Analyses of the Production System Development Process in Manufacturing Industries - A Comparative Analysis study on Manufacturing Industries in Sweden and India

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Abstract
In the competitive world of manufacturing, the companies would like to produce their products at reduced price and superior quality. In the production system, the company faces many problems during the production of their products. Over the past years the manufacturing industry follows suitable techniques in their production system for the improvements in production. Still, companies are in search for new technology or techniques to improve their production in radical ways during a short period of time. Many researchers have discussed the development of production system through continuous improvements. Techniques like lean, kaizen etc are implemented in the production system but the effect of these techniques is realized in production unit only after many years. Kaikaku is another technique in lean production which occurs in a radical way to eliminate waste to provide a greater value. It is a radical process improvement which takes place in short period of time. Kaikaku is normally used when Kaizen techniques are not providing enough positive results to keep an organization effective. Still, radical improvements often need capital investment. It is often focused on introducing new technology, new strategies, or completely new production system.

This main objective of this thesis is to understand and analyze the production system development process in manufacturing industries and suggest how it is effective to keep an organization competitive. The basic conception and research aid of various authors are explained in the theoretical framework, and is done for the enhanced understanding of the reader and also a new conceptual theory structure framework is done to introduce the new concept of process innovation for radical improvements in the company. The proposed structure framework can help companies to practice the process innovation in the production system for development in short period of time. Based on the conceptual structure and relevant theoretical understandings, the interview questions are framed and case companies are analyzed for the process improvements and process innovation performance in the production system. The empirical data is collected from case companies through interviews. With the help of empirical results and the related theoretical results, an analysis and discussion is made which clearly explains about the problems faced in the production system and how they can be solved through in a radical way.

Keywords: Process Innovation, Radical improvements, Kaikaku, Production system, Process Improvements
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1. Introduction

The first section of this thesis begins with introducing the background of the thesis project. Next the objective and research questions in the thesis are presented and the delimitations are discussed at the end of the chapter.

1.1 Background

There are many challenges that industrial enterprises face in order to maintain their competitiveness. Just running industrial operations effectively is not enough in the long run. Capabilities of innovation and utilizing innovativeness in new ways are also required in future competition.

The requirement for improved ways of developing the area of industrial production is bigger than ever, both for individual manufacturing companies and for national industries as a whole, in the fight to sustain competitiveness in international market. According to Bellgram (2010), the production developments are about improving existing production systems as well as developing new ones. The production system should be developed in integration with the product, as a part of the overall product realization process, and not in sequence after the product had already been designed.

In general, innovation can be defined as introduction of something new. The innovation process is defined as planned and measured set of activities designed to turn out a precise output for a particular customer or market. Innovation can be used along with the process which brings a radical change. The process of innovation is the combination of structure for performing work and direction for visible and radical results. This process innovation is totally different from process improvements. The process of innovation brings about the work activity in a radically new way, whereas process improvements makes the same work activity for little incremental efficiency or effectiveness.

According to Champy (1993), the fundamental rethinking and radical redesign of business processes have to be done to achieve dramatic improvements in critical, contemporary measures of performance, such as cost, quality, service and speed. According to Lowenthal (1994), the fundamental rethinking and redesign of operating processes and organizational structure, should be focused on the organizations core competencies, to achieve dramatic improvements in organizational performance.

1.2 Objective

As mentioned in the introduction, the manufacturing industry faces many challenges in their production system in relation to conducting improvements. Thus, in several companies, various tools have been developed and are used for achieving an effective improvement process. Still, they are in need of process innovations for managing radical improvement which helps to make the company more effective and stable with the competitors. The
The objective of the thesis is to investigate and analyze the innovative development process of production systems in the manufacturing industry.

The process innovation for radical change helps to increase efficiency of the production system, conducted in a short period of time. In this thesis, a conceptual theoretical framework for process innovation is proposed. This framework is used to analyze and compare the current practices in the manufacturing companies. Also, the purpose of the conceptual theory building is to increase awareness for companies in improving skills for conducting radical improvements.

The production innovation process that takes place in the production system in various manufacturing companies is compared with the conceptual theory framework and challenges and problems are identified for future development.

1.3 Research Questions
In order to meet the objective of the thesis, the following subsequent research questions have been proposed. Also the research questions provide an opportunity to recognize regarding the formation of the research work covered in the thesis.

1. What are possible approaches for creating process innovation for radical changes in developing a new production system in order to achieve the radical improvements (Kaikaku) that can yield high profit to stakeholders (manufacturing industry)?

This question intends to look for and explore the process innovation process for radical change. Hence a proper theory framework and a strategy are explained briefly. The various approaches and steps are explained briefly in order to the manufacturing industry to practice process innovation in their production system. With this strategy, a new production system can be formed with all facilities and new technology that make a way for high profit to stakeholders.

2. What are current practices carried out in process improvements and process innovation in industry, assisting in the development of production system in manufacturing companies?

Here it is interesting to investigate current practices in manufacturing firms. How they perform the process improvements and process innovation for improving their production system. The related supporting information from the case companies is collected and with the theoretical and empirical findings and analysis is done to contribute towards production system development.
1.4 Project Delimitation

During the research evolution, the three main limitations are declared here. As per the thesis objective, literature on analysis of production system development was researched. Unfortunately theoretical literature on Process Innovation for radical change (Kaikaku) has its own limitation. This is new emerging topic which does not provide available sufficient data for performing pre-study work. Hence an own approach for process innovation strategy is prepared and this strategy is compared with case companies. The production system development is a broad area and it has more complexity; it consists of many process and phenomena in it. Hence this thesis focused only important strategy that plays important role in developing a production system and gathering information becomes a problem in this thesis.

The data are collected from the companies through interviews; hence physical observation was not done in the company. Three international companies with foot prints all over the world were interviewed in the empirical results.

1.5 Outline of the thesis

This thesis report consists of eight chapters,

Chapter 1 - The introduction, this chapter briefly describes about the background of the project which states the problem area, objective, research questions, project limitations and the outline of the thesis.

Chapter 2 - Research Methodology, this chapter explains about the different types of research methods and it also describes about the method chosen for this thesis. It also describes about how the questionnaires and interviews are framed based on the thesis.

Chapter 3 - Theoretical Background, this chapter describes about the theoretical studies on various topics such as production system development, process innovation, and process improvements. This chapter presents the fundamental knowledge about this thesis topic.

Chapter 4 - Empirical Data, this chapter describes about the real time data collected from the company through interviews. This chapter demonstrates and unites with chapter 3 and chapter 5.

Chapter 5 - Analysis and Discussion, the analysis and discussion is done with help of the results obtained from the both literature study and empirical study.

Chapter 6 - Conclusions, the conclusions drawn in this project are summarized on answering the research questions.

Chapter 7 - The various references used for this thesis are presented here.

Chapter 8 - The appended papers are listed.
2. Research Methodology

This chapter illustrates the research methods used in the thesis. Common and exacting reasons for the choosing the research method are described and also how the interviews, analyses and evaluations of the results to tribute the research.

2.1 Research Method

In general, research is illustrated as a search of knowledge. It can be also described as a scientific and systematic search for pertinent information on a specific topic. In fact, research is an art of scientific exploration. In scientific research there are often two main types of methodologies, they are qualitative and quantitative. According to Bryman (2002), the choice of the research method depends upon the aim of the inquiry and use of the findings.

The qualitative research consists of an study that,

- Look for reply to a question
- Methodically uses a predefined set of measures to respond the questions
- Gathers evidence
- Generate results that were not determined in progress
- Produces answer that is relevant outside the instantaneous limits of the study

The qualitative method served the purpose well since the objective of the thesis is to analyze the current production system process of manufacturing industries and to identify the problems in the production system development. The analysis is done between India and Sweden manufacturing industries. These questions can be answered only through qualitative method and qualitative research split these features and will makes to understand the listed research problem from the viewpoint of the local population it involves. According to Brymann and Bell (2003), listed the general procedure for performing the qualitative research is shown in the Figure 1.
2.2 Research Design

2.2.1 Literature review
The method chosen for this thesis is literature review. The main motive behind choosing this method is to identify with our determined topic in a comprehensive way and to show the answers that would eventually assist us to conclude our information regarding the area. According to Hart (1998), the literature review is a collection of available documents on relevant topics which may be either published or unpublished. Literature review includes information, data, ideas and evidence which have taken from a definite viewpoint of the specific topic. The viewpoint should have a certain aim and it should give the idea about how the topic will be investigated.
In this study, the theories those are relevant to the production system development and methods for process innovation. The paper also focuses on different journals related to process innovation for radical change, Kaikaku, tools used for process improvements and development of production system.

The interview questions are framed only after performing a deep study within the previous research in the area of production system development and linked appropriate literature. This is done to attain a better understanding about the concept and also make the discussion more fascinating and interactive during the interview session.

### 2.2.2 Preparing the interviews

According to McNamara (2009), the importance of the preparation stage in order to maintain an unambiguous focus as to how the interviews will be erected in order to provide maximum benefit to the proposed research study. According to Chenail (2009), provides a number of pre-interview exercises researchers can use to improve their instrumentality and address potential biases.

The interview questions were initially framed according to the type of person to be interviewed. The managers in the production system of manufacturing industries were chosen to be interviewed. The main aim of this thesis is to bring alertness of Kaikaku – radical change among the Indian manufacturing industry and also to make some opportunity for them to develop their industry. The proposal and the interview questions that are considered to ask in the discussion have been sent to the appropriate persons to make them recognize about the goal of the thesis.

### 2.2.3 Preparing the questionnaire

The interview questions are framed in respect to the objective of the thesis and it has some relevancy with the research questions stated. The different types of questions were formulated like open questions, multiple choice questions, probing questions etc. The respondent was also provided with an option of answering on their own if any of the suggested solutions which does not accumulate their profile.

### 2.2.4 Selection of participants

As Creswell (2007) asserts that, the researcher should utilize one of the various types sampling strategy such as criterion based sampling or critical case sampling in order to obtain qualified candidates that will provide the most credible information to the study. He also suggests the importance of acquiring willing participants are openly and honestly share information. It might be easier to conduct the interview with participants in a comfortable environment where the participants do not feel restricted or uncomfortable to share information.

The participants for this interview session were selected according to their profile and position in the different manufacturing sectors. The two Indian industries and one Swedish industry were focused to understand the problems faced in the production system in global.
The study has been made an attempt to analyze deeply on each industry. The Table 1 explains the three case companies with list of respondents.

<table>
<thead>
<tr>
<th>Company</th>
<th>Business</th>
<th>Primary Product</th>
<th>Position of the Respondent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mahindra &amp; Mahindra Limited (M&amp;M)</td>
<td>Automobile Manufactures</td>
<td>Automobiles, Farm Equipments, Military Vehicles and Automobile Components</td>
<td>Manager – Production Planning</td>
</tr>
<tr>
<td>Ashok Leyland</td>
<td>Automobile Manufactures</td>
<td>Trucks, Buses, Emergency and Military Vehicles</td>
<td>Manager – Production Development</td>
</tr>
<tr>
<td>ABB</td>
<td>Electrical Equipment Manufactures</td>
<td>Wide Range of products and service in Power Transmission and Industrial Automation</td>
<td>Professor – Mälardalen University</td>
</tr>
</tbody>
</table>

Table 1: List of Respondents

Case companies

Respondent 1 is a Manager - Production Planning Department in Mahindra and Mahindra Limited. (M&M) is an Indian Multinational automaker Headquartered in Mumbai, India. It is one of the largest automobile manufactures by production in India. Mahindra & Mahindra is a major automobile manufacturer of Automobiles, Farm Equipment, Military Vehicles, and Automobile Components. M&M's automotive division makes a wide range of vehicles including MUVs, LCVs and three wheelers. It offers over 20 models including new generation multi-utility vehicles. They sell more than 4.5 lakhs vehicles in car segments and more than 2.5 lakhs farm equipment vehicles like tractors.

Respondent 2 is a Manager – Production Development Department in Ashok Leyland. Ashok Leyland is a commercial vehicle manufacturing company located in Chennai, India and it is founded in 1948. They manufacture commercial vehicles such as Trucks, Buses and Emergency and Military vehicles. They also manufacture spare parts and engines for industries and marine applications. It sells about 60,000 vehicles and 7000 engines annually. It is second largest commercial vehicle manufactures in India. In India, It is the largest market leader in Bus segments and it claims over 60 million passengers a day. In Truck
segments, mainly concentrates on the 16 tons to 25 tons range of weights. Total employees will be around 11,500.

Respondent 3 is a Professor at Malardalen University who has been working for ABB. ABB is a Swedish-Swiss multinational cooperation headquartered in Zurich, Switzerland. ABB is one of the largest engineering companies as well as largest international business company. They operate more around 100 countries globally. They manufactures different kinds of products in power and automation technologies, such as power products, power systems, discrete automation and motion, low voltage products and process automation.

2.2.5 Conducting the interviews
According to McNamara (2009), the strength of the general interview guide approach is the ability of the researcher ‘to ensure that the same general areas of information are collected from each interviewee; this provides more focus than the conversational approach, but still allows a degree of freedom and adoptability in getting information from the interviewee’

The answers delivered from the respondents were hand written and some answers were responded through mail. In Indian manufacturing industry, the appointment was taken through phone from above listed respondents. The interview questions, short description and objective of the thesis were sent before to them to make the discussion easier. The interview was held more than an hour and the answers delivered by them were more fascinating and it helps for this thesis. The interview during the Indian respondents, the communication takes in my regional language which helps to understand better.

2.3 Data Analysis
According to Robert K.Yin (2003), the data analysis consists of three general categories, relying on theoretical propositions, thinking about rival explanations and developing a case description. These strategies can be analyzed using five specific techniques that are pattern matching, explanation building, time series analysis, logic models and cross case synthesis. Relying on theoretical propositions would be a suitable strategy for analyzing the thesis, the techniques used for analysis would be pattern matching.

The researchers for this thesis have framed three research questions in a logical manner. In this thesis, it’s mainly about the analysis of current production system in manufacturing industry and also comparisons study between Indian and Sweden manufacturing industry. Within each research questions, the author provided general interview and other documentation showing the resource of findings. To make the reader more clear, much of the data are illustrated as figures, tables and the survey questionnaire referred in footnotes and appendices.
2.4 Validity and Reliability
According to Winter (2000), “the Reliability and Validity are tools of an essentially positivist epistemology”.

Reliability
According to Joppe (2000), he defines reliability as the extent to which results are consistent over time and an accurate representative of the total population under study is referred to as reliability and if the results of a study can be reproduced under a similar methodology, then the research instrument is considered to be reliable.

The information and data are collected from the appropriate professional and the information delivered by them is recorded in handwritten. Hence there will not be any chance of missing any data and hence the work is more reliable.

Validity
According to Wainer and Braun (1988), they described the validity in quantitative research as “construct validity” the construct is the initial concept, notion, question or hypothesis that determines which data is to be gathered and how it is to be gathered. They also assert that quantitative researchers actively cause or affect the interplay between construct and data in order to validate their investigation, usually by the application of a test or other process.

The interviews are made with the respondents who are professional by experienced and relevant person in the field. The validity was conducted to know about the concept of process innovation and kaikau which helps in development of production system in manufacturing industry. The tactics use for validating is the pattern matching technique which could validate through literature review and previous researches conducted.
3. Theoretical Background

3.1 Overview – Process Innovation for Radical Change

In general, innovation can be defined as introduction of something new. The process is defined as planned, measured set of activities designed to turn out a precise output for a particular customer or market. This innovation can be used along with the process which brings a radical change. The process innovation is the combination of structure for performing work and direction for visible and radical results. This process innovation is totally different from process improvements. The process innovation brings about the work activity in a radically new way, whereas process improvements makes the same work activity for little incremental efficiency or effectiveness. The radical process development can be also called as business process redesign or business reengineering. The business reengineering is typical represented as design of the new process. It also include various activity like new work strategy, redesign of actual process, and implementation of the changes in all elements like information technology, human and organizational. The characteristics for process innovation and process improvements are differentiated in the Table 2.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Process Innovation</th>
<th>Process Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level of change</td>
<td>Radical</td>
<td>Incremental</td>
</tr>
<tr>
<td>Starting point</td>
<td>Clean state</td>
<td>Existing process</td>
</tr>
<tr>
<td>Frequency of change</td>
<td>One-time</td>
<td>Continuous</td>
</tr>
<tr>
<td>Time required</td>
<td>Long</td>
<td>Short</td>
</tr>
<tr>
<td>Participation</td>
<td>Top-up</td>
<td>Bottom-up</td>
</tr>
<tr>
<td>Risk</td>
<td>High</td>
<td>Moderate</td>
</tr>
<tr>
<td>Type of change</td>
<td>Cultural/Structural</td>
<td>Cultural</td>
</tr>
</tbody>
</table>

Table 2: Characteristics of Process Innovation Vs Process Improvements (Davenport, 1993)

The company needs combination of both process innovation and process improvements for quality program. The company is mainly concerned to make their process more stable and they start their business with continuous improvements, then they attempt for process innovation. These both process innovation and process improvements differ from some challenges. The company should able to be aware of risk by performing process innovation. The process improvements should be performed through the process for better quality improvement and process innovation should be carried out in a particular time for radical change to meet the competitive and pressure force. This process innovation for radical change is called as Kaikaku and the process improvement for continuous improvements is called as kaizen. The Figure 2 explains about the outline performance of these Kaikaku and Kaizen in a company over a period of time.
3.1.1 Methodology for process innovation

Most of the manufacturing companies around the world are taking steps to make a move for radical change initiatives. The proper guide way for performing a process innovation is created and described briefly here. The process innovation initiative is totally different from the business management activities. The process innovation should be handled and view as a special activity, assigned to project teams or task forces. The special project or initiative structure is the only way to bring about radical change.

A project orientation emerges to be the best way for introduce innovation and experience within an organization. Only the process innovation is projected to achieve radical business improvements. It is a separate initiative that must be combined with other initiative for ongoing change. It is impossible to achieve radical innovation while practicing continuous improvements. The company must learn how to perform these both in simultaneously across the different process and like clockwork for a single process. The difficult challenge in process innovation is making of successful transition to a continuous improvement environment.

The structured way of performing process innovation for radical change consists of five major steps. The steps are identifying process for innovation, identifying change force; develop process vision, understanding the existing process, designing & prototyping the new process. The main importance of performing these steps must be in sequential order. The high level approach makes the foundation for creating these process innovations. The project team who is going to handle these structured way must be selected and trainee them well. The Figure 3 shows the sequential structure for performing process innovation is shown below,
3.2 Identifying the process for innovation

The identification process is done by doing a survey of the process background to identify processes that are aspirant for innovation. On the whole, all the process should be listed and focus should be on requiring immediate innovation ideas are fundamental to the success of innovation efforts. This identifying of process helps to set up the boundaries for the each process that are to be addressed, which helps the firm to focus on the important process that are to be done with radical change.

The main activities carried out in identifying the process for innovation is,

- List all the major process in detail.
- Decide the process boundaries.
- Consider the each process for improvements.
- Provide high level judgments.
- Non Selected process should be carefully measured.

The goal of process identification is important of making these definitions and determining their implications. The key source benefit for process is improving handoffs between functions, which can be done only when the process are described briefly for radical change. If the identification of process is few and boarder, there is a great chance of innovation through process integration and the greater the problems of understanding, measuring and
changing the process. The strategic planning and systems planning is advance to have a business process which helps to identifying the process.

3.2.1 Decide the process boundaries
After identifying the process that is in need of innovation at high level, the boundaries need to be managed between those processes. Because process definition is more art than science, boundaries are random. The following information makes the company to decide how to define the boundaries for the identified process. They are,

- The company should decide when to start and end the process.
- The firm should decide when process customers involvement will start and end in the process.
- When the sub process should start and end.
- Check whether process is fully implanted within another process.
- Judge the gain which is likely to result from combining the process with other process or sub process.

The end of deciding the boundaries for any process is the start for another process; moreover it may be inside or outside the organization. The process innovation will frequently results in changes to upstream and downstream process. The process management is the most excellent activity, in which innovation in one process will need to re-innovate or modify.

3.2.2 Measure strategic relevance
Once finding out the boundaries for the major process, the each process should be ranked in priority basics. In which top most priority process should be selected for innovation. The main scope of the innovation effort should be based on an organization’s capabilities and their resources. In many firms, they will be insufficient in resources like people, funds and design. Ahead of resources, most organizations couldn’t continue the magnitude of organizational change that involves all the process simultaneously to sudden change. The firm should understand well about their level of change and disturbance it can carry on and the innovation team members should learn about all the process and decide how many processes can move further for successful innovation. It is very difficult to coordinate for simultaneous change in many processes. Hence it is advisable to perform one process at a time.

At beginning stage, it is better to focus on small process in order to gain experience with innovation initiate and they can use their resources liberally for the critical process. The four criteria should be considered before execution of process innovation. They are

- The process centrality to the implementation of the firm’s business strategy.
- Process health.
- Process qualification.
- Manageable project scope.
The best way for approaching the process selection is to select the processes most central to carry out the organizational strategy. If the selection is based on the process health, the target is redesigning process that are currently problematic and also it needs some process improvement. The main objective of process qualification is to determine the cultural and political climate of a target process. After selecting the specific process, the firm should define the process in a way that can yield profits or positive results in a manageable innovation project scope.

3.2.3 Unselected processes should be carefully measured
The process which is not selected for the process innovation must be still addressed. The business orders may vary from time to time depends upon the market and competitors. The firm which has the resources for process innovation may rise and fall irregularly; hence it is advisable to form a time table for establishing the innovation process. It is recommended to use this time for less than three years, because after these certain periods process priority and the resources available in the firm may change.

3.3 Identify change force

3.3.1 Information Technology as an enabler for process innovation
The information technology will have more complexities, but still the role of IT in process innovation, are stated by many authors, According to Davenport T (1993), he believe that information technology has a major enabling role in process innovation and that many process innovation contain IT as one of its major components. The installing of new hardware and software, as well as using systems analysis and modeling tools are major components in process innovation effects (Guha, et.al, 1993). According to Al-Mashari and Zairi (1999), points out that over the past decade IT has become both a major tool and fundamental enabler of large scale change.

The information technology is having a major two elements, they are enabling role and being one of the major components of radical change. The first element is enable role of IT can happen continuously throughout the process innovation for radical change. Based on this, IT can help in number of categories, informational, tracking, analytical, integrative and communicative. The second element is IT components, the IT is part of the change object, hence it impose on the radical change will include the ability to change legacy and proprietary systems, the existing quality and standard of it in regard to process and product management for the adoption on new emerging IT.

The successful use of IT in process innovation, its capabilities, constraints and behaviour need to carefully understand.

According to Higgins J (1993), he sees the role of IT in process innovation as having three major aspects,

1. Knowing what new business opportunities are made possible with computer-based technologies.
2. Building an active platform of systems and capabilities.
3. Focusing on the process of delivering new systems.

According to Childe, et al., (1996), the application of IT in process innovation are under two groups, they are change technologies and support technologies. The change technologies, they are mean analyzing, modeling and mapping existing process, assessing their efficiency and effectiveness, measuring performance and providing structured support for the change project management and associated planning and control functions. They describe support technologies as relating to implementing IS to support the process configuration needed. The information planning strategy is necessary to map organizational plans and structure to a business wide communication infrastructure. Adequate use of open systems, fourth generations programming languages, advanced data base management systems (DBMS) and software re-usability techniques may reduce the inflexibility of IT systems, so they can support process innovation more effectively.

3.3.2 Organizational enablers for process change
The organizational enablers for process change are divided in two main categories. They are structural and cultural enablers.

Structural Enablers
There are many kind of structural change that can help for new process innovation, but the powerful structural enablers are by performance of teams. According to Taylor’s era (1998), the more isolated the worker, the more efficient the performance of the task. Yet more processes or sub processes can be performed by team or collection of teams. The team work is measured in terms of productivity, motivation and satisfaction of workers. The work of individual on new designs with technology is less productivity than the work team with no technology. The team work is better for new process design because they combined multiple functions into one unit, permitting to change conditions inside the process.

At present, many firms have started to investigate about the purpose of independent teams as their primary unit of work organization. The main benefits of teams are,
First, the firm is looking for a cross functional skills in single work units. The cross functional expertise make possible of functional interface and parallel design activities. Hence broad set of skills helps to result in multifunctional requirements. Second, the employee team structure helps to increase the improved quality of work life in the organization. Working as a team with social interaction like small talk, development of friendship and understanding reactions from other employs, results in increased productivity levels, process improvements and quality control.

It also should be taken in account that social interaction of teams’ members is not always positive. In cross functional teams, they may be lack of culture, leading to conflict among them and misunderstanding arises. Hence the team members should carefully selected in terms to cultural perspective.
Cultural Enablers
The recent trend in organizational culture is in the direction of greater empowerment and participation in decision-making. Cultural enablers which have a structural side in flatter organization hierarchies or broader spans of control which leads to both higher productivity and greater employee satisfaction. The process like customer-facing such as order management and customer service are well suited to empowering frontline employees to satisfy customer demands. The three enablers of team, empowered team members and collecting more information on customers can yield radical improvements in customer-oriented process. After preparing broad structure for process innovation and it have been implemented. An innovation culture can motivate minor improvements that benefits day to day process improvements. Information technology can support culture for process innovation like control and empowerment. It can pass the information to each employee that will help them to make their own process decision or it can help how to perform each process step.

3.3.3 Human Resource Enablers for Process Change
The organization and human resource enablers of process innovation must be tied together. The organization must help the individual employees to be trained, motivated, compensated, evaluated etc. The development of new process should need more new skills, because there should be more great work empowerment and border set of work tasks. The variety of training program should be conducted for the employees to mould them for process innovation. The most common type of training in a process innovation is specific process training. In process innovation, if a new process or new technology is designed in a organization, the necessary skills and training should be given to the specify employee about the specify process. If there is no expert to train workers in the carrying out of a process, the only choice is to teach the process and its associated skills to number of flexible, adoptive employees and have them in their new knowledge and skills.

The organization must know these drawbacks while providing training to employees,
1. To attain the skills and knowledge from the training will take more time than the process design. But the need of worker with innovative skills may be urgent before their training can be completed.
2. There will be some employees with experience and knowledge to train others, if the process is truly innovative then there will no one qualified people to train others.
3. If the workers are under the qualification for their jobs, then it is difficult to find employees with enough knowledge and standard job skills to implement the new innovative process.

In overall organizational culture, it emphasizes skill enhancement and job rotation has been cited as a key factor in the flexibility and innovativeness inherent in Japanese manufacturing processes. In some cases, the process innovation not only needs new skills, it needs some new employees with different backgrounds, latest knowledge and different skills. The firm should hire a flexible employee from the beginning and they should invest for their ability to increase their skills and make them implement to the new process.
According to Richard Hackman and Greg R. Oldham (1976), they suggest that work motivation derives from five key aspects of the job,

- **Skill variety** (the variety of skills necessary to complete the job)
- **Task identity** (the degree to which a job involves completion of an entire activity)
- **Task significance** (the perceived importance and impact of the job)
- **Autonomy** (the freedom and discretion with which the job is performed)
- **Feedback** (the extent to which information about the performance of the job is provided to the worker)

There are number of other human guiding principle can be taken in account for enablers in process innovation when combined with technological and other organization changes. The main guiding principles are compensation, life time employment, career paths, work role rotation etc.

### 3.4 Creating a Process Vision

The process innovation is meaningful only if it improves a business in ways that are consistent with its strategy. The purpose of creating a process vision is on represents an organization strategy in a vision for the future process state. Inspiring a vision for operational processes clearly is not the only role of strategy. High quality, low cycle time products and services are only useful if they fit the external environment and satisfy the customer demand. The comparison or alignment between strategies and processes is essential to radical change in business process. According to James Brian Quinn (1980), the Strategy and process objectives must reinforce one another and echo similar themes. The 7S model is calls for alignment among strategy, structure, style, systems, skills, staff and super ordinate goals (Anthony G. Athos and Richard T. Pascale, 1982)

A well structured strategy will provide a framework for process innovation and the motivation to undertake it. The radical changes cannot be achieved if it’s not directed in a clear direction. The main activities carried out in existing process activities for innovation are,

1. Assess existing business strategy for process directions.
2. Consult with process customers for performance objectives.
3. Benchmark for process performance targets and examples of innovation.
5. Develop specific process attributes.

### 3.4.1 Assessing an existing business strategy

The main aspire of strategy and vision focuses on the content of strategy and the formulation of strategy position relative to environment, customers and competitors and so on. The implementation of strategy helps to guide and also to inspire the process innovation activities. The vision process is more powerful and tactical than strategy. The both vision and strategy
must be formulated at a high level. And moreover strategy should be visionary for future process and vision strategy should be key focus to each process. A defined strategy is a primary in both the selection and development of process vision for processes to be innovated. The roles of business strategy and other aspects of a firm’s atmosphere in selecting processes for innovation were discussed. The relationship between strategy and process vision has to be established deeply for creating the context for process innovation. The strategy which is to posting a broad examination of a potential state must assemble the following condition. They are,

1. Strategies have to be at least in some measures in nonfinancial.
2. The components for a strategy should eventually be quantifiable.
3. Strategy should focus on organization on specific characteristic of its business to which process innovation can be usefully functional.
4. Strategy should be characteristic to an industry and company.
5. A strategy should be inspirational.
6. A strategy should be made for the long term – five or ten years.
7. According to Peter Schwartz (1991), the method employed to create a strategy, should have change levers that enable process innovation and should be broadly focused and address key tools for change. The planning method that best seems to do is scenario-based planning.

3.4.2 Customer Inputs into Process Visions
The main endeavor of creating a process vision is to understand the customer’s perspective on the process. In a process, the customers may be either internal or external to the firm. But in general, most firms are more anxious about the viewpoint of external customers and therefore place a high priority on customer-facing process. The customers can be interviewed for the needs of them and requirements of process which supply multiple purposes. In the framework of creating vision for process innovation, the customers understanding delivers both ideas and objectives for process performance. The ideas from the customers will also make a close relationship and these results will essentially factor into process designs for radical change to fully attain this objective. Finally, new processes may require that customers change their own behavior for the process to be fully effective.

In some cases, many processes will contain multiple customers, but it is not very useful to treat all the customers equally. It is recommended to focus on a few customers makes for less structured interview processes in which innovative information can be hunted. The type of inputs that should be requested from customers are based on the broad, encompassing desired process outputs, performance, flow, enablers and relevant factors. A focus group may be the best way to deal with the individual rather than organizational, customers. In many cases, the customer provides breakthrough ideas for process innovation. Hence their objectives are helps to improve the existing process incrementally.
3.4.3 Process Benchmarking
The benchmarking facilitates the company to formulate the objectives for continuous process improvements process. It also act as an effective tool for finding out the process objectives and to identify the innovation process attributes. In recent development, there are various research has been made for process innovation and benchmarking hypothesis and practices in an challenge to meet the demands of large-scale revolutionize and increased globalization and competitiveness in organization.

According to McFadzean (1999), he points out that benchmarking can enable organizations to create new external knowledge leading to create new external knowledge leading to increased creativity and visioning. Benchmarking acts as a catalyst in the creativity-vision interaction (Povey, 1988)

The benchmarking affords a longitudinal axis for any conceptual model development in a large-scale change and continuous benchmarking acting as a guide for when and where large-scale change should take place. The many number of large-scale change methodologies viewing benchmarking being limited to a singular step in the process. Hence this approach limits the capability of the change team to create new knowledge and develop visions all through the change project.

According to Zairi (1992), a benchmark can be considered to be anything that is used and measured as a point of comparison or as a standard by which service can be offered. He also considers benchmarking as “an enabler for achieving and maintaining high levels of competitiveness.”

When this concept is applied to innovative processes and practices, benchmarking helps to find out the unconstructive gaps in performance. This helps to enable suitable actions in all areas and maximize the level of performance that is needed to be best in the class. According to Carlson and McNurlin (1992) in this field, benchmarking encourages the re-engineering efforts of business processes to measure performance and quality.

3.4.4 Linking strategy and external information to produce process innovation
The main tools like Strategy, customer standpoint and benchmarking are very essential for process innovation for radical change, but they are not sufficient to establish the methodology for process innovation. When the process to be changed, the methodology must be made explicit and execution through a set of visions that define the desired process functionality, specify change objectives for the redesign of the process and identify the qualitative characteristic of the process future state. These visions help for necessary directions for the design team.

The process vision helps to build a relationship between strategy and action. This helps to change high level strategies into measurable targets for the process performance and understandable characteristics of process operations. It also places a target for both designers of a process and also for those manage it. The analysis of business strategy is combined with
information from external sources is way to create a process vision. Thus process vision gives rise to objectives and attributes. The Figure 4 explains the connections between the strategies, visions, objectives and attributes in a structural form.

![Figure 4: Strategies, Visions, Objectives and Attributes (Davenport, 1993)](image)

3.4.5 Formulating Process Objectives
The objectives of process innovation for radical change has overall process goals, specify type of improvement, numeric target for the innovation and time frame in which the objectives are to be accomplished. The creation of process objectives begins with a vision team asking them and key stakeholders. This addresses the functions and value the process is expected to bring customers.

The process objectives must be quantified as specific targets for change. An example of quantitative process objectives for various industries includes.

1. Reduce new drug-development cycle time by 50% in three years.
2. Double customer service satisfaction levels in two years.
3. Reduce involuntary employee turnover to 10% by the end of next fiscal year.
4. Reduce processing costs for customer orders by 60% over three years.

3.4.6 Developing Process Attributes
The process attributes is explanatory, non-quantitative attachment to process objectives, constitute a vision of process operations in a future state. They address both high level process characteristics and specific enablers. According to Thomas H Davenport, et al.,
(1989), the process attributes might be considered principles of operations, they are simple statements that describes as organizations philosophy and intent regarding the process operations and can be an effective means of engaging senior management in discussions about visions for new process.

The enablers that are used in the process innovation for radical change have been recognized as relevant in previous phases of innovation initiative also become attributes of the process. These may contain information, information technology, or organizational and human factors.

3.4.7 The Visioning Process
The process objectives and process attributes are obtained from numerous sources, in which analysis of corporate strategy and vision, high level overviews of the roles of technology and people, customer interviews, benchmarking of the best processes in other companies and firms performance objectives during visioning sessions at the beginning of a specific process imitative. According to Al-Mashari and Zairi (1999), an overview vision of the future state of the radically changed organization or part of the organization is essential for both directing and driving large-scale change. According to Fuerer, et al., (1996), they speak of “envisioning the future environment” and the vision is a “force, ideal of the future...An evolving phenomenon appealing to motivation and values” (McGivern and Tvorik, 1988)

The visioning process is purposeful in all aspects of the vision must be stated with a high degree of specificity. The specificity of process visions is the source of both their control and their complexity. Detailed attributes and assessable objectives are dominant because they clearly express the function of process innovation efforts. A process vision should therefore determine on the basics of what is necessary from a business point of view, rather than what seems practical or skilled.

According to Demarest, (1997), the individuals and teams critically reflect upon and debate each other’s suggestions leading to fundamental change based on the iconoclastic questioning of underlying assumptions. The process objectives should be broadening targets for an organization. Unless their reach seems to exceed an organization grab, they will not motivate design teams to go beyond incremental improvement. According to Mcgriven and Tvorik (1988), the need for two aspects of vision for large-scale change, namely that of business strategy and organizational culture. They point out that the large-scale change efforts must be driven by both of these aspects of the change vision. The Figure 5 represents the Creativity and vision autopsies for radical change.
The vision for an organization, which acts as a pull feature for radical change, is basically initiated with the managing director and management team. The formation of the vision and ensuing strategy change plans are influenced by the exposure of the management team to radical change in best practice organizations. The process vision and the strategies that support them are key elements of a context for process innovation. Other aspects of management practices, clear strategies and visions are good ideas for all companies, but they are essential for process innovation.

3.5 Understanding and Improving Existing Process

Understanding the existing process is very important before proceeding to process new design. But in some process redesign approaches, this understanding of existing was not considered. There are four reasons to consider the understanding of existing process before scheduling to innovation. They are,

1. Understanding existing process helps to communicate among the team members for innovation initiative. The plans and documentation of the current process will lead a way for process innovation to make understand everyone about the current state of the process.

2. If we consider a large and complex organization, it is impossible to implement a new process without understanding the current process. The information and data from the current process is an important input data for initial step for innovation and implementing a new process. This is very useful to understand the magnitude of anticipated change and the tasks required to move from the current to a new process.

3. Considering the problems in a current process can help the team members for not repeating in the new process. It is not unusual for process problems to go unrecognized until an entire process is analyzed.

4. This understanding of the current process will provide a measure of the value of the proposed innovation. The baseline data collection is one aspect of current situation analysis. Given a process objective of reducing cycle time.
3.5.1 Existing Process Activities
The improvements initiative needs more information on current process than innovation imitative. The time should be taken in weeks for analysis of current process in a view on innovation context. Even when the existing approach to work has already been viewed in process terms, it may not have been analyzed in sufficient breadth. Process analysis in terms of quantity initiatives usually deals with narrow process, which may differ from one part of company to another. The main activities carried out in existing process activities for innovation are,

- Describe the current process flow.
- Measure the process in terms of the new process objectives.
- Assess the process in terms of the new process attributes.
- Identify problems with or short coming of the process.
- Identify short-term improvements in the process.
- Assess current information technology and organization.

The analysis of existing process should include evaluation of both information technology and organization. The evaluation of information technology architecture should contain existing applications, databases, technologies and standards. The evaluation of organization should include job description, skills inventory, and information about recent organizational changes.

3.5.2 Improving the Current Process
The improvement of current process is a natural follow-on to documenting them. The analysis of existing process creates a chance for the employees to have document problems they may have known about for many years. The examining of a process on the whole results in highlighting the long standing problems, such as bottlenecks, idleness and non added value activities. Many number of firms occupied in process innovation initiatives for radical improvements are coupled with short term improvement and break through innovation. The short term improvements are carried out by employees who perform the processes day to day. In a organization, the process innovation team should be split in to two. In which one team approaches for process innovation and another team is on improvements of existing process, these should takes place in parallel. A proper communication should takes place between these teams for proper information sharing about the current process and future vision.

3.5.3 Standard Approaches to Process Improvements
There are many numbers of approaches for improving business processes. The standard approaches like process value analysis, activity-based costing, information engineering, and business process innovation. These approaches deliver two functions; first, it makes organization to understand the difference between the traditional approach and process innovation for radical change. Second, it helps to identify the tools and techniques that will help for process improvements phase for the process innovation initiative.
Quality based improvements
According to James Harrington (1991), he defines an approach to business process improvements with foundations in total quality management. This systematic step up step approach to streamlining processes and establishing a culture of continuous improvements is robust and comprehensive. The information technology which he equates with automation must be considered only after a process has been improved. The standard approaches cannot make a way through for creativity breakthrough or radical change. The process programming or flowchart can be used for understanding the current process. The documentation of the current process and analysis results are in use for process improvements. The development of detailed flowchart will help for establishment of improvement activities.

Industrial Engineering
According to Gavriel Salvendy (1982), the task of industrial engineering is to design and redesign, through study, analysis and evolution, the components of machine systems. It is started from improving interaction between employees and machines through time and motion studies to the examination and optimization of systems needed to produce products and service. In various approach, the implication of employees is not considered, only in industrial engineering employees are considered for the process improvements. The main weakness of industrial engineering includes the absence of information technology as a change enabler and the lack of focus on broad, cross functional processes. Apart from the other tools and techniques, the industrial engineering is the process model, a work flow diagram that gives brief information about the cost, cycle time, and isle time associated with given tasks or activities. The multiple charts are very much useful for differentiating between process activities performed by the individuals and those performed by machines.

3.6 Designing and Implementing the New Process
Innovation for Radical Change
The designing activity is a well-built subject of having group of intelligent, creative people re-examine the information collected in the earlier phase of the process and in production of new innovative process. The selection of participants for the new process should be directed by both design and implementation consideration. The participant who participated in the process identification and creating vision process should participate in the design phase too. The main activities carried out in designing and implementing the new process innovation is,

1. Brain storming alternatives
2. Consider feasibility, risk and benefits of design alternatives and select the preferred process design
3. Prototype the new process design
4. Develop a migration strategy
5. Implement new organizational structures and systems
3.6.1 Brain Storming Design Alternative
According to Gini Graham Scott (1989), the design innovation is best accomplished in a series of workshops and brain storming is an effective means of surfacing creative process designs. The importance of brain storming session should be on creativity and idea generation and non judgmental atmosphere is necessary. The main objective of brain storming is to develop creative; this can be achieved by using the information collected in earlier phase and also the inputs from process vision, change enablers and benchmark knowledge developed in earlier phase of process innovation. The graphical representing of a process design is more helpful in understanding, communication and recording of process flows.
To begin the new design, it should be started from the high level flow of overall process with the process vision. Next each sub process should be explained in detail by considering all the factors as who will perform it.

3.6.2 Assessing Feasibility, Risk, and Benefits
To begin the design activity, the design team should have full information regarding all the process. And also they should be familiar with broad performance parameters of the current process. The most important is high level approach of analysis should be given as inputs to the design planning. During the brain storming session, many number of creative design which be proposed, but it should be analysis with feasible to evaluate their advantages, costs, risks and time frames. The new proposed design and current process should be compared with respect to the structure, technology, organization to understand the effect of each process. The results will give a better idea about for selecting the optimum design.

3.6.3 Prototyping the New Process
Developing a new prototype model is a way to simulate and test the operations of a new process. According to Dorothy Leonard-Barton (1988), the definition is a small scale, quasi-operational version of new process that can be used to test various aspects of its design; this kind of prototype is called as organizational prototype. The prototyping must be viewed as a learning activity by process designers and users alike. More iteration is needed to attain a proper design.

The computer based simulation is the best way to prototype a new model. The information to be included for new design can be done by paper based information test of the process. The prototype should be taken to a stand-Alone process test. This makes a way for adding of information system to the process. The final prototype will include all technologies, skills and organization structure. Each phase helps refine the process design and the information needed to support it, taken together, these phases will helps to reduce the implementation risk.

3.6.4 Migrating to a New Process
After designing and testing of prototype model, the organization faces many difficulties for migrating from the existing process to the radically new design. The introducing cutover may be difficult or impossible. If the new prototype model includes customers, revenues, valued
employees and the process is highly visible in considering internal or external factors. The company will not face any difficulty or risk on it. The cutover should include phase introduction, creating a pilot or creating an entirely new business unit.

A pilot is a smaller scale, but fully operational, implementation of a new process in a relatively small unit of the organization based on a particular geography, product or set of customers. The aim should be to attain successes rather than merely objectively test. Thus the unit selected should be the one most capable of achieving successful change. If there is more limitation within the current process or environment, then it is difficult to create a new organization for the new process. In this regard, the organization should run the process parallel to the existing process by focusing on specific products, channels or customers.

3.6.5 Implement New Organizational Structures and Systems

The organization structures are based on the function or product orientation. In functional orientation based companies, have difficulty meeting customer needs seamlessly across different functions because no one owns the issue of how long it takes or how much it costs to fulfill the customer requests. In product orientation based companies, have difficulties in determining total business done with individual customers or cross selling different products to the same customers. According to Steven Dichter (1991), to abandon any form of structure beyond the self managing teams is frequently worse than the problem or at least much less well defined. It is not suggested to have processes as the only basis for organizational structure. The functional skills are more important to a process orientation, with respect to product management and the running of strategic business units. The firm who adopt to process based organizational structure will processes be managed in congruence with the other aspects of the organization. According to Kim and Takahiro Fujimoto (1991), the role has coordination responsibility for product development from concept to market, across such functional areas as engineering, manufacturing, marketing and sales. Although relatively high in the organizational hierarchy, the heavy weight product manager exercises relatively direct influence over the activities of engineers at the workers level.

The organization should move toward process based structure, because,

1. Concern that the level of organizational change from process innovation is already high and converting to a process based organization might constitute too much change.
2. Fear that if functions are no longer the primary basics of organization, functional skills will be lost.
3. A belief that process is an unstable basic for organization because processes change more quickly than the function.
3.7 Process Improvements techniques

3.7.1 Lean Production
The lean manufacturing is to represent a systematic approach to identifying and eliminating elements not adding value to the process. Consequences of this are striving for perfection and a customer – driven pull to the process. According to NIST (2000), a systematic approach to identifying and eliminating waste through continuous improvement, flowing the product at the pull of the customer in pursuit of perfection.

At the heart of lean manufacturing lies lean thinking. Lean thinking is the dynamic, knowledge driven and customer focused process by which all people in a defined enterprise continuously eliminate waste with the goal of creating value. The value is inclusive of value to the stake holder’s like enterprises, workers, society and customers.

According to Womack and Jones (1996), the lean thinking helped us to understand the principles of lean:

1. The identification of value.
2. The elimination of waste.
3. The generation of process flow

Lean manufacturing promotes the fundamental rethinking of how to produce and deliver goods and services to meet challenges. The lean manufacturing philosophy is revolved on designing a manufacturing system that completely blends together the fundamentals of minimizing cost and maximizing profit. The main fundamentals beyond lean manufacturing are man (labor), material and Machines (Equipment). it is called as 3Ms of manufacturing. A well sense of balance results in

2. Best possible module size
3. Smooth traffic flow of men and materials
4. Less manufacturing of cost of products produced
5. Low investment
6. Reduce labor force
7. Increase return on net asset

According to Melton (2005), the benefits of being ‘LEAN’ are seen within non-process industries such as the automotive industry. This benefit makes lean a very real and physical concept essential for manufacturing.

1. Decreased lead times for customers
2. Reduced inventories for manufactures
3. Improved knowledge management
4. More robust processes(as measured by less errors and therefore less rework)
According to Chriser Karlson and Par Ahlstrom (1996), in assessing towards lean production we feel that it is important to make a distinction between the determinants and the performance of a lean production system. The ultimate goal of implementing lean production in an operation is to increase productivity, enhance quality, shorten lead times, reduce costs etc. These are factors indicating the performance of a lean production system. The determinants of a lean production system are the actions taken, the principles implemented and the changes made to the organization to achieve the desired performance. The Figure 6 describes the model for operationalizes the determinant of a lean production system

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<thead>
<tr>
<th>Lean Development + Lean Procurement + Lean Manufacturing + Lean Distribution = Lean Enterprise</th>
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<tr>
<td><img src="image" alt="Figure 6: The model described operationalizes the determinant of a lean production system (Chriser Karlson &amp; Par Ahlstrom, 1996)" /></td>
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3.7.2 Kaizen – Continuous improvement

According to Yuji Yamamoto (2010), kaizen is defined as a continuous and incremental improvement of an activity with the purpose of increasing the performance of a production system. Typical activities are updating working standards and gradually reducing wastes in an operation. The performance increase as a result of kaizen is usually less than 20 or 30 % in a given period of time.
Kaizen is a set of ongoing improvements involving everyone, including both managers and workers. According to Imai (1986), the kaizen philosophy assumes that “our way of life deserves ways to improve processes and then immediately implementing these improvements”.

According to Wittenberg (1994), Kaizen promotes process-oriented thinking because processes must be improved before improved results are obtained. This may be very different from the result-oriented thinking of most western managers. Moreover, kaizen is people oriented being directed at people’s efforts. Of course results count, but kaizen assumes that improvements in peoples’ attitudes and efforts are more likely to produce improved results in the long term run than mere result – oriented would do. The characterizes of kaizen are

- Starts with people
- Focuses its attention on people’s efforts
- People work on processes
- Processes are continuously improved
- Improved processes improve results
- Improved results satisfy customers

According to Berger (1997), the features of kaizen can be summarized into three key notions. They are,
1. Process orientation
2. Small step improvement
3. People orientation

Process orientation means that attention is directed at creating sound processes, assuming that good results will follow automatically. Kaizen is distractive in this focus on small improvements of work standards as a result of an ongoing effort. People orientation means that kaizen involves everyone in the organization from the top management to the workers at the shop floor believing that their effort is going to “pay off” in the long run.

According to Brunet and New (2003), they identify three core principles of kaizen: it is continuous, usually incremental in nature and participative. Kaizen methods and tools have been developed and widely applied in industry. For example, a problem – solving process called PDCA (Plan, Do, Check, Action), problem-solving tools called “seven quality tools”, small group improvements activities called “quality control circle”, individual suggestion system and a performance management method called “policy development” that connects overall system targets and local kaizen activities.

3.7.3 Six Sigma
According to Magnusson et.al (2003), six sigma is defined as a business process that allows companies to drastically improve their bottom line by designing and monitoring everyday business activities in ways that minimize waste and resources while increasing customer satisfaction by some of its proponents.
Six Sigma could also be described as an improvement program for reducing variation, which focuses on continuous and breakthrough improvements. Improvements projects are driven in a wide range of areas and at different levels of complexity, in order to reduce variation. The main purposes of reducing variation on product or service are to satisfy customers. The goal of six sigma is that only 3.4 per million customers should be unsatisfied.

The six sigma conception of the company model formed more by process flow than hierarchical structure allows establishing a wide integration among management improvements and processes. According to Pande et.al (2001), six sigma integrates customer’s satisfaction with the financial dimension to produce sustained medium and long term results. The focus outside the organization reinforced the search for customer’s satisfaction, guided by excellence patterns without forgetting the economic profitability perspective. Operationally, it prioritizes

- Costs reduction.
- Flaw elimination.
- Product and service cycles improvement
- Quality certifications.

One of the key elements of Six Sigma is the use of measurement and analysis of data for process improvement and analysis of data for process improvement. Measurement and analysis of activities allow us to characterize or gain understanding of key processes, products, resources and environments. Evaluation of results can help determine the status with respect to the plans, in the end; it can help improve the process and the product by identifying roadblocks, root causes, inefficiency and other factors.

3.8 Process Innovation Techniques

3.8.1 Kaikaku – Radical Improvement

Kaikaku is defined as reformation, drastic change or radical change. Japanese manufacturing companies have been using the term to name an improvement in production that is more radical than kaizen. The expression of Kaikaku is delivered in different ways by various authors,

According to Womack and Jones (1996), he states that Kaikaku is a radical activity to eliminate waste and it is transforming batch production to flow production.
According to Kondou (2003), he states that, the process of attaining dramatic results by replacing existing practices with new ones and it is Important to obtain new knowledge as well as to acquire new and externally available methodology.
According to Uno (2004), he states that, fundamental change toward the ideal state, discarding the conventional way.
Kaikaku tends to bring about a dramatic increase in performance. The increase is usually larger and obtained quicker than that from kaizen. According to Womack et.al, (1996), they mention that the Kaikaku bonuses released by changing a class batch and queue production system to continuous flow with effective pull is a doubling of labor productivity, a cut in production throughput times by 90 percent and a reduction of inventories by 90 percent.

According to Yamamoto (2010), he defined Kaikaku with dissimilarity to the definition of kaizen as

Kaikaku is an infrequent but radical improvement where fundamental change occurs in the production system and a dramatic performance increase is obtained. Initiated often by top management, fundamental changes are made through reformations or replacements of the system by introducing new knowledge, work methods, strategies, production technologies, or equipment and so forth. The performance increase as a result of kaikau is often 30 to 50% more.

Realization of Kaikaku

According to Okada (2009), he reforms in real-world situations occur through a combination of three patters, the three patterns are mentioned as following,

- Pattern where the relationship between the purpose and means or the problem and solution is predicted with some uncertainty.
- Pattern where individuals displaying diverse opinions are integrated into a certain direction.
- Pattern where reform occurs in a complex system.

According to Yamamoto (2010), the realization of Kaikaku is carried out in three various stages as when, who and how to realize Kaikaku. When to initiate Kaikaku is determined by a strategy analysis. In strategy analysis, the various internal and external factors of the production system should be investigated. The Table 3 shows the differentiate between the internal and external factors of the production system,

<table>
<thead>
<tr>
<th>Internal Factors</th>
<th>External Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Performance of the current production system</td>
<td>1. Market situation</td>
</tr>
<tr>
<td>2. Skill and knowledge of the employee</td>
<td>2. Competitive position of the company</td>
</tr>
<tr>
<td>3. Their capability of handling radical changes</td>
<td>3. Financial situation of the company</td>
</tr>
<tr>
<td>4. Awareness of the need of change</td>
<td>4. Product structure</td>
</tr>
<tr>
<td>5. Technological level of the equipment</td>
<td>5. Volume</td>
</tr>
<tr>
<td></td>
<td>7. Available and upcoming technologies</td>
</tr>
</tbody>
</table>

Table 3: Various Internal and External factors of the production system (Yamamoto, 2010)
The next stage is who to perform the kaikaku in the company. Many researchers states that the initiate of kaikaku is carried out usually by top or senior management. It also can be change champions like top management, change agents or external consultants. Who has to perform kaikaku is also depends upon the,

- Context of the company.
- Type of changes.

The final stage is how to realize a radical improvement in production. In this stage it is divided in to two approaches, they are Systematic approach and Contingency & learning approach.

Production system model of Kaikaku
According to Shibata (2001), the Kaikaku is a system improvement where a new working method is introduced. According to Yamamoto (2010), the production system level is analyzed in macro level with the help of this Kaikaku model. The Figure 7 represents the four types of production system model of Kaikaku.

```
<table>
<thead>
<tr>
<th>Area of Kaikaku</th>
<th>Kaikaku type I</th>
<th>Kaikaku type III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structural</td>
<td>“Structural change”</td>
<td>“Structural change beyond the state of the art”</td>
</tr>
<tr>
<td>Infrastructural</td>
<td>“Infrastructural change”</td>
<td>“Infrastructural change beyond the state of the art”</td>
</tr>
<tr>
<td>Incrementally innovative</td>
<td>Radically innovative</td>
<td></td>
</tr>
</tbody>
</table>
```

Figure 7: Four types of Production system model of Kaikaku (Yamamoto, 2010)

In this model, the kaikaku is categorized in two different ways which is representing in the horizontal and vertical column. The horizontal column of this model represents the innovativeness of the outcome of the kaikaku and the vertical column in the model represents the different areas of kaikaku. According to Garcia and Calantone (2002), Kaikaku can be categorized in to two types; they are incrementally innovative and radically innovative.

1. Incremental innovative
Incremental innovative kaikaku occurs when a newly formed production system as an outcome of kaikaku is novel to the plant or to the company. This type of innovative can be useful in the industry sectors like international manufacturing industries, automobile industries, home electric appliances and mobile telephones. This type of kaikaku often occurs when off-the shelf equipment or packaged production management solutions are introduced to a plant or company.
2. Radically innovative
Radically innovative kaikaku occurs when a newly formed production system is not only new to the plant or to the company but also new to the industry. In this type of kaikaku, novel technological solutions, work methods, production flows and work organization are invented and used in the company.

The vertical column of this model represents the categorization in terms of the area of change in kaikaku. According to Wheelwright (1984) and Fujimoto (2001), they classify the decision categories into two groups, they are structural and infrastructural. The Table 4 describes the structural and infrastructural of decision categories.

<table>
<thead>
<tr>
<th>Structural</th>
<th>Infrastructural</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The changes take place in the structural area like plant network and production equipment.</td>
<td>1. The changes take place in infrastructural area like production control system, quality control system, material flow and organization.</td>
</tr>
<tr>
<td>2. This type of changes needed more capital investment and it tends to cause long-term impact.</td>
<td>2. This type of changes needed less capital investment but they tend to require more continuous and consistent efforts in improving the operation.</td>
</tr>
<tr>
<td>3. The structural areas like production capacity, plant network design, production technology and vertical integration.</td>
<td>3. The infrastructural areas like human resource, production planning &amp; control, quality control, cost control, maintenance and organization.</td>
</tr>
</tbody>
</table>

Table 4: The structural and infrastructural of decision categories (Fujimoto, 2001)

The four types of kaikaku for production system are explained below in detail.
Kaikaku type 1: changes in the “structural area”, this result in an incremental innovative outcome. This type of kaikaku tends to be realized by importing existing solutions in the structural area.

Kaikaku type 2: changes in the “infrastructural area”, this result in an incremental innovative outcome. This type of kaikaku realized by importing a set of work processes developed by external parties or packaged company-wide improvement initiates, such as TPM, Lean production and six sigma.

Kaikaku type 3: changes in the “structural area beyond the state of the art”, in this type of kaikakaku, new technologies, production equipment or other kinds of solutions related to the structural area are invented and applied to the plant or to the company.
Kaikaku type 4: changes in the “infrastructural are beyond the state of the art”, in this type of kaikaku, innovative work progress, production flows or other kinds of unique solutions in the infrastructural area are created and used in the plant.
4. Empirical Results

In the empirical studies I have tried to find out practically, how the process improvements and process innovation techniques helps to develop the production system of manufacturing companies. Here I present the findings of interviews carry out from Mahindra and Mahindra, Ashok Leyland and ABB. These results are based on interviews with persons that have real time understanding and knowledge in the process improvements and process innovation for the development of production system. This Empirical Result chapter is divided in to two phases, the first phase describes about case company results of process improvements and the second phase describes about case company results of process innovation.

4.1 Case Company Results: Process Improvements

Case Company 1 – Mahindra & Mahindra, India

About the company
Mahindra and Mahindra is an Indian multinational automaker headquartered in Mumbai, India. It is one of the largest automobile manufactures by production in India and a subsidiary of Mahindra group conglomerate. M&M is a major automobile manufactures of utility vehicles, passenger cars, pickups, commercial vehicles, and two wheelers. Its tractors are sold on six continents. It has acquired plants in china and the United Kingdom, and has three assembly plants in the USA. M&M has partnerships with international companies like Renault, France and International Truck and Engine Corporation, USA.

They have about 15,215 employees and their net income (2011) was about US$ 6 Billion. It is the leading production in the utility vehicles segment in India. It offers over 20 models in each segment and they produce more than 200,000 vehicles in SUV / LCV / MUV utility vehicles and farm equipments. M&M vehicles are sold in 40 countries on 6 continents.

Existing run through
The company decided to use process improvements in enhancing the production system for break down free, cost reduction, quality improvements, avoid fire fighting, improve life efficiency and for safety aspects in the production and assembly line. At present, the company uses only Total quality management & Total productive maintenance technique as a tool of practicing process improvements. The company identifies the blunder process in the production system by following circumstances,

- Frequent breakdowns
- Getting more feedbacks and problems faced by the worker
- Bottlenecks in the assembly line
- Current process which does not meet the TAKT time.
- Quality issues
The company also has a special team for improvements which are driven by the top management and also management supports & encourages the special team in many ways, even the workers are engaged in these teams to make the production line more efficient. The company will ask for each worker to pour their own improvements/innovative ideas to the management. Even they conduct some competition between the workers to come up with more no ideas to increase their production efficiency by proving some various appreciations like Quality King, TPM King and Smiley Awards. The various departments are involved in practicing the process improvements like central manufacturing engineering, plant engineering, production department and quality department.

The company faces more problems while providing special training about the process improvements to the workers. Some of the workers are uneducated and few of them are less aware of the production knowledge. Even though the company helps in educating the workers and officers by following sessions, they are

- Mahindra advanced production system
- Mahindra quality way
- TPM automobile basics
- Dexterity labs

Though the company produces more than 200,000 vehicles per year, they still face more problems in quality, accidents in assembly line etc. But the company seeks for more ideas and it is increasing day by day for their process improvements. The Table 5 represents the company's activities in terms of process improvements.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Special Improvement Team</td>
<td>3 months / Every year</td>
</tr>
<tr>
<td>Special Training to employees</td>
<td>5 days / Every year</td>
</tr>
<tr>
<td>Production Technique Methods</td>
<td>1 month / Every year</td>
</tr>
</tbody>
</table>

Table 5: Several activity time plan for Process Improvement
Case Company 2 - Ashok Leyland, India

About the company
Ashok Leyland is a commercial vehicle manufacturing company based in Chennai, India. Founded in 1948, the company is one of the India’s leading manufacturers of commercial vehicles, such as trucks, and buses, as well as emergency and military vehicles. Operating six plants, Ashok Leyland also makes spare parts and engines for industrial and marine applications. It sells about 60,000 vehicles and about 7,000 engines annually. It is the second largest commercial vehicle company in India in the medium and heavy commercial vehicles (M&HCV) segment with a market share of 28% (2007-2008)

Ashok Leyland is a market leader in the bus segment. The company claims to carry over 60 million passengers a day, more people than the entire Indian rail network. In the trucks segment, Ashok Leyland primarily concentrates on the 16 ton to 25 ton range of trucks. However Ashok Leyland has presence in the entire truck range starting from 7.5 tons to 49 tons. The joint venture announced with Nissan Motors of Japan would improve its presence in the light commercial vehicle (LCV) segment (≤7.5 tons)

Existing run through
The company made a decision to implement process improvements to focus on reducing the defects, improving the efficiency, increasing the productivity by finding out the non value added activities. The various process improvements tools that are used in the company for practicing process improvements are
- lean manufacturing,
- six sigma
- Total quality management.

The company identifies the process that has a need for improvement by following steps, by finding out the areas which influenced the gap between Targets vs. Actual production, the process which decides the TAKT time. The top management sustains the improvement team by proving several arenas and facilities to find out the areas of improvements to solve them. One such platform is called as Mission Gemba.

The various departments participated in the continuous improvement process are unit planning department, project planning department, maintenance department, quality department and production department. The organization provides the special training to the departments regarding latest technology in the process improvements by finding out the skill set of the workforce and the training are given by proper identification and try to meet the requirements. The theoretical and practical oriented training sessions are organized through certified organization. Example: Lean Six Sigma courses with assistance from ASQ.

But still the company doesn’t satisfy with the current improvements process and the management is trying to improve the every process. The below table represents the company
performs on various audits and inspection on production system for process improvements are as follows,

<table>
<thead>
<tr>
<th>Activity</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Special Improvement Team</td>
<td>1 month / Every year</td>
</tr>
<tr>
<td>Special Training to employees</td>
<td>4 months / Every year</td>
</tr>
<tr>
<td>Production Technique Methods</td>
<td>Every day</td>
</tr>
</tbody>
</table>

Table 6: Several activity time plan for Process Improvement

Case Company 3 – ABB, Sweden

About the company
The ABB Group, a leading company in power and automation technologies, employs about 124 000 people in around 100 countries. This multinational corporation is headquartered in Zürich, Switzerland. The long history of ABB goes back to Sweden, all the way to the late nineteenth century. At that time, a man named Ludvig Fredholm established Elektriska Aktiebolaget in Stockholm, Sweden, a company that manufactured electrical lighting and generators. A few years later in Switzerland, namely in 1891, Charles E.L. Brown and Walter Boveri established Brown, Boveri & Cie in Baden, Switzerland, the first company to transmit high-voltage power. It was about 100 years later since the founding of Elektriska Aktiebolaget which at that time was named ASEA (Allmänna Svenska Elektriska Aktiebolaget), and BBC (Brown Boveri & Cie) to merge in 1986 and eventually become ABB (Asea Brown Boveri) as it is known today (About ABB and Our Businesses, 2011)

Both companies have had a long tradition of innovation within the area of electrical engineering, where ASEA historically has focused primarily on high voltage power transmissions and Brown, Boveri & Cie on power plant applications, turbines and generators. Today, ABB is the world’s largest builder of electricity grids and is active in many industrial sectors. The core business today is in power and automation technologies which are further divided into five divisional business areas are

1. Power products.
2. Power systems.
3. Discrete automation and motion.
4. Low voltage products.

The strategy of the company for the next coming years is to continue improving the performance of utility and industrial applications while lowering the environmental impact. This will be possible together with technological capability and leadership, as well as global presence and local expertise. The ABB Group will also continue to focus on core strengths in power and automation technologies, in compliance with its vision statement “Power and
productivity for a better world” (Mission and Vision 2011, 2008). The corporation strives for an organic and profitable growth and top-quality products and systems.

Existing run through
The company determined to use process improvements in the production system to develop their market demands, to maintain their supplier based cost issue, to increase the overall performance of the company every year and competitiveness. The top management is the main driver for the process improvements with the vision of long term experience for continuous improvements. The process improvements is carried out in both management and on shop floor area in the manufacturing sectors, these are planned and monitored by the process engineers. The tools used by the organization for practicing process improvements are lean manufacturing including a man floor technology. These techniques are practiced continuously by having a continuous education and seminars to the employees and visual management. The processes to be identified in the production system for improvements are performed by,
- The measurement of the process is carried out,
- Each process is well analyzed by modeling the current process and it is simulated through the simulation software,
- Pre-study is done by the process engineer, which creates an opportunity for them to create a new idea and an actual implementation.

The top management supports the process improvements by forming a special team called blue collar team know as project team, they mainly served for the purpose of monitoring the process improvements in long term run. This project team consists of 5 to 6 persons. They also give some opportunities for students and research scholars in research projects. These blue collar teams and manufacturing engineers perform continuous monitoring on the production system. The various departments involved in the continuous improvement process are logistics department, production department and manufacturing department.

The organization also provides some special training when they implement new technology which is given by the consultant to the engineers and workers to each department which are involved in process improvements. These training occur only when there is a start-up or implementation of a new technology. In this company they have has a particular start and end with improvements project and also it has each improvements goals, but still the management wants to increase the current continuous process and continuous project.

Percentage of Improvements
In general, the companies like Mahindra and Mahindra, Ashok Leyland and ABB are practicing the Process improvements techniques like lean, kaizen, six sigma and TQM. But still the organization cannot achieve the maximum percentage of improvements in the production system all over the year. The rough present percentage of improvements for all the three companies is listed in Table 7 and Figure 8 displays the present percentage of process improvements for three case companies.
<table>
<thead>
<tr>
<th>Company Name</th>
<th>Process Improvements (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mahindra &amp; Mahindra</td>
<td>15%</td>
</tr>
<tr>
<td>Ashok Leyland</td>
<td>10%</td>
</tr>
<tr>
<td>ABB</td>
<td>20%</td>
</tr>
</tbody>
</table>

Table 7: Represents the present percentage of Process Improvements

Figure 8: Represents the present percentage of Process Improvements in Graph
4.2 Case Company Results: Process Innovation
Case Company 1 – Mahindra and Mahindra, India.

Existing run through
The main objective of the company for process innovation in production system is meeting customer requirements in an effective way, trouble free production system and assembly system. The organization has less awareness about the process innovation for radical change and they know by looking at reduced no of reworks, breakdowns, quality and field concerns. The company always looks for a time being solution, because they want to achieve the present day production target. So they always prefer for unstable solution and the organization is not ready to invest more money unless they get more break downs or production stop due to the technical or machine failure. The various risks are faced by the company while implementing a new technology in the production system are the workers are not trained and also they are not aware about the new technology and new process makes more panic among the workers and wrong perception is regard by management. But still the organization conduct special classes to workers and some methods are taken by the organization to overcome and reduce these panics among workers by giving apperceptions, awards, smiley’s, gift voucher and promotions. The top management takes necessary steps for implementing a new technology for radical change and they always prefer the better innovation techniques with frugal mindset with respect to cost effectiveness and also it should be serving for long time and it should be reliable, consistent and repetitive.

The company doesn’t have any special team for implementing new process innovation techniques in production system, but still the process improvements teams and cost reduction teams are performing these jobs when they need of new technology. The process in the production system is identified by the frequent machine failure, break downs, more no of reworks, quality concern. The information technology plays a role in process innovation for better tracking and measuring the effectiveness of improvements, but still company uses information technology in only at certain important departments.

The view of organization on structural and cultural enablers by encouraging employees for the process innovation and process improvements with frugal mindset with respect to cost effectiveness. The company measures the non value added activities in existing production system by measuring the time consumption of each process through time study, not giving any value to the product and also measures the operator’s motion study, man movements and material movements in this company. The top management act as a facilitator during brain storming session for designing a new concept for radical change and the supports them only if they are satisfied and they are ready to invest money only if the management was satisfied with new technology but the approval will take around more than a year to implement the new technology.

The rate of improvements is obtained while performing the process innovation for radical change is 10 %.
Case Company 2 – Ashok Leyland, India

Existing run through
The important goal of the company in process innovation in production system is to have a constant look out for tools and techniques which radically enhances the company’s objective. The company has less awareness about the process innovation for radical change is no compromise in quality, safety of the process carried out during implanting process innovation. The company prefers time being solution in production development because they want to meet the customers need as soon as possible before the competitors does it. Currently this company faces many difficulties and risks in implementing a new process due to budget problems, availability of resources at the right place and most importantly in the right form. The various methods and steps taken by the organization to overcome these risks by using inventory management tools, consumables, so that unwanted cost can be avoided and this can be allocated for new innovations. Also they do separate sourcing team to work dedicatedly to bring out the best out of the suppliers.
At present this company doesn’t have any special innovation team in development of production system. But In future, if the process innovation brings a definite radical change in the organization, the company will not hesitate to implements these techniques. The various process that are to be identified in the production system for radical change, by looking at the critical process and the process effectiveness and efficiency are very poor and then it will be identified and kept in high priority. The information technology plays a role in resolving communication problems and thus it helps to reduce the time. The organization does not have any idea or view on structural and cultural enablers for process change.
The top management of the company is ready to implement the new organization structure for effective and efficient production only if it has more worth and has some improvements. The rate of improvement is obtained while performing the process innovation is around 10 %.

Case Company 3 – ABB, Sweden

Existing run through
The main goal and vision of the company for process innovation in production system is to improve productivity and reduce cost/ produced product throughput time. This company has more awareness about the concept of process innovation and it is inspired by the Japanese Research on Kaikaku. They always prefer for the stable solution and they need some radical changes which are supported by the management and also pre-study is done by the engineers.
The various difficulties and risks faced by the organization in implanting a new process are,
- Acceptance from the blue collars and employees
- The long term goals are not enough and it is difficult to follow over the years.
The various methods taken by the organizations to overcome and reduce these risks are
- Project management
- Training to the workers
- Good and proper management
• Implantation of new process

The organizations will take necessary steps for implementing a new technology through process innovation is mainly due to the awareness of Kaikaku/Radical changes through the drivers for long term. In this company, they don’t have any special team for process innovation but there is a team who works for new innovation in production development and also company has some external innovation team for production system. The various processes is identified in the production system for radical change by,

• Pre-study is done on each process, the measurement of the process is carried out by modeling the current process and it is simulated through simulation software and it is finally analyzed to identify the process.

• A strategy process is also used to identify the process.

The information technology plays an active role in process innovation. It consist lot of tools which is used for simulation and modeling. It also plays a role for visualizing and analyzing the changes. The information technology helps in increasing the overall efficiency of the process. The view of organization on structural enablers for process system is,

• Criticizing the other ideas should be avoided
• Acceptance of employee and engineers
• Acceptance of the top management
• Steer clear of the outside threats

The non value added activities are measured by the tools like Value stream mapping and process study mapping. In this company, the top management will not act as a facilitator during the brainstorming session and they responds only to the new ideas not on the development of the project. The top management is ready for continuous change and they change formal structure and responds to change over time. The rate of improvement is obtained while performing the process innovation is 40 % and it is mainly depends upon the payback period, continuous improvement and achieve the goal.

Percentage of Improvements

The percentages of improvements through process innovation are, the Indian companies are practicing only process improvements techniques only in smaller level; hence there is only a few chance of using process innovation techniques for radical change. In Indian companies even the organizations and engineers are not aware about the term Kaikaku for radical change. But when we compared with developed nation, the companies in Sweden have more awareness about the Kaikaku and they follow and practice the process innovation for the development of production system. The present percentage of improvements through process innovation is shown in Table 8 and Figure 8 displays the present percentage of process innovation for three case companies.
<table>
<thead>
<tr>
<th>Company Name</th>
<th>Process Innovation (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mahindra &amp; Mahindra</td>
<td>10%</td>
</tr>
<tr>
<td>Ashok Leyland</td>
<td>10%</td>
</tr>
<tr>
<td>ABB</td>
<td>40%</td>
</tr>
</tbody>
</table>

Table 8: Represents the present percentage of improvements through Process Innovation

Figure 9: Represents the present percentage of improvements through Process Innovation in Graph
5. Analysis and Discussions

In this chapter, the theory is analyzed and discussed in relation to the collected results about the effect of process innovation and process improvements in the production system from the case companies. Also, various roles of Kaikaku and Kaizen for improving the production systems are discussed and various practical scenarios are analyzed and explained that serves to make an enhanced understanding to the readers regarding the industrial development.

5.1 Production System Development

According to Gasvaer (2012), the Production system development might be use differently for the different purpose of the manufactures, but on the whole concept of production development system is not different from others. It is the invention of process production, product production and the improvement of production ability.

The production system in a manufacturing company can be developed in many ways to make it more efficient. According to Yuji Yamamoto (2010) in lean production system, there are two approaches to develop the production system more efficiency and effectiveness. Those are Kaizen and Kaikaku. In general, Kaizen is known as process improvements and Kaikaku is known as process innovation. In this thesis, the experts in production system from three companies were interviewed to know about the current practices of process improvements and process innovation in the manufacturing company.

5.1.1 Improvement of production system through process improvements techniques

From the interview carried out with three companies, the company faces many problems in different conditions for practicing the process improvements techniques during production. The main problems faced by the companies are

1. Types of tools used
2. Time period of tools usage
3. Special Improvement teams
4. Identification of process
5. Training to the workers
6. Percentage of improvements

In common, these are the problems faced by the case companies; many researchers have found many tools and techniques for improving the production system in manufacturing company. In this case companies, the different types of tools are used for the development of production system in different conditions. But the experts in the company should decide what type of tools should be used for various processes. The various tools like Lean production, TQM, TPM, 5s, Six Sigma, Kaizen are used in the company. The selected tool for particular process should be decided and practice in the production line.
These tools should be used daily in the company for improvements in the production system. Using of these tools will give better results in effective way. The company ABB uses the process improvements tools daily to make increase their productive and also they provide some seminars, visual management and continuous education to the employees. The companies in India are using these tools only once in a month. Practice of these tools in these manners will never provide good results to the company. Hence top management should take necessary steps to run through these tools daily.

ABB Company which has a Blue collar team is called as project team. The team consists of five to six persons for monitoring the process improvements in long term run. These teams perform the improvement task daily in order to achieve better results. According to Taylors era (1998), the team work is measured in terms of productivity, motivation and satisfaction of workers. The work of individual on new designs with technology is less productivity than the work team with no technology. The team work is better for new process design because they combined multiple functions into one unit, permitting to change conditions inside the process. The Indian company Ashok Leyland Company and Mahindra & Mahindra should form a multiple team for monitoring the process for improvements.

The manufacturing firms will have more number of process and sub-process during the production of products. The organization should take necessary steps to measures and monitor all the process by using various tools. These should carry out in regular interval of time by blue collar team. The non value added or defects can be found during these measurements. The team should make a top priority order and the each process should be decided and they should be ordered according to their defects. Top most process should be rectified soon for making more efficient.

In India, the most of the workers in company are uneducated. Hence they don’t have any awareness about improving the process through various tools. Hence organization should provide a special training to the workers in regular period of time. Some companies are proving a special training to the workers once in a year, so there is a chance in fail to remember these techniques by the workers. Hence proper and frequent training about the latest technology should be providing to the workers in the company.

Many researchers states that, by practicing the improvements tools will give better productivity in long term. In developed nations like Sweden, they have follow over the year and hence they have better results than India. For example, the process improvement technique like Kaizen is defined as, According to Yuji Yamamoto (2010), kaizen is defined as a continuous and incremental improvement of an activity with the purpose of increasing the performance of a production system. Typical activities are updating working standards and gradually reducing wastes in an operation. The performance increase as a result of kaizen is usually less than 20 or 30 % in a given period of time. The result would obtain around 20 to 30% in a given period of time. But from the interview the percentage of improvements in each company is very low. The figure 10 describes the percentage of Present improvements Vs Ideal improvements.
Figure 10: Represents the percentage of Present improvements Vs Ideal improvements

This figure describes, there is a big gap between the present and actual prediction of improvements in case companies. Hence organizations should take necessary steps to improve their productivity through process improvements techniques. These effects of improvement tools will takes place in a long term. The organization should avoid these problems and they should make use of these techniques will provides more productivity in efficient and effective way.

5.1.2 Improvement of production system through process innovation techniques

The process innovation is the combination of structure for performing work and direction for visible and radical results. This process innovation is totally different from process improvements. It brings about the work activity in a radically new way. The process innovation for radical change (Kaikaku) is a new research topic; hence manufacturing company has less idea about it. But still the experts from our case companies have been interviewed for the development of production system through process innovation in radical way. From the interview results for process innovations, there are few problems faced by the company for the development of production system and also they have only less idea about the innovation process. The lists of problems faced by the company are listed below, they are

1. Awareness
2. stable solution
3. Identification & improving the current Process
4. Enabler – Information Technology
5. Designing a new process
6. Percentage of improvements through process innovation
Awareness
The companies in India have little innovation process in the production system, but still they are not aware of these new techniques. The developing countries like India are still doesn’t have awareness about the Kaizen technique. The case companies from India have no idea about the new tool called Kaikaku, but the company ABB from Sweden, which have a clear idea about the innovative process through researchers. Hence they practices innovative process in the production system to gain the improvements of more than 60 % in a short period of time. So the case companies from India, the organization should spend more money on researching new technology, they should provide some external agents to conduct some classes regarding new technology and also the government should encourage the manufacturing by proving some apperception while implementing these type of techniques which provides better results while practicing this type of new technology.

A Stable Solution
The stable solutions are better remedy for all the causes. In Indian companies, organization will not prefer for a stable solution. The top management are not ready to invest more money to attain stable solution. Hence they prefer only for non stable solution. It is not advisable to prefer for non stable solution. This makes small difference in decreasing the company efficiency. Hence management must come forward to invest more money for innovation. The effect of innovation can attain in short period of time, but the sot for implementing these techniques is high. These can be compromised while producing more products in short period of time than the competitors. The case companies in Sweden are preferred only for a stable solution; the top management is also ready to spend money for new technology.

Identification and improving the current process
The identification is the important factor to be considered which are aspirant for innovation. In manufacturing firm, they will have many process and sub process in production system. There may be many errors or accidents happen in current due to the invisible mistakes. Hence each process should be carefully identified and management should be able make the process innovation than improvements. Elaborate details of identifying the process can be found in section 3.2. After identifying the process that has to be improved, the examining of a process on the whole results in highlighting the long standing problems, such as bottlenecks, idleness and non added value activities. The company ABB is occupied in process innovation initiatives for radical improvements are coupled with short term improvement and break through innovation. The details about improving the existing process can be found in the section 3.5.

Enablers
Information Technology
The information technology plays an important role and act as enabler for process innovation. According to Davenport (1993), he believe that information technology has a major enabling role in process innovation and that many process innovation contain IT as one of its major components and According to Al-Mashari and Zairi (1999), they points out that over the past
decade IT has become both a major tool and fundamental enabler of large scale change. In our case companies, the information technology is used only for few purposes in the company. The management should spend more money for implementing an information technology in the production system. The IT Enablers will helps to perform analyzing, modeling, mapping of existing process associated planning and control functions. Hence companies should move on forward to implement the information technology in large scale.

Designing a New process
The case company which encounters a most problem is designing a new process, the company ABB which produces a prototype model which helps to evaluate the existing process. The special team should be formed to design a new process and brain storming sessions should e conducted for bringing out more ideas for development of new process. The parameters like feasibility, risk and benefits should be analyzed well in all the process before designing it. Management should spend some money for prototyping a new process. According to Dorothy Leonard-Barton (1988), our definition is a small scale, quasi-operational version of new process that can be used to test various aspects of its design, this kind of prototype is called as organizational prototype. The prototyping must be viewed as a learning activity by process designers and users alike. More iteration is needed to attain a proper design. Hence the Indian companies, should identify all the process which are to innovated to attain full efficiency must design a new process, prototyping it and simulation should be carried out to check all its function.

Percentage of Improvements through process innovation
The companies in India have only few ideas about innovative techniques to make their organization more stable than competitors. But manufacturing firm from Sweden has more idea and knowledge about Kaikaku. Hence rate of improvement through process innovation for radical change is very less when compared to process improvements. The companies must come forward to implement the innovation idea that can give better productivity in a shorter period of time. Kiakaku is new topic and only few researchers have done some research on this field, according to Yamamto (2010), Kaikaku is an infrequent but radical improvement where fundamental change occurs in the production system and a dramatic performance increase is obtained. Initiated often by top management, fundamental changes are made through reformations or replacements of the system by introducing new knowledge, work methods, strategies, production technologies, or equipment and so forth. The performance increase as a result of kaikau is often 30 to 50% more. If the firm practices process innovation strategy in their production system, they can attain an improvements rate of more than 50 %. The figure 11 describes the percentage of Present improvements Vs Actual improvements through process innovation.
5.1.3 Combination of both Process improvements and process innovation

In few manufacturing companies, the process improvements techniques will be used for their improvements and certain innovative techniques will be used by some companies. The company needs combination of both process innovation and process improvements for quality program. The company is mainly troubled to make their process more constant and they start their industry with continuous improvements, then they try for process innovation. These both process innovation and process improvements vary from some disputes. The company should able to be aware of risk by performing process innovation. The process improvements should be carried out through the process for better quality development and process innovation should be carried out in an exacting time for radical change to meet the competitive and pressure force.

The process innovation (Kaikaku) should be done at once by spending huge amount for implementing in the production system. The improvements can be achieved in radical way. But the process improvements should be practices daily in the company in order to make the process to sustain and these process improvements will maintain the overall improvement of the production system. By the combination of these both techniques, the company can produce the products in effective and efficient way.
5.1.4 Conceptual strategy framework for process innovation

The Process innovation for radical change is a new topic for improving the production system in recent days. But there is only limited number of materials is available to perform pre study work. Hence a by referring a various materials on business process reengineering, a conceptual framework is done to make clear and more understanding about the process innovation. The Figure 12 represents the conceptual strategy framework for process innovation. The explanation of this figure can be found at chapter 3.

Figure 12: Represents the conceptual strategy framework for process innovation
6. Conclusions

The objective of this thesis have been to identify and analysis the problems that affects production system development in manufacturing firms and comparative analysis is done in manufacturing industries between Sweden and India. During this thesis project, the varieties of problems that take place in manufacturing companies are identified in both process improvements and process innovation. The objective of this thesis has been fulfilled through a literature study as well through three case companies. Two research questions were presented in the introduction (see chapter 1) and they have been explored in the case studies. The research questions and the summarized conclusions are presented below:

RQ 1: What are possible approaches for creating process innovation for radical changes in developing a new production system in order to achieve the radical improvements (Kaikaku) that can yield high profit to stakeholders (manufacturing industry)?

The process innovation for radical changes (Kiakaku) is a new research topic, therefore the availability of materials and books on this topic is very less and no clear idea was given by any researcher. To start this thesis, I need of material and resources to enhance my knowledge about the process innovation, by referring various books and journals about the BPR (Business Process Reengineering) gained some knowledge about the process innovation and framed a conceptual theory framework strategy were created.

In this framework, how the process innovation for radical change should be carried out and there are many steps and procedures to be followed to implement the process innovation in a manufacturing company. A normal reader can use this framework to develop and implement these techniques in the manufacturing company which gives high yield in small period of time.

RQ 2: What are current practices carried out in process improvements and process innovation in industry, assisting in the development of production system in manufacturing companies?

In recent times, the organization wants make their company a efficient and effective one. After attaining the knowledge about the process innovation and process improvements, the two manufacturing companies from India and one manufacturing firm from Sweden are interviewed about their improvements in the production system. From the empirical study, the problems were listed out which makes the company struggle while developing the production system. Both process improvements and process innovation were analyzed separately and suggestions were given to the company. These are all done by having referring a conceptual framework explained in chapter 3. Here current practices of three case studies were analyzed and comparison is done between the manufacturing firms between Sweden and India.
7. Reference

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8. Appendix

Interview Questions

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A. Process improvements

Process improvement is a phase of organizational development, in which a series of actions are taken by a process owner to identify, analyze and improve existing business processes within an organization to meet new goals and objectives, such as increasing profits and performance, reducing costs and accelerating schedules. These actions often follow a specific methodology or strategy to encourage and ultimately create successful results. Process improvement includes the restructuring of company training programs to increase their effectiveness.

1. Why did your company decided to use process improvements?
2. What did you understand about the concept of process improvements?
3. What are the tools used by your organization for practicing process improvements?
   Explain why it is used.
   - Lean manufacturing
   - Just in time manufacturing
   - Process management
   - Six sigma
   - Total quality management
4. How often you use these techniques for making effective production?
5. How will you identify the process in production system that is in need for improvements?
6. How the organizations support the team for improvements?
7. How often the improvement team will perform inspection/monitoring on the production system?
8. What are the departments involved in the continuous improvement process?
9. Will the organization provides special training regarding latest technology to the departments involved in the process improvement?
   ✓ What type of training do they provide by the organization?
   ✓ How often the training occurs?
10. Does the organization satisfied with the current improvement process?
11. How much percentage of improvements is obtained in the production system?

B. Process innovation

In general, the innovation can be defined as introduction of something new. The process is defined as planned, measured set of activities designed to turn out a precise output for a particular customer or market. This innovation can be used along with the process which brings a radical change. The process innovation is the combination of structure for performing work and direction for visible and radical results

1. What is your goal/vision for process innovation in production system?
2. How the organization is aware about the concept of process innovation for radical change?
3. What will the company prefer for finding solution in production development? Reason for preferring?
   • A stable solution.
   • A time being solution.
4. At present, what are the difficulties/risks faced by the organization in implementing a new process?
5. What are the methods taken by the organizations to overcome and reduce these risks?
6. In future, Will the organization takes any necessary steps for implementing a new technology through the process innovation for radical change in the production system?
7. Does the organization have some special innovation team for production system?
8. How the process is identified in the production system for radical change?
9. How the information technology plays a role in process innovation in your organization?
10. What is the view of organization on structural and cultural enablers for process change?
11. How will you measure the non value added activities in existing production system?
12. Will the top management act as a facilitator during the brainstorming session for designing the new concept for radical change?
13. How the prototype model of new production system helps for radical change?
14. Will the top management of the company is ready to implement the new organizational structure for effective & efficient production?
15. What is the rate of improvement is obtained while performing the process innovation?