CHAPTER VII

FINDINGS

AND

RECOMMENDATIONS

From this in depth study of operations of the Foundry Industry, number of problems are identified and grouped them as internal and external. After probing into these issues, some possible solutions are recommended.
### 1. Key Indicators

**TABLE VII.1 KEY INDICATORS OF BELGAUM DISTRICT FOUNDRY INDUSTRY**

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</thead>
<tbody>
<tr>
<td>Per Ton of Castings (Rs '000)</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Pig Iron</td>
<td>1.25</td>
<td>1.27</td>
<td>1.36</td>
<td>1.62</td>
<td>1.87</td>
<td>2.09</td>
<td>2.31</td>
<td>2.52</td>
<td>2.80</td>
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<td>Scrap</td>
<td>1.08</td>
<td>1.11</td>
<td>1.22</td>
<td>1.40</td>
<td>1.64</td>
<td>1.90</td>
<td>2.22</td>
<td>2.68</td>
<td>2.81</td>
<td>1.79</td>
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<td>Ferro Silicon</td>
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<td>0.01</td>
<td>0.02</td>
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<td>0.02</td>
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<td>0.03</td>
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<tr>
<td>Other Material</td>
<td>0.49</td>
<td>0.53</td>
<td>0.57</td>
<td>0.62</td>
<td>0.66</td>
<td>0.69</td>
<td>0.75</td>
<td>0.83</td>
<td>1.01</td>
<td>0.68</td>
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<tr>
<td>Total Material</td>
<td>2.83</td>
<td>2.92</td>
<td>3.17</td>
<td>3.66</td>
<td>4.19</td>
<td>4.71</td>
<td>5.31</td>
<td>6.05</td>
<td>6.65</td>
<td>4.39</td>
</tr>
<tr>
<td>Power &amp; Fuel</td>
<td>0.50</td>
<td>0.54</td>
<td>0.60</td>
<td>0.66</td>
<td>0.74</td>
<td>0.83</td>
<td>0.97</td>
<td>1.13</td>
<td>1.25</td>
<td>1.52</td>
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<tr>
<td>Wage Cost</td>
<td>0.41</td>
<td>0.50</td>
<td>0.62</td>
<td>0.68</td>
<td>0.73</td>
<td>0.80</td>
<td>0.85</td>
<td>0.94</td>
<td>1.10</td>
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<td>Factory OH</td>
<td>0.58</td>
<td>0.70</td>
<td>0.80</td>
<td>0.89</td>
<td>0.91</td>
<td>1.06</td>
<td>1.14</td>
<td>1.36</td>
<td>1.58</td>
<td>1.00</td>
</tr>
<tr>
<td>Office OH</td>
<td>0.50</td>
<td>0.54</td>
<td>0.56</td>
<td>0.61</td>
<td>0.61</td>
<td>0.75</td>
<td>0.91</td>
<td>1.02</td>
<td>1.15</td>
<td>0.74</td>
</tr>
<tr>
<td>Sales OH</td>
<td>0.04</td>
<td>0.04</td>
<td>0.03</td>
<td>0.03</td>
<td>0.04</td>
<td>0.05</td>
<td>0.07</td>
<td>0.08</td>
<td>0.09</td>
<td>0.05</td>
</tr>
<tr>
<td>Cost of Sale</td>
<td>4.86</td>
<td>5.23</td>
<td>5.78</td>
<td>6.54</td>
<td>7.22</td>
<td>8.20</td>
<td>9.25</td>
<td>10.58</td>
<td>11.81</td>
<td>7.72</td>
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<tr>
<td>Sale Price</td>
<td>5.00</td>
<td>5.47</td>
<td>6.15</td>
<td>6.80</td>
<td>7.63</td>
<td>8.80</td>
<td>10.43</td>
<td>12.15</td>
<td>13.60</td>
<td>9.45</td>
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<tr>
<td>Profit</td>
<td>0.14</td>
<td>0.24</td>
<td>0.37</td>
<td>0.26</td>
<td>0.41</td>
<td>0.60</td>
<td>1.18</td>
<td>1.57</td>
<td>1.79</td>
<td>0.73</td>
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**Other factors:**

<table>
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<tr>
<td>Capacity Used (%)</td>
<td>56</td>
<td>59</td>
<td>58</td>
<td>60</td>
<td>63</td>
<td>64</td>
<td>65</td>
<td>65</td>
<td>65</td>
<td>61</td>
</tr>
<tr>
<td>Casting/Worker Ton</td>
<td>7.06</td>
<td>7.51</td>
<td>7.70</td>
<td>7.86</td>
<td>7.47</td>
<td>7.32</td>
<td>7.04</td>
<td>7.85</td>
<td>7.87</td>
<td>7.52</td>
</tr>
<tr>
<td>ROI (%)</td>
<td>5.79</td>
<td>9.17</td>
<td>12.00</td>
<td>7.51</td>
<td>10.70</td>
<td>14.08</td>
<td>23.73</td>
<td>27.81</td>
<td>29.99</td>
<td>15.64</td>
</tr>
<tr>
<td>ROI Trend</td>
<td>100</td>
<td>158</td>
<td>207</td>
<td>130</td>
<td>185</td>
<td>243</td>
<td>410</td>
<td>480</td>
<td>518</td>
<td>270</td>
</tr>
<tr>
<td>NOP/SALES (%)</td>
<td>2.70</td>
<td>4.31</td>
<td>5.97</td>
<td>3.80</td>
<td>5.37</td>
<td>6.79</td>
<td>11.33</td>
<td>12.91</td>
<td>13.13</td>
<td>7.37</td>
</tr>
<tr>
<td>T1/SALES</td>
<td>0.51</td>
<td>0.53</td>
<td>0.55</td>
<td>0.57</td>
<td>0.58</td>
<td>0.52</td>
<td>0.53</td>
<td>0.53</td>
<td>0.50</td>
<td>0.54</td>
</tr>
<tr>
<td>Debtor Turnover</td>
<td>4.77</td>
<td>4.80</td>
<td>4.82</td>
<td>4.59</td>
<td>4.69</td>
<td>4.93</td>
<td>4.64</td>
<td>4.76</td>
<td>4.90</td>
<td>4.77</td>
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</tbody>
</table>
It is apparent (Table VII.1) that the Belgaum District Foundry Industry could make use of 61%, mean production capacity. The mean annual productivity per worker amounts to 7.52 TPA. The average price realisation has been Rs 8,450 per ton and cost of sale is Rs 7,720. Mean net operating profit before tax, earned was Rs 730. The average total cost was made up of material cost (56.30%), energy (10.60%), labour (9.59), factory overhead (inclusive of depreciation cost) 12.97% and office and sales overhead (10.26%).

Photo VII.1 The researcher in discussions on findings, with Mr. Jathar, the Secretary, The Institute of Indian Foundrymen, Belgaum Chapter.
In the chapter VI, it is noticed that Total material productivity is not at all good. Especially productivity of pig and scrap has maintained status quo. A general reporting of material loss is melting loss 4-6%; runners and risers 10-15%, and production rejects 5% and customer rejects 4%. All these types of losses make almost 1.5 months production equivalent. Due to favourable market conditions and generous credit sales (average collection period 76 days) that the Belgaum District Foundry Industry could experience better price recovery. Better price recovery toward materials and status quo material productivity could enable the Foundry Industry to sustain profitability.

It is also observed that labour productivity has been better off, average 7.21 TPA. Definitely it is on lower side when compared to all India Foundry Industry, big and highly mechanised, norm of 20 TPA. Looking at the aspect, that the Belgaum District Foundry Industry is not fully mechanised, 7.21 TPA is definitely acceptable. With capital investment deepening, the labour productivity has improved, but at the cost of capital productivity.

The labour cost has pushed up beyond the proportion of output price rise. As a result the labour price recovery has suffered adversely. It is because of sound labour productivity, the Foundry Industry could maintain status quo of labour cost-effectiveness.
As regards capital productivity, steep fall to 46% is noticed. Successive investment activities that took place in the Belgaum District Foundry Industry, caused capital intensity on rise. The additional capacity created with more funds should fetch yields in the years to come. If it does not happen, then capital commitment is not worth-while and desirable any more. With fall in the depreciation, interest and repairs cost (DIR), the capital price recovery has been extremely good. Poor capital productivity and excellent price recovery enabled the Foundry Industry to achieve and sustain some what better capital profitability.

The productivity of energy is not satisfactory. Power interruption and shut down has caused loss in furnace foundries. In cupola foundries, it is poor quality hard coke; very small sized and high ash content (28-30%), that has affected the energy productivity. Despite poor energy productivity, there could be reasonably good profitability, mainly because of strong price recovery.

The Belgaum District Foundry Industry is least burdened with selling overhead. Also the office overhead is not high. Better overhead productivity, equated to labour productivity, and good price recovery resulted in profitability.

The Belgaum District Foundry Industry earned mean net
operating profit at 7.37% of sales and experienced mean ROI of 15.64%. The total investment turnover is 0.54 times.

The debtors and bills turnover is 4.77 times and thus resulted in an average collection period of 76 days. The inventory turnover works out to be 9.33 times in a year, which is definitely good position. What it implies is, there is frequent buying of materials, and low holding period.

2. External Problems:

2.1 Irregular and inadequate power supply:

It is observed that the foundries, especially using induction furnaces, suffered production loss due to irregular and inadequate power supply. It results in heavy thermal and other chemical losses and causes rise in cost of castings and uncompetitive in the market.

The KEB (Karantaka Electricity Board), the only supplier of power for foundry units, should be held responsible for such loss. However due to monopolistic position and unilateral contractual terms of contract restrain foundry units from taking legal action. It is also suggested that the KEB, for that matter the Govt. should assume the role of a partner in the prosperity.
As it is, Karnataka is a power-starved state. Power-cut and shutdown is unavoidable. What KEB can do is have a staggered power-cut programme, try to improvise distribution system and reduce transmission loss. The requests of the Belgaum industrialist to install two more 5 MVA 33/11 KV transformer should help to solve power problem.

Another solution, within the firm, is to go in for generator set or else switch over to Oil/Gas Rotary Melting Furnace. Besides providing good quality metal, it is possible to use alloying agents, and cause less pollution.

2.2 Unhealthy rate competitions:

The unhealthy practice of under-cutting of prices can be solved only with unity among foundry units and honest dealings. Revival of association of foundrymen of the Belgaum District and their active participation in the association will go a long way in solving this unfair trade practice.

2.3 Quality Coke:

The hard coke, mostly supplied by Coke and coal consumers' Co-operative society, is not sufficient and poor in quality. It is hoped that with commissioning of Usha Ispat and Sesa Goa, mini steel mills around 100 Kms. distance, will help solve coke problem.
2.4. Boundary dispute:

Due to unsettled boundary dispute between Karnataka and Maharashtra states, the Belgaum District has not been able to get large industries. In fact, many opportunities of setting of big industrial units have slipped away. A broad outlook should be taken by the Governments concerned and the public at large that the Belgaum District is part of India and working for its upliftment is for every body's good.

2.5. Infrastructure Facilities:

Long standing aspirations of the people of the Belgaum District for conversion of meter gauge railway to broad gauge is coming true. The unit-gauge scheme of the Government of India is going to help in speedy transportation, least handling and incidental wastage. It will also help expansion of business.

There is need for proper maintenance and extension of road ways. The air services should be on irregular basis. The Karwar and Goa ports need to be developed to extend facilities to the Belgaum District.

2.6. Central excise:

With coverage of castings under central excise, the foundrymen are hard hit. As observed nearly 5% of finished castings get rejected from customers. These rejected castings are mostly remelted for making fresh castings. As
they have already suffered excise it is but legitimate to get excise credit. But the directorate of the excise of this region is not allowing. This has cut the competitive edge.

2.7 Pollution:

Incidental to the production process is great amount of foundry waste, in the form of burnt sand, slag, fly ash etc. It is estimated that the Foundry Industry of the Belgaum District generates waste of 65 thousand TPA. Currently, this waste is dumped on the rough roads and used for earth filling. It is suggested that fly ash and sand may be used for brick making and slag for cement manufacture.

3. Internal Problems:

3.1. Labour shortage and absenteeism:

To attract skilled labour sound wage plan has to be adopted. In order to reduce absenteeism attendance and production linked bonus scheme is advocated. Proper manpower planning as to leaves and weekly off are suggested.

3.2. Material and finished casting testing:

A small scale foundry should be equipped with minimum equipments for sand mixing compatibility test and hardness test, measuring moisture content in moulds, measuring permeability, measuring carbon-sulphur content
(in CI foundries), tensile test etc. For others metallographic examination, X-ray and Gamma-ray equipments are needed. But most of the foundry units are doing without testing. Whenever occasion arises castings are got tested from local Engineering Colleges or from Polytechnic Institutes or from private agencies, elsewhere. In view of growing foundries it is suggested that the state Govt. should set up a centralised laboratory for material and castings testing. This will not only create an atmosphere of quality awareness and concern but also will ensure quality products. The appeals made by foundrymen of the Belgaum District to extend facilities offered by Regional and Field Testing Centres operated by SIDO (Small Industries Development Organisation) should be looked into on top priority by the Government.

3.3. Shortage of working capital (WC) finance:

For procuring raw materials foundry units have to make advance payment, particularly for Govt. supplies and rarely enjoy credit facilities from private suppliers. On the other hand, they have to sell the castings to big industrial units on 60 to 90 days credit. Besides this, stringent credit squeeze by the banks results in strain on working capital. Financing against bills by the banks can, to a great extent, solve the problem of working capital finance.
3.4. Reducing waste & rejections:

It is found that nearly 1.5 months production of a year is in the form of waste, rejections and defectives, which needs to be reduced, though unavoidable. It is suggested that necessary data has to be gathered and analysed by human, dimension, chemistry and metallurgy. Further defects may be analysed by production process, customer rejection, and rejection value. The quantum of runners and risers could be brought with proper work combinations and methods.

3.5. Material usage review:

The material cost amounts to 57% of total cost. In order to reduce the material cost and exercise control over it, a proper review of material usage is desirable. An analysis for heat charge is recommended. Also analysis by vendors of raw materials is warranted.

3.6. Computerization:

With substantial reduction in the cost, it is possible for a unit with 200-400 TPM, with 3000 different jobs, to go in for computerisation. The financial commitment in PCs will be less than Rs 1 lakh.

3.7. Management attitude:

The management has to change its attitude towards technical professionals, accounting function and information
system. The financial accounting is done as a ritual. In fact, in their own interest, to exercise better control over operations, they are supposed to keep detailed cost records. In this regard services of professional Cost Accountant should be sought. In the matters of layout, and production process, technical advice be sought instead of doing from own raw experience.

3.8. Modernisation:

Most of the foundries are using old and orthodox method of production. They need to be modernised. Any modernisation and technology upgradation programme, should start with identification of the gaps in technology that exists in and then fill it with appropriate technology.

The foundry technology can be viewed from two angles: (I) Product technology, and (II) Process technology.

There is considerable scope for improvement in the manufacturing technology of products made of high duty cast iron, SGI, alloy cast iron and steel. There are very few foundries which use static and centrifugal casting technique for the manufacture of alloy steels, for which there is great potential market.

The process technology, consisting of methods and operations of castings production, needs improvement in the following areas
3.8.1 Layout:

It is found that layout is highly neglected area. The layout in most of the small foundries is not well planned and is hapazard. With scientific layout it is possible to cut the cost of materials by minimising material handling and reducing its wastage.

3.8.2 Pattern Making:

Infact, quality of the castings produced rests on the pattern. But still this is considered as skill of the craftsmen. Patterns should be made considering fluid dynamics and freezing characteristics of alloy to be cast. Directional solidification should be taken into account for positioning ingates and risers. Ingates and risers should form part of the patterns in place of hand cut ones. Also runner and rising system should be based on scientific methods instead of personal judgments. By making use of special purpose CNC (Computer Numerically Controlled) machines and compatible technology not only the dimensional accuracies can be achieved but also lead time in their supplies be reduced. For plastic patterns special metal coating technique could be used. Use of computer in designing - CAD (Computer aided design) and machining - CAM (computer aided machining) of patterns can not be ruled out any more; to ensure improved yield by cutting down the rate of rejections.
3.8.3 Sand Preparation :

Another area of improvement is sand conditioning, which can be done at two stages - 1) Controlled preparation of sand mix and 2) effective use of prepared sand mix in making of mouldings. In sand preparation, modern technology includes use of intensive mixers, sand conditioning plants with various process controls, sand reclamation plant. For a Foundry with 1000 TPA (working in 3 shifts a day), the following sand conditioning equipments are desirable:

- Sand riddle 2 Ton/Hr Capacity
- Muller 200 Kg/batch
- Mixer 100 Kg/batch
- Aerators 1-2 Ton/Hr
- Drum Type Magnetic separator

Double or single shift working need proportionately high capacity equipments.

It is found in most of GI foundries, that natural sand is mixed with clay and some additives. Though this kind of mixture is cheap but it is costly. In the sense, that due to clay and moisture contents in the sand, the casting defects, such as blow holes, sand fusion and expansion defects, are more. Also heavy castings poured in such sand moulds are prone to scab and sand burning defects, thereby causing more fettling cost. Switching over to synthetic sand is costly, although it ensures good quality castings and relatively cheap fettling. In order to
reduce the cost of synthetic sand it is recommended to use it for facing up to 30-40 mm thickness depending on the complexity of castings and its thickness.

To reduce the cost of sand it is advisable to recycle the used moulding sand. This will require crushing lumps, metal particle separation, sieving, and addition of pure silica sand with proportionate binders and additives.

3.8.4 Moulds and Core Making:

It is observed, the most common moulding technique is floor moulding. Since the drag portion of the mould is on the floor, by absorbing moisture in the adjoining area, the mould will cause heavy rejections.

A common practice of ramming the sand mixture is into the moulds is by hand. But this does not ensure hardness of 90 and above on horizontal flat faces, and 80-85 on vertical walls, which is desirable to minimise dilation and sand wash problems. To improve productivity pneumatic rammers may be used in place of hand ramming.

Double box moulding technique could be used to minimise the rejection rates. For accurate and consistent quality castings pin lift mould machines may be used. This will improve productivity.

For repetitive and mass production units, high pressure automatic precision moulding machines, mould handling, and push out equipments are recommended.
The practice of core making out of clay bound sand and drying in open air or baked in open fire or in ovens of obsolete design with no air circulation, needs to be changed with good baking systems. Else cores be made of synthetic sand, which harden due to chemical actions.

3.8.5 Melting Practice:

It is found most commonly adopted route for melting is cold blast cupola. The cupolas are mostly home made, not scientifically built. As a result the coke consumption is high and yield is low. The situation is further aggravated with the supply of coke with high ash content (28-30%), with low shatter index. For higher productivity it is recommended to go in for modified versions of cold blast cupola furnace such as hot blast, warm blast, balanced blast, and divided blast.

In hot blast cupola the combustion air is preheated using exhaust gas of cupola by employing recuparators. This increases heat input to coke bed and thus coke consumption is reduced by 20-25% for the same melting rate in cold blast cupola. It also offers, increased metal rate, increased melt temperature, and increased usage of steel scrap for making higher grade castings. Foundries operating cupola on alternate day may go in for this. But it needs additional investment, maintenance and water cooling in the melting zone and coke bed to preserve the lining. Many small units may not be able to do this.
In warm blast cupola separate heat exchangers are used. This will increase moderately the metal temperature. Thus, it is possible to use lower grade coke. Some use of steel scrap is also possible. This type of cupola needs relatively less investment as compared to hot blast cupola. Therefore, it is suited to those small foundries which melt once in a week.

In balanced cupola, the blast supply is made through main and auxiliary rows of tuyers. It is claimed that coke consumption comes down to 10-15%.

Divided blast cupola is a recent design, and is based on the research of BICRA (British Cast Iron Research Association). Here layers of tuyers are used. The advantages claimed by divided blast cupola are: 1. coke consumption goes down by 15-20% for same metal temperature, 2. metal temperature goes up by 45-50 °C for the same coke consumption. Information on design and operations is sparingly available (very few foundries around Delhi are reported to be using this) and the results claimed are not confirmed.

In arc furnace melting, successive heats need less energy. Power consumption in large furnace in ordinary steel melting is 600 kwh per ton of melting and additional 180kwh for refining and holding molten metal. If furnace is operated continuously, the second heat needs 30-40 kwh/ton lesser than first heat, and 10-15% less than second heat.
To achieve higher productivity there is need of balancing of moulding equipments with melting rate.

In Table VII.2 comparative picture of different melting routes is given.

Table VII.2 Comparison of Melting Routes

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Cupola</th>
<th>Oil fired Rotary Furnace</th>
<th>Electric Induction Furnace</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investment (Rs Lakh)</td>
<td>1.25</td>
<td>2.25</td>
<td>25 to 40</td>
</tr>
<tr>
<td>Fuel Required</td>
<td>Hard Coke</td>
<td>Furnace Oil</td>
<td>Electric Power</td>
</tr>
<tr>
<td>Fuel per Ton of Molten Metal</td>
<td>250-300 Kgs</td>
<td>300 Ltrs</td>
<td>700-750 Kwh</td>
</tr>
<tr>
<td>Maximum Temperature</td>
<td>1400 °C</td>
<td>1450 °C</td>
<td>1500 °C</td>
</tr>
<tr>
<td>Daily Melting Duration</td>
<td>6 Hrs</td>
<td>Whole Day</td>
<td>Whole Day</td>
</tr>
<tr>
<td>Daily Molten Metal (Tons)</td>
<td>13</td>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td>Ferrous Casting Products</td>
<td>6I</td>
<td>6I</td>
<td>6I, S6I, Malleable Iron</td>
</tr>
<tr>
<td>Casting Grades (Tensile strength)</td>
<td>Up to 25Kgs/mm²</td>
<td>Up to 30Kgs/mm²</td>
<td>Up to 40Kgs/mm²</td>
</tr>
</tbody>
</table>

3.8.6 Pollution:

As one of the longterm measures of containing air pollution use of solid state system induction furnace is advocated. Induction furnace results in lot of saving in energy, provide good quality metal alloy and is pollution free.

Automatic pouring machines reduce not only human efforts but also result in improvement in yield and accuracy.
3.8.7 Fettling and finishing:

It is observed that the most common equipments of cleaning and fettling are hammer, chisels and wire brushes. As a step towards modernisation, use of grinders, pneumatic chipping hammers, tumbling barrels, sand blasting etc; may be thought of by modern thinking founders. For large and mass producers of castings, there is scope for using shot blast machine, manipulators and special purpose riser breaking machines, special purpose finishing devices etc.

3.8.8 Material Handling:

The minimum material handling equipments found in the small foundries are pallets, wheel barrows, tread trolleys and chain pulley blocks. There is scope for making use of cupola charge hoist, roller conveyer for machine moulding, and manual/electrical/pneumatic hoists with traveling crane for heavy castings. Other facilities like air compressors, drilling and welding machines may also be added. Positively these equipments will help in improving productivity and cost effectiveness.

3.8.9 Quality Control:

In the area of quality control, very accurate methods of dimensional (i.e. endoscope and digital measuring instruments), metallurgical, chemical (i.e. Vacuum emission spectrometers) and non-destructive (i.e. X-ray, on-line fluroscopic system, ultrasono graph) testing could
be introduced in the Indian foundry industry.

3.8.10 Modernisation Strategy:

The strategy for technology upgradation in the foundry industry has to be short term, medium term, and long term. The short term strategy includes the utilisation of existing resources as efficiently as possible. The medium term strategy includes investing in more productive capital equipment. The long term strategy includes the development of new products and processes and opening new markets for castings.

3.9. Non-viability:

Due to operational non-viability (no enough production orders to feed modern machines) and financial constraints most of the units cannot modernise. For others foundries who are contemplating to modernise, power shortage has been deterrent to them. It is observed that some entrepreneurs, who have succeeded, are not going in for expansion and modernisation but go in for a new unit. To some extent this practice is in vogue to take tax shelter and overcome excise trap. It is to be realised that with opening up of Indian economy, domestic and foreign competition has intensified. It is suggested that the industrialists should not look for doles, concessions, subsidies and shelter, but go in for self sustenance and growth.