Green IT: An Analysis of Eco-Friendly Information Technology Strategies

Mark Clifton*

PO Box 5311, Plymouth, MI 48170, USA

Abstract: As technology progresses and proliferates, there is a growing need to address the environmental impact. The increasing energy demands and waste disposal needs are often overlooked areas of Information and Communications Technology (ICT). The magnitude and rapid pace of technological advancement have brought on concerns about sustainability and environmental responsibility. This article details those concerns, identifies challenges to green technologies and Information Technology (IT) management, and highlights possible strategies and solutions for the future.

Keywords: Green Information Technology.

1. INTRODUCTION

1.1. Climate Change

Since the Industrial Revolution, Earth’s ecology has been undergoing constant change. The world’s exponential population growth has brought on an ever-expanding depletion of natural resources. Large-scale, factory-based production has led to serious environmental concerns, including deforestation, depletion of oil and gas reserves, and increasing carbon emissions [1].

In the past century, a number of global climate changes have been observed. Human activities have led to excessive increases in heat-trapping gases. Global average temperatures and sea levels have risen, and precipitation patterns have changed significantly [2]. Over the next several decades, it is predicted that an unprecedented combination of climate change and associated repercussions will exceed a number of ecosystems’ capacities for resilience [3].

Since the dawn of the modern environmental movement, a significant amount of scientific research has been devoted to observing and detailing the effects of global climate change, which adversely impacts human life and all natural systems on Earth [3]. The Intergovernmental Panel on Climate Change has stated that it is virtually certain that global surface temperatures will continue to rise at an increasing rate, between now and 2100, causing further changes in water cycles, weather patterns, and sea levels [4].

1.2. Technology and the Environment

While studies have implicated the positive improvements that technology can bring to the issue of global climate change [5], most innovations of the past few decades have done little to slow down or reverse environmental damage [1]. In fact, the rise of big data and mass computing has added to the burden. In the United States, electricity usage for servers and data centers creates a carbon dioxide equivalent of 103 billion pounds [6]. Perhaps even more concerning, a significant portion of the electricity used in these data centers is unnecessary, with 20 to 30 percent of the servers being unused or obsolete, yet still plugged in and drawing power [7].

1.3. ICT Waste Disposal

Proper disposal of electronic waste is another major concern. In 2016, roughly 45 million metric tons of e-waste was generated globally, yet only 20% was properly recycled [8]. In 2010, the US alone disposed of 52 million computers and 152 million mobile devices [9]. A large amount of this waste is exported to developing countries, which poses serious concerns from both sustainability and social responsibility perspectives [10].

The development of information technology and computing power continues to rapidly grow in both scale and scope. As the production of devices becomes cheaper and more precise, the cost of data storage and processing capabilities becomes lower. Thus, there is less of a need to be selective about data retention. With an almost endless amount of data being stored in cloud data centers, and devices being manufactured and replaced at an increasing rate, the amount of waste generated far outpaces current...
sustainability efforts [1]. The manufacturing process alone represents 60-85% of a personal computer's life cycle energy demand and 50-60% of a mobile phone's [6].

1.4. Going Green

Over the past five decades, many companies have faced economic challenges in dealing with tougher environmental standards. Prior to government laws and regulations, the primary costs of pollution were realized by society. These costs have subsequently been monetized internally by pollution-generating companies [11]. For years, corporate efforts to create green initiatives and enforce environment-friendly policies were seen as an economic burden [11]. Green initiatives, especially ones that go beyond compliance, have typically been cost prohibitive for companies.

The proposition of this article is that for green initiatives and technologies to become prevalent in businesses, and more specifically the field of Information and Communications Technology, there must be a clear economic incentive. Increased profits, direct cost savings, or a competitive advantage must exist in order for companies to be motivated to adopt green practices and technology. Analysis was conducted to identify green initiatives that meet this criteria.

2. METHODOLOGY

The scope of this article involves a systematic review of relevant literature and empirical evidence on green practices, technologies, and relationships to the field of Information and Communications Technology. As IT is typically a function that supports business, a broader analysis of the economic viability of green technologies has been done.

The primary goal of the study was to identify green IT initiatives that have a reasonable chance at succeeding in the profit-driven business world. Given the high energy consumption and e-waste generated by IT, it may be a prime candidate for furthering the environmental cause, while also providing cost savings to the respective companies.

This article intends to provide an overview of these concepts. Articles, case studies, and company examples were identified through an open search on Google Scholar and the East Carolina University Library research tool, One Search. The selected sources were chosen in order to provide relevant background information, as well as supporting evidence.

The literature review for this article was conducted with the scope of the topic in mind, and began with an iterative process of brainstorming keywords pertinent to Green IT and accompanying phrases. The specific term “Green Information Technology” returned 2,010 hits on Google Scholar and 1,143 hits on the ECU library search. In order to obtain newer, possibly more relevant results, the search was trimmed to text that was published within the last three years (329 hits – ECU Library). Additionally, the term search was expanded to other search engines, such as Elsevier Science Direct, ProQuest, and EBSCO. Similar hits and sources were obtained. Several other terms and phrases were searched, some in combination, to gather further information surrounding Green IT. Phrases such as “Challenges to Green Technology” and “Benefits of Green IT” were used, and the terms “IT”, “ICT”, “Information Technology”, and “Technology” were swapped to provide overlap of coverage.

After identifying articles and books that matched the search criteria, abstracts and summaries were read and evaluated. They were categorized into groups of “direct relevance”, “indirect relevance”, and “not relevant”. Texts determined to be directly relevant were then further evaluated to determine if they were relevant to this study.

Relatively few articles exist on the specific topic of Green Information Technology. The area of Green Manufacturing, or the broader Green Technology, produce significantly more literature and research studies.

3. RESULTS

3.1. Environmental Regulations

The problem of climate change and environmental damage is not new. The modern environmental movement in the United States dates back to the 1960s and early 1970s. A handful of human-caused disasters brought the matter into the public spotlight. Oil spills off the coast of California, health effects from widespread use of pesticides, and wildlife deaths caused by pollution in the Great Lakes, helped set the wheels of environmentalism in motion [12]. In 1970, the formation of the Environmental Protection Agency, along with the Clean Air Act, set the basic framework for regulatory legislation and oversight of environment-related activities [12].
The environmental movement has brought ever-increasing regulations and legal restrictions for businesses. In more recent years, companies have begun to invest in environmental corporate social responsibility initiatives. One of the challenges of these programs is finding a balance between meeting environmental objectives and maintaining competitive advantage [13].

3.2. Effects on Business

Many companies have struggled to successfully implement green technologies, largely due to high upfront costs and implementation difficulties. Estimates suggest that most green IT projects are canceled before ever coming to completion [1]. Other studies have cited raw material shortages as a reason for the unrealized potential of many green technologies [14]. A significant number of material bottlenecks have been identified in the long-term production and development of wind power, solar thermal power, and passenger electric vehicles [14]. The recycling rate for many materials, such as lithium, will need to increase significantly, in order for green technology production to overcome the constraints [14]. These challenges have built upon some of the long-held beliefs that green initiatives are costly and counterproductive for business profitability [11].

3.3. Going Beyond Compliance

Information Technology presents a ripe area for putting green practices in place that can reduce environmental harm and provide immediate cost savings to businesses. IT comprises a big part of a company’s environmental footprint. Networks and end user devices have a relatively short lifespan, ranging from 3 to 7 years. The manufacture of IT devices has created toxic hotspots, and IT energy consumption is a large portion of an organization’s total electricity costs [15]. Energy usage may be one of the biggest areas for improvement. Based on mid-range estimates, the global ICT ecosystem uses as much electricity as was used to illuminate the entire world in 1985 [1]. In 2013, U.S. datacenters consumed 91 billion kWh of electricity, at a cost of $13 billion [6]. Modest reductions to energy use in IT would provide significant improvements to environmental sustainability and save company’s money [15].

3.4. Green ICT Initiatives and Recommendations

There are a variety of green technological developments, both on a component and system level, which can be considered by companies when designing a sustainable framework and IT infrastructure [16]. While promising, many organizations are hesitant to voluntarily adopt these technologies due to high upfront costs [17]. However, there are a number of low-cost practices that companies can implement that will both save money and promote environmental sustainability. With economic incentive, these initiatives are much more likely to see success [15]. Recommended measures include the following:

- Making informed IT purchase. Both Energy Star and the U.S. EPS’s Electronic Product Environmental Assessment Tool provide excellent resources for researching the environmental impacts of IT equipment [6].
- Implementing virtualization to consolidate server hardware [15].
- Extending device lifecycles to reduce waste and prevent early, unnecessary disposal [6].
- Implementing proper recycling processes for all IT equipment [1].
- Utilization of power-saving modes on IT equipment. It is estimated that energy consumption could be reduced by 23% if all office equipment had and used low-power mode [6].
- Adopting a basic server utilization metric for data centers. A metric such as the average CPU utilization would help curb the primary data center efficiency issue of underutilization of servers [7].
- Align financial incentives with energy-efficiency best practices. Standard data center contracts in the U.S. do not promote efficiency, with most based on square footage rather than power consumption [7].
- Disclosure of data center energy and carbon performance. Data center and IT energy usage is often overlooked or unreported. Public disclosure can be a means of driving change and promoting corporate and social responsibility [7].

4. CONCLUSION

Based on the reviewed literature, green technology and innovations offer some promise for the future, but
raw material and cost challenges exist. This, in turn, can prevent cost-conscious businesses from adopting efforts.

A practical strategy for businesses and IT departments to become more eco-friendly, and simultaneously reduce costs, is to implement green IT practices. Process improvements that pay attention to energy use, e-waste disposal, and recycling can provide significant cost savings and promote sustainability [6].

In the larger scope of industrial environmental damage, these initiatives may seem small and inconsequential. One company recycling equipment and being energy-conscious may not appear to make much of a difference. But, if the general IT community promotes green processes and implements recommended best practices, it can make a sizable contribution to overall sustainability efforts [1].

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