CHAPTER 3.0

AREA OF STUDY

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3.2 Quality Improvement
3.3 Cost Reduction
3.4 Private Sector Industries in Pune Region
3.5 The Role of Private Sector in the National Economy
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CHAPTER 3.0
AREA OF STUDY

3.1 SCOPE:
As research is concerned with Quality Improvements and related Cost Reduction Programmes adopted by Private Sector Industrial Units in Pune Region, the key factors in the scope are further elaborated as under:

3.2 QUALITY IMPROVEMENT:
Definition
Quality Improvement is defined as “actions taken throughout the organization to increase the effectiveness and efficiency of activities and processes to provide added benefits to both the organization and its customers”

Improvement can be defined as “the act of making something better” or “a change in something that makes it better”. Quality Improvement has been defined as "Quality Management focused on increasing the ability to fulfill quality requirements"

3.2.1 Quality Improvement through Kaizen
Masaaki Imai defines improvement as “Improvement is a mind-set inextricably linked to maintaining and improving standards. In a still broader sense, improvement can be defined as KAIZEN and innovation, where a KAIZEN strategy maintains and improves the working standard through small, gradual improvements and innovation calls forth radical improvements as a result of large investments in technology and/or equipment”.

The question of improvement is closely related with measurement and analysis. Without analysis and measurement improvement cannot be said to
have taken place. Directly concerned with quality improvement issue are the customer, the processor and the supplier.

Kaizen is nothing but step-by-step continuous and sustained improvement achieved through ideas from all. Kaizen is less expensive than improvement achieved through break-through innovative type of activity which needs much more investment. Innovation may be a result of a work done by an individual while Kaizen involves all. Kaizen is called as the key to Japanese competitive success. As described by Masaaki Imai\textsuperscript{62}, the Quality Guru, Kaizen is the basic philosophical underpinning for the best in Japanese management.

3.2.2 Juran's Trilogy\textsuperscript{55}
It explains quality improvement as a process to solve chronic problems while sporadic problems can be tackled through quality control process. The chronic problems are traceable to an inadequate quality planning process. Quality improvement is achieved by improving processes. It is a continuous activity. The aim is for higher process effectiveness and efficiency. The efforts for improvements need to be directed towards constantly seeking opportunities for improvements. Corrective and preventive actions for problems noticed is a common strategy for quality improvements. Creation of an environment for quality improvement is a management responsibility. Planning and measurement system of quality improvement need to be developed by assessing quality losses and customer satisfaction, losses in processes as well as societal losses. Various quality tools and techniques for numerical and non-numerical data are used to support decisions in quality improvements.

3.2.3 Improvements through Failure Analysis:
Many times improvements have a previous history of some failure. Each failure has a root cause, which needs to be detected and corrected to prevent recurrence. Causes are preventable and prevention is not only a
permanent cure, but, it is usually cheaper. The strategy for improvement is therefore:

a) Solve problems by prevention so that the cost of failure is reduced. Prevention by methods such as “Fool Proofing” or “POKA YOKE” needs an investment but it pays for itself.

b) Post production inspection or appraisal is a post mortem activity. It is not only costly but also time consuming. The alternative such as Statistical Quality Control may be resorted to if found necessary.

c) Monitoring and evaluation of prevention activities as a continuous process.

It is usual to form CFTs (Cross Functional Teams) for solving problems on individual basis. External failures such as field failures or warranty claims need attention through corrective action on priority to achieve customer satisfaction before internal failures can be investigated to reach preventive action. Any solution needs a close monitoring by follow-up action to ensure that the problem does not recur and also is a sign that the “right preventive action” has been identified and implemented. The management’s involvement in improvement programme definitely improves motivation of the team.
3.3 COST REDUCTION MEASURES:

Every organization attempts to reduce costs through number of ways. It can be a well-planned programme or a fire fighting type of approach. Some of the popular measures taken for cost reduction are:

3.3.1) Value Analysis & Value Engineering
3.3.2) Quality Improvement
3.3.3) Process Improvement
3.3.4) Analysis of Cost of Quality & Wastes
3.3.5) Statistical Process Control
3.3.6) Six Sigma and Lean Approach
3.3.7) Kaizen
3.3.8) Innovation
3.3.9) Quality Circles & Suggestion Scheme
3.3.10) Efficient Supply Chain
3.3.11) Logistics Management
3.3.12) Poka Yoke
3.3.13) QA, TQM & TPM

3.3.1 Cost Reduction through Value Analysis / Value Engineering (VA / VE):

The objective of VA / VE is to achieve equivalent or better performance at a lower cost while maintaining all functional requirements defined by the customer. The purpose of VA / VE is to simplify products and processes and cut costs of unnecessary functions / activities. VA / VE does this by identifying and eliminating unnecessary costs.

*Value Analysis* is the disciplined procedure directed towards the achievement of necessary functions for minimum cost without detriment to quality, reliability, performance and delivery.

*Value Engineering* is the application of Value Analysis techniques in the main design / development and planning phases.
In brief, VA is a remedial process while VE is a preventive process.

A further exercise – called – “Design to Cost” consists of similar method to design a component to a predetermined budgeted cost so as to avoid cost overruns.

Cost reduction through value engineering provides optimum value for money to the customer. Since costs always change due to various external factors over which an organization has no control so also the customer’s expectations and perception are always on increase, it is necessary that VA / VE need to be applied as a continuous measure to avoid cost escalations to provide desired functions.

3.3.2 Cost Reduction through Quality Improvement:
Earlier, people thought that an improvement in quality would mean increase in cost. However, it is a myth. In fact, as quality improves, cost reduces due to reduction in wastage as a result of non-conformance. Improvement means- the process of something becoming better than before – which may be considered to be less costlier than before.

A great deal of profit can be made by quality improvements in products and services. Cost of non-conformance to quality standards i.e. cost of quality can drain a company of 20-30% of its revenue or turnover. Even a small improvement in quality can turn a loss making company into a profitable organization. One of the essential aspects of quality is to prevent non-conformance rather than detecting the same at the end of process. This way, not only that the cost of rejection can be avoided but the quality of end result is assured through improvement of process quality. This way the cost of inspection, which does not add any value, is reduced.
However whether a particular process is necessary or can be avoided depends on whether the process is "value-added" or "non-value-added" one. It is estimated that in case of many organizations the non-value added activities – i.e. concerned with customer perceived values – can be as high as eighty five percent of the annual turnover. Analysing this through Activity Based Costing helps to identify such activities which are non-value-added activities and attempt is needed to continuously monitor them.

Not all cost reduction projects improve quality but all good quality improvement projects reduce costs.63

The current economic conditions demand for review and tight control on costs and expenses. In such a situation quality gets a low priority due to financial constraints and priority is for "fire fighting". Ironically such situations present greatest opportunities to reduce operational losses by pursuing quality improvement projects. The quality approach to financial controls is to minimize inefficiencies and waste. Philip B. Crosby says "Quality is free. It is not a gift but it is free. What costs money is unquality things – all the actions that involve not doing jobs right the first time." The cost of (bad) quality is the expense of doing things wrong.

3.3.3 Cost Reduction through Process Improvement:
Improvement of process is an important aspect for reduction of costs and improvement in productivity. Kiyoshi Suzuki67 has identified twelve principles for process improvement summarized at Table 3.1
### Table 3.1

**Twelve Principles of Process Improvement**

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Principle</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Organize the Workplace</td>
</tr>
<tr>
<td>2.</td>
<td>Develop Quick Set-up</td>
</tr>
<tr>
<td>3.</td>
<td>Eliminate Transportation Loss</td>
</tr>
<tr>
<td>4.</td>
<td>Low Cost Automation</td>
</tr>
<tr>
<td>5.</td>
<td>Introduce Multiprocess Handling</td>
</tr>
<tr>
<td>6.</td>
<td>Synchronize Process</td>
</tr>
<tr>
<td>7.</td>
<td>Single Piece Flow</td>
</tr>
<tr>
<td>8.</td>
<td>Introduce Jidoka Concept</td>
</tr>
<tr>
<td>9.</td>
<td>Introduce Poka Yoke, SPC</td>
</tr>
<tr>
<td>10.</td>
<td>Eliminate Machine Break Down</td>
</tr>
<tr>
<td>11.</td>
<td>Determine Cycle Time</td>
</tr>
<tr>
<td>12.</td>
<td>Standardize Work Procedures</td>
</tr>
</tbody>
</table>

Ref: The New Mfg. Challange

Brief description of twelve principles is as under:

1. **Organize Work Place:**
   This includes 5S principles concerned with house keeping – a principle of “a place for everything and everything in its place”. This takes care of quick retrievability, cleanliness, safety in storage and clean disciplined habits.

2. **Develop Quick Set-up:**
   This concerns with saving of time as much as possible in non-productive activities like machine setting, tool-setting, change over of product etc. This is also called as SMED – (Single Minute Exchange of Dies)

3. **Eliminate Transportation Loss:**
   This refers to an optimized plant layout and factory layout which ensures that flow of materials and operators is smooth, unidirectional as much as possible.
and does not result in cris-cross movements. This can be achieved by "product oriented layout". Frequent loading / unloading and storage / issue of material needs to be avoided. This helps to save internal transportation cost and time. As regards movement of operators a technique called "MOST" (Maynard Operations Sequence Technique) is now getting accepted at many places. It deals with saving operator's productive time and reduces idle time through standardized movements and motions. This has an acceptance by World Labour Organization (WLO)

4. **Low Cost Automation:**
This concerns with low cost automation using stop switches, pneumatic power, cam operated automation ideas. It saves operator's productive time wasted in non productive activities and assures consistent quality.

5. **Introduce Multiprocess Handling:**
This is essentially multi-skill development done through Job rotation and facilitated through a flexible layout so that it can be modified quickly as business conditions change. This develops ownership attitudes and encourages strong teamwork. Reduction in man-hours is a direct advantage of multiskilling.

6. **Synchronise Processes:**
By combining the concepts of flow production and improved operator skills as well as "Line Balancing" production processes are more streamlined and result is substantial productivity gains.

7. **Single Piece Flow:**
With a product-oriented layout and multiskilling achieved by operators, U shaped layout helps operators to produce and transfer one by one components – also called as "single piece flow". Cost advantages are achieved through reduction of inventory, operators, cycle time, space and machines.
8. **Introduce Jidoka Concept:**

Jidoka[^7] is a Japanese word meaning an equipment or a machine able to govern itself or control its operations (autonomous). This consists of adding of intelligence to machines to start or stop operations as needed and emit signals to operators whenever required. This is a low cost automation added to machines. The objective is to save down time.

9. **Introduce Poka Yoke, Statistical Process Control:**

The key for achieving 100 percent quality is to prevent transferring defects to the next process. Poka Yoke[^23] ideas are generated as a team effort. The members of the team have knowledge and experience in a particular process.

One of the most important criterions of a good quality is elimination of a variation of output characteristics achieved through a statistical process control. By the application of Control Charts it is possible to identify problems areas and such problems can be overcome by use of Q.C. tools. Process Capability can be established through an application of distribution curve analysis. Statistical studies can be focused on men, material or method changes affecting a process quality. Cost savings due to elimination of rejects and consistent assured quality are the benefits from Poka Yoka and S.P.C.

10. **Eliminate Machine Breakdowns:**

In order that productive time loss due to break down of machines, equipment or infrastructural facilities is minimum it is necessary that these are well maintained before they break down. This is achieved by Preventive Maintenance concept where maintenance schedules are designed based on past failure history and the current load pattern.
An activity of Total Employee Involvement in achieving minimum wastage through preventive maintenance operation is called Total Productive Maintenance (TPM). TPM and TQM concepts both involve all employees and therefore they are very much dependent on effective leadership and motivated workforce.

11. **Determine Cycle Time:**
Cycle time is determined from the available time in a day for production divided by desired production volume per day. It is also called as “time between the completion of the last product and completion of the next product. It is always the endeavor of the production manager to reduce cycle time through continuous improvement in order to improve productivity.

12. **Standardize Work Procedure:**
This consists of Maintaining Cycle time, W.I.P. (Work in Process) and monitoring machine time and human movement time in a broken down manner. This is being continuously monitored and attempts are made for improvements. Assistance of time and motion study is taken to establish “Standards". for future cost reduction studies.

3.3.4 **Cost Reduction through Analysis of Cost of Quality and Wastages:**

a) **Cost of Quality:**
Cost of Quality is a measure of impact of quality of business. It spells total business cost in achieving quality business processes.

b) **Wastages:**
Important areas of wastages in an organization are material, capital and time. Time happens to be the biggest cost wastage.

Fujio Cho of Toyota defines waste as "anything other than the minimum amount of equipment, materials, parts, space and worker's time which are absolutely essential to add value to the product".
Kiyoshi Suzaki\textsuperscript{67} says "if it does not add value it's waste". More than 95 percent of an operator's time is not being utilized to add value to the product. Actually it adds cost to the product. Similarly, more than 95 percent of the time inventory is either in stores waiting to be transferred, processed or being inspected. A machine may produce unnecessary or defective products or waiting for repairs or maintenance or setting. Fig. 3.1 explains details.

"Waste": waiting for materials, watching machine running, production defects, looking for tools, fixing machine breakdown, producing unnecessary items, etc.

\textbf{Figure – 3.1}

\textbf{How Materials Spend Time in Typical Factory}

\begin{itemize}
  \item Value Added Portion of Time
  \item Waste
\end{itemize}

"Waste": transportation, storage, inspection and rework

\textbf{How Machines are Utilized in Typical Factory}

\begin{itemize}
  \item Value Added Portion of Time
  \item Waste
\end{itemize}
"Waste": unnecessary movement of machine, setup time, machine breakdown, unproductive maintenance, producing defective products, producing products when not needed etc.

Ref.: The New Manufacturing Challenge – Techniques for Continuous Improvement – By Kiyoshi Suzaki pp – 10-11

Toyota has identified seven types of wastes, which are as under.

1. Waste from overproduction
2. Waste from waiting time
3. Transportation waste
4. Processing waste
5. Inventory Waste
6. Waste of Motion
7. Waste from Product defects

3.3.5 Cost Reduction through Statistical Process Control:
Consistent performance of manufacturing processes rather than hundred percent sorting and rework or scrap rejected items can be achieved only by a process that is inherently capable of providing consistency in the long run.

Statistical Process Control (S.P.C.) helps to achieve defect prevention and enables continuous improvement. More important, it helps to reduce variation in process output, delivery times, methods and attitudes.

For analyzing a process majority of companies use:

1. Flow Charts
2. Histograms
3. Run chart
4. Control Charts
Process capability is a measure of variation of a process and its ability to produce components consistently within specifications. Process capability can be worked out only if the process is in statistical control. Statistical control exists where process is being influenced by only common causes and special causes have been eliminated. Common causes are those where solutions are in the hands of management. Special causes are usually corrected at the process by the operator.

Process Capability Index (Cpk) is an index, which measures the variability of the process relative to the specification and process setting. When Cpk is less then 1.00, 100 percent inspection must be implemented and actions to improve Cpk value to a minimum of 1.00 must be initiated.

Machine capability studies are conducted in the similar manner before identification of special causes. A minimum machine capability of 1.33 is required for approval of samples to enable continue efforts for continuous improvement and cost reduction.

Control charts enable to identify special causes of variation. When they appear and reflect the extent of common cause variation that must be reduced by the system / management or by process improvement. Control charts for both averages ($\bar{X}$) and the ranges (R) are plotted for taking instant corrective actions on shop floor.

3.3.6 Cost Reduction through Six Sigma Concept and Lean Approach:
Amongst the latest and most comprehensive quality tools is Six Sigma. It is a tool that allows companies to drastically improve their bottom line by designing and monitoring day-to-day business activities in ways that minimize waste and resources while increasing customer satisfaction. It guides companies to make fewer mistakes in every activity.
It is the most effective break through strategy.

Table 3.2 shows relationship of sigma and quality level.

<table>
<thead>
<tr>
<th>σ Level</th>
<th>Cost of Quality % of Turnover</th>
<th>% of Quality</th>
<th>Defects PPM*</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>&gt; 40 %</td>
<td>–</td>
<td>6,90,000</td>
<td>Non Competent</td>
</tr>
<tr>
<td>2.</td>
<td>30 – 40 %</td>
<td>–</td>
<td>3,08,537</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>20 – 30 %</td>
<td>99.73</td>
<td>66,807</td>
<td>Industry Average</td>
</tr>
<tr>
<td>4.</td>
<td>15 – 20 %</td>
<td>99.9937</td>
<td>6210</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>10 – 15 %</td>
<td>99.999943</td>
<td>233</td>
<td>World Class</td>
</tr>
<tr>
<td>6.</td>
<td>&lt; 10 %</td>
<td>99.9999998</td>
<td>3.4</td>
<td></td>
</tr>
</tbody>
</table>

* PPM – Defects per million occasions

The Lean Approach:
The principles of six sigma do not focus on time; they are concerned with reducing variation of output and identifying and eliminating defects. Any savings in time, if achieved, are usually a by-product of defect reduction.

This means that even with Six Sigma concept implementation the deliveries to customers do not get appreciably improved. General Electric annual report in 1998 accepted the fact that there is too much of a variation in delivery time varying between 4 days to 20 days delay. The December 2000 issue of *Industry Week* included a survey of manufacturing companies which exposed that over half the firms had not achieved 98% on-time delivery and three quarters had not been able to reduce lead time by even 20% over the last five years performance. Therefore it is essential that companies apply both techniques simultaneously – i.e. Six Sigma and the Lean. When a company applies both – Lean and Six Sigma simultaneously dramatic improvements are achieved more rapidly.
Lean Six Sigma is a methodology that maximizes shareholder value by achieving the fastest rate of improvement in customer satisfaction, cost, quality, process speed and invested capital. The synergy of both, Lean and Six Sigma is required because Lean alone cannot bring a process under statistical control and Six Sigma alone cannot dramatically improve process speed.

A Lean process is one in which value added time in the process is more than 25% of total lead time of that process.

The lean metric is cycle efficiency.

Process Cycle Efficiency = Value Added Time / Total Lead Time

Process cycle efficiency varies for different processes, but an average of 25% is world class. Table 3.3 shows typical and world class cycle efficiencies.

<table>
<thead>
<tr>
<th>Process</th>
<th>Typical Cycle Efficiency</th>
<th>World Class Cycle Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Machining</td>
<td>1 %</td>
<td>20 %</td>
</tr>
<tr>
<td>Fabrication</td>
<td>10 %</td>
<td>25 %</td>
</tr>
<tr>
<td>Assembly</td>
<td>15 %</td>
<td>35 %</td>
</tr>
<tr>
<td>Continuous Manufacturing</td>
<td>30 %</td>
<td>80 %</td>
</tr>
<tr>
<td>Business Processes Transactional</td>
<td>10 %</td>
<td>50 %</td>
</tr>
<tr>
<td>Business Processes Creative / Cognitive</td>
<td>5 %</td>
<td>25 %</td>
</tr>
</tbody>
</table>

Ref: 69 Lean Six Sigma – Michael George
3.3.7 Cost Reduction through Kaizen:

Kaizen needs little investment but more efforts to sustain the change. The net effect is a cost reduction. Toyota Motor Chairman Eiji Toyoda\(^2\) said “one of the features of the Japanese Workers is that they use their brains as well as their hands. Our workers provide 1.5 million suggestions per year and 95% of them are put to practical use”.

*Hence so many Kaizens naturally bring substantial profits. Kaizen thus, is a powerful and effective tool for improving bottom line.*

Two different cultures for achieving corporate objective of maximizing profits exist. Profit can be either increased by keeping the fixed expenses low or the other culture where profit is achieved by increasing sales volume despite high fixed expenses.

3.3.8 Cost Reduction Through Innovation:

Innovation results in a drastic improvement in the status quo as a result of large investment in new technology and equipment. Japanese companies generally favour the gradualist approach while the Western companies follow great-leap approach – an approach also called as “Innovation”. Japan is strong in Kaizen but weak in innovation. West is stronger in innovation but weak in Kaizen. Innovation can bring substantial reduction in costs.

Figure 3.2 explains the chain of observations, data, information and innovation\(^6\). It means that although we see many things in a day-to-day life we hardly notice them. What we notice we normally ignore to record observations, which may become valuable data. Data can be useful only when analysed in the fashion customer wants so that it can become useful information. This is the base for knowledge, which, when applied in a systematic way may lead to an innovation and birth of a new technology.
Practical requirements include large investment but little effort to maintain innovation. This culture is better suited for fast growing economy. Cost reduction or improvement in profitability due to innovation is therefore abrupt, may not be regular or continuous and usually needs huge investments besides need for employing specialized R & D staff unlike in Kaizen where every worker's brain is utilized with almost no additional investment.
3.3.9 Cost Reduction Through Quality Circles and Suggestion Scheme:

a) Quality Circle is a small group of employees usually 8 – 10 in the same work area or doing a similar type of work who voluntarily meet regularly for about an hour every week to identify, analyze and resolve work related problems, leading to improvement in their total performance, cost reduction and enrichment of their work-life.

Intangible benefits include problem solving capability, encouraging an attitude of problem prevention, improving communication, promotion of personal and leadership development and catalyses attitudinal changes.

Quality circles to be successful need a support system. In the West and also in India the managements look only at the bottom line i.e., cost reduction savings forgetting other criteria which keeps the Quality Circle Activities alive. These include method of problem solving, selection of a problem, mode of meetings conducted, leadership qualities, participation rate etc.

b) Any suggestion from anyone is expected to cover an improvement aspect. As such many companies run suggestion schemes. These are meant for understanding the “voice of employees” on aspects where they have no direct say e.g. product design improvement, process improvement etc. Infact, the suggestion scheme is an integral part of individual-oriented Kaizen. It is necessary that top management take full interest in suggestion scheme to keep it alive.

3.3.10 Cost Reduction Through Efficient Supply Chain Management:

The function of the supply chain is to establish linkage between customer and source of product and services that a company provides to the market place.

One of the important criteria for cost control is Vendor Managed Inventory i.e. vendor to take responsibility providing supplies just-in-time and as
needed by the customer eliminating double buffers. IT based supply chain information management tool provides intelligent decision support and execution management. This provides online updated status information to all members of supply chain avoiding all kinds of confusion, wastage of time, inventory, man hours, materials and logistic costs.

SCM operates most effectively on lean approach, pull system, avoidance of waste and concentration of Value Added activities.

Figure No. 3.3 explains an overall supply chain focusing an Integrated Management of all logistical operations


**3.3.11 Cost Reduction Through Logistics Management:**
With Logistics management in its most efficient manner great savings are possible. *Survival chances are available for global player on the basis how it is able to manage its logistics process for an efficient management of supply chain and hence costs.*
One of the most important principles of an efficient business is how one can process product fastest through the supply chain before it reaches the customer. One of the dimensions for faster delivery is shortest distance to be covered by the inventory from vendors to dealers, retailers up to actual user. This is where efficiency of logistics management plays an important role.

Logistics is concerned with getting products and services where they are needed when they are needed. High level of logistical competency is now expected. Logistics is a management function that supports total cycle of material flow from purchase of raw material to distribution of finished goods.

For individual firms logistics expenditure typically ranges from 5 to 35% of annual sales. This expenditure is second only to materials in manufacturing or cost of goods in wholesaling or retailing. Logistics is thus expensive.

There exists tremendous scope for cost savings in logistics costs. Its success depends upon careful planning, effective information system, support by training in up-to-date techniques, comprehensive measurement and continuous improvement.

3.3.12 Cost Reduction Through Application of Poka Yoke:

Poka Yoke is a Japanese word meaning “fool-proof mechanism” or “Mistake Proofing”. This significantly reduces inspection time and improves customer satisfaction. The cost reduction therefore, due to Poka Yoke is cost savings due to elimination of defectives plus savings of expenses for inspection. In addition, it improves delivery time and thus customer satisfaction. Fig. 3.4 and 3.5 show examples of Poka Yoke and early detection of defects reduce cost of rejection.
Example of Poka Yoke\textsuperscript{67}

Fig. 3.4

Limit Switch

Right Position

Wrong Position

Ref.: Kiyoshi Suzaki “New Manufacturing Challenge”. pp 100

Use of a limit switch to monitor the procedure. If it is performed incorrectly, the machine will not start to operate.

Figure 3.5 shows Identifying Defects at the source lowers costs

<table>
<thead>
<tr>
<th>Defects found at Cost to the Company Impact to the Company</th>
<th>Own Process</th>
<th>Next Process</th>
<th>End of Line</th>
<th>Final Inspection</th>
<th>End User</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rs</td>
<td>Rs</td>
<td>Rs</td>
<td>Rs</td>
<td>Rs</td>
<td>Rs</td>
</tr>
</tbody>
</table>

- Very minor
- Minor Delay
- Rework
- Reschedule of Work
- Significant rework
- Delay in Delivery
- Additional Inspection
- Warranty Cost
- Admin. Cost
- Reputation Cost
- Loss of Mkt. Share

Ref: 67 The New Manufacturing Challenge – Kiyoshi Suzaki pp 99
3.3.13 Cost Reduction through Quality Assurance, Total Quality Management and Total Productive Maintenance:

a) Cost Reduction Through:
Quality Assurance:
Toyota-1994 defined quality assurance as “quality assurance means assuring that the quality of product is satisfactory, reliable and yet economical for the customer” while ISO8402 defines quality assurance as “all the planned and systematic activities implemented within the quality system and demonstrated as needed, to provide adequate confidence that an entity (i.e. an activity or a process or a product or an organisation) will fulfill requirements for quality”.

Quality Assurance comes from evidence – quality plans and audits – system audit, (e.g. I.S.O. 9000), product audit, process audit, service audit etc. This is undertaken on the basis that prevention rather than detection practices are followed with focus on process and striving for continuous improvement. In such an environment it is not necessary for inspection activities on 100% basis and savings in cost of inspection and time can be substantial.

b) Cost Reduction Through:
Total Quality Management (T.Q.M.)
Some of the concepts of T.Q.M. concerning cost reduction are discussed here. A great deal of profit can be made by quality improvements in products and services, business processes and people. IBM (International Business Machines) put cost of non-conformance of 11 percent equal to 5.6 billion dollars in 1986, in addition to costs of poor business processes. Subsequent program on “Quality focus on business processes” alone was targeted to save $ 2 billion. Thus, potential savings were worth $ 7.6 billion.

Rather than relying exclusively on increasing sales to gain profit, additional profits are achieved through quality improvements which come through T.Q.M. concepts. Figure 3.6 explains that to gain an increase in profit P
through increased sales would require a significant increase in operating costs (e.g. sales personnel, travel, promotion / advertising, inventories etc.)
to make the same increase in Profit P through quality improvement would require only a fraction of those operating costs, which in any case,
diminish through time. Figure 3.7 illustrates the more the quality improves, the faster sales will increase because customer satisfaction carries its own acceleration.

**Fig. 3.6**

*Quality Pays For Itself In Cost Reduction*

![Graph showing cost reduction](image)

**Fig. 3.7**

*Quality pays for itself in Sales Growth*

![Graph showing sales growth](image)
“Right first time” as coined by Phil. Crosby²² is based on the fact that with TQM it is possible to achieve defect free work most of the time.

c) Cost Reduction through:
Total Productive Maintenance (T.P.M.)
TPM involves everyone the objective being to achieve highest availability and overall effectiveness of the production equipment through employee participation in productive maintenance activities. The concept of TPM includes formation of teams to identity, analyze and solve maintenance problems for increasing uptime of equipments and reduce cost of maintaining an equipment besides defect free production and faster delivery.
3.4 PRIVATE SECTOR INDUSTRIES IN PUNE REGION:

3.4.1 There are 97 Private Sector Manufacturing companies in Pune Region\(^{27}\).

3.4.2 There are 87 Research Institutes in Pune\(^{27}\).

3.4.3 Exports from Pune region have grown from Rs. 50 crores to 5500 crores over the last few decades. The biggest strength of Pune is the ever increasing availability of skilled human resource. Pune houses five Universities and many national and international level educational and R & D institutions. It is hence viewed as an ideal destination for investment.

3.4.4 Pune has fifteen major industrial estates as shown in Table 3.4

<table>
<thead>
<tr>
<th>Table 3.4</th>
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<tbody>
<tr>
<td><strong>Industrial Estates In Pune Region</strong></td>
</tr>
</tbody>
</table>

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pimpri Chinchwad</td>
<td>6</td>
<td>Ranjangaon</td>
<td>11</td>
</tr>
<tr>
<td>2</td>
<td>Bhosari</td>
<td>7</td>
<td>Hinjewadi</td>
<td>12</td>
</tr>
<tr>
<td>3</td>
<td>Chakan</td>
<td>8</td>
<td>Pirangut</td>
<td>13</td>
</tr>
<tr>
<td>4</td>
<td>Hadapsar</td>
<td>9</td>
<td>Talegaon</td>
<td>14</td>
</tr>
<tr>
<td>5</td>
<td>Sansawadi</td>
<td>10</td>
<td>Mundhawa</td>
<td>15</td>
</tr>
</tbody>
</table>

Some of the industrial estates like Ranjangaon, Hinjewadi have excellent infrastructure. Pune has good connectivity with Mumbai with express highway. Also air and rail connectivity to some of the major cities in the country is available. Imports and exports of air cargo, direct rail link to
gateway port of JNPT (Jawaharlal Nehru Port Trust) and of late International air connectivity to Singapore and Dubai are some of the major milestones in the infrastructural improvement in Pune.

3.4.5 A new international air-port is coming up near Rajgurunagar to meet the increase in passenger and cargo traffic. In addition an International Convention Centre is now available in Pune. The first auto-cluster of the country to assist automotive ancillary units in improving quality is being set-up at Chinchwad.

3.4.6 'Forbes' website has mentioned that, “Equity International” an American company dealing with property development reports that due to cutting-in technology, skilled labour and increase in purchasing power amongst the young citizen of Pune, Pune could be third best city for business for future⁵⁷.

3.4.7 The Governor of Okayama, Japan, Mr. Masohiro Ishii on his recent visit to Pune⁵⁸ said "Most Japanese states have been interacting with China for building bi-lateral ties and friendship. Okayama Government is the first Government to focus on India and especially Pune for such an interaction as Pune is IT hub as well as center for manufacturing varied products and automobiles. We have information that it is the Indian City, which is famous for its culture and IT professionals but after coming here, we have discovered that the city is doing fairly well in many other sectors too".

72
3.5 THE ROLE OF PRIVATE SECTOR IN THE NATIONAL ECONOMY:

3.5.1 The Private Sector:
India is a mixed economy consisting of Public Sector, Private Sector and also the Joint Sector.

Private Sector enterprise may consist of an individual proprietary concern or a joint stock enterprise, either domestic or foreign, basically having private ownership and management. The organization growth happens due to personal involvement and initiative of the promoter and profit is usually the prime motive.

3.5.2 Industrial Policy:
The Government announced the new Industrial Policy in 1991. The main objectives of the new policy was to relieve the industrial economy from:
1) Unnecessary bureaucratic control.
2) To introduce liberalization with the world economy.
3) To remove restrictions on foreign direct investment and
4) To free the domestic entrepreneur from the restrictions of MRTP (Monopolies and Restrictive Trade Practices) act.

Further, the policy aimed to reduce the load of public enterprises, which have shown a very low rate of return or are incurring losses over the years. All these aspects led the Government to take a series of initiatives in respect of policies in the following areas:
a) Industrial Licensing
b) Foreign Direct Investment
c) Foreign Technology Policy
d) Public Sector Policy
e) MRTP etc.
As a result of the above and further liberalization by de-reservation in April – 1993, only 15 industries were left reserved for compulsory licensing.

Also eight industries were reserved for Public Sector such as Defence equipment, Mineral Oils, Mining of various Metals, Atomic Energy, railway transport etc.

3.5.3 Private Sector Vis-à-vis Public Sector:
It is interesting to study the growth\textsuperscript{56} of the corporate sector in India over the last four decades as highlighted in Table 3.5 and in Table 3.6, giving comparison of government and non-government companies.

Table 3.5
Growth of Corporate Sector\textsuperscript{56}

<table>
<thead>
<tr>
<th>Sector</th>
<th>1957</th>
<th>1971</th>
<th>2000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of Companies</td>
<td>29,357</td>
<td>30,322</td>
<td>5,42,308</td>
</tr>
<tr>
<td>(a) Government</td>
<td>74</td>
<td>314</td>
<td>1257</td>
</tr>
<tr>
<td>(b) Non-Government</td>
<td>29,283</td>
<td>30,008</td>
<td>5,41,051</td>
</tr>
</tbody>
</table>

Table 3.6
Paid up Capital of Government and Non-Government Companies
(Rs. Crores)

<table>
<thead>
<tr>
<th></th>
<th>All Companies</th>
<th>Government Companies</th>
<th>Non-Government Companies</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1,080 (100%)</td>
<td>70 (6.8%)</td>
<td>1,010 (93.2%)</td>
</tr>
<tr>
<td></td>
<td>4,500 (100%)</td>
<td>2,060 (45.8%)</td>
<td>2,440 (54.2%)</td>
</tr>
<tr>
<td></td>
<td>2,67,898 (100%)</td>
<td>95,842 (35.8%)</td>
<td>1,72,056 (64.2%)</td>
</tr>
</tbody>
</table>

Source\textsuperscript{56} : Tata Services Ltd. Statistical Outline of India.

Note: Figures in brackets are percentages of total paid-up capital (2003-2004)
3.5.4 The Government's Role in Private Sector:
To support the private sector the Government of India has set-up financial and infrastructural institutions like ICICI (Industrial Credit and Investment Corporation of India), IDBI (Industrial Development Bank of India), the EXIM Bank, State Financial Corporations, IFCI (Industrial Finance Corporation of India), State Industrial Development Corporations (viz. MIDC) etc.

In addition, the Government had also set-up elaborate structure for control and regulations for private sector. In practice, however, all these support and regulatory requirements eventually became restrictive instruments. This clearly showed lack of trust and understanding between the Government and the private corporate sector. This resulted in slowing down of the growth rate in the industry.

In recent years the Government has given up its rigid stand and liberalized various control-regulatory measures to suit the fast changing needs of a diversified industrial economy.

3.5.5 Role of the Private Sector:
Having adopted mixed economy the Government allotted specific role to the private sector in introduction of new technologies, new processes and a new outlook towards manufacturing and production. Private sector has played an important role in the country's industrial development. The first Iron and Steel plant, the factories to produce automobiles and aircrafts were first set up by private sector in India. Industries such as cotton, jute, textiles, tea, sugar etc were set up even before independence. After independence more stimulant was given to produce intermediate goods, machinery resulting in growth of such industries like machine-tools, plastics, rubber, chemicals and paints, iron-castings and non-ferrous metals. This provided self sufficiency status in many consumer goods and infact, resulted in exports to other developing countries.

Private sector plays an important role in Indian Economy.
Besides, it also plays a major role in Agriculture, Trading and Small Scale and Cottage Industries.

3.5.5.1 Private Sector in Indian Economy:
Private sector makes an important contribution to the national income and employment generation. Private Sector’s contribution to the Net Domestic Product (NDP) in 2000-01 was 75% while the public sector contributed only 25%. This is illustrated in Table 3.7

Table 3.7
Contribution of Private Sector

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Sector</th>
<th>Public Sector</th>
<th>Private Sector</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(in Rs. billion)</td>
<td>(in Rs. billion)</td>
<td>(in Rs. billion)</td>
</tr>
<tr>
<td>1.</td>
<td>Agriculture, Forestry and Fishing</td>
<td>4545 (1.7%)</td>
<td>2,65,677 (98.3%)</td>
<td>2,70,222 (100%)</td>
</tr>
<tr>
<td>2.</td>
<td>Mining and Quarrying</td>
<td>18,348 (84.4%)</td>
<td>3,386 (15.6%)</td>
<td>21,734 (100%)</td>
</tr>
<tr>
<td>3.</td>
<td>Manufacturing</td>
<td>17,363 (10.9%)</td>
<td>1,45,599 (89.1%)</td>
<td>1,58,962 (100%)</td>
</tr>
<tr>
<td>4.</td>
<td>Electricity, Gas and Water</td>
<td>16,673 (109.9%)</td>
<td>-1,505 (-9.9%)</td>
<td>15,168 (100%)</td>
</tr>
<tr>
<td>5.</td>
<td>Construction</td>
<td>10,046 (16.9%)</td>
<td>49,450 (83.1%)</td>
<td>59,496 (100%)</td>
</tr>
<tr>
<td>6.</td>
<td>Trade, Hotels and Restaurants</td>
<td>4,863 (2.9%)</td>
<td>1,65,759 (97.1%)</td>
<td>1,70,622 (100%)</td>
</tr>
<tr>
<td>7.</td>
<td>Transport, Storage and Communications</td>
<td>43,839 (56.2%)</td>
<td>34,224 (43.8%)</td>
<td>78,063 (100%)</td>
</tr>
<tr>
<td>8.</td>
<td>Finance, Insurance, Real Estate and Business Services</td>
<td>44,903 (33.1%)</td>
<td>90,723 (66.9%)</td>
<td>1,35,626 (100%)</td>
</tr>
<tr>
<td>9.</td>
<td>Community, Social and Personal Services</td>
<td>1,00,396 (65.7%)</td>
<td>52,327 (34.3%)</td>
<td>1,52,723 (100%)</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>2,60,976 (24.6%)</td>
<td>8,01,640 (75.4%)</td>
<td>10,62,616 (100%)</td>
</tr>
</tbody>
</table>

Note: Figures in brackets show share w.r.t. total NDP

Source\(^5\) Compiled and computed from National Accounts Statistics (2003)
3.5.6 Private Sector Weaknesses and Limitations:
Some of the private sector enterprises adopted undesirable practices like hoarding, profiteering and being monopolistic with concentration of economic power and wealth. Some of them were also subject to industrial unrest and industrial sickness leading to either closure or takeover.

In recent times private sector is faced with a major problem of stiff international competition in India itself demanding superior quality and faster delivery. But the major crux of the problem is cost. If Quality, Cost and Delivery is to be balanced against international competition then there is a need for complete transformation in the attitudes and mindset of private sector where profit can automatically follow customer satisfaction for a lean approach. Hence the objective of this research.
3.6 ABOUT PUNE:

The city of Pune, which not only is a cultural heritage of the State of Maharashtra, but is an important center for education and industry—especially, engineering and automotive industry. Pune has always been the businessman's paradise—great history, good year-round climate and excellent workforce. Till recently, infrastructure and transport links could be described as good but now more upgradation and expansion is needed to cope with rapid growth at a phenomenal rate of service industries especially of IT (Information Technology) and B.P.O. (Business Process Outsourcing) sector.

Needless to mention, a huge base of ancillary industries exists which support some of the technological driven organizations in auto-sector and engineering sectors in various industrial estates developed around Pune. Pune is also a base for a number of Research and Development Laboratories both, in Public Sector, as well as in Private Sector.

Pune is students' choice number one for higher and specialized education and men with outstanding talent and intellect have brought out several innovations, which have received world acclaim.

Pune has a rich heritage for Art, Indian classical music dovetailed in Marathi musical drama and an undisputed center for Maharashtrian culture, Pune being at a vantage location in Maharashtra State.
General information about Pune can be summarized as mentioned in Table 3.8

Table 3.8
General Information on Pune

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height above Mean Sea Level</td>
<td>570 Meters</td>
</tr>
<tr>
<td>Population –</td>
<td>2001</td>
</tr>
<tr>
<td>Pune Municipal Corporation</td>
<td>25,40,069</td>
</tr>
<tr>
<td>Pimpri, Chinchwad Corporation</td>
<td>10,06,417</td>
</tr>
<tr>
<td>Pune Cantonment Board</td>
<td>80,191</td>
</tr>
<tr>
<td>Kirkee Cantonment Board</td>
<td>76,608</td>
</tr>
<tr>
<td>Dehu-Road Cantonment Board</td>
<td>47,000</td>
</tr>
<tr>
<td><strong>Total No. of Vehicles on Road</strong></td>
<td><strong>11,40,000</strong></td>
</tr>
<tr>
<td>Registered Units with Dir. of Industries in Pune District:</td>
<td></td>
</tr>
<tr>
<td>Small Scale Industries</td>
<td>44,816</td>
</tr>
<tr>
<td>Medium Scale Industries</td>
<td>697</td>
</tr>
<tr>
<td>Small Scale Economically Backward Area</td>
<td>2626</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>48189</strong></td>
</tr>
<tr>
<td>Manufacturing Companies in Pune District</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>13150</strong></td>
</tr>
<tr>
<td>Organized Sector (Private Sector) Manufacturing Companies in Pune Region</td>
<td>97</td>
</tr>
<tr>
<td>ISO-9000/QS-9000 Certified Companies in Pune Region (Small, Private limited and Limited Companies)</td>
<td>198</td>
</tr>
<tr>
<td>Companies with Foreign Direct Investment</td>
<td>163</td>
</tr>
<tr>
<td>Parameter</td>
<td>Details</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
<td>---------------</td>
</tr>
<tr>
<td>Working Factories in Pune District</td>
<td>3,394 (2001)</td>
</tr>
<tr>
<td>Educational Institutions in Pune District:</td>
<td></td>
</tr>
<tr>
<td>Primary</td>
<td>4,230</td>
</tr>
<tr>
<td>Secondary</td>
<td>883</td>
</tr>
<tr>
<td>Higher Education</td>
<td>104</td>
</tr>
<tr>
<td>Total Railway Length in Pune District</td>
<td>311 km</td>
</tr>
<tr>
<td>Total Road Length in Pune District</td>
<td>8695 km</td>
</tr>
<tr>
<td>Hospitals</td>
<td>38</td>
</tr>
<tr>
<td>Primary Health Centres</td>
<td>90</td>
</tr>
<tr>
<td>Research Institutes</td>
<td>87</td>
</tr>
</tbody>
</table>
3.1 and 3.2 Bibliography

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   Tata McGraw Hill – 2000 pp 7,8,9,10

   Vocabulary – Second Revision – International Organizations for
   Standardization – 2000 Published by Bureau of Indian Standards pp-
   9 clause 3.2.12

62. KAIZEN (Ky'zen) The Key to Japan’s Competitive Success By
   (Glossary) pp xxix, xxxi

3.3

   Hall of India – 1996 pp 22-23

22. “Quality is Free” Philip B. Crosby – Mentor New York – 1980 pp 111-
   112

23. Poka-Yoke – Improving Product Quality by Preventing, Defects –
   Edited by Nikkan Kogyo Shimbun Ltd. Productivity Press with
   preface by Shigeo Shingo Ph. D. ppx

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   Chrysler, Ford and G. M. Corporation pp1, 5, 20, 21-55

62. Kaizen (Ky’zen)- the Key to Japan’s Success by Masaaki Imai –

63. “Cost Reduction Through Quality Improvement” – George P. Laszlo
   The Quality Management Forum – ASQ August 1997 pp 12-14

66. “Design to Cost of Predicting the cost of Future Products in Design”
   – A report by SARA Tech. Services Pvt. Ltd., Delhi 1979 pp 21-23
   and Fig 8 & 9

67. The New Manufacturing Challenge – Techniques for Continuous
   8, 10, 100, 99
68. "Relationship between observation, data, information, knowledge and Technology" – Teaching Notes on “Innovation and Technology Management – W. N. Khatavkar, Visiting Faculty, IMDR, - MBA 2005


3.4


58. “We have seen more than what we expected of Pune”, Times of India 13.02.2006

3.5


3.6

27. Industrial and Commercial Directory of Pune-MCCIA, Pune-2005 pp 635
3.1 and 3.2 Foot Notes

61. "Quality Improvement" has been defined at clause No. 3.2.12 as part of "quality management focused on increasing the ability to fulfill quality requirements". This has been defined in ISO-9000-2000 "Quality Management Systems – Fundamentals and Vocabulary"

This is an authentic definition of Quality Improvement.

62. Masaaki Imai has defined improvement as a part of successful Kaizen Strategy. He includes both, Kaizen and innovation as part of improvement strategy giving salient points in each case. He clarifies that workers responsibility is to maintain standards while management’s responsibility is to improve standards.

Masaaki Imai has described Kaizen as a strategy – the single most important concept in Japanese management – the key to Japanese competitive success. This is so because Kaizen is the basic philosophical underpinning (foundation) for the best in Japanese management. It spells improvement.

55. Juran has illustrated a model of continuous improvement as perceived by the customer, the processor and the supplier or the vendor. The model developed by AT&T Paradyne, identifies the actions to be taken in each of these three roles to pursue continuous improvement.

While describing the process of management of quality Juran has illustrated the basic elements of quality management viz. quality planning, quality control and quality improvement. He calls them as Trilogy and they are very similar to the financial process viz. financial planning (i.e. budgeting), financial control (i.e. expense measurement) and financial improvement (i.e. cost reduction). This is clearly illustrated in 3.4.2 and the figure 6.
3.3

20. John Bank in his book ‘The Essence of Total Quality Management’ has cited the example of IBM corporation regarding profit to be made by quality improvements in products and services. A programme on cost savings entitled Quality Focus on the Business Process launched in May 1985 billion worldwide in improving processes alone. In addition arresting the cost of non-conformance of 11% or $5.6 billion together represented a $7.6 billion worth of potential savings.

22. Phil. Crosby in his famous book “Quality is Free” emphasized the absolutes of quality management: - Quality means conformance, not elegance.
   - There is no such thing as quality problem
   - There is no such thing as the economics of quality is always cheaper to do the job right the first time.
   - The only performance measurement is the cost of quality.
   - The only performance standard is Zero Defects.

23. Poka – Yoke is a technique for avoiding simple human errors at work. Poka-Yoke devices play a major role in zero quality control as they perform as tools for 100% inspection. Thus it is the key for achieving 100% quality to prevent transferring defects to the next process.

46. QS-9000 – Quality Systems Requirement (for automotive products) has published a supplement on Statistical Process Control as one of the important mandatory requirement. Control charts for both, $\bar{X}$ and $R$ help to identify problem areas so that the process can be improved on a continuous basis. Control charts enable to identify special causes of variation. The fundamental advantage is that it enables to reduce variation in the process parameters.
62. The definition mentioned by Masaaki Imai in his book ‘Kaizen (Ky’sen) The key to Japan’s Success’ is in fact a definition made at Toyota Motor Corporation.

63. George P. Laszlo in his article Cost reduction through quality improvement in Quality Management Forum, a news letter for Q. M. Division of American Society for Quality says that “the current economic conditions make it necessary for all organizations to review and tightly control cost and expenditure. At such periods of time management often has the tendency to put Quality on the back burner due to financial constraints. Ironically, those are the occasions which present the greatest opportunities for minimizing operational losses by the judicious pursuit of quality improvement projects”.

66. Sara technical service’s paper on “Design to Cost” examines some of the methods industry can use to predict product costs and to compare these predictions with cost estimates of the design as it matures in order to provide some measure of cost viability to the design engineer and the management. A successful programme called “Target Cost Programme” has also been described in the paper.

67. Kiyoshi Suzaki has mentioned principles for process improvement in his book “The New Manufacturing Challenge”. He says that just as discipline helps in acquiring skills in sports, certain principles will help in learning the skills for process improvement more quickly. He has therefore stated 12 principles for process improvement which are illustrated in section 3.5.3 (Table 11)

- In the same book he has mentioned about Japanese technique called “Jidoka” meaning autonomous control. This means adding “intelligent” features to machine to stop or start operations as needed giving signals to the operator when necessary (section 3.5.3 – 8)
Kiyosho Suzaki has dealt with elimination of waste in work environment. He has quoted Fujio Cho, president, Toyota Motor Corporation as saying “anything other than the minimum amount of equipment, materials, parts, space and worker’s time which are absolutely essential to add value to the product”.

He has referred to the Henry Ford’s book ‘Today and Tomorrow written in 1920s which Toyota people diligently studied later. To summarize it meant ‘If it does not add value it is waste’.

An example of Poka yoke used on shopfloor shows a limit switch to monitor the right position of a component avoiding mistake and loss due to rejection.

Identifying defects at the source lowers the cost illustrating the importance of ensuring quality at the source. The longer the delay in discovering a problem, the higher the cost of delivery.

Relationship between the observations and information leading to knowledge and technology has been illustrated in the Figure 12. It is generally observed that many people do not make a habit of recording observations in the work environment which could become a valuable data for future. New techniques viz. 6 sigma depend heavily on past data. It also provides a valuable information for problem solving.

While advocating the need for combination of lean and six sigma Michael L. George has referred to a December 2000 issue of ‘Industry Week’ in which a survey has been published saying that in the absence of lean methods the on time delivery performance was very poor.
Lean metric is regarded as cycle efficiency and he has specified that for a world class industry the cycle efficiency has to be 25% or more. Most processes run at a cycle efficiency less than 10% due to inprocess Waiting time.

70. Donald J. Bowersox et. al has given an overall logistics expenditure typically ranging from 5 to 35 percent of sales turnover. This expenditure is second only to cost of materials turnover. This expenditure is second only to cost of materials used in manufacturing. Therefore logistics management is one of the most important challenges today.

While attempting to minimize inventory costs the overall impact of increasing number of warehouses an average inventory needs to be studied.

71. ISO 8402 – 1994 clause No. 4.4 gives 'model for quality assurance' i.e. the definition which has been stated in section 3.5.13.

3.4

57. An article in Marathi daily "Sakal" dated 11-02-2006 has referred to a report by an American Company – "Equity International" and is available on the website of Forbes. This report has published a list of Top seven cities of the world which have a great potential to grow as ideal locations for industry, commerce and business. Pune is listed and the 3rd in a list of seven cities.

58. Masahiro Ishii, the Governor of Okayama, has preferred Pune over Chinese towns for increasing bilateral ties under Japan friendship programme. He is preference to Pune is because Pune is IT hub, centre for education and manufacturing centre for automobiles and
engineering industry. He looks forward towards exchange of experts in sectors like I.T. electronics automobiles etc. They would also send a group of students as a part of home stay exchange programme. This report has come in Times of India dated 13-02-2006 entitled “We have seen more than what we expected of Pune”.

3.5

56. Ruddar Datta et al in their book “Indian Economy have given the latest update on the role of private sector in the Indian economy. It is highlighted that faster progress by the private sector in relative terms is due to the fact that the top management get personally involved and the initiative taken by the promoters result in more profits and growth.

3.6

27. Industrial and Commercial Directory of Pune- Published by MCCIA (2002) gives detail statistics about Pune such as population, number of vehicles, number of different categories of industries etc.