper also concentrates on how the new technologies help us to increase the productivity and the profitability of the foundries. It has been done with the help of the data collected from the two reference companies. The reference companies are selected based on the conventional and non-conventional categories. The companies are "AMMARUN foundries, Coimbatore & LAKSHMI REKHA foundries, Coimbatore".

1.2 COMPANY PROFILE:

The foundry was established in the year 1991. It is a large ferrous foundry setup located in southern part of India. It's an ISO /TS 16949:2002 registered firm.

- AF went in to commercial production to meet the growing need for intricate castings of the region and of the country on the whole.

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- Nowadays most of the manufacturing companies are go with the modern technologies to cope up with the recent trends and to satisfy the customer's needs and demands in an efficient manner.
- This method will increase the productivity and the profitability to the company. Above all this method is used to compete with the competitors and to develop the brand value of the company.
- Hence it is important to study about the modern technologies in foundries and this study will create awareness about modern technologies for conventional foundries and it will be helpful to them in future.

- Committed to high technology from the very start, AF over the years has grown to become a large Jobbing Ferrous Foundry in Southern India.

Production capabilities to turnout large volume castings of Grey Iron and Ductile iron to the tune of 15000 metric tonnes/annum. Today, the Foundry caters to the requirements of various segments ranging from Automotive, tractor, valve, Motor and Pump, Textile and General Engineering Industries

Apart from serving Domestic market, AF has gone Global and has a strong international presence. In its Quest for excellence AF continuously absorbs new technologies(ERP, ISO/TQM/SPECTRO/SPC, LEAN MANUFACTURING, KAIZEN/5S, AUTOMATION, JUST IN TIME)/adopts to changing customer Focus, which has made it ' Most dependable Foundry ' in Southern India. Apart from the above, AF today has a strong managerial man power heading various functional areas of Foundry operations and motivated employees on the whole to engineer the growth of the Foundry

1.3 STATEMENT OF THE PROBLEM

Due to more demand there are so many new foundries are still emerging in and around the Coimbatore city of more capacity with new technologies. It affects the existing foundries. To cope up with the new foundries, the existing foundries should focus on their technology/production part rather than the other areas.

Nowadays the non-conventional foundries are also performing well, But the wastage in their productivity is more, overall productivity is comparatively less and the time taken is very much high. This study is to quote the importance of modern technology in terms of productivity.

1.4 NEED AND SCOPE OF THE STUDY:

- India is the second largest Nation in terms of more contribution through foundries (next to china).

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CHAPTER 2

REVIEW OF LITERATURE

*Dr. B. Ravi:

This paper attempts to answer the question: "Is CAD/CAM necessary and economically justifiable for small and medium foundries?" by focusing on four aspects: key developments, benefits, bottlenecks and strategies. Key developments in computer-aided product design, casting design, simulation, rapid tooling, intelligent advisory systems and Internet-based collaboration are reviewed, supported by relevant vendor information. Immediate tangible benefits (shorter lead-time, higher productivity and lower rejections), and long-term intangible benefits (better image, higher confidence and stronger partnerships) are illustrated with suitable examples. Various factors hindering small and medium foundries in fully adapting CAD/CAM technologies are examined. These include external factors (price, manpower availability and technical support) as well as internal factors (perceived need, culture clash and integration). Finally, an explore-adopt-adapt-integrate strategy is outlined to spread the risk/investments and allowing more time to assimilate and fully utilize the technology.

*R. M. Torielli, R. A. Abrahams, R.W. Smillie and R.C. Voigt:

Lean manufacturing is often seen as a set of tools that reduce the total cost and improve the quality of manufactured products. The lean management philosophy is one which targets waste reduction in every facet of the manufacturing business;

1. Associate Professor of Mechanical Engineering, In-Charge, Casting Simulation Laboratory, Co-Founder, Rapid Prototyping & Tooling Cell, Guest Faculty, School of Management, "CAD/CAM Revolution for Small and Medium Foundries", 48th Indian Foundry Congress, Coimbatore, February 11-13, 2000.
2. Industrial and Manufacturing Engineering Department, The Pennsylvania State University, University Park, PA 16802, USA; 2. RWS Productivity & Consulting, L.L.C., Northville" Using lean methodologies for economically and environmentally Sustainable foundries" MI 48168, USA

However, only recently have studies linked lean management philosophies with improving environmental sustainability. These studies suggest that lean manufacturing is more than a set of lean tools that can optimize manufacturing efficiencies; it is a process and mindset that needs to be integrated into daily manufacturing systems to achieve sustainability. The foundry industry, as well as manufacturing in general, has significant challenges in the current regulatory and political climate with developing an economically and environmentally sustainable business model. Lean manufacturing has proven itself as a model for both economic sustainability and environmental stewardship. Several recent studies have shown that both lean and green techniques and "zero-waste" policies also lead to reductions in overall cost. While these strategies have been examined for general manufacturing, they have not been investigated in detail for the foundry industry. This paper will review the current literature and describe how lean and green can provide a relevant framework for environmentally and economically sustainable foundries. Examples of lean and green technologies and techniques which can be applied to foundries in a global context will be described.

***Fawaz Abdhullah:**

The research was based on the application of lean manufacturing concepts to the continuous production/process sector with a focus on steel industry. Goal of the research was to investigate how lean manufacturing tools can be adapted from the discrete to the continuous manufacturing environment and to evaluate their benefits on a specific application instance.

3. BS in mechanical engineering, university of south Carolina, 1996 and MS in industrial engineering, university of Pittsburgh, 1999, "**Lean Manufacturing Tools And Technologies In The Process Industry With A Focus On Steel**", university of Pittsburgh, 2003.

The paper clearly explained that the output efficiency of the pouring system. It has been measured that the Overall production jumped from 100 tons per day to 120 tons per day shortly after the automatic pouring system was commissioned. When more melting/holding capacity was added to the melt shop, the automatic pouring system was able to process 160 tons of production per day.

***Milan Horacek, Ondrej Charvat, Tomas Pavelka, Josef Sedlak, Martin Madaj, Jindrich Nejedly, and Jan Dvoracek**

The paper explains about the production technology of knee joint replacement by using rapid prototyping technology. The aim of the work is to outline the manufacturing technology intended for prototype production with the use of rapid prototyping and investment casting technology for use in orthopaedics and the surgery of knee joint replacement. The research results should make an effective contribution in the attempts to minimize the invasive surgical procedure, shorten the production of knee joint replacement as well as reduce the cost. At present, the research is focused on the preparation of STL data from CT (Computed Tomography) and verification of the production technology of prototypes made using available RP technology and its evaluation.

*** R. Vinayagasundaram¹, V. R. Nedunchezian¹**

The research was based on the importance of modern technology and its impact on profitability and productivity. The paper mainly concentrated on the contribution of Indian foundries to all over the world.

6. Faculty of Mechanical Engineering, Institute of Manufacturing Technology-Department of Foundry Engineering, Brno University of Technology, Technická 2896/2, 616 69 Brno, Czech Republic, Feb. 2011

7. Associate Professor, Business School, Kumaraguru College of Technology, Coimbatore. "**Application of Modern Technology in Foundries and its Impact on Productivity and Profitability**", 2012

***Douglas G. Smith, *Ernest M. Burgess:**

The report explains the current clinical uses of CAD/CAM in prosthetics and orthotics. To achieve the study they have conducted interviews to contrast patterns of CAD/CAM use in different private practice settings, at two different teaching institutions and within two large Prosthetic and Orthotic delivery systems. Investigation into those patterns of use has revealed several lessons to them. First, the fabrication techniques that are currently being used with CAD/CAM systems are still rather traditional techniques. Most devices are still laminated or formed over computer carved models. Although research continues into advanced fabrication techniques, the prosthetics and orthotics industry has not yet taken advantage of the possibilities in the computer-assisted manufacturing side of the equation. Second, a growing number of prosthetic and orthotic devices are successfully being fabricated and fit with CAD/CAM technology after starting the process with simple measurements instead of casted, scanned, or digitized exact anatomic data. Third, the business of manufacturing and selling up-to-date CAD/CAM equipment and software has a tremendous impact on how this technology is used in prosthetics and orthotics.

***Sanjay Paranjape, P. D. Chaubal**

The main objective of the paper was to explain about how the modern technology (automation pouring technology) helps Mahindra Hinoday Ind, to increase their productivity.

4. MD; 2.MD, PhD, University of Washington; Prosthetics Research Study, and the Amputee Coalition of America, Seattle, WA. "**The use of CAD/CAM technology in prosthetics and orthotics- Current clinical models and a view to the future**" Journal of Rehabilitation Research and Development Vol. 38 No. 3, May/June 2001, Pages 327-334

5. Vice President - Operations, Mahindra Hinoday Industries Ltd.; 2. Product Manager, Inductotherm India Pvt. Ltd, "**Automatic Pouring Systems Boosts Output at Mahindra Hinoday Ind**", June 2010.

According to the study India is the second largest producer of castings next to china. They compared conventional foundry (Non technology) and technology foundry estimate the profitability. By using the Statistical package (SPSS and MINITAB) the Wilcoxon signed rank test and Chi-square test were analyzed. By the conclusion modern technology plays an important role in emerging foundries in terms of productivity and profitability.

***Tuncer Ören¹, Professor Emeritus¹**

The paper explained about the Examples to the growing importance of modelling and simulation (M&S) are given. The implications are highlighted in three categories: (1) Professional implications, (2) Ethical implications, and (3) Desirable research and development (R&D) areas in science, methodology, and technology of modelling and simulation; trustworthiness, reliability, quality, and efficiency in modelling and simulation; application areas; consolidation and dissemination of modelling and simulation knowledge; and modelling and simulation professionalism.

***Enikő LEGEZA¹**

The study explains about the importance of quality logistics, Because of the sophisticated characteristics of logistics it is difficult to survey the needs of customers and to create a comprehensive quality requirements system. On the joint points of logistics chain we always find a seller-buyer relation. The buyer has his quality requirements to be satisfied by the seller.

8. Ottawa Center of the McLeod Institute of Simulation Sciences of the SCS, School of Information Technology and Engineering University of Ottawa, Ottawa, Ontario, Canada, "**Growing Importance of Modelling and Simulation: Professional and Ethical Implications**"

9. Department of Transport Economics, Budapest University of Technology and Economics, "**MEASUREMENT OF LOGISTICS-QUALITY**"

***Warren Kriesel and Kevin T. McNamara**

Quality measuring indicators will be suggested in the following three areas: logistics facilities, logistics process, sub processes, human factors, management and organization. They had been analyzed by a logistics performance and logistics costs matrix. The ultimate aim of the study is to explain the importance of quality characteristics. The Empirical analysis of manufacturing plant location requires the use of a single industrial site quality measure. Under hedonic price theory, the price of Weber's sites can be explained by their quality characteristics. The estimated site price is included with ten other location factors in an ordered, categorical logit model of plant attraction to Georgia counties. The results inform public decision makers the relative impact of site location factors and how changes in location factors can alter the probability attracting a manufacturing plant.

*** Robin Ford¹**

This research project examines the principles now widely used in manufacturing-Lean, Kaizen, and Six Sigma, and explores how they would apply to the day to day operations within the Ocala Police Department. This study presents the results of a survey administered to both sworn and non-sworn supervisors of the Department and presents their current problems and views regarding the principles and how they would apply to their respective areas of responsibility. This study presents a positive view supporting the concept that using the methodologies of Lean, Kaizen, and Six Sigma could benefit the Ocala Police Department and improve its customer service.

10. "A COUNTY-LEVEL MODEL OF MANUFACTURING PLANT RECRUITMENT WITH IMPROVED INDUSTRIAL SITE QUALITY MEASUREMENT", SOUTHERN JOURNAL OF AGRICULTURAL ECONOMICS, JULY 1991

11. ¹bachelor's degree from St. Leo University and a Master's Degree in Criminal Justice from the University of Central Florida, " **A Study of Using the Principles of Lean, Kaizen, and Six Sigma at the Ocala Police Department to Improve Customer Service to the Community**".

CHAPTER 3

RESEARCH METHODOLOGY

3.1 TYPE OF RESEARCH

Type of research used here is both analytical and descriptive methodology.

3.1.1 Primary research

A research is also classified as primary and secondary research depending on the type of data used. If the data is primary, i.e. collected for the study, it is called primary. In this study the data has been collected primarily, based on the questions framed.

3.1.2 Descriptive research methodology

Anything which describes the data is labeled as descriptive research, i.e. it includes mean, median, mode, standard deviation, measure of skewness, etc. In this study we use mean formula to find out the tons/month, output efficiency, etc.

3.2 OBJECTIVE OF THE STUDY:

Primary objective

1. The ultimate aim of the study is to find the increase in productivity due to modern technologies (such as CAD/CAM, SIMULATION, ERP, ISO/TQM/SPECTRO/SPC, LEAN MANUFACTURING, KAIZEN/5S, AUTOMATION)
2. The study is to find whether the productivity of the foundry is increased due to modern technologies or not.

Secondary objective

1. Compare the technological and non-technological data in terms of productivity.

3.3 DATA AND SOURCE OF DATA

The data which is collected from the company is completely primary. It doesn't depend on any other document or any other report. The question

***R. E. Smith¹**

The research project sought to review what some of the lean practices within one of South Africa's financial institutes are. The research examined how performance could be further improved by expanding on the existing lean methodology.

The empirical study revealed the prevalence of some of the best practices identified in the literature review, in the cash centres. The study went about identifying which tools are applicable in cash centres. The study concludes that all the tools reviewed, are applicable in the product part of the cash centre. The study also concludes that there is scope for making improvements to the current environment by using lean tools, and that the application of a lean philosophy would enhance virtually all aspects of the cash centre operation.

***Gunasekaran.S**

The main objective of the paper is to explain the importance of complete automation in food processing industry, as the other field of industries has been emerged or still emerging with computer and complete automation. The author focused on the rapid advances in computer technology and heightened expectations of consumers and regulatory agencies for improved food quality and safety have forced the food industry to consider automation of most manufacturing process.

12. Faculty, business and economic sciences at the Nelson Mandela Metropolitan University, "Application of lean manufacturing tools in cash centers to improve operational efficiency", Jan 2011.

13. Department of biological systems engineering, university of Wisconsin- Madison, USA, " AUTOMATION OF FOOD PROCESSING"

has been framed to collect the data. According to the questionnaire the past and the present data was collected. The same process has been done in both of the companies (conventional and non-conventional company).

3.3 TIME PERIOD COVERED

Total time period to taken to frame the questionnaire and to collect the data from conventional and non-conventional foundries was 42 days, i.e. from June 26, 2012 to Aug 6, 2012.

3.4 POPULATION AND SAMPLE SIZE

The sample size of this study is two companies. They are the following,

1. **Ammarun foundries, Coimbatore &**
2. **Lakshmi rekha foundries, Coimbatore.**

3.5 SAMPLING TECHNIQUE

In this study the above sample company has been selected based on "conventional sampling". The following companies have been selected on the basis of objective of the study. The objective of the project is to compare the conventional and non-conventional foundries in terms of their productivity. Since we need the data for both conventional and non-conventional foundry, the sample taken is as follows,

- a. **Non-conventional foundry(Ammarun foundries, Coimbatore)**
- b. **Conventional foundry(Lakshmi rekha foundries, Coimbatore)**

3.6 STATISTICAL TOOLS USED

The analysis part includes the following statistical tools.

1. **Percentage analysis through SPSS**
2. **Productivity =output/input in%**

3.7 LIMITATIONS OF THE STUDY

The ultimate limitations of this study would be the following,

1. In this study the main comparison is between past and present data of the non-conventional company itself. This will not be satisfied for all the companies
2. The other comparison is the productivity between conventional and non-conventional foundries. But the size of the two samples is not equal. One company is 10 years old and the other company is just 3 years old. Hence comparing the above two companies is not fair.
3. Both the companies are not maintaining the proper report. All the data is collected from different person from different departments. So the data which is collected may not be accurate.

Though the above process appears to be simple, the foundry men will have to take care of about number of parameter, right from selection of raw materials to dispatch and demands technical knowledge for obtaining better quality castings. Hence it requires the help of modern technology to improve the efficiency of the foundry for all the above mentioned process.

4.1.1 TECHNOLOGY MANAGEMENT

Advanced Manufacturing technology facilities in foundry include Automation level, Melting facility and supporting facilities for heat treatment, machining, and testing. A high level of automation enables the foundries with higher consistency, accuracy, and production rate. The level of automation can be judged by the type of facilities available for sand preparation (manual, Muller, or sand plant), Moulding (manual, mechanical or automated) Pouring (manual, controlled or automatic), mould handling (batch transport, continuous by conveyor), and fettling. The melting equipments criterion is evaluated based on the type of melting facilities available in the foundry. The type of furnace should be compatible with the material and quality requirements of the casting. Cupola may be acceptable for melting cast iron, whereas induction furnaces are preferred for steel and ductile iron and other factors that may be taken into account while choosing a furnace include melting cost, melting rate, melting cycle time, melt capacity requirement, energy consumption, and furnace efficiency.

Table 4.1: Modern Technologies in foundries

Sl.No	Modern Technology	Year of implementation
1	CAD/CAM (Computer-Aided Casting)	Outsourcing
2	Simulation (Casting Modeling Software)	Outsourcing
3	ERP (Enterprise Resource planning)	2009
4	ISO,TQM , SPC and Spectro (QMS and Modern testing equipments)	2002
5	Lean manufacturing (Waste elimination)	2006
6	Kaizen, 5s (Continuous improvement)	2006
7	Automation (Robotic application)	2009

CHAPTER 4
ANALYSIS & INTERPRETATION

4.1 MS excel ANALYSIS

Foundry deals with the process of making casting in moulds formed whether sand or some other material. Casting process is basically one of introducing molted metal into a cavity in the mold, previously shaped as desired and allowing it solidifies. The whole process of producing castings may be classifies into six stages -

i) **Designing system:** Method and Gating: The design supplied by customer is further designed to provide with necessary allowances and selection of parting line. Method and gating are the tools for achieving this process while methoding consists of feeders, which compensates the shrinkage in the castings; the gating system consists of spruce and runner and in gates which allows the molten metal into the mold.

ii) **Pattern making:** Replica of the castings is prepared on the basis of drawings given by the customers. Patterns are made with wood and aluminum.

iii) **Molding and Core making:** Moulds are prepared in the sand with the help of patterns to get the same shapes to pattern. Core making will be useful for getting hollowness in the casting.

iv) **Melting and Casting:** Metals will be melted in suitable furnaces to get the required composition and molten metal will be poured into the molds.

v) **Fettling:** After solidification of castings, these will be removed from mold boxes and unwanted metal attachments like runners and raisers will be removed and sand adhered to the castings will be cleaned.

Later these castings will be sent for further operations like heat treatment and machining.

vi) **Testing and Inspection:** Before dispatching of the castings, visual and dimensional inspection carried out. As per customer requirement non destructive test like ultrasonic radiography tests are carried out to know the internal soundness of the castings.

In this study we are not going to concentrate on CAD and SIMULATION technology. The companies are not having both the technologies, they going for outsourcing. Hence they are concentrating on other technologies. They are the following,

4.1.2 ENTERPRISE RESOURCE PLANNING (ERP)

ERP is the dominant application system for manufacturing information management. However, because investment, labour, energy and material costs are continuously increasing, and obtaining higher prices for shorter delivery times, smaller lot sizes or higher quality is extremely difficult, many foundries are looking for further opportunities to improve profitability. In this situation, implementation of ERP will help for intelligent data gathering and evaluation and process optimization, based on more process information.

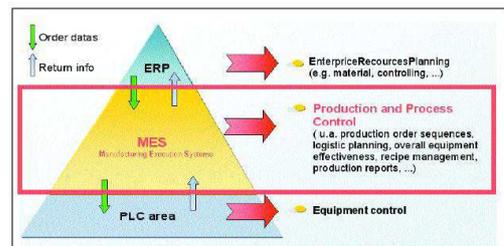


Figure 4.1: Enterprise resource planning advantages

- ◆ The parameters taken to analysis the benefits of Enterprise resource planning technology before and after implementations are: Improved manufacturing efficiency, Overall cost reduction (Rs), Material Planning Accuracy (Percentage), Annual Inventory cost (Rs), Lead time (T), Human resource in material planning(No's).

Table 4.2: Data analysis of ERP

ERP	Before		After	
	Before	After	Before	After
MANUFACTURING EFFICIENCY (%)	85	90	85	90
CUSTOMER SATISFACTION (IN %)	80	90	80	90
MATERIAL PLANNING ACCURACY (IN %)	87.5	96.5	87.5	96.5
OVERALL COST REDUCTION(in LAKHS)	9	5.4	100	60
ANNUAL INVENTORY COST (in Cr)	17.1	8.55	100	50
LEAD TIME(IN WEEKS)	3	1.5	100	50.00
NUMBER OF HUMAN RESOURCE	5	3	100	60

4.1.3 ISO CERTIFICATION, TQM, SPC AND MODERN TESTING

4.1.3.1 ISO CERTIFICATION

ISO 9000 is a series of international standards developed by the International Organization for Standardization for Quality Management and Assurance. ISO 9000 standards measure quality of management. These standards do not have any specific procedure and technology. Their stress is in the areas where firms need quality standards and make organizations responsible for providing the standards. ISO 9000 meets the requirements of most customers and sets the foundation for further development of management approaches to cope with the need for upgrading the capacity. The latest ISO 9001:2000 revision is based on the eight quality management principles: customer-focused organizations; Leadership; Involvement of people; Process approach; System approach to management; Continual improvement; Factual approach to decision-making; and Mutually beneficial supplier relationships.

4.1.3.2 TOTAL QUALITY MANAGEMENT

Total quality management (TQM) refers to management methods used to enhance quality and productivity in organizations, particularly businesses.

Table 4.3: Data analysis of ISO, TQM and SPC

ISO.TQM.SPC	Before		After	
	Before	After	Before	After
EXPORT BENEFITS	2	10	100	500.00
EXPORT/INCREASED TURNOVER (IN %)	10	25	100	250.00
REJECTION RATE(IN %)	15	5	15	5
LEAD TIME	3	1	100.00	33.33
INSPECTION TIME(IN Hrs)	2	1	100	50.00
DOCUMENTATION PROCESS(IN Hrs)	2	0.5	100	25.00

4.1.4 LEAN MANUFACTURING

Lean manufacturing defines seven types of waste that make a production system inefficient and costly. These are:

- Over-production:- Producing too much, too soon.
- Inventory:- Extra production required to buffer process variability.
- Transportation:- Movement of materials without adding value.
- Waiting:- Increasing production cycle time without adding value.
- Movement:- Movement of operators without adding value.
- Defects:- Product that does not conform to customer specifications.
- Over-processing:- Processing a material more than is necessary to meet customer specifications.

The root causes of these wastes may be identified by means of fishbone (Ishikawa) diagrams (Figure 2). They can be used as "straw models" to identify the root causes of wastes in your specific value stream and then the appropriate methodology/tool can be applied to address it.

Lean manufacturing in the foundry

The following parameters were identified to analyze the benefits due to implementation of lean manufacturing in foundries: Waste (Percentage), Profitability (Rs), Waiting time (T), Inventory cost (Rs), Rejection rate (Percentage)

TQM is a comprehensive system approach that works horizontally across an organization, involving all departments and employees and extending backward and forward to include both suppliers and clients/customers. TQM is only one of many acronyms used to label management systems that focus on quality. Other acronyms that have been used to describe similar quality management philosophies and programs include CQI (continuous quality improvement), SQC (statistical quality control), QFD (quality function deployment), QIDW (quality in daily work), and TQC (total quality control).

4.1.3.3 STATISTICAL PROCESS CONTROL (SPC)

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, equipments both for the company and operators.

4.1.3.4 STATISTICAL QUALITY CONTROL (SQC)

Statistical Quality Control (SQC) is a scientific method to analyze manufacturing data. Based on this analysis, measures are taken to maintain the quality of the manufactured product. One of the techniques that are used to monitor manufacturing processes and provide feedback is Statistical Process Control (SPC). The feedback is used to maintain and improve the capability of the process and to ensure product conformance. SPC is used to control the process by signaling when adjustments may be necessary. Some techniques associated with SPC include frequency histograms and control charts. A control chart is the tool used to monitor the variation in a process and ensure that the process is in a state of control. This allows the operator to monitor the trends occurring in the process.

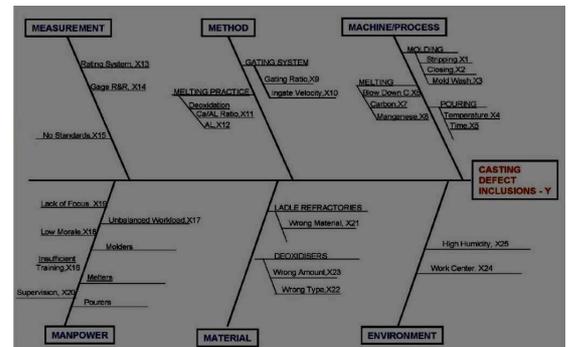


Figure 4.2: Cause and Effect Diagram or Fish Bone Diagram

Table 4.4: Data analysis of Lean

LEAN	Before		After	
	Before	After	Before	After
WASTE IN %	17.5	8	17.5	8
REJECTION IN %	15	5	15	5
INVENTORY COST IN Cr(MONTHS)	17.13	8.565	100	50
WAITING TIME IN MINUTES/SHIFT	60	30	100	50
PROFITABILITY IN LAKHS/MONTH	2.855	6.852	100	240

4.1.5 KAIZEN, 5S (CONTINUOUS IMPROVEMENT)

The word Kaizen means "continuous improvement" in quality, technology, processes, company culture, productivity, safety and leadership. It comes from the Japanese words ("kai" which means "change" or "to correct" and "Zen" which means "good". Kaizen is a daily process, the purpose of which goes beyond

simple productivity improvement. 5S methodology is the major parameters of kaizen.

5S is the name of a workplace organization method that uses a list of five Japanese words: seiri, seiton, seiso, seiketsu, and shitsuke. The list describes how to organize a work space for efficiency and effectiveness by identifying and storing the items used, maintaining the area and items, and sustaining the new order. The decision-making process usually comes from a dialogue about standardization, which builds understanding among employees of how they should do the work. There are five primary 5S phases are the following.

4.1.5.1 Sorting (Seiri)

Eliminate all unnecessary tools, parts, and instructions. Go through all tools, materials, and so forth in the plant and work area. Keep only essential items and eliminate what is not required, prioritizing things per requirements and keeping them in easily-accessible places. Everything else is stored or discarded.

4.1.5.2 Stabilizing or Straightening Out (Seiton)

There should be a place for everything and everything should be in its place. The place for each item should be clearly indicated.

4.1.5.3 Sweeping or Shining (Seiso)

Clean the workspace and all equipment, and keep it clean, tidy and organized. At the end of each shift, clean the work area and be sure everything is restored to its place. This makes it easy to know what goes where and ensures that everything is where it belongs. Spills, leaks, and other messes also then become a visual signal for equipment or process steps that need attention. A key point is that maintaining cleanliness should be part of the daily work – not an occasional activity initiated when things get too messy.

4.1.6 FOUNDRY AUTOMATION

Like many other industries, foundries must be looking constantly for new ways to boost their productivity, cut costs, and increase quality. Robotic automation is one of these. Robots can provide foundry-floor production capability that allows the operators to respond effectively to global pressures and future market changes. Although difficult to measure, this capacity has a clear economic value. A robot can be reprogrammed and retooled so that it can be a valuable tool as customers' needs change. An automated foundry work cell will reduce direct labour and related cost, and reduce the requirements for employee services and facilities.

Material cost savings:- Robotic automation can reduce a metal caster's material costs in two ways:

1. By creating products with greater metal integrity, less metal will be needed to be re-worked, reducing wasted throughput time.
2. Robotics minimizes the amount of spilled metal, by being able to pour more consistently than individuals who may tire as a grueling day wears on. For example, if a manufacturer pours 100 lb. of metal an hour spilling 10% over the course of an eight-hour shift, and operations run 24 hours/day, 365 days/year, a manufacturer can lose over 40 tons of metal per year — wasting hundreds of thousands of dollars of metal.

Considering the benefits of automation, the parameters taken for study are: Number of melts / day, Productivity due to automation (Tonnes), Quality improvement (Percentage), Rejection rate (Percentage), Profitability (Rs), Human Resource (Nos).

4.1.5.4 Standardizing (Seiketsu)

Work practices should be consistent and standardized. All work stations for a particular job should be identical. All employees doing the same job should be able to work in any station with the same tools that are in the same location in every station. Everyone should know exactly what his or her responsibilities are for adhering to the first 3 S's.

4.1.5.5 Sustaining the Practice (Shitsuke)

Maintain and review standards. Once the previous 4 S's have been established, they become the new way to operate. Maintain focus on this new way and do not allow a gradual decline back to the old ways. While thinking about the new way, also be thinking about yet better ways. When an issue arises such as a suggested improvement, a new way of working, a new tool or a new output requirement, review the first 4 S's and make changes as appropriate. It should be made as a habit and be continually improved. Other phases are: safety, security, and satisfaction. The following parameters were identified to analyse the benefits due to implementation of KAIZEN, 5s in a foundry: Productivity (Percentage), Rejections (Percentage), Cost reduction due to housekeeping(Rs), Delivery performance (T), Accident level (No's), Morale of operators, Man-hour utilization (Hrs).

Table 4.5: Data analysis of kaizen

KAIZEN	Before		After		converted into %	
	Before	After	Before	After	Before	After
PRODUCTIVITY IN %	85	95	85	95	85	95
REJECTIONS IN %	15	5	15	5	15	5
COST REDUCTION(HOUSE KEEPING) IN LAKHS	8.4	5.04	100	60	100	60
DELIVERY PERFORMANCE IN WEEKS	8	6	100	75	100	75
ACCIDENT LEVEL	4	1	100	25	100	25
MAN HOUR UTILIZATION(MAN Hrs/DAY)	240	144	100	60	100	60

Table 4.6: Data Analysis of Automation

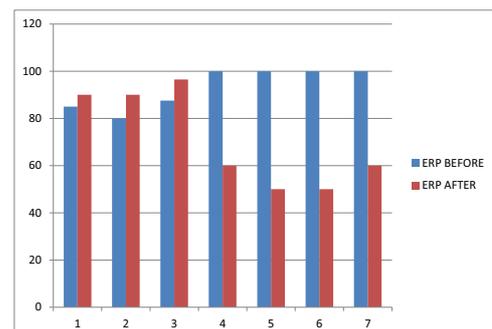
AUTOMATION	BEFORE		AFTER		converted into %	
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
PRODUCTIVITY /DAY IN %	20	60	20	60	20	60
QUALITY IMPROVEMENT	96	99	96	99	96	99
REJECTION RATE	15	5	15	5	15	5
HUMAN RESOURCES	7	3	100	42.86	100	42.86
PROFITABILITY IN Cr/Yr	3.43	10.28	100	300	100	300

4.2 MS excel INTERPRETATION

Table 4.7: PARAMETERS OF ERP

1. Manufacturing efficiency (%)
2. Customer satisfaction (%)
3. Material planning accuracy (in %)
4. Overall cost reduction (in LAKHS)
5. Annual inventory cost (in Cr)
6. Lead time(in weeks)
7. Number of human resource

GRAPH 4.1: Parameters of ERP

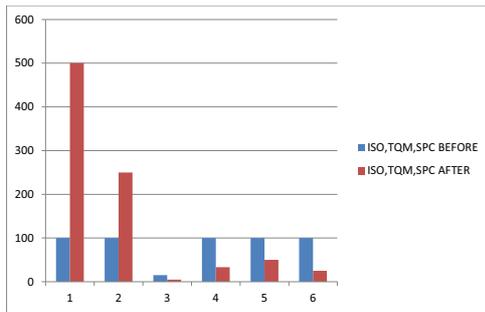


The above graph explains about the impact of ERP before and after implementation of modern technology. From the above diagram, there is a huge change in the last three parameters such as annual inventory cost, lead time and number of human resource required. Hence all these parameters have a greater impact due to modern technology.

Table 4.8: PARAMETERS OF ISO, TQM, SPC

1. Export benefits
2. Export/increased turnover (in %)
3. Rejection rate (in %)
4. Lead time
5. Inspection time(in hrs)
6. Documentation process(in hrs)

GRAPH 4.2: Parameters of ISO, TQM, SPC

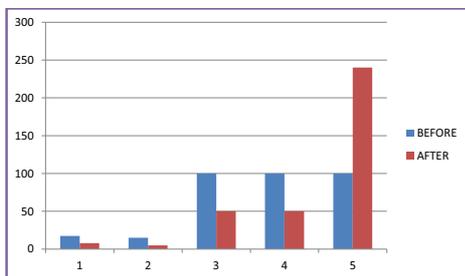


The above graph explains about the impact of QUALITY MEASUREMENTS before and after implementation of modern technology. From the above diagram, there is a huge change in the first two parameters such as export related benefits. Hence all export related parameters have a greater impact on modern technology.

Table 4.10: PARAMETERS OF LEAN

1. Waste in %
2. Rejection in %
3. Inventory cost in Cr (months)
4. Waiting time in minutes/shift
5. Profitability in lakhs/month

GRAPH 5.4: Parameters of LEAN

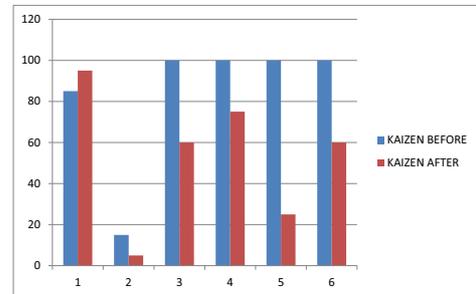


The above graph explains about the impact of LEAN before and after implementation of modern technology. From the above diagram, there is a huge change in the last parameter, i.e. PROFITABILITY DUE TO WASTAGE REDUCTION.

Table 4.9: PARAMETERS OF KAIZEN

1. Productivity in %
2. Rejections in %
3. Cost reduction (House keeping) in lakhs
4. Delivery performance in weeks
5. Accident level
6. Man hour utilization(man hrs/day)

GRAPH 4.3: Parameters of Kaizen

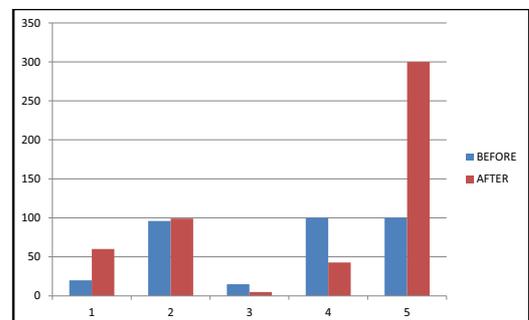


The above graph explains about the impact of KAIZEN before and after implementation of modern technology. From the above diagram, there is a huge change in the 5th parameter, i.e. ACCIDENT LEVEL. Hence all these parameters have a greater impact due to modern technology.

Table 4.11: PARAMETERS OF AUTOMATION

1. Productivity /day in %
2. Quality improvement
3. Rejection rate
4. Human resources
5. Profitability in Cr/yr

GRAPH 4.5: Parameters of AUTOMATION



The above graph explains about the impact of AUTOMATION before and after implementation of modern technology. From the above diagram, there is a huge change in the last parameter, i.e. PROFITABILITY DUE TO HIGH AND QUALITY PRODUCTION.

4.3 SPSS ANALYSIS

Table 4.12: production due to Technology (qualitative data)

PRODUCTION DUE TO TECHNOLOGY		
	AMMARUN FOUNDRY	LAKSHMI REKHA
Design methodology	MEDIUM	HARD
Testing	EASY	HARD
Resource planning	EASY	MEDIUM
Quality measurement	EASY	HARD
Waste elimination	LESS	HIGH
Safety measurement	VERY HIGH	MEDIUM
Rate of production	HIGH	LESS

Convert the above qualitative data into quantitative data, by using scaling techniques. All the above parameters have been given with 5 point scaling, stating from (very easy-5 to very hard-1). The last three parameters is given with reverse scaling, (very high-1 to very less-5). Output of the SPSS tools is given below.

Table 4.13: AMMARUN foundry percentage analysis

		Frequency	Percent
Valid	M	1	14.3
	E	5	71.4
	VE	1	14.3
	Total	7	100.0

Graph 4.6: AMMARUN foundry percentage analysis

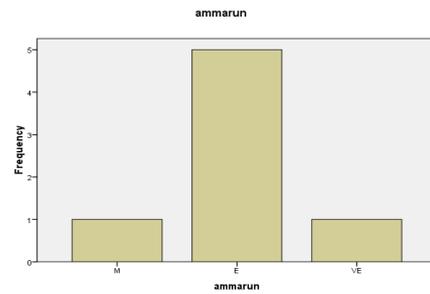
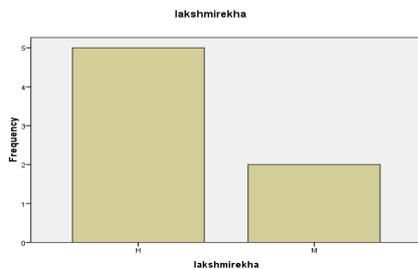


Table 4.14: LAKSHMI REKHA foundry percentage analysis

		Frequency	Percent
Valid	H	5	71.4
	M	2	28.6
Total		7	100.0

Graph 4.7: LAKSHMI REKHA foundry percentage analysis



4.4 SPSS INTERPRETATION

Hence from the above interpretation it has been clearly found that the production part of the non-conventional foundry "easy", while the production part of conventional foundry if "hard". So the productivity will be more in non-conventional foundries than the conventional foundries.

4.5 PRODUCTIVITY CALCULATION

Table 4.15: Productivity comparison between two foundries

AMMARUN FOUNDRIES (NON-CONVENTIONAL)	LAKSHMI REKHA FOUNDRIES (CONVENTIONAL)
INSTALLED CAPACITY/ INPUT=15000tons/year Actual output from the company= 9750tons/year Productivity =output/input*100 in% Productivity=9750/15000*100 % = 65%	INSTALLED CAPACITY/ INPUT=3000tons/year Actual output from the company= 1680tons/year Productivity =output/input*100 in% Productivity= 1680/2800 *100 % =56%

4.6 INTERPRETATIONS

From the above calculation it is clearly shown that the productivity of the modern technology foundry is 9% more than the conventional foundry. Hence modern technology plays very important role in productivity.

CHAPTER 5

FINDINGS, SUGGESTIONS AND CONCLUSIONS

5.1 FINDINGS

- The company is mainly depends on the modern technologies which is mentioned earlier.
- The modern technology (Automation) alone produces 60% of the company's total productivity.
- The implementation cost for CAD and simulation technology is comparatively high than the others. So the companies are going for outsourcing.
- Among all the modern technologies automation plays a very vital role.
- Lean manufacturing is effectively maintaining by the non-conventional foundry
- As the result of lean manufacturing technology the wastage minimized is very high.
- Kaizen technology plays a very important role. It fully reduces the no. of accidents inside the company.
- By comparing the conventional and non-conventional company data, the non-conventional/modernized foundry's output very much high with less inspection time and low wastage and low rejections.
- Hence it is advisable to the conventional foundries to adapt with the modern technologies to increase their productivity and their profitability.

2. Better decision making and problem management
3. Better documentation procedures

5.2.4: Production benefits

1. Improved quality of products and raw materials
2. Reduced wastes and defective rates
3. Clear working instructions and procedures

5.2.5: Supplier related benefits

1. Timely inflow of material from suppliers
2. Improved quality of materials received
3. Better suppliers' management
4. Reduced priced quotations from suppliers

5.2.6: Employee related benefits

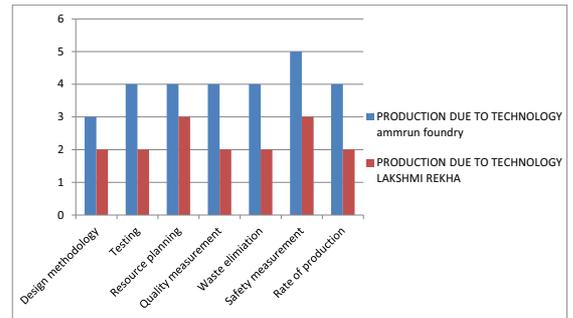
1. Improvement in job satisfaction and staff motivation
2. Improved team spirit and quality awareness in company
3. Effective communication among employees and management

5.2.7: Customer related benefits

1. Improved identification of customer requirements and proper response to them
2. Improved customer satisfaction/ loyalty
3. Enhanced on-time delivery culture

5.3 CONCLUSION

The study highlights the contributions of various modern technology implementation initiatives in the AMMARUN foundries for accruing benefits for meeting the challenges posed by the competitors. The empirical analysis has been employed in this study to investigate the role of various modern technology components in achieving significant performance improvements in the Coimbatore foundries. For the purpose, various modern technology performance parameter categories have been established in the study. The study reveals that the modern technology initiatives like technology/ automation is far more influential in affecting manufacturing performance improvements. Technology activities in the foundries have to be managed carefully in order to achieve the desired output.



GRAPH 5.1: production due to technology (converted qualitative data into quantitative by using 5 point scaling technique)

5.2 SUGGESTIONS

Based on the output of the study it has been found that the modern Technology is not only useful for increasing the productivity; it also increases some other benefits to the company. Some of them are the following.

5.2.1: Business related benefits

1. Enabling competitive prices of the products
2. Improved company's image
3. Improved productivity
4. Improved profitability

5.2.2: Technological benefits

1. Improved control over process flow
2. Development of systems for next generation technology
3. Improved inspection methods
5. Effective use of existing technologies

5.2.3: Operational benefits

1. Improvement in purchasing procedure

Ammarun foundry has made rapid progress in exploring and adopting modern technology in the last four years. There is now a high penetration of technologies such as Enterprise resource planning, Modern testing equipments, ISO, Total quality management and Statistical process control, followed by a medium penetration of medium-cost technologies including CAD/CAM, lean manufacturing, kaizen, 5s. From this study it is found that there is an impact on productivity and profitability before and after implementation of modern technology and also there is improvement on productivity in non-conventional foundries which implemented more technologies when compared to the less technologies implemented/conventional foundries.

5.4 SCOPE FOR FURTHER STUDY

1. Nowadays most of the foundries are implemented with modern technologies, because it is very useful to focus on their productivity with more quality.
2. In future all the manufacturing industries are going to operate based on modern technologies only.
3. Hence this study will help to create the awareness among conventional foundries to adapt with new technologies/global competitors.

And also nowadays all the companies are recruiting only well skilled and talented employees. This study will make them to upgrade the knowledge in new technologies.

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- Strategies for Growth of Indian Foundry Industry, **V. S. Saravanan** General Manager, Indoshell Cast Pvt. Ltd., Coimbatore.

Appendix

COMPARISON STUDY BETWEEN CONVENTIONAL AND NON-CONVENTIONAL
FOUNDRIES WITH RESPECT TO NEW TECHNOLOGY ON PRODUCTIVITY

Part- A. General Information

1. COMPANY DETAILS

- A. Company Name:
Address:
- B. Company Name:
Address:

2. Year of establishment _____

3. Metal handled by the foundry.

Gray Iron Malleable Iron Ductile Iron
Stainless Steel Carbon Steel Other _____

4. Main applications of castings produced at foundry

Automobile Agriculture/Mining Railways
Pumps & Valves Machine Tools Motors & Generators
Defense Other: _____

5. What is the total installed capacity of the foundry. _____ Tons / year.

6. State the total output of the foundry. _____ Tons / year.

7. What percentage of capacity was utilized last year _____ (%)

8. Capital investment of the foundry. _____ (Rs)

9. Annual turnover of your foundry _____ (Rs lakhs)

10. Number of employees _____

Part- B. Modern Technology

11. Rank the importance of Modern Technologies for foundries

Sl.No	Modern Technology	Rank the Technology
1	CAD/CAM	
2	Simulation	
3	ERP	
4	ISO, TQM, SPC and Spectro	
5	Lean manufacturing	
6	Kaizen, 5s	
7	Automation	

12. Modern Technologies used in your foundry

Sl.No	Modern Technology	Technology implemented	Year of implementation
1	Computer-Aided Casting / Computer-Aided Manufacturing (CAD/ CAM)		
2	Casting Modeling Software (Simulation)		
3	Enterprise Resource planning (ERP)		
4	Modern testing equipments/Quality Measurement Technique (ISO, TQM, SPC and Spectro)		
5	Waste elimination (Lean manufacturing)		
6	Continuous improvement (Kaizen, 5s)		
7	Robotic application (Automation)		

13. Benefits due to implementation of **Enterprise Resource planning** in a foundry

Sl.No	Description	Before implementation	After implementation
1.	Improved manufacturing efficiency		
2.	Overall cost reduction (Rs)		
3.	Material Planning Accuracy (Percentage)		
4	Annual Inventory cost (Rs)		
5	Lead time (T)		
6	Human resource in material planning(No's)		
7	Customer satisfaction (Percentage)		

14. Benefits due to proper implementation **ISO, TQM SPC and Spectro** in a foundry

Sl. No	Description	Before implementation	After implementation
1.	Rejection rate		
2.	Total Lead-time for Melting (T)		
3.	Export related benefits (No's)		
4	Export/ increased turnover (Rs)		
5	Inspection time (T)		
6	Documentation Process time (T)		

15. Benefits due to proper implementation of **LEAN** Manufacturing in a foundry

Sl.No	Description	Before implementation	After implementation
1.	Waste (Percentage)		
2.	Profitability (Rs)		
3.	Waiting time (T)		
4	Inventory cost (Rs)		
5	Rejection rate(Percentage)		

16. Benefits due to proper implementation of **KAIZEN, 5s** in a foundry

Sl.No	Description	Before implementation	After implementation
1.	Productivity increase (Percentage)		
2.	Rejections (Percentage)		
3.	Cost reduction due to housekeeping(Rs)		
4.	Delivery performance (T)		
5.	Accident level (No's)		
6.	Morale of operators		
7.	Man-hour utilization (Hrs)		

17. Benefits due to proper implementation of **AUTOMATION** Technology in a foundry

Sl.No	Description	Before implementation	After implementation
1.	Number of melts / day		
2.	Productivity due to automation (Tones)		
3.	Quality improvement (Percentage)		
4.	Rejection rate (Percentage)		
5.	Profitability (Rs)		
6.	Human Resource (Nos)		

18. Technological issues between the companies (waste elimination-reverse scale)

	Very easy	Easy	Medium	Hard	Very hard
Design methodology					
Testing					
Resource planning					
Quality measurement					
	Very high	High	Moderate	Low	Very low
Waste elimination					
Safety measurement					
Rate of production					