

EMERGENCE OF INTEGRATED CIRCUIT AS A MEANS OF DEEPENING DEVELOPMENT IN ENGINEERING IN ERA OF GLOBALIZATION

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ABSTRACT: *One of the solid-state (semiconductor) devices utilized in electronics is integrated circuit (IC), usually built using silicon. In this modern era characterized by globalization, integrated circuit, through its application in electronic devices and computer, serves as a means to foster development in engineering. The paper is a discussion on how emergence of integrated circuit is a means to deepen development in engineering in era of globalisation. The paper emphasized on: engineering as a resource for development, use of integrated circuit in modern electronics, and utilization of electronics in promoting development in engineering. Certain recommendations were made based on the role and value of integrated circuit (IC) used in electronics for enhancing development in engineering. The paper pointed out that integrated circuit is employed in electronic system like computer which has brought about the existence of information technology and the internet. The use of electronic systems has helped in development of engineering in era of globalization by fostering productivity, intellectual acquisition, and communication.*

Keywords: Integrated Circuit (IC), Engineering, Electronics, Computer, Globalization, Development

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INTRODUCTION

Globalisation in the ordinary sense is to make a product or idea worldwide. It was originally seen as economic event of integrating nations together in terms of trade and financial transactions. Practically, globalisation as a process implies a worldwide interconnection among nations and peoples on virtually all fronts –

economics, finance, political, social, cultural, and environment, among others (Ozigbo, 2003). Daniel (2011) pointed out that globalisation has made it possible that in the last decade, the divisive blocks between nations and peoples have literally disappeared such that this growing worldwide integration has prompted a whole series of impact in economic, politics,

culture, environment and education – the lives of people have been linked more closely, more intensely, more deeply, more immediately than it has ever been. The effect of globalisation is not felt only in trade and finance markets. Globalisation as a concept and process that connotes interaction and interconnection among people and nations of the world in various aspect of human life also borders on scientific and technological activities. Science and technology has brought about that effects of globalisation are felt in the huge exchange of ideas, data and information. For instance, the emergence of information and communication technology (ICT) which has made the world a ‘global village’ is based on science and technology. ICT is a technology that is pivoted on electronic and computer technology. Electronics as seen in this modern era is possible due to emergence of solid state device like integrated circuit which is usually built using semiconductor material like silicon.

An essential aspect of the economy in which the emergence of integrated circuit can be very useful in this era of globalisation is engineering. Engineering is a discipline and profession that involves the knowledge and application of science and technology. Usually, science and technology

enables man understand and enjoy his natural environment; and so, engineering is a great resource for human and national development. Based on its value, engineering needs to be fostered in this era of globalisation. That can be achieved using electronics and computer which usually involves the use of integrated circuit. The paper discussed how electronics through the emergence of integrated circuit can be applied to deepen development in engineering in the modern era of globalisation. Issues the paper looks at are: engineering as a resource for development, use of integrated circuit in modern electronics, and utilization of electronics in promoting development in engineering. Recommendations that pertain to the use of IC in electronics for engineering development in era of globalisation are also stated.

Engineering as a Resource for Development

Engineering is a discipline or activity that is in between science and technology for it deals with the use of scientific principle in designing and production of materials and devices that make man feel more comfortable in his environment (Nwosu, 2010). Idowu (1992) opined that engineering is a profession in which knowledge of mathematical and natural science gained by study, experience and

practice is applied with judgment to develop ways of economically utilizing the materials and forces of nature for the benefit of mankind.

Engineering is a resource for development because it gears towards the socio-economic and technological wellbeing of human society. Engineering is vital in national development for it is anchored on science and technology. Usually, existence of scientific-based society will lead to production of people who are equipped in technology. Okorafor (2006) posited that science as the basis of technology leads to national development and any nation whose scientific and technological education is weak cannot attain great economy nor become self-reliant. Engineering has brought about technological products that foster the wellbeing of man in various area of human endeavour such as transportation, health-care delivery, food production and processing, communication, and housing. For instance, in this modern era, positive and improved human activities has occurred through the use of products of electronic engineering and technology such as radio, television, computer, telephone, video machine, calculator, and audio amplifier. Nwosu & Chijioke (2004) asserted that electronic technology has led to production of solid state devices such as diode, transistors and integrated circuits

and the devices has helped in the development of electronic systems such as computer system, communication system and security system.

Unfortunately, a lot of Nigerians do not have a value system that promotes effective study and application of engineering activities that gears towards national development (Nwosu, 2010). If Nigerians have strong focus on a value system that promotes effective study and application of engineering, people can be equipped for development in engineering. Equipping Nigerians for development in engineering require teaching and learning engineering in a practical way. Exposure only on theoretical basis is not encouraging. Active participation of human resources (engineering lecturers, government, members of the home, and the general public) is also needed for development of engineering in Nigeria. It is well known that human resource is the most vital factor – without human resource, material resources are useless. Also, it should be understood, just as pointed out by Nwosu (2010), that a resource for enhancing engineering in Nigeria is embracing of good moral. However, an essential material which can aid and lead Nigerians in development of engineering is integrated circuit (IC), which is very vital and being used in modern electronics.

Use of Integrated Circuit in Modern Electronics

Electronics is concerned with passage of electrical charges through semi-conductor materials or valves (vacuum and gas-filled devices). Chiwetalu (2004) asserted that electronics involves the study, design, construction and application of devices, whose operations are based on the conduction of electricity in vacuum (vacua), or gases or semiconductors. In this modern era, valves are rarely used; modern electronics is principally concerned with passage and use of electricity mostly in semiconductor materials and devices for technological use. Semiconductor is a material whose electrical conductivity lies between that of conductors (i.e. metals) and insulators. Semiconductor is greatly used in electronic technology as a solid state material – solid state material in an electronic system serves or behaves as a non-moving solid material in place of thermionic valves and mechanical components such as relays. There is a wide range of materials that act as semiconductor. The best known and most widely used material is silicon, followed to a lesser extent by germanium. The majority of solid-state devices, such as diodes, transistors, and integrated circuits, are made from silicon; germanium is used to make diodes and transistors; and other

semiconductor materials – particularly gallium arsenide – are used for more specialized applications (Meadows, 1978).

It can be deduced that apart from production of discrete elements, like diode and transistor, silicon is vital in production of integrated circuit (IC). Thereja & Theraja (1999) stated that an integrated circuit is a complete and packaged electronic circuit in which both the active and passive components are fabricated on an extremely tiny single chip of silicon. Botkar (2005) pointed out that an integrated circuit is a collection of discrete elements (diode, resistors, capacitors and transistors) created by means of a single construction process in which all elements are formed. IC is distinct from discrete component. Discrete component is a separate component, such as resistor, capacitor, inductor, diode and transistor, arranged or soldered on a printed circuit board. A discrete circuit (contrasted with IC) is a circuit built by connecting each component, produced separately, together to make electrical contact. In the case of integrated circuit, all the active and passive elements and their interconnections are placed on a single thin semiconductor sheet called a chip. The use of integrated circuit offers some advantages over the use of discrete components. Botkar (2005) and Theraja & Theraja (1999)

pointed out that advantages of ICs are very small size and weight, reduced cost, extremely high reliability, suitability for small-signal operation, low power consumptions, easy replacement, and improvement in speed.

By employing silicon technologies, the main component used to produce integrated circuits are resistor, diode, transistor and capacitor. In the use of silicon to produce integrated circuit, transistor is the most complicated component and all other parts are fabricated in conjunction with the transistor processes (Theraja & Theraja, 1999). The production of IC involves a bottom layer (6 mils thick) which is P-type silicon and it serves as a substrate upon which the integrated circuit is to be built. The P-type substrate which is required as a foundation for the integrated circuit is obtained by growing an ingot from a silicon melt with a predetermined number of impurities. The crystal ingot is subsequently sliced into round wafers approximately 6 mils thick, and one side of each wafer is lapped and polished to eliminate surface imperfections (Millman & Halkias, 1971). In terms of application, integrated circuit can be classified as analogue integrated circuit and digital integrated circuit. Analogue IC, also known as linear IC, performs amplification or other essentially linear operations on signal which are

continuously varying quantities such as temperature, pressure. Digital IC deals with discrete quantities (fractional number or integer) and so it handles data/information in binary digits (bits). Integrated circuits (ICs) are used in building modern computers. Miniaturization is possible in computer because of existence of integrated circuit. The ICs employed in computers are mostly digital ICs. Application of digital integrated circuit in production of computer is because of binary operations encountered in computer. The tasks usually performed by a computer are: input, processing, output, and storage. A computer system is design and built such that there are a number of interrelated elements (components) that operate together, with little or no human intervention, for the purpose of producing information from data.

The components of computer system include hardware (the physical devices and circuitry) and software (the program installed in computer). Without the software component, the computer (hardware) cannot work. An essential part of a computer is the microprocessor, also known as the Central Processing Unit (CPU). A microprocessor is an integrated circuit (a chip) having some control and logic circuits that is able to carry out logical decisions based on input data and then brings out a desired and equivalent

arithmetical and logical output. A computer with microprocessor is called microcomputer. In fact, the microprocessor is the heart of any computer and the existence of integrated circuit contribute to use of microprocessor. A microprocessor along with input/output(I/O) ports, times/counters, memory, analogue-to-digital converter/ digital-to-analogue converter (ADC/DAC), etc integrated on a single chip is a microcontroller. A microcontroller is a complete microcomputer. A microcontroller has been essentially designed for a dedicated application and hence, it is called dedicated microcomputer (Singh & Singh, 2006). The existence of integrated circuit as seen in its use in computer shows that IC is beneficial in electronics which can be applied in various field of human endeavour including engineering.

Utilization of Electronics in Promoting Development In Engineering

Development in engineering demands the utilisation of electronic media such as radio, television, telephone, audiotape, videotape, projectors, etc. These electronic media usually have integrated circuits (ICs) as part of their circuitry. The use of electronic media in engineering education can bring about better understanding of engineering academic topics. As asserted by Ukachukwu

(2003), electronic media such as television, radio, computer, transparencies and video tapes are playing a significant role in education and can be used to maximum advantage to improve instructions in classroom. Electronic media can promote practical experiences in engineering using audio-visual device like television. For example, an industrial activity or field experience relating to engineering can be broadcasted and observed in a television; and such act is educative. Also, engineering activities can be videotaped and watched within and outside school environment for an improved knowledge on engineering principles and practice. Telephone can also be used to promote development in engineering through its use in communicating issues and businesses pertaining to engineering. One of the ingredients for development in engineering activities is productivity. Fortunately, computer system, of which IC is one of its major components, is a vital technological and electronic device that can promote productivity.

Actually, a lot of manual works are globally being replaced with computer. Ekemezie (2003) asserted that the purpose of computer system is to speed up problem solving and increase productivity. Nwosu & Chijioke (2006) noted that computer is an

electronic device that makes works easier for man by accepting input data and, based on set of logical instruction called programme, processes the data with a high speed and accuracy to generate an output result. Engineers can use computer system to make their job easier. For instance, engineering designs, analysis, drawings and simulations can be done accurately, faster and with lesser stress using computer software like Computer Aided Design (CAD). Works can also become easier for people involved in engineering activities if they have healthy body through relaxation. According to Nwosu (2009), adequate relaxation of the body and mind promotes healthy living required for productivity and development. The relaxation can be achieved by using the computer for entertainment or recreational activities such as playing games, watching film, and playing music.

Computer system serves as an electronic device useful in human development of people involved in engineering activities by aiding in intellectual enhancement. That is computer system can aid in acquisition of education. Nwosu (2009) pointed out that some education packages like Computer Assisted Instruction (CAI), Computer Aided Learning (CAL), and Computer Managed Instruction (CMI) can be installed in the computer. Intellectuals (e.g. lecturers and students) in engineering can use the

education packages to obtain knowledge and skills with ease and at a convenient pace for better understanding. Computer system can also serve educational purpose useful in fostering development in engineering by using the electronic device in watching educative films on engineering principles and practices.

Existence of computer system has brought about the emergence of Information Technology (IT). Two technologies involved in Information Technology are computer technology and telecommunication technology – both technologies involve the use of integrated circuit. Information Technology makes globalization possible. Inyama (2004) pointed out that that Information Technology has transformed the human world into “global village” where people can easily communicate with one another in multimedia electronically, from any point in the globe and the technology affects socio-economic activities. Thus, information technology, as a product of electronics, can be employed in the development of engineering. A major and prominent part of IT is the Internet. Internet stands for “International Network” and it is the largest computer network such that each computer in the network can communicate one another from any part of the world, irrespective of the geographical distance. Internet is a very powerful electronic system which people concerned

with engineering can browse and get information for knowledge concerning issues, concepts, ideas and technologies relating to engineering. In fact, Internet can be used for electronic learning (E-Learning) usually employed in distance education.

Internet serves as a resource to ensure effective communication needed to deepen development in engineering. Students, lecturers, practitioners and administrators in engineering can use the internet to communication with people and organizations for vital information needed in their work and programmes. Communication can take place in the Internet using communication facilities like electronic mail (E-Mail), online phone, E-Conferencing, and E-chatting. Thus, globalization of knowledge and ideas is possible using the Internet. With the use of Internet as a resource for communication, development in engineering can be enhanced for people in engineering can stay in their classroom, offices or residences and communicate with one another without travelling; and thereby minimizing transportation hazards.

CONCLUSION

In this era of globalization, a lot of activities in human endeavour are directly or indirectly associated with engineering.

Engineering is a discipline and profession that involves science and technology; and so it is greatly employed for pleasant and comfortable life in human society. Based on its relevance, development in engineering should be encouraged, especially in developing nation like Nigeria. Electronics can be utilized as a means of deepening development in engineering. Electronics has led to production of computer and, hence, the existence of information technology (IT) that has contributed to the technological and socio-economic wellbeing in human endeavours including engineering. Advancement made in modern electronics is possible because of use of semiconductor (solid state) material like silicon in production of integrated circuit (IC). Integrated circuit is greatly used in production of electronic devices and computer system which are useful in engineering. It then implies that integrated circuit is a solid state device valuable in engineering. Thus, emergence of IC can be seen as a means of deepening development in engineering in era of globalization.

RECOMMENDATIONS

Based on the role and value of integrated circuit (IC) in enhancing development in engineering, it is recommended that:

- Engineering family should endeavour to make effective use of

electronic devices and computer in engineering activities.

- Strong researches should be carried out by science-based intellectuals concerned with material science on semiconductor devices which include integrated circuit.
- All stakeholders in educational institutions concerned with electronics should be diligent in promoting studies and researches on effective use of semiconductor devices like integrated circuit.
- Funds and financial supports should be provided by government, organizations, and wealthy individual to support and encourage studies and activities relating to use of integrated circuit in building electronic systems vital in engineering.
- Human society should have strong focus on the study and utilization of science and technology especially as it relates to use of integrated circuits and electronic systems.

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