CHAPTER 2

METHODOLOGY AND LITERATURE REVIEW

This chapter focuses on the methodology of the thesis. Various aspects of the research strategy and research approach are presented. The chapter also describes the study of literature, choice of data collection, methodology and tools used in the DMAIC project and finally a discussion of the validity and reliability of the thesis.

Methodology is a tool or a way to solve problems and thereby get new knowledge. Everything that is helping the researchers to reach their goals is methodology

2.1 RESEARCH APPROACH

A governing thought within modern science is that research results should be published and used freely to aid the growth of science. Other researchers must be able to review models, methods and results. Are the data valid? Are the interpretations and analyses reliable? Are the conclusions only applicable under certain circumstances or are they of a more general nature? For all these questions answers should be available after the work.

2.1.1 POSITIVISM OR HERMENEUTICS

Humans observe the world in different ways and that's the reason why there are different perspectives of science and knowledge. There are two extremes of research directions that are dominating today, namely Positivism and Hermeneutics
The meaning of Positivism is that a science thesis only has a value if it could be empirically verified. Everything that can't be tested empirically, like feelings, values, religious and political statements don't belong to the scientific sphere means that Positivism's only sources of knowledge are observations and logic. The opposite of Positivism is Hermeneutics, which can be translated to interpretation science and origins in theories about bible and other text interpretations. Hermeneutics is about interpretation of meanings in its widest sense. This thesis, investigating a possible Six Sigma implementation at the Transformer making/bearing manufacturing facility, has got elements of mostly Positivism. Qualitative data is collected through interviews, a focus group and by running a DMAIC project.

The DMAIC project concerning the GRINDING PROCESS related problems also includes quantitative data and logical and fact-based decisions, a positivistic approach. In fact, the evaluation of a possible Six Sigma implementation must be based on observations and empirical results from the current situation at the bearing manufacturing facility, consequently a positivistic approach.

2.1.2 INDUCTION OR DEDUCTION

Rationalism is a philosophical branch, which claims that it is possible to obtain knowledge about reality only by using reason. Empiricism on the other hand is a branch that, in contrast to rationalism, emphasizes experience as the base of our knowledge. Empiricism and rationalism lead to two principally different


approaches to research, Deduction and Induction.

Deduction: Hypotheses, that can be verified, are formed on the basis of a theory. Results will be obtained through logical contemplation.

Induction: On basis of separate phenomena in reality, more general conclusions are drawn and theories and models are formed

![Diagram showing deductive and inductive approach in research](image)

Figure 2.1 Deductive and Inductive approach in research.

In the deductive approach to research, theory has got a more important and independent position than the inductive approach. This thesis has got a deductive approach. The starting-point of the thesis is a review of existing theories in the area. Then the empirical studies are conducted, after which the empirical results are analyzed on the basis of existing theories
2.1.3 QUANTITATIVE OR QUALITATIVE METHOD.

Quantitative and qualitative methods are principally two different types of research methods. Qualitative data consists of detailed descriptions of for example situations, events and people. It can give information about different people's experiences, attitudes, opinions and thoughts. Quantitative data give information about how many, how much, amount, frequency and the distribution of the data. Qualitative methods have primarily a purpose of understanding and by using different data collection methods get a deeper understanding of the studied problem. Quantitative methods are more formalized and structured and often mean more control from the researcher. Statistical methods play an important role within quantitative research. Combining qualitative and quantitative methods results in success in research because advantages and drawbacks with each method complement each other. In this thesis there are elements of both qualitative and quantitative data and information. The majority of the data or information gathered is of a qualitative nature, in the form of interviews, focus groups and the use of qualitative tools in the improvement project. However, quantitative data or information is also gathered by the use of check sheets and review of quantitative data provided by SUJANA/VEL.

2.2 RESEARCH STRATEGY

There are several ways of doing research. Examples are experiments, surveys, historical studies, analyses of archival
information and case studies. Case studies are the preferred strategy when the questions "how" or "why" are being asked. In this thesis, questions like "how can the Six Sigma methodology be implemented to improve the existing production process?" and "how and why should SUJANA/VEL introduce Six Sigma in the organization?" are valid. To be able to fulfill the purpose of the thesis, the author concluded that a thorough study of the company's current way of working was needed. Likewise the author saw the need for a careful analysis of the DMAIC project.

This motivated the choice of a Case Study as the starting point of the data collection methods used in the thesis. Case Study strategy as follows: "In brief, the Case Study allows an investigation to retain the holistic and meaningful characteristics of real-life events - such as individual life cycles, organizational and managerial processes, neighborhood change, international relations and the maturation of industries."

The advantages of a Case Study are that the research is carried out under real circumstances and it provides the possibility to generate in-depth knowledge about the research object. The Case Study is often very useful in such research. The strategy is then used as an alternative approach together with other methods. The purpose of a Case Study is simply to take a small part of a whole course of events to let the case represent and describe reality. Case study will have own limitations, as discussed below.
2.2.1 WEAKNESSES OF THE CASE STUDY

1) It is not uncommon that equivocal information and/or biased views are allowed to influence the conclusions of the Case Study.

2) Case studies provide a rather little basis for scientific generalization.

3) Case studies can become massive and take too long time, hence being hard to analyze. These shortages need to be considered by the author as they can affect both the validity and the reliability of the thesis.

2.3. LITERATURE REVIEW

As the author has chosen a deductive approach, which uses theories as a starting point of the research, there was a need for an extensive literature study. Since Six Sigma is an approach with many different advocates, the author decided to look for information about Six Sigma from a number of articles to get an own objective point of view. Four books about Six Sigma used frequently by the author are: i) Pande, Neuman & Cavangh [49]. ii) Breyfogle, F.W. [5] iii) Harry, M. and Schroeder, R. [18] iv) Kai Yang & Basem S. El-Haik[25]. Besides these a total of around 68 papers in different journals and text books were referred to have a grip on Six Sigma.

2.4. CHOICE OF DATA COLLECTION METHOD

The data collected in the research can be of two kinds: 1) Primary data, and 2) Secondary data
2.4.1. PRIMARY DATA

This is new information that the research team has to collect. A basic method to find what people are experiencing is to ask them. This can be done by a standardized interview or by a questionnaire. The possibility to adjust the questions to a single individual is important. Qualitative interviews of this kind are called in-depth interviews. The strength with the qualitative interview is that the interview situation is similar to an everyday situation or conversation.

In depth interviews were carried through with Quality Manager, Production in charge at the SUJANA/VEL, The author attended Six Sigma programme (Green belt certification programme) at ESCI Hyderabad to gain experience in Six Sigma. Primary data in the DMAIC project was gathered by the use of selected tools at different stages in the DMAIC methodology. Such tools are Process Mapping, Pareto Charts, Cause-and-Effect Diagram, Process FMEA. These tools were used in the improvement group assembled to deal with the quality shortages in the Grinding Process. The author prepared the use of these tools by studying them in advance and then acting as supervisors as well as team members. The author mapped the Core Coil Preparation/GRINDING process by directly observing the process.

Shorter, unstructured interviews and conversations were also carried out with technicians and operators who are familiar with the processes and the grinding problems. An interview with the accounts dept. of the SUJANA/VEL was done to gather information about costs.
concerning the DMIAC project.

### 2.4.2. SECONDARY DATA

This is information, already gathered by someone else, which can be used in the research. It is often appropriate to use secondary data at the beginning of the research because it is easier and cheaper. Data for case studies can come from six sources: documents, archival records, interviews, direct observation, participant-observation and physical artifacts.

Secondary data in the improvement project is collected from internal complaint records and files from quality dept, which gives information about the capability in the grinding process studied. The author has collected information about the current process from process sheets, information is gathered from SUJANA/VEL websites, annual reports and company internal documents describing work approach and economical numbers. Information is also gathered within the company from conversations with employees.

### 2.5. METHODOLOGY AND CHOSEN TOOLS IN THE DMAIC PROJECT

As mentioned previously the author use Six Sigma methodology DMAIC (Discussed thoroughly in Section 4.2) in the practical improvement project concerning the Grinding Process in SUIL and Core making, coil winding and CCA(Core, Coil Assembly) in VEL. Various tools used in the in the Six Sigma projects are listed below.
- **Project Charter**: This tool clarifies the purpose and current status in the project. The tool was also a way to ensure that the improvement team will meet the expectations from the sponsor.

- **Process Mapping**: This tool gives an overview to the studied process and all members of the improvement team get a common view of the situation.

- **Pareto Chart**: This tool brings out the most common reasons to problems and which problems are the most important to work with.

- **Cause-and-Effect Diagram**: This tool is helpful to find underlying causes of the problem. It’s easy to use and often gives appreciable results. The tool was carried through with brainstorming sessions.

- **Process FMEA**: This tool detects potential problems but also gives these problems a priority number.

- **Design of experiments and Taguchi methods**: These tools are very important tools in quality engineering. These tools used by the author in case study-4 in optimizing the Grinding Process parameters.

These tools are chosen, because they were recommended in the literature for each specific phase. However there are other tools that maybe would have been applicable in the different phases of the DMAIC project as well. The author doesn’t claim that the tools chosen are the only or best mix, but they are suitable candidates in the
different phases. Another reason was that the author had some previous experience of the tools selected.

2.6. RELIABILITY AND VALIDITY

Information gathered, processed and presented in the various results output must always be critically reviewed in order to decide how reliable and valid it is.

2.6.1. VALIDITY

Validity measures how well a certain approach will describe what was intended. Validity can be defined as a measurement instrument’s ability to measure what it was designated for. The validity will increase the closer you are to who or what you are studying. The choice of the Case Study as research strategy provided the author with the opportunity to be close to the organization studied and thereby increase the validity. By interviewing people both within and outside the organization the author tried to get a balanced view of the situation and thereby strengthen the validity of the thesis.

The author’s strategy when performing interviews was to try to prepare most questions in advance to be able to conduct the interviews in the same way with different interview issues. This was also a way for the author to make sure that the questions were valid and not drifted too far away from the purpose of the interview. Also, after the interviews were carried through, the author compiled summaries that were then sent to and confirmed by the interviewees. This also increases the validity as well as the reliability. The fact that the tools chosen in the Six Sigma project did not demand an extensive
previous training also increases the validity since the risk of misunderstandings by the team members will decrease. The many different categories of professions in the assembled improvement group were also a deliberate action to strengthen the validity by getting many different points of view of the problem.

2.6.2. RELIABILITY

Reliability is a measure of to which extent a certain procedure gives the same result when applied under similar conditions at different occasions. As an example, a specific question that gives one answer under certain circumstances and another answer under different circumstances is not a reliable question. Reliability aims to minimize errors and biases in a study. If an instrument isn't reliable then there will also be a lack of validity. A high level of reliability does not necessary imply a high level of validity. A question may give the same or almost the same answer at different occasions but still not measure what was designated. To strengthen the reliability in the study of the grinding process the author personally informed the operators on how the study was going to be made.
2.7. EARLIER QUALITY IMPROVEMENT APPROACHES

In the next section literature is reviewed with emphasis on TQM and earlier quality improvement approaches.

2.7.1 TOTAL QUALITY MANAGEMENT

Business organizations are using quality as a strategy to increase their market share in the light of huge competition and globalization. Japanese quality revolution inspired by Juran and Deming resulted in evolution of innovative quality improvement tools like “Zero Defects approach”, “quality circles”, “Kaizen “, etc. One of the important continuous improvement (CI) tool liked and practiced by several organizations throughout the world for long time is TQM (Total Quality Management). TQM has a huge success because of its focus on customer satisfaction as a goal. Several authors linked Six Sigma with TQM and compared both the methodologies. For this reason author has given much importance on TQM in this chapter.

2.7.1.1 DEFINITION

TQM is a model, a management philosophy, a continuous improvement methodology in doing business using a new management system. The TQM philosophy primarily developed from the continuous improvement programs with a focus on quality as the important parameter of business. In TQM, priority is given to the quality of the product or services. TQM not only includes statistical process control, but, includes a wider scope of management activities
of how we manage human resources and systems by focusing on the complete process, not just simple metrics.

"TQM is the mutual co-operation of everyone in an organization and associated business processes to produce products and services which meet and, hopefully, exceed the needs and expectations of customers"

TQM is a comprehensive management system which:

- Focuses on meeting owners'/customers’ needs by providing quality services at a cost that provides value to the owners/customers
- Is driven by the quest for continuous improvement in all operations
- Recognizes that everyone in the organization has owners/customers who are either internal or external
- Views an organization as an internal system with a common aim rather than as individual departments acting to maximize their own performances
- Focuses on the way tasks are accomplished rather than simply what tasks are accomplished
- Emphasizes teamwork and a high level of participation by all employees

**2.7.2 TQM BELIEFS**

Presented here are universal total quality management beliefs.

- Owner/customer satisfaction is the measure of quality
• Everyone has owners/customers; everyone is an owner/customer
• Quality improvement must be continuous
• Analyzing the processes used to create products and services is key to quality improvement
• Measurement, a skilled use of analytical tools, and employee involvement are critical sources of quality improvement ideas and innovations
• Sustained total quality management is not possible without active, visible, consistent, and enabling leadership by managers at all levels
• If we do not continuously improve the quality of products and services that we provide our owners/customers, someone else will

2.7.3 PRINCIPLES OF TOTAL QUALITY MANAGEMENT

Total quality management (TQM) is a way of leading and managing an organization with ever-increasing efficiency and effectiveness to meet or exceed the needs of all the organization’s customers. TQM involves major elements such as customer focus, process management and continual improvement, supplier partnerships, leadership, and participation by all affected parties. The fundamental principles of TQM are the following:
• Quality is defined by the customers.
• Quality is the result of human efforts.
• Entire work is part of a process, not just core process.
• Decisions should be taken based on facts and supported by data.
• Suppliers are also part and parcel of the organization.
• Quality improvement is continuous and has no end.

In the light of the last principle, the label “continuous quality improvement“ (CQI) has replaced that of TQM in some instances. TQM can be applied to any organization that exists to create value for its customers. This includes all types of for-profit, professional, and educational organizations as well as government agencies.

TQM starts from the customers voice. These needs are translated back into the work of the organization, that is, the tasks or processes by which the organization creates values for its customers. The processes of the organization are in turn closely aligned and linked with their suppliers, and these suppliers are treated as an integral part of the organization. The entire value-creating chain from supplier to customer is managed and continually improved to be ever more efficient in resource consumption and maximally effective in creating value for customers.

In order to manage and continually improve the capability of an organization to create value for its customers, it is necessary to involve and lead the people of the organization. TQM asks the leaders of the organization to provide direction, empowerment, and support for the people who create value for the customers.

TQM has two dimensions, horizontal and vertical. The horizontal dimension is concerned with how value is created for customers. This dimension has three components. The first one is
customer focus. This involves understanding who the customers are, what they need and expect, and how well the organization is meeting those needs. It also involves translating customer needs into product, service, and process requirements so that value-creating tasks can be aligned to meet customer needs. TQM offers many tools and methods for listening to the voice of the customers, including “quality function deployment”, which is methodology for cross-functional teams to translate the voice of the customer into product or service requirements.

The second component of the horizontal dimension is process management and continual improvement. A process is a set of interrelated tasks that has specific inputs from suppliers and produces specific outputs for customers. A process can be large and cross-functional or small and located within a single function. A central tenet of TQM is that all processes should have two outputs, value created for customers and information about how the processes can be performed more efficiently and effectively. TQM offers a powerful array of methods and tools for managing and continually improving processes. One of these, the best current practice approach, “Best Manufacturing Practices” (BMP) program, has had considerable success.

The last component of the horizontal dimension of TQM is supplier partnerships; these are ways in which the organization aligns and work with its suppliers to create more value for its customers. Customers make no distinction between an organization and its
suppliers. From the customer’s viewpoint, all value comes from the organization itself. But a substantial amount of the value that comes from an organization is in fact created by its suppliers. These suppliers are crucial to the organization success. TQM stresses the need for an organization to build new relationships with its suppliers, relationships based on cooperation, trust, and working toward the common goal of satisfying the organization’s customers. Under TQM, suppliers are considered to be an integral part of the organization.

The vertical dimension of TQM is concerned with how one involves people in the success of the organization. The vertical dimension of TQM in many ways inverts the traditional organizational hierarchy.

### 2.7.4 CONTRIBUTORS TO TQM

TQM relies heavily on the involvement of people and on pushing decision making to the lowest practical level. Active involvement occurs when people working in the key processes of the producing organization view their role as satisfying the needs of their internal and external customers, when middle management views its role as enabling the front-line workers to satisfy their customers, and when senior management views its role as enabling middle management, and thereby front-line workers, to satisfy customer needs with increasing efficiency and effectiveness [Pande[49]]. However, to achieve positive results from active involvement of all workers and managers, considerable education and training of people are required. While training is often defined as developing the capability of someone to
perform a specific task, education is often defined as developing knowledge and understanding. Training, especially context-based training, is needed in basic skills required to perform a specific job, solve problems, or contribute effectively to team performance. Education, on the other hand, is required to communicate and to create understanding of the organization's strategic plans, mission, vision, values, and so on. Education enables everyone to understand where the organization is going, how it will get there, how each as an individual fits into these plans, and why new skills may be needed to carry out these plans effectively. It is a much more extensive endeavor than the traditional one-shot training program. It is also much more effective.

Teamwork is very important in TQM since no single individual has all the knowledge and skills required to solve complex problems. Teamwork does not occur naturally, but requires training and nurturing. There is a wealth of material available on team roles, meeting management, evaluating team effectiveness, and structuring education and training for teams. Cross-functional process management teams are often used to manage key processes that require several types of functional expertise. Teams are an effective means of reducing the "turf barriers" typical of most hierarchical management systems. The producing organization needs to use team structures that best fit its strategic plans and that help accomplish its goals most effectively.
Ideally, an organization should adopt total quality management in all of its operations and in the operations of its contractors. At least some TQM experts would argue that one cannot apply TQM to some areas of operation and not to others. However, practical exigencies might preclude such a comprehensive embracing of TQM throughout an organization. Much improvement can nevertheless be made in most organizational data collection and analysis and decision-making activities by merely employing the concepts and tools of TQM without formally adopting TQM as the foundation of the organizational management system. For instance, one white-collar, non-routine public-sector context to which the concepts of quality management readily apply is that of collecting and using data for decision making and strategic planning

2.8 BENCHMARKING

The best current practice (BCP) approach can be an effective means of establishing and implementing goals for improving key processes. The best current practice is one that is as effective and efficient as any comparable method or procedure throughout an industry or type of activity. The process of determining a BCP is called benchmarking which is explained in figure 2.2. BCPs advance quality by

- Promoting widespread use of proven successful methods,

- Offering documented methods for process improvement, and

- Reducing mistakes that result from untried methods.
Benchmarking is the organized search for best systems, innovative ideas, and highly efficient operating methods. Benchmarking compares the experience of others and utilize the others methods. Indeed, it is the common-sense proposition to learn from others what they do right and then imitate it to avoid reinventing the wheel.

![Benchmarking Concept Diagram](image)

**Figure 2.2 Benchmarking Concept**

Continuous improvement programs such as total quality management and just-in time management are prevalent in organizations. The main purpose of such programs is maintaining a sustained effort at improving the efficiency and effectiveness of work-processes. These programs consist of combinations of practices that aim to encourage and enable the participation of frontline personnel in process improvement. Different combinations of work practices emerge from time to time as new continuous improvement programs.
Total Quality Management (TQM) and Business Process Reengineering (BPR) programs gained tremendous popularity as combinations of practices for continuous process improvement. However, after prevailing for some time these programs were dismissed by many as fads that mainly benefited the consultants who advocated them. Despite the fate of such continuous improvement programs, new combinations of practices such as lean operations and agile supply chains continue to emerge and gain in popularity.

SUIL/VEL has well laid procedures in implementing TQM. TQM ingredients are shown in Fig 2.3. SUIL/VEL has already obtained ISO 9001:2008 certification. The companies have good supplier network, sound testing equipment. The companies also have tie-up with reputed testing agencies to calibrate the measuring instruments. This thesis intends to explore implementation of Six Sigma in SUIL/VEL using existing TQM methodology adopted.
Figure 2.3: Total Quality Management Ingredients.
2.9 LIMITATIONS IN TQM IMPLEMENTATION

Tracing the evolution of quality programs from Quality Circles thru TQM, it may be pointed out that under the old model preceding TQM, quality evolved within dedicated functional departments consisting of small numbers of quality experts reporting to manufacturing. The purpose of these quality experts was mainly defect detection. In the TQM model, the definition of quality was expanded to include customer oriented perspectives and therefore included the ability to efficiently make changes in response to customer needs. The scope of quality became dynamic, necessitating the need for flexibility and resulting in a model that empowered employees. Organizations recognized the need for improving cross-functional co-ordination and maintaining a unified strategic outlook while continually making process improvements. The accumulation of these various principles under the expanded view of quality labeled TQM is classified among three main percepts: (a) focus on customer satisfaction, (b) continuous improvement and (3) total system view of the organization.

The development of TQM took place in parallel with industry changes in the areas of flexibility and cost reduction. Quality, which was earlier treated as a tradeoff with cost and/or flexibility started being treated as an omnipresent priority. The integration of TQM with just-in-time (JIT) and human resource management (HRM) practices
lead to the birth of lean manufacturing. For academic research it became increasingly difficult to discriminate activities related to TQM from those related to JIT, total preventive maintenance (TPM) and HRM as evidenced from the various labels attached to quality, just-in-time manufacturing and lean manufacturing initiatives. The definition and scope of TQM itself morphed and broadened over time.

An unintended consequence of the broadening of the scope of quality initiatives under TQM and the addition of organizational change agendas to quality programs was that the underlying structure and rigor were sacrificed. With decentralization, quality became everyone’s responsibility and no one’s. During this extended evolution of TQM, a number of gaps in the way organizations sought to implement the program became apparent; these are listed below.

Limitations in TQM implementations are summarized below:

a) Benefits expected to be long term and non-measurable

b) Training all in quality

c) No-cross –functional coordination

d) No transfer of learning

e) No proactive scanning

In fact, failures in TQM implementation in these areas are often attributed to lack of leadership. Under TQM implementations, organizational leaders failed to engender the commitment of employees and generate open discussions about the progress of quality from a holistic perspective going beyond cross-functional
boundaries. A closer look at the content of TQM, however, reveals that it fails to provide guidance about creating such a quality culture. In the absence of instituted practices it becomes difficult for leaders of large complex organizations operating in dynamic environments to continually motivate employees throughout the ranks to proactively seek out the overall organizational benefit while maintaining a systems view. The alternative avenue of intrinsic motivation for generating employee enthusiasm through work characteristics alone has not proven to be effective, especially in Western firms.

A superimposed structure specifically for coordinating long-term organizational deployment and daily operational implementations of quality practices can go a long way in creating a sustained quality culture. This is empirically supported in the context of TQM; found structural elements to have significant moderating effects on the success of TQM. Six Sigma introduces structures for organizational and operational level implementation of practices and addresses this deficiency in TQM implementations.

2.10 CONTINUOUS PROCESS IMPROVEMENT: This section discusses some of the continuous process improvement approaches.

Different approaches to Continuous process improvement:

a) JURAN’s Triology
b) Shewhart’s Plan-Do-Study-Act cycle.
c) Kaizen
2.10.1 JURAN TRIOLGY: Process improvement involves planning. One of the best approaches is the one developed by Dr Joseph Juran. It has three components: planning, control, and improvement and is referred to as the Juran Triology.

PLANNING: The planning starts with external customers. Where there are numerous customers, a Pareto diagram might be useful to determine the vital few. Once the customers are determined, their needs are discovered. The next step in the planning process is to develop product and/or service features that respond to customer needs, meet the needs of the organization and its suppliers, are competitive, and optimize the costs of all stakeholders. This step typically performed by a multifunctional team. QFD, Taguchi’s Quality Engineering, Quality by design are some of the approaches that can be used. It is important that the design team, rather than a single department, approve the final design and that the team be composed of all functional areas within an organization as well as customers and suppliers.

CONTROL: Uses feedback – measure the actual performance, compares with goals and act on the difference.

IMPROVEMENT: The third part of the triology aims to attain levels of performance that are significantly higher than current levels.

2.10.2 PDSA CYCLE: Plan-Do-Study-Act cycle was first invented by Shewhart and then refined by Deming. The PDSA cycle is a standard paradigm for continual improvement in TQM. The PDSA cycle was first formulated by Shewhart in 1939 as a methodology for
improvement based on the scientific method which is depicted in figure 3.3. The power of the methodology lies in the fact that it provides a rational structure in which one may take actions at all levels of an enterprise and also provides the opportunity for learning based on that improvement.

Figure 2.4 PDSA- Cycle

2.10.3 KAIZEN:

Kaizen is a Japanese word meaning continuous improvement for the philosophy that defines management’s role in continuously encouraging and implementing small improvements involving everyone. It is the process of continuous improvement in small increments that make the process highly efficient, effective, and adaptable. Improvements are usually attained with less or no
expense, without sophisticated methods or costly equipment. In this 
process first complex process are broken down to small process and 
then these smaller processes are improved.

The Kaizen improvement stresses on the use of:

1. Value-addition and non-value-addition processes.
2. Muda, which meaning to the seven categories of waste-over-
   production, delay, processing, inventory, transportation, 
wasted motion, and defective items.
3. Principles of motion/method study and the utilization of cell 
technology
5. Documentation of standard operating procedures.
6. The five S’s for workplace organization, which are five Japanese 
   words that mean proper arrangement (Seiko), orderliness 
   (Seiton), personal cleanliness (Seikesto), cleanup (Seiso), and 
   discipline (Shitsuke)
7. Visual management by means of visual displays that everyone 
in the plant can use for better communications.
8. Produce only the units in the right quantities, at the right time, 
   and with right resources and apply the concepts of JIT.
9. Implement Poka-Yoke to prevent or detect mistakes.
10. Team dynamics, which include problem solving, 
    communication skills, and conflict resolution.
Kaizen heavily dependent on a culture that encourages suggestions by operators who continually struggle to incrementally improve their job or process.

**2.10.4 BUSINESS PROCESS RE-ENGINEERING (BPR):**

The approach was evolved in 1990 – business process re-design or re-engineering (BPR). It refers to the radical change to a business activity and the aim of BPR is to make discontinuous, huge improvements as illustrated in fig 2.5. This means, invariably organisational change and the extent of that change depends upon the scope of the process being re-designed.

Definitions of the concept include:

“The fundamental re-thinking and radical re-design of business processes to achieve dramatic improvements in critical, contemporary measures of performance, such as cost, quality, service and speed.”

“To rethink, restructure and streamline the business structures, processes, methods of working, management systems and external relationships through which we create and deliver value.”

Many processes within organizations are very good and do not need re-designing, or not for a while at least. These processes should be forced to a state of continuous improvement. It is the poorly performing activities that need a radical review.
Figure 2.5: Continuous Improvement Vs Breakthrough Improvement

Because the degree of change in BPR is high, it is essential that ownership exists at the highest level in the organisation. BPR is therefore a top-down approach and takes the form of a project, typically having seven phases 1) Discover, 2) Establish the re-design team, 3) Analyze and document process(es), 4) Innovate and rebuild, 5) Re-organise and re-train, 6) Measure performance 7) Continuous re-design and improvement

CONCLUSIONS: This chapter discussed earlier quality improvement approaches like TQM and related other process improvement approaches. Principles, philosophies and tools used in the different methods were discussed. Because, the Six Sigma evolved from the foundation of the previous improvement programs, this chapter discussed in length about the principles of TQM