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IMPACT OF IMPLEMENTATION OF GREEN MANUFACTURING TECHNOLOGY IN AN INDIAN FMCG GOODS MANUFACTURING INDUSTRY

Anuja Bhattacharjya[1], Annanya A Baruah[2], Prof. Suchismita Satapathy[3]

[1,2,3] *Mechanical Engineering, Kiit, Bhubaneshwar, (India)*

ABSTRACT

Nowadays firms are facing a growing pressure to turn greener and more environmental friendly in the manufacturing approaches. Different firms contribute differently towards their environment like some implement reverse logistics, some green supply chain management, some green purchasing and marketing. All these and other factors combined form the basis of green manufacturing technology implementation. GM stresses on reducing parts, rationalizing materials, and reusing components, to help make products more efficient to build. In this paper we describe a case study where ITC Limited, an FMCG goods manufacturing industry has been considered. Using MINITAB 17, factor analysis and regression have been used to validate how green manufacturing has successfully been implemented at ITC Limited.

I INTRODUCTION

By definition, green manufacturing is a system that integrates product &process design issues with issues of manufacturing, planning & control in such a manner as to identify, quantify, assess, and managethe flow of environmental waste with the goal of reducing and ultimately minimizing environmental impact while also trying to maximise resource efficiency.

Green manufacturing technology is one of those sciences which has been studied and experimented for many years but very seldom implemented. The impacts, costs and other social issues are what probably stops experienced managers to implement the earth-soothing technological methods. But, young Indian entrepreneurs are looking into this issue with great concern and interest. The current scenario of green manufacturing implementing is not very advanced or strong in India. Many companies want to change their manufacturing techniques to greener methods so that they can strengthen their position globally. Now to achieve such standards the company has to follow certain measures and practices. These measures if properly followed can help the industry to successfully implement green manufacturing practices.

1.1 Literature Review

Although the concept of Green manufacturing is new, it has been a topic of research for many years considering the topic of waste management.There are many instruments required to appropriately assess the impact green manufacturing has had on any particular organization as a whole. A lot of research has been conducted in this field and many conclusions have been derived. But since, most importantly, organizational performance is the key factor of research for any organization, the exact factors required to determine the performance graph need to be decided from previous work done by other renowned researchers. Given below is a list of some of the work that has been done relating to this field.

- Paul I.D., Bhole G.P. (Procedia Material Science,2014, pg.1644-1649) have stated the importance , methodology and applications of green manufacturing technology. The paper tells us about how green manufacturing can help us to combat pollution and waste, highlighting how green manufacturing can be used to form sustainable products and reusing them. It also stated green supply chain as a useful tool. Future works include quantifiable green strategies within factories like lighting.
- Mittal Varinder Kumar & Sangwan Kuldip Singh (Procedia CIRP 17 (2014) 559 – 564) have studied on prioritizing economic, social and environmental barriers to green manufacturing technology. Since various barriers come up when GM is implemented, these barriers need to be prioritized because of limited resources. A fuzzy TOPSIS multi-criteria decision model has been developed to prioritize these barriers from environmental, social and economic perspectives. Future work states the government needs to step in and take steps for better implementation of green manufacturing in the manufacturing sector.
- Voon-hsien-lee et.al.(2014) has talked about how green supply chain management and technological innovation are related.
- Sezen and Cancaya(2013) have establishes the effects of green manufacturing and eco-innovation on sustainability performance, as firms are facing the pressure to become more environmental friendly.
- Zhu and Sarkis(2004) saw how Firms today realize that there is a need to balance economic performance and environmental management.
- Rehman et.al.(2013) have conducted a case study on a steel industry and graded it on the basis of how green manufacturing has been validated in the organisation as a tool for sustainable development.
- According to Gutowski et al. (2005) [6] Motivating factors for GM are regulatory mandates, economic advantage, reduced waste treatment and disposal costs, conservation of energy, water, materials, product take-back system, supply chain requirements, corporate image, and employee satisfaction.
- Rehman M.A. and. Shrivastava R.L (2011) [10] identified nineteen measures of GM includes Top management commitment, Need and role of employee team responsible for GM ,Green process/practices ,Green design ,Green purchasing/marketing ,Green packaging, Green transportation ,Green supply chain management GSCM ,Reverse logistic ,Reduce /remanufacture/recycle (3R) etc.

- According to Lele .S (2009) [9] there are many drivers which are expanding the boundaries for green manufacturing.
- According to Cote and Richardson (2009) [2] the corporate drivers for green manufacturing include public opinion, shareholder value, cost reductions, joining industry leaders and complying with environmental management regulations.
- Achanga Pius, et.al(2006) [14] identified Several critical factors that determine the success of implementing the concept of lean manufacturing within SMEs that includes leadership, management, finance organisational culture and skills and expertise.

A growing number of executives today feel that going green will help them to compete more effectively in the marketplace in the long term.

Case Study- ITC Limited:

II OBJECTIVE

- To provide a practical example of performance improvement of the ITC Limited that has implemented Green Manufacturing initiative.
- To assess the Green Manufacturing implementation practices and performance improvement of the organization.
- The study was conducted in an industry that has already implemented this initiative. The study would help in evaluating the industry's GM implementation and overall business performance.
- The status of the industry before implementing Green Manufacturing is compared to its current status, i.e., after implementing Green Manufacturing.
- Evaluation of the industry's GM implementation and overall business performance.

III ABOUT THE COMPANY

ITC Limited or ITC is an Indian conglomerate headquartered in Kolkata, West Bengal. Its diversified business includes five segments: Fast Moving Consumer Goods (FMCG), Hotels, Paperboards & Packaging, Agri Business & Information Technology.

Established in 1910 as the Imperial Tobacco Company of India Limited, the company was renamed as the Indian Tobacco Company Limited in 1970 and further to I.T.C. Limited in 1974. The periods in the name were removed in September 2001 for the company to be renamed as ITC Ltd. The company in 2012-13, had an annual turnover of US$8.31 billion and a market capitalization of US$45 billion. It employs over 25,000 people at more than 60 locations across India and is part of Forbes 2000 list. Its main products are:

- Cigarettes-ITC Ltd sells 80 percent of the cigarettes in the India, where 275 million people use tobacco products and the total cigarette market is worth close to $6 billion (around Rs.35,000 crore) ITC's major cigarette brands include W.D. & H.O. Wills, Gold Flake Kings, Gold Flake Premium,Gold Flake Super Star, Navy Cut, Insignia, India Kings, Classic (Verve, Menthol, Menthol Rush, Regular, Citric Twist, Mild & Ultra Mild), 555, Silk Cut, Scissors, Capstan, Berkeley, Bristol, Lucky Strike, Players, Flake and Duke & Royal.
- Foods: ITC's major food brands include Kitchens of India; Aashirvaad, Mint-o, Sunfeast, Candyman, Bingo! and Yippee. ITC is India's largest seller of branded foods with sales of over Rs. 4,600 crore in 2012-13. It is present across 4 categories in the Foods business namely Staples, Snack Foods, Ready-To-Eat Foods and Confectionery.
- Lifestyle apparel: ITC sells its products under the Wills Lifestyle and John Players brands. Wills Lifestyle was accorded the 'Superbrand' status and John Players was included in the top 10 'Most Trusted Apparel Brands 2012' by The Economic Times.
- Personal care products include perfumes, haircare and skincare categories. Major brands are Fiama Di Wills, Vivel, Essenza Di Wills, Superia and Engage.
- Stationery: Brands include Classmate, PaperKraft and Colour Crew. Launched in 2003, Classmate went on to become India's largest notebook brand in 2007.
- Safety Matches and Agarbattis: Ship, i Kno and Aim brands of safety matches[40] and the Mangaldeep brand of agarbattis (Incense Sticks).
- Hotels: ITC's Hotels division (under brands including WelcomHotel) is India's second largest hotel chain with over 90 hotels throughout India.
- Paperboard: Products such as specialty paper, graphic and other paper are sold under the ITC brand by the ITC Paperboards and Specialty Papers Division.
- Packaging and Printing: ITC's Packaging and Printing division operates manufacturing facilities at Haridwar and Chennai and services domestic and export markets.
- Information Technology: ITC operates through its fully owned subsidiary ITC Infotech India Limited, which is a SEI CMM Level 5 company.(Wikipedia.com)

3.1. Basic highlights of the company

- More than 40% of energy consumption at ITC is from renewable sources.
- All ITC's premium luxury Hotels are LEED Platinum certified.
- ITC's Social and Farm Forestry initiative has greened over 1,42,000 hectares.
- The company has also recently got the GRI-G3 A+ application checked and approved of.
- ITC was conferred the prestigious 'World Business and Development Award 2012' at the Rio+20 UN Summit for its Social and Farm Forestry Initiatives.

- ITC was conferred the Corporate Social Responsibility Crown Award for Water Practices from UNESCO and Water Digest (2008) and The Asian CSR Award for Environmental Excellence, given by the Asian Institute of Management (2007).
- ITC is an ISO 14001: Environment Management Systems certified organization.(ITC sustainable report-2013)

3.2. Environmental performance

- In line with the National Action Plan on Climate Change (NAPCC), strategies have been adopted to address climate change-related impacts and develop appropriate mitigation and adaptation plans.
- It has been running water positive 11 years in a row i.e. the water it uses is returned back as fresh water to the environment.
- It has been carbon positive for 8 consecutive years.
- It has been solid waste recycling positive for the last 6 years.
- 55.7% of the 21,347 Terra joules of energy consumed by ITC comes from fossil fuels, 41.2% from renewable resources and the rest are purchased from the respective state electricity boards where consumption of renewable energy has increased by 8.2% from the previous year.
- Each category of waste is individually addressed and tracked to ensure that it can be reused, if possible, and if not, recycled. Almost 99.8% of the waste is recycled.
- Itc monitors combustion efficiencies to achieve lower specific emissions and invests in state-of-the-artpollution control equipment.(ITC sustainable development report-2013)

3.3. Social performance

- ITC gives special emphasis to the Occupational Health & Safety interests of its employees (including that of service providers) and all visitors to its establishments. This is ensured through adherence to Corporate Environment, Health & Safety Guidelines, which incorporates best international standards and practices.(ITC sustainable development report-2013)

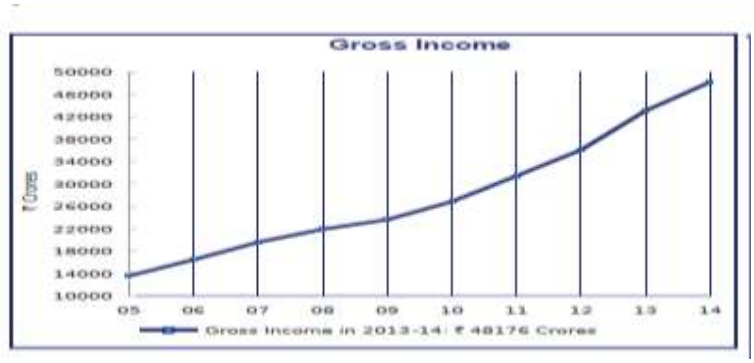

Fig.1. The growth of the company in the past 10 year

IV RESEARCH METHODOLOGY

- A survey was carried out to find the overall performance of the Industry/Company before and after implementation of Green Manufacturing.
- Based on the evaluations the current situation of the industry's GM implementation and overall performance will be obtained.
- A questionnaire of two pages were designed consisting of the extent of relationship between various GM implementation practices and overall performance.
- 150 questionnaires were distributed and sent for survey, out of which 130 were evaluated.
- The research instrument validated by Minhaj Ahemad.A.Rehman was used for the compilation of data.
- Using Minitab the data obtained from the questionnaires were evaluated. Factors were extracted using Varimax rotation. A reliability test based on Cronbach's Alpha was used to assess whether the dimensions were consistent and reliable. (Bulent Sezen and Sibel Yildiz Cankaya, 2013).
- The data was then analysed using regression analysis to determine direction of the relation between the factors and their components. . (Bulent Sezen and Sibel Yildiz Cankaya, 2013).

V DATA ANALYSIS AND RESULTS

Table 1- Mean and Proportionate Marks

Mean and Proportionate Marks	
1.00 - 1.50	1(Not at all)
1.51 - 2.00	2
2.01 - 2.50	3
2.51 - 3.00	4 (To a moderate extent)
3.01 - 3.50	5
3.51 - 4.00	6
4.01 - 4.50	7
4.51 - 5.00	8 (To a very large extent)

The above table shows the relation between the parameters and the factors.' 1' mark means there is no relation and as the marks go on increasing, the relationship percentage too goes on increasing.(Minhaj Ahemad.A.Rehman, R. R Shrivastava, Rakesh. L Shrivastava,2013)

Table 2:Assessment of Various Factors

	Assessment result – Factor 1: Organizational Capabilities			
Question Nos.	Addressed items of the factors	Mean	Grand Mean	Max Marks
1	Organization Capabilities lead to improvement in financial, manpower and Operational performance	3.275	3.6833	6
11	Organization Capabilities lead to continuous improvement and improvement in competitive advantage and stakeholder's enrichment	3.775		
22	Organization Capabilities lead to improvement in green SC performance	4		
	Assessment result – Factor 2 : Green Design Initiatives			
	Addressed items of the factors	Mean	Grand Mean	Max Marks
2	Green design Initiatives lead to improvement in financial, manpower and Operational performance	3.925	3.9667	6
12	Green design Initiatives lead to improvement in continuous improvement and improvement in competitive advantage and stakeholder's enrichment	4.05		
23	Green design Initiatives lead to improvement in green SC performance	3.925		
	Assessment result – Factor 3: Green Standards Adoption			
	Addressed items of the factors	Mean	Grand Mean	Max Marks
3	Green Standard Adoption lead to improvement in financial, manpower and Operational performance	3.7	3.8083	6
13	Green Standard Adoption lead to improvement in continuous improvement and improvement in competitive advantage and stakeholder's enrichment	3.775		
24	Green Standard Adoption lead to improvement in green SC performance	3.95		
	Assessment result – Factor 4 : Suppliers Management			
	Addressed items of the factors	Mean	Grand Mean	Max Marks
4	Supplier Management lead to improvement in financial, manpower and Operational performance	3.775	3.75	6
25	Supplier Management lead to improvement in green SC performance	3.725		
	Assessment result – Factor 5 Technology Innovation			
	Addressed items of the factors	Mean	Grand Mean	Max Marks
5	Technology Innovation lead to improvement in financial, manpower and Operational performance	4.025	3.975	6
14	Technology Innovation lead to continuous improvement	3.925		
	Assessment result – Factor 6 GM Planning			
	Addressed items of the factors	Mean	Grand Mean	Max Marks

15	GM planning lead to continuous improvement and improvement in stakeholder's enrichment	3.9	3.9	6
	Assessment result – Factor 7 Green purchasing & marketing			
	Addressed items of the factors	Mean	Grand Mean	Max Marks
6	Green Purchasing & Marketing lead to improvement in financial, manpower and Operational performance	4.075	3.9167	6
16	Green Purchasing & Marketing lead to continuous improvement and improvement in competitive advantage and stakeholder's enrichment	3.95		
26	green purchasing & marketing lead to improvement in green SC management	3.725		
	Assessment result – Factor 8 Implementing RL			
	Addressed items of the factors	Mean	Grand Mean	Max Marks
7	implementing RL lead to improvement in financial, manpower and Operational performance	4	3.833	6
17	implementing RL lead to continuous improvement and improvement in competitive advantage and stakeholder's enrichment	3.775		
27	implementing RL lead to improvement in green SC management	3.725		
	Assessment result – Factor 9 Top management Commitment			
	Addressed items of the factors	Mean	Grand Mean	Max Marks
8	top management commitment lead to improvement in financial, manpower and Operational performance	3.85	3.775	6
18	top management commitment lead to continuous improvement and improvement in competitive advantage and stakeholder's enrichment	3.65		
28	top management commitment and Customer focus lead to improvement in green SC management	3.825		
	Assessment result – Factor 10 Customers Focus			
	Addressed items of the factors	Mean	Grand Mean	Max Marks
19	Customer focus lead to continuous improvement and improvement in stakeholder's enrichment	3.6	3.6	6
	Assessment result – Factor 11 Green Disposal initiatives			
	Addressed items of the factors	Mean	Grand Mean	Max Marks
9	Green Disposal Initiatives lead to improvement in financial, manpower and Operational performance	3.925	3.975	6
20	Green Disposal Initiatives lead to continuous improvement and improvement in competitive advantage and stakeholder's enrichment	4		
29	green Disposal Initiatives lead to improvement in green SC management	3.775		
	Assessment result – Factor 12 Process management			
	Addressed items of the factors	Mean	Grand Mean	Max Marks
10	Process Management lead to improvement in financial, manpower and Operational performance	3.925	3.975	6

21	Process Management lead to continuous improvement and improvement in competitive advantage and stakeholder's enrichment	3.975		
30	Process Management lead to improvement in green SC management	4.025		

Using the above table 1 marks have been assigned to the various factors affecting the parameters. From the results we can see that all the factors have a more than average impact on the parameters which determine the overall betterment of performance of the organization after implementation of GM techniques. Out of them, Green design initiatives, Green disposal initiatives, process management and technology innovation got the maximum score. .(Minhaj Ahemad.A.Rehman, R. R Shrivastava, Rakesh. L Shrivastava,2013)

Table 3- Factor and Reliability Analysis Result

organisational capabilities	Cronbach's alpha	mean	grand mean	green design initiatives	Cronbach's alpha	mean	grand mean
1		3.275		2		3.925	
11	**0.818**	3.775	3.68	12	**0.809**	4.05	3.967
22		4		23		3.925	
green standard adoption				supplier management			
3		3.7		4	**0.902**	3.775	
13	**0.9**	3.775	3.81	25		3.725	3.75
24		3.95					
technology innovation				implementing RL			
5		4.025		7		4	
14	**0.87**	3.925	3.98	17	**0.848**	3.775	3.833
				27		3.725	
green purchasing and marketing				top management commitment			
6		4.075		8		3.85	
16	**0.856**	3.95	3.92	18	**0.834**	3.65	3.775
26		3.725		28		3.825	
green disposal initiatives				process management			
9		3.925		10		3.925	
20	**0.905**	4	3.9	21	**0.905**	3.975	3.975
29		3.775		30		4.025	

GM planning							
15	**0.751**	3.9	3.9	19	**0.858**	3.6	3.6

Table 4- Effects of Organizational capability on the corporate sustainable performance

independent variable	dependent variable		
organisational capability	financial, operational and operational performance	continuous improvement and improvement in competitive advantage and stakeholder's enrichment	improvement in green SC performance
R square	0.0318	0.134183	0.031
Adjusted R square	0.00632	0.1113984	-0.03
t	7.23997	8.1999404	6.762
F	1.24799	5.8891825	1.235
Significance	0.27095	0.0200859	0.273

Table 5- Effect of Green Design Initiatives on the corporate sustainable performance

independent variable	dependent variable		
Green design initiatives	financial, operational and operational performance	continuous improvement and improvement in competitive advantage and stakeholder's enrichment	improvement in green SC performance
R square	0.00801	0.0037142	0.037
Adjusted R square	-0.0181	-0.0225038	0.011
t	8.62789	7.2922278	7.021
F	0.30665	0.1416667	1.442
Significance	0.58299	0.7087232	0.237

Table 6- Effect of Green Standard Adoption on the corporate performance

independent variable	dependent variable		
Green standard adoption	financial, operational and operational performance	continuous improvement and improvement in competitive advantage and stakeholder's enrichment	improvement in green SC performance
R square	0.00984	0.0007151	0.009

Adjusted R square	-0.01622	-0.0255818	-0.02
t	9.52091	7.9368792	7.799
F	0.37748	0.0271947	0.357
Significance	0.54261	0.8698905	0.554

Table 7- Effect of Supplier Management on the corporate sustainability performance

independent variable	dependent variable	
Supplier management	financial, operational and operational performance	improvement in green SC performance
R square	0.09328	0.0047474
Adjusted R square	0.06942	-0.0214434
t	10.232	7.1466123
F	3.90922	0.1812632
Significance	0.05531	0.6726917

Table 8- Effect of Technology Innovation on the corporate sustainability performance

independent variable	dependent variable	
Technology Innovation	financial, operational and operational performance	continuous improvement
R square	0.13617	0.0485258
Adjusted R square	0.11344	0.023487
t	3.24178	5.4766011
F	5.99004	1.9380241
Significance	0.01912	0.1719776

Table 9- Effect of Green purchasing and marketing on the corporate sustainability performance

independent variable	dependent variable		
Green purchasing and marketing	financial, operational and operational performance	continuous improvement and improvement in competitive advantage and stakeholder's enrichment	improvement in green SC performance
R square	0.00021	0.0001153	0.001
Adjusted R square	-0.0261	-0.0261974	-0.02
t	6.38112	8.7471767	8.174

F	0.00781	0.0043829	0.049
Significance	0.93003	0.9475627	0.826

Table 10- Effect of Implementing RL(reverse logistics) on the corporate sustainable performance

independent variable	dependent variable		
implementing RL	financial, operational and operational performance	continuous improvement and improvement in competitive advantage and stakeholder's enrichment	improvement in green SC performance
R square	0.0943	0.0642347	0.017
Adjusted R square	0.01883	0.0396093	-0.01
t	5.55571	6.0195617	7.725
F	1.24946	2.6084746	0.662
Significance	0.30623	0.1145679	0.421

Table 11- Effect of Top management commitment on the corporate sustainability performance

independent variable	dependent variable		
top management commitment	financial, operational and operational performance	continuous improvement and improvement in competitive advantage and stakeholder's enrichment	improvement in green SC performance
R square	0.02382	0.000294	0.686
Adjusted R square	-0.00187	-0.026014	-0.03
t	6.49286	5.873111	7.237
F	0.92711	0.0111765	0.002
Significance	0.3417	0.9163616	0.968

Table 12- Effect of Green disposal initiatives on the corporate sustainability performance.

independent variable	dependent variable		
Green disposal initiatives	financial, operational and operational performance	continuous improvement and improvement in competitive advantage and stakeholder's enrichment	improvement in green SC performance
R square	0.02649	0.1000313	0.004
Adjusted R square	0.00087	-0.0263158	-0.02
t	9.83676	5.6469681	8.471
F	1.03412	1.3337972	0.166

Significance	0.31562	0.2785962	0.686

Table 13- Effect of Process management on the corporate sustainability performance

independent variable	dependent variable		
Process management	financial, operational and operational performance	continuous improvement and improvement in competitive advantage and stakeholder's enrichment	improvement in green SC performance
R square	0.01886	0.0669903	9E-04
Adjusted R square	-0.00696	0.0424374	-0.03
t	9.52369	10.107602	6.32
F	0.73054	2.7284091	0.035
Significance	0.39807	2.7284091	0.852

Table 14- Effect of GM Planning on the corporate sustainability performance

independent variable	dependent variable
GM planning	continuous improvement and improvement in competitive advantage and stakeholder's enrichment
R square	0.06481
Adjusted R square	0.0402
t	6.31212
F	6.31212
Significance	0.11289

Table 15- Effect of Customer focus on the corporate sustainability performance

independent variable	dependent variable
Customer focus	continuous improvement and improvement in competitive advantage and stakeholder's enrichment
R square	0.03148
Adjusted R square	0.00599
t	8.09326
F	1.235
Significance	0.27342

In this study, regression analysis is also conducted to test the hypotheses and to define the direction of

relations. Table 3 to Table 15 shows us the results obtained when the data obtained by collection was used for regression analysis where the factor was taken as the independent variable and the parameters individually were taken as the dependent variables. (Bulent Sezen and Sibel Yildiz Cankaya, 2013).

VI DISCUSSION

One of the most important areas of application of GM is manufacturing & design sector. All companies have a social responsibility and on GM implementation the company was found fonder to environmentally friendly products. The basic challenges of GM implementation found out were long term effort, investment, increase in production cost and specialized engineers.

From the data obtained using regression analysis, we can see that **organizational capability** has a greater positive effect on continuous improvement and stakeholder's improvement(t=8.1999404, F=5.8891825) compared to financial, operational and operational performance(t=7.23997, F=1.24799) and improvement in green SC performance(t=6.762, F=1.235). Likewise other factors were also compared and it was deducted that the maximum values of t and F were for the factor **Supplier management**(t=10.232) followed by **Process management**(t=10.10, 9.52), **Green initiatives**(t=9.83) and **Green standard adoption** (t=9.52). this proves that the organization has to improve on the implementation of the other factors of Green Manufacturing to put them to the utmost use.But production costs had been deeply affected and reduced, leading to an increase in income which has been shown in the graph(Fig. 1) previously. Thus by implementing GM the company has had the dual advantage of protecting the environment, fulfilling its social responsibility and bringing in better returns for the company.

VII CONCLUSION

Environmental issues are rapidly emerging as one of the most important topics in strategic manufacturing decisions. Growing public awareness and increasing government interest in the environment have induced many companies to adopt programmes aimed at improving the environmental performance of their operations. State of the art literature has proposed many models to support executives in the assessment of a company's environmental performance. Unfortunately, none of these identifies operating guidelines on how the systems should be adapted to support the deployment of different types of "green" manufacturing strategies. The present paper seeks to illustrate the impacts green manufacturing has had on the various important factors which determine organisational growth and productivity, to support the implementation of feasible "green" manufacturing strategies.

One of the most important areas of application of GM is manufacturing & design sector. All companies have a social responsibility and on GM implementation the company was found fonder to environmentally friendly products. The basic challenges of GM implementation found out were long term effort, investment, increase in production cost and specialized engineers.

But production costs had been deeply affected and reduced, leading to an increase in income which has been shown in the graph previously. Thus by implementing GM the company has had the dual advantage of protecting the environment, fulfilling its social responsibility and bringing in better returns for the company.

REFERENCE

[1]Rehman Minhaj Ahemad.A., Shrivastava R. R, Shrivastava Rakesh. L, "Validating Green Manufacturing (GM) Framework for Sustainable Development in an Indian Steel Industry ", Universal Journal of Mechanical Engineering 1(2): 49-61, 2013

[2]Paul. I.D., Bhole G.P., Chaudhari J.R, A review on Green Manufacturing: It's important, Methodology and its Application., Procedia Materials Science 6 (2014) 1644 – 1649.

[3]Mittal Varinder Kumar, Sangwan Kuldip Singh, Prioritizing Barriers to Green Manufacturing: Environmental, Social and Economic Perspectives, Variety Management in Manufacturing. Proceedings of the 47th CIRP Conference on Manufacturing Systems, Procedia CIRP 17 (2014) 559 – 564.

[4]Zhu, Q., & Sarkis, J. (2004). Relationships between operational practices and performance among early adopters of green supply chain management practices in Chinese manufacturing enterprises. Journal of Operations Management, 22(3), 265–289.

[5]Digalwar A. K. & K. S. Sangwan (2007)"Development and Validation of Performance Measures for World Class Manufactures" Journal of Advanced Manufacturing SystemsVol. 6, No. 1 (2007) 21–38.

[6]David M Jeffrey J,Uma S (1997) "Promotion of Environmentally Conscious ("Green") Manufacturing Techniques" (Group C, MoT 1 Project Outline Fall 1997).

[7]ITC Limited, www.wikipedia.com.

[8]Sustainability-report-2013, ITC Limited.

[9]Report-Accounts-2014, ITC Limited.