



Relation of ICT and Sustainability in Different Aspects of Businesses

Saba Bahrami

Department of Industrial Design, Tabriz Islamic Art University, Tabriz, Iran.

Corresponding Author: n.anzabi@tabriziau.ac.ir

Received: 20 June 2020

Accepted: 26 July 2020

Published: 17 August 2020

Abstract

Sustainability has increasingly become important to societies in various aspects of business, research and practice. It is as a result of rapid depletion of natural resources and concerns over wealth disparity and corporate social responsibility. In this context, the relation between information technology and sustainability is a subject of controversy by the media and by decision makers in business and politics, as IT is being considered to be a green technology and in relation with issues of energy and environment. The transition to a global information society holds many opportunities for sustainable development. Although various studies have proven the influence of IT, there is not a clear framework describing the linkages between IT and sustainability. Therefore the paper aims to clarify the role of IT in sustainable development by dividing the linkages into positive and negative sides. It is concluded that IT has positive effects in environmental, economic and social aspects while there are detrimental effects in informational, environmental and economic sides related to sustainability.

Keywords: Sustainability; information technology; triple bottom line; linkage.

How to cite the article:

N. Anzabi, *Relation of ICT and Sustainability in Different Aspects of Businesses*, *J. Practical IT*, 2020; 1(4): 07-12,

1. Introduction

In the last few decades, the idea of sustainability has progressively developed in the world and it has become as the cornerstone of social, economic and environmental policies. It considers the three mentioned domains (environment, economy and society) as the most important aspects which are named "The Three Pillars of Sustainability"[1] and tries to balance among them. "In this context, sustainability assessment has emerged as a new scientific discipline that aims to inform all actors in order to steer society towards that goal" [2]. "The use of this term goes back at least to the 1960s in economics and to the early 1970s in environmental management" [3].

However, it was in the 1987 that the first document widely recognized as the minter of the sustainable development with the title "Our common future"(also known as the Brundtland report) from the World Commission on Environment and Development (WCED) of United Nations [4,5]. The report reached more importance in late 20th century's environmental policies, though. It had a central role at the United Nations

Conference on Environment and Development (UNCED) in Rio de Janeiro in 1992 and provided the basic ideas for the Agenda 21 document adopted there. More recently, sustainable development has also become a catchword for corporate social responsibility [3,6].

The WCED discussed the definition of sustainability as "the development that meets the needs of the present without compromising the ability of future generations to meet their own needs" [7]. This very concise sentence distills the three pillars of sustainability, which are economic, environmental, and social development. However, some authors institutes "the triple bottom line" to the three-pillar concept, to refer to the economic, environmental, and social issues of sustainability [4]. In fact, TBL was firstly coined by Elkington that "he used the terms profit, people, and the planet as the three lines" [8]. Driven by sustainability, TBL provides a framework for measuring the performance of the business and the success of the organization using three lines: economic, social, and environmental [9]. In essence, TBL expresses the expansion of the environmental agenda in a way that integrates the economic and social lines [10].

While sustainability has increasingly become an important issue in every field such as management, business, economy, industry and etc., its relation to new incoming modern technologies has been a subject of controversy. Most importantly, information technology (IT), which is the dominant technology in the 3rd millennium, has also opened its way into the sustainable development. “Recent research has shown that competition in the business market has heightened since the mid - 1990s and that one of the main reasons is the significant increase in investments and application of Information Technology” [11]. Various studies have proven the influence of IT in all aspects of business and the importance of IT resources in enabling business capabilities that help firms survive and thrive. However, little research has examined the role of IT resources in enabling firms develop capabilities to address TBL issues.

“In practice, the major contributions of IT to sustainability has been centered on reducing IT’s energy consumption through green IT initiatives” [12]. However, assessing the sustainability through information technology isn’t just a matter of measuring environmental pollution. It’s an all-encompassing view of how we design, organize and operate the information systems that allow us to carry out our work and live our lives and doing so in a way which considers not only the impact on the planet today, but also how we develop, use and preserve information resources for ourselves and others in the future. “Meanwhile, in order to develop capabilities to address TBL issues, businesses need to engage in wide ranging activities such as changing business culture and redesigning business processes. Given the recognized role of IT resources in enabling business capabilities, it is arguable that IT resources should be critical in enabling firms to develop capabilities to address sustainability issues, deliver sustainability values to stakeholders and gain sustained competitive advantage” [11].

This paper aims to clarify the contribution of IT to sustainability. After the introduction, section 2 provides a brief review of sustainability definitions

and the triple bottom line. Section 3 introduces information technology and its general effects. Section 4 and 5 follows to identify the linkages between IT and sustainability which is divided into two main parts of positive and negative effects.

2. Sustainability

The term sustainability has been widely used and it seems more frequent than the concept of sustainable development. “It is intimately connected with the idea of intergenerational equity through the preservation of the environment or ‘ability to sustain’ usually leaving aside subjective social constructs around the questions of what exactly constitutes human development. In this sense, sustainability may be understood as a synonym of environmental sustainability”

[13] However the most popular definition mentioned in the previous part, is rather broad and even difficult for organizations to understand and apply, “much of the focus on sustainable development tends toward an ecological perspective without explicit incorporation of the social aspects of sustainability” [14]. “Still, different concepts of sustainability understood in a broader sense have been devised from different perspectives and scientific fields with the intention to boil these definitions down to a certain set of meaningful and objective indicators or operational principles”

[13] On the other hand, TBL is another construct that expresses the expansion of the environmental agenda in a way that integrates the economic and social lines as Elkington discussed. TBL provides a framework for measuring the performance of the business and the success of the organization using the economic, social, and environmental lines A TBL perspective of sustainability is illustrated in Fig. 1 [11]. “The term has also been referred to as the practical framework of sustainability. Targeted toward corporations, the TBL agenda puts a consistent and balanced focus on the economic, social, and environmental value provided by the organizations” [8].



Figure 1: The triple bottom line of sustainability [11]

In fact, it is argued that long-term profitability is best served by balancing it with social and environmental aspects. “A growing majority of corporations (68% of the top 250 global companies on the Fortune 500) has embraced TBL public reporting, alternately termed corporate responsibility or sustainability reporting. Many of those companies vie for industry, national, and international honors, such as the Dow Jones Sustainability Index, awarded to the world’s most sustainable firms by industry sector” [15].

“The success of the sustainability concept depends at least in part on the fact that it struck a middle ground between more radical approaches which denounced all development, and the idea of development conceived as business as usual” [3]. In particular, sustainable development is more palatable to most economists and politicians than the previously popular concept of ‘zero growth’ that implied an irresolvable conflict between economic growth and environmental preservation, and required the submission of the former to the latter [16].

3. Information Technology

The Information Technology which is the application of computers and internet to store, retrieve, transmit, and

manipulate data, or information, often in the context of a business or other enterprise, has provided many to help generate and process data, communicate globally, and improve productivity. Information Technology (IT) is generally defined as the technology for using, creating, storing, and exchanging information in a digital format. The industry is typically broken into three sectors: hardware, software and services. There are also a growing list of various sub-sectors.

IT has an enormously important effect in many fields such as economy and production. In fact, “by drastically reducing the cost of information and communication, IT advances have had tremendous economic effects. By helping to drive the globalization of markets and contributing to a greater knowledge intensity of economies, IT has led to the “knowledge-based economy, also known as the “new economy” or “weightless economy”” [17]. Chart 1 illustrates how IT has helped to drive knowledge-intensity growth in economic development. Despite the economic downturn that began in 2000 and continues today, IT continues to play a significant role in economic prosperity [17]. Chart 2 illustrates how IT is contributing a significant share to the productivity growth of many countries.

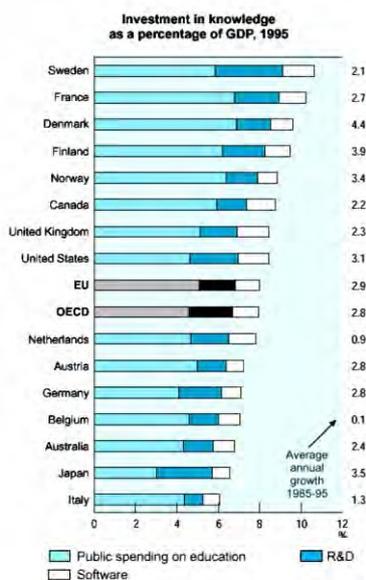


Chart 1: Knowledge Intensity of Today’s Economies [17]

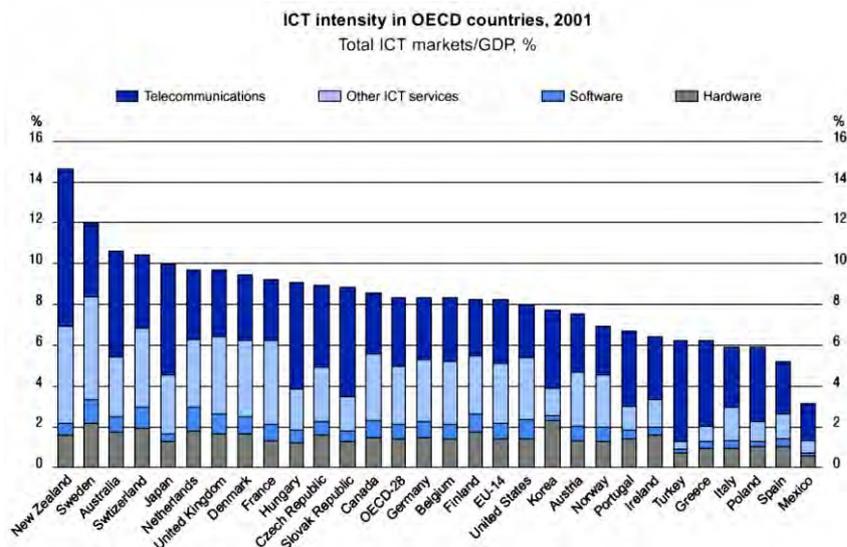


Chart 2: IT Contribution to Gross Domestic Product, 2001. [17]

In addition, there are a lot of reports by the United States, European Union, OECD and International Institutions related to the impacts of IT on the country’s development.(see for example: <http://www.oecd.org/EN/home/0,,EN-home-21-nodirectorate-no-no--21,00.html> and http://europa.eu.int/information_society/basics/aboutus/index_en.htm)

By developing sustainability as a concept to reach a balance among economy, environment and

society, many countries made tremendous efforts to reach to sustainability and simultaneously many efforts have been focused on IT as a potentially powerful, yet accessible and affordable means to facilitate the transition towards sustainability. “For example, there are a significant number of international initiatives focused on the potential role of IT in the empowerment of developing countries” [17].

However, the linkage between sustainability and IT has both positive and negative sides. The IT sector is uniquely positioned to realize new opportunities for triple bottom line. The need is growing for sustainability-oriented IT systems that can capture, manage, and integrate a complex range of economic, ecological, and social information for use in core business strategy and operations decision-making. For example, "Leading companies such as Hewlett Packard, Ford Motor Company, and DuPont are all exploring how to apply sustainability factors to supply chain logistics and product design. These firms are part of the first stages of a larger transition from environmental management to sustainability-oriented strategy and operations. An increasing number of analysts assert that this shift is becoming integral to corporate success in the changing context of the 21st century" [18]. Following, both sides of positive and negative effects of IT and sustainability will be discussed.

4. IT and Sustainability: Negative Linkages

Information technology plays a key role in facilitating the shift toward sustainability-oriented business. As the use of IT in business grows and both public and private demand for environmental and social responsibility increases, the need for effective sustainability-oriented IT systems will equally expand.

4.1 Decrease in Information Quality

"The IT revolution, particularly the advances in the Internet, has enabled tremendous growth in the quantity of all types of information. However, the consistent growth seen in the quantity of information has not translated into an increase in the overall quality of information available via the Internet. In fact, some may argue that the overall quality of information has unavoidably decreased, due to a "dilution" effect caused by a wide range of information sources and the unreliability of many of these sources. Information that is provided by IT tools and services is often automatically assumed to be usable, even reliable, when the reverse is more likely the case. This trend has potentially serious implications for utilizing IT for sustainable development, because projects could be relying on unsound information for guidance" [17].

4.2 Environmental Rebound Effects

One of the most significant disadvantageous effects of IT on sustainable development can be broadly classified as "rebound effects." An environmental rebound effect is a trend that emerges to counteract the energy, resource, and pollution reductions gained by IT production or use. Harmful rebound effects potentially occur when the widespread consumption of these products

result in harmful environmental impacts that offset the initial resource savings. These effects are usually classified as primary or secondary. Primary effects are direct environmental impacts due to the production and use of IT infrastructure [17]. Waste and Energy are the two aspects of primary effects. Although IT products seem to have less production of waste, it reveals that this is not always true [19]. Additionally, there are some examples of rebound effects from energy consumption due to IT use. For example, one study on book purchasing in Japan found that B2C e-commerce consumes slightly more energy than traditional retailing [20].

Secondary effects are environmental impacts that arise from "increased consumption of new IT products and services, and other changes in consumer behavior, which could outweigh IT's direct benefits" [17]. For example increased paper consumption is considered; even Email contributes to increased consumption. According to one source, an organization that uses email sees an average 40% increase in paper consumption as a result [21].

4.3 Economic Dependence

Another significant negative linkage between IT and sustainability is related to the over-dependence on IT for economic prosperity. The "bubble burst" of 2000 [22] is a solid example of this potentially harmful linkage. While the IT revolution helped to stimulate many economies in the industrialized and developing economies alike, it also contributed to an economic over-dependence on IT, which had disastrous consequences when the IT market began to suffer in 2000. Therefore, the implementation of diversified economic plans, which balance the focus between IT and more traditional markets and assets, represent a key and necessary strategy to leveraging IT for sustainable development.

5. IT and Sustainability: Positive Linkages

Many studies have argued that IT have significantly contributed to sustainable development goals. However there is a lack in holistic review. This part focuses on positive contributions between IT and sustainability.

5.1 Waste Minimization

The main and most considerable effect of IT is dematerialization. Shifting from tangible products toward intangible products, consist of services, is one of the main aspects in information revolution [23]. Indeed, substitution of services for physical products is one of the more profound examples in IT which introduced services such as voice mail to replace physical machines. In an example, the Swedish telecommunications company Telia conducted a life cycle comparison of their Telesvar

voice mail service with traditional answering machines, and found that voice mail services resulted in a 20-fold waste reduction [24]. Also the dematerialization of hardware results in significant cost savings for many businesses [17].

5.2 Energy Savings

“Energy intensity is an indicator that is commonly used to measure progress in energy efficiency. For example in the United States, energy intensity has declined steadily since the 1970s, with a more dramatic drop in intensity since the late 1990s” [17]. Mainly it is four sources that IT has effect in energy consumption: residential, commercial, industrial, and transportation. For example the market in new “clean” transportation is predicted to grow from \$2 billion today to \$10 billion in 2005 and \$ 48 billion by 2010.36 IT systems will play an important role in guiding both the development and deployment of clean transportation technologies [18].

5.3 Economic Stimulation

Economy is the other subject influenced by IT. For example the positive impacts of IT are visible in United States. According to the U.S. Department of Commerce, although IT industries account for a relatively small share of the economy's total output (an estimated 8.3 percent in 2000), they contributed to nearly 33% of U.S. economic growth between 1995 and 1999 [25]. “The declining costs and growing availability and diffusion of IT leads to potentially great prospects for stimulation of developing economies. For example, IT enables developing countries to leapfrog old technologies, such as copper wires and analog telephones, and invest in a wireless infrastructure, which is typically cheaper to install and easier to maintain than the traditional land line infrastructure” [17].

5.4 Lifestyle Changes

The potential of IT in using intangible products and developing services cause to change the lifestyle by affecting consumption patterns and preferences. For example teleconferencing allows employees to conduct meetings without having to travel. In addition, the availability of online stores has reduced the need to go to physical stores for shopping.

5.5 Social Benefits

The social benefits are the last positive impact of integration of IT and sustainability to mention. Internet based education, for example, is one of the best relevant cases. African Virtual University (AVU), an Internet-based university that provides online education and resources to students in 17 African countries, is an example of this case. Since its launch in 1997, AVU has taught semester-long

courses in technology, engineering, business and the sciences to over 24,000 students (see: African Virtual University (AVU) website: <http://www.avu.org/>).

“IT can also make significant contributions to social initiatives on a local level. Tarahaat.com, an Internet portal with a full range of services targeted to Indian rural villagers, contains links to vital information on health, water, sanitation, women's issues, education, community events, and agriculture. Aside from providing important information, Tarahaat.com also offers services to villagers. For example, Tarahaat users can ask medical questions from health professionals. Villagers can participate in e-commerce initiatives through the portal, selling their commodities to other villagers, and expanding their business to urban and overseas consumers as well” [17].

6. Conclusion

Sustainability as a new concept of 20th century, has recently obtained increasing and widespread attention among business practitioners and scholars. The most popular definition says “*the development that meets the needs of the present without compromising the ability of future generations to meet their own needs*”. Indeed, sustainability considers three main branches of environment, economy and society and tries to balance between them. Besides focusing on economic profits of business activities, firms also need to take into account the social and environmental impacts of their business activities. It helps firms reduce cost, increase profitability, sustain their business market, gain competitive advantage, and become viable contributors to the society and business market in the long-term. Information technology as the new widespread technology of the century has contributions with sustainability. One global trend with significant implications for sustainability is the extraordinarily rapid development and application of information technology, often referred to as the “IT revolution. Although the linkage between IT and sustainability is discussed mainly from view of environmental sustainability, it is not restricted to it.

The main contribution of this paper is assessing the impacts and linkages of IT advances on prospects for sustainability. The approach consists of two main elements: 1. positive linkages and 2. negative linkages between IT and sustainability goals.

As a whole, the linkages of IT and sustainability in negative side divide into three main branches of informational, environmental and economic. Uncontrollable increase of information due to IT and as a result decrease of information quality is one of the disadvantages mentioned related to

sustainability, particularly in the social side. On the other hand, unlike the dominant assumption of less consumption and waste, IT has had some detrimental effects on environment such as increased waste and energy consumption. The economic side is the last one which contributed to an economic over-dependence on IT, which had disastrous consequences when the IT market began to suffer in 2000.

The positive linkages between IT and sustainability are also divided into three parts of environmental, economic and social ones. Decrease of wastes and energy savings are of the prominent impacts due to the dematerialization and shifting from products to services. Considerable developments in economy of some countries like US admit the positive effect of IT in business and marketing. Additionally new advances in education and access to resources based on information technology, is another obvious representation of social developments due to IT. In conclusion, both positive and negative sides of linkages between IT and sustainability should be considered and as it is reviewed there is not a fixed line determining the effects between IT and sustainability.

References

- [1] Azapagic, A. Perdan, S. (2000) Indicators of Sustainable Development for Industry: A General Framework, Process Safety and Environmental Protection, Vol. 78, No. 4, pp. 243-261.
- [2] Janeiro, L. and Patel, M. K. (2014) Choosing Sustainable Technologies. Implications of the Underlying Sustainability Paradigm in the Decision-Making Process, Cleaner Production,
- [3] Hansson, S. O. (2010) Technology and the Notion of Sustainability, Technology in Society, Vol. 32, No. 4, pp. 274-279
- [4] Manca, D. (2015) Economic Sustainability of Products and Processes, Computer Aided Chemical Engineering, Vol. 36, pp. 615-642.
- [5] World Commission on the Environment and Development, (1987) Our common future. Oxford: Oxford University Press.
- [6] Balakrishnan, U. and Duvall, T. Primeaux, P. (2003) Rewriting the Bases of Capitalism: Reflexive Modernity and Ecological Sustainability as the Foundations of a New Normative Framework, Business Ethics, Vol. 47, No. 4, pp. 299-314.
- [7] Drexhage, J. and Murphy, D. (2010) Sustainable Development: From Brundtland to Rio 2012, prepared for consideration by the High Level Panel on Global Sustainability at its first meeting, 19 September, New York.
- [8] Alhaddi, H. (2015) Triple Bottom Line and Sustainability: A Literature Review, Business and Management Studies, Vol. 1, No. 2, pp. 6-10.
- [9] Goel, P. (2010) Triple Bottom Line Reporting: An Analytical Approach for Corporate Sustainability, Finance, Accounting, and Management, Vol. 1, No. 1, pp. 27-42.
- [10] Elkington, J. (1997). Cannibals with Forks – Triple Bottom Line of 21st Century Business, Gabriola Island, BC ; Stoney Creek, CT: New Society Publishers, Canada.
- [11] Dao, V. Ian Langella, I. Carbo, J. (2011) From Green to Sustainability: Information Technology and an Integrated Sustainability Framework, Strategic Information Systems, Vol. 20, pp. 63-79.
- [12] Wagner, S. Hespeneide, E. Pavlovsky, K. (2009) The Responsible and Sustainable Board, Deloitte Review, Issue. 4, pp. 60-71.
- [13] Janeiro, L. (2011) Towards a Methodology for the Sustainability Assessment of Technologies, Submitted to the Geo Sciences Division in Partial Fulfillment of the Requirements for the Degree of Master in Sustainable Development, University of Utrecht, Netherlands.
- [14] Carter, C.R. and Rogers, D.S. (2008) A Framework of Sustainable Supply Chain Management: Moving toward New Theory, Physical Distribution & Logistics Management, Vol. 38, No. 5, pp. 360-387.
- [15] Colbert, B.A. and Kurucz, E.C. (2007) Three Conceptions of Triple Bottom Line Business Sustainability and the Role for HRM, Human Resource Planning, Vol. 30, No. 1, pp. 21-29.
- [16] Munda, G. (1997) Environmental Economics, Ecological economics and the Concept of Sustainable Development, Environmental Values, Vol. 6, No. 2, pp. 213-33.
- [17] Haghseta, F. S. (2003) Information Technology and Sustainable Development: Understanding Linkages in Theory and Practice, Submitted to the Engineering Systems Division in Partial Fulfillment of the Requirements for the Degree of Master of Science in Technology and Policy, Massachusetts Institute of Technology, United States.
- [18] Girshick, S. Shah, R. Waage, S. (2002) Information Technology and Sustainability: Enabling the Future, The Natural Step, San Francisco, California, United States.
- [19] Institute of Electrical and Electronics Engineers (2002), In the Proceedings of IEEE International Symposium on Electronics and the Environment, <http://www.isee2002.org/>
- [20] Williams, E. (2002) Energy Efficiency of B2C E-Commerce in Japan, In the Proceedings of 2002 IEEE International Symposium on Electronics and the Environment, San Francisco, California, United States.
- [21] Sellen, A. and Harper, R. (2001) The Myth of the Paperless Office, MIT Press: Cambridge, Massachusetts, United States .
- [22] Marcus, A. (2015) Innovations in Sustainability, Cambridge University Press, Cambridge, United Kingdom.
- [23] Lindström, J. (2016) When Moving from Products and Services tTowards Functional Products: Which Sustainability-Oriented Customer Values are of Interest?, Procedia CIRP, Vol. 48, pp.16 - 21.
- [24] Global e-Sustainability Initiative, (2002) Industry as a Partner for Sustainable Development: Information and Communications Technology, Global e-Sustainability Initiative: United Kingdom.
- [25] United States Department of Commerce (2000), Digital Economy 2000, <http://www.esa.doc.gov/508/esa/DigitalEconomy.htm> .