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EMBEDDED SYSTEMS DESIGN AND DEVELOPMENT AND ACHIEVING VISION20:2020

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Abstract

This paper presents massive investments in human capacity building to enhance the development of the Nigerian indigenous embedded systems technology as a key factor towards achieving Vision20:2020. The goals and objectives of Vision20:2020 as well as necessary steps or actions that have been identified as vital to the achievement of the vision are briefly discussed. Investment in technology driven Agriculture as well as Hi-tech manufacturing industries to boost the Nation's gross domestic product (GDP) and gross national income (GNI) stands out among the vital steps identified. Developed and emerging economies in the world were investigated to ascertain the key factor responsible for their growth and development. The research findings show that no nation can develop beyond her technology or experience economic boom on borrowed technology without investing in developing it indigenously. Engaging in human capacity building through establishment and funding of research and training centers on embedded systems design and development will provide the platform for indigenous solutions in the form of equipments, machines, tools, products, etc ranging from very simple to complex systems to be developed so as to meet the growing needs of our agricultural, manufacturing and other industrial sectors. An embedded system is a micro-processor based system that is built to control a function or range of functions and is not designed to be used by the user in the same way that a personal computer (PC) is. Embedded digital technology is present in many equipments and systems, and is used to increase functionality, as well as to improve operation at low cost. They are now found in almost all technical devices, from simple everyday home appliances, to facilities and facility management such as heating, air conditioning, elevators and escalators, in agricultural equipments and in production units from robotics to production automation and control systems, etc. With appropriate Government policies and the will to stick to the implementation plans, in place, sustenance of achieved development and economic growth resulting from development of embedded system technologies will be guaranteed. Soon we will have Nigerian made digital watches, mp3 players, phones, traffic lights, cable modems, calculators, technology driven farm tools, manufacturing and processing equipments, cars,

medical equipments, etc designed, developed and produced by Nigerians for Nigerians and for other countries of the world. This will strengthen and grow our economy by boosting our GDP and GNI at an accelerated pace and vision20:2020 will then be achieved.

Introduction

Nigeria often referred to as the Giant of Africa (Itibari, 2009; Anthony, 1998) by her citizens and citizens of some other nations, has not really been able to show dominance in many of the metrics used in comparing nations. Nigeria has not taken the number one position when it comes to key metrics such as the standard of living of her people, gross domestic product (GDP), gross national income (GNI) non prevalence of HIV/AIDS, level of corruption, technological advancement, economic growth, per capital income, etc (NairaBrain, 2009; USAID, 2010; NigeriaWorld, 2009; Segun, 2010; Nigeria-Planet, 2011,). Although Nigeria is a country with a vast land resource and endowed with abundant natural and human resources, she has continued to lag behind among the committee of nations due to the inability of her government and people to identify and summon the will to invest massively in key areas that will make the most impact on her economy. The prevalence of corruption in both the public and private sector, (NairaBrain, 2009) coupled with the lack of adequate commitment and dedication as well as unwillingness of Nigerians to make sacrifices has made things worse.

Over the years several governments in Nigeria have come up with different policies and plans aimed at achieving certain set goals which were clearly defined. These policies and plans include: The Colonial Development Plan (NPC, 2011) the Green revolution (NigerianWiki, 2008), Structural Adjustment Programme (SAP)(Ogugua, 1994), National Economic Empowerment and Development Strategy(NEEDS)(Ikeanyibe, 2009), Vision 2010 (NigeriaWorld, 1999), etc. These policies and plans have not yielded the expected results due to weak implementation and lack of political will to see the development strategy through to the end (NPC, 2011). This is evident considering the development and efficiency level of public infrastructures and systems ranging from bad roads, epileptic power supply, inadequate housing facilities, poor and inadequate water supply facilities, inadequate and inefficient security systems and health institutions, continual dependence on subsistence agriculture rather than mechanized farming, low commitment and dedication in the Public service, prevalence of corruption in all facet of our lives, etc. These have resulted in poverty, hunger, lack of employment opportunities, fallen standards in education and living, low GDP, declining per capital income, insecurity, brain drain from the country, unstable exchange rate, high inflation rate, etc. Indeed the problem of Nigeria has many faces but it must be tackled from selected front lines where the most efficient result will be obtained.

At the end of the 2008 Nigeria Economic Summit, a vision was identified to put the nation among the top 20 economies in the world by the year 2020 (SciCon, 2011). This vision was termed NIGERIA VISION 20: 2020. Progressive achievement of this laudable vision is the focus of all development programmes embarked upon by the nation's governments and people, since then. The first medium term implementation plan for the vision which covers 2010 to 2013 was approved by President Goodluck Jonathan in June 2010(SciCon, 2011).

All stake holders involved in pursuing and implementing this vision must take necessary steps to prevent a repetition of history where the goals and objectives of the vision will not be realized by the end of the projected period. Key areas identified as front-liners in achieving the vision must be vigorously pursued so that maximum results will be obtained. It has been generally agreed by many stakeholders that investing in developing the Nation's technological education is a major key to achieving economic growth and development (Allafrica, 2009; Onyenekenwa, 2011; Accessmylibrary, 2008). Engaging in human capacity building through establishment and funding of research and training centers on embedded systems design and development will provide the platform for indigenous solutions in the form of equipments, machines, tools, products, etc ranging from very simple to complex systems to be developed. Hence the growing needs of our agricultural, manufacturing and other industrial sectors will be met. Embedded digital technology is present in many equipments and systems, and is used to increase functionality, as well as to improve operation at low cost. Countries that must lead other countries in economy, GDP, GNI, developed infrastructures, etc must first lead in the development and the sustenance of their technology.

Research methodology

A hypothesis that massive investment in research and development of embedded systems technologies is key to achieving vision20:2020 (which aim to make Nigeria one of the first 20 economies in the world) is set. To verify the claim, some selected developed and emerging economies were investigated and the key factors that determined their growth were identified. Based on the findings conclusions and recommendations were made to support or discard the hypothesis.

Background of the study

Nigeria's Vision 20: 2020

The Nigerian Vision 20:2020 (NV20:2020) is Nigeria's long term development goal designed to propel the country to the league of the top 20 economies of the world by 2020 (NPC, 2011; Onyenekenwa, 2011). The vision Statement is as follows (NPC, 2011):

"By 2020, Nigeria will have a large, strong, diversified, sustainable and competitive economy that effectively harnesses the talents and energies of its people and responsibly exploits its natural endowments to guarantee a high standard of living and quality of life to its citizens".
Attainment of the Vision would enable the country achieve a high standard of living for its citizens. The NV20: 2020 was developed by Nigerians for the Nigerian people and involved a process of thorough engagement with all stakeholders across all levels of government and society. The Vision is therefore, a rallying point for all Nigerians, regardless of ethnicity, political leaning, economic status, or religion behind a common cause of placing the country on a sustainable development path and transformation into a modern society better able to play a greater role in the committee of nations (NPC, 2011). The Vision will be pursued through a series of three – four year plan which will further articulate the strategies, policies, projects and programmes among other things.

Objectives of the NV 20:2020?

The two broad objectives are to (NPC, 2011):

1. Make efficient use of human and natural resources to achieve rapid economic growth
2. Translate the economic growth into equitable social development for all citizens.

The development aspirations cut across four dimensions (NPC, 2011):

1. Social - building a peaceful, equitable, harmonious and just society;

2. Economic - developing a globally competitive economy;
3. Institutional - having a stable and functional democracy; and
4. Environmental – achieving a sustainable management of the nation’s natural resources.

Why vision:20:2020?

Vision 20:2020 is important for the following reasons (NPC, 2011):

(1) The Need for Nigeria to plan development on a long-term basis in order to achieve structural transformation;

(2) The Need to reduce the country’s overdependence on oil;

(3) The Need to effectively transform the lives of Nigerians in terms of significant improvements in their standards of living; and

(4) The Need for the country to take its rightful position among the nations of the world

Necessary actions to be taken to achieve the vision

Specific steps or actions must be taken in order to realize the vision. These steps include (NPC, 2011):

(1) Steps to urgently address the most serious constraints to Nigeria’s growth and competitiveness. The domestic and external constraints that have been identified as hindrances to achieving the vision include (NPC, 2011):
   - (a) Poor and decaying infrastructure
   - (b) Epileptic power supply
   - (c) Weak fiscal and monetary policy co-ordination
   - (d) Fiscal dominance and its implications for inflation and private sector financing
   - (e) Pervasive rent-seeking behavior by private and public agents, including corruption
   - (f) Weak institutions and regulatory deficit
   - (g) Policy reversals and lack of follow-through
   - (h) Inordinate dependence on the oil sector for government revenue/expenditure
   - (i) Disconnect between the financial sector and the real sector
   - (j) High population growth which places undue stress on basic life- sustaining resources and eventually results in diminished well-being and quality of life.
   - (k) Insecurity of lives and property
   - (l) Threats of climate change, especially in relation to food production
   - (m) Vulnerabilities in the global economic environment, in particular, the global economic crisis and disturbances in the international oil market.

(2) Aggressively pursue a structural transformation of the economy from a mono-product to a diversified and industrialized economy.

(3) Investing in human capital to transform the Nigerian people into active agents for growth and national development.

Major Contributors to the Growth of the Nigerian Economy

Over the past decade, agriculture, wholesale and retail trade, telecommunications and manufacturing sectors contributed most to the growth of Nigerian economy. At present, manufacturing sector's role, as key driver is limited but it has high potentials. This role will be stimulated during the vision period in order to maximize its linkage with other relevant sectors of the economy. It is important to note that advancement in manufacturing is driven by technology. Fig1 shows the sectoral growth driver of the Nigerian economy from 1999 to 2008.

Picture of the Desired Economy by 2020

Under the NV20:2020 manufacturing and services are expected to dominate the structure of national output, while gross national investment is expected to increase, and the infrastructure base of production is expected to improve considerably. Income per capita should have risen to $US4,000 from the estimate of US$1,230 in the year 2008. Table1 shows existing and desired structure of national output by 2020.

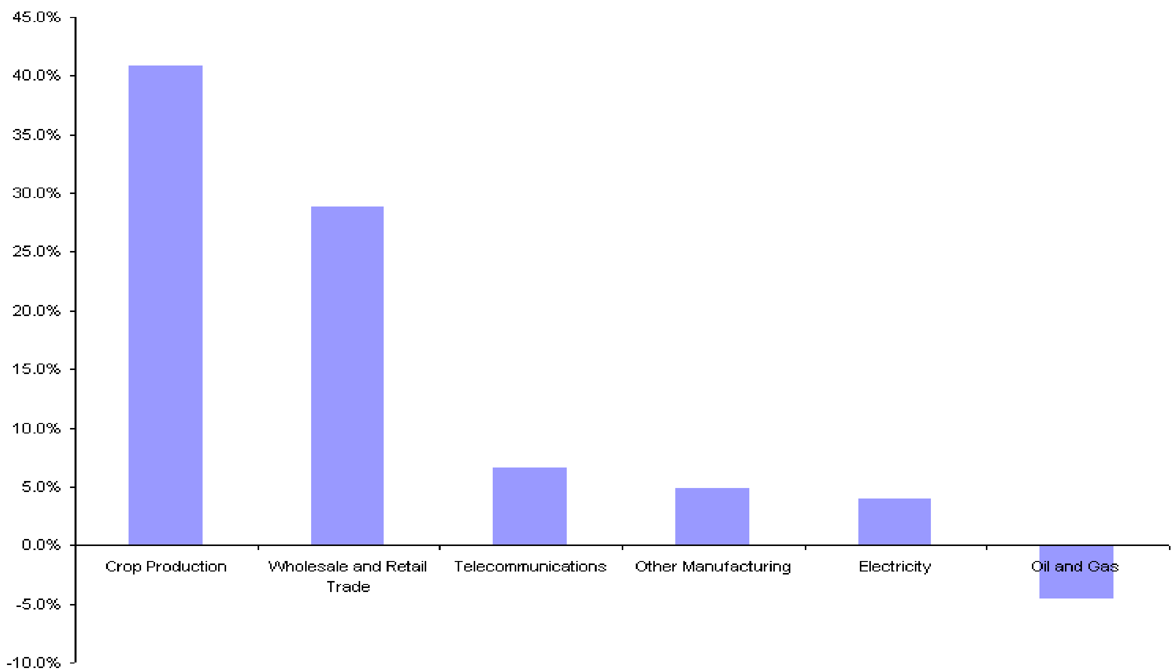

Fig1: Sectoral growth driver of the Nigerian economy from 1999 to 2008.

Table1: Existing and desired structure of national output by 2020.

Activity Sector	Projected Share of Output by 2020 (%)	Existing Share of Output (%)
Agriculture	3-15	42.1
Industry	30 – 50	23.8
Manufacturing	15 – 30	4.0
Services	45 – 75	34.1

Improving the Well-Being and Productivity of Nigerians

The main goal of Nigeria's Vision 20:2020 is to improve the well-being of Nigerians. In this direction, the Vision aims to (NPC, 2011):

1. Eradicate extreme hunger and poverty
2. Guarantee food security
3. Enhance access to quality/affordable healthcare
4. Sustain access to portable water and basic sanitation
5. Make housing accessible and affordable
6. Develop human capital
7. Enhance acquiring education and skills
8. Generate employment and protect jobs
9. Empower persons with disability
10. Ensuring gender equality and women empowerment
11. Improve access to micro-credit
12. Enhance productivity through entertainment and recreation.

Developing Key Sources of Economic Growth

The vision will also focus on developing key sources of economic growth. It plans to transform Nigeria socially, politically and economically. This implies a firm commitment to harnessing current and potential drivers of economic growth. The growth strategy requires divestment from dependence on oil as an engine of growth, transformation of the structure of exports from primary to processed/manufactured goods and the attainment of high levels of efficiency in production. Thus, NV20:2020 targets greater global competitiveness in the production of specific processed and manufactured goods by effectively linking industrial activity with the primary sector, domestic with foreign trade, and the services sub-sector to all other productive activities. The aim is to stimulate primary production by:

(a) Promoting Minerals & Metals Sector
(b) Transforming Agriculture
(b) Developing Oil and Gas Sector
(c) Exporting Processed and Manufactured Goods
(d) Developing Industrial Clusters
(e) Prioritising Industry Sub-Sectors
(f) Enhancing Domestic and Foreign Trade in Value-Added Products and Services
(g) Promoting Export
(h) Administering the Borders
(i) Promoting Domestic Trade

Linkages among key sectors of the economy such as**:** Financial sector Transportation, Information and Communications Technology will also be strengthened

Sustaining Social and Economic Development

Social and economic development will be sustained through:

(a) Creating strong, efficient and effective public service institutions and tackling corruption
(b) Promoting competitive, private sector-led business environment
(c) Ensuring national security and improved administration of justice
(d) Promoting unity in diversity, national pride and conservation of our cultural heritage

(e) Developing sufficient and efficient infrastructure to support sustained economic growth
(f) Improving power supply
(g) Improving transportation
(h) Information and communications technology (ICT)
(i) Preserving the environment for sustainable socio-economic development
(j) Transforming Nigeria's six geo-political regions into economic growth poles
(k) Developing Niger Delta region

For Nigeria to realize the Vision 2020 and become the 20th largest economy, it must grow at least 9.5% annually within the next eleven years, 2010 included. It was ranked 44th ($174b (nominal), 2009) and chasing Belgium which is 20th ($471b, 2009), according to IMF (Admin, 2011). Making that jump will require a compounded interest of 298% by 2020 which will translate to 171% percentage growth in the GDP. This analysis assumes that the GDP of the 20th economy will remain constant in 2020. For a nation that has averaged about 5.5% in growth, in the last seven years, it does mean that it needs a new growth engine.

From the foregoing, it is clear that the enhanced growths in the industrial, manufacturing, agriculture as well as service sector of the economy are key to achieving vision 20:2020. These sectors of the economy can only yield maximum output on what is invested in them, if they are technology driven. Investing in technology based education will therefore provide the platform for the key sectors of the economy to flourish, thereby setting the country on the path to achieving vision20:2020.

Over the years, Science and technology has influenced the course of human civilization. The developed economies of the world know the significance of utilizing scientific and technological knowledge in industrial production, and have explicitly put in place institutions and mechanisms for their exploitation. The success of these countries shows the need to focus on ways to exploit scientific and technological knowledge for national development rather than rely solely on resource endowment. The importance of science and technology to economic development explains the advancement of some countries with very little natural resources that have transformed imported raw materials into high value products and services through the application of science and technology. Embedded systems design is a technology that will give Nigerians the opportunity to provide indigenous technological solutions to our indigenous problems. This is so because this technology enables you to design and develop products ranging from simple to very complex systems at reduced cost while maximizing functionality.

What are Embedded Systems?

Embedded systems are small, fast, and very powerful tools, gadgets and equipments which have become part of our everyday life. They are those computer systems that do not look like computer systems to the everyday user. They form a part of a larger system or product, part of anything, from mobile phones to medical devices, from agricultural farming tools to manufacturing equipments. An embedded system is a micro-processor based system that is built to control a function or range of functions and is not designed to be used by the user in the same way that a personal computer (PC) is (Heath, 2003). It is a combination of computer hardware and software, and perhaps additional mechanical or other parts, designed to perform a dedicated function (Netrino, 2011). In some cases, embedded systems are part of a larger system or product, as in the case of an antilock braking system in a car. Although the user can make choices concerning the functionality, he cannot change the functionality of the system

by adding or replacing software as is possible with the PC. In a PC, you can change functionality from word processing to games and then to mathematical computation by simply changing the software application but this is not possible in embedded systems. An embedded system is designed to perform one or a few dedicated and/or specific functions but with choices and different options (Michael, 2007; Heath 2003).
Fig2 and Fig3 are examples of embedded systems. Today, more microprocessors around the globe are used in embedded systems rather than in PCs. Those already large numbers are increasing at a phenomenal rate as the devices that surround us in our everyday lives become smarter. This is a consequence of an insatiable drive towards having control over devices and access to data anywhere, anytime. Needless to say we prefer them connected - wired or wireless.

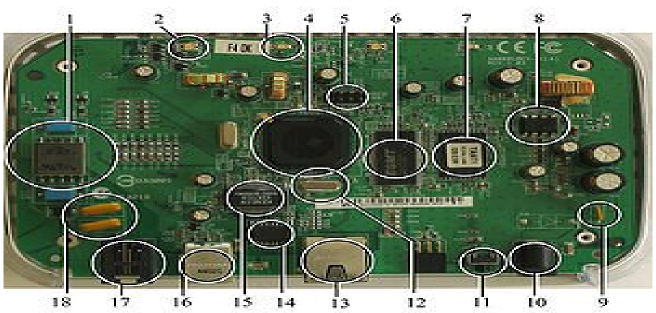

Fig2: Picture of the internals of an ADSL modem/router. (A modern example of an embedded system. Labeled parts include a microprocessor (4), RAM (6), and flash memory (7)).

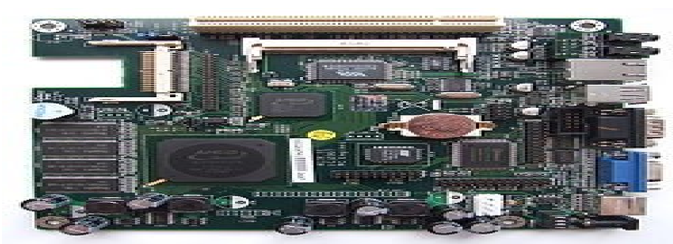

Fig3: PC Engines' ALIX.1C Mini-ITX embedded board with an x86 AMD Geode LX 800 together with Compact Flash, miniPCI and PCI slots, 44-pin IDE interface, audio, USB and 256MB RAM

Why do we need embedded systems?
The first reason why we need embedded systems is because general-purpose computers, like PCs, would be far too costly for the majority of products that incorporate some form of embedded system technology (Christoffer, 2006). Another reason why we need embedded systems is because general-purpose solution might also fail to meet a number of functional or performance requirements such as constraints in power-consumption, size-limitations, reliability or real-time performance etc.

The digital revolution, started decades ago, has reached a stage that we cannot conduct our normal modern daily lives without this technology. Indeed, it is safe to say that we already own at least one piece of equipment, which contains a processor, whether it is a phone, a television, an automatic washing machine or an MP3 player. The colossal growth of processing power in small packages has fuelled the digital revolution. All sectors of the economy have been influenced by the digital revolution and the industry has experienced tremendous developments in all aspects of engineering disciplines (Bruce, 2011).

Challenges in Industrial applications of embedded systems

Many of the benefits and requirements such as low cost, small size, etc are typical of embedded systems in general. Some challenges are more specifically associated with industrial applications. Industrial requirements vary enormously from application to application, but special industrial requirements typically include (Christoffer, 2006; Philip, 1997):

(a) Availability and reliability.

Automation and power systems must have very high availability and be extremely reliable in order to minimize the cost of operation (ie to minimize scheduled as well as unplanned maintenance time).

(b) Safety

While customers demand high quality and reliability from most of their embedded systems, it is not necessarily critical if, say, a PDA (personal digital assistant) needs to be restarted after an application causes the system to fail. For industrial applications, however, the effect of a failure in the system could be devastating. A gas leakage at an oil platform, for example, must be detected and followed by a safe shutdown of the process. Otherwise, expensive assets or even human lives could be at risk. Similarly, instabilities in power transmission and distribution networks should be detected before they are allowed to propagate and cause large blackouts. Economic security and personal safety depend on high-integrity systems.

(c) Real-time, deterministic response

'Real-time' is a term often associated with embedded systems because these systems are used to control or monitor real-time processes. They must be able to perform certain tasks reliably within a given time. But the definition of 'real-time' varies with the application. A chemical reaction, for instance, may proceed slowly, and the temperature at a given point may need to be read no more than once per second. However, the schedule must be predictable. At the other end of the scale, protection devices for high-voltage equipment need to sample currents and voltages thousands of times per second in order to detect and, where necessary, act within a fraction of a power-cycle.

(d) Power consumption

At first glance, the power consumption of industrial electronics may appear insignificant because of the abundance of power that is available. However, this power is not always available, and the need to keep installation costs low has created a demand for electrical protection devices that do not require a separate power supply for the electronics. These devices are self-sufficient with respect to power and meet their needs by extracting small amounts of energy from their surroundings. Wireless sensors for building, factory or process-automation must offer years of battery life or a completely autonomous mode of operation. Self-sufficient power supplies can be designed to extract minute levels of energy from electromagnetic or solar power, temperature gradients or vibration in the environment. This is frequently referred to as energy "harvesting." Even when power is available, low-power design can be used to reduce the generation of excessive heat that would otherwise necessitate expensive and error-prone cooling devices.

(a) Lifetime.

Yet another requirement that is frequently imposed on industrial embedded systems is a long lifetime of the product itself and the life-cycle of the product family. While modern consumer electronics may be expected to last for less than five years, most industrial devices are expected to work in the field for 20 years or more. This imposes challenges not only on the robustness of the electronics, but also on how the product should be handled throughout its lifecycle: Hardware components, operating systems and development tools are constantly evolving and individual products eventually become obsolete.

General Key issues in developing embedded systems

1. Slowly changing and non changing challenges.

Some challenges involved in the design of embedded systems have not really changed in the last couple of decades. The drive for robust products with increased performance at reduced cost, size and weight, for instance, will continue as long as developments in the underlying technologies will permit (Christoffer, 2006; Philip, 1996). Low price translates to reduced resources such as processor speed and memory size which in turn constrains software development and execution. Often embedded devices are very sensitive to cost. A variation of even a few cents per device can be significant due to the huge multiplier of production quantity combined with the higher percentage of total system cost it represents.

2. Rapid changing challenges

Other challenges involved in embedded system design are changing rapidly. Three areas should be given particular attention (Christoffer, 2006, Philip, 1996): complexity, connectivity and usability.

(a) Complexity

While the steadily increasing transistor density and speeds of integrated circuits offer tremendous opportunities, these improvements also present developers (individuals, teams, organizations) with a huge challenge: how to handle the added complexity? A modern embedded system can consist of hundreds of thousand lines of software code. More and more products now include complex embedded systems and the development organizations must evolve with the products and their technologies. It is necessary to establish suitable development processes, methods and tools. Developing product platforms also ensures re-use of technology and increased efficiency.

(b) Connectivity

Before the widespread deployment of digital communication, most embedded systems operated in a stand-alone mode. They may have had some capabilities for remote supervision and control, but, by and large, most functions were performed autonomously. This is changing rapidly. Embedded systems are now often part of sophisticated distributed networks. Simple sensors with basic transmitter electronics have been replaced by complex, intelligent field devices. As a consequence, individual products can no longer be designed in isolation. They must have common components. Communication has gone from being a small part of a system to being a significant function. Where serial peer-to-peer communication was once the only way to connect a device to a control system, field buses are now able to integrate large numbers of complex devices. The need to connect different applications within a system to information and services in field devices drives the introduction of standard ICT technologies like Ethernet and web-services.

(c) Usability

Complex field devices are often programmable or configurable. Today's pressure transmitters can contain several hundred parameters. The interaction with a device either from a built-in panel or from a software application in the system has become more complex. The task of hiding this complexity from the user through the creation of a user-friendly device has sometimes been underestimated. Most other requirements are easily quantifiable or absolute, but "usability" is somewhat harder to define. Yet an embedded system that is intuitive and simple to operate will reduce the cost of commissioning and maintenance. It will reduce errors and be a key factor in the overall customer satisfaction. That is why usability must be given a high priority in the design and development of products, from the conceptual stage, right through to the final testing.

Latest Trends in Embedded systems.

A major latest embedded systems trend is the Systems on Chip (SoC) (Christoffer, 2006).The emergence of SoC has enabled extremely powerful systems including hardware and software to run on configurable platforms that contain all the building blocks of an embedded system (Christoffer, 2006): microprocessors, DSPs, programmable hardware logic, memory, communication processors and display drivers, to give but a few examples.

Other trends are related to built-in wireless communication and self-configurable networked devices (Christoffer, 2006). These trends enable extended use of intelligent field devices in applications where wiring costs for such devices are prohibitive. ABB Ltd, First Atlantic Semiconductors & Microelectronics Ltd and some other embedded systems technology companies are at the forefront of developing technologies and applications that benefit from the latest advances in research combined with technologies from other industries such as telecommunications and consumer electronics.

Exactly what power and automation systems will look like twenty years from now is impossible to predict. But whatever developments we witness, embedded systems will be key enablers and drivers for change.

Key Growth Indicators in Some Selected Developed and Emerging Economies

European economies

The European industry projected to invest more than N 22 billion per annum in embedded systems research and development by 2009 (Kostas, 2006). This is almost double what it invested in 2003. Because of the importance of embedded systems technology for key industrial sectors (from industrial automation and medical equipment to automotive and avionics), the European Commission has devoted a specific part of its Information Society Technologies (IST) program to embedded systems research (Kostas, 2006). From 2003 to 2006 alone, it has invested Є140 million in collaborative projects between industry, academia and research centers (Kostas, 2006). These projects focus largely on systems design, safety-critical systems, embedded computing, middleware platforms, wireless sensor networks, and distributed and hybrid control systems. Embedded systems were also one of the six "pillars" of ICT research in the European Commission's proposals for the 7th Framework Programme, that started in 2007 (Kostas, 2006). In 2004, the Technology Platform ARTEMIS (Advanced Research and Technology for EMbedded Intelligence and Systems) was set up. ARTEMIS is an industry-led initiative to reinforce the EU's position as a leading global player in the design, integration and supply of embedded systems (Kostas, 2006). The driving force behind ARTEMIS is the vision of a society where all systems, machines, and objects have become digital, communicating, self-managed resources. These transformations are possible through advances in embedded systems technologies and their large-scale deployment, not only in industry and services, but in all areas of human activity (Kostas, 2006). Such developments have a range of important consequences for society and the economy which include (Kostas, 2006):

(a) Life in our society and its safety and security will depend increasingly on embedded systems.
(b) The competitiveness of European industries, in almost all sectors, will rely on innovation capabilities in the area of embedded systems.
(c) Given the dramatically increasing importance of embedded systems to productivity growth, these technologies will be critically important in redressing the present imbalance in productivity growth between Europe, the US and Asia.

Maintaining a leading position in embedded systems technology will require significant investment in research and development that is focused on specific joint priorities.

German Economy

"The financial and economic crisis is presenting Germany with enormous challenges. To emerge from this crisis even stronger than before, we will have to make immense joint efforts. In addition to managing the crisis in the short term, we will have to commit ourselves to a path of growth and economic success. Investments in education, science and research are the right way to make such a commitment" (BMBF, 2009).

This was the forward presented by Prof. Dr. Annette Schavan, a member of the German Bundestag, Federal Minister of Education and Research on the publication titled "Research and Innovation for Germany, Results and Outlook" in the year 2009. Research and innovation are indispensable for highly developed, resources-poor countries such as Germany. Innovative goods and services keep the economy moving, creating jobs and high incomes. Production, value creation and employment grow far more strongly in highly innovative companies than they do in weakly innovative ones. The prosperity of the country, and of its citizens, depends on research and innovation, as does the country's ability to provide for its citizens' futures and their quality of life (BMBF, 2009).

In Germany, the proportion of value-added products and services based on research is higher than in any other industrialized country (BMBF, 2010). The export of technological goods makes up one fifth of the country's economic output. Hence, research and development are very important to the economic power and economic growth in Germany (BMBF, 2010). Since 2005, the German central government expenditure on research has risen by 21 percent; private sector investment in research has increased by 19 percent (BMBF, 2010). This puts Germany in the leading group among European countries (BMBF, 2010). They have also steadily increased the number of scientific publications and patents.

The Federal Report on Research and Innovation underlines the key findings of the report on research, innovations and technological performance (Gutachten zu Forschung, Innovationen und technologischer Leistungsfähigkeit) compiled by the Expert Commission on Research and Innovation (Expertenkommission Forschung und Innovation). The report showed that Germany has a powerful and internationally recognised scientific system and a high proportion of innovative enterprises (BMBF, 2010).

Worldwide, research and innovation systems are in a process of strong growth and transformation hence global expenditure on research and development (R&D) has doubled since 1997(BMBF, 2010). In total, more than 5.7 million people work in research and development compared to just below four million in 1995 (BMBF, 2010). Many industrial and emerging countries are increasingly investing in education, research and innovation. For Germany, it is a question of asserting itself in this competitive environment with the appropriate emphasis. The German economy needs new prospects for growth (BMBF, 2010). In a leading industrial nation like Germany, research and development activities based on the latest findings from research and development in particular form an essential basis for new and sustainable growth. New, because it is based on the latest findings from research and development and sustainable because it is derived from proactive and courageous decisions for promising products, processes and services.

In recent years, the German Federal Government has moved research and innovation closer to the core of its growth policy. It has consistently given priority to education, research and innovation. The German Federal Government's research and innovation policy measures were re-initiated and bundled together to form the High-Tech Strategy (BMBF, 2010). The central and local government reform initiatives the Excellence Initiative (Exzellenzinitiative), the Higher Education Pact (Hochschulpakt) and the Joint Initiative for Research and Innovation (Pakt für Forschung und Innovation) have strengthened the performance capability of the German science system and made Germany even more attractive as a scientific location (BMBF, 2010). This High-Tech Strategy, the reform initiatives and the strategy for the internationalization of science and research complement each other perfectly.

The following data and facts show that the chosen path is the correct one (BMBF, 2010; BMBF, 2009):

- In 2007, absolute expenditure on R&D in Germany was higher than in any other country in Europe. Compared internationally, only the USA, Japan and China spent more on R&D.
- According to preliminary calculations by the Federal Ministry of Education and Research (BMBF), expenditure on R&D as a percentage of GDP rose to about 2.64% in 2008. This is the highest level since German reunification and a further step towards the 3% targeted of the Lisbon Strategy.
- In absolute terms, total expenditure on R&D (government, industry and others) between 2005 and 2007 increased from 55.7 billion euros to 61.5 billion euros. This corresponds to an increase of approximately 10%. A further increase to over 65 billion euros was expected in 2008.
- Central government expenditure on R&D increased from 9 billion euros in 2005 to 10.9 billion euros in 2008, a rise of around 21%. In 2009, central government expenditure on R&D increased further to 12.1 billion euros (target), a rise to 12.7 billion euros is planned for 2010.
- Despite the uncertainty caused by the financial and economic crisis in 2008, German companies have increased internal expenditure on R&D, compared to the previous year, by 7% (to 46.1 billion euros). As a result, enterprises in Germany increased their

annual R&D investments between 2005 and 2008 by around 19% (7.4 billion euros). Increases were recorded by large, small and medium-sized enterprises.

- Never before have so many people in Germany been employed in R&D: in 2008, the number of researchers, laboratory technicians and engineers employed in industry rose to 333, 000 (measured in full-time equivalents). Compared to 2005, this is an increase of almost 30 000 people.
- The proportion of research-intensive products and services providing added value is more than 45% in Germany higher than in any other industrialized country. The USA, which was ahead in 2000, has now been surpassed. The German economy is excellently positioned in the global technology markets. The creativity and technological performance of those companies impressively demonstrates how new ideas can open up future markets and top international positions.
- Statistics have proven that, by the end of 2008, there was a positive innovation climate: around 31% of companies can trace their innovation behavior back to central government's improved research and innovation policies.

The sum total of all the scientific, economic and political initiatives has had considerable impact: Germany has taken significant steps forward in research, development and innovation, as confirmed by the German Council of Economic Experts and the Expert Commission on Research and Innovation (BMBF, 2010).

Key technologies, such as biotechnology and nanotechnology, optical technologies, microsystem, materials and production technologies, aeronautics technology, as well as information and communication technology (which all depend on embedded system designs) are the drivers of innovation and form the foundation for new products, processes and services (BMBF, 2010). They are essential in solving global challenges in the demand fields. Its benefits will depend critically on how successfully they can be converted into industrial applications. In Germany, key technologies' funding will therefore focus more on fields of application.

British or UK Economy

"In these tough economic times for our world we look to science to provide new solutions, new technologies, new opportunities to further our common goals" (STFC, 2011).
This statement was made by Rt Hon Gordon brown who was Prime minister of the United kingdom from 2007 to 2010.
In the vision document of the UK's Science and Technology Facility Council (STFC), the need for science and technological innovations to drive the economy has been clearly articulated. The World Wide Web, medical imaging, gene technology, clean energy, life-prolonging drug delivery systems, and improved security devices were all once 'things that never were'. They were dreamt of, and then turned into reality. The UK needs to turn more dreams into realities if it is to remain economically competitive globally and thus be able to afford to maintain high standard of living and high social values. The UK is not a low cost economy based on extractive industries or cheap labour. To compete they need to innovate (STFC, 2011).
Recently, the UK's economy entered recession. Moreover, the world at large faces perhaps the most challenging financial and economic situation for half a century, placing even further

pressure upon our collective ability to address long term global challenges such as climate change, hunger, poverty and disease, and the insecurity and uncertainty they breed. Now, more than ever, the world needs the solutions that science and technology can offer (STFC, 2011).

The interlinked challenges of the 21st century such as: energy, global climate, health, security concerns, etc, demand scientific and technical innovation. Successful innovation depends on the highest quality research facilities and new ways of bringing technology and applications together between industry and academia (STFC, 2011).

The UK needs to use the prodigious talents, knowledge and curiosity of their scientists and engineers to encourage innovation, and thus help build a more sustainable economy, able to recover rapidly from slowdowns of the kind currently being experienced, and move forward robustly to address the global challenges humankind faces over the next 20 years and beyond (STFC, 2011).

The Rt. Hon. David Willetts, the UK Minister for Science and Universities visited China in June 2011 to reinforce the position of UK and China as partners for growth through science and education. During his visit the Minister co-chaired the 6th Meeting of Sino–UK Joint Commission on Science and Innovation Cooperation alongside Minister WAN Gang, Chinese Minister for Science and Technology. He also met with Vice President LI Jia Yang of the Chinese Academy of Science to discuss research collaboration and highlight opportunities for future collaboration, and with Vice Minister HAO Ping of the Ministry of Education to further strengthen educational cooperation, particularly in higher education and research (STFPC, 2011). This shows the importance that the British government attaches to the use of technology to enhance economic growth.

Whether through power supply, sensors, invisibly embedded systems, lasers or displays, the Key Technology Area (KTA) of Electronics, Photonics and Electrical Systems (EPES) underpins activity in all industrial sectors and throughout the consumer market. Global markets for electricity ($1.2 trillion), electronic products ($2.0 trillion) and photonics products ($0.6 trillion) all continue to expand strongly (TSB, 2011). $260 billion of this is accounted for by semiconductors, with 900 million transistors being produced every year for every man, woman, and child on Earth (TSB, 2011). The UK is well placed to profit from these markets, as it benefits from a strong science base and a long tradition of inventiveness in the uses of electricity and light. The UK economy at a glance shows that it has benefited immensely from its technology base. For example, Electronics, Photonics and Electrical Systems (EPES) manufacturing employs more than 330,000 people in 14,000 UK businesses, with £42 billion turnover (TSB, 2011). This is 10% of UK manufacturing industry (TSB, 2011). EPES distribution, wholesaling and retail adds £73 billion and electricity transmission and distribution a further £55 billion (TSB, 2011). The value added by these activities totals 4% of GDP, with telecommunications adding a further 2%, and EPES technology underpins activity throughout the remainder of the economy (TSB, 2011). The UK boasts nearly a third of Europe's silicon design companies three times as many as either France or Germany (TSB, 2011). The Technology Strategy Board recognizes the importance of these technologies to the UK economy, and will continue to champion a sector that received over £114 million of investment from the Technology Programme during 2004-2008 (TSB, 2011). The economic benefits (the goal of the UK's EPES strategy) can be achieved by developing ideas from the science base into industrially relevant new EPES technologies, and onwards to become products in the marketplace; but they can also be achieved by the adoption of existing technologies into new applications in the healthcare, transport, energy, retail and environmental sectors (TSB, 2011). This benefits both the technology providers in the device industries and the technology adopters in the end-use markets.

This UK strategy has identified five technology pillars for investment, where Technology Strategy Board involvement will have a significant and lasting impact on the UK economy (TSB, 2011): Control systems and power engineering, Plastic and printed electronics, Data and image acquisition, Communications, Systems design and integration. These technology pillars all make use of embedded systems. Hence design and development of embedded systems technologies will provide a platform for a lasting impact on the economy of UK.

The fifth annual Science and Innovation Investment Framework 2004-2014 report for 2009, published November 30th 2009 by the Department for Business, Innovations and Skills (BIS), outlines the latest achievements that have enabled the UK to become a world leader in research and emerge as a powerhouse for innovation (InnovationUk, 2009). The then Minister for Science and Innovation Lord Drayson welcomed the report's positive findings. "The evidence is clear – record levels of investment have helped us to build a world-class, sustainable research base," he says. "However, we need to maintain this progress and continue to invest in talent, science and innovation. Our future depends on it." The UK remains second only to US in worldwide scientific excellence, despite increasing competition from other countries. It is also the most efficient and productive nation for research in the G8 (InnovationUk, 2009).

The economic importance of technology and innovation is great since, according to Mokyr: "The difference between rich nations and poor nations is not […] that the rich have more money than the poor, but that rich nations produce more goods and services (Panayotis, 2004). One reason they can do so is because their technology is better; that is, their ability to control and manipulate nature and people for productive ends is superior" (Mokyr, 1990). If Western Europe has been superior, in terms of economic growth, compared to most of the Central-Eastern and Former Soviet Union (F.S.U.) countries, this is undoubtedly, at least partly, due to its technological superiority (Panayotis, 2004).

United States of America

The global economy has no doubt, got the privilege of boosting itself up with the advances and proliferation of the technologies across various borders. Between 1991 and 2000, the US economy grew at an exceptional rate. The gross domestic product (GDP) rose by an average of 4% per annum between 1994-1999, with the rate reaching 4.2%, 4.3%, respectively, between 1997 and 2000 (Bisht, 2001). Policies to promote technological advance are playing a significant role in the economic growth strategies of most mature and emerging economies (Bisht, 2001). Long-term studies show that advances in technology have been responsible for as much as one half of economic growth in the United States over the past 50 years, through improvements in capital and labor productivity, and the creation of new products, services, and systems (Bisht, 2001).

In other countries, the contribution of technology to economic growth has been even greater. For France, technology is estimated to have accounted for 76 percent of economic growth, for Germany, 78 percent, for the United Kingdom, 73 percent; and for Japan, 55 percent (Bisht, 2001).

Anyone who uses computers and the Internet knows how technology can increase their personal efficiency. A growing array of software productivity tools and e-commerce technologies makes it easier than ever for people to do business, shop, learn and communicate. Now, several reports out of Washington, D.C. underscore just how significant and extraordinary these productivity gains are-not only for individuals and businesses, but for the entire nation (Microsoft, 1999).

In a recent appearance before the Joint Economic Committee of Congress, Federal Reserve Chairman Alan Greenspan observed that "something special has happened to the American economy in recent years. An economy that twenty years ago seemed to have seen its better days, is displaying a remarkable run of economic growth that appears to have its roots in ongoing advances in technology" (Microsoft, 1999). Mr. Greenspan went on to note that technology is enabling businesses to better manage everything from employees to inventories. In addition, it is helping eliminate unnecessary production processes, speeding the delivery of goods to market, compelling businesses to keep prices low and, most important, enabling companies to better meet individual customers' needs (Microsoft, 1999).

Just a few days prior to Mr. Greenspan's comments, the U.S. Department of Commerce issued a report noting that although the information technology industry accounts for only about 8 percent of America's gross domestic product, it generated more than one-third of the nation's economic growth from 1995 to 1998 (Microsoft, 1999).

The Commerce Department study, “The Emerging Digital Economy II”, also noted that falling prices in the information technology sector cut overall inflation by 0.7 percent. Meanwhile, the technology industry showed dramatic increases in productivity: an average of 10.4 percent annually from 1990 to 1997, compared with less than 1 percent outside the technology sector (Microsoft, 1999).

The technology sector has done a magnificent job creating new opportunities and helping build a productive American economy. Healthy competition, innovation and consumer choice are clearly the most effective tools to ensure that this prosperity continues (Microsoft, 1999).

The information and communications technology industry has impacted the US economy positively over the years. This is evident in several reports of researches carried out (Robert, 2002; Michael, 2001; InfoUSA, 2011; Microsoft, 1999; Futurework, 2011; C-Span, 2011)

The computer and IT revolutions have changed virtually every industry in the economy. Numerous examples illustrate the point (Futurework, 2011):

- A manufacturing plant can be operated by a handful of technicians controlling robotic systems.
- State-of-the-art inventory systems can supply needed parts “just in time” for assembly.
- New jobs have been created in airfreight and delivery systems to service such just-in-time inventory operations.
- Handheld mobile phones have become commonplace, and digital phone systems will soon be able to reach anyone in the world via satellite.

One thing stands out in all of these: The ICT sector, which is responsible for the massive growth experienced in the US economy, is driven by embedded systems made using embedded systems technologies. Today, it won’t be wrong to say “embedded everything” as almost any equipment or gadget you find is made using embedded systems technology. This is the driving force behind the US economy.

Asian Countries

Asia is equally aware of the significance of embedded technologies for future economic growth and prosperity. Government-backed programs exist in Japan, Korea and China, each with its own flavor and emphasis (Peter, 2006). All these regional and national programs are driving towards the pervasive use of embedded devices in a multitude of applications across industries and large infrastructures, health and entertainment, fixed and mobile networks.

Chinese Economy

The Chinese Government as a matter of policy rewards those who return to china with a new technology (David, 2009). This is a measure taken to develop the Chinese technology and hence enhance their economy. China's central government, local governments, universities, research laboratories, and the marketplace all reward mainlanders who return to China with technology. In fact, technology helps generate today's reverse migration, particularly among business entrepreneurs and scientists, as the rewards for bringing back technology are significant. This strategy has made China economy a threat to the US economy and many researcher are already speculating that China will soon be the no one economic giant in the world (Oded, 2005).

In the late 1980s, the Central government's Torch Plan established New High Tech Development Zones in cities around China (David, 2009). By 1991, there were 27 such parks; by 1997, there were another 25 parks (David, 2009). These zones established incubators for returnees, which protect them from the vicissitudes of China's bureaucracy and marketplace until their firms are ripe; but to receive special privileges, projects have to involve new technology and local Science and Technology. Bureau must certify that such projects included new technology.

The national real GDP of China has increased tremendously, giving an annual average real GDP growth rate of 9.8 percent in the past two decades (Kui-Wai, 2007). China experienced a double or close to double digit real GDP growth rate for the period of 1992 – 2004 (Kui-Wai, 2007). This growth is attributed to the development of the Chinese technology which has positively impacted the economy. In the context of the frontier production analysis, it is shown that productivity change or the growth of total factor productivity (TFP) is a composition of technical progress, technical efficiency change and scale of economy (Kumbhakar, 2000).

The export processing zones established in China in the 1980s initiated a complete transformation of China's coastal regions. The export processing trade, supported by a strong manufacturing base established in the 1950s and complemented by technology imported since the 1980s, progressively became a catalyst for China's economy (Barry, 2010). Following in the footsteps of other Asian catch-up countries, China's exports rapidly started moving up the value chain away from low-tech products. Between 1992 and 2005, China's medium- to high-technology exports grew 22 per cent annually, while high-technology exports grew by 32 per cent (Barry, 2010). By 2008, 43 per cent of China's exports were directly related to machinery, mechanical appliances and electrical equipment, and China now dominates the global markets for these and other types of machinery (Barry, 2010).

Huawei Electronics, one of the major companies responsible for the global emergence of Chinese technology and innovation, has consistently spent 10 percent of its revenue on R&D every year (Barry, 2010). The firm's credentials as an innovator are beyond question, yet its greatest achievement is that it so effectively fused two often disparate elements: good quality at low prices.

Capital accumulation, labor growth and technology progress are major factors to long-term economic growth on modern economic growth theory. China's economy keeps sustained, rapid, healthy development and wins remarkable achievements since they began to reform and open up (MA, 2008). In summary, advancing technological innovation, increasing total factor productivity and promoting industrial restructuring and optimization are the key factors for improving the quality of economic growth and ensuring economic sustainable development (MA, 2008).

Japanese Economy

Japan is a leading nation in scientific research, particularly technology, machinery and biomedical research. Nearly 700,000 researchers share a US$130 billion research and development budget, the third largest in the world (McDonald, 2006). Japan is a world leader in fundamental scientific research and she has a large industrial capacity, and is home to some of the largest and most technologically advanced producers of motor vehicles, electronics, machine tools, steel and nonferrous metals, ships, chemical substances, textiles, and processed foods (WikipediaJapan, 2011).

The success of Japanese manufacturing in the global marketplace has stimulated attempts to identify and understand the factors that have led to Japan's competitive advantage. Efforts by North American manufacturers to close the perceived gap with Japan have often been frustrated because of the ability of Japanese corporations to implement new technologies and introduce new products within very short cycle times (Hannam, 1990; Weirmair, 1990; Clark & Takahiro, 1989). Japan achieved sustained growth in per capita income between the 1880s and 1970 through industrialization driven by technological advancement. This trend continued till the year 1990. Moving along an income growth trajectory through expansion of manufacturing is hardly unique. Indeed Western Europe, Canada, Australia and the United States all attained high levels of income per capita by shifting from agrarian-based production to manufacturing and technologically sophisticated service sector activity (Mosk, 2004).

Japan experienced a miracle Growth as a result of a protracted historical process involving enhancing human capital, massive accumulation of physical capital including infrastructure and private manufacturing capacity, the importation and adaptation of foreign technology, and the creation of scale economies, which took decades and decades to realize (Mosk, 2004).

For three decades from 1960, Japan experienced rapid economic growth, which was referred to as the Japanese post-war economic miracle. With average growth rates of 10% in the 1960s, 5% in the 1970s, and 4% in the 1980s, Japan was able to establish and maintain itself as the world's second largest economy from 1968 until 2010, when it was supplanted by the People's Republic of China (Wikipediaeconomyofjapan, 2011).

On November 12, 2007, Tata Consultancy Services (TCS) (BSE: TCS.BO, NSE: TCS.NS), a leading IT services, business solutions and outsourcing organization, announced a series of investments in the field of embedded Systems to help Japanese corporations innovate and remain globally competitive (TCS, 2007). TCS will invest $10 million over the next 12 months for a dedicated Innovation Lab for embedded systems research in key verticals like automotive, consumer electronics, telecom, and office automation to fuel innovative solutions focused on the needs of the Japanese market (TCS, 2007). The new lab will be based in Pune, India along with a Center of Excellence in Embedded Systems in Yokohama, Japan. Girija Pande, EVP and Head TCS-APAC said that Japan, being the second largest market in terms of technology spends globally, is a key strategic market for TCS. Also as a world-class Manufacturing and Hi-Tech hub, they have identified Embedded Systems as one of the key focus areas for their growth strategy in Japan (TCS, 2007). Masahiko Kaji, President of TCS Japan said that with a significant talent shortage facing the Japanese market, TCS is investing in Embedded Systems R&D and Japan specific Delivery Center, to help their customers in

applied innovation and reducing their go-to-market cycle time. He added that these new investments underscore their commitment to Japan and eagerness to address the current market imperatives (TCS, 2007).
There is no doubt that this feat has been achieved by the people of Japan due to advancement in their technology as well as readiness to massively invest in development of newer technologies.

South African Economy
The honorable minister of science and technology in South Africa recently stressed the importance of stepping up investment in science and technology, if they are to remain competitive in a fast changing world. In her words "The funding of Science and Technology must be improved if we are to realize our ambitious national goal of building knowledge based economy. One of the areas that must be addressed is increased support for post graduate study and for senior researchers plus a more stable funding model for all our research performing institutions" (DST, 2011). South Africa is one of Africa's most developed nations. Today South Africa is following the steps of the US in trying to build a knowledge based economy where economic growth is driven by information and knowledge creation and easy transfer as provided by a strong ICT platform (Breitenbach, 2005; Wolf, 2001).
The most significant development affecting business operations in the second half of the twentieth century has been the emergence of the new economy or knowledge economy. The new economy, speaks of an economy where wealth is generated by information technology and knowledge. It is an open economy affected by globalization, rapid changes in financial markets, deregulation, the expansion of communications, innovative financial engineering, improvements in technology and increased market volatility. New economies are based on the production and distribution of knowledge (Evan, 2000).
Technological developments after the Second World War, such as the development of the transistor, microprocessors, satellites and the computer, led to new capabilities in the provision of information. The capture, analysis and dissemination of information have altered the ways in which businesses operate (Evan, 2000). The South African Government as a matter of policy supports the formation of ICT clusters in different regions (Sagren, 2003) as well as advances in science technology and innovation since it gained independence (OECD, 2000).
South Africa is the economic powerhouse of Africa, leading the continent in industrial output and mineral production and generating a large proportion of Africa's electricity.
The Gross Domestic Product (GDP) in South Africa expanded 4.8 percent in the first quarter of 2011 over the previous quarter. From 1993 until 2010, South Africa's average quarterly GDP Growth was 3.27 percent reaching an historical high of 7.60 percent in December of 1994 and a record low of -7.40 percent in March of 2009 (Tradingeconomics, 2011). South Africa has a two-tiered economy; one rivaling other developed countries and the other with only the most basic infrastructure. It is therefore a productive and industrialized economy that exhibits many characteristics associated with developing countries, including a division of labor between formal and informal sectors and an uneven distribution of wealth and income. The primary sector, based on manufacturing, services, mining, and agriculture, is well developed (Tradingeconomics, 2011).
Not only is South Africa itself an important emerging economy, it is also the gateway to other African markets. The country plays a significant role in supplying energy, relief aid, transport,

communications and investment on the continent. Its well-developed road and rail links provide the platform and infrastructure for ground transportation deep into Africa.

Conclusion and Recommendations

The investigation carried out points to one fact: better technology then better economy. Every other factor like population strength (e.g China), natural resource endowment, etc only rides on developed technology. Embedded systems form the bedrock of most technology systems found today. This means that developing embedded systems technologies will provide the platform for other technologies to thrive. Nigeria as a nation has lots of advantages such as abundant human capital, natural resource endowment, good climatic conditions, etc. By summoning the will to have and implement policies to develop our indigenous embedded systems technologies (through massive investment in research and development as well as collaboration between academia and the industry), we will see unprecedented growth in our economy. This is how it happened in the US, the UK, Germany, China, Japan and even South Africa. We must take the same steps if we are to get the same results. It is therefore very clear that Nigeria must invest massively in embedded systems research if she must be among the first 20 world economies by the year 2020.

The following are some recommended steps the nation should take to develop embedded systems technologies in Nigeria:

1. Have at least 10% of the nation's budget invested in Research and development
2. Encourage inflow of technologies into the country by rewarding those who return with new technologies.
3. Encourage development of new and indigenous local technologies when identified.
4. Establish and fund research and development centers on embedded systems design and development
5. Provide the platform for a sound technical education right from primary to tertiary levels.
6. Fight corruption at all levels.
7. Provide the platform for technological breakthroughs to be transformed into products and services by creating a cordial collaboration between the academia, research institutes and the industry.
8. Invest in provision of basic infrastructure such as Power supply, good roads, etc.
9. Improve on the present security situation in the country.

By taking these steps, we will advance speedily on our journey to fulfilling vision 20:2020

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