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Digital Technologies and Environmental Impact

Monica Rathee ¹, Jyoti ^{2,*} and Anju Bala ³

¹ Department of Computer science, GPGCW Rohtak, Haryana, India.

² Department of Computer Science, GCG Mohana, Sonipat, Haryana, India.

³ Department of Computer Science, Haryana, India.

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Abstract

Information and communication technologies (ICTs) are a collection of devices and services that acquire, transfer, and display data and information digitally. Information and communication technology (ICT) is developing rapidly and is playing an increasingly important role in society. The role of ICT in environment management gains more importance due to its extensive use in various arenas of environment like weather forecasting, systems in the climate change, forest Degradation, hurricanes and typhoons anticipations, smart waste management systems, energy supply efficiency and tourism industry. The impacts of ICT can be seen both positive as well as negative. Thus, ICT plays a crucial role in environmental economics. ICT needs to be use in most effective ways thereby reducing the operational challenges that are directly responsible for production of significant amount of electronic waste generated at the end of the useful lifecycle of an ICT gadget and Green House Gases (GHGs). The collaboration of ICT with environment must focus on reducing energy consumption and carbon emissions from the design, use and disposal of technology products.

Keywords: ICT; Sustainable Development; Green ICT; Pollution

1. Introduction

The term "information and communications technology" (ICT) refers to a broad range of communication devices and applications, including satellite systems, radios, televisions, cell phones, computers, network software, and so forth, along with the numerous services and applications that are related to them, like videoconferencing and distance learning. Conventional and traditional methods for designing, implementing, and validating ICT systems usually address one or two primary system concerns at once, such as an enterprise system's functionality or dependability or a database's security and privacy. A different engineering effort often addresses additional aspects. System engineering techniques that are not intended to reflect, detect, or manage the interdependencies are the result of this separation of concerns.

A key component of digitalization's sustainability is reaching environmental protection objectives. Growing digitalization poses a problem to resource conservation as well as an opportunity. The increasing adoption of information and communication technology (ICT) has led to a rise in resource and energy consumption, even if intelligent control of devices, systems, processes, and networks greatly helps to save energy in many areas. Microelectronics and power electronics require significant transformation in terms of both design and production. However, in order to completely eradicate the environmental pollution that ICTs cause, the current ICT model needs to be improved. Some specific methods that can be taken to prevent environmental pollution from ICT include designing server centres with minimal energy consumption and ICT devices with long lifespans. The goal of green ICT is to lessen the environmental impact of ICT. The goal is to lower the energy consumption of servers, PCs, and data centres.

* Corresponding author: Jyoti

2. ICT and Environment

ICTs and the environment have a complicated and nuanced interaction since they can have both beneficial and bad effects. Dematerialization and online distribution, the replacement of transportation and travel, a variety of monitoring and management systems, increased energy efficiency in production and use, and product stewardship and recycling can all have positive effects. Negative effects might result from short product life cycles, eWaste, energy consumption in usage directly and for cooling, materials utilized in the manufacture and distribution of ICT equipment, and exploitative uses like remote sensing.

Environmental management and protection: involves everything related to managing and mitigating impacts on the environment as well as helping adapt to given environmental conditions. This includes resource and energy conservation and management systems, GHG emission management and reduction systems and controls, pollution control and management systems and related methodologies, including mitigating the ill effects of pollutants and man-made environmental hazards.

Impact and mitigating effects of ICT utilization: producing, using and disposing of ICTs require materials and energy and generate waste, including some toxic waste in the form of heavy metals. ICT use can mitigate the environmental impacts directly by increasing process efficiency and as a result of dematerialization, and indirectly by virtue of the secondary and tertiary effects resulting from ICT use on human activities, which in turn reduce the impact of humans on the environment.

Environmental capacity building: efforts to improve environmental conditions rely on the actions of individuals and organizations. Capacity building includes efforts to increase public awareness of environmental issues and priorities, the development of professionals, and integrating environmental content into formal education.

ICTs can have direct effects on the environment, such as energy consumption and e-waste; indirect effects on the environment, such as the effects of ICT applications, like intelligent transportation systems, buildings, and smart grids; or third-order and rebound effects, which are the effects made possible by the direct or indirect use of ICTs, like increased use of more energy-efficient transportation. The precise nature of ICT's benefits and the potential for rebound effects are hotly debated subjects. Nonetheless, it is evident that assessments of ICT's environmental consequences must consider the full life cycle and possible rebound effects in addition to the immediate effects of the product or service.

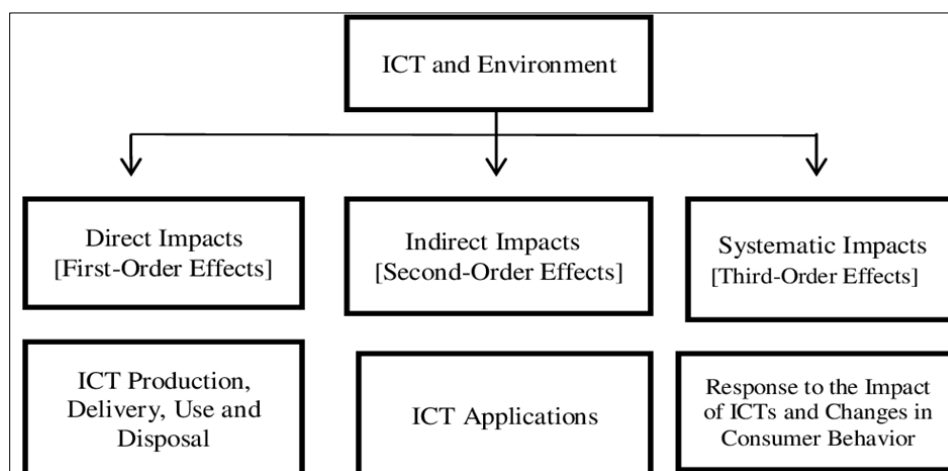


Figure 1 Ecological Dimensions of ICT

Three orders of impacts combine to produce the environmental impact of ICT in cities: The procurement, manufacture, usage, and disposal of raw materials are all factors in the first order effects of ICT goods and networks in urban areas. Consideration is given to the effects of the entire life cycle for products, networks, and services.

The second order effect refers to the environmental impact owing to the usage of ICT in other products or sectors in order to minimize their GHG emissions or energy consumption. Urban infrastructure such as airports, buildings, public administration, sports venues, transportation, street lighting, water management, and security systems may all be made

more sustainable with the help of ICT. ICT can also promote dematerialization and improve other technologies' optimization, including boosting power efficiency.

3. Impacts of ICT

ICTs and the environment have a complicated relationship because they can have both beneficial and bad effects. Information and communication are at the core of ICTs, and these are the responsibilities that matter most. Data must be gathered, examined, and evaluated in order to provide knowledge that helps people make more environmentally friendly decisions. Knowledge must then be disseminated to people in a way that will enlighten, educate, and influence their behavior. Even if it were possible to correctly interpret price signals, it is not enough to just shape behavior. Information-gathering, performance monitoring, and non-price feedback must also be given in order to inspire and incentivize people and communities to build sustainable means of subsistence.

Table 1 Environmental impacts of ICT

	Positive impacts	Negative impacts
The first-order or direct impacts	The use of ICT in environmental monitoring and control	Environmental impacts of the manufacturing and use of ICT devices and equipment (e.g. generation of electronic waste)
The second-order or indirect impacts	Structural changes and resource conservation (a reduction in the amount of resources consumed in the economy)	Incomplete substitution of goods and services with ICT Systemic or rebound impacts
The third-order impacts	Lifestyle changes (e.g. directing consumption towards green and environment-friendly consumption)	
Source: Organization for Economic Co-operation and Development (OECD, 2001)		

4. Positive Impact

Understanding the environment and the effects of climate change requires the use of ICTs. ICTs can also offer instruments to reduce greenhouse gas emissions by, e.g., updating mass transit or improving the efficiency of electrical load and energy management. They can also be very helpful in disseminating knowledge about disaster relief and climate change.

In response to disasters, innovative technologies and ICTs are being rapidly deployed around the world as they offer new options to mitigate and adapt to new risks such as climate change. ICTs aid in environmental protection, awareness-raising, monitoring, and analysis of both short- and long-term climatic changes, as well as in lowering carbon emissions. Concern over how human activity affects the environment, and specifically our climate, is growing as it affects life as we know it. People are becoming more vulnerable to major weather disasters like hurricanes. ICTs are crucial in generating useful data that aids decision-makers in formulating well-informed policies and recognizing and controlling the risks of disasters.

5. Negative Impact

Negative effects might result from short product life cycles, e-waste, energy consumption in usage directly and for cooling, and materials utilized in the manufacture and distribution of ICT equipment.

ICTs may have a detrimental impact on both our health and the environment. This is primarily due to the electronic waste produced when an ICT device reaches the end of its useful life, rather than just the operational consumption. As can be seen, ICT use is expanding exponentially, permeating every part of our lives—at work, at home, in the air, on the water, and in many retail establishments, to mention a few. ICTs have also assisted us in overcoming a number of obstacles, including increasing our productivity, effectiveness, and efficiency as well as connecting us globally and

providing us with endless entertainment options. But this worthwhile sector also has a drawback, which is its contribution to greenhouse gas emissions.

Hardware for information and communication technology (ICT) is required by society in order to create, handle, and preserve extremely important information. Naturally, the production of this technology has an impact on the environment at every stage of its life cycle. Rare earth metals, for example, are valuable and limited resources that are frequently mined under harsh environmental conditions. This causes pollution of the air, water, and soil both now and in the future. Energy utilization has an effect on the environment while ICT hardware is being used. Additional environmental effects of ICT hardware disposal in landfills as e-waste, recycling, or disassembly at the end of its useful life. A growing number of producers and users—particularly businesses—want to quantify these effects, which is a difficult undertaking. The production and use of ICT devices has the potential to become a significant source of emissions, even if they can be used to increase energy efficiency and minimize CO₂ emissions and environmental deterioration. Furthermore, non-renewable and non-recyclable components included in many ICT gadgets have the potential to seriously harm the environment.

6. Conclusion

Rapid advancements in both developed and emerging nations' economies and technology could have a negative impact on the environment globally. From the standpoint of globalization, the quick development and expansion can be used to improve communication and exchange of ideas between individuals, groups, and nations worldwide, including China. This helps to support economic growth on one hand while negatively impacting the environment on the other. In light of this, the study's primary objective is to examine how globalization and information and communication technologies relate to environmental deterioration, including CO₂ emissions and ecological footprints, while maintaining an eye toward economic progress. Green ICT could be a solution with aim to minimize the negative effects of IT operations on the environment by designing, manufacturing, operating and disposing of servers, PCs and other computer-related products in an environmentally friendly manner. The motives behind green IT practices include reducing the use of hazardous materials, maximizing energy efficiency during a product's lifetime, and promoting the biodegradability of unused and outdated products.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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