Relationship between organisational value addition and environmental sustainability performance in an Indian pulp and paper manufacturing unit and its supply chain: a longitudinal case study

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Abstract: Organisations that improve 'value addition' by implementing several initiatives, does not verify impact of these initiatives have on environment. Modern sustainability era, demands for eliminating environmental impacts, i.e., a Positive correlation is expected between value addition and environmental performance on long term basis. Many studies on Corporate Sustainability Management, based on the data at one point of time, did not examine above said relationship. This paper discusses the relationship between value addition and environmental sustainability using ten years data of an Indian Paper Mill. Analysis of the data reveals that there is a negative correlation between value addition and environmental sustainability over the ten-year period.

Keywords: corporate sustainability management; value addition; environmental sustainability performance; renewable resources; pulp and paper industry.

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1 Introduction

Between two world summits on sustainable development – Rio in 1992 and Johannesburg in 2003 the concern for environment has increased remarkably in many companies. A variety of private and public initiatives, new regulations, and consumer activism have created incentives and pressures on companies to be more aware of their impact on the environment. Although one of the more established themes in the corporate citizenship area, in which the companies have made the most progress, the environment was still listed by about half of the responded CEOs as a key issue that needs to be addressed by the corporate sector (Nelson, 2003). Companies try to minimise the environmental impacts by meeting international environmental management standards, cutting carbon dioxide emission due to fissile fuels and investing in cleaner production. While the necessary condition for environmental sustainability is using raw materials and energy from renewable resources, the sufficient condition is the elimination of the emission of carbon dioxide due to fossil fuels combustion. Hence when a manufacturing organisation grows economically (increasing the value addition) large, its activities should not have affected the environment. Hence the long-term relationship between economic value addition and the environmental sustainability should ideally be positive correlation. Empirical evidence of such research works is not available in literature.

Many survey related studies have been carried out to analyse the environmental sustainability of various organisations in different sectors, in a particular point of time. Referring all of them will require volume of pages and hence some of the relevant literatures are reviewed here. Most of the survey questionnaire carried both the performance indicators, as well as practices. Pricewaterhousecoopers (www.pwcglobal.com/eas) have conducted a survey in the year 2002 to determine what 140 US companies are doing with regard to sustainability. The survey revealed that in the sustainability report, 45 companies are issuing reasons for pursuing sustainability as enhanced reputation, competitive advantage and cost reduction, and the important sustainability initiatives pursued as pollution prevention, environmental management system, employee volunteering, community outreach and corporate philanthropy. The survey is conducted at one point of time and does not evaluate the overall sustainability performance of a company over a period of time. One study (Marc Diebacker, 2000) is on comparing the three factories (one in India, one in Indonesia, and the third in Zimbabwe). Marc analysed the three factories in terms various environmental parameters. The environmental parameters considered are water consumption, energy consumption, and water emissions (COD, BOD of effluents). Marc further analysed relationship between environmental performance and social performance. Marc concluded that the improvement in environmental protection can be achieved faster and would be more sustainable if accompanied by improvements in social aspects of the production process. The social aspects that were considered in the above study are occupational and health/safety, non-discrimination, communication/work environment, working hours, wage, training, education and awareness.

Another study (Emil Morhardt et al., 2002), evaluated the extent to which current published voluntary reports meets the requirements of two new sets of guidelines:

- the global reporting initiative (GRI 2000) sustainability reporting guidelines
- the ISO 14031 environmental performance evaluation standard.

The study found that reporting practices are well below the standards set by both GRI 2000 and ISO 14031.

Japanese Research Institute, (Adachi, 2003) while studying the Japanese companies concluded that there is a positive correlation between environmental performance and social performance. The issues considered under environmental performance included resource input, water usage, energy consumption, green house gas emission, water discharge, water discharge, product assessment, green procurement. The study has been conducted again by looking at the reports published by nearly 200 companies in Japan under various industrial sectors. The social issues considered were customer relations, employee relations, operation in global market, and commitment to society.

None of the researchers have studied the relationship between economical performance due to development of an organisation and the environmental impacts (sustainability) due to these developments over long periods of time. Economical performance of a company is best described by the trend of value addition on a long-term basis. Several changes occur not only within the manufacturing unit, but also in its supply chain, such as raw material supply chain and energy supply chain. It is not enough if only the environmental indicators of a manufacturing unit are compared as stand-alone. Changes in raw material or changes in fuels and sourcing them do have positive and negative impact on the environment. Hence when the environmental sustainability performance of an organisation is studied, the environmental indicators are scored in such a way that negative scores are given if the environmental impact persist and the scores are also normalised to a percentage scale. In order to arrive at an overall environmental sustainability index, appropriate weights are selected for the environmental indictors based on the cost components. By taking an Indian pulp and paper mill as an example, this research studies the relationship between enterprise value addition and the environmental sustainability performance over a period of ten years. The identity of the case study organisation is not revealed due to confidentiality. The methodology adopted for measurement of value addition is discussed in Section 2, methodology for measurement of environment sustainability is discussed in Section 3, relationship between value addition and environmental sustainability is discussed in Section 4 and conclusions in Section 5.

2 Measurement of value addition

Quite often, value addition is defined in financial area as net income less non-wage expenses. This definition suffers on account of two issues. One issue is that it is not affected by change in wage structure of an organisation over a period of time. Many organisations add value to the company by applying the concept of business process reengineering, out sourcing, etc. Such value additions are not considered in the above definition. The second issue is that the above value addition definition, does not consider changes in value addition due to the capital addition. Such capital additions lead to depreciation. Hence the effect of depreciation is removed from the net income. In this paper, enterprise value addition (called as EVA) is defined as equal to {Income – Excise Duty – Expenses – Depreciation}. Here the expenses include all expenses including

employees' salaries, wages and benefits. This is because there is reduction in number of employees in the organisation due to down sizing during the period of study. Further, such EVA calculation considers the value addition due to changes in wages. The EVA is also normalised with regard to the total income by computing the EVA as a percentage of total income – where total income is equal to sales realisation and other income and is adjusted to changes in stock of products and raw materials and other inputs.

The case study of the organisation for the period from 1995–1996 to 2004–2005, the data is given below: In this paper, EVA is defined as equal to {Income – Excise Duty – Expenses – Depreciation}. Here the expenses included all expenses including employees' salaries, wages and benefits. This is because there are reductions in number of employees in the organisation due to down sizing. The data and the EVA for the case study organisation for the period 1995–1996 to 2004–2005 are shown in Table 1.

Table 1 Calculation of enterprise value addition as a percentage of total income (in million rupees)

Description	*1995–1996*	*1996–1997*	*1997–1998*	*1998–1999*	*1999–2000*
Income					
Total sales including excise and cess	1653.54	1601.75	1476.50	1699.31	1721.48
Income from lease and others	101.76	86.08	97.86	118.08	147.04
Increase/(decrease) in stock	–0.85	0.00	59.42	–59.42	21.68
Total income	1754.45	1687.83	1633.78	1757.97	1890.19
Expenditure					
Materials consumed	491.15	506.56	539.22	576.04	575.81
Power and fuel	353.47	355.53	388.81	414.92	459.49
Employee' cost	167.35	170.43	182.57	193.90	236.28
Other expenses	53.62	46.24	49.50	44.06	43.59
Repairs and maintenance	93.48	83.80	79.50	87.23	100.72
Decrease in stock in process	–1.64	0.16	2.72	–3.04	–1.49
Total expenditure	1157.44	1162.71	1242.33	1313.10	1414.39
Excise duty and excise cess	187.18	213.76	182.57	204.03	228.84
Depreciation	59.82	116.10	119.16	124.60	112.98
Entrepreneurial value addition	350.02	195.26	89.72	116.24	133.98
EVA as a percentage of total income (%)	19.95	11.57	5.49	6.61	7.09

Table 1 Calculation of enterprise value addition as a percentage of total income (in million rupees) (continued)

Description	*2000–2001*	*2001–2002*	*2002–2003*	*2003–2004*	*2004–2005*
Income					
Total sales including excise and cess	2621.41	3622.01	3912.4	4180.039	4140.533
Income from lease and others	175.06	33.49	32.2	89.08	76
Increase/(decrease) in stock	225.56	–247.23	0	0	0
Total income	3022.02	3408.26	3944.60	4269.12	4216.53
Expenditure					
Materials consumed	1146.75	1362.10	1526.3	1724.841	2069.81
Power and fuel	622.60	695.93	664.95	692.095	913.57
Employee' cost	230.27	240.43	248.9	254.205	292.34
Other expenses	50.29	66.35	138.71	136.729	150.40
Repairs and maintenance	129.84	134.03	852.08	93.294	102.62
Decrease in stock in process	–2.19	–13.26	2.958	–67.84	0.00
Total expenditure	2177.55	2485.57	2667.07	2833.324	3528.74
Excise duty and excise cess	447.26	510.55	386.9	438.491	466.8
Depreciation	138.02	106.68	109.565	111.106	128
Entrepreneurial value addition	259.18	305.47	781.07	886.20	93.00
EVA as a percentage of total income (%)	8.58	8.96	19.80	20.76	2.21

As seen in Table 1, it can be inferred that during 1995–1996, the EVA was 19.95% and after that it has shown a downward trend for two years, and from 2000–2001, it picked up again. This is due to lower realisation in the market despite increase in cost of production before 2000–2001. The company expanded the paper production capacity by adding one paper machine with a production capacity of 60,000 tonnes per annum. Thereby, the installed capacity was increased to 1,15,000 tonnes per annum. Since no expansion was carried out in the in house pulp plant, the new paper relied on imported pulp mainly from Indonesia. The company achieved a peak EVA% of 20.76% in the year 2003–2004 due to increased market realisation and reduced cost of energy by using economical fuels (such as imported coal compared to Indian coal) and improved in-house cogenerated power. However, in the year 2004–2005, the EVA % dropped to a new lower level in the history of the company due to sudden price increase by 20–30% for wood and bagasse, respectively, and also 30% price increase in imported coal.

3 Measurement of environmental sustainability

Measurement of environmental sustainability is more complicated than the value addition. Some of the researchers used both the practices and performance for calculation of sustainability index (see for example Dow Jones Sustainability Index). Mere transparency in disclosing the information cannot simply mean that the company is moving towards sustainability. Different companies, to move towards sustainability,

adopt many practices. The performance indicators of the sustainability are the end results of such practices. Hence combing practices and performance and arriving at a sustainability index are not a genuine sustainability index. It is not an acceptable methodology in view of the fact that the practices lead to improvement in performance. Another study (Gutberlet, 2000) was based on the concept that defines sustainability as dematerialisation and continuous reduction of ecological impacts. Further, another study (Dyllick and Hockerts, 2002) defined ecologically sustainable companies as those companies that use only natural resources that are consumed at a rate below the natural reproduction, or at a rate below the development of substitutes. Therefore, in this paper the environmental sustainability is defined as the situation that a company has to reach where there is no practices that have detrimental effect up on the natural environment we live now. As the principle of industrial ecology is based on recycling, renewable resources, etc., negative scores are to be given for the environmental impacts in determining the performance of environmental sustainability. Many studies were not truly based on the true environmental sustainability. Environmental sustainable companies go in tune with the environment and not against it. Further, many studies are static with regard to time factor. That means that there are rather insignificant number of studies that reveal what happened to the environmental sustainability performance of an organisation over a long period of time say ten years.

3.1 Environmental sustainability indicators considered in the research

Hence this study for the computation of environmental sustainability for a period of ten years following environmental performance factors are considered for an integrated pulp and paper mill.

Indicator	*Description of the indicators of environmental sustainability*
1	Proportion of raw material that are purchased from renewable sources to the total raw material purchased from all sources
2	Proportion of fuels that are purchased from renewable sources to the total fuels purchased from all sources
3	Proportion of non-chlorine chemicals purchased to all the chemicals used for bleaching
4	Percentage reduction in the CO_2 emission due to transportation of raw materials (tonnes Kilometres) compared to base year
5	Percentage reduction in the CO_2 emission due to transportation of fuels (tonnes Kilometres) compared to base year
6	Proportion of trees planted to the proportion of equivalent trees consumed

3.2 Use of renewable raw materials

Due to the serious damage that the industrial developments have done so far to the environment, a company is environmentally sustainable if it based on raw materials that are from renewable resources. Typical raw materials for example for papermaking are straw, sugarcane bagasse, wood from industrial plantation or (Farm Forestry) and the waste paper. Hence the indicator for a paper manufacturing company for raw material side is "Proportion of raw material that are from renewable sources to the total raw materials purchased from all sources".

3.3 Plantation of trees

Trees help in many ways and their advantages (Grover, 2002) are

- trees absorb carbon dioxide and converts it into oxygen
- one hectare of natural green forest gives 600–650 kgs of oxygen within 18 hours and uses up to 900 kgs of carbon dioxide
- manage ground water recharge and higher water levels in the wells
- acts as wind breakers and absorb air pollutants
- prevents soil erosion provides natural noise barrier.

One of the paper industries in the south India called as Mysore Paper Mills located in Bhadravati in Karnataka state has been quietly nurturing the a captive plantation on 30,000 hectares of degraded forest land leased to it by the state government (Anand, 2004). The mill is getting wood at US$ 20, which is equal to the price of wood that an Indonesia Pulp Mill will buy. The plantation produces 1,30,000 tonnes of pulpwood every year and 15,000 tonnes is sold to government as leasing charge. The local villagers get lops tops and bark free. The plantation provides employment of 570 man-days per hectare for plantation and 240 man-days for harvesting by local people. About 115 species of birds 19 species of mammals live here. The plantation has reduced pressure to nearby forest and improved water table. Plantation of trees on large scale in India can trigger greater prosperity to the society besides its green cover. Green cover will bring more rain and sustain the growth of more trees. Besides it creates jobs for thousands and thousands of people in the farm forestry based activities. Hence planting of trees is most important for the pulp and paper mills that use wood as a raw material for making paper. Pulp and Paper Manufacturing units should take effort to plant number of trees equal to the number of equivalent trees consumed for a year. For example a company, which consumes around 1,50,000 tonnes of wood every year, needs to plant 75,000 trees every year and cut them for raw material after the seventh year. Hence the total number of trees always under plantation is equal to 5,25,000 trees. After that the company can get sustainable supply of wood for its manufacturing activities.

The environmental sustainability indicator for plantation is ratio of the trees planted in a year to the ratio of trees that should have been planted for sustained supply of wood to its manufacturing operation. For calculation purposes, it is assumed that eucalyptus tree grows to a weight of around 30 kgs at the end of six years. The trees to be planted that are equal to the wood demand of a typical paper mill.

3.4 Use of energy from renewable resources

Paper industries use energy in the form of fuels and electricity. A typical Indian Pulp and Paper Mill has several fuels available in the market at varying calorific values, varying unit prices, and in varying quantities. Use of low cost fuel is driving force for the energy cost management point of view. A typical paper mill uses fuels such as imported coal, lignite, bagasse, and biomass fuels. Bio fuels include, black liquor by-product, which is a prime energy source built into the manufacturing process of pulp, coconut shell, groundnut shell, paddy husk, cashew nut seeds, etc. Further, some companies buy electricity from outside sources such as state grid. It is to be noted that 80% of state grid

power is generated from fossil fuel based energy sources. A sustainable company should focus on moving away from fossil fuel based energy to renewable energy sources. Renewable energy sources include energy from all kind of biomass, wind and solar energy. Hence the environmental sustainability indicator for use of energy resources is the "Proportion of energy consumed from renewable energy sources to the total energy consumed from all sources".

3.5 Use of non-chlorine chemicals used for bleaching of pulp

If pulp is used as raw material for white paper or board, it has to be bleached. This fact has been the cause of perhaps the most extensive environmental debate and activity during the last decades, i.e., the campaign against chlorine bleaching. The driving force (Jaakko Pöyry Consulting Oy, 2003) in the development of Kraft pulp production, in the past ten years, has been the need to reduce or discontinue completely the use of chlorine chemicals in bleaching. The use of elementary chlorine as a bleaching agent has globally to a large degree been displaced by the use of chlorine dioxide and total chlorine free processes. Instead of chlorine and chlorine dioxide bleaching sequences, chlorine dioxide, and oxygen compounds are used. The new bleaching methods have led to an increased consumption of oxygen, hydrogen peroxide and ozone. Hence ratio of non-chlorine chemical used to the total of all chemicals used for bleaching is another environmental sustainability indicator used in this study.

3.6 Emission of carbon dioxide due to transportation of raw material to production units

For a typical pulp and paper mill trucks on roads to the factories transport the raw materials such as wood traditionally. Around a distance 200 kilometres is found to be an economical distance (Anand, 2004). Paper Industries in India are lobbying with central and state governments for allocation of dry non-productive wastelands for production of trees as farm forestry. However, due to economic and technological reasons, some paper mills import waste paper and pulp from foreign countries for substantiating their paper production. Such actions though economical will lead to more emission of carbon dioxide than if raw materials are transported from closer locations with in a radius of 200 kilometres. The carbon dioxide emission intensity is taken as 265 gms of carbon dioxide equivalent per tonne-kilometre for trucks on road and 39 gms of carbon dioxide emission per tonne-kilometre for ships on sea (Greenhouse gas division, 1990–2000). Hence when a company moves different raw materials from different places, it is important to account for carbon dioxide emission due to this increased transportation. Thus, the environmental indicator proposed is the ratio of the carbon dioxide emission in a year due to raw material transportation to the carbon dioxide emission in the base year. It is expected that over long-term periods, the company does not contribute to increase in carbon dioxide emission in the transportation of its raw materials.

3.7 Emission of carbon dioxide due to transportation of raw material to production units

A typical paper mill transports fuels such as lignite, bio-mass (agricultural based), by truck and imported coal by sea from foreign countries. Hence when a company moves different fuels from different places, it is important to account for carbon dioxide emission due to this increased transportation. Thus, the environmental indicator proposed is the ratio of the carbon dioxide emission in a year due to fuel transportation to the carbon dioxide emission in the base year. It is expected that over long-term periods the company does not contribute to increase in carbon dioxide emission in the transportation of its fuels.

3.8 Weightages for indicators selected

The weights for the above indicators are computed based on the proportion of cost involved in the particular activity. The weights are determined as shown below

	Rs. per current year
Cost of raw materials	C1
Cost of fuels	C2
Cost of power	C3
Cost of bleaching chemicals	C4
Cost of raw material transportation	C5
Cost of fuel transportation	C6
Total cost above items	C = C1 + C2 + C3 + C4 + C5 + C6
Weightages for raw material	C1/C
Weightages for fuels	C2/C
Weightages for fuel transportation	C6/C

Accordingly weightages (Table 2) for all environmental indicators considered in the study were arrived at.

Table 2 Weight for indicators

Weightages for indicators	*Percentage*
Raw materials from nature of source	25
Wood plantations	25
Cost of energy	30
Cost of bleaching chemical	15
Cost of transportation of raw material and fuels	5
Sum of all weightages	100

In order to determine the overall environmental sustainability index for a year, the individual environmental performance values (in percentage, see Table 3) achieved in a year are multiplied by the weightages that are arrived as elucidated above.

Table 3 Environmental indicators for the case study mill

Performance values for environmental indicators	*1995–1996* (%)	*1996–1997* (%)	*1997–1998* (%)	*1998–1999* (%)	*1999–2000* (%)
Proportion of raw material from renewable resources	100	100	100	99	100
Proportion of trees planted to the proportion of trees consumed	1	2	3	3	3
Proportion of energy from renewable resources	47	43	45	50	38
Proportion of non-chlorine chemicals used for bleaching	0	0	0	10	11
Percentage reduction in CO_2 emission compared to base 1995–1996 in transportation of fuels and raw materials	0	4	12	10	–34

Performance values for environmental indicators	*2000–2001* (%)	*2001–2002* (%)	*2002–2003* (%)	*2003–2004* (%)	*2004–2005* (%)
Proportion of raw material from renewable resources	87	78	76	74	69
Proportion of trees planted to the proportion of trees consumed	2	2	2	2	2
Pro-portion of energy from renewable resources	41	38	34	33	31
Proportion of non-chlorine chemicals used for bleaching	11	6	6	6	6
Percentage reduction in CO_2 emission compared to base 1995–1996 in transportation of fuels and raw materials	–65	–93	–128	–144	–145

3.9 Environmental sustainability index for the case study mill for ten years

As discussed above the data has been collected from the case study organisation for a period of ten years. The environmental sustainability index is calculated and shown in Table 4.

Table 4 Environmental sustainability index

Environmental sustainability index	*1995–1996* (%)	*1996–1997* (%)	*1997–1998* (%)	*1998–1999* (%)	*1999–2000* (%)
Renewable raw materials	25.00	25.00	25.00	24.77	24.93
Plantation of trees	0.28	0.56	0.63	0.71	0.84
Renewable energy	14.02	12.87	13.54	14.96	11.39
Non-chlorine chemicals	0.00	0.00	0.00	1.51	1.59
Reduction in CO_2 emission due to raw material and fuel transportation in supply chain	0.00	0.22	0.60	0.52	–1.68
Overall environmental sustainability index	39.31	38.65	39.76	42.46	37.07

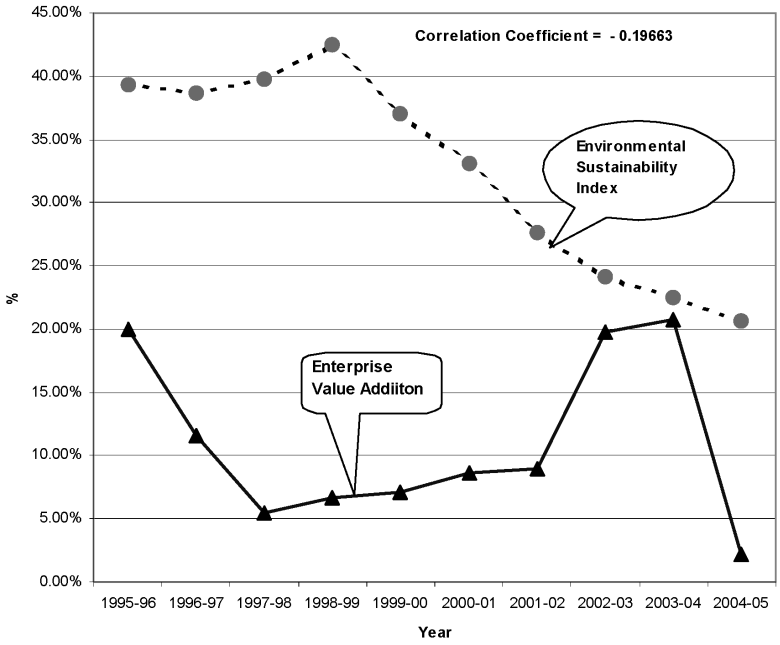
Table 4 Environmental sustainability index (continued)

Environmental sustainability index	*2000–2001* (%)	*2001–2002* (%)	*2002–2003* (%)	*2003–2004* (%)	*2004–2005* (%)
Renewable raw materials	21.79	19.60	18.99	18.38	17.17
Plantation of trees	0.59	0.47	0.44	0.44	0.45
Renewable energy	12.23	11.29	10.28	9.91	9.44
Non-chlorine chemicals	1.71	0.94	0.85	0.91	0.87
Reduction in CO_2 emission due to raw material and fuel transportation in supply chain	–3.27	–4.64	–6.41	–7.18	–7.26
Overall environmental sustainability index	33.05	27.66	24.15	22.45	20.68

4 Relationship between value addition and environmental sustainability

Pearson correlation coefficient is computed for the value addition and environmental sustainability as shown in the previous tables. It is shown also in the form of a graph (Figure 1). The company improved its value addition starting from the year 1998–1999. Until 2003–2004, the value addition increased. It increased substantially during the years 2002–2003 and 2003–2004. It drastically dropped in the year 2004–2005 (Projections). This is due to efficiency improvements in the manufacturing plant during the periods of increase. The market prices of raw materials and fuels jumped by 25–30% in 2004–2005 and eroded the values the company has added so far.

Figure 1 Enterprise value addition and environmental sustainability index



However, the environmental sustainability indexes shown a downward trend starting from 1998–1999. The company increased its dependency on imported or Indian purchased pulp and imported coal. Its plantation efforts are meagre. Its dependency on chlorine for bleaching increased due to increased in house pulp production. It depended on non-renewable sources for pulp and coal. It increased the emission of carbon dioxide due to fuel and pulp transportation.

The coefficient of correlation was calculated between the value addition and environmental sustainability index. It was found that they negatively correlated. Meaning that even though the company has achieved increased value addition over a period of nine years from 1995–1996, by growing in size and turnover and changing its supply chain for raw material and energy, its environmental performance with regard to the selected environmental indicators has declined over the period of the study.

5 Conclusions

Whether an organisation is growing and becoming bigger, its growth should not be at the cost of environmental impact. Organisations should grow, but at the same time their effort should have resulted improved environmental performance, both in its manufacturing operation as well as its significant supply chains, such as raw material and energy. Generally, economists hypothesise that firms performing well on economical side also do so on the environmental side. However, this hypothesis was rejected by findings of the case study, on a long-term basis. In the case study, it was found that the there is opposing relationship between value addition and environmental sustainability performance when we consider the data for ten years Manufacturing companies should move towards usage of renewable resources and eliminate carbon dioxide emission due to burning of fossil fuels.

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