

The Impact of Technology and Innovation (Technovation) in Developing Countries: A Review of Empirical Evidence

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Abstract Over the period since 1970s, developed countries have improved its relative productivity performance, but there remains a significant gap in market sector productivity between Developed and developing countries. Much of the gap between them is due to lower levels of capital intensity and skills. However, even taking these into account, there remains a significant gap. This reflects not just a weakness in high tech areas but an inability to absorb best-practice techniques and methods in wide swathes of the market sector. Part of this is due to a weakness in technological innovation despite a high quality science base. This includes comparatively low and falling levels of R&D and patenting as well as a distinct lag in the diffusion of innovations relative to other countries. This paper illustrates why technological innovation is considered as a major force in economic growth and focuses on some of the most distinctive features of innovation in the highly industrialized economies of the OECD area. In particular, the paper attempts to examine a primary single feature, “uncertainty” that dominates the search for new technologies by drawing several cases on the developed countries experience. It also touches on the impact of technological innovation in the developing countries and how it is transforming their business.

Keywords: *innovation, technology, productivity growth, technovation*

Cite This Article: Audrey Paul Ndesaulwa, and Jaraji Kikula, “The Impact of Technology and Innovation (Technovation) in Developing Countries: A Review of Empirical Evidence.” *Journal of Business and Management Sciences*, vol. 4, no. 1 (2016): 7-11. doi: 10.12691/jbms-4-1-2.

1. Introduction

Technical Innovation means developing new ideas, products, services, and processes which exploit technology. It may be driven by a new technology (How can we use this?) or by needs (What technology might we apply to improve this?). At its best, technovation creates valuable products and services no one has yet asked for or creates "disruptive" change (major leaps in the way things are done). Every year technology challenges all over the world to build a mobile application that will address a community problem. Since 2010, over 28 countries have submitted to Technology and Innovation (Technovation), this makes global changes around the world. Technology (from two Greek words: *téchnē* and *logos*) means the ability of humans to create things using hands and/or machines [28]. It is the application of knowledge to the practical aims of human life or to changing and manipulating the human environment [31]. Technology includes the use of materials, tools, techniques, and sources of power to make life bearable or more pleasant and work more productive. Whereas science is concerned with how and why things happen, technology focuses on making things happen. Technology can be internal or external [20].

In the external view, technology means the systematic discourse about practical art. Technology is the science about practical art just as entomology is the science about insects and geology about planet Earth. Here “logos” belongs to scholars who take practical art and artists as their topics of investigation but is foreign to and not a part of the art or artists. It neglects the cognitive ability of the artists and concentrates on their products and social status [20]. The internal view inherits the Greek notion of *téchnē* containing its own logos, so that technology means the systematic reasoning of practical art itself. In this view, art and reasoning are inseparable entities that later enter into a marriage. They are intertwined cognitive potentials inherent in every human being, because living in, coping with, and modifying the real world is primordial to all human life. Technology is the explicit rendition of reasoning inherent in practical art; the systematic abstraction of essentials; the articulation, generalization, refinement, and development of knowledge involved in productive and creative activities [20].

Technovation’s success in changing world’ attitudes about technology and Innovation rely on local country Products. Together, they come up with a creativity idea, conduct user research, create a business plan, and build the world of Innovation. Countries that lead from the technology and business Innovation help other countries

that are less Technology to learn from them and hence it reaches many area of the world.

Technological change, particularly in developing countries, is not only about innovating at the frontier, but also about adapting existing products and processes to achieve higher levels of productivity as applicable to their local contexts [14]. In this process, the ability of local firms and enterprises to access technological know - how is fundamental to shaping their ability to provide products and services, both of the kind that are essential to improve living standards, and that could also promote growth and competitiveness [14].

However, the changes include technological trends and breakthroughs which will support innovation, availability of capital for new product development and introduction, displacement of existing products, management of entrepreneurial ventures, management of innovation in medium-sized and large organizations, organizational structures intended to facilitate innovation, investment strategies related to new science – or technology-based enterprises, the innovator as an individual and as a personality type, and technology transfer to developing nations. Case studies which illustrate how innovation occurs from business and technical standpoints are also included, together with reviews and analyses of governmental and industrial policy which inhibit or stimulate technological innovation.

The overall aim of this report is to provide a conceptual foundation for co-ordinated international efforts to advance the science, technology, and innovation needed for achieving the goals of sustainable development. A great deal of highly relevant and valuable R&D work is already being carried out by individuals and groups around the world. What is needed in addition however, is a concerted effort to identify, promote, and support priority R&D needs that are not being adequately addressed.

The empirical evidence on ongoing south - south exchange shows that the surge of economic growth in developing countries, particularly emerging countries, has been made possible in large part by their growing technological capabilities. This is reflected in the increase in their capital goods imports in recent times [3]. Although capital goods imports by developing countries are growing, and are considered to be an indication of technological leaning, the trends show that a large share of the capital goods exported and imported is concentrated in a sub-set of developing countries. These are countries that have some level of technological capabilities to integrate into GPNs, and their level of economic growth enables them to import capital goods [10]. On the other hand, a large number of developing countries, particularly LCDs, are not major importers or exporters of capital goods.

There is no doubt about the potential of rapid technological progress to help the world meet the defining challenges of our time. Yet many individuals in the developing world, access are still a major challenge, hindering their ability to learn how to use technologies that would improve their lives and promote enterprise development. That challenge is multiplied many times over for national policymakers seeking to use technologies to address energy poverty, food insecurity, environmental threats and job creation. The increasing of daily new Technology in developed countries are a signals of the

beginning of new era in developing country and in global development. If we are to build on and expand the progress that has been made towards the Millennium Development Goals, the international community will need to find innovative way of closing this gap.

2. Research Methodology

This paper is therefore designed to make review of existing empirical literature on the technovation and its impact in developing countries. Towards achieve this objective the author conducted a rigorous review of literature and documentary information germane to the subject matter. The paper is thus purely based on desktop and library research methodology. In this paper we conduct research using empirical methods, which rely on on existing studies. In this regard articles selected from top Enterprises journals, research papers, diagnostic study reports have been surveyed in making this study. Through quantifying the evidence or making sense of it in qualitative form, a researcher can answer empirical questions, which should be clearly defined and answerable with the evidence collected (usually called data). Research design varies by field and by the question being investigated. The review is mainly on technovation researches conducted around the world between 2005 and now.

3. Understanding Technovation Concept

The paper encompasses all facets of the process of technological innovation from conceptualization of a new technology-based product or process through commercial utilization. Topics include technological trends and breakthroughs which will support innovation, availability of capital for new product development and introduction, displacement of existing products, management of entrepreneurial ventures, management of innovation in medium-sized and large organizations, organizational structures intended to facilitate innovation, investment strategies related to new science- or technology-based enterprises, the innovator as an individual and as a personality type, and technology transfer to developing nations [2] Case studies which illustrate how innovation occurs from business and technical standpoints are also included, together with reviews and analyses of governmental and industrial policy which inhibit or stimulate technological innovation.

Innovation should be understood as something new to a local context. This relativity to the context is important and particularly relevant for developing countries. In a global perspective three forms of innovation can be distinguished. The first one relates to local improvements based on the adoption of technologies which are more or less available worldwide or locally (“technology adoption” from a global perspective). The second type of innovation materializes in the building up of competitive activities with some adaptation made to existing technologies (“technology adaptation”). The third type of innovation is the design and production of technologies of a worldwide significance (“technology creation” from a global perspective) [18].

Innovation and technology management is an inevitable issue in the high end technological and innovative organizations. Today, most of the innovations are limited with developed countries like USA, Japan and Europe while developing countries are still behind in the field of innovation and management of technology [21]. But it is also becoming a subject for rapid progress and development in developing countries. Innovation and technology environment in developing countries are by nature, problematic, characterized by poor business models, political instability and governance conditions, low education level and lack of world-class research universities, an underdeveloped and mediocre physical infrastructure, and lack of solid technology based on trained human resources. This paper provides a theoretical and conceptual framework analysis for managing innovation and technology in developing countries like India and China. We present the issues and challenges in innovation and technology management and come up with proposed solutions.

In this paper, an attempt has been made to point out key problems in innovation and technology management, which requires thorough investigation. Most of the innovations are limited to developed countries. Developing countries are still dependant on developed world technology. From the experience of China, India and Mexico suggests that developing countries have strong potential for innovation and technology management. But the challenge is how to approach the issues faced by developing countries [25]. The existence of chief technology management component, developed infrastructure, coordination and linkages development between educational institutions and business world, up gradation of knowledge and skills in the context of country's specific technical, cultural and social environment are only part of indicators of innovation and technology management. Future considerations involve a detailed survey of issues and challenges being faced by companies in developing countries. This could initiate further development in the process of innovation and management of technology in developing world companies.

4. Empirical Studies on Technology and Innovation

This section presents the empirical studies world-wide on innovation and firm's performance across industries. This aims to enlighten the research on the existing results and conclusions thereon which is useful in research gap identification. According to UN published paper 2015, any effective global partnership supporting inclusive development therefore needs to frame development for all as the overall goal. This will need a rebalance of priorities and concerns globally to achieve a paradigm shift where the relevance of cross - cutting issues, such as technology and innovation, is not contestable [29]. Such a new global deal will need fresh thinking, supported by effective policies and instruments in order to provide a roadmap for action and performance. Whether a set of narrowly defined targets will help to accomplish this purpose will need to be debated.

In addition to its role in providing global public goods, science, technology and innovation (TI) serves as a crucial

driver of rising prosperity and improved national competitiveness. However, [4] because technological knowledge and skills are cumulative, first mover advantages have created a very uneven global landscape [29]. Connecting local technological needs to international technological opportunities is a particular challenge for many developing countries. In this review of alternative conceptions of innovation, the problem revealed is not necessarily that innovation is inaccessible and neglected, but that many readily available conceptions and straightforward daily observation, give at best only a limited view of the innovation process. This is perhaps not surprising, but it reinforces the conclusion drawn in the first part of this chapter: that if general understanding is the object, then a broad conception of technological change is the appropriate one [9]. It follows, then, that the rest of this study should be dedicated to an analysis of change in the elements of the broad definition of technology [29]. The change in Technology affects innovation and motive to the cluster concern.

The debate on the importance of technological opportunity against market demand dates back to the time of who emphasizes the fact that entrepreneurs are led by technological opportunities [24]. Contrary to this approach, well-known in literature as "technology push" suggests that the direction and rate of technological change is defined, not by demand, but by appropriateness of technology in special industrial usage [23] and [24]. Researchers and empirical evidence support this approach [5,7].

The benefits of copying technology in countries at earlier stages of development is that their entrepreneurs can focus on delivering incremental improvements to foreign designs, rather than the risky development of products and technologies that are new to the world [15]. This is a process of innovation that is new to the local market or the domestic firm but new to the world. Once rapid growth is underway, there is a gradual shift - in the most successful countries - to innovation at the frontiers of knowledge [27]. This is largely the story (and present challenge) of technological innovation and development in developed countries in the modern era.

Many changes are taking place in science and technology policy across the OECD. The OECD can contribute to the diffusion of better policy practices across Member countries. Work is currently underway to benchmark the links between science and industry in different OECD countries [17]. This will lead to a better understanding of the main barriers affecting the role of science in innovation, and should contribute to improved policies in OECD Member countries. In 2001, the OECD's work on economic growth were conclude in a comprehensive report to Ministers, which was include a set of policy recommendations regarding the role of science, technology and innovation (Technovation) in economic growth. Efforts will also continue to develop improved measures of scientific advance and technological progress, especially in areas relevant to the new economy, which will lead to a better understanding of the roots of economic growth and social change. In his study shows that, in less industrialized countries, much if not most; technological change consists of the adaptation of imported technology to the local environment and factor supply [12]. Diffusion of an innovation occurs

through a series of communication channels over a period among the members of a similar social system. However it indicates that the adoption of an innovation occurs through a five-step process [19]. The five steps or stages are knowledge, persuasion, decision, implementation, and confirmation.

In his study [10], he empirically concluded that; Over the period from 1970, Britain has improved its relative productivity performance, but there remains a significant market sector productivity gap between Britain and both Continental Europe, the United States and African countries. Much of the gap between Britain and Continental Europe is down to lower levels of capital intensity and skill [26]. However, between Britain and the US, there remains a significant gap even if these are taken into account. These gaps cover all sectors and reflect not just a weakness in high tech areas but an inability to absorb best-practice technology and methods into wide swathes of the market sector. Underlying causes here include low level so product market competition, high level so product market regulation and general lack of exposure to best practice methods and technology [16]. Part of this story is a weakness in technological innovation despite a high quality science base. Technovation has been growing in many developed countries and it is spreading year after year and improvement has been confessed by many clusters that have engaged in that. In developing countries there is a gap to fill for the countries to invest in Technovation. This includes comparatively low and falling levels of R&D and patenting as well as a distinct lag in the diffusion of innovations.

Another study reveal that distribution channels innovation is positively related to overall firm performance [11]. In their studies they find entrepreneurial orientations via innovativeness to be positively associated with Technology. Consistently in Turkey context examined innovation and firm performance in automotive industry [1,11,22]. Their results demonstrated that technological innovation (product and process innovation) has significant and positive impact on firm performance, but no evidence was found for a significant and positive relationship between non technological innovation - Technnovation (organizational and marketing innovation) and firm performance. Results that Corroborates that shows which report positive effects of innovation types on firm performance in Pakistan`s manufacturing sector [1,8].

Why has China been much more innovative than the other emerging economies? China`s success lies in its effort to obtain technological innovations – Technovation from abroad, in combination with its willingness to invest in domestic R&D [14,15]. It got multinationals to transfer their technologies to the local Chinese context (i) through directly transferring technology to their affiliate or joint ventures (JV); (ii) through promotion of their spillover - effects and (iii) by encouraging multinational firms to specifically develop and implementing technologies through shifting their R&D to the country – setting in motion the internationalization of R&D [27]. China attracted most of this technology – transferring FDI into its manufacturing sector. Manufacturing is in many ways intricately linked with technological innovation - Technovation. Manufacturing is by its nature important for knowledge accumulation, and generates positive externalities, including spillovers of information and new

management practices, and generates variety. There are currently an estimated 9 billion different variety of goods in production, more than the number of people on the planet [13].

5. Discussions of Results from the Review

"Accelerated technological change has become a fact and will continue to challenge industrial and societal development in this new century." Anticipating these changes seems to be crucial for success in technology-based companies. For Technovation these changes have two sides: on the one side, the Technology is an object of change and on the other side, it is subject to change. As an object of change the Innovation has to adapt quickly to new environments [6]. This requires a high degree of flexibility and speed of response because of their limited resources. Employees and organization have to be open to new ideas and able to realize them quickly, because they cannot rely on unlimited financial resources and are often working in small, innovative niche markets.

Technological innovation across the world is one of the driving forces behind productivity advance. However, it is hard to argue that technological innovation or the lack of it, in economy is an important factor in explaining the vicissitudes of the last fifty years.

The unemployment/inflation story has only the most tenuous connection with technological advance. Even the large fluctuations in productivity and GDP per capita relative to other countries have less to do with technological innovation, perse, and more to do with the extent to which developed countries utilize best practice methods. These are, of course, intimately related to technology but the fundamental problem is more organizational than technological [30]. And the basic questions concern the incentives to utilize best practice methods and the barriers against doing so. These are, of course, big issues which we only discuss tangentially in what follows. Here, we focused on the role of technological innovation although this was inevitably; lead us to touch on how innovations are used.

As we have seen, the relative productivity performance of the Developed countries has improved over the last two decades particularly given factor inputs. Over this period, technology growth has been among the highest in these countries. Creating links between knowledge generation and enterprise development is one of the most important challenges facing developing countries. There are a variety of ways in which governments can help stimulate small and medium-sized enterprises; for instance, by supporting business and technology 'incubators', export processing zones, and production networks that allow small enterprises to pool business services and labor pools. Targeted taxation regimes and market-based instruments, and a wide variety of strategies for unlocking financial capital, are needed to create and sustain enterprises that contribute to sustainable development.

The actions that contribute to sustainable development goals occur on all spatial levels, ranging from international framework agreements, to national policies and action plans, to the decisions and behavior of local communities, families, and individuals. The actions are taken by governments, business and industry, and a wide

range of civil society organizations. There is therefore a need for a wide range of mechanisms to inform and influence the actions taken at these different levels and different actor groups. For instance, at the international level, there is a need to continue input from the science and technology communities in intergovernmental ministerial conferences, whereas local- and individual-level decisions may be most effectively informed through long - term commitments to strengthening educational curricula and institutions. These mechanisms will have to evolve over time in response to the evolving overall agenda for harnessing science and technology for sustainable development.

6. Conclusion and Implications

Technology in developing countries is challenged by the lack of deep pockets (Capital), by the nature of their organization still being innovative and by being in a rapidly changing environment. For a successful management of technologies under these circumstances, a management system has to be compact, flexible and adaptable. The Pocket concept (Pocket Technology Management or technology and innovation management) aims at supporting according to their entrepreneurial needs, possibilities and opportunities.

To compete with larger competitors, New Technology-Based Firms (NTBFs) must develop advantages of flexibility and speed of response. In order to capitalize on these advantages, NTBFs require a technology and innovation management approach that enhances the NTBFs' competitive advantages in terms of entrepreneurial organizations, short communication paths and intelligent decisions mechanisms. However, virtually all the research on technology and innovation management has taken place in large firms, therefore in another context.

Technological innovation plays an important role across the full range of issues described in the previous sections, and is highlighted here because of its critical relevance to both short and long-term economic, societal, and environmental sustainability. Technological innovation can be seen as a double-edged sword with respect to sustainable development. There is no doubt that much of the improvement in human welfare over the past century can be accounted for by technological innovations in areas such as public health and agriculture. But at the same time, many of the world's critical sustainability problems are unintended consequences of technological developments, especially those aimed at increasing production and extraction of natural resources.

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