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Quality & Productivity in Direct Reduced Iron Industry and Factors Affecting It

Vidhyadhar P.Kshirsagar
Assistant Professor, Tulsiramji Gaikwad-Patil College of Engineering and Technology, Nagpur

ABSTRACT: *Direct Reduced Iron (DRI) industry is recent in India as compare to other industries. Stared in1980s, it has reached to a status of highest sponge iron industry in the world. However, it is going through teething problems. And the effect is mostly on quality and productivity. In this paper, an attempt has been made to access the Quality and Productivity (Q & P) situation in global, national and regional plants. As we thought, the situation needs improvement in regional plants as compare to national and global plants. Subsequently seven factors affecting the gap and Critical Success Factors (CSF) are identified which could be helpful in improving quality and productivity situation.*

Keywords: *Sponge Iron, DRI, Quality & Productivity, Factors affecting Q & P, CSF*.

I. INTRODUCTION:

The recycling of scrap after IInd World War was great work done to find out the way to clear all war debris during 60's. The contribution of Arc furnace to meet such challenge was also established in the recovery of steel. The process was widely accepted by almost all developing countries where generation of scrap was less in comparison to requirements. Steel produced by recycling process found much cheaper than the steel produced by blast furnace process. The scrap vanished gradually causing threat to the arc furnace where BF-BOF process continued its predominance as age-old process in the world. During 70's, the reduction of iron ore in small way was carried out in USA and birth of DRI / sponge iron was brought into existence (Sahoo, 1998). The story of sponge iron also known as Direct Reduced Iron (DRI) industry is very interesting as far as India goes. The three decades old industry came into existence all of sudden when mini steel plants were looking out for raw materials randomly. Production of coal based Sponge iron in the beginning was taken as viable option. Sponge iron industry grew at a very slow speed till the mid of 1980 due to government's restrictive licensing. The year 1985 proved as a historical year for the industry & for steel industry in particular. In this year, the DRI production was de- licensed and since then the industry started growing rapidly to reach today's level (Chandekar, 2004). Another main factor for the mushrooming growth of sponge iron industry in India is due to large availability of non-coking coal, small investment and availability of labour. It is observed in the regional plants that for the sake of production, the quality was neglected. Due to the influence of large no of factors, Quality and productivity both have been affected to the large extent. Sponge iron is the nerve for steel making (Chandekar, 2004). Techno-economical evaluation for deciding technology according to available raw material resources and economical scenario, skilled manpower with good knowledge of present process, pollution free environment and local people acceptance is important. Apart from this there are many critical factors which have to be considered for improving quality and productivity in specially coal based DRI manufacturing. Our exhaustive study about current scenario of global, national and regional sponge iron manufacturing units through literature survey, data collection, industrial visits, have revealed the gap between quality and productivity of global, national and regional sponge iron manufacturing units and focused on some critical factors affecting quality & productivity. The work has proved the need of Q & P improvement. CSFs affecting Q&P of sponge iron industry for use in a possible frame work that addresses sustainable quality and productivity improvement have been identified. Study helps upgrading the system and makes it eligible through the process of benefication that will not only help industry to sustain fast growth, but the distinct advantage to compete in international market.

In the past years, the Indian as well as global economy has witnessed a very high degree of uncertainty and volatility. The Indian sponge Iron Industry also felt the cascading effects of economic slowdown. However the industry feels squeezed, but with its fundamentals still intact, it has the strength to utilize its full potential and grow at double-digit rates when backed by the Government in terms of raw material inputs. The key

growth drivers being infrastructure development and high level urbanization, escalating demand from housing, automobile, white goods and rural/ agricultural development sectors. There has been tremendous response and support from government to the Industry, which is helping to easing of the situation and also showing clear signs of recovery. But obviously this road is long and improvement is going to be gradual. To achieve the production target of 124 MT till the year 2020, for growth, the steel Industry has to heavily depend on the secondary route, using Sponge Iron as a major source of quality metallic. The Sponge Iron Industry is fully geared up for the future but policy initiatives from the Government on availability and prices of raw materials have become a pressing need of the manufacturers. We are confident about helps for our sunrise Industry and await all steps with optimism. India is the largest producer of sponge iron since 2004-05 (Bhatnagar, 2009). To retain this spot we have to concentrate on our strength and weakness.

II. SWOT ANALYSIS FOR DRI INDUSTRY IN INDIA [E1]:

Strength
a) Abundant resources of iron ore
b) Low cost and efficient labour force
c) Strong managerial capability
d) Strongly globalised industry and emerging global competitiveness
e) Modern new plants & modernized old plants

Opportunity
a) Huge infrastructure demand
b) Rapid urbanization
c) Increasing demand for consumer durables
d) Untapped rural demand
e) Increasing interest of foreign steel producers in India

Weakness
a) High cost of energy
b) Higher duties and taxes
c) Lack of Infrastructure
d) Quality of coal
e) Stringent Labor laws
f) Depend on import of equipments & technology
g) Slow statutory clearances for development of mines

Threat
a) Slow growth in infrastructure development
b) Market fluctuations and China's export possibilities
c) Global economic slow down

IV. QUALITY & PRODUCTIVITY IN SPONGE IRON INDUSTRY:

Year	Production, (MT)	
	Targeted production	Achieved production

In the past decade, during eighties there was a great demand for sponge iron due to shortage of scrap. Moreover, many new sponge iron plants were established after 1985 (Bhattacharjee, 2007). Thus, during eighties quality of sponge iron was not an important factor as there was a huge demand due to the shortage of scrap. Very little attention was paid to the quality of sponge iron. But during nineties there was a good competition among the sponge iron plants, so there was a need to focus on the quality and productivity improvement to survive in the competition. After the formation of SIMA i.e. Sponge Iron Manufacturing Association, in 1992, the sponge iron manufacturers had to set standards of quality of sponge iron. Thus quality of Sponge iron gradually began a point of concern in the past. According to steel ministry, India has to achieve 11% annual growth in steel industry to meet the present GDP growth and has decided the target of 124 MT up to 2020 (Bhattacharjee, 2007). India has huge resources of raw material like iron ore and coal to meet any type of challenges but we shall review our weakness, strength, policies and technologies to retain the number one spot in world for sponge iron manufacturing. The SWOT analysis has given us insight into DRI industry in India.

	Gas based	Coal based	Total	Gas based	Coal based	Total
2004-05	6.1	6.0	12.1	4.6	5.5	10.1
2005-06	6.1	8.5	14.6	5.7	6.5	12.2
2006-07	7.1	11.0	18.1	7.0	8.5	15.5
2007-08	7.1	13.0	20.1	7.0	10.0	17.0
2008-09	7.1	17.0	24.1	7.0	15.3	22.3
2009-10	7.1	18.0	25.1	7.0	14.0	21.0

Table1: Details of DRI production in India (Chatterjee, 2010)

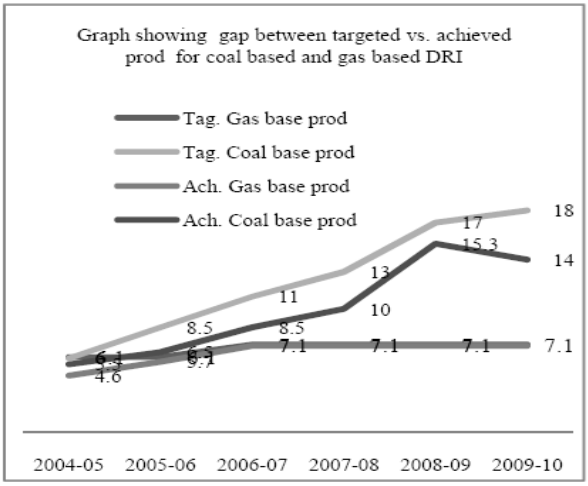

Fig 2: Details of DRI production in India (Chatterjee, 2010)

Countries	Production in metric tons per annum				
	2005	2006	2007	2008	2009
India	11.1	14.7	19.0	21.2	22.3
Iran	6.85	6.9	7.4	7.46	8.20
Venezuela	8.95	8.6	7.7	6.87	5.61
Russia	3.34	3.3	3.4	4.56	4.67
Mexico	5.98	6.2	6.3	6.01	4.15
Saudi Arabia	3.63	3.6	4.3	1.68	2.10
Trinidad & Tobago	2.25	2.1	3.5	2.78	1.99
South Africa	1.78	1.8	1.7	1.18	1.39
Canada	0.59	0.5	0.9	0.69	0.34

Table 2: Comp. of global production of DRI, (Chatterjee, 2010)

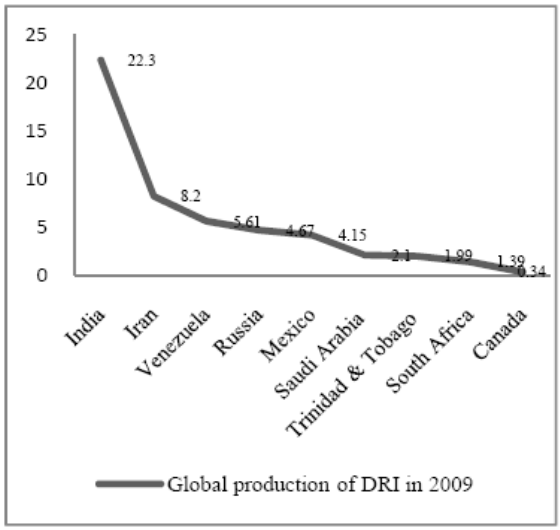

Fig 4: Comp. of global production of DRI, (Chatterjee, 2010)

V. SOME GLOBAL, NATIONAL AND REGIONAL PLANT ANNUAL PRODUCTION AND METALLIZATION DATA OF

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GLOBAL, NATIONAL AND REGIONAL PLANTS FOR 2010:

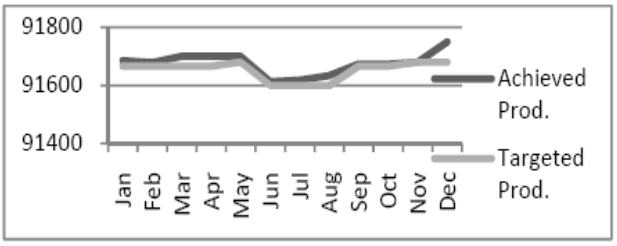


Fig 5: Achieved prod. vs. Targeted prod. of Libyan steel, (Libya, 2010)

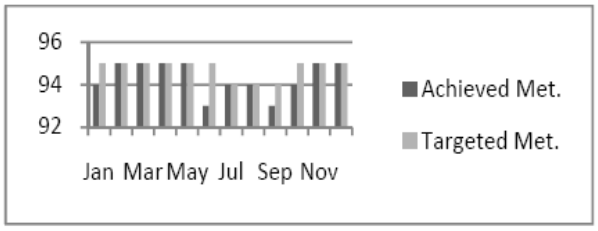


Fig 6: Achieved Met. vs. Targeted Met. of Libyan steel, (Libya, 2010)

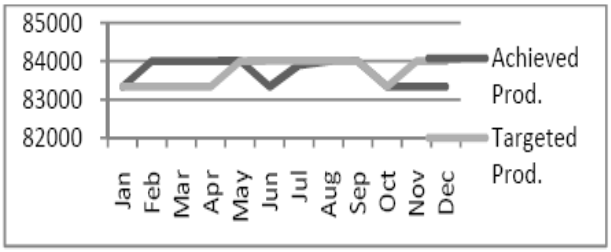


Fig 7: Achieved prod. vs. Targeted prod. of Cosmigua steel (Venezuela, 2010)

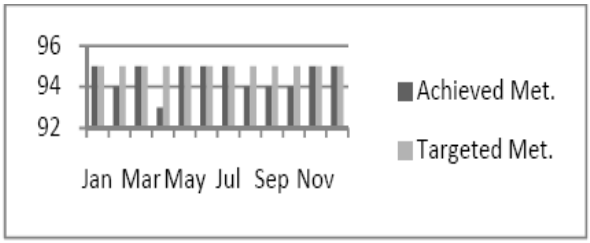


Fig 8: Achieved Met. vs. Targeted Met. of Cosmigua steel (Venezuela, 2010)

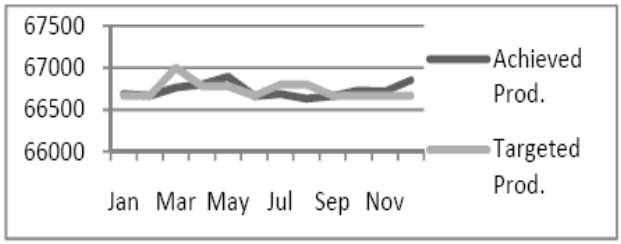


Fig 9: Achieved prod. vs. Targeted prod. of Qatar steel, (Qatar, 2010)

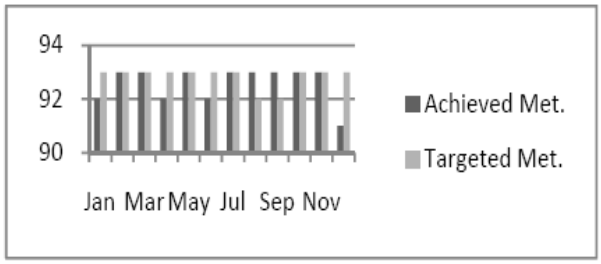
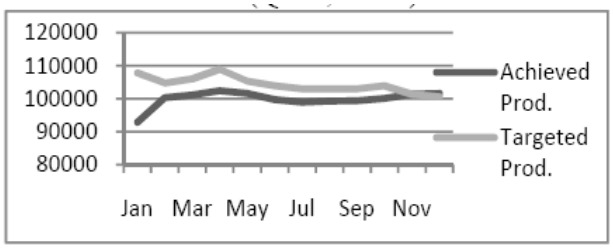


Fig 10: Achieved Met. vs. Targeted Met. of Qatar steel (Qatar, 2010)



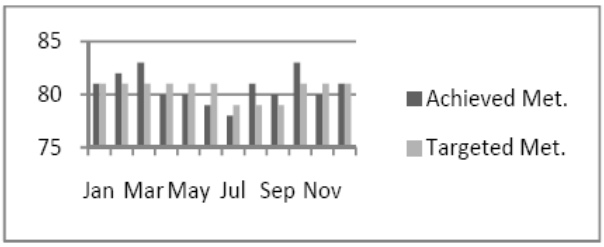
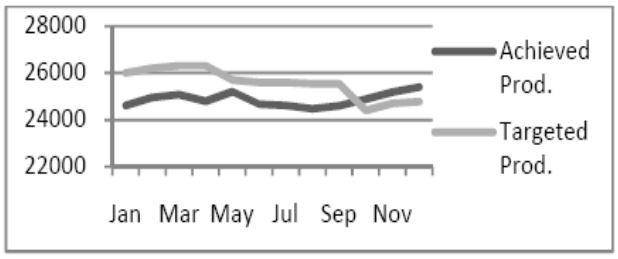


Fig 11: Achieved prod. vs. Targeted prod. of Jindal steel and power ltd, Raigarh (C.G) (Jindal, 2010)

Fig 12: Achieved Met. vs. Targeted Met Jindal steel and power ltd, Raigarh (C.G) (Jindal,2010)



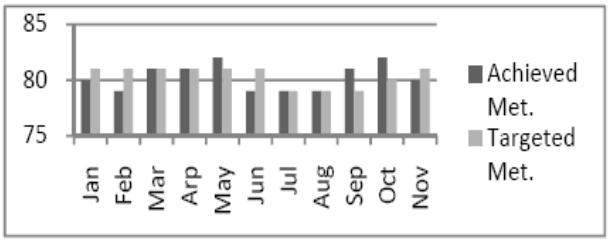
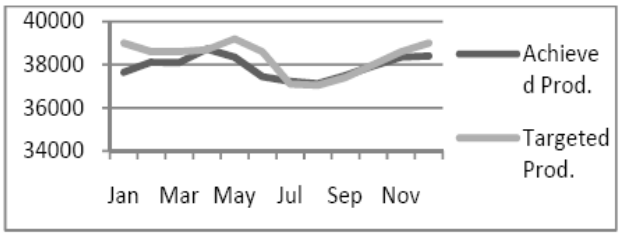


Fig 13: Achieved prod. vs. Targeted prod. of Tata sponge iron ltd, Jharkhand (Joda) (Tata, 2010)

Fig 14: Achieved Met. vs. Targeted Met. Tata sponge iron ltd, Jharkhand (Joda) (Tata, 2010)



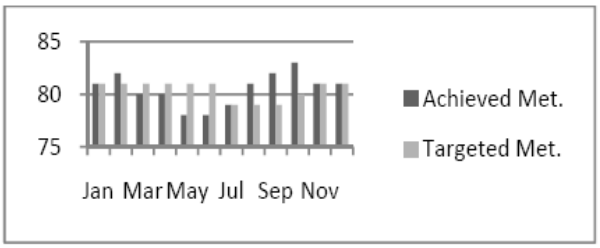
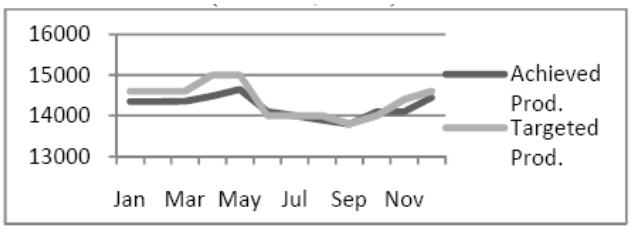


Fig 15: Achieved prod. vs. Targeted prod. Monnet ispat and energy ltd, Kharsia (C.G) (Monnet, 2010)

Fig 16: Achieved Met. vs. Targeted Met. Monnet ispat and energy ltd, Kharsia (C.G) (Monnet, 2010)



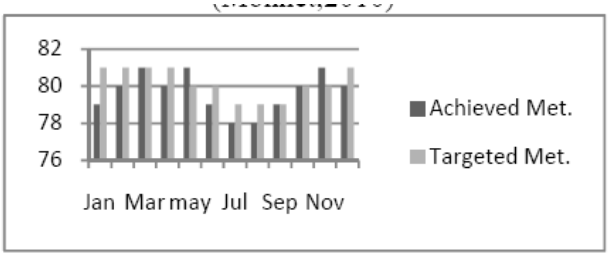


Fig 19: Achieved prod. vs. Targeted prod. of MSP steel and power ltd, Jamga (C.G) (MSP, 2010)

Fig 20: Achieved Met. vs. Targeted Met. of MSP steel and power ltd, Jamga (C.G) (MSP, 2010)

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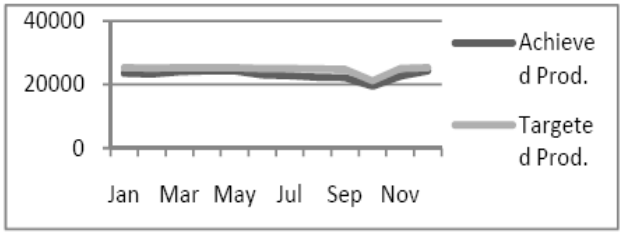

Fig 19: Achieved prod. vs. Targeted prod. of Lloyds metal and engineers ltd, Ghugus (M.S) (Lloyds, 2010)

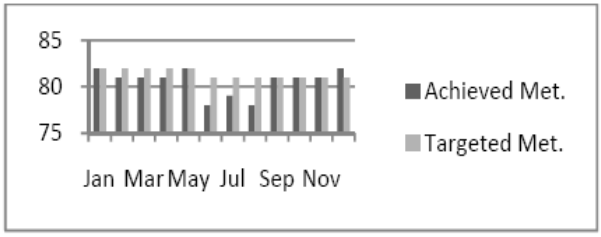

Fig 20: Achieved Met. vs. Targeted Met. of Lloyds metal and engineers ltd, Ghugus(M.S) (Lloyds, 2010)

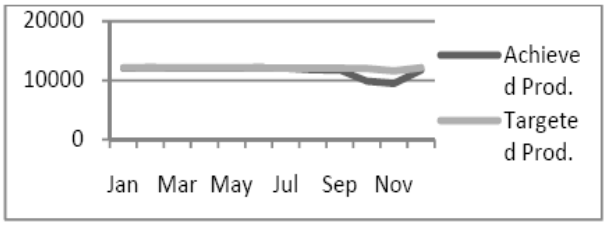

Fig 21: Achieved prod. vs. Targeted prod. of Gopani iron and power pvt. Ltd, Tadali (M.S) (Gopani, 2010)

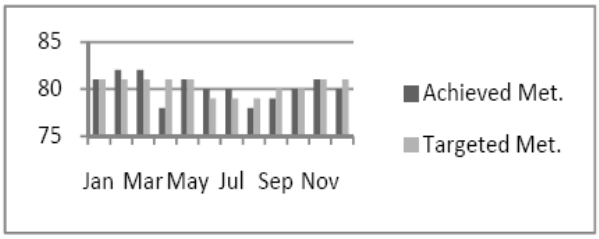

Fig 22: Achieved Met. vs. Targeted Met. of Gopani iron and power pvt. Ltd, Tadali(M.S) (Gopani, 2010)

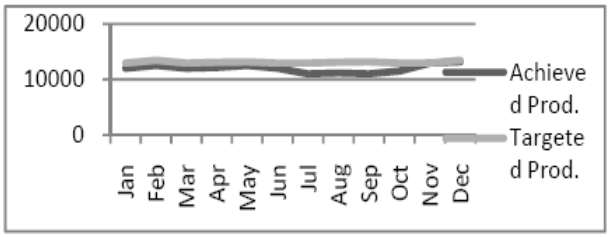

Fig 23: Achieved prod. vs. Targeted prod. of Sunflag iron and steel ltd,Bhandar road (M.S) (Sunflag, 2010)

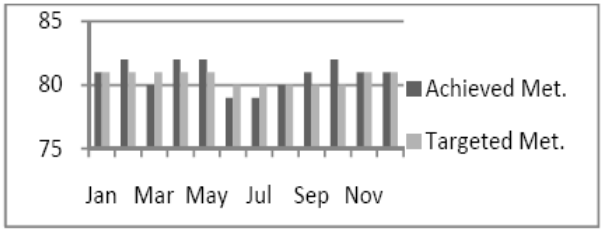

Fig 24: Achieved Met. vs. Targeted Met. of Sunflag iron and steel ltd,Bhandar road (M.S) (Sunflag, 2010)

It is observed from the graph that the production target is achieved most of the time in the companies on global level such as Libya steel, Cosmigua steel, Qatar steel they have also shown better metallization as compare to the companies on national level such as Jindal steel, Tata sponge iron, Monnet ispat & MSP steel and the companies on regional level such as Lloyds metal, Gopani iron & sunflag. The regional companies have achieved production always less than or equal to the targeted production. The quality of sponge iron is judged on the basis of metallization; the metallization in regional plants is also not satisfactory and shows lot of scope for improvement. Thus the survey of production and metallization on global, national & regional level clearly shows the gap at various levels. Hence there exists a need of improvement in quality and productivity in sponge iron industry.

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Sr. No	Name of DRI plants	DRI prod (Ton)	Coal consumption (Ton of Coal / Ton of DRI)	Iron ore consumption (Ton of Iron ore / Ton of DRI)	Dolomite consumption (Ton of Dolo / Ton of DRI)	Power consumption (KWh/Ton of DRI)
1	Lloyds metal and eng.ltd, Ghugus	276794	1.500	1.580	0.0299	84.53
2	Gopani iron and power pvt ltd, Tadali	139220	1.499	1.587	0.0300	77.57
3	Sunflag iron and steel ltd. Bhandara Road	144600	1.493	1.587	0.0300	87.13
1	Jindal steel and power ltd, Raigarh	1207270	1.450	1.538	0.0300	44.72
2	Tata sponge iron ltd, Joda.	279066	1.449	1.538	0.0300	74.82
3	Monnet ispat and energy ltd, Raigarh.	454900	1.450	1.538	0.0300	47.48
4	MSP steel and power ltd, Raigarh.	170616	1.449	1.538	0.0299	63.3
		HBI Prod (Ton)	Gas consumption (Gal / Ton of DRI)	Iron ore consumption (Ton of Iron ore /Ton of HBI)	Lime consumption (Ton of Lime /Ton of HBI)	KWh/Ton of HBI
1	Libyan steel, Libya	1100103	2.300	1.470	0.0149	23
2	Qatar steel, Qatar	1004585	2.300	1.470	0.0149	20
3	Cosmigua steel, Venezuela	800747	2.299	1.470	0.0149	12

Table 3: Resource consumption for producing DRI for various plants for year 2010
(All fig. in metric ton) (From production & metallization data of companies for year 2010)

From the data of comparison of various resources for the production of various resources for the production of per ton of DRI/HBI in global, national and regional plants, it is observed that the production of plant on global level is best. However the plants all over the world are gas based, resulting in to better quality and productivity. The comparison of plants on national and regional level clearly shows the productivity gap indicating the need of productivity improvement. Quality & productivity are opposite to each other. Generally when one is achieved, the other is lost. Increased production should not be confused with increased productivity. Production can be increased by increasing the input resources. But productivity may remains the same, or decline due to the inefficient use of input. Similarly, productivity can be improved by economic and efficient use of input resources, but the production may not increase. Some factors which improve productivity are discussed below (Sharma, 2005).

VI. FACTORS AFFECTING PRODUCTIVITY (SHARMA, 2005):

a) Internal factors:

1) Environmental factors within company
2) Level of mechanism use in manufacturing system.
3) Technical and managerial skill available
4) Use of raw material and process.
5) Application of productivity
6) Type of industrial relation exists in the factory

b) External factors:

1) Economic factor, such as, availability of capital, raw material, power and market.
2) The level of competition.
3) Government rules and regulation.
4) Policies followed by government.
5) Sociological factors.

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VII. SOME COMMON INDICATORS OF LOW PRODUCTIVITY:

Understanding the productivity problems will help to look at some common indicators and causes. Assessing these areas first will eliminate frequent problem areas and help to focus on any specific issues that may be affecting your overall productivity. Many indicators and causes of low productivity are obvious but often overlooked or disregarded because of more urgent concerns. Some factories consider these indicators as normal conditions due to lack of knowledge of ideal conditions. Factors below present some indicators of low productivity and probable causes (Calzado, 2003).

a) Idle workers
b) Idle machinery
c) High volume of rejects and rework
d) High volume of material wastes
e) Unmotivated workers, slow pace of
f) Late deliveries
g) High in-process inventory
h) Low worker output

VIII. SOME QUALITY INDICATORS [E2]:

a) Customer satisfaction
b) Customer loyalty
c) Satisfaction with quality of work output by peers
d) Work output by peers is consistently delivered accurately
e) Work output by peers is consistently delivered complete
f) Internal process satisfaction
g) The extent to which all products or services produced meet established specifications
h) On-time delivery of products or services
i) The extent to which employees react quickly to resolve unexpected problems
j) The extent to which no further changes or rework is needed after the final products or services are produced
k) The extent to which no scrap is produce

IX. QUALITY GAPS MODEL [E2]:

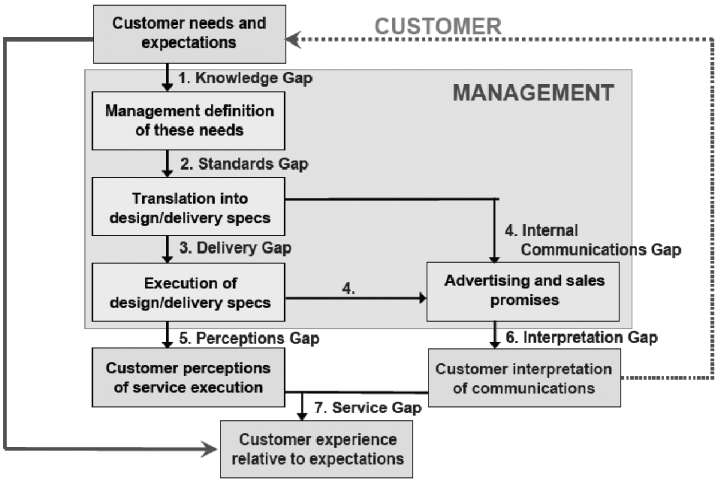

Fig: Seven Factors Affecting Quality Gaps Model (SFAQGM) [E2]

X. PRESCRIPTION FOR CLOSING QUALITY

a) Knowledge gap: Learn what customers expect
1) Understand customer expectations
2) Improve communication between frontline staff and management
3) Turn information and insights into action

b) Standards gap: Specify SQ standards that reflect expectations
1) Set, communicate, and reinforce customer
2) Measure performance and provide regular feedback
3) Reward managers and employees

c) Delivery gap: Ensure service performance meets standards
1) Clarify employee roles
2) Train employees in priority sett
3) Eliminate role conflict among employees
4) Develop good reward system

d) Internal communications gap: Ensure that communications promises are realistic
1) Seek comments from frontline employees and operations personnel about proposed advertising campaigns
2) Get sales staff to involve operations staff in meetings with customers
3) Ensure that communications sets realistic customer expectations

e) Perceptions gap: Educate customers to see reality of service quality delivered
1) Keep customers informed during service delivery and debrief after delivery
2) Provide physical evidence.

f) Interpretation gap: Pretest communications to make sure message is clear and unambiguous
1) Present communication materials to a sample of customers in advance of publication

g) Service gap: Close gaps 1 to 6 to meet customer expectations consistently

XI. TWELVE CRITICAL DIMENSIONS FOR QUALITY CONTROL IMPLEMENTATION [E2]:

a) Top management commitment and visionary leadership
b) Human resource management
c) Technical system, including service process design and process management
d) Information and analysis system
e) Benchmarking

f) Continuous improvement
g) Customer focus
h) Employee satisfaction
i) Union intervention and employee relations
j) Social responsibility
k) Services capes
l) Service culture

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