

Environmental Impacts of E-Commerce

Sunita Tiwari

Department of Computer Science
Krishna Engineering College
Gaziabad, India
sutiwari@gmail.com

Pratibha Singh

Department of Computer Science
JSS Academy of Technical Education
NOIDA, India
pratibhahbti2004@gmail.com

Abstract—The widespread expansion of Internet has set a prospect for the development of a new way of conducting Business called E-Commerce. E-Commerce is the paperless exchange of business information and refers to Internet shopping, online stock and bond transactions, the downloading and selling of “soft merchandise” and business-to-business transactions. E-commerce has been developed by the high integration of transportation infrastructures, information and communication technology. The rapid growth of the e-commerce is the basis of different, positive as well as negative impacts on environment. This paper explores the literature study on environmental impacts of E-commerce and focuses on spreading awareness regarding these possible impacts among people.

Keywords—E-commerce; Environmental impacts, Internet, Intranet, Extranet, Global warming.

I. INTRODUCTION

Due to vast and fast development of e-commerce, companies and businesses are paying so much attention to the production of low cost products. Also, they are focusing on developing efficient methods and practices which increases productivity in minimum efforts and cost. They are not aware and hence not concerned about its adverse environmental implications. The Internet has now entered almost every corner of the world. Furthermore E-commerce can well coordinate, collaborate and manage the business activities but it may have some negative effects like air pollution, harmful radiation etc. E-commerce is the foundation of the economy development in several developing and developed nations [5].

Tuerk and Fichter [1, 2] adopted a comparable classification for the type of environmental effects of Internet and e-business. They both adopted a three-layer classification: *primary effects*, *secondary effects* and *tertiary effects*. Primary effects mainly come from IT infrastructure like terminal equipments, mobile phones, network infrastructures; secondary effects stem from applications, for example, change in warehousing, transportation or packaging; tertiary effects centrally refer to the consumption patterns and rebound effects [2, 9]. According to a report by ‘Digital Future project of the European Community’, among the five stages of resource extraction, infrastructure production, infrastructure installation, Internet usage and electronic waste,

primary effects are through all processes but secondary and tertiary ones stay in the Internet use stage [4].

Here, Environmental Impacts of E-Commerce are considered for case study and survey. It is very tempting to know that the marketing on the Internet is beneficial to the environment. The literature study revealed some possibly negative effects as well as positive effects of e-commerce. For example, one can argue that pollution from the transportation used to reach shopping malls can be avoided, retail space can be reduced, inventories and waste can also be reduced by the virtue of E-Commerce. However, one should also consider the fact that a product ordered online may be shipped partially by air freight across the country and require local truck delivery. Also, the product is likely to be packaged individually, which in turn causes various negative impacts. The adverse impacts on the environment due to such transportation can be significant, and the net effect of different logistics systems is not obvious. In our study we have focused on three major issues- energy, resources and pollution as these are crucial factors behind global warming [5]. In this respect we have also conducted a survey to know the level of awareness among people. Our aim behind this study and survey is to create awareness on the environmental impact of e-commerce and to find whether people are prepared to fix this problem at personal level and to figure out their level of concern about the ‘Mother Nature’.

The rest of the paper is organized as follows. A brief description of relation between ‘Environment and E-Commerce’ is given in section II. Section III describes the effects of E-Commerce on Global Warming. The survey conducted on ‘Environmental impacts of E-Commerce’ is discussed in Section IV and finally section V concludes the paper.

II. E-COMMERCE AND THE ENVIRONMENT

The overwhelming sustainable development and major technological innovations have not only brought fundamental change to the economic system but also extensive environmental impacts, for better or worse. The environmental implications, in most cases are a reflection of human economic activities as mediated by technology. After decades of development, the Internet brings a new era, in which world wide participants has been increasing as shown

in figure 1. This estimate is given for 1,966,514,866 Internet users on 30th June 2010 [8]. E-Commerce sales value is also increasing dramatically along with the Internet users.

From 2009 onward, the Internet is expected to grow significantly in Brazil, Russia, India, China, and Indonesia (BRICI countries). These countries have large populations and moderate to high economic growth, but still low Internet penetration rates. In 2009, the BRICI countries represented about 45 percent of the world's population and had approximately 610 million Internet users. But it is expected that, by 2015, Internet users in BRICI countries will be doubled [7]. With this increase in the usages of Internet its applications, more and more people will use the electronic commerce activities.

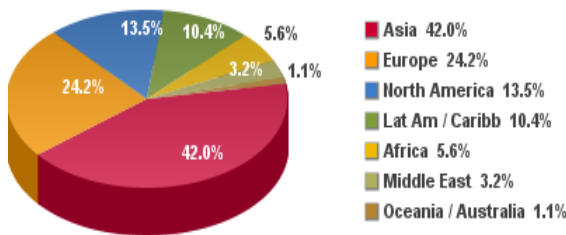


Figure 1. Internet user Development Internet world (source: [statshttp://www.Internetworldstats.com/stats.htm](http://www.Internetworldstats.com/stats.htm) [8])

As a consequence of increased Internet penetration some important questions are raised with some overwhelming challenges for scientists, policymakers and human society and they are as follows.

- Can the Internet-led information technologies serve as one of the most important means to improve the environment?
- Do demands for the development of a sustainable economy compete or coincide with the new reality of the e-commerce?
- Is e-commerce a truly clean, environmentally caring economy, which will simply lead to the substitution of information for physical resource flows along energy and transportation networks?
- Or alternatively, does e-commerce encourage more movement by generating new demands for material and energy that will further deteriorate the fragile environment?
- What kind of environmental policies should we develop in the Internet-led information age?

The founding father of modern computer science and technology ‘John von Neuman’ claim in his under-appreciated essay “Can we survive technology?” that technological power and efficiency is an unsure achievement. The study showed that e-commerce is not always the most efficient model in terms of cost, energy consumption, pollution, dematerialization, de-carbonization and demobilization [3].

A. Conceptual Model for Environmental Implications of E-commerce

Kalakota and Whinston, defined e-commerce from four perspectives: *communication perspective, business process perspective, service perspective and online perspective*. From a communication perspective, e-commerce is the delivery of information, products/services, or payments over telephone lines, computer networks, or any other electronic means; from a business process perspective, e-commerce is the application of technology toward the automation of business transactions and work flow; from a service perspective, e-commerce is a tool that addresses the desire of firms, consumers, and management to cut service costs while improving the quality of goods and increasing the speed of service delivery; from an online perspective, e-commerce provides the capability of buying and selling products and information on the Internet and other online services[1].

E-commerce has one broader and one narrower definition. The broader definition says that e-commerce is the activity that takes place among suppliers, customers and companies. The narrower definition of e-commerce concerns the Extranet and Intranet behavior.

The conceptual model of environmental implications defines e-commerce as the correlative activities among companies and their suppliers. It consists of two layers: company layer and its effects layer. Company layer has Intranet view and extranet view, and effects layer consists of *primary effects, secondary effects and tertiary effects*.

Primary effects are mainly caused by various infrastructures as communication infrastructures, computer infrastructures and Internet infrastructures. Secondary effects come from diversified applications as shown in warehousing, inventories, transportation, packaging and so on. Tertiary effects refer to the adjustment of the consumption pattern, new habits and so on [5,3].

1) Primary Effects

Internet is a very useful tool in reducing the building energy intensity. It also encourages sharing of infrastructure like equipments, networks etc. companies providing online movie centers, online advisory agencies, online billing systems do not need physical locations. Thus Internet can prevent the release of large amount greenhouse gases in the world [5].

2) Secondary Effects

Internal departments of the traditional companies, when apply advanced information technologies then it becomes highly efficient with tight collaboration, well communication and fast response. Companies grow very fast by moving many of its operations to the Internet. Many organizations are now using the Internet to improve communication between companies; and its departments. 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 [5].

3) *Tertiary Effects*

People used to visit, search, read, write and access the material online in intra-company systems or inter-company systems. This change in the habit of the individuals avoids the use of papers and thus result in large sum of saved paper consumption. E-commerce 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. Customer purchasing behavior is changed due to ecommerce 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 [5].

Therefore we can say that E-commerce supports paperless, building less and pollution less environment.

B. *Positive Impacts of e-Commerce on Environment*

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. Business may further reduce their carbon foot print, by allowing their employees work in virtual office, shopping online and working from home which reduces the number of commuters on the road. The number of commuters may further reduced if more business transactions could be conducted online. Moving towards the paperless society would be advantageous for deforestation which contributes to global warming. There are many ways in which digital transfer of information through ecommerce could be useful.

Ecommerce can potentially reduce waste and the need for inventory, warehouse space, operating cost of business. For example it is not required to have the office space on rent or to send out bills via the traditional more expensive means using papers. Further for the benefit of the environment recyclable packaging of goods must be used.

E-commerce has also been alleged to prevent waste by vastly increasing the efficiency of the market for secondary materials through online auctioning on a global scale [4, 3].

C. *Negative Impacts of e-Commerce on Environment*

The imagination of the “negative environmental impact” of e-commerce is very difficult. It does not release any pollutants and also not uses much energy or natural resources. The negative environmental impacts of E-commerce are not only present but also these impacts are significant. The nature and magnitude of these negative impacts are such that the ways to resolve them are by no means evident or familiar to us.

A closer look at the environmental impacts of the Internet quickly reveals that the potential positive impacts are only one side of the story. Although the potentials of the Internet to save material and energy cannot be denied, it is too early to conclude that e-commerce has only positive impacts on environment. Each potential positive impact is coupled with a potentially overwhelming negative impact as well. For example, moving business online can reduce waste such as printed catalogues, retail space, and transportation requirements, but we have to manufacture more energy intensive computers instead! Web-based marketing may encourage profligate rather than savvy consumption. Indeed, the Internet has already dramatically increased mass production of various products on a global scale. The ease of online shopping itself causes people to buy more.

In terms of energy consumption, faster delivery requirements tend to create a situation in which trucks are moving half empty. E-commerce also tends to favor faster transportation modes, which can increase fuel consumption exponentially. When we opt for trucks instead of boats or rail, energy use goes up by a large factor. Moving the same package by air again increases the energy use dramatically. Therefore, some of the increase in transport energy consumption can be attributed to the growth in e-commerce as it tends to encourage the consumer preferences to more energy-consumptive, faster deliveries trips. The Internet economy is a double-edged sword. Despite the growing literature on environmental impacts of e-commerce, our knowledge of the extent of, and mechanisms behind, the patterns of material use and energy consumption are very limited. At this stage the question may arise: Can we survive the Internet? [3]

The environmental effects of e-commerce focuses on three aspects: energy, resources and pollution [5]. As of today the scientists or policy makers still do not have clear statements about relationship between the ecommerce and the environment. But of course it has potentials of positive environmental impacts which has been summarized as three D's for the new economy: dematerialization which reduces the material consumption by shifting books to bytes, compact disks to MP3s, check books to clicks and so on, de-carbonization by reducing the Green House Gas emissions and making the goals of Kyoto protocol easier [6] and demobilization by reducing the transportation [3].

III. EFFECTS OF E-COMMERCE ON GLOBAL WARMING

‘Global Warming’ is a phrase that refers to the effect of human activities on the climate. The burning of fossil fuels (coal, oil and gas) and large-scale deforestation cause emissions of large amounts of greenhouse gases, of which carbon dioxide emission has most significant impacts on global warming. Political leaders had gathered in Kyoto, Japan, in December 1997 to consider a world treaty restricting human production of “greenhouse gases,” chiefly carbon dioxide. They feared that CO would result in “human-caused global warming”—hypothetical severe

increases in Earth's temperatures, with disastrous environmental consequences. Many political efforts have been made to force worldwide agreement to the Kyoto treaty during the past 10 years [6].

E-commerce strongly improves the energy efficiency of the economy [4]. Each potential positive impact is coupled with a potentially vast negative impact as well. For example, moving business online can reduce waste such as printed catalogues, retail space, and transportation requirements, but we have to manufacture more energy intensive computers instead! In fact, carbon dioxide emissions and energy use for the online purchase were found to be 35% less than a trip in a car to the mall [5, 6].

IV. SURVEY ON ENVIRONMENTAL IMPACTS OF E-COMMERCE

We conducted a survey on Environmental Impact of E-commerce At JSS Academy of Technical Education, Noida. The survey contained ten questions, all of which were created by us. 500 people who are well aware of e-commerce were surveyed in total. After this we analyze the results of survey. In this survey we had involved the students and faculty members of JSS Academy of Technical Education, NOIDA. We spent several hours devising a 10 question survey form with closed questions which aims to create awareness, concern and willingness to act regarding environmental impacts of e-commerce.

A. Notable findings and Analysis

Q1. Are you aware of Global Warming?

- a. No
- b. Yes, I have heard of it but am *unsure* what it is
- c. Yes, I have heard of it and have *some* understanding about what it is
- d. Yes, I have heard of it and have a *good* understanding of what it is

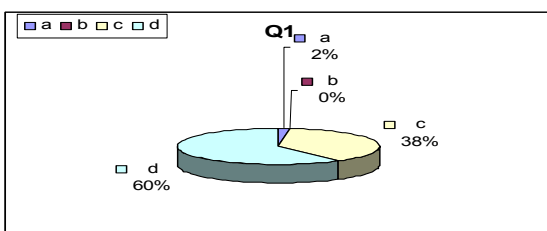


Figure 2. Result of Question 1.

Q2 Do you responsible for think E-Commerce increasing Global Warming?

- a. Yes
- b. No
- c. Unsure

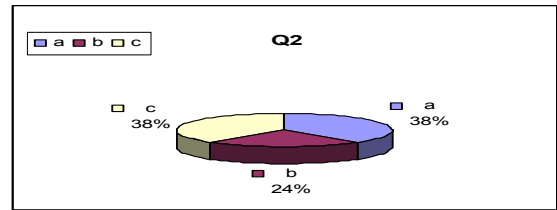


Figure 3. Result of Question 2

Q3 On a scale of One to Five how concerned are you about Global Warming?

- a. 1
- b. 2
- c. 3.
- d. 4
- e. 5

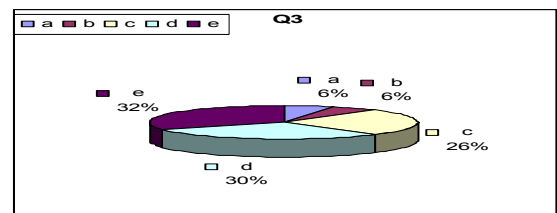


Figure 4. Result of Question 3

Q4. Do you think potentially positive Environmental impacts of E-commerce are much more than potentially negative impacts?

- a. Yes
- b. No
- c. Unsure

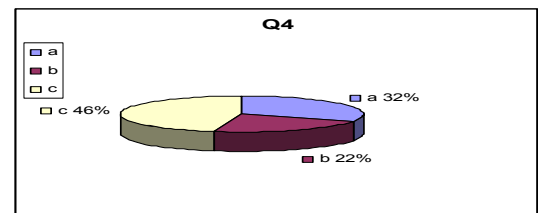


Figure 5. Result of Question 4

Q5. On a time scale, when will the impacts of E-Commerce be a major risk to Environment?

- a. They are now
- b. Not for at least 10 years
- c. Not for at least 20 years
- e. Not for at least 50 years
- f. Not at all

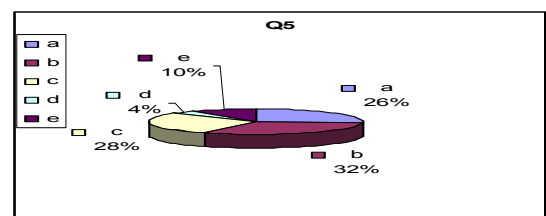


Figure 6. Result of Question 5

Q6. How quickly do you think something should be done about Global Warming?

- a. Start Now
- b. to do something in the next 5 years

- c. Start to do something in 10 years time
- d. Start to do something in 20 years time
- e. Never, it is not a problem

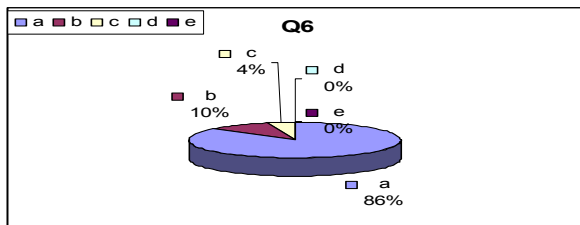


Figure 7. Result of Question 6

Q7. Are you personally prepared to do something about Global Warming?

- a. Yes
- b. No

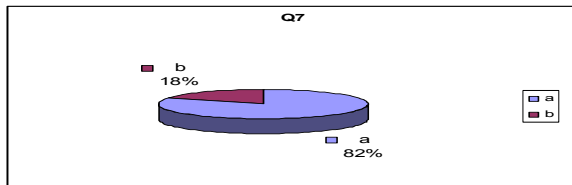


Figure 8. Result of Question 7

Q8. Do you believe acting on environmental impacts of E-Commerce will end up costing you financially?

- a. Yes
- b. No
- c. Unsure

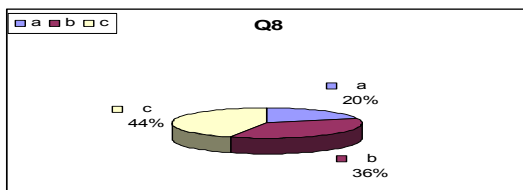


Figure 9. Result of Question 8

Q9. Do you think it is possible to reduce negative impacts of ecommerce on environment?

- a. Yes
- b. No
- c. Unsure

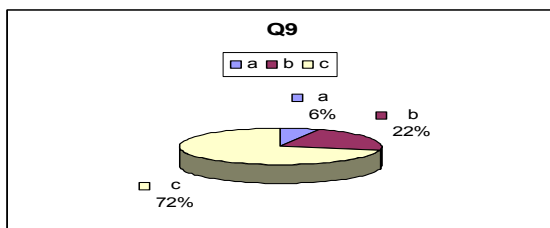


Figure 10. Result of Question 9

Q10. Who do you think should be responsible for doing something about reducing negative impacts of ecommerce on environment?

- a. Governments
- b. Businesses
- c. Individual's
- d. Both a and b
- e. All a, b and c
- f. No-one

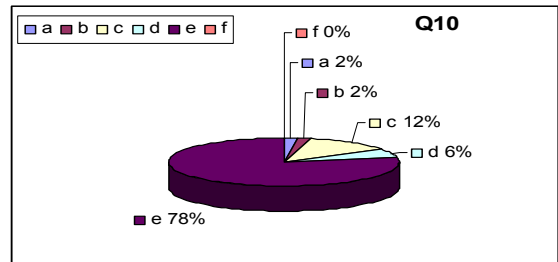


Figure 11. Result of Question 10

We came up with some interesting facts which are listed further. Sixty percent of the people have heard of global warming and have a *good* understanding of what it is. People do not have clear idea about the relation of E-Commerce and global warming and also its positive or negative impact. Almost sixty percent of people think that e-commerce will not be the major risk to environment for at least 10 to 50 years while 26 percent of people think that it is on the door. 86% of the people think that we should take the steps now and they are personally prepared for it but approximately 72% people do not know whether it is possible to reduce negative impacts of ecommerce on environment or not. Finally 78% public is agree on the fact that Government, Businesses, and Individuals altogether should be responsible for doing something about reducing negative impacts of ecommerce on environment.

V. CONCLUSION

It is very clear from the different studies, surveys and our experiences that the ecommerce is actually a double-edged sword. The positive impacts of ecommerce are that it is energy saving and time saving but these aspects are related to negative impacts also, such as pollution, wastage of material, resources and energy. So it is very difficult to state that the environmental implications are positive or negative and it is not easy to clearly define whether the positive effects have the weigh over the negative ones, or the reverse is true. Since, it has two aspects so people need to find how to balance these two aspects. It is totally dependent on the people who are the users of the Internet that how they use it. If it is used properly then it will be in the benefit of the society otherwise it may be the reason of spoiling the environment for forthcoming generations. The important issue is that environment does not have to bear at the cost of the economy.

In the future, as consumers become more attentive of the negative environmental impacts of e-commerce, they may insist to select e-commerce with only those organizations that

follow the rules and enforce an ethical perspective for reducing its negative impacts as carbon emissions.

REFERENCES

- [1] Tuerk V., "Assessing the resource intensity of the Internet structure" Master's Thesis, International Institute of Industrial Environmental Economics, Lund University, Lund, 2001
- [2] Fichter, K., "Environmental effects of e-business and Internet economy", Working Paper for the German Federal Environment Ministry (BMU), Borderstep Institute for Innovation and Sustainability, Berlin, 2001.
- [3] Daniel Z. Sui, David W. Rejeski, "Environmental Impacts of the Emerging Digital Economy: The E-for-Environment E-commerce?" ,Springer-Verlag New York Inc Environmental Management Vol. 29, No. 2, pp. 155–163, 2002.
- [4] Digital Europe – EC Project, "Virtual Dematerialization: E-business and Factor X", project funded by the European Community and the Information Society Technology Programme, 2002
- [5] Lifang Peng, Qi Li2, Xianfeng Zhang " Optimism or Pessimism: Environmental Impacts of the E-Commerce." Environmental Informatics Archives, Scholl of Management, Xiamen University, Xiamen 361005, China 2School of Economics and Finance, Volume 3, pp 263 – 269, 2005.
- [6] Keshnee Padayachee, "Utilizing E-Commerce and M-Commerce Applications to Address the Effect of Global Warming", E-Leader Karakow ,School of Computing University of South Africa Unisa, South Africa, 2008
- [7] Hanne Siikavirta, Mikko Punakivi, Mikko Ka`rkka`inen and Lassi Linnanen "Effects of E-Commerce on Greenhouse Gas Emissions.", A Case Study of Grocery Home Delivery in Finland, *Journal of Industrial Ecology* Volume 6, Number 2 , pp 83-97, 2008
- [8] "Internet users in BRICI countries set to double by 2015". International BusinessTimes ,IBTIMES.com, 2010-09-01, <http://www.ibtimes.com/art/services/print.php?articleid=48062>, Retrieved on 09/12/2010
- [9] Internet usage statistics, "The Internet Big Picture World Internet Users and Population Stats" ,<http://www.Internetworldstats.com/stats.htm> retrieved on 09/12/2010.