

## IMPACT OF E-COMMERCE ON ENVIRONMENT

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### ABSTRACT

Electronic commerce (e-commerce) as part of the information technology revolution became widely used in the world trade in general. The advent of the Internet and e-commerce has brought a new way of marketing and delivering many products. The e-commerce technology helps the business houses to maintain the inventory level as low as possible, which ultimately saves the investment and space required to store the inventory. The reductions in inventories and returns provide significant environmental savings, but some major concerns of the new e-commerce business models are the energy and packaging materials used by the logistics networks for product fulfilment and delivery. This study analyses the impacts of e-commerce on natural environment and assesses the environmental and cost effects of different delivery systems.

**Keywords:** E-commerce, Environment, Online.

### INTRODUCTION

E-commerce as anything that involves an online transaction. E commerce includes not only buying and selling goods over Internet, but also various business processes within individual organizations that support the goal. E-commerce provides multiple benefits to the consumers also in form of availability of goods at lower cost, wider choice and saves time but it is tough to assess the environmental impacts of e-commerce. After all, it doesn't emit any pollutants or uses much energy and natural resources. It would also be hard to connect it with climate change, biodiversity and habitat losses.

A closer look at environmental impacts of the e-commerce quickly reveals that transportation is responsible for a large percentage of carbon dioxide emissions. It is obvious that reducing the number of vehicle trips is one way of reducing the level carbon emissions. E-commerce applications are the means of conducting business without actually commuting. Companies may allow their employees to work in virtual office and working from home reduces the number of commuters on the road. Moreover it is not required to have the office space on rent or to send out bills via the traditional means using papers. Moving towards the paperless society would be advantageous for deforestation which contributes to global warming.

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The use of e-commerce as an alternative channel to procure the raw material by manufacturing companies can reduce inventory requirements. E-commerce can replace inventory with information to speed up processes so that smaller buffer inventories are needed (**Siikavirta, Punakivi, Ka and Linnanen 2003**). Changes in the supply relations between companies have positive effects on the environment. It may reduce the distance of the raw material or components that are transported and may play a role in re-engineering the sourcing process, which can cut down overproduction. (**Buzzell and Ortmeier 1995**). E-commerce develops the future demand in advance by taking online orders which results in a situation in which pull-controlled manufacturing is the most suitable option for production companies, means that production follows the fluctuation of demand more accurately. If production matches demand more accurately, overproduction can be decreased (**Prouty 2000**).

The potential positive impacts of e-commerce to save material and energy cannot be denied but it is too early to conclude that e-commerce has only positive impacts on environment. The internet economy is a double-edged sword because each potential positive impact is coupled with a potentially overwhelming negative impact as well. On the flip side, e-commerce technology requires necessary equipments mainly computers, keyboards and other hardware devices which becomes obsolete very quickly due to technological innovation and generates the problem of e-waste. This e-waste creates environmental pollution and hazardous to public health. E-commerce also tends to favour faster transportation modes, which can increase fuel consumption exponentially. As website gets the product order online, it may be shipped partially by airfreight across the country and require local truck delivery. When we opt for private vehicles instead of rail transport, energy use goes up by a large amount (**Daniel and David 2002**).

Some scholars have discussed three layer effects of E-commerce in their researches. These layers are as follows:

**1. Primary Effects:** E-commerce is a very useful tool in reducing the building energy intensity because it encourages sharing of infrastructure like equipments, networks etc. in all functions of sourcing and distribution of material flows. Companies providing online services such as movie centres, online advisory agencies and online billing systems do not need physical locations. Thus EC can prevent the release of large amount greenhouse gases in the world.

**2. Secondary Effects:** Indirect environmental effects of EC is due to its power to change processes such as production or transport processes, resulting in a modification (decrease or increase) of their environmental impacts. When traditional companies apply advanced information technologies then it becomes highly efficient with tight collaboration, well communication and fast response. Companies grow faster by moving many of its operations to the internet.

It allows the company to better utilize its existing manufacturing capacity for large investments without making any kind of additional investments. In E-commerce, companies may experience larger numbers of orders with smaller size than experienced in the conventional purchasing system, and this means a new perspective on the packaging issue: durable and reusable packaging sources are needed.

**3. Tertiary Effects:** EC supports to less paper resource use or paper less society when often using digital communication for placing orders, sending bills, paying bills and so on. It leads to a "paperless office" or "paper less society" story. People used to visit, search, read, write and access

the material online which change in the habit of the individuals and they avoids the use of papers and thus result in large sum of saved paper consumption. Customer purchasing behavior is changed due to e-commerce and they are now moving for online shopping and retailing. Therefore, the rates of logistics will be increased, while there are some services and commodities that can be moved directly online. Therefore we can say that EC supports paperless, building less and pollution less environment.

**Table 1: Types of Environmental Impacts of E-commerce**

Effects	Caused by	Examples	Aspects
Primary effects	Infrastructure	Terminal Equipments such as PC, Mobile phones, Network Infrastructure, Servers, etc.	Energy Consumption, Material Consumption, Toxicity of end of life equipment
Secondary Effects	Application	B2B, Change in Warehousing, Change in transportation and Packaging	Energy Consumption, Material Consumption, Traffic, Land Use
Tertiary Effects	Changes in consumption pattern, new habits, rebound effects	Increase in consumption, Substitution Effects, Side Effects	Energy Consumption, Material Consumption, Traffic, Land Use

Source: Abukhader and Jonson (2003) and Tuerk. V. (2001)

## LITERATURE REVIEW

Many researchers studied the impact of e-commerce on environment and found various positive and negative effects. **Rayport and Sviokla (1995)** pointed the impact of e-commerce on environment by using the real time information through internet to all key parties mainly retailers, customers, suppliers and manufacturers to manage their transportation and logistics resources more effectively. The Internet-based technologies would not only help for efficient transport routes and less pollutable transport mode but also help to manage warehousing and storage space requirement with better efficiencies. **Magretta (1998)** studied the impact of e-commerce on green-house gas emission due to transportation of inventories. Companies can use information technology for rapid and efficient sharing of information for inventory management and to speed up processes so that smaller buffer inventories are needed. The companies offering their products in global market does not necessarily need production facilities at every market, rather they should have the production facilities near the suppliers and the customers or outsourcing the production whenever needed. **Stein and Sweat (1998)** emphasised the communication aspect of e-commerce under which companies can accurately predict consumer demands by receiving real-time information from customers, suppliers and manufacturers. This would help companies to maintain the optimum level of inventory at the retail level and replenishing them on a just-in-time basis. This could decrease the space needed to store excess inventories, thereby minimising the environmental impacts of warehousing: the consumption of open spaces by warehouses; the materials used to build them; and the energy needed for heating, cooling and lighting. **Romm, Rosenfeld and Herrmann (1999)** has focused on the impact of the internet energy consumption comparing two time periods at United States of America (USA), one is from 1992-1996 (pre internet era) and another time frame is after 1996 (post internet era). They found the positive impacts of e-retailing on environment where goods are stored in warehouses and require far less energy per square meter than physical retail stores because warehouse can contain more products per square meter than a retail store. An e-commerce

retailer also helps to reduce the green-house gas emissions due to reduction in distance covered to deliver the products. Another benefit of e-commerce on environment is use of energy efficient computers. **Walker (1999)** found that manufacturers invest large amounts of money in the design of packaging which results into solid waste and the environmental costs of packaging are enormous. **Matthews, Williams, Tagami and Hendrickson (2002)** highlighted the negative impact of e-commerce on environment while comparing online and offline retail channel for books in Japan. They found that e-retailing has a slightly bigger carbon footprint than traditional retailing due to the need for additional packing. Some other important factors were found mode of transport for shipping, distances covered, population density, packaging and number of items per order have impact on the energy and cost efficiency of the systems. **Macauley (2003)** found the negative health impacts of e-commerce, generated from the growing stock of obsolete electronic equipments particularly computer monitors. Environmental concerns in this matter were associated with disposal of the lead embodied in cathode ray tubes used in most monitors. **Berkhout and Hertin (2004)** identified three main types of effects: direct impacts of the production and use of information and communication technologies on the environment such as resource use and pollution related to the production of infrastructure and devices, electricity consumption of hardware, electronic waste disposal. Indirect impacts related to the effect of information and communication technologies on production processes, products and distribution systems as de-materialisation, substitution of information goods for material goods, and substitution of communication at a distance for travel. Structural or Behavioural impacts, mainly through the stimulation of structural change and growth in the economy by information and communication technologies and through impacts on life styles and value systems. **Peng, Li and Zhang (2005)** explained three positive effects of e-commerce on environment consisting primary, secondary and tertiary. The primary effects of the internet are to prevent the release of large amount greenhouse gases in the world by reducing the building energy intensity because online advisory services, online billing systems do not need physical locations. Secondary effects come from diversified applications in warehousing, inventories, transportation and packaging, by improving the communication between companies and its departments. Tertiary effects of e-commerce promote paperless office or society and pollution less environment, when companies use digital communication for placing orders, sending bills, paying bills and so on. **Ladou (2008)** analysed the impacts of e-commerce on environment due to electronics equipment waste which includes discarded computers, computer monitors, television sets, and cell phones. Many of them are discarded with household trash out of ignorance or disregard of the hazardous materials contained in them. The rapidly growing e-waste stream presents public health difficulties because a wide range of hazardous metals and chemicals are used in electronics products and in their manufacture. **Edwards, McKinnon, Cherrett, McLeod and Song (2010)** examined the impacts of e-commerce on environment for failed home deliveries when various customers are not-at-home to receive deliveries during the working days. These unsuccessful deliveries increase the cost to customers as well as to the carriers and they also have a detrimental effect on the environment. The study assessed the additional carbon emissions generated by failed delivery (as opposed to a successful first-time delivery) on a per drop basis and suggested to consider the potential environmental savings from the use of alternative collection or delivery locations such as post offices and railway stations over traditional delivery methods. **Abdallah, Farhat, Diabat and Kennedy (2012)** found that most of the carbon emissions and resource consumption occurs in heavy manufacturing industries. They can reduce the environmental impacts of their transportation and focus on greening supply chain by greening their internal activities through adoption of green manufacturing technologies. Consequently, adopting green procurement

methods where suppliers are not only chosen based on price and quality but also their environmental footprint can be realized as a competitive strategic advantage for such companies.

## RESEARCH METHODOLOGY

**Objective of the Study:** The prime objective of the study is to investigate the impacts of e-commerce on environment that positively and negatively influence e-commerce in Indian scenario.

**Research Design:** The present study is exploratory cum descriptive study.

**Sample Design:** This sample of 500 respondents was taken from the persons having some knowledge of e-commerce.

**Time of study:** The duration of this present study was conducted from December 2012 to April 2013.

**Research Tool:** Well-structured questionnaire having 18 statement related to e-commerce was used as research tool. Respondents were asked to answer on Likert 5 point scale ranging from least signification to highly significant. MS-Excel and SPSS software were used to process and analyse the data.

## ANALYSIS & INTERPRETATION

The relevant data for the present study has been obtained from the primary sources. A well-structured and pre tested questionnaire was used for data collection consisting 18 statements. (Annexure-1) This sample was taken from the persons having some knowledge of e-commerce, included both male (59%) and female (41%) respondents. Out of the entire sample 80.2% were married. As per education is concerned 50.6% were post graduate and remaining 49.4% were graduate. Occupation wise 8.4% respondents were students, 23.2% were from business background, 40.4% were the employees and remaining 28% were professionals. (Annexure-2)

The value of Cronbach's alpha was found as 0.674. To test the appropriateness of factor analysis technique the correlation between the variables is checked and Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy statistic is also used for the same. The approximate chi square statistic value is 1866.182 with 153 degree of freedom, which is significant at 0.05 level. The value of KMO statistic (0.655) is also large (>0.5).

**Table 2: Total Variance Explained**

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings	
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance
1	3.13	17.37	17.37	3.13	17.37	17.37	1.95	10.85
2	2.00	11.11	28.48	2.00	11.11	28.48	1.94	10.76
3	1.90	10.56	39.04	1.90	10.56	39.04	1.90	10.54
4	1.49	8.27	47.31	1.49	8.27	47.31	1.84	10.23
5	1.24	6.89	54.20	1.24	6.89	54.20	1.68	9.32
6	1.12	6.23	60.43	1.12	6.23	60.43	1.57	8.72

Extraction Method: Principal component Analysis

In the table 2, it can be seen that first six factors account for 60.43 per cent of the variance from the cumulative percentage of variance, contributed by first component is 17.37 followed by second (11.11 per cent), third (10.56 per cent), fourth (8.27 per cent), fifth (6.89 per cent) and sixth (6.23 per cent) of total variance.

**Table 3: Rotated Component Matrix**

Statements	1	2	3	4	5	6
1		0.840				
2		0.884				
3		0.555				
4			0.651			
5			0.824			
6			0.642			
7	0.574					
8	0.799					
9	0.689					
10						0.611
11						0.808
12						0.605
13					0.724	
14					0.745	
15					0.540	
16				0.697		
17				0.754		
18				0.674		

Extraction Method: Principal Component Analysis.  
Rotation Method: Varimax with Kaiser Normalization.

Table 3 namely rotated component matrix is useful for interpreting the factors. The rotation is made by the most commonly used method i.e. varimax procedure. This is an orthogonal method of rotation that minimizes the number of variables with the high loadings on a factor, thereby enhancing the interpretability of the factors. This table clearly depicts that Factor-1 is linear combination of variable number 7, 8 and 9. Factor- 2 comprises variables number 1, 2, 3. Factor-3 includes variable number 4, 5, 6. Factor-4 covers statement number 16, 17 and 18. Factor-5 is linear combination of variable number 13, 14, 15 and last Factor-6 consists of variable number 10, 11 and 12. After the number of extracted factors is decided, the next task is to interpret and name the factors which are shown in table 4.

**Table 4: Principal component results of Impact of e-commerce on environment**

Factors	Description	Loadings	Eigen values	% of Variance
<b>F1</b>	<b>Environment Friendly</b>		<b>17.37</b>	<b>10.85</b>
	Moving Business online can reduce the waste such as printed catalogues, retail space and transportation requirements.	0.574		
	EC provides home delivery services which creates significant potential for traffic reduction.	0.799		
	EC encourage on-line shopping which do not need physical location.	0.689		
<b>F2</b>	<b>Cost Reduction</b>		<b>11.11</b>	<b>10.76</b>
	E-commerce sites reduce the transportation cost of shipping.	0.840		
	There is reduction in carbon dioxide gas due to less transportation.	0.884		
	E-shopping saves the packaging cost.	0.555		
<b>F3</b>	<b>Virtual Shopping Benefits</b>		<b>10.56</b>	<b>10.54</b>
	EC compressed intermediation process which reduces the cost.	0.651		

	Growth of e-shopping can supposedly reduce the number of shopping centres.	0.824		
	EC reduce the fuel consumption and conserve energy due to virtual shopping malls.	0.642		
<b>F4</b>	<b>Green House Benefits</b>		<b>8.27</b>	<b>10.23</b>
	E-materialisation of paper saves energy.	0.697		
	EC reduce the waste by on-line auctioning of reused and recycled products.	0.754		
	EC supports to 'paper less society' by offering digital communication.	0.674		
<b>F5</b>	<b>Computerisation</b>		<b>6.89</b>	<b>9.32</b>
	E-commerce is responsible for e-waste.	0.724		
	EC activities encourage manufacturing of energy intensive computers.	0.745		
	E-commerce leads to high economic growth.	0.540		
<b>F6</b>	<b>Impact of IT</b>		<b>6.23</b>	<b>8.72</b>
	EC can potentially reduce the need of inventory, warehouse space and operating cost of business.	0.611		
	IT products pollute the environment.	0.808		
	Electricity consumption is increased due to IT products.	0.605		
	<b>Total Variance Explained</b>			<b>60.43</b>

## CONCLUSION

The finding of research paper clearly states that e-commerce has the potential to improve the efficiency of commerce that could reduce automobile use, reduce traffic, and enable businesses and consumers to be savvy green shoppers. By reducing the amount of energy and materials consumed by business, the e-commerce stands to revolutionise the relation between economic growth and the environment. It also helps decrease resource waste and associated pollution by improving the efficiency of economic activity.

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**ANNEXURE-1****Description of "Environmental implications of E-commerce" statements**

Statements	Description
1	E-commerce sites reduce the transportation cost of shipping.
2	There is reduction in carbon dioxide gas due to less transportation.
3	E-shopping saves the packaging cost.
4	EC compressed intermediation process which reduces the cost.
5	Growth of e-shopping can supposedly reduce the number of shopping centres.
6	EC reduce the fuel consumption and conserve energy due to virtual shopping malls.
7	Moving Business on-line can reduce the waste such as printed catalogues, retail space and transportation requirements.
8	EC provides home delivery services which creates significant potential for traffic reduction.
9	EC encourage on-line shopping which do not need physical location.
10	EC can potentially reduce the need of inventory, warehouse space and operating cost of business.
11	IT products pollute the environment.
12	Electricity consumption is increased due to IT products.
13	E-commerce is responsible for e-waste.
14	EC activities encourage manufacturing of energy intensive computers.
15	E-commerce leads to high economic growth.
16	E-materialisation of paper saves energy.
17	EC reduce the waste by on-line auctioning of reused and recycled products.
18	EC supports to 'paper less society' by offering digital communication.

**ANNEXURE-2****Characteristics of the sample**

S.No.	Variables	Categories	Number	Percentage (%)
1	Age	20-30	49	32.7
		30-40	68	45.3
		40-50	33	22.0
		50 and above	0	0
		<b>Total</b>	<b>150</b>	<b>100</b>
2	Education	Graduate	77	51.3
		Post Graduate	73	48.7
		<b>Total</b>	<b>150</b>	<b>100</b>
3	Gender	Male	96	64.0
		Female	54	36.0
		<b>Total</b>	<b>150</b>	<b>100</b>
4	Marital Status	Bachelor	67	44.7
		Married	83	55.3
		<b>Total</b>	<b>150</b>	<b>100</b>
5	Occupation	Businessman	75	50.0
		Employee	75	50.0
		<b>Total</b>	<b>150</b>	<b>100</b>