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Conceptual Framework for the Role of Information and Communication Technology (ICT) in achieving the Sustainable Development Goals

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Abstract - *This paper seeks to evaluate the role of ICT in achieving the sustainable development goals adopted by the United Nations in 2015. While SDGs do not specifically address ICT, or include a goal on development of ICT, as argued (Berleur & Avgerou, 2005) in this paper, it is an underlying element embedded in the very concept of sustainable development rooted in the definition as propounded by the Brundtland Report. The objective of this paper is to evaluate whether there is a possibility to develop a conceptual framework to ground the use of ICTs in achieving SDGs. For this purpose, this research has evaluated the common conceptual frameworks developed by scholars and posits that rather than developing an all-encompassing framework, it is possible to identify certain necessary features for the role of the ICTs in achieving SDGs. This approach enables policy and decision makers to look at the role of ICT as an integral component of socio-economic and environmental decision making and implementation.*

Keywords: *Sustainable development goals; ICT; governance*

1. INTRODUCTION

History has witnessed five waves of innovation, accompanied by technological and social change (Silva & Di Serio, 2016[11]). The first wave of innovation was the Industrial Revolution; the second, the Age of Steam; the third, the Age of Electricity; the fourth, the Age of Mass Production; and the fifth, the rise of Information and Communications Technology and Networks (Moody & Nogrady, 2010[8]) . And scholars have set out that the potential sixth wave would be Sustainability (Silva & Di Serio, 2016[11]). The potential for development of ICT is on the rise with infinite possibilities to radically change the socio-economic lives that we once perceived. This paper attempts to evaluate the role of ICT in achieving sustainable development goals. The first section sets at outline for the relationship between ICT and sustainable development, and introduces the relationship between sustainable development goals and ICT, the second section delves into the role of ICT in achieving the SDGs and the limitations involved which leads up the to conceptual framework for the role of ICT with the conclusion that there are certain rudimentary features that ought to be given attention to in developing frameworks for engaging ICT in achieving SDGs.

2. RELATIONSHIP BETWEEN ICT AND SUSTAINABLE DEVELOPMENT

Brundtland Commission Report defined sustainable development as 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs' (Brundtland, 1987[3]). This definition married two types of justice identified as intragenerational justice and intergenerational justice recognizing the finite nature of the resources of in the world.

Hilty and Hercheui identify that the claims within intergenerational equity or justice is an ethical dilemma that feeds into the existing consumption patterns of the industrialized countries, to face this dilemma countries have to make structural changes in the economy that will affect the industrial patterns of production and consumption in a pervasive manner (Hilty & Hercheui, 2010[5]).They also note that in terms of the role of ICT in the sustainability dilemma, 'there are two opposite positions: the optimistic view based on the belief that this structural change is already under way due to the development and world-wide diffusion of ICT; the pessimistic view in which ICT adds to resource consumption and pollution and reinforces unsustainable structures and behavior (Hilty & Hercheui, 2010[5]).

Analysis on the role of ICT and sustainable development reveal that there is a critical role for ICT to play in providing and looking for data accurate and scientifically proven answers to the big global problems that sustainable development seeks to address. However, there is a growing body of research that also indicates the adverse effects of ICT in achieving sustainable development. Therefore, as Hilty and Hercheui point out,

it is necessary to look for conceptual and strategic frameworks of ICT governance to use it for the development of solutions to achieve sustainable development (Hilty & Hercheui, 2010[5]).

3. ROLE OF THE ICTS IN SUSTAINABLE DEVELOPMENT

This section will evaluate the role of ICT as a facilitator in achieving the sustainable development goals.

Information and communication technologies (ICTs) are accelerators, amplifiers, and augmenters of change (Lehr, 2018[7]). They make it feasible to more flexibly and dynamically reconfigure, and hence transform all aspects of how resources are produced and used, fundamentally restructuring economies and redefining human interactions and communication (Lehr, 2018[7]). ICT also assist in real-time communications, data analysis and decision making which increases the speed of economic and market changes, and in turn results in a more volatile market (Lehr, 2018[7]). With the increased use of ICTs and the use of eCommerce supply chains have revolutionized. ICT is also capable of closing the skills gap and creating more employment opportunities.

There is also more democratization of information and knowledge. Access to information is now redefined through the use of internet and open source to mean free and easy access to information. Certain information that would not have been public knowledge at all a few decades ago is now openly available making consumers take more informed decisions. This access to information has also opened the path to more access to education (Heeks, 2010[4]).

There are also critics of increased use of ICT that highlight the fact that developing and low-income countries become marginalized with the increased use of ICT due to the increase of infrastructure costs and additional economic burden placed on the systems by the changing technologies. Scholars have noted that despite the potential of the ICTs in enhancing the economic growth, the socio-economic inequalities (Lehr, 2018[7]).

ICT also has a critical role to play in developing energy efficient solutions and processes. It has the capacity to develop solutions to global problems like climate change and create opportunities for developing countries to obtain technical assistance they need in data collection and data analysis from developed countries who have more developed technologies (Kostoska & Kocarev, 2019[6]). ICT is sees as a part of the solution for energy consumption and energy waste enabling more sustainable use of energy. This again highlights the role of ICT not merely as an infrastructure but a driving force of the solutions to problems related to climate change.

In the international level, the role of ICT in achieving sustainable development was highlighted that at the UN Sustainable Development Summit in September 2015, where the world leaders adopted a new 2030 Agenda for Sustainable Development which is 'a plan of action for people, planet and prosperity' designed to 'shift the world onto a sustainable and resilient path' (Summit, 2015[13]). This agenda resulted in identifying seventeen global goals that were far more expansive that the previous millennium development goals and the UN has identified that achievement of these goals largely depend on the countries changing their Business as Usual approach, since it cannot deliver the SGDs (Summit, 2015[13]). Hence, it is noted that ICT and especially mobile broadband, is an essential infrastructure platform for the SDGs and a principal acceleration technology that can get societies away from the BAU trajectory (Kostoska & Kocarev, 2019[6]).

Kostoska and Kocarev posit that 'asside from delivering connectivity, innovation, and productivity, ICT can also reinforce flexibility of the crucial infrastructure and help to succeed in dealing with the social and economic exclusion' (Kostoska & Kocarev, 2019[6]).

While none of the 17 SDGs is particularly about ICT and only several targets refer to ICT and technology, the 2030 Agenda for Sustainable Development fundamentally recognizes that the scope of ICT and global interconnectedness has a huge potential to speed up the human progress, to bridge over the digital divide and to create knowledge societies (Summit, 2015[13]). It should be noted that the use of ICT in this manner depends largely on many other factors such as technological infrastructure, technical know-how and financial resources, especially in developing countries like Sri Lanka.

Even through Sri Lankan laws and policies have embraced the developments in the ICT sector, we are yet to develop the necessary bureaucratic and administrative structural changes necessary to facilitate the use of ICTs in daily decision making and implementation. This is noted as a general requirement of the developing countries where scholars highlight the need of developing countries to have the right ICT infrastructure, skilled workers, and institutional and policy frameworks that reflect best-practice learning but also are responsive to local context constraints and opportunities.

4. THE LIMITS OF TECHNICAL SOLUTIONS TO SUSTAINABLE DEVELOPMENT

The views in the extreme ends that assume the optimistic or the pessimistic role of ICT are based on the assumption that technological development is an autonomous process that cannot be controlled or regulated (Hilty & Hercheui, 2010[5]).

However, scholars such Berleur & Avgerou. describe point towards the need to view ICT as a solution by viewing it as appropriate use by all, which include

economic growth, particular interests, political and democratic concerns, social values, cultural identity, social organization and justice (Berleur & Avgerou, 2005[2]).

5. CONCEPTUAL FRAMEWORKS FOR ICT AND SUSTAINABLE DEVELOPMENT

A conceptual framework for an analytical approach to the relationship between ICT and sustainable development first has to decompose the normative concept of sustainable development. As the Brundtland Report indicates 'fulfilment of all these tasks will require the reorientation of technology the key link between humans and nature (Brundtland, 1987[3]). First, the capacity for technological innovation needs to be greatly enhanced in developing countries so that they can respond more effectively to the challenges of sustainable development. Second, the orientation of technology development must be changed to pay greater attention to environmental factors' (Brundtland, 1987[3]). It also highlights that 'technologies of industrial countries are not always suited or easily adaptable to the socio-economic and environmental conditions of developing countries (Brundtland, 1987[3]). To compound the problem, the bulk of world research and development addresses few of the pressing issues facing these countries, such as arid-land agriculture or the control of tropical diseases. Not enough is being done to adapt recent innovations in materials technology, energy conservation, information technology, and biotechnology to the needs of developing countries. These gaps must be covered by enhancing research, design, development, and extension capabilities in the Third World (Brundtland, 1987[3]).

One possible approach is to integrate ICT in to the three pillars of sustainable development. Hence, the role of ICT can be evaluated along the lines of environmental, social and economic dimensions. This would include trying to identify the role of ICT in addressing environmental problems, how can ICT be used to increase the understanding of ecosystems and to reduce environmental burden and how can the burden imposed by ICT on the environment be reduced (Ex: disposal of IT equipment). Brudntland report indicates that 'development of environmentally appropriate technologies is closely related to questions of risk management' (Brundtland, 1987[3]). Such systems as nuclear reactors, electric and other utility distribution networks, communication systems, and mass transportation are vulnerable if stressed beyond a certain point. The fact that they are connected through networks tends to make them immune to small disturbances but more vulnerable to unexpected disruptions that exceed a finite threshold. Applying sophisticated analyses of vulnerabilities and past failures to technology design, manufacturing standards, and contingency plans in operations can make the consequences of a failure or accident much less catastrophic (Brundtland, 1987[3]). It also provides that there is a key role to play for law and public policy in this aspect, to ensure, through incentives and disincentives, that commercial organizations find it worthwhile to take fuller account of environmental factors in the technologies they develop.

Trying to identify how ICT plays a role in the social dimension of sustainable development in terms of how ICT can support communities working towards sustainable development and how can social justice on a global level be supported by ICT and how can the contribution of ICT be increased.

The economic dimension includes concerns related to the role of ICT in the structural change of the economy from an industrial to a post-industrial mode. How can ICT contribute to a de- coupling of economic growth from growth in resource consumption, to substitute virtual forms of production and consumption for energy-intensive processes, to dematerialize relevant parts of the economic system? And how can ICT help emerging economies to leapfrog into this mode without copying the unsustainable patterns of the industrial mode first? (Hilty & Hercheui, 2010[5]).

As Kostoska and Kocarev point towards a framework with three modules data module, sustainability module, and governance module (Kostoska & Kocarev, 2019[6]). It envisions governance systems and procedures that address SDGs on the local level by assessing/modelling various social-ecological systems, which are connected in a network of local platforms, ensuring global challenges to be addressed holistically (Kostoska & Kocarev, 2019[6]).

The methods from network governance together with mixed qualitative and social network analysis can be used (1) to ascertain the link between network governance properties, leadership positions and decision-making outcomes, (2) to assess network management strategies and their relation to outcomes, and (3) to analyse relations across multiple levels of networks in order to improve understanding of processes and outcomes (Kostoska & Kocarev, 2019[6]). Moreover, the platform links social networks, behavioral sciences, data science, governance science, and digital technologies to effectively address SDGs by creating intelligent governance models and decision-making tools for citizens and governing bodies (Kostoska & Kocarev, 2019[6]).

However, Hilty and Herchui argue that it is necessary to de-compose the role of ICT in this context, since digital ICT is an almost universal technology and application categories are more relevant than the technology as such (Hilty & Hercheui, 2010[5]). In addition, it is noted that none of the conceptual frameworks can fully describe how ICT can be integrated in to sustainable development and the fluid definition of sustainable development makes

it difficult to provide one dimensional frameworks to address the link (Hilty & Hercheui, 2010[5]).

One approach that Hilty and Herchui have identified one of the most common approaches to be one that focuses on applications of ICT and first asks in which way they influence the environment (Hilty & Hercheui, 2010[5]).

The three levels cover environmental impacts ranging from the most direct effects (physical effects of using the hardware) to the most indirect effects such as the influence of ICT on economic structures and lifestyles: 'First-order effects: Includes all environmental impacts resulting from ICT hard- ware during the product lifecycle, covering production, use, and disposal. Second-order effects: The use of ICT causes effects to other processes such as traffic or industrial production and influences their environmental impacts indirectly. Third-order effects: Owing to the assumed widespread use of ICT in everyday life, economic structures and lifestyles can change, indirectly affecting the ex- pression of first- and second-order effects (Hilty & Hercheui, 2010[5]).

As Kostoska and Kocarev posit, that in developing a conceptual framework ought to proceed based on the principles that SDGs performance should be shaped by three disciplines: governance science, sustainability science, and data science; SDGs implementation should be triggered by various actors at different spatial scales (e.g., farm, local, region, state, national, international), temporal scales (e.g., daily, monthly, annual) and decision making scales (e.g., individual, group, institution); SDGs governance should be emphasized by various governance theories (including adaptive governance, collaborative governance, network governance, and so on) triggering actions across many levels and involving actors from multiple sectors; and SDGs implementation should be influenced by the human behavior (Kostoska & Kocarev, 2019).

6. CONCLUSIONS

The main objective of this paper was to engage in an evaluation of the potential to develop a conceptual framework and evaluate the attempts by other scholars. While this research is not a comprehensive description of all the conceptual frameworks developed, this does include the common approach towards developing such frameworks and identified certain core features that should be included. Hence this research started at a different level than defining what ICT encompasses and sustainable development. These questions are research on their own right.

This research concedes with the notion of Hilty and Herchui, that analyzing the relationship between ICT and sustainable development poses challenges in terms of : finding a meaningful decomposition of the concept of sustainable development, finding a meaningful classification of ICT interactions with aspects of sustainable development (Hilty & Hercheui, 2010[5]), finding methods to quantify effects of the ICT life cycle, of ICT applications and the way ICT changes societal structures (including the economic system), and finally, embedding these analyses in an or political context of decision- making and in a societal discourse (Kostoska & Kocarev, 2019[6]).

However, despite the difficulties in developing a conceptual framework for ICT and SDGs, there are certain features that can be identified as crucial elements. These include: an approach that integrate governance, science and sustainability and data sciences with digital democracy, increased awareness of governance structures in the local and global levels, data intensive approaches, governance enhanced approaches and effective communication along with citizen participation (Kostoska & Kocarev, 2019[6]).

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