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Information and Communication Technology for Sustainable Development

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Introduction

On September 2015, the world leaders have adopted the 2030 Agenda for Sustainable Development which officially became active on January 1st 2016. It describes the 17 Sustainable Development Goals which harmonized on the success of the Millennium Development Goals – have the challenging object to build a sustainable world where basic human rights are everywhere observed and respected. All countries are asked to contribute in order to end any form of poverty, eliminate inequalities and assure a long-lasting growth while protecting the planet. In order to do so it is necessary to develop a set of strategies aimed at promoting a sustainable and prosperous economic growth in all countries, being them rich, middle-income or poor.

Information and Communication Technology (ICT) is a set of changing and evolving devices and applications, such as computers, hardware and software, satellite systems, which has the incredible potential to meet growing necessity of the countries. In particular, ICTs are crucial in responding the requirements of the Sustainable Development Goals. The digital inclusion is nowadays fundamental in order to reach these development outcomes in both developed and developing countries.

Since 1990 the growth of ICT has considerably affected the economy so that this technology revolution has been widely studied; as a general purpose technology, it has huge potential in increasing productivity in almost all sectors of the economy.

For this reason, in this paper we are going first to review the basic economic theories which have proved the role of ICT and the importance of the knowledge economy on productivity, in order to land on practical examples which once again testify its potential.

Then we will research and match each technology with the most relevant SDGs. In order to have an acknowledgment of the stated research, we will focus on some specific assets regarding ICT and KBC evidencing their spread and diffusion all over the world.

This will let us upon a window on the concluding suggestions for policy makers because public policies are fundamental in order to realize their full potential.

PART I – Review of the literature

I. Brief economic outlook

The decrease in economic growth, registered in the first half of 2015 all over the world, was characterized by a further slowdown in emerging markets and a slight recovery in advanced economies, with respect to the previous year.
However, in emerging market and developing economies, the outlook is projected to improve: in particular, countries in economic distress in 2015, such as Brazil, Russia, Latin America and Middle East, are projected to increase their growth, even if it may remain weak or negative, offsetting also the expected gradual slowdown in China. (IMF 2015)
Looking for ways to increase productivity growth, it is widely understood that investing in competitiveness is becoming fundamental in our economy. The area of investment might include R&D, education, intangibles and complementary tangibles; in particular the ICT sector, on which this paper is going to focus, can be a reliable and efficient resource to boost economy growth.
"Information and communication technologies (ICTs) include any communication device - encompassing radio, television, cellular phones, computer and network hardware and software, satellite systems and so on, as well as the various services and applications associated with them, such as videoconferencing and distance learning." (Whatis, 2005)

II. The knowledge economy and the shift from tangibles to intangibles

The growing process - started in 1950's when the firsts personal computers became available and concluded with the current plateau of productivity of the Internet and its services - is leading to a new working environment which has different potentials for our economy to better off. As a result, what drives the economy are those new technologies based on knowledge and information.
Advanced economies are becoming more and more dependent on the service sector as a source of growth, instead of the manufacturing sector, showing how knowledge can be effectively placed either in goods or services. All this process is the result of a broader shift from tangible to intangible goods.
It is not enough to pursue new investment opportunities because profitably economies are based on knowledge creation. One of the most important value of knowledge-based investments is that, unlike tangible investments, they tackle the economic and financial crises quite well. Over the past decades, it has become evident the importance of technologies based on knowledge and of information production and dissemination as the leading edge of the economy. From this new study field, the term "Knowledge-based economy" has been indeed coined to identify the role of knowledge and technology in economic growth.

Indeed Knowledge Economy is defined as "the production and services based on knowledge-intensive activities that contribute to an accelerated pace of technological and scientific advance as well as equally rapid obsolescence" (Powell and Sellman, The Knowledge Economy, 2004, p.3). In this respect, a greater importance must be given to intellectual capacities rather than to physical components and natural resources; they are to be combined with adequate improvements along the whole production process. The benefits are identified in GDP growth due to intangibles (Abramovitz & David 1996).

III. Productivity paradox

A challenge in the economic literature has been the research of efficient units of measurement for knowledge and intangible capital. Indeed, despite they have been proved fundamental in boosting productivity, we need to understand the extent to which this is true, that is how much they are fundamental.
The relation between technology and labor productivity - the amount of real GDP produced in an hour of labor - helps us understand the knowledge economy.
Economists came to a blind spot when Roach (1987) showed data for the US economy relative to the paradoxical relation between computer investments and labor productivity during the ages from 1970 to 1985. The increase in computer investments, which was observed particularly in the service's sector, was accompanied by a slowdown in productivity, which was more important again in the service's sector.
Moreover Loveman (1994) exposed that the return on investment in IT of manufacturing firm between 1978 and 1984 was indeed negative. Even including other variables in the equation, like oil prices, data still measured a slowing productivity with the increase in the use of IT. Finally, Berndt & Morrison (1995) found that the gross marginal product of technological investment in manufacturing was lower than its cost.
All of this has resulted in the famous quote from Robert Solow: "You can see the computer age everywhere except in the productivity paradox" (1987, p.36). Indeed the term "productivity paradox" is used to describe this lack of data representing the relation between technology investment and productivity. The productivity paradox may be explained in several ways.
Let us consider Acemoglu et al. (2006) with the concept of technological frontier. When an economy approaches its technological frontier, it reduces the possibility of importing capital and know-how from abroad. As a consequence, inputs must come from home education and R&D so that innovation and technological change would satisfy the demanded economic growth.
Moreover, has stated in David (1990), technology takes time to diffuse and prove growth; before this happens, a negative impact is recorded on data because of the time and investment, like institutional changes and public acceptance, which are necessary to settle into. Indeed, some productivity losses may occur if new technologies have to interact with old organizational systems. This is the case, for example, described by Brynjolfsson et al. (1997) when losses occurred because the introduction of computer-based manufacturing was still associated with time-tested organizational work.

Also, policy makers need to increment the right set of rules so that investment in ICTs can actually benefit the economy.
As previously stated, if the "IT revolution" was evident in everyday life, it was not apparent in the productivity data. This concept has been resumed, among others, by Alan Greenspan who noticed that the most computer-using industries had negative growth in productivity. Also, together with Nordhaus (1997) and Hausman (1999), pointed out the inability of the CPI to account for the IT revolution.
By the mid-1990s, the productivity data became finally quite detailed when the IT capital has been recognized as a primary source of growth in a series of paper (Jorgenson & Stiroh, 2000; Oliner & Sichel, 2002; Jorgenson & al.,2002; Stiroh, 2002a).
In particular, in its paper "Are ICT Spillovers Driving the New Economy?" (2002b), K. Stiroh looked for a link between TFP measures and ICTs use. Previous studies demonstrated how average labor productivity growth was consistent with a massive use of ICTs. However, this statement well-suits the "Old Economy" with all its characteristics. Instead, consistent with the idea of the "New Economy", is the growth associated with total factor productivity (TFP), the portion of value added measured by factors other than inputs like labor and capital. ICTs give its contribution to TFP growth via non-monetary frames.

Despite this data have proved the economic recovery, there is a missing contribution due to the role of intangibles. They have been wrongfully addressed as expenses in accounting records rather than parts of GDP, neglecting their role in economic growth. So, to conclude, the use of technological knowledge in its many forms together with the inclusion of intangibles in the productivity equation, are fundamental in order to explain economic growth.
After years of research (Grindley & Teece 1997; Griliches 1990), patents have been used as indicators of economically worthy intellectual capital, that is as a good unit of measure for intangibles. They can be a proof of how innovation can lead to cost reduction and to the production of completely new goods and services. On the other hand, the demonstrated increase in patent could be due to changing regulations and laws which may encourage enterprises to patent their inventions more often (Heller & Eisenberg 1998, Lessig 2001, McSherry 2001). Nevertheless, it is still evident a non-negligible innovation in the production process.
If patents evidence innovation in intangibles, the measure of human capital can be seen in the size of the science and engineering workforce.

Another important outcome derives from Kramer and Dedrick (1994) in a study of eleven Asia Pacific countries. They demonstrated a positive relation between IT and GDP growth, recognizing the potential of these technologies. But remembering the fundamental econometric quote "Correlation does not imply causation", they showed a dynamic relation between ITs and growth because they are related also to wages, wealth and infrastructures.

Even taking into account any remained uncertainty of the greatness of the IT revolution, the majority of the literature in this field does agree that investments in information and communication technology have the ability to boost and sustain economic growth; whatever contradiction could be attributable to data errors.

IV. Introduction on developing countries

We are living the era of the digital revolution as we are facing a shift from mechanical to digital technology; together with the huge phenomenon of globalization, they are responsible of the changing world of work. Indeed, these transformative forces are reflected in job creation and destruction, innovations, new networks, different patterns of trade and clearly economic growth.
In such a busy world, it becomes fundamental to develop strategies and policies aimed at meeting these new trends where the technical knowledge becomes obsolete in the twinkling of an eye. In effect this accelerating pace makes the rules of yesterday worthless for today and tomorrow. Governments, policymakers, education providers have the challenge to keep up in order to increase productivity and growth.

Over the past century the world economy has moved its activities from agriculture, to service, to industry, as it is reflected into the value added as a proportion of GDP and into employment patterns.
As a consequence, the economic importance of agricultural activities is steadily decreasing when referring to the developed world, however with respect to Sub-Saharan Africa and South Asia, its importance to workers remains high – in 2010, 33.1 percent of the world's labor force worked in the agricultural sector (ILO 2014).
Then, the industrial activity together with job creation declined in recent years, in particular global value added in industry dropped from 32.8 percent of GDP in 1995 to 26.9 of GDP in 2010 (World Bank 2015) and employment increased by only 1.2 percentage points (Human Development Report Office calculation based on ILO 2014).
Finally, the service sector is increasing even if job creation is not fully resolved into the high-tech advanced industry.
Clearly each of these trends should reflect into a specific policy so that efforts are focused into productivity growth.

IT has the potential to increase growth in labor productivity. So investment in IT should improve because it affects not only the industrialized countries, but also the developing ones, low and middle income countries. Indeed they need to adapt to this changing economy in order to reduce the gap or at least to avoid a further increase in it.
So to catch up, developing economies need to acquire and invest in new technologies, but at the same time they have to look for new organizational and social forms suitable for this New Economy.

Poor countries face many issues which get back at their economic performance. Among others we can mention: export based on undiversified commodities, limited or inefficient industrial capacity, inadequate or dysfunctional infrastructure, nascent or weak entrepreneurial forces, shortage of professionals due to inefficient education systems, weak institutions, human capital poorly developed, which would be the key for growth.
However, we can identify some positive progress: liberalization and deregulation, together with democratic reforms, are helping developing countries in strengthening market forces; then regional integration and cooperation create larger markets which benefit from economies of scale.
So there are necessary new all-inclusive policies aimed at developing new markets and product niches; promoting the access and use of ICTs which, beyond their known advantages, have low barriers to entry; encouraging local medium enterprises.

V. The role of Human Capital in developing countries

In the first part we discussed the Knowledge Economy from the perspective of industrialized country; let us look at the importance of Human Capital (HC) in developing countries, well highlighted by the African Development Report (1998).
Investment in HC, that is investment in education, health and nutrition has a direct impact on labor productivity and on living standards.
Thanks to the knowledge economy, developing countries can have the possibility to progress and participate in global economy because it increases the capacities and skills of the labor force. Knowledge economy and ICTs are the key to eradicate poverty and reverse its trend: they are instrument for learning. Indeed a good percentage of Africa economic disadvantage is due to its limited access to basic phone services and then to the internet which would be great instrument of progress. They have the capacity to shorten the gap between industrialized and developing countries.

Nowadays the technological revolution is literally changing the concept of work, so that the correlation between human development and work creation and the resulting policies aimed at people well-being, are being reshaped. Indeed our main goal would be the accessibility of these technologies that represent the new economic and social era. In this respect government plays a fundamental role because knowledge needs to be considered as a public good. As a such, it needs appropriate structural reforms and regulations in vital sector as telecommunication, so that the macroeconomic performance of our countries would eventually better off.

After the two previous industrial revolutions – the first driven by steam, the second by energy - we are now living the third one in which computers and networks are the main characters. As history has thought us, these transformations in the short run may have negative consequences because of the required social changes and the revolutionized work. However in the long run, they would generate opportunities and build new capabilities in order to improve people's lives. Today, the main consequence is the replacement of unskilled workers with automatized machines because there is a change in the required skills and job's positions. As the economy has shifted from the agricultural to the industrial sector, workers are required to be more educated, more technologically capable and more creative: people need to be ready to compensate for the human shortages of the machine.

Prices are less driven by the cost of physical production and more by the sophisticated knowledge embodied in the good. R&D together with human skills determines a huge increase in value. As a result workplaces are changing and the knowledge economy needs to maintain the pace of technological innovation in order to increase productivity. We are attending a new demand for knowledge, skills, innovation and experience, moving on the routine transactions and hand jobs which are increasingly disappearing because of automatized machines.

Also in developing countries the demand for workers is changing: it requires professionals with at least a secondary education and some trained capacities. Indeed it is necessary an early intervention in order to invest in children and develop their potential.

VI. ICT and globalization

The technological revolution has also resounded into the economic globalization creating new global networks through outsourcing and international value chains.

Digital technologies have boosted international competition both among workers and among enterprises. Once geographical barriers have been removed, work connections could be done through the internet or mobile phones

- **OUTSOURCING**

  Outsourcing is the process of decentralizing business services away from corporate headquarters to generate greater profit, an example is information technology enterprise in India.

  As the result of this process, developing countries – such as China, Mexico, Costa Rica, Sri Lanka, Dominican Republic (ILO 2003) – adopted export-oriented industrialization which determined job creation and boost local development although the quality of work varied.

  Information and communication technology has enabled the outsourcing of production and service provision abroad, yet in 1990.

Then in 2001-2002 thanks to the burst of the dotcom bubble, technology companies were able to further cut their costs by relocating noncore activities over lower wages countries with technical skills, like India where the number of jobs in ICTs roses from 284,000 in 2000 to 2.26 million in 2010 (Bardhan, Jaffee and Kroll 2013). Other offshoring destinations include the Russian Federation, Africa and Latin America. Clearly in developed countries this process has contributed to the fear of job losses.

- **GLOBAL VALUE CHAIN**

  Globalization has also moved production boarders, forgetting the rule of moving one single activity, of a single company, offshore. Global value chains concern multinational companies with internationally production processes, distributed overseas from the raw material to the finished good. Here, the headquarters are located in developed countries, while suppliers, partners, and minor affiliates are dislocated in developing countries. The digital revolution and ICTs play key coordinating roles in this process.

  We can figure out both benefits and drawbacks for the economy. We have assisted to an increase employment in developing countries, with greater women participation and a subsequent learning process for young people. But on the other hand, there are concerns relative to the unemployment of older women and more skilled workers, and to labor protection. Also, developing countries face limited work opportunities, wage loss and low skills development.

  ILO (2015) has shown that while productivity is higher thanks to global value chain, wages are the same for workers both inside and outside the global value chain activity.

  In this competitive economy, companies are increasingly trying to cut their costs off by using temporary contracts and by outsourcing employees.

  In this respect coordinated actions among regional, national and international governments are necessary in helping people develop in this globalized world.

We should now understand why developing countries must invest in technological development and how science creates wealth. Only the use of untapped natural wealth, the development of human resources, and the effective policy execution, can create an explosive wealth with which they can give a real contribute to the phenomenon of globalization

Behind the prosperity of nations there is a simple concept: ideas matter.

While the western societies innovated and developed over the past 300 years, Sub-Saharan African, Latin American and South-Asian countries have remained stuck in their primitive aspect for several reasons. We would not be able to live without our daily technological comforts that make our existence easier and more economically productive. But people from the other side of the continent, living in condition of extreme poverty, do not worry about electricity, telephones, refrigerators, computers and so on.

We are living the XXI century, this trend needs to change. We need to deeply understand the economic importance of a technological advanced society.

Information technology nowadays is one of the main drivers of Globalization, together with international trade and investment. Indeed globalization can be defined as the result of the "interaction and integration among the people, companies, and governments of different nations". Clearly to get a positive gain from this huge phenomenon, we need to maximize the constructive cooperation among all nation, being them either industrialized or developing. Mainly today, we are facing a devastating reality in which marginalization is leading to a Third World War. In turn, it can be found, among others, in migration issues, refugees' problems, human sufferings, violated fundamental human rights, religious extremists that impose cruelly themselves on people's life. In order to try to overcome these problems, we need to benefit from international cooperation which is fundamental in shortening the gap among nations.

Indeed globalization should not be seen as an oppressive dominance force but, again through the use of ICTs, it can be the starting point of a well advanced society, any country excluded. ICTs allow the annulment of time and space barriers, a main characteristic of globalization. Indeed, within the global context, they enable more value added activities and they are related to socio-economic transformations.
In this process of knowledge creation, each country should build its technological know-how, thanks also to foreign investment and cooperation among nations.

Let us try to understand how developing countries can raise.
The decisions governments are taking today, affect the results the next generation will face. Are governments actually doing something effective about population growth, job creation, and poverty eradication? As they continue with this pace, we will get a doubled population with thousands of unemployed young people, in forty years from now. Instead if we challenge to create jobs faster than the speed at which population grows, if we create skills on human capital that balance out this growth in population, then we may avoid the Malthusian dilemma.
Let us give a deeper look to Malthus population problem

VII. **The Malthusian population problem**

Looking back to the economic literature, we find that three main evidences opened the door to Malthus's theory.

First of all, starting from about 1790, England overturned the tendency of being fairly self-sufficient in its food supply. Indeed prices rose noticeably as a consequence of the conspicuous import of food. Then, in the depths of the Industrial Revolution, cities became highly urbanized and production shifted from the household level to the factory's one. In this respect the poverty of low-income classes appeared to increase, as the gap between high and low income classes deepened. Finally, Malthus opposed the idea elaborated by W. Godwin and M. de Condorcet, his father accepted. They stated that the character of an individual is shaped by the environment in which he lives: the perceived happiness, misery and vices, indeed play key roles. From here comes Godwin's philosophy of anarchism: everything is attributable to Governments decisions. Going against this theory, Malthus showed that changing institutions would not remove the evils of the society.

Having said that, Malthus formulated his theory grounding on two basic assumptions: first, food is necessary for our subsistence and second, passion between sexes is necessary and will not disappear.

Then he stated that in the absence of checks on population, it tends to grow geometrically (1..2..4..8..16…), while food supply can only increase arithmetically (1..2..3..4..5…). Here lies the cause of poverty and misery. His first solution was the development of positive and preventive checks on population but then he realized that they would result in vice and misery, so he introduced and concluded with a moral restraint.

Even if Malthus's theory on population gave great contribute to the development of the Economic theory and its policies, it embraced several flaws but it is still existing – as Giambattista Vico taught in its "Scienza Nuova" history materializes in recurring cycles (*corsi e ricorsi della storia*).

First of all, he never considered the possibility of contraception as mean of controlling population. Then, he misunderstood the instinctive sexual desire with the desire of having children; in this respect we can mention that a higher level of education - which is reflected in the growth of human capital – tends to introduce the distinction between the two desires. Finally, and here most important, his arbitrary assumption that the food supply cannot increase faster than population growth, is greatly wrong and nowadays we can see why. At Malthus's time there was not still a theory explaining the impact of technological development on the economy, which is now exactly reflected in the role of ICT on economic growth. So due to historical reasons, Malthus failed to look into the possibility that as the population increases, education increases, technological development increases, then agricultural productivity increases to a level sufficient to feed that increased population.

After having demolished Malthus's theory, we can assert that a growing population will not have a negative impact on the economy: instead it will be a resource because a skilled population will be able to produce more with less. This process will gradually lead to food security over small hectares of land. Western societies have beaten the population dilemma thanks to a continuous innovation that embraces science and technology, that is the secret of prosperity.

VIII. What does ICT can practically offer?

As previously stated the digital revolution is changing the world of work. In particular, the knowledge base capital has greater impact on the global economy with respect to capital and labor. It accounts for half of global productivity and its shares are rising, growing at 1.3 times the rate of growth of labor (McKinsey Global Institute 2014).
The effects of this changing economy vary differently according to the social context of each country. Indeed each of them reflects the different amount of used ICTs resources and the different developed human capabilities, into the shares of agriculture, industry and services to the economy. Also digital technologies affect differently the labor market, that is the ratio of paid to unpaid work and the job positions.
ICTs are influencing daily activities in the developing world. For example, mobile phones are used in Ethiopia to check for coffee prices (Gabre-Madhin 2012); dry lands in Saudi Arabia are irrigated through wireless technology for wheat cultivation (Atta, Boutraa and Akhkha 2011); phones are used by female entrepreneurs in Bangladesh to provide paid services to neighbors.

Currently, mobile phones are an expanding asset given their versatile nature, thanks to services of instant messages, VoIP, applications and phone calls. There are several examples of new opportunities they may guarantee:

- *Price information are more easily accessible*. In India, an 8 percent increase in profit and a consequent 4 percent decrease in prices for consumers resulted from a better access to information because farmers and fishers were able to track weather conditions through mobile phones. In the same way, in Niger a 10 percent drop in grain price results from the use of mobile phones. (Deloitte 2014)
- *Productivity growth*. In Malaysia, Mexico and Morocco, an 11 percent increase in productivity resulted from the reduction of transaction costs and of barriers to entry (Deloitte 2014)
- *New job opportunities*. Direct and indirect jobs in technological-based enterprises are created thanks to the internet and mobiles.
- *Increased efficiency*. It derives from the possibility of keeping track of supplies and deliveries which result for example in reducing food waste

- *Better services*. In Kenya, India, Uganda, mobile phones are used to better off technical agricultural services (Aker and Mbiti 2010)
- *Labor market services*. Mobile phones can help matching employees with jobs availability; indeed in South Africa a 15 percent increase in employment, mostly for women, has been associated with this service (IDRC 2013). For example voice message have been useful whenever workers faced problems with reading and writing.
- *Easier banking system*. Thanks to the possibility of making payments and transferring funds through mobiles, farmers working in urban areas can easily support households in the countryside.
- *Easier financial services*. Investors around the world can easily finance small business enterprises in rural areas. An example is CARE International which is helping the matching between interested parties and small business ideas in 10 countries (CARE International website).

As we have seen, there are several opportunities that can be realized thanks to the access to the internet and to the use of mobile phones. In particular women and people in rural areas could benefit from these opportunities because they can exploit creativity and ingenuity or illiteracy. Deloitte (2014b) has estimated that if internet access were the same in developing countries as they are in developed ones, then a $2.2 trillion increase in GDP and 140 million jobs would be generated.

IX. New frontiers for work

- **NEW PRODUCERS**

  Thanks to digitalized knowledge and applications a better productivity is generated: they can be produced at almost zero extra cost. This perspective of zero marginal costs has generated new producers. Another characteristic of the digital economy is the production of consumed goods and services directly by consumer. The best example is Wikipedia, counting more than 73,000 volunteers, has contributed in 2012 to the ceased publications of the print editions of Encyclopedia Britannica after 244 years (McCarthy 2012). Also, new technologies have enabled new forms of production in the energy sector because households now can sell their excess power to have an economic return.
- **IMPACT SOURCING**

  Impact sourcing is a global initiative to bring internet-based jobs to disadvantage communities. It helps connect organizations with a service provider that hires and trains skilled but disadvantaged young people.

- **START-UPS**

  Start-ups are becoming widely used in both developed and developing countries giving opportunities to young people thanks to financial technology. Challenges arise with respect to availability of capital, sustainable development and weaker legal institution in developing countries.

- **CREATIVE INNOVATIONS**

  Technological innovations and ICTS, after having changed the world of work, has sped creativity and innovation. In addition to increase productivity, they contribute to people's well-being and work satisfaction.

  Every day small adjustments and contributions may lead to big gains that cumulate in the workspace. For example, Japanese companies are expecting 100 times more suggestions from their workers rather than from US companies (May 2007).

- **OPPORTUNITIES FOR WOMEN**

  Globalization and ICTs are allowing a growing number of women to enter into the workforce and to apply their potential and abilities. For example, in developing countries, the access to mobiles has enabled them to get market information and financial resources easily from home.

  Yet in 1997 in Bangladesh, female entrepreneurs used leased phones from Grameen Bank to sell services to other villagers (Maier 2008). In India, women used e-Seva services to provide online services, which include online auctions, pay bills, obtain land and birth certificates, gain access for agricultural services (Maier 2008).

  Given that this new world requires higher level of education and skills and women have not fairly possibilities of gaining them, it is necessary to boost female participation for example through EdX, an online learning destination and MOOC provider, founded by Harvard University and MIT in 2012, offering high-quality courses from the world's best universities and institutions to learners everywhere.

X. Some drawbacks

Despite the growing opportunities created by the new technologies, most gains in productivity are yet to be observed.

As previously stated, new technologies create new demand for jobs indeed since the industrial revolution we have recorded a big increase in productivity and employment. On the other hand, the fear of job losses because of automation increases as well: by 2025 almost 50 percent of today's jobs may become useless (CBRE Global 2014). Computers and human are going to work jointly, each performing specific tasks that would require valuable skills.

Then, as with all revolutions, the technological revolution has raised inequalities with respect to income distribution, denoted even in better educated and trained people. But clearly advanced economies enjoy the largest share of gains and incomes. Here the big risk is that ICTs could contribute to a new "global apartheid" because they are designed or applied in a way inconsistent with development goals (Bezanson and Sagasti 1995); unprecedented level of scientific advance and technological innovations has increased the gap. Those with access to them will head the competition and run the world. Those unable to gain such access will be increasingly marginalized. These differences can be seen in the different abilities people have in order to emerge over the knowledge revolution.

The market is not self-regulated, as Adam Smith's Invisible Hand established. Because of inequalities and losses derived from the technological revolution, policies and development strategies are necessary. Governments together with NGOs, International organizations, need to cooperate in order to take advantage of the great opportunities we are facing. Moreover, it is necessary to build a more sustainable world where the globalization can be a real source of growth for everyone.

PART II – ICT as a source of sustainable development

I. Sustainable Development Goals

Sustainable development has been defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development 1987). Two key concepts arise from this definition: the concept of needs and the idea of limitation. Thus an overriding priority should be given to the essential needs of all the people around the world so that fundamental human rights can be similarly respected.

The Earth's natural resources are fundamental to the survival and development of the whole population. Food, water, forests, wildlife are renewable resources provided that exploitation does not exceed regeneration. Current rates of depletion of the Earth's stocks of renewable resources due to heavy consumption and levels of pressure on their regenerative capacity might already be beyond this threshold. Minerals, oil, gas, coal as non-renewable resources are objects of governmental conservation plans where recycling and proper energy saving are an integral part of our social ethics.

Sustainable development must be taken up by society as the leading principle behind each citizen's everyday choices as well as for the big political and economic decisions. This requires profound changes in thinking, in economic and social structures and in consumption and production patterns.

The 2030 Agenda for Sustainable Development is a big step forward implemented by the United Nation agency and by all signatory countries.

The 17 Sustainable Development Goals and 169 targets which were announced on September 2015 are integrated, indivisible and want to harmonize three core elements: economic growth, social inclusion and environmental protection. "Their aim is to end all forms of poverty, fight inequalities and tackle climate change, while ensuring that no one is left behind. To this end, there must be promotion of sustainable, inclusive and equitable economic growth, creating greater opportunities for everyone, reducing inequalities, raising basic standards of living, fostering equitable social development and inclusion, and promoting integrated and sustainable management of natural resources and ecosystems". (UN site)
The SDGs are a step forward to Millennium Development Goals, a 15 year agenda established in 2000; they drove progress in several important areas. For example, poverty has been halved in 70% of developing countries, infant mortality has also been halved and diseases like HIV/AIDS and Malaria are hitting less and less people.
But to get a world where all human rights are respected the path is long. If in industrialized country maternal death is near zero, in the developing world 1,500 out of 100,000 women die while giving birth. The access to education is still denied, almost seen as a privilege rather than a human right; just as women are still discriminated in working areas and public life: the world needs to recognize them as a resource. Over 750 million people lack access to clean water. (Close The Gap site)
For this reason the SDGs have been set, hoping to reach a fairer and more equal world by 2030

II. The role of ICT in sustaining SDG

All three pillars of sustainable development – economic development, social inclusion and environmental protection – need ICTs as key catalysts, and ICTs will be absolutely crucial for achieving the SDGs.
ICTs have incredible potential to improve development outcomes in both the developing and the developed world, and it is self-evident that digital inclusion is necessary for sustainable development in the 21st century. Information and Communications Technology for Development (ICT4D) can beat the digital divide between countries, giving the less developed world the possibility to finally catch up.
On May 17th 2016 Geneva has hosted the World Telecommunication and Information Society Day (WTISD 2016) which focused on "ICT entrepreneurship for social impact" - in accordance with Resolution 68 and as endorsed by ITU Council 2015. The attention has been placed on "ICT entrepreneurs and start-ups and small to medium-sized enterprises (SMEs) that have a particularly relevant role in ensuring economic growth in a sustainable and inclusive manner."

“These technologies provide smart solutions to address climate change, hunger, poverty and other global challenges,” the United Nations Secretary-General Ban Ki-moon said. “They are key instruments for providing mobile health care and access to education, empowering women, improving efficiencies in industrial and agricultural production, and safeguarding the environment.”

He recognized ICTs as key drivers of productivity growth, thanks to the interaction with small and medium enterprises, fundamental in this process. At the same time, high-growth firms contribute substantially through job creation and spillovers from innovation.

ITU Secretary-General Houlin Zhao noted that we are surrounded by a smart and networked environment, which includes cloud computing, big data, and new applications in all aspects of our lives.

“ICT entrepreneurship is set to bring about a paradigm shift in making significant social impact. We need their expertise, innovation and investment to achieve our common goals of sustainable economic and social development,” he said.

All sectors of our society must be included because each of them has a role, from government, to young people, to entrepreneurs, to experts, in achieving sustainable development and promoting growth.

Let us have a deeper look to Sustainable Development Goals and associated ICTs capacities

- **SDG-1** and **SDG-2** - ***Eradicate Poverty and Hunger***. The objective is to reduce by at least 50% the number of man, women and children living in poverty with less than 1.25$ per day. Then we need to reduce hunger, conditions of malnutrition, ensuring food security and preventing food losses. Here the World Food Programme from the United Nations gives a massive contribute.

  Moving to ICTs, they are an economic valuable resource which allows access to work, thus increasing income. They enable services such as mobile banking and microcredit which guarantee small and medium enterprises to rise and develop; in this respect they have already brought a lot of benefits. A practical example is a project started in September 2009 in some African countries such as Burkina Faso, Chad, Côte d'Ivoire, Mali, Senegal, and Sudan. “Nkalo: the right price at the right time” provides timely and accurate information to producers ensuring fair trade and preventing that price volatility affects negatively their activities.

  ICTs can also better off storage capacity, thus reducing food losses. In Nicaragua for example the agricultural economy is not well developed. It is totally inconvenient for families to produce a surplus of food, they limit themselves to a subsistence level. This is because farmers do not have equipment to stock and they have also to repay heavy loans, so they sell their products as soon as possible even with low prices, falling into an infinite loop. Here and in many other countries ICT can be a great resource because they could create a trade for farmers. This cycle of issues prevent families to lighten hunger problems.

- **SDG-3** – ***Good Health and Well-being***. The objective is to reduce maternal and child mortality, combat HIV/AIDS, malaria and other diseases and give access to health facilities.
  In this respect, ICT has the ability to improve health administration, improve health services thanks to the collection and storage of health-related data, create awareness and distributing information on important health issues.

- **SDG-4** – ***Quality education***. The objective is to ensure all boys and girls free and good quality primary and secondary education. In this respect The Malala Fund is working for 12 years of education for every girl (Malala site).
  Then the knowledge gap between high and low income countries is widening by the lack of access to information and communication technologies, the key drivers for improving education and giving economic stability. Close the Gap is an international no-profit organization which donates second-hand computers offered by European companies to medical, educational and social sectors in developing countries. Also, in order to overcome the digital divide, they have developed a Digitruck which provides connection to electricity in remote areas in Africa. It is an IT lab powered by solar energy that allows an equitable access to education.
  Another example is WorldLoop which "is an international no-profit organization committed to extending the positive impact of ICT projects in developing countries by offsetting the negative environmental impact of its hardware" (WorldLoop site). WorldLoop is sustaining a lot of SGDs, it ensures sustainability of both production and consumption, it protects ecosystems improving water quality and betters off health conditions.
  Finally relative to education and sustainability, the role of young people is fundamental. They are not the future, they are our present. The United Nation event Youth Entrepreneurship for Sustainable Development held in September 2015 has emphasized the importance of young people and their potential which, combined with the access to technologies, could generate a more educated world.
  To conclude, ICT have a strong impact on education because it affects all teaching mechanisms, the availability of information to teachers and students, and the fundamental quality of the learning process.

- **SDG-5** – ***Gender equality and women's empowerment***. The objective is to end all forms of discrimination and violence against women. All over the world women have key roles in their families, so it necessary to finally recognize them rights and respect.
  ICT4D is an initiative promoted by the UN Development Program. As previously stated, its objective is to bridge the digital divide and aid the economic development by ensuring equitable access to up-to-date communications technologies.

It has developed many projects to create new working opportunities for women, allowing them to develop their skills.

Moreover, AkiraChix, a no-profit organization aimed at creating a successful work force of women in technology, is changing Africa's future by matching women and the ICT sector.

Girls, excluded also because of cultural barriers, cannot take advantage of the growing sector of ICT and its benefit, if the world does not change.

- **SDG-17** – ***Develop a global partnership for development***. The objective is to increment support from the international community, implement their development assistance, mobilize additional financial resources. In cooperation with the private sector, the new technology can help implement this goal, giving a speed to the whole process.

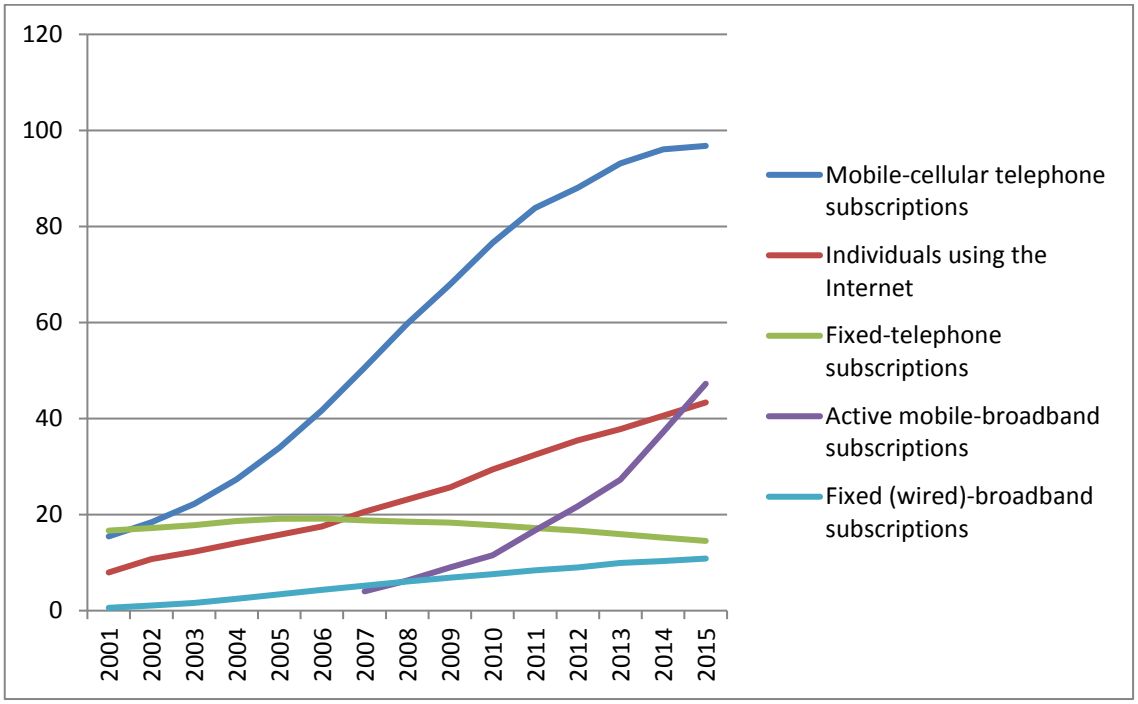
Summing up, Information and communication technology can help developing countries tackle a wide range of health, social and economic problems: technology empowers the people who use it to create solutions for themselves. However the benefits of ICT are not fully realized in many countries: ICT is often out of reach of the poor and those in rural areas.

PART III – Empirical evidence of the impact of ICT and KBC

I. Empirical evidence of the spread of ICT all over the world

As previously stated, ICT have a fundamental role in development because it has the capacity to improve specific sectors of the economy by adding value to the capital deepening and therefore raising productivity, by improving efficiency and therefore the multifactor productivity and finally by lowering transaction costs and boosting innovation.
So we are going to look at selected assets as evidence of its described importance.

- **Global ICT development from 2001 to 2015**

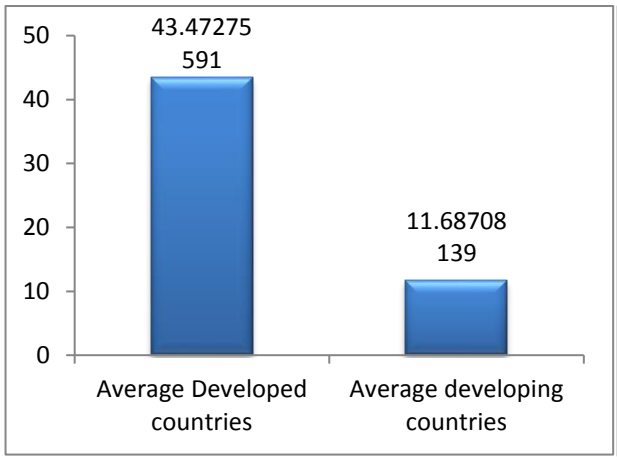


[Graph 1]

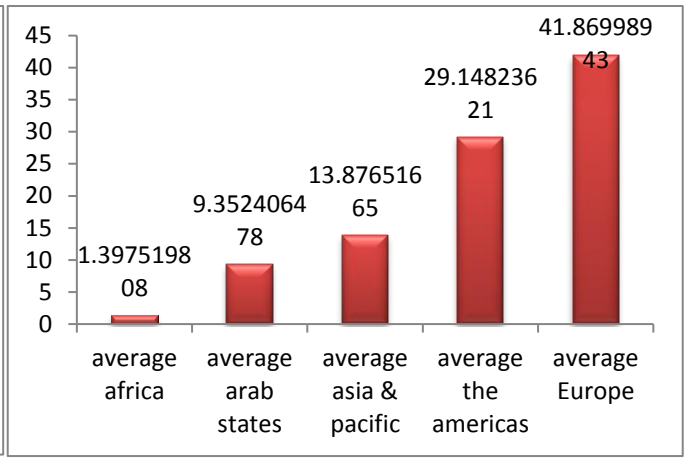
Source: ITU database 2015

Graph 1 shows the spread of the main sectors characterizing ICTs all over the world in recent years. All sectors of ICTs have increased from 2001 to 2015; the only exception is the sharp decline in the subscription to fixed-telephone which could be due to substantial growth in mobile-cellular telephone subscriptions. The benefits from mobile telephone, internet, mobile and fixed-broadband are seen in the growth in productivity in both developed and developing countries.
Mobile broadband is the most dynamic market segment: since 2007 it has increased 12 times.

- **Fixed-telephone subscription**



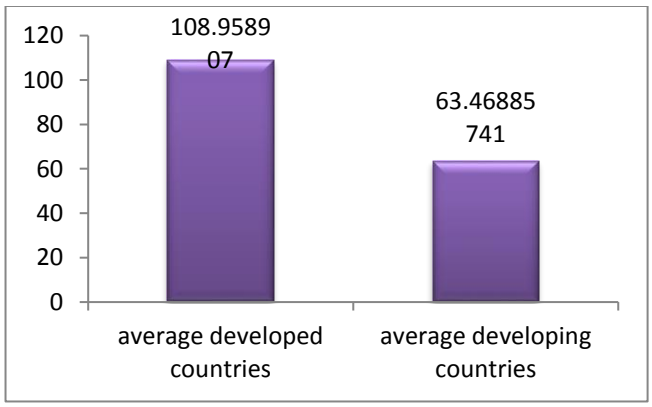
[Graph 2] *Source: ITU database 2015*



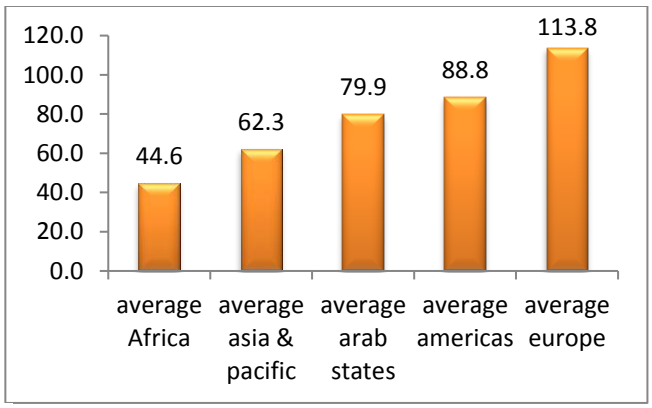
[Graph 3] *Source: ITU database 2015*

Graphs 2 and 3 show the average amount of fixed-telephone subscriptions, per 100 inhabitants, from 2005 to 2015 making a comparison, respectively, between developed and developing countries and between regional sectors, that is between African, Arabic states, Asian & pacific, American and European countries. Developed countries almost increase fourfold the average of developing countries; in particular African countries give the lowest contribute with an average all over the years of 1.39 subscriptions per 100 inhabitants.

- **Mobile-telephone subscriptions**



[Graph 4] *Source: ITU database 2015*

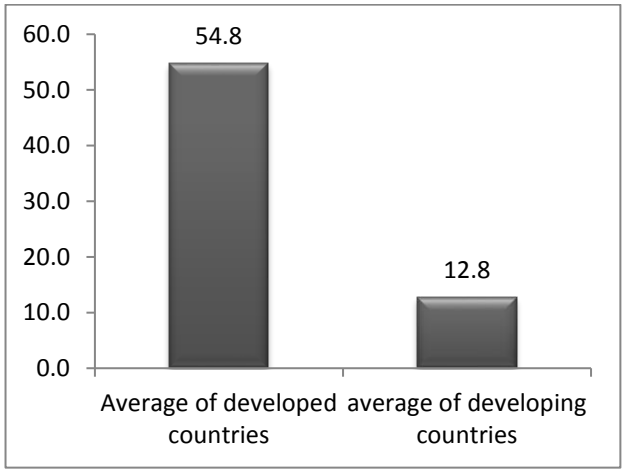


[Graph 5] *Source: ITU statistics 2015*

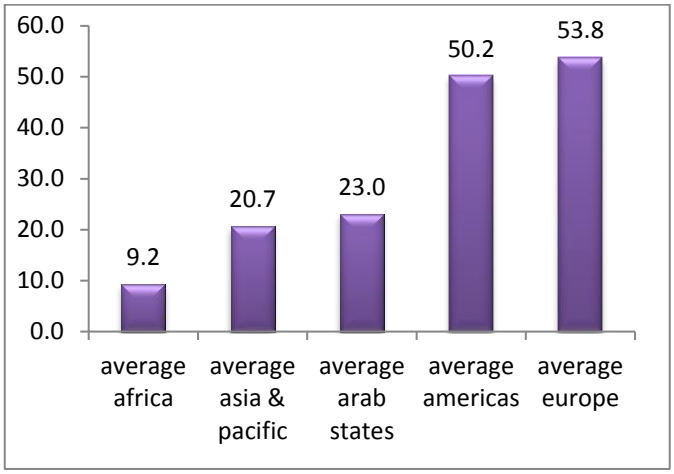
Graphs 4 and 5 show the average amount of mobile-telephone subscriptions, per 100 inhabitants, from 2005 to 2015 making a comparison, respectively, between developed and developing countries and between regional sectors, that is between African, Arabic states, Asian & pacific, American and European countries.

In this case, even if the spread between developing and developed countries is still large, mobile phones are more diffused around the world, demonstrating the efficiency of this asset.

- **Active mobile-broadband subscriptions**



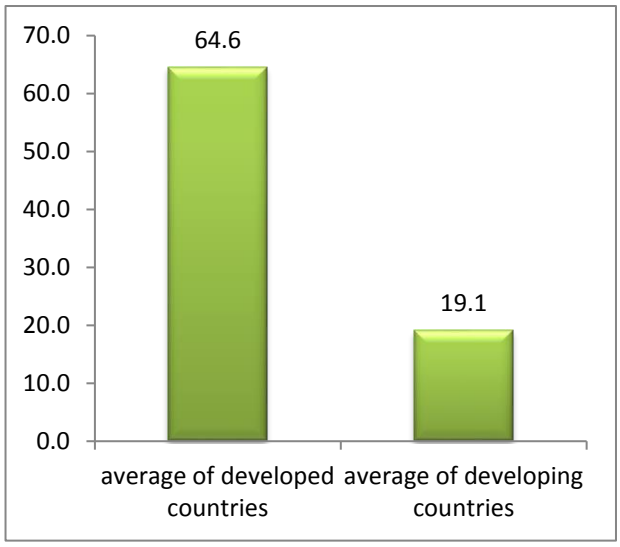
[Graph 6] *Source: ITU database 2015*



[Graph 7] *Source: ITU database 2015*

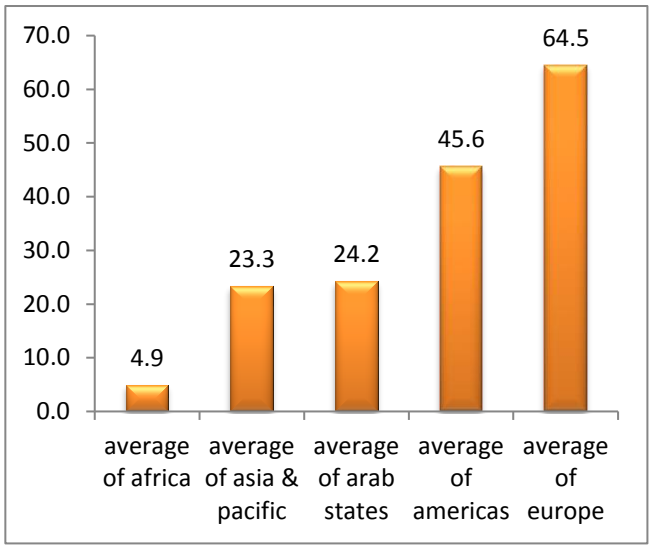
Graphs 6 and 7 show the average amount of active mobile-broadband subscriptions, per 100 inhabitants, from 2005 to 2015 making a comparison, respectively, between developed and developing countries and between regional sectors, that is between African, Arabic states, Asian & pacific, American and European countries. This wireless-broadband Internet subscriptions are very poorly diffused among the developing areas; in particular while American and European areas have an almost equal amount of subscriptions, about 51 per 100 habitants, Asian, African and Arab countries face at most the half amount, showing a greater cost of implementation of this asset. Indeed in developed countries, average monthly mobile-broadband prices are half the ones in developing countries, in PPP$. (*ITU 2015*)

- **Households with internet access at home**



[Graph 8]

Source: ITU database 2015

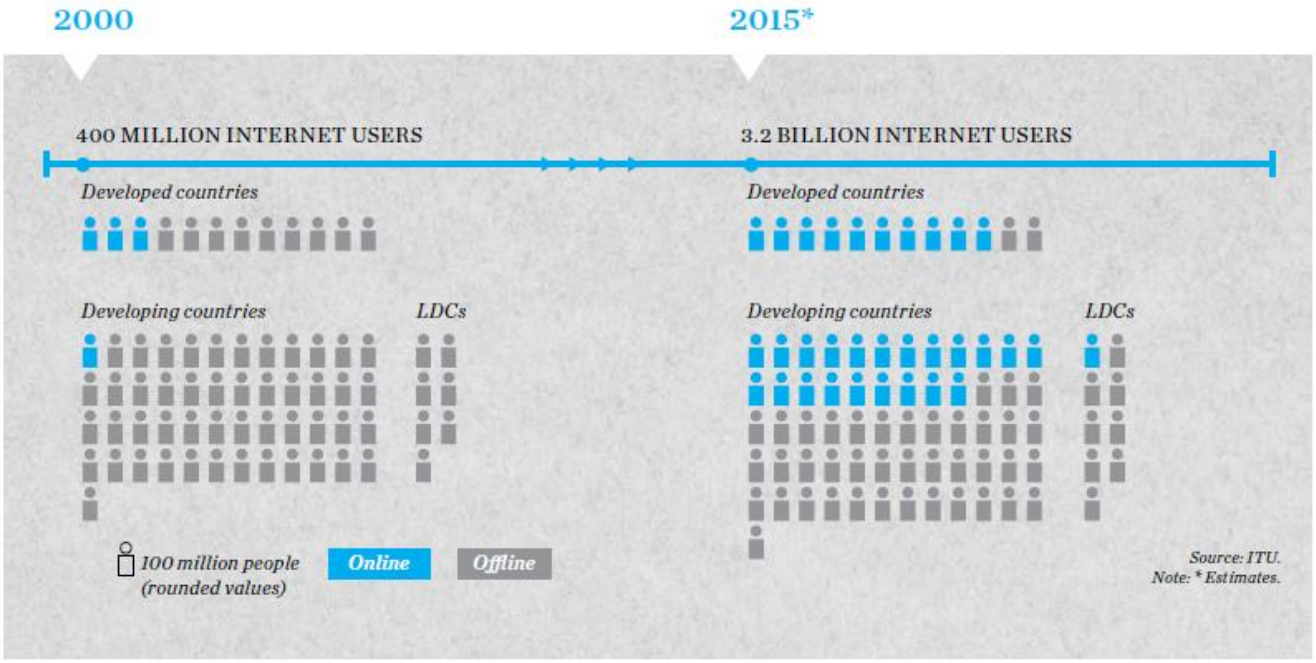


[Graph 9]

Source: ITU database 2015

Graphs 8 and 9 show the average amount of households with internet access at home, per 100 inhabitants, from 2005 to 2015 making a comparison, respectively, between developed and developing countries and between regional sectors, that is between African, Arabic states, Asian & pacific, American and European countries. Again, developing countries have a poor access to the internet; in particular in Africa only 4.9 households have internet at home.

- **ICTs revolution and remaining gaps**



Source: ITU database 2015

This picture is a mere example of how technological development has fostered global development in the past fifteen years.

Of the 3.2 billion current internet users, 2 billion are from the developing world. But the 4 billion off-line users are the two third of that population. Finally, only 9.5% of the population in the least developed countries (LDCs) uses the internet. (*ITU 2015*)

ICTs are going to have a more and more significant role in the past 2015 development agenda and in achieving the 17 sustainable development goals because the digital revolution is by now widespread, bridging the gap between developing and developed countries.

One of the main goals of government is to connect everyone and to create high-quality systems of data and statistics to measure progress all over the world.

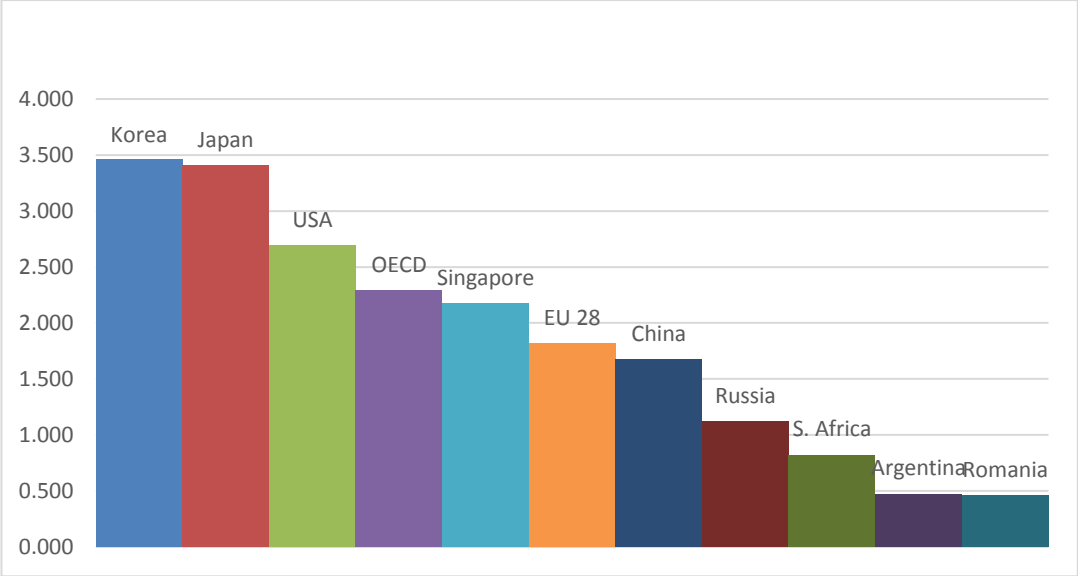
II. Empirical evidence of the spread of KBC all over the world

As previously stated, intangible knowledge-based capital has a key role in the formation of new ideas and technologies, which are willing to provide a source of productivity growth.
Including all knowledge-intensive activities, KBC has been classified by Corrado, Hulten and Sichel (CHS) (2009) into three broad categories:

- computerized information – which includes software and databases;
- innovative property – which includes R&D, Mineral exploration, Entertainment and artistic originals, Design and other new product development costs
- economic competencies – which include Branding – i.e. market research and long-lived advertising –, Firm-specific human capital – i.e. training – and Organizational capital – i.e. business process investment.

Many assets included in this framework have not been measured yet and we still lack homogeneous and complete databases for them. In particular, economic competencies and innovative property are not included in national accounts and researchers are trying to estimate some figures. Especially developing countries face this problem. On the other hand, R&D expenditures have received much attention. However, we will show those evidences that data have permitted.

- **Gross Domestic Expenditures on R&D (GERD)**



Graph 10

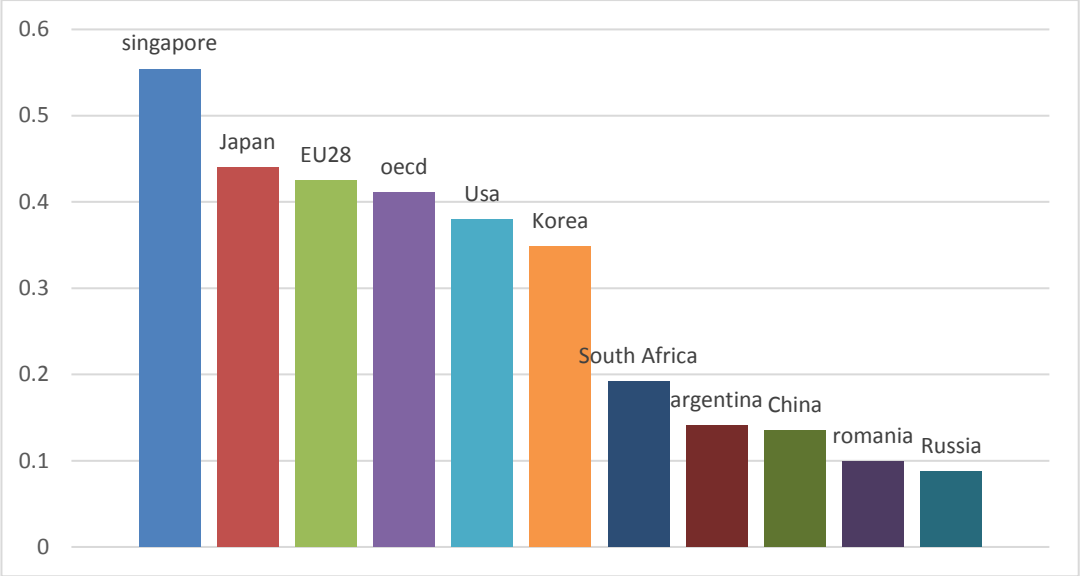
Source: MSTI Main Science and Technology Indicators OECD 2014

Graph 10 shows the Gross domestic expenditure on R&D as a percentage of GDP for selected countries, taking the average from 2005 to 2014. It has been defined as "Research and experimental development (R&D) comprise creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society and the use of this stock of knowledge to devise new applications" (Frascati Manual, 2002 edition, p. 63).

R&D intensity reaches its highest level in Korea and Japan with values almost equal to 3.5%, while in South Africa, Argentina and Romania, as representatives of the developing world, it is less than 1%.

Here governments play a fundamental role by channeling funds and by supplying financial incentives in basic or applied research, and also in the sectorial differentiation of R&D.

- **Higher education expenditure on R&D (HERD)**



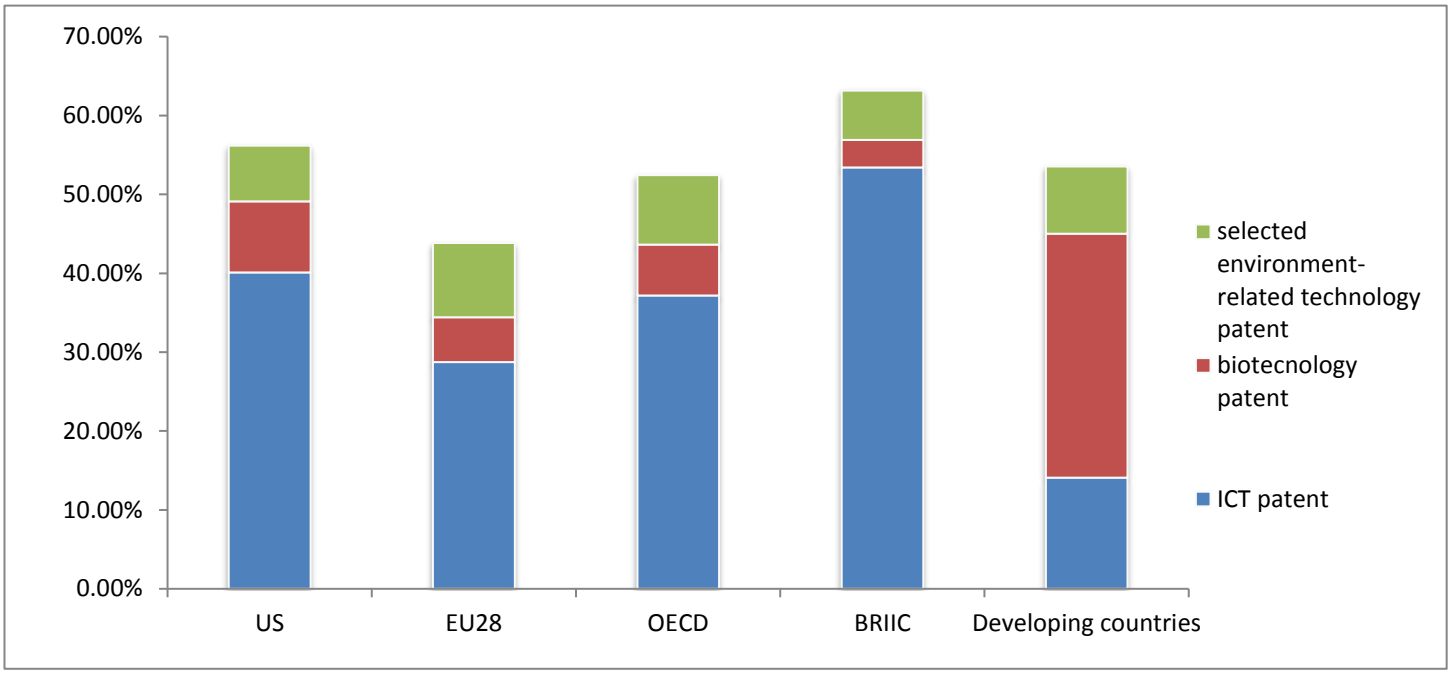
Graph 11

Source: MSTI Main Science and Technology Indicators OECD 2014

Graph 11 shows the higher education expenditure on R&D as a percentage of GDP for selected countries, taking the average from 2005 to 2014. This sector is not officially recognized by the System of National Accounts but it had been defined by the OECD and other organizations because of the importance covered by universities, and other tertiary education institutions, relative to R&D.

Among selected countries Singapore seems to give the greatest contribution and the OECD average, lying around 0.4% of GDP. There are differences among countries on the way Herd is funded. For example, in US, Luxembourg and Poland, government funds play the major role; in EU countries international organizations give their major contribution and China refers to private business. (*OECD Science, Technology and Industry Scoreboard 2015*).

- **Patent**



Graph 12

Source : OECD database 2015

Graph 12 exhibits the percentage of three different patents – that is selected environment-related technology patents, biotechnology patents and ICT patents – relative to the total number of patents. In order to make an efficient comparison data have been extracted for United States and for four groups of countries, namely EU 28[1], OECD[2], BRIIC[3] and, because of availability of data, a group of countries representing the developing world[4]; these reference countries stand for the inventor's country of residence. The patent applications represented are filed under the Patent Cooperation Treaty (PCT) and reference date is the application date.

ICT patents have a major representations for all groups but for developing countries, which once again testifies the necessity of improving and spreading the ICT revolution in there. The 30% of biotechnology patents showed in developing countries, much greater than the average 6% in the other groups, may be due to the fact that these inventions tend to push development in a wide variety of sectors. However the country that jumps this number up is Cuba, being as a consequence an outlier in this case.

[1] EU countries include Austria, Belgium, Bulgaria, Cyprus, Croatia, Denmark, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Leetonia, Lithuania, Luxemburg, Malta, Oland, Poland, Portugal, United Kingdom, Check Republic, Romania, Slovakia, Slovenia, Spain, Sweden, Hungary

[2] OECD countries include Australia, Austria, Belgium, Canada, Chile, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, South Korea, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, United Kingdom, United States

[3] BRIIC countries include Brazil, Russian Federation, India, Indonesia, People's Republic of China, South Africa

[4] Developing countries include Cuba, Ecuador, Kenya, Mongolia, Tunisia, Zimbabwe

Indeed during the last twenty years the Cuban Center for Genetic Engineering and Biotechnology (CIGB) has reached extraordinary results in research, development and production of products so much that the international community has recognized their quality and singleness.

Notwithstanding researchers are looking for better measures for the knowledge economy, besides the mere count of patents: the goal is to construct variables which capture the value of innovation in order to advice policy-makers over taxation, policies to support innovation and to mobilize worldwide knowledge-based assets.

- **Design to measure creativity**

  Design, as identified in the second category of the CHS framework, is an important tool in measuring business competitiveness. It has received much policy attention because of the lack of accurate metrics which reflect the broad array of associated activities. Related asset may be created through R&D, technological and non-technological form of innovation and measured through Intellectual Property Rights (IPR).

  An example is the United States Patent and Trademark Office (USPTO) which grants patents aimed at protecting the exclusive design of a product. Through its statistics can be observed the increasing importance of design patents in US and also in East Asian countries. Also, in 2008 the UK Art and Humanities Research Council and the Engineering and Physical Science Research Council conducted a survey which has evidenced that for the United Kingdom the design spending are about 5% of total innovation expenditures. Because the amount spent on the acquisition of external knowledge is near this percentage, the importance of design activities is highlighted, as well as the need to better measure and control creativity. (OECD 2013)

- **Organizational capital**

  Organizational capital (OC) is an asset belonging to the third category of the CHS framework. Even if its importance has already been accomplished, there are still missing agreed patterns for its measurement. It can be defined as a series of work practices, not limited to managers but extended to all agents who contribute the well-functioning of a business enterprise.

  In this respect, the OECD has conducted an experimental research based on the data from the Occupational Information Network (O*NET) of the United States Department of Labor. It showed that the managerial activity is fundamental to the OC but those jobs which by definition do not have a manager aspect, like support staff, engineers, scientists, education and health related employees, are also OC-relevant. (OECD 2013)

It is necessary to extend this experiment to other countries, especially to the developing ones, in order to demonstrate the importance of human capital and skilled employees and to develop the right policies.

PART IV – Public policies

Considerations for public policies

Information and communication technologies and the knowledge economy play a key role in enabling a sustainable development and growth all over the world. They are even more efficient when applied to small and medium enterprises.

In this process, one of the main actors is government which has the power to develop a set of policies aimed at promoting e-literacy and innovation. In doing this, governments have an economic interests because the individual benefits to these enterprises translate into a collection of positive results for the society, that is job creation, positive profits and greater competition for the whole country.

Policy-makers are necessary in order to eliminate those factors hindering the use of ICTs and also to increase their efficiency. Among these factors there is the lack of funds to finance ICTs and e-commerce; in particular SMEs focusing on everyday operations cannot put attention on new technologies and suffering from budget constraints, they fear eventual losses. Consciousness of these problems is the first step toward a government intervention which can implement a series of policies.

The government is the primary buyers of goods and services. Therefore they can purchase from local enterprises using e-commerce in order to implement the use of these resources from SMEs. Some developing countries like Russia, Romania, Chile, Philippines are currently applying this policy.

The capacity to acquire and generate knowledge in all its forms is perhaps the most important factor in the improvement of the human condition: without access to the benefits of scientific and technological advances, it is simply not possible to improve standards of living – both material and non-material - of the majority of the world's population or to increase the opportunities for people to realize their full potential. Therefore any rethinking of development and progress must include adequate structural policies facilitating the acquisition, utilization and generation of technology within individual states, societies and communities. So, instead of focusing on cheap labor force and raw materials, countries should develop a comparative advantage in the technological sector, as India evidenced. This has been the result of a great investment in education and so in knowledge based assets and the development of important research centers like the Indian Institutes of Technology.

However India is not a secluded case: its example has been followed by many countries such as Korea, Singapore, China, Malaysia. Indeed investing in IT and human capital has proved to produce a greater return and growth with respect to building an economy on commodity exports like oil and other natural resources. All industries demand a knowledge-based society and therefore the government should take actions in order to produce an ICT's trained and skilled labor force, starting from primary and secondary schools. This is because it is required a minimum level of education in order to at least understand and then work with ICTs; furthermore training programs must be implemented in order to update the competencies of those laborers who started working before the coming of new technologies. The whole education system must be constantly updated.

Moreover governments should strategically invest in the construction of the infrastructures of emerging start-ups in place of state-owned enterprises which do not generate a sustainable and long-lasting growth for the country. Archetypes of this sort can be extracted from the United Stated and East Asia. ARPANET, the prototype of the internet, has been initially created for military purposes by the Department of Defense of the United States. Here this governmental agency, together with business and academic professionals, has contributed to the development of the ground of the IT society without any monopoly from the government itself. East Asian countries on their side have developed the legal and technical frame in order to attract investors and skilled workers.

From the financial point of view, one source of funding could be the venture capital: it could be more efficient than direct loans but it needs to be used shrewdly as the collapse of internet companies has shown in the 2000s. This financial assistance should be directed at under-served groups: the aim is to increase innovation and efficiency and to promote positive externalities and network effects.

As a founding qualification the economic environment should be healthy. In this respect the government should engage in policies aimed at improving transparency and increasing accessible and competitive markets. One way to fulfill this goal is to take advantage of broadband and e-Governance because they have the capacity to increase access to information which leads to more efficiency and business opportunities. They enhance good governance and improve public and financial services (e-voting, e-banking) thanks to the internet connection. As a consequence, in both developed and developing countries governments need to put more efforts into the access to broadband. Broadband can be defined as a General Purpose Technology (GPT) which goes beyond the mere high speed network because it is considered a broad environment where different elements like users, networks, services and applications, use high-speed connectivity in order to interact (World Bank).

With this definition in mind, we should be aware of the just mentioned legal framework governments should supply in order also to rend an equitable access to this resource. Indeed until now, broadband has been supplied only to urban center because of the higher costs for rural areas, with low population density, and of the technical issue related to the lower speed as the distance from the urban area increases. By intervening, governments can gain because broadband enhances investment, employment and creates entrepreneurship and spillover effects. In this respect the World Bank can play its role by stimulating investment and assisting in funding and strategic processes. Examples of its intervention are the East African Submarine Cable System (EASSy), the construction of about 10,000 km of fiber optic submarine cable over the East Africa in order to connect Sudan to South Africa and to Djibouti, Somalia, Kenya, Tanzania, Madagascar and Mozambique; and the Regional Communications Infrastructure Program (RCIP) aimed at supporting Eastern and Southern African countries in order to have quality and cheap telecommunication services.

While regarding e-Governance, it can be defined as an efficient allocation of ICT services to the government sector. Going beyond a mere electronic service, ICTs yield a lot of benefits; some non-comprehensive examples are improving democracy, allowing citizens participation, increasing transparency and enabling better services to businesses. E-Government services must meet citizens' needs. So, in order to improve the quality of life, policy-makers should supply minimum ICT's infrastructures, road and electricity, mainly renewable. Thanks also to a partnership between the private sector, the public and the government, technology is a tool in achieving this revolutionary change in how government works. Partnerships can also serve other objectives. In order to "empower through knowledge", they need to focus on capacity building, that is the development of new network to link firms all over the world of all sizes into joint marketing, production and R&D. Then, as Dohlman and Halvorson-Quevedo (1997) explained, for a new approach to development, are necessary partnerships between donors and recipient countries which involve pragmatic approaches to the shared interests between firms and governments in industrialized and developing countries.

Concerning the trade, policy-makers can develop programs in order to benefit from the use of ICTs in the export industries. Besides producing ICT goods, both developed and developing countries can meet their own export needs. They have the capacity to tear down transaction costs and to increase information available to exporters.

An everlasting paradox is the one referred to Intellectual Property Rights according to which governments should try to assure the protection of new ideas so that innovators have the incentive to invest in new researches without limiting the public's access to information.

Leaders should find a way to exploit these technological opportunities.

For example, the Vision 2014 is National plan employed in South Africa which has showed how ICT allows a solid, rapid and cheap way for the public to get information and knowledge in order to have an economic role in the community.

The Vision also encourages South Africa to shift from being an ICT consumer to a producer and innovator. Indeed one of the main problems is their dependence upon the goods of the developed world, which increases access costs. It is not necessary that all countries start producing ICTs but each country must develop capabilities to tailor ICT to their specific needs. Indeed ICT has shift its meaning from "drivers" of change to tools providing potential to combine the information embedded in ICT system with the creative potential and knowledge embodied in people.

Developing countries are at different starting positions: each country should implement a national ICT strategy responsive to sustainable development goals. And although the research costs for doing this are high, the costs of not doing so are likely to be much higher.

So the priority of governments should be training to enhance the capacity for creativity producing or using ICTs; they need to take into consideration also those linguistic barriers impeding local population to actually use these assets until they are made available in local languages.

Let us conclude with some practical examples of how ICTs have benefited critical sectors of rural communities and which show that the whole project, we have so far discussed, is real, has a ground, is not idealistic.

ZARNet – Zimbabwe Academic and Research Network

ZARNet is an institution established in 1997 by Zimbabwe Government with the original goal to supply internet to the various sectors of the society. Nowadays it provides ICT services and Internet access to ever increasing shares of the population at affordable rates; in particular the Government encourages ZARNet to support populations in rural areas by educating them to the use of e-mail and the Internet. In order to do this, it has developed powerful partnership in the ICT sector. Among its strategies, the most important are the e-literacy of the population in Zimbabwe, the offering of connectivity to school and to small business enterprises and establishing internet access in surrounding areas.

e-Hurudza

e-Hurudza is an African private sector program aimed at promoting the agrarian reform: it has succeeded in poverty eradication thanks to the empowerment of the local community. The characteristics of this program include the supplying of agricultural information, the education on the growth process of region-specific crops, the supplying of necessary inputs such as seed, irrigation, chemicals, labor force. In order to run the program there are necessary ICT infrastructures like computers, printers, then basic notion of e-Literacy, internet access and a solid network.

Rural Districts

Rural areas in Africa have poor or no access to local radio and newspapers; television and mobile phones do not broadcast to the area; availability of electricity and computer equipment in schools is limited. These necessities are being met by the National University of Science and Technology which is working with two districts Bulilima and Mangwe and has partnered with the W. K. Kellogg Foundation Southern Africa Regional Office and the Computer AID International UK, who supplied computer and servers equipment and training for locals. The aim is to provide scientific and technological knowledge to the community in order to solve current problems by themselves. Local population needs to access information, in particular farmers are provided with information on market prices in order to save time and costs.

Communities are advised through group discussions and sessions, being the most suitable way to transmit knowledge. After the training, workers are embodied with technical skills and basic information and computer related abilities, like word processing, power point, email, webpages. Up until now the project has increased the level of e-literacy, the employment especially youth, the network of connected rural communities, the utilization of local resources.

Conclusion

In brief, Information and Communication Technologies can play a critical role in sustainable human development and poverty eradication. They are an effective tool in meeting the requirements of Development Goals thanks to their capacity to improve communication and the exchange of knowledge and information necessary for development processes.

Considering ICT as a driver, multiplier, accelerator and most of all innovator of productivity and thus economic growth, we need to highlight that it is not only powerful but also an indispensable tool.

Furthermore, while the technology revolution is not a panacea for the problems affecting countries in need, it does provide huge opportunities to reduce social and economic inequalities, in particular those connected to hunger, poverty, gender equality, education and environmental protection.

The value of information and accumulated knowledge within developing countries is an important aspect of future growth potential. Only a very few developing countries have succeeded in narrowing the development "gap" by harnessing the production or use of ICTs to their development goals. As we said, these technologies do not offer a magical potion that can be expected to provide a cure for the sick, to prevent environmental degradation, or to create jobs. However, if these technologies can be combined with domestic and external human resources, they can be instrumental in achieving major changes in the organization of industrial activity and the conduct of everyday life. If the changes are consistent with development goals, countries can gain from ICTs and avoid the risks of exclusion and marginalization. However this requires national ICT strategies that build upon the strength of each country. For this reason there are necessary public policy and partnerships aimed at increasing transparency and economic competition.

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