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Felix Bankole Dr

University of South Africa, bankofo@unisa.ac.za

Lucas Mimbi

University of South Africa, mimbilg@unisa.ac.za

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ICT Infrastructure and its Impact on National Development: A Research Direction for Africa

Research Paper

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Felix Olu Bankole
School of Computing
College of Science, Engineering & Technology
University of South Africa
bankofo@unisa.ac.za

Lucas Mimbi
School of Computing
College of Science, Engineering & Technology
University of South Africa
mimbilg@unisa.ac.za

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ABSTRACT

Discussions on Development that encompasses how ICTs can make a difference in climate, political, health disturbances and business environment require a multidisciplinary approach which demand contributions from IS community, the private sector, development agencies, practitioner and other academia. This would enable the development community to identify the objectives of technology for empowerment and how they should be achieved in the practice of national development. This study serves as a response to the call for more macro/micro level policy research on the role of ICT on national development. The paper reviews the previous research in this domain and proposes a research direction for macro/micro level impact of ICT on national development on the Africa continent.

Keywords

ICT Infrastructure, National Development, Innovation, Research, Data Analytics, Policy, Africa.

INTRODUCTION

National development is referred to as the type of achievements and choices that are essential for human life to prosper (Hamel, 2010). These types of achievements are “*non-hierarchical, irreducible, incommensurable, and basic kinds of human ends that are valuable objectives for human progress beyond social or cultural values* [e.g. human rights]” (Alkire, 2002, p. 186). Simply put, national developments

are well thought-out programs to achieve outcomes that people value, and for which they are willing to labor. The discourse on national development centers on human development (Bankole et al., 2011a; 2013), trade (Bankole, Osei-Bryson and Brown, 2015a) and governance (Rise, 2011), and other dimensions to mention a few. For example, the delineation of national development encapsulates the notion of human development as the means of enlarging people's choices in order to raise levels of well-being so as to lead a long healthy life, to acquire knowledge and to have access to the resources needed for a decent standard of living (UNDP, 2006). For its part, trade (both international and regional) serves as cornerstone of socio-economic development by creating and enlarging regional and international economy from small and unequal national economies thereby stimulating productive capacity and industry competition for national development (IMF, 2008; WTO, 2001; Bankole et al., 2015a &b).

On the other hand, governance is the structure and process of government in a nation for national development. This structure entails the level of institutions and constellations of actors involved (Treib et al., 2007), while process pinpoints the modes of social coordination by which actors engage in decision making and implementation for provision of collective goods and services for national development (Borzel and Rise, 2010).

The role of information communication technologies (ICTs) infrastructure investments in promoting national development cannot be overemphasized. ICT has been receiving enormous scientific and political attention among International Organizations [e.g., the World Bank, the United Nations, the WTO, the IMF the others] (Soper, Dermirkan, Goul and St.Loius, 2012). This has led to a continued debate on strategy to position investments in ICT for global development. However, the role of investments in ICT to aid national development is not yet fully understood, and to-date there is still not sufficient published mainstream Information Systems (IS) research that looks at the impacts of ICT on national development. In addition, several of the national leaders, policy makers and the development practitioners that have the capability to initiate changes in both developed, developing and transition economies (e.g., Africa) have not been able to determine how the limited resources set aside for national development should be effectively allocated (Soper, 2008; Soper et al., 2012).

The opinions on the bearings of ICT infrastructure for development are in two perspectives vis- à-vis national development: first, the adoption of ICTs has the potential to empower communities and countries. Second, the ICT revolution can lead to imbalances and inequalities through lack of ICT adoption, access and usage (UNDP, 2003).

In light of this situation, the present study proposes the direction for research on the impact of ICT for national development that addresses the resource allocation and policy decisions especially in Africa. Therefore, the research question posed is: what are the research directions for the impact of ICT infrastructure investments on national development in Africa?

To answer this question, the present study adopts the nomological network to analyze the interrelations linking ICT and national development constructs to set the research agenda for Africa. The nomological network may be defined as a tool of construct validity that represents constructs (concepts) of interests in a study, their observable manifestations, and the interrelationships among these (Cronbach and Meehl, 1955). In addition, the present study adopts a guideline proposed by Rowe (2014) to present philosophical views on ICT infrastructure and national development in order to unravel the concepts surrounding the notion of national development. The study also attempts to review the previous studies that have investigated ICT impacts on national development at macro level for policy decisions. This review aims at providing an in-depth understanding of what has been covered and proposes a nomological framework for emerging research and future research direction on ICT infrastructure and national development for developed, developing and transition economies especially in Africa.

The rest of the article is organized as follows: section two discusses the philosophical dialogue on ICT infrastructure and national development. Section three provides the reviews on ICT impact on national development. Section four presents the nomological framework for ICT and national development. Section five presents a research agenda followed by the summary and conclusion in section six.

PHILOSOPHICAL DIALOGUE ON ICT INFRASTRUCTURE AND NATIONAL DEVELOPMENT

The concept of national development is multifaceted and comprises a range of different factors as mentioned in section 1. However, national development is targeted to change the conditions in less developed, developing and transition countries through specific action plans, agenda and strategies (Coetzee, 2001). National development from the perspective of modernization theory or dependency theory concerns a change in the issues arising from the institutional and organizational conditions of less developed or underdeveloped countries (Coetzee, 2001).

Modernization theory of development means the total social process associated with socio-economic development, according to their preconditions and consequences (Bernstein, 1971). On the other hand, dependency theory assumes that the process of development entails macro level analysis of regional, central and peripheral factors responsible for and the cause of underdevelopment (Uche, 1994). Underdeveloped or less developed are words often used with regards to poor, traditional, and rural communities where there is a lack of industrialization (Barnet, 1988, p. 173). This measure of development is restricted to an action plan for implementing social changes in the society. All of these early development theories (modernization, dependency, and welfarist etc) focus on a narrow view of economic growth (standard of living) and national income (Bankole et al., 2011a; Srinivasan, 1994).

Over the last three decades, the lexicon of national development has been expanded to move beyond national income to include social factors and other intervening variables such as the aspects of human welfare [e.g. education, health, political freedom, urbanization, trade, governance and industrialization, rationality and specialization of functions] (Desai, 1991; Anand and Ravallion, 1993). This form of development entails a form of social change that strives for controlled transformation. This conforms to the theories of many scholars such as Fielding (2002) and Roode (2002). Fielding (2002) emphasizes that national development is not independent of material welfare, democratic development and economic growth but involves interaction with other developmental factors while, Roode (2002) states that national development occurs by means of a multidimensional process that is determined by a change in people's attitudes, and social structures, improvement in the level of institutional quality, acceleration of economic growth, the reduction of inequality, and the eradication of poverty.

These modes of reasoning see national development as something that encompasses a wide variety of factors, outside the measure of Gross Domestic Product (GDP), but including other social transformation measures such as health, education and freedom. This has also been established in the work of Amartya Sen (1977, 1984, cited in Sen. 1985). Sen's theory of 1980 deals with the capability approach to human development with a philosophical articulation of commodities, capabilities and standard of living. It entails the notion of what an individual can actually do or achieve (Anand and Ravallion, 1993; Alkire, 2010). Sen's capability approach has been widely recognized as offering the philosophical foundation of national development through human development.

a. Human development

The notion of human development was first presented in the 1990 Human Development Report published by the United Nations Development Programme (UNDP). The underlying assumption of this approach is grounded in the work of Sen (Desai, 1991; Anand and Ravallion, 1993). The human development view advocates for the opportunity to fulfil the aspirations for a better life for the present and future generations (Moran, Wackernagel, Kitzes, Goldfinger and Boutaud, 2008). These opportunities must be made available to people at all levels. Consequently, a measure of human development known as the Human Development Index (HDI) was introduced by UNDP. HDI captures three essential dimensions of human life: longevity, knowledge acquisition and income for a decent standard of living.

The dimension of longevity and knowledge acquisition describes the structure of human capabilities, while the income for a decent standard of living dimension serves as a surrogate for people's choices in achieving their capabilities. The HDI consists of an equally weighted measure of a country with regards to each of the three dimensions to assess the level of the country's socio-economic development. These are health {life expectancy at birth/infant, mortality rates or survival rates}, education {literacy and gross enrolment in schools}, and standard of living {real income GNP/GDP} (UNDP, 1990). The Human Development Index for all countries has been published annually in Human Development Reports since 1990.

b. Trade

The notion that trade (both regional and international) stimulates the growth of the economy has been argued in literature for many years (Chikhasu, 2007). The main basis for trade transactions between countries relies on the fact that countries have different resources, preferences, technologies, economic structures, social institutions and capacity for growth and development, that can be exchanged. To realize this requires trade transactions and competitiveness to be developed and pursued by the governments of the countries concerned. According to traditional trade theory initiated by Smith (1766) and Ricardo (1817), trade serves as a comparative advantage for a country that produces goods or services, by exporting such goods and specializing in those export lines in order to produce gains (Chikhasu, 2007). This traditional trade theory is based on how productive a country is at producing a certain product when compared with another country.

In the 1930s, the industrial revolution expanded production and export capacities, whereby Hechscher and Ohlin (HO) improved the traditional trade theory to accommodate relative resource or factor abundance.

This improvement helped to explain trade and its evolution. The trade theory allows to account for natural resources, agricultural products, industrial, technology and the services sectors. Therefore, the Heckscher and Ohlin theory of comparative advantage was extended to accommodate factors such as a trade enabling environment (institutional quality, macro policy) availability of productive resources (labour force and geography) and quality of infrastructure (transport networks and ICT infrastructure) which are essential for trade competitiveness. (Attaran and Zwick, 1987; UNECA, 2004).

Trade competitiveness is the capacity of a country to compete effectively in the global economy and sustain real improvements in output and wealth thereby enhancing social and economic development (Attaran and Zwick, 1987; UNECA, 2004). Trade competitiveness is based on the Ricardian model which allows for causes of trade, trends and intra-regional integration and a technology intensive approach. For example, the study by Koren and Tenreyro (2004) concludes that the productive structure of a country determines the level of their trade and development while Melitz (2003) demonstrates that international trade enables reallocation of resources for global participation thereby promoting development. Another example is the economic geography approach that states that the performance level of trade is determined through geographical locations such as land and business environment (Redding and Vanables, 2003). The increases in trade transactions have been expanding the opportunities for global trade and international markets engagements. Trade can facilitate, promote and sustain the development process of a nation. For instance, trade engagements by individual nations are one of the prerequisites for sustained growth (UNDP, 2006). Country leaders and policy makers are forming strategies to promote trade and to shape the level of their national engagements with both local and international economies. A case in point is the countries of Africa that have been exploiting opportunities (e.g., provision of ICT infrastructure, transport networks) for trade services.

In addition, it has been established that increases in trade flows are positively associated with future increases in social welfare as measured by national development (Davies and Quinlivan, 2006; Gunduz et al., 2009). This means that trade transactions occur when people are well nourished, have access to safe drinking water, sanitation facilities, and shelter facilities that are provided through equal opportunities for participation in economic activities. This is also dependent on having a good education, decent work, and freedom to exercise choices and fulfil their potential.

Trade as one of the key cornerstones of economic growth can certainly enhance national development (World Bank, 2010). This sort of transition occurs when the economic, domestic and international structures are refashioned in developing countries through development agents [e.g. telecommunication, institutional quality, good transport systems, and good governance].

Trade changes the structure of the economy and the rate of growth, which in turn has an impact on employment (capital and labour). However, it has been argued that trade is not an end in itself but a means to realize a broad range of national development objectives for the developing and least developed countries. Though, trade helps to alleviate poverty and reduce human deprivation. Good governance through public policy can be used to ensure that trade benefits national development (Bankole et al., 2015b).

c. Governance

Governance comprises of many facets. It can be referred to as structure, process, mechanism and strategy (Bartolini, 2011; Rise, 2012). The distinction between these facets of governance can be clarified based on their usage in analytical and theoretical purposes. As a structure, governance indicates the architecture of formal and informal institutions; as a process it implies the dynamics and steering functions involved in process of policy making; as a mechanism it connotes institutional procedures of decision-making for compliance and control. Lastly, as a strategy it signifies the actors' efforts to govern and manipulate the strategy of institutions and mechanisms so as to shape choice and preferences (Levi-Faur, 2011).

The past few decade have seen significant improvement on dimensions of governance such as rule of law and voice and accountability. However, a similar number of countries have experienced marked deteriorations, while others have experienced short-lived improvements that were later reversed, and numbers of countries have not seen significant trends in one way or the other. Several countries show that very high standards of governance can be attained, yet there are few others that are exceptions. Serious governance challenges can be found in every region of the world, and at all income levels. High level of governance is an issue for both rich and poor countries.

Over the years, researchers and politicians alike have indicated that ICT investments are likely to promote governance for national development in states particularly those in Africa (Mimbi and Kyobe, 2016 forthcoming). Worldwide development forums are dominated by themes related to potential of ICT in improving governance, particularly in Africa where quality of governance is mostly poor. The

international community and governance watchdogs contend that ICT is a panacea of governance related problems (Groshek, 2009; West, 2004). Governance has been proposed as one of the dimension of national development and has been measured yearly using World Governance Indicators (WDI). World Governance Indicators is are measures used to assess quality of governance of a nation. WGI consist of six dimensions of governance: voice and accountability, political stability and absence of violence, government effectiveness, regulatory quality, rule of law and control of corruption. The value of each of the indicators ranges from 0 to 1 with a higher value representing better governance.

d. ICT Infrastructure as an Enabler

The growth in the national structure of both developed and developing countries as a result of rapid evolution of digital and networked technology has enabled the responsive governing of their states by governments and the maintenance of the global economy (Castells, 2000). This pervasive and ubiquitous computing environment has created concerns within the development community on how to assess or understand the connection between national development and the impact that these technologies have on people. In the 1980s, the International Telecommunication Union (ITU) embarked on an initiative that led to major research on how ICTs and their interconnected network could be expanded across the world in order to align with the national developmental benefits (e.g. health, social services, administration and commerce) and to motivate economic growth that could enhance the quality of life. In 2003 and 2005, the World Summits on the Information Society (WSIS) organized by the United Nations served as opportunities for governments, development practitioners and international donors to deliberate on issues related to the potential impacts of ICTs and their roles in global development (Hamel, 2010). The outcome of the summits positioned ICTs as an essential tool that have the potential to deal with national development concerns and that could be used to realize Millennium Development Goals.

ICT infrastructure is the physical capital that has been assumed to promote growth through developing the capital stock and facilitating the new technologies into the production process (OECD, 2007). It serves as the most dynamic component of investments in the last few decades due to its capability to improve global economies by easing the ups and downs of the economic cycles (OECD, 2007; ITU, 2007). For instance, investment in ICT at the individual level is targeted to improve the quality of life by giving that individual access to information and the exchanges of thoughts and aspirations which often occur in all levels of economies. On the other hand, there is no doubt that investments in national ICT infrastructure

are visible in all countries, though with varying investments focus from country to country (Kim, Kang, Sanders and Lee, 2008).

The constant investments in ICT coupled with good governance, leads to technology readiness, which influences high level of ICT usage (Pick and Azari, 2011). There is also a direct relationship between ICT infrastructure investments and levels of human development (Bankole et al., 2011a&c). However, the challenges that face IS scholars and practitioners are to understand the research direction at macro-policy level at which investments in ICT Infrastructure usage have impacted national development. Some of these challenges are associated with lack of a unified theoretical framework and a lack of in-depth understanding of the research direction (Bankole et al., 2011b&c; Soper et al., 2012). This dialogue responds to the latter as an attempt to resolve some of these challenges. It is therefore emphasized that ICT utilization is related to a measure of direct and indirect usage of technology such as computing devices, the Internet and all channels of telecommunications (Bankole et al., 2011b; Pick and Azari, 2011). It is the degree to which individual citizens in a country utilize these technologies to understand their various societies, learn about choices, understand democracy and participate in activities. This means that the usage of ICT infrastructure is associated with achievement in the aspects of national development through efficient resource allocation, as described by Sen's capability theory (Laving and Qiang, 2004). ICT infrastructure usage will provide a platform (see Figure 1) as an enabler through provision of information regarding access to resources and the management of such resources efficiently (Bankole et al., 2011b).

Consequently, the increased ICT infrastructure usage leads to innovation and productivity through improvement in the allocation of scarce resources, technical efficiency (Qiang and Pitt, 2003; Bankole et al, 2011b) which in turn influence socioeconomic development (Solow, 1994; Fielding and Torres, 2009). To this end, the contribution of ICT usage to society necessitates examination of dimensions such as efficiency and competitiveness (resourceallocation), transparency and empowerment (governance, democracy and institutional quality), new business models and opportunities (local and international trade), as these dimensions influence national development as represented in Figure 1. The above philosophical views are expressed systematically in the proposed nomological network (Figure 1) discussed in section four.

REVIEW OF STUDIES ON ICT IMPACTS ON NATIONAL DEVELOPMENT

The contribution of investments in ICT to productivity was first investigated in the work of Oliner and Sichel (1994) and Jorgenson and Stiroh (1995, 1999). The subsequent studies by Jorgenson and Stiroh (2000) and Oliner and Sichel (2000) focused on the perspectives of the US economy. Since then, a number of articles have been published in various research outlets. In the present study, a literature review of articles in the domain of ICT and national development was carried out through an extensive search of Journal databases and Google Scholar to ensure conformity with the area of investigation. Papers published in IS/IT/ICT centric journals and other development related outlets were included in the analysis. The main criteria for selection of these papers includes whether a paper focuses on aspects of ICT and national development and has been published between 2000 and 2016. Although there were few empirical studies that specifically focused on ICT and national development, a total of 29 articles were found to be relevant to ICT and national development, which reported in a variety of ways on the effect of macro policy, institutional quality, geography and labor force. Though, these 31 articles are not a complete set of empirical research that have been published in the ICT and national development domain, but represent a sample of predominantly cited publications.

Table 1: Impacts of ICT Studies in Individual Developed Countries

No	Article	Country	Methodology
1	Cette, G., Kokglu, Y & Mairesse, J (2000). The Diffusion of Information Communication Technologies in France. Measurement and Contribution to Growth and Productivity. <i>Economie and Statische</i> , NO 339-340	France	Regression
2	Gretton, P., Gali, J, & Parham, D. (2004). The Effects of ICTs and Complementary Innovations on Australian Productivity Growth, in the Economic Impact of ICT Measurement, Evidence, and Implications, pp. 105-130, OECD, Paris	Australia	Regression (OLS)
3	Javala, J & Pohjola, M (2001). Economic Growth in the New Economy	Finland	Regression
4	Khan, H & Satos, M. (2002). Contributions of ICT use to Output and Labour Productivity Growth in Canada. Working Paper 2002-7, Bank of Canada, Ottawa	Canada	Regression
5	Oulton, N. (2002). ICT and Productivity Growth in the UK. <i>Oxford Review of Economic Policy</i> , 18(3), 363–369.	United Kingdom	Regression
6	RWI & Gordon, R. (2002). New Economy- An Assessment from a German View Point. Research from a research project commissioned by the ministry of Economics and Technology. Berlin	Germany	Regression
7	Van der Wiel, H. (2001). Does ICT Boost Dutch Productivity Growth, CPB Document No.016, CPB. Netherlands Bureau of Economic Policy Analysis.	Netherlands	Regression

To determine a comprehensive set of articles would entail further searches in different sources, which is definitely not within the scope of this study. Overall, this identified set of articles is sufficient for this analysis as the articles were obtained from reliable sources and provided support. Further analysis was carried out on the 31 articles to cluster them into respective countries, regional or economies.

Table 2: Impacts of ICT Studies in Group Level of Developed Countries

No	Article	Countries	Methodology
1	Ark, Van, B., Melka, J, Mulder, N., Timmer, M., & Ypma, G. (2002). ICT Investments & Growth Accounts for the European Union, 1980-2008. Final Report on ICT and Growth Accounting for the DG Economics and Finance of the European Commissions, Brussels	EU	Regression
2	Colecchia, A & Schreyer, P. (2001). ICT Investments and Economic Growth in the 1990s: Is the United States a Unique Case? A Comparative Study of Nine OECD Science, Technology and Industry Working Papers. 2001/7	OECD	Regression
3	Daveri, F. (2002). The New Economy in Europe 1992-2001. WIDER Discussion Paper/World Institute for Development Economies. (UNU-WIDER) N.2002/70	EU	Regression
4	Jorgenson, D. W. (2003). Information Technology and the G7 Economics. World Economics, 4(4), 139-169.	G7	Regression
5	Schreyer, P. (2000). The Contribution of ICT to Output Growth. A Study of G7 Countries. STI Working paper 2000/2.	G7	Regression

Some of the prominent studies that focus on the analysis of individual and group countries are presented in Table 1 and 2 respectively. In table 1, a total of seven articles were identified and these focused on European countries. All these articles adopted regression as a methodology. On the other hand, five articles were identified to have been published in this domain with a regional focus in the developed world (Table 2). These articles focused on the European Union (EU), the Organization for Economic Cooperation and Development (OECD) or the Group of Seven (G7) - the United States, Canada, France, Germany, Italy, Japan, and the United Kingdom (Table 2). Further analysis was conducted to separate the remaining seventeen articles into two groups based on their geographical focus. Table 3a presents eight articles that focus on the Impact of ICT on national development in developing and transition economies in Africa. Nine articles were identified to have focused on global or regional economies including developing/emerging/transition economies. These articles are presented in table 3b.

Table 3a: Impacts of ICT Studies in Africa and other developing economies

No	Article	Countries	Methodology
1	Ngwenyama, O., Andoh-Baidoh, O., Bollou, F., & Morawczynski, O (2006). Is there a relationship between ICT, Health, Education and Development? An empirical analysis of five West African Countries. <i>Electronic Journal of Information Systems in Developing Countries</i> , Vol 23 (5), 1-11.	West Africa	Regression Splines
2	Bollou, F (2006). ICT Infrastructure Expansion in Sub-Saharan Africa. An Analysis of Six West Africa Countries from 1995 to 2002.	West Africa	Data Envelopment Analysis
3	Morawczynski, O. & Ngwenyama, O. (2007). Unravelling the impacts of ICT investments in ICTs, education and health on development: An analysis of archival data of five West African Countries. <i>Electronic Journal of Information Systems in Developing Countries</i> , Vol 29 (5), 1-15.	West Africa	Regression Splines
4	Bollou, F & Ngwenyama, O (2008). Are ICT Investments Paying Off in Africa? An Analysis of Total Factor Productivity in Six West African Countries from 1995 to 2002. <i>Information Technology for Development</i> , Vol 4 (4) 294-307	West Africa	Data Envelopment Analysis
5	Bankole, F.O., Brown, I & Osei-Bryson, K-M (2011c). The Impacts of ICT Infrastructure on Human Development: An Analysis of ICT- Use in Southern African Development Community (SADC). <i>Proceedings of 11th International Conference on Social Implications of Computers in Developing Countries (IFIP 9.4 working group)</i> , Kathmandu, Nepal.	SADC	Regression
6	Bankole, F.O., Osei-Bryson, K.M & Brown, I (2011b). ICT Infrastructure Utilization in Africa: Data Envelopment Analysis Based Exploration. <i>Proceedings of SIG GlobDev Americas Conference on Information Systems</i> , Detroit. United States.	Africa	Data Envelopment Analysis
7	Bankole, F.O. Osei-Bryson, K-M & Brown, I (2015a). The Impact of ICT Infrastructure and Complementary Factors on Intra-African Trade. <i>Journal of Information Technology for Development</i> , Vol 21(1), 29-43	Africa	Multi-method Data Analytics
8	Bankole, F.O., Osei-Bryson, K-M & Brown, I (2015b). The Impact of Telecommunication Infrastructure and Institutional Quality on Trade Efficiency in Africa, <i>Journal of Information Technology for Development</i> , Vol 21 (1), 43-56	Africa	Multi-method Data Analytics
9	Riggins, F., & Weber, D. (2016). Exploring the Impact of Information and Communication Technology (ICT) on Intermediation Market Structure in the Microfinance Industry. <i>The African Journal of Information Systems</i> , Vol 8 (3), 1.	Africa	Exploratory – Mixed-Methods
10	Mimbi, L., & Kyobe, M. (forthcoming). Public Perceptions of the Role of IT in Resolving Governance Challenges in a Transition State: The Case of Tanzania. <i>Electronic Journal of Information Systems in Developing Countries</i> , Vol 78 (2).	Tanzania	Mixed-Methods

Many of the studies on the impacts of ICTs focus on firm performance, labor and productivity (Brynjolfsson and Hitt, 2000; Brynjolfsson and Hitt, 1994; Oliner and Sichel, 2000), while the studies that examine the impact of ICTs and national development, especially in Africa and other regions are few. From the Table 3a & b presented above, the reader would notice that most of the studies focus on transition economies, emerging economies and developing economies. A few studies that exist at the present focus on West Africa and recently studies by Bankole et al. (2015a, b) and Riggins and Weber (2016) looked at Africa as a whole. Several efforts to evaluate the impact of ICT on national development in Africa have

been hindered by insufficient empirical data and lack of cross-country evidence. This has hindered the efforts to indicate impact of the ICT sector on productivity. In addition, the rapid evolution of ICTs and the methodological challenges in terms of lack of unified framework to assess variables and models of causality causes a significant barrier (Kiptalam and Rodrigues, 2009).

Table 3b: Impacts of ICT Studies – Global and Regional economies

No	Article	Countries	Methodology
1	Bankole, F. O., Shirazi, F., & Brown, I. (2011a). Investigating the Impact of ICT Investments on Human Development. <i>The Electronic Journal of Information Systems in Developing Countries</i> , 48 (8), 1-19.	Global Economies	Multi-method Data Analytics
2	Bankole, F.O., Osei-Bryson, K-M, & Brown, I. (2013). The Impact of ICT on Human Development, <i>Journal of Global Information Technology Management</i> , 16 (2), 59-85.	Global Economies	Multi-method Data Analytics
3	Ngwenyama, O & Morawczynski, O (2009). Factors affecting ICT expansion in emerging economies: Analysis of Latin American Countries. <i>Journal of Information Technology for Development</i> , Vol 15 (4), 237-258.	Latin America	Data Envelopment Analysis (DEA)
4	Balioune-Lutz, M. (2003). An Analysis of the Determinants and Effects of ICT Diffusion in Developing Countries. <i>Journal of Information Technology for Development</i> , 10, 151-169	Developing Economies	Regression
5	Samoilenko, S. (2013). Investigating Factors Associated with the Spillover Effect of Investments in Telecoms: Do Some Transition Economies Pay Too Much for Too Little? <i>Journal of Information Technology for Development</i> , 19(1), 40-61.	Transition Economies	Data Analytics
6	Samoilenko, S.(2014). Investigating the Impact of Investments in Telecoms on Microeconomic Outcomes: Conceptual Framework and Empirical Investigation in the Context of Transition Economies, <i>Journal of Information Technology for Development</i> , 20(3), 251-273.	Transition Economies	Multi-method data analytics
7	Samoilenko, S. and Osei-Bryson, K.M. (2011). The Spillover Effect of Investments in Telecoms: Insights from Transition Economies. <i>Journal of Information Technology for Development</i> , 17(3), 213-233.	Transition Economies	Multi-method data analytics
8	Samoilenko, S. & Osei-Bryson, K.M. (2008). An Exploration of the Effects of the Interaction between ICT and Labor Force on Economic Growth in Transitional Economies, <i>International Journal of Production Economics</i> , 115, 471-481	Transition Economies	Multi-method data analytics
9	Soper, D. S., Demirkan, H., Goul, M., & St. Louis, R. (2012). An Empirical Examinations of the Impact of ICT Investments on Future Levels of Institutionalized Democracy and Foreign Direct Investments in Emerging Societies, <i>Journal of the Association of Information Systems</i> , Vol 13(3), 116-149.	Emerging Economies	Maximum Likelihood Estimation (Regression)

There is an extant literature on ICT adoption that recognizes the availability and accessibility in developing countries. But a few studies that focus on the impacts of ICT on national development that can inform ICT policy and decision-making in Africa exist (Dewan and Riggins, 2005; Mbarika , Okoli, Byrd and Datta, 2005; Soper et al., 2012). Overall, this present article serves as a response to the call for a research direction that puts Africa in the mainstream of Information Systems (IS) research. As such the continent is sadly neglected in terms of IS focused macro-analysis studies (Mbarika et al., 2005).

NOMOLOGICAL NETWORK

Nomological network is a concept derived from the Greek word ‘nomology’ meaning ‘lawful’ or ‘lawlike’ as it is known in philosophy of science. The nomological network is the tool of construct validity that represents constructs (concepts) of interests in a study their observable manifestations, and the interrelationships among and among these (Cronbach and Meehl, 1955). The notion of nomological network provides a clear understanding of the research issues while focusing on the main associated literature in the area. The nomological network process entails the mapping of core concepts, their association and influences in the phenomena of interest (Benbasat and Zmud, 2003). It is an illustration through theory and observation to describe the concepts of research as well as expanding knowledge of the existing association between the elements (Weems and Stickle, 2005). The nomological network is appropriate for the present study as it provides the necessary linkage mechanism of interrelated concepts of ICT infrastructure and national development. The nomological network has been used in other studies in Information Systems (e.g., Zhang, 2013; Zhang and Venkatesh, 2013).

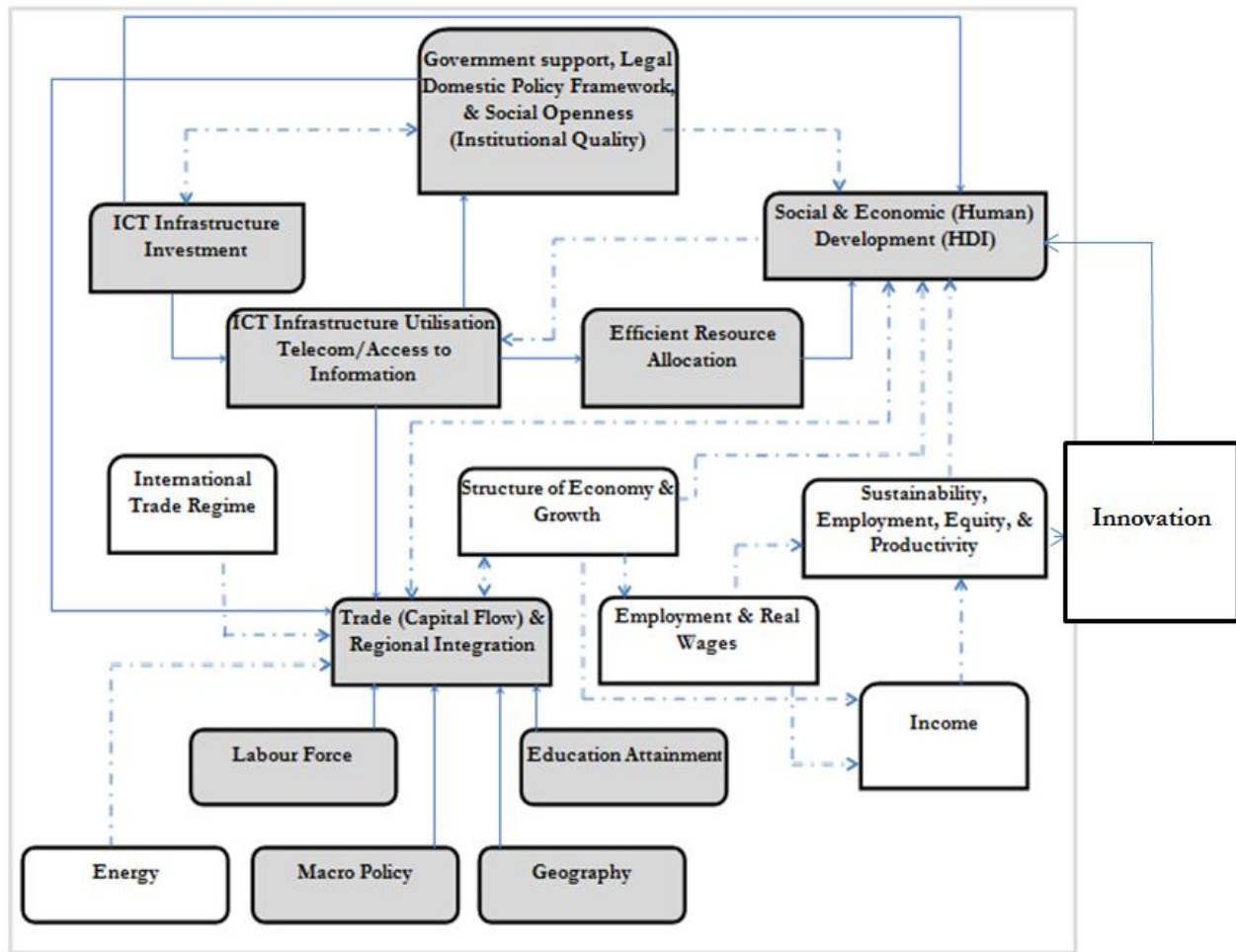
a. Nomological Network of ICT Infrastructure Impact on National Development in Africa.

A nomological network is formulated to illustrate the relationship between ICT infrastructure investments and national development. This is achieved through the literature review of the articles published between 2000 and 2016; and these must have focused their research on Africa (Table 3a). The central concepts or

constructs of the articles were grouped before these were mapped to link their respective constructs or concepts related to institutional quality, ICT infrastructure investment/utilization, resource allocation, human development, trade and trade enabling environments. The objective of the nomological network is to demonstrate the broad, multifaceted, complex nature of the phenomena, thereby providing means by which it can be better understood. This would improve the understanding and guide further research in this area through which theory and policies can be synthesized. Figure 1 presents the nomological network of ICT infrastructure and national development. It showcases and highlights the broad context and the core issues relating to the impacts of ICT infrastructure investments on national development. The bold connection in figure 1 depicts the researched area that have been investigated by studies focusing on Africa (presented in Table 3a); while the dotted line represents the emerged area for future research direction.

As ICT interacts with other factors in a complex way, the knowledge of ICT impacts alone is not sufficient to understand their broad effect on socioeconomic development. Hence, it is necessary to understand how different components that are interconnected in the nomological network interact to impact national development. Investment in ICT yields a variety of levels of ICT infrastructure in different countries, which in turn contributes to the socioeconomic growth in different ways. As depicted in Figure 1, these assumptions have been validated in many instances in the literature. For example, investments in ICT {technology and business} are associated with institutional quality {government support of IT, legal framework and societal openness}, ICT utilization (technology), and socioeconomic development (human development) (Bankole, et al., 2011b; Pick and Azari, 2011).

Conversely, a country with good institutional quality such as good ICT regulations and interest, lack of corruption, good intellectual property laws, a stable democracy and rule of law, will attract internal or external ICT investments (Shiraz, Gholami, and Higon, 2009; Pick and Azari, 2011). In addition, constant investments in ICT coupled with good government policies, leads to technology readiness, which in turn influences high level ICT usage (Pick and Azari, 2011). There is also a direct relationship between ICT infrastructure investments and levels of human development (Bankole et al., 2011). However, two of the challenges that face IS scholars and practitioners are to assess the conditions under which, and to what extent, such investments have facilitated ICT infrastructure usage and have contributed to national development.





Legend:		
	Dotted blue lines	Emerging areas of Research
	Bold blue lines	Investigated areas of Research

Figure 1: Nomological Network of Research on ICT Infrastructure and National Development

CT usage is the degree to which individual citizens in a country utilize the Internet, computers and mobile technologies. ICT usage serves as a channel used by people to understand their various societies, learn about choices, understand democracy, and participate in activities. This means that usage of ICT infrastructure is associated with achievement in the aspects of human development, as described by Sen’s capability theory. Sen’s capability theory focuses on the general level of human development that is achievable for individuals in a society (Clark, 2005). It sets out and explains the set of attainable functions

people can achieve in the society. For example, an individual should be able to choose between different commodities for usage. This is obtainable by appropriating all possible usages to all attainable commodity packages (Sen, 1985; Clark, 2005). Overall, ICT infrastructure usage influences the level of human development through efficient resource allocation as depicted in Figure 1.

However, ICT infrastructure usage will not directly realize socioeconomic development, but rather serves as an enabler through provision of information regarding access to resources and the management of such resources efficiently (Lavin and Qiang, 2004).

The contribution of increased ICT infrastructure usage leads to productivity through improvement in the allocation of scarce resources (known as technical efficiency) and growth in total factor productivity (Qiang and Pitt, 2003). Improved productivity and growth in turn influence socioeconomic development (Solow, 1994; Fielding and Torres, 2009). This contribution of ICT usage to the society requires examination of dimensions such as efficiency and competitiveness (resource allocation), transparency and empowerment (democracy and institutional quality), new business models and opportunities, and these dimensions influence national development (Tongia, Subrahmanian and Arunachalam, 2004).

In Figure 1, the reader would observe that there is a relationship between trade and institutional quality this relationship is expanded by Heckscher and Ohlin theory of comparative advantage to accommodate trade enabling environment where production and export capacities can be maximized. These enabling environments are institutional quality, macro policy, availability of productive resources (labor force and geography), and quality of infrastructure (transport networks and ICT infrastructure) which are essential for trade competitiveness (Attaran and Zwick, 1987; UNECA, 2004).

Trade competitiveness is the capacity of a country to compete effectively in the global economy and sustain real improvements in output and wealth, thereby enhancing social and economic development (Chikasu, 2007). The productive structure of a country determines the level of their trade and development. Melitz (2003) contends that international trade enables reallocation of resources for global participation, thereby promoting development. A case in point is the economic geography approach that states that the performance level of trade is determined through geographical locations such as land and business environment (institutional quality) (Redding and Vanables, 2003). These relationships are also depicted in Figure 1.

In Africa, the concept of trade competitiveness is essential for economic growth and globalization by helping to overcome inherent dangers such as external shock, high transport cost, and resource base distribution to ensure economies of scale. Trade can certainly enhance human development when the economic, domestic and international structures are refashioned in developing countries through development agents [e.g., telecommunication, institutional quality, good transport systems] (World Bank, 2010). The connections between trade and human development are also presented in Figure 1.

Trade changes the structure of the economy and the rate of growth, which in turn has an impact on employment (capital and labor). Public policy can be used to ensure that trade benefits human development. The feedback loop from human development to trade impacts directly on or is mediated through the domestic policy framework. The feedbacks affect work through income, competence, skills, and power of advocacy on policy makers. Consequently, human development has a direct influence upon the structure of the economy, the rate of growth, trade, sustainability and innovation.

The nomological network shows two-way causal links between trade, productivity, innovation and human development that constitute overall national development. The fundamental focus in the nomological network (Figure 1) are ICT infrastructure investments, ICT infrastructure usage, resource allocation, trade, productivity, innovation and human development, and the causal links between them. Given the complex interrelationships of the components observed in the nomological network (figure 1), the research agenda is proposed and discussed in the next section.

RESEARCH AGENDA

As presented in figure 1, interrelationships between the concepts linking ICT and national development aspects are complex and the concepts in the nomological network impact on each other in variety of ways. For example, human development has a direct influence on the structure of the economy, the rate of growth, trade, sustainability and innovation by which these also have impacts on human development. Given this complex nature, investigating ICT impacts on national development in Africa needs a multi-method data analysis approach. The interrelationships between the concepts linking ICT and national development aspects require a deployment of this approach to entangle the relationships between variables of interest. Multi-method data analysis approach can provide evidence of quantifiable measures of variables, quantifiable frameworks, and draw inferences about phenomena from a sampled population. Therefore, the positivist paradigm would be considered suitable (Orlikowski and Baroudi, 1991; Dube

and Pare, 2003; Urbach and Akhlemann, 2010). Furthermore, the research on the impact of ICT on national development that addresses the resource allocation and policy decisions is better explained by making use of data mining and analytics techniques (see Osei-Bryson and Ngwenyama, 2014; Agarwal and Dhar, 2014; Bankole et al., 2015 a & b). These techniques can reveal the hidden patterns from the data that can inform policy to achieve national development.

SUMMARY AND CONCLUSION

Conversations on development that encompasses how ICTs can make a difference in climate, political and health disturbances require a multidisciplinary approach. This approach requires contributions from IS research, the private sector, development agencies and other academia. These would enable the development community to identify the objectives of empowerment and how they should be achieved in the practice of national development. The emphases should be directed towards people-centric approaches to technology through human capability. The focus is on technology usage and the extent to which it affects or helps members of the society achieve their developmental objectives. Addressing the impact of ICT on development from a national perspective on macroeconomic would ensure the importance of proper planning and strategies that reflect national interventions. The macroeconomic impact of ICT on national development could be presented using several data analytics techniques as discussed in section 5 from which inferences and conclusions are drawn for theory, practice and policy making.

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