

# Contributions of Information and Communication Technology to Global Development: A Trend Analysis.

*Felix Olu Bankole, S'MIEEE and Irwin Brown*

*Department of Information Systems, University of Cape Town*

*Emails: [felix.bankole@uct.ac.za](mailto:felix.bankole@uct.ac.za); [irwin.brown@uct.ac.za](mailto:irwin.brown@uct.ac.za).*

**Abstract— In the last two decades, the worldwide information and communication technology (ICT) market has been growing at a rapid rate. This has led to the global net increase in ICT usage and investments. International organizations, ICT vendors, Policy makers have been trying to determine if such huge investments are worthwhile. However, the result regarding this issue is inconclusive, for this research area is fraught with complexity and existing empirical study is limited. In this study, the four aspects of ICT investments were investigated. The analysis implies that all the four aspects of ICT investments considered in this study are contributing to development.**

**Index Terms— Human development, Information Communication technology (ICT), Gross Domestic Product (GDP).**

## I. INTRODUCTION

The worldwide development of information and communication technology (ICT) has increased drastically over the past few decades. This has been on by an increase in global economy as a result of technological advancement and market competition that led to price reduction in ICT equipments and services. ICT equipments offered a strong advantage for capital and labour replacement. The trend and revolution in various ICT sectors, the loosening of trade policies increased the growth and expansion of ICT infrastructure (Zhen-Wei Qiang et al., 2004). ICT investments have grown substantially in developed and developing countries, the cumulative annual growth rate of ICT spending in developing countries was 12 percent and 6 percent in developed countries between 1993 to 2001 (Zhen-Wei Qiang et al., 2004).

ICT investments have grown in every economy worldwide, regardless of GDP or population growth rates. Asia, Latin America and Eastern Europe experienced the fastest growing ICT investments market with five year annual growth rates of 14.5%, 13.6% and 9.5% respectively between 1992 to 1997. Many African countries have been increasing investment in their ICT infrastructure since 1995 in response to social and business demands (Bollou, 2006). The global annual growth rate of ICT investments peaked in 2004 at 12.3 % following a slowdown in 2001. ICT growth was moderated to 7.7% and 7.9 % in 2005 and 2006 respectively. 2007 was a transition year in ICT investment. The recession in US economy and other developed nations affected the ICT sectors and ICT

investments accounted for a growth rate of 10.3% in 2008 at moderate global economy growth (WITSA, 2008). The International Data Corporation (IDC) predicted that the moderate global economy growth and increased ICT penetration will support ICT investments growth by 2011. The demand for ICT products will reduce in developed countries due to slowing economies and the weak US dollar will encourage the exportation of ICT goods from US to emerging economies (WITSA, 2002). The total ICT investments will be \$ 4.4 trillion in 2011 compared to \$2.1 trillion recorded in 2001 at compound annual growth rate of 7.7% (WITSA, 2002). The increase in ICT spending will enhance ICT production and use thereby contributing to the economic growth. It is clear that ICT investment is an important element of global economy. The ICT sectors are contributing significantly to the overall economic health of the global economy, an average growth increase in total factor productivity (TFP) of 1/3 % per annum based on ICT investments in industrial countries during 1995 to 2000 was estimated ( Lam & Lam, 2005). The United States ICT investment recorded TFP of 1/2 % per annum during this period. ICT and productivity growth in England contributed 1/5 % GDP growth during 1989 and 1998 (Oulton, 2004). It was also demonstrated in African countries that ICT investments increased TFP (Bollou & Ngwenyama, 2008). The positive impact of ICT investments on global economic growth in developed and developing nations has been established in most literature. However, the focus of this study is to investigate the contributions of ICT investments to human development.

## II. MOTIVATION AND PROBLEM STATEMENT

The increase in ICT investment has been used in developed nations and newly industrialized economies (NIEs) to foster economic development ( Ngwenyama et al., 2006), while several countries like United States, Singapore, Spain and South Korea have used their ICT sectors to support economic growth. With the rapid increase in ICT spending in many nations, international organizations, country leaders, scholars and professionals have not stated clearly the benefit of such investments to human development and the empirical studies in this regard are few (Ngwenyama et al., 2006). The human development is a broader definition of human well being so as to lead to a long and healthy life, to acquire knowledge and to have access to the resources needed for a decent standard of living (UNDP, 2006).

Moreover, ICT investments aspects consist of hardware, software, internal spending and telecommunication investments while human development is a composite of GDP (economic), literacy & enrolments and life expectancy. Software investment is the total value of all the purchased software products including software packages, database systems, and utility software and programming tools. Hardware investment is the total computer hardware spending in a country. (Kim et al., 2008). Internal spending describes the amount of internal software customization, capital depreciation, human capital development and IT related spending. telecommunication spending are local and long distance wire- line and wireless communication such as broadband and other telecommunication networks. These need to be assessed at country level as their effect on national performance differs across countries. For example the returns on ICT investment for high income countries might be different from low income countries due to structural differences like ICT investment policy, existing infrastructure, human capital development and non-capital item (Kim et al., 2008). A review of the literature revealed that the increase in ICT investments in countries should be properly addressed to enable the policymakers to fully understand how resources should be allocated. This research is an attempt to clarify these issues.

### III. BACKGROUND OF THE COUNTRIES

The data used in this study were collected from three different sources, the ITU, the UN and the WITSA databases. The databases are a rich source of secondary data that provide detailed current and historic information about the actual phenomena. The ITU data base provides statistical data for the telecommunication sector for all countries. The United Nation provides social, economic and demography indices for all countries. The WITSA provides the data about Information and Communication technology (ICT) for all countries around the world based on research of International Data Corporation (IDC). The data covers the period of 1994 to 2003. The ten year period experienced the rapid increase in ICT investments worldwide and changes in telecommunication sector especially in African countries (Bollou, 2006). For example, Asia/Pacific, Latin America and Eastern Europe demonstrated the fastest growing ICT investment market with average annual growth rate of 14.5%, 13.6%, and 9.5% respectively during 1992-1997 and worldwide ICT investment is growing at over 27% faster than the worldwide GDP (WITSA, 1998). The 51 countries included in this study are: Argentina, Australia, Austria, Belgium, Brazil, Bulgaria, Canada, Chile, Colombia, Czech Republic, Denmark, Egypt, Finland, France, Germany, Greece, Hong Kong, Hungary, India, Indonesia, Ireland, Israel, Italy, Japan, Korea, Malaysia, Mexico, Netherland (Holland), New Zealand, Norway, Philippines, Poland, Portugal, China, Romania, Russia, Saudi Arabia, Singapore, Slovakia, Slovenia, South Africa, Spain, Sweden,

Switzerland, Taiwan, Thailand, Turkey, United Kingdom, United States, Venezuela and Vietnam.

The countries were grouped as high income, mid income and low income countries based on GDP per capita in 1994-2003. These countries were selected and grouped based on GDP per capita because the countries represent the ICT industries largest country markets around the world (WITSA, 2002) and their relative importance in terms of ICT investments were considered. This serves as a meaningful analysis of impact of ICT spending. The first 17 countries above two-third percentile were defined as high income countries and the second 17 countries within one-third percentile as mid- income countries while the last 17 countries below one- third percentile were defined as low-income countries.

### IV. TREND ANALYSIS OF ICT INVESTMENTS

In this section, the ICT investment was analysed using trend analysis. The attempt is to collect, compare the investment in ICT around the world and to spot a pattern or trend and the possible causes. As observed in Figure 1, there are clear patterns that ICT investment in high income countries increases at a rapid rate from 1994 until 2000 (Colecchia & Schreyer). This was as a result of growth in *internet* and *dot-com boom* that led to increase in ICT investments such as employment of IT executives to manage the emerging technology (Ward, 2006). ICT investments fell significantly in 2001 at 7% rate difference with 2000 value (WITSA, 2002, Ward, 2006). The decline in ICT investment in 2001 was the aftermath of “*millennium bug*” due to over investment in ICT in make up to the year 2000 (Wallis, 2006). This also affected the mid income countries between 2000 and 2001. The Y2K compliant factor affected individuals, organizations and countries to reduce investment in ICT (Wallis, 2006).

The decrease in investment in 2001 coupled with slow growth in 2002 led to 4.1% compound annual growth rate in spending between 1999 and 2003 (WITSA, 2004) Despite the millennium factor and slow growth, the investment in high income and mid income countries increased at 8.0% compound annual growth rate between 2003 (WITSA, 2004). individuals, organizations and countries to reduce investment in ICT (Wallis, 2006). The decrease in investment in 2001 coupled with slow growth in 2002 led to 4.1% compound annual growth rate in spending between 1999 and 2003 (WITSA, 2004) Despite the millennium factor and slow growth, the investment in high income and mid income countries increased at 8.0% compound annual growth rate between 2003 (WITSA, 2004). In low income countries, the observation that stands out from the analysis is that a rise in general trends of investment from 1994 till 2003. The investments in low income countries increase steadily every year till 2003. This finding is validated in the study of Bollou, 2006 that the period of 1995 to 2002 has

seen highest investments in ICT sector especially in African countries. The literature also reveals series of beneficial effect of this investment on the economies of the world (Colecchia, & Schreyer, 2002).

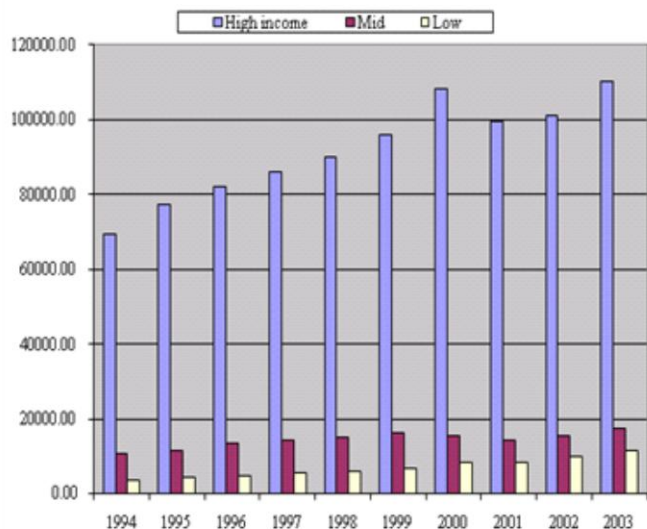


Figure 1: Trends analysis of ICT Investments

The increase in ICT spending from 1994- 2001 led to creation of new companies in high income and mid income countries, For example there existed a net increase of 90,000 companies in the United States, Canada, Australia, the United Kingdom, Italy, the Netherlands and Sweden. United States alone accounted for more than average 7,200 new tax-paying ICT companies (WITSA, 1998). This is also evidenced according to Manalo & Camacho (2007), that an increase in ICT investments strengthen ICT sector in countries and hence poses greater advantage over other countries with weak ICT structure. It has also been observed that the dismal performance of Japanese economy in 1990s and early 2000s was as a result of insufficient ICT investment (Nishimura & Shirai, 2003). The global economic trends show that ICT investment is associated with productivity though the increase is often lagging by some years (Wang, 1999). Yet, ICT investments improve the quality of life through access to information and exchange of ideas in both developed and developing economies (Colecchia, & Schreyer, 2002). The four aspects of ICT investments are explained in the following section.

### 1)Telecommunication Investments

With regard to telecommunication investments, the Figure 2 shows different variation in investments. The countries investment varies more widely. The High income countries investments increase steadily from 1994 until 1999, it then skyrocketed in 2000 and then decreased in 2001 and rose consistently till 2003. The mid income and low income countries investment also increased constantly from 1994 till

2001 while there was a slight slowdown and then it continued to rise up to 2003.

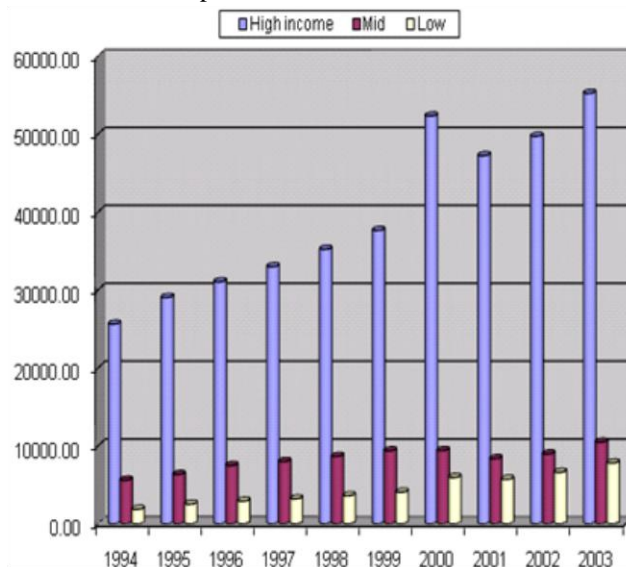


Figure 2: Trends analysis of ICT Telecommunication Investments.

The clear drop in investment between 2001 among high income, mid income and low income countries was the effect of “Y2K and Dot. Com crash” (Wallis, 2006; Cooper et al., 2005). There was a decrease investment in internet and information technology sectors during the period (Goldfarb et al., 2007). Telecommunication services and equipment still remained the largest share of the total global ICT investment with about 55% and more than 50 million individuals are added to the global communication network every year due to investments in telecommunication infrastructures (WITSA, 1998). For example more than 118 million computers were installed in homes and colleges worldwide in 1998 (WITSA, 1998). The three regions countries evaluated in this study show annual double growth computer installation base rate (WITSA, 1998). The global reduction in computer prices improved the growth of ICT from business medium to home market (WITSA, 2002).

Traditionally, personal computers (PCs) were installed at home for entertainment but in recent time, internet has expanded the concept of home –PC entertainment model. The PC connected to internet is useful to access information, share ideas with people around the world (WITSA, 1998; ITU, 1999). Computer simulations, educational software serves as classroom enhancement for students.(WITSA, 1998) PC penetrations at home improve personal productivity, work at home, home banking, home shopping thereby adding values and time to people’s lives (ITU, 1999). In United States, the PCs proliferation has encouraged work-at home scenario. This allows employers to minimise cost by creating contract hours and work-at-home options and also employees were able to reduce day-care and commuting costs (WITSA, 1998). Internet growth

is increasing at an alarming rate; the internet host has been increasing twenty fold since 1994 providing access to information for rich and poor nations and individual (WITSA, 1998; ITU, 1999). The internet and affordable computing services has bridged the digital divide that hindered ICT development. World Wide Web (WWW) phenomenon has largely affected ICT spending; over 320 million people were able to access WWW in 2002 and WWW devices increased to 515 million (WITSA, 2002).

As indicated in Figure 2 above, telecommunication investments are visible in all countries but vary from region to region. The countries like China and Brazil (mid and low income countries) are ranked among the 10 predominant ICT markets around the world in 1997 (WITSA, 1998). The observation revealed that the high income countries (advanced market) are currently focusing on maintaining their existing telecommunication infrastructures while the mid and low income countries (emerging market) are concentrating on building basic telecommunication and computer infrastructure (WITSA, 1998). The emerging economies now see telecommunication as a primary tool to enhance the economy and broaden people’s horizons (Waverman et al., 2005). Telecommunication is presently the backbone of ICT and all other investments such as hardware and software will lag behind until telecommunication infrastructure is put in place. The mid and low income countries have been investing heavily on ICT backbone (Garbacz & Thompson, 200), while the high income countries are investing more in related software needed to access the telecommunication structure. (WITSA, 1998). This has been attracting the ICT vendors migrating towards mid and low income countries (WITSA, 1998). The world telecommunication market is huge and booming at present, the provision of telecommunication infrastructure for the information age is exciting (WITSA, 1998).

### 2)Software Investments

The software investments increase in high, mid and low income countries from 1994 till 2003 (See Figure 3). The pattern shows that there is consistent spending on software in all the three levels of the countries and it was not affected by economic situation (Li & Gao, 2003). The country level observation provides a clear picture of this trend, for example spending in the software markets continue to grow rapidly around the world which resulted to high demand for employees such as software developers, engineers and programmers (Arora & Athreye, 2002).

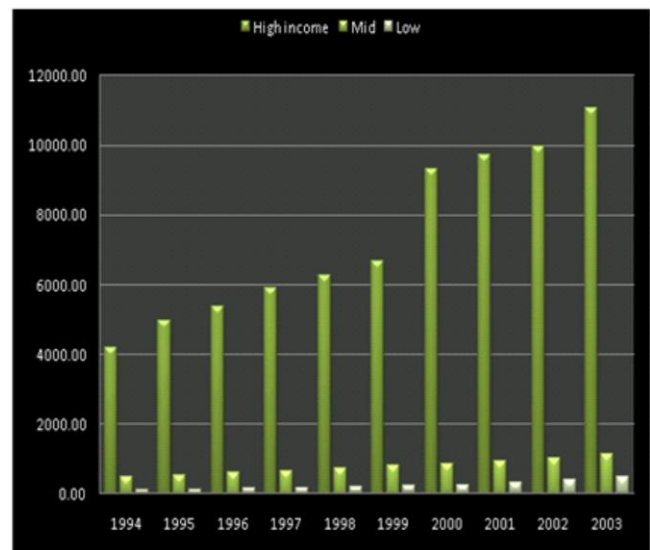


Figure 3: Trends analysis of Software Investments.

The high income countries are presently focusing on the maintaining their existing infrastructure by investing on new software (WITSA, 2002). The Organization for Economic Development (OECD) approximated about 600,000 unfilled IT software jobs worldwide (WITSA, 2002). The demand is very high for IT professionals and the shortage of these skills in developed and developing countries is posing threat to the growth of the software industry (Cappelli, 2000). The second observation from Figure 4.3 is the exception to the trend of high income countries between 1999 and 2000, which shows about 70% increase in 2000 as in comparison to 1999 ( WITSA, 1998). This is accounted for the impact of millennium. The high income countries invested heavily in purchasing new updated software and hardware (Wallis, 2006).

### 3)Hardware Investments

The hardware investments in mid and low income countries increased steadily between 1994 and 2003. In high income countries the investment increased up till 2000 and started decrease as countries started focusing on maintain the existing structure after the year 2000. Hardware spending growth increased in mid and low income countries at an impressive rate of 9.8% due to constant migration of ICT vendors (WITSA, 1998)., and the demand of international organization such as ITU, IMF and World Bank to increase ICT investments in these countries ( Ngwenyama et al., 2006). The demand for networking equipment remains another key driver of hardware growth (Gibson & Meter, 2000). The networking environment created an opportunity for the vendors to have impact on the future of ICT industry in mid and low income countries (WITSA, 1998). The general observation shows that there was a continuous rise in hardware spending among the high, mid and low income countries from 1994 till 2000.

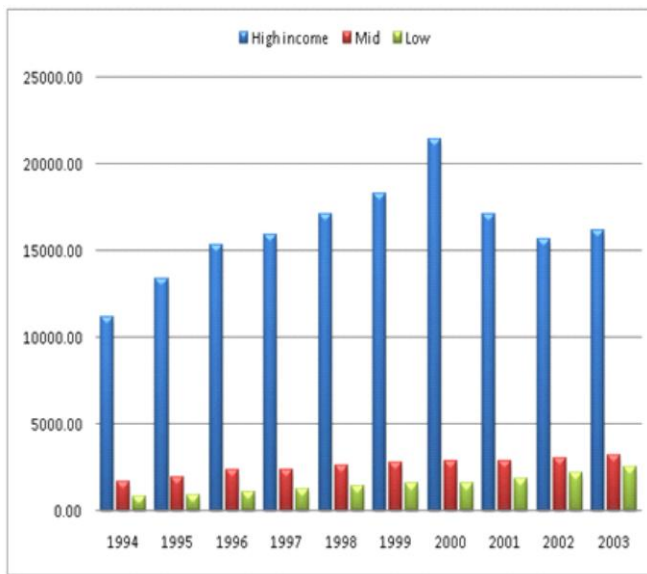


Figure 4: Trends analysis of Hardware Investments

The decrease in the trend in the year 2000 was due to infrastructure failure as a result of Y2K bug and dot com crash effect. For example, the London Stock Exchange experienced system crash in April 2000 which affected their online trading and capital gain (Williams, 2001). Though in mid and low income countries, the limited financial resources have been a hindrance to the society's ability to make full scale investments required to catch up with the high income countries (WITSA, 1998; Ngwenyama et al., 2006) (Figure 4.4). The important factor to be mentioned is that as the mid and low incomes countries continue to increase their hardware investments', reaping the benefit of such investments requires planning and careful decision making within the context of ICT investment and development policy. Hardware investments comprise 18% of the world market and remain one of the fastest growing at 9.8% in 1997 (WITSA, 1998).

#### 4) Internal Spending

The levels of internal spending vary considerably among high, mid and low income countries (See Figure 5). There is a more significant difference in comparison with the other categories of investments. The high and low income countries shows an increase in internal spending from 1994 till 2000, when they slow down drastically, and then continue to increase in 2003. This occurrence in both high income and low income countries has different reasons, the proportion of internal spending in high income countries represents human capital development such as paying of salaries to the individuals installing and maintaining networks and developing the software. The increase in demand for IS professionals led to increase in salary demanded and the cost of employing an IS professional rose sharply between the period of 2000 and 2003 that many

organizations sourced for alternative solution providers to perform the function of IS department through outsourcing (WITSA, 2008).

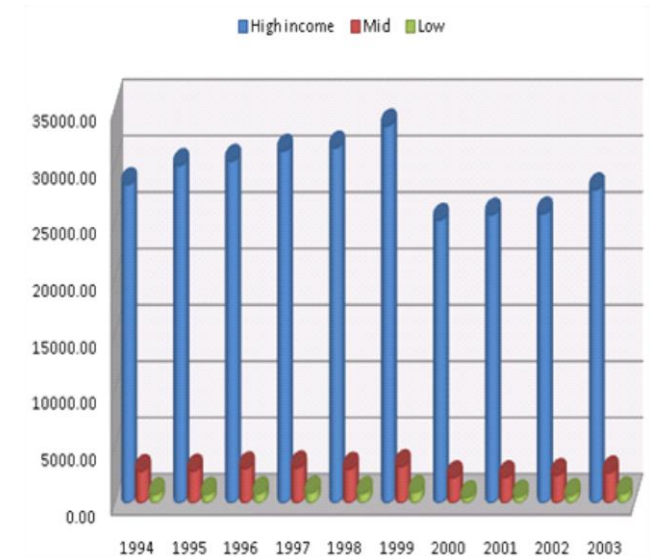


Figure 5: Trends analysis of Internal Spending

In high income countries more and more organizations are hiring outside firms and contractors to manage their ICT sector without incurring the additional expense of employing them directly. For example in the United States, the internal spending declined in about one percent within this period (WITSA, 1998). In low income countries, the decrease in internal spending was caused by rapid investment in other segments such as hardware, software and telecommunication in 2000, these increase investment in other segments of ICT led to shortage of IS professionals and many of the ICT projects in low income countries were outsourced during the period (WITSA, 1998). The exceptional case is the mid income countries, the internal spending remained stable even though it reduced slightly in 2000; most notable is Taiwan and Korea. The two countries were able to increase their spending on human capital development in response to increase in other segments (WITSA, 1998). This shows that countries have dissimilar capability to utilize resources and knowledge accumulated through ICT investments (Kim et al., 2008). The observation also revealed that most of the IS professionals in high income countries are moving towards mid and low income countries as the countries are offering better salaries to IS professionals than high income countries. This is evidenced in the studies of Kim et al. (2008) that high income countries need to invest more in acquiring expertise to improve the level of utilization of their heavily equipped hardware.

The mid and low income countries have now continued growing capital development and continue to grow their infrastructures so corporate outsourcing are less on the agenda of these countries until basic infrastructures are in place (WITSA, 1998).

## V. TREND ANALYSIS OF ICT INVESTMENTS AND DEVELOPMENT

This section explains the trend of development using the human development index data from 1994 to 2003. The trends were analysed with regard to ICT investment. The average human development indexes were computed for high, mid and low income countries as shown in Figure 5. The development index in high income countries does not follow a particular pattern. The high income countries values are in the upper range of human development. The development index remain constant at the value of 0.93 from 1994 ,until 1996, then slowed down slightly to value of 0.91 between 1997 and 1998 and then continued to rise till 2003 at the value of 0.94. When compared with the growth in ICT investment, it was discovered that as the ICT investment increased from year 2003, the level of development also increased.

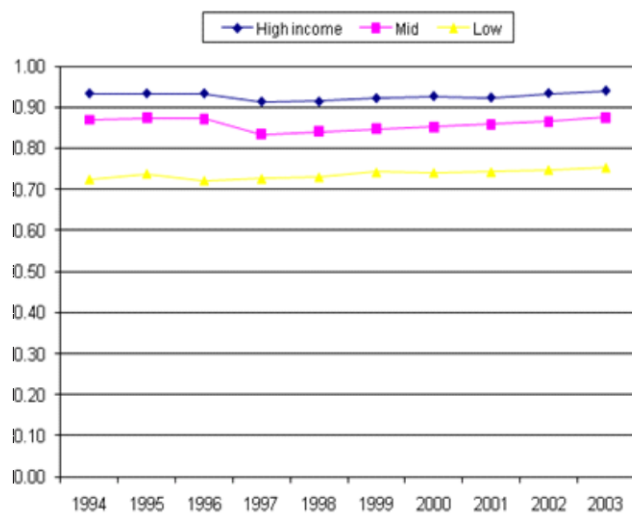


Figure 5: Trends analysis of Development

The mid income and low income countries followed similar pattern with high income countries, development index trend in mid income countries show a constant value of 0.87 between 1994 and 1996 where there was a slow down to value of 0.83 from 1997 to 1998 and then continued to rise as ICT investment increased till 2003. In low income countries, development rises with some ups and downs at a value of 0.72, 0.74, 0.72, 0.73 and 0.73 for the year 1994, 1995, 1996, 1997 and 1998 respectively. The notable trend similar to high and low income is the change in development value to 0.74 in low income countries as the ICT investment increases from year 2001 up till 2003.

## VI. CONCLUSION

The four aspects of ICT investments were investigated on human development using trend analysis. The analysis

implies that all the four aspects of ICT investments have a significant impact on human development. Moreover, the results also indicate that telecommunication investments are important to improve the level of development in all countries. These findings show that the relationship between investments in ICT and human development is not straightforward, thus suggesting that each aspect of ICT investments has differential effects on the level of development. The overall results show that the deployment of the right aspects of ICT investment is primarily associated with the improvement in human development. Based on these findings, we recommend to the policy makers and telecommunication vendors that telecommunication investments should first be taken into consideration when investing in the area of ICT for national development.

## REFERENCES

- Bollou, F. (2006). ICT Infrastructure Expansion in Sub-Saharan Africa: An analysis Of Six West African Countries from 1995-2002. *Electronic Journal of IS in Developing Countries*, 26 (5), 1-16.
- Colecchia, A., & Schreyer, P. (2002). ICT Investment and Economic Growth in the 1990s: Is the United States a Unique Case? A Comparative Study of Nine OECD Countries. *Review of Economic Dynamics*, 5(2), 408-442.
- Garbacz, C., & Thompson, H. G. (2007). Demand for telecommunication services in developing countries. *Telecommunication Policy*, 31(2007), 276-289.
- ITU: International Telecommunication Union (2007). *World Information Society Report*
- Kim, Y.J., Kang, H., Sanders, G.L., & Lee, S. T. (2008). Differential effects of IT investments: Complementarity and the effect of GDP level. *International Journal of Information Management*, 28(2008), 508-516.
- Morawczynski, O., & Ngwenyama, O. (2007). Unraveling the impacts of investments in ICTs, education and health on development: An analysis of archival data of five West African countries using regression splines. *Electronic Journal of IS in Developing Countries*, 29(5), 1-15.
- Ngwenyama, O., Andoh-Baidoo, F.K., Bolou, F., & Morawczynski, O. (2006). Is There A Relationship Between ICT, Health, Education and Development? An Empirical Analysis of five West African countries from 1997-2003. *Electronic Journal of IS in of Developing Countries*, 23 (5), 1-11.
- UNDP: United Nations Development Programme (2006). *The Millennium Development Goals, UNDP*.
- WITSA. (1998, 2002). *Digital planet 2002: The global Information economy*. Arlington, VA: The World Information Technology and Services Alliance.
- Zhen-Wei Qiang, C., Pitt, A. (2003). *Contribution of Information and Communication Technologies to Growth*. The World Bank Working Paper, Vol: 24.