



**DRAFT TRAINING MANUAL  
FOR  
GENERAL ENTREPRENEURSHIP COURSES IN  
UNIVERSITIES**

**COURSE 1: ENTREPRENEURSHIP AND INNOVATION**

**MODULE 4: TECHNOLOGICAL ENTREPRENEURSHIP**

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## **DRAFT MODULE 4: TECHNOLOGICAL ENTREPRENEURSHIP**

### **Learning Outcomes**

Upon completion of this module, students would have been able to:

- Explain the interface between Entrepreneurship and technology development
- Discuss how advances in technology have opened up a whole range of new opportunities for Entrepreneurial mind-set
- Examine the impact of technology on business.
- Identify new technology and entrepreneurship opportunities

### **Content**

- (a) The Interface between Technology Development and Entrepreneurship
- (b) Technological Development and Entrepreneurial
- (c) Technological Environment and Business.
- (d) New Technology and Entrepreneurship Opportunities

### **INTRODUCTION**

**Technological Entrepreneurship** according to Dorf and Byers as contained in Ndagi (2005) is a style of business leadership that involves identifying high-potential, technology-intensive business opportunities, gathering resources such as talent and capital, managing rapid growth and significant risk using principled, real-time decision making skills. Technology Entrepreneurship involves a process of industrial innovation and technology transfer, which is relevant for both independent start-ups and established corporations. Technological Entrepreneurship according to Aderemi (2008) is needed to make use of knowledge of science and technology currently available to meet market needs, thereby making the business, state or country in question more productive and more competitive locally and internationally (Abubakar,2010). Thus, techno-preneurs are entrepreneurs who used technology as their driving factor in transforming resources into goods and services, creating an environment conducive to industrial growth.

### **HAND OUT 1**

#### **AN OVERVIEW OF INDUSTRIAL REVOLUTION**

Industrial revolution refers to the rapid development of industry in Britain in the late 18th and 19th centuries, brought about by the introduction of machinery. It was characterized by the use of steam power, the growth of factories, and the mass production of manufactured goods. In 1860s, there were major changes in agriculture, manufacturing, mining, transportation, and technology which had profound effect on the social, economic and cultural conditions of the times. It began in the United Kingdom, and then subsequently spread throughout Western Europe, North America, Japan, and eventually the world.

The Industrial Revolution marks a major turning point in history; almost every aspect of daily life was influenced in some way. Most notably, average income

and population began to exhibit unprecedented sustained growth. In the two centuries following 1800, the world's average per capital income increased over tenfold, while the world's population increased over six-fold. In the words of Nobel Prize winner Robert E. Lucas, Jr., "For the first time in history, the living standards of the masses of ordinary people have begun to undergo sustained growth. Nothing remotely like this economic behavior has happened before". Starting in the later part of the 18th century, there began a transition in parts of Great Britain's previously manual labor and draft-animal-based economy towards machine-based manufacturing. It started with the mechanization of the textile industries, the development of iron-making techniques and the increased use of refined coal. Trade expansion was enabled by the introduction of canals, improved roads and railways. With the transition away from an agricultural-based economy and towards machine-based manufacturing came a great influx of population from the countryside and into the towns and cities, which swelled in population. The introduction of steam power fuelled primarily by coal, wider utilization of water wheels and powered machinery (mainly in textile manufacturing) underpinned the dramatic increases in production capacity. The development of all-metal machine tools in the first two decades of the 19th century facilitated the manufacture of more production machines for manufacturing in other industries. The effects spread throughout Western Europe and North America during the 19th century, eventually affecting most of the world, a process that continues as industrialization.

The impact of this change on society was enormous. The First Industrial Revolution, which began in the 18th century, merged into the Second Industrial Revolution around 1850, when technological and economic progress gained momentum with the development of steam-powered ships, railways, and later in the 19th century with the internal combustion engine and electrical power generation. The period of time covered by the Industrial Revolution varies with different historians. Eric Hobsbawm held that it 'broke out' in Britain in the 1780s and was not fully felt until the 1830s or 1840s, while T. S. Ashton held that it occurred roughly between 1760 and 1830. Irrespective of the timing the first and second industrial revolution actually took place and served as the foundation of modern technological development as chronologically shown on the table below:

<b>Technological Revolution</b>	<b>Approx Period</b>	<b>What the Period Represented</b>	<b>The main Technological Significance</b>	<b>Main Products</b>	<b>Remarks</b>
First	1770-1830	First Industrial Revolution	Earliest mechanization	Textiles, Chemicals, Iron castings, mechanized agriculture	We are yet to take a grip of this level of technological development
Second	1830-1880	Victorian Prosperity	Steam power railway	Steam engines, steam ships, rails, shipping	Without infrastructure, capital goods industries cannot take off.
Third	1880-1945	Great Depression or the Threshold Age	Electrical machinery engineering goods	Electrical components steel	The great depression rather than demoralize the Europeans, galvanized them into greater inventions, the third World should emulate such worthy examples.
Fourth	1945-1990	The Golden Age and Keynesian Full Employment	Fordist mass production, music/entertainment bliss. Hollywood and Hospitality Biz	Nuclear tech automobiles, trucks, tractors, aircrafts, petrochemicals etc	Having just recovered from the World War II, the world in spite of the cold war was indeed at its best, with full employment and entertainments. The music of that era is still the best no wonder some say the Cold War was a blessing in disguise
Fifth	1990 to date	Post Cold War Era	Information Technology (IT)	Space tech computers, electronics, robotics, satellites, genetic-engineering, biotech, cloning nanotech etc.	This will probably lead to the final frontier when humanity generate new knowledge to create unimagined technologies or destroy itself with negative technology such as cloning and nuclear technologies.

SOURCE: Technology is power by Sam Momah (1999)

## Handout 2:

### The Interface between Technology Development and Entrepreneurship

**Technology** is the usage of science and technical knowledge in engineering production, manufacturing in the industries and processing efficient and effective service delivery for the benefit of mankind. The components of technology are:

- a) **Machines, equipment and tools:** machine are designed to perform a particular task, usually powered, equipment and tools or instruments required for a particular kind of work or activities while tools are implement used or required for a particular trade or profession.
- b) **Techniques, methodology and strategy:** techniques is a skill in the practical aspect of an art which could as well means proficiency in an art, methodology is the system of methods, principles and above all procedure used in a particular activities while strategy is the means adopted to achieve organizational or individual objectives, goals and set targets.
- c) **Know-how, skills and competence:** Know-how is specialized skills. Skill is talent or gift naturally acquired or developed through training and competence. It is a capability or training to do something efficiently. To successfully utilize technology, machines, techniques and skills are required. The big question now is who is an entrepreneur that requires machines, techniques and skills and above all where, when and how can he/she source these components of technology.

**An entrepreneur** is a person who is willing and able to convert a new idea or invention into a successful innovation or a person who organizes and operates a business or businesses, taking on greater than normal financial risks in order to achieve the desire objectives. The word entrepreneur according to Stokes (1998) was derived from a French vocabulary meaning some one who goes between i.e. middleman. This is because in the early ages entrepreneurs are seen as those who managed projects on behalf of the actual owners. In the early 1800s, a French economist wrote that an entrepreneur is someone who consciously moves economic resources from an area of lower productivity into an area of higher productivity and yield. David Stokes sees this definition and explains an entrepreneur as an instrument of change, someone who does not seek to protect or optimize existing ways of doing things but searches instead for a new and different ways of doing things.

Schumpeter, (1942) observed that entrepreneurship resulted in new industries but also in new combinations of currently existing inputs. Schumpeter's initial example of this was the combination of a steam engine and then current wagon making technologies to produce the horseless carriage. In this case the innovation, the car, was transformational but did not require the

development of a new technology but merely the application of existing technologies in a novel manner. It did not immediately replace the horse drawn carriage, but in time, incremental improvements which reduced the cost and improved the technology led to the complete practical replacement of beast drawn vehicles in modern transportation.

**Entrepreneurship** is the act of being an entrepreneur, which can be defined as one who undertakes innovations, finance and business acumen in an effort to transform inventions into economic goods through innovations. This may result in new organizations or may be part of revitalizing mature organizations in response to a perceived opportunity. The most obvious form of entrepreneurship is that of starting new businesses (referred as Startup Company).

### **THE ROLES OF AN ENTREPRENEUR**

There are three basic roles of entrepreneurs, these include:

- a) **The Innovator:** She/he turns creativity into reality. The entrepreneur as innovator produces new things or creates new ways of doing things. Many innovators are obsessive or single-minded about their invention.
- b) **The promoters:** He/she is concerned more about how to develop the innovation into a viable and successful business proposition.
- c) **The Catalyst:** He/she facilitates the functions of the innovator and the promoter by
  - i. Identifying opportunities for innovation
  - ii. Identifying new business opportunities
  - iii. Commits resources to exploit these new opportunities
  - iv. Takes a personal risk whether in financial or status terms
  - v. Contemplate and accept the consequences of failures.

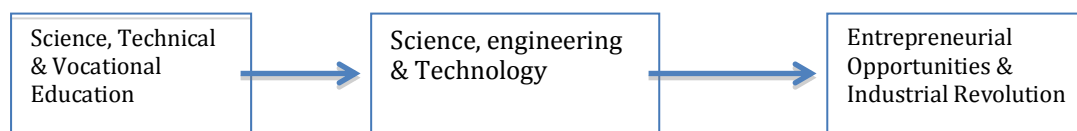
### **THE INTERFACE**

The interface between technology development and entrepreneurship was in the early twentieth century when Schumpeter popularized entrepreneurship. He argued that entrepreneurship is a disequilibrating phenomenon rather than an equilibrating force. He further proposed a theory of creative destruction, where new firms with the entrepreneurial spirit displace less innovative incumbents, ultimately leading to a higher degree of economic growth. In his book *Capitalism, Socialism and Democracy*, Schumpeter (1942, p.13) further argued that entrenched large corporations tend to resist change, forcing entrepreneurs to start new firms in order to pursue innovative activity. This resulted in to what is referred to by Peter Drucker as TECHNO-PRENEUR known as Technology value added entrepreneur.

## **2. TECHNOLOGICAL DEVELOPMENT AND ENTREPRENEURIAL OPPORTUNITIES**

Technological development starts from the teaching of introductory sciences and integrated sciences at the junior secondary school level while introduction to basic sciences starts at the senior secondary school level. The basic and applied sciences are at the tertiary level while designs, models and pilot plants are the advanced level of the applied research results being promoted

by the Research Institutions. At this level, the research results are ready for full commercialization by entrepreneurs.



**Science, Technical and Vocational Education** is a comprehensive term referring to those aspects of the educational process that evolved in addition to general education. It represents the study of technologies and related sciences and the acquisition of practical skills, attitudes, understanding and knowledge relating to occupations in various sectors of economic and social life.

**Science** is the intellectual and practical activity encompassing the systematic study of the structure and behavior of the physical and natural world through observation and experiment.

**Technical Education** is that branch of education designed at upper secondary and lower tertiary levels to prepare middle level personnel (technicians, technologists, middle management etc.) and at University level to prepare engineers for higher management positions.

**Vocational Education** is designed to prepare skilled personnel at lower levels of qualification for one or group of occupations, trades or jobs. It is usually provided at upper secondary level, which includes general education, practical training for the development of skills required by the chosen occupation and related theory.

The proportions of these components may vary considerably but the emphasis is usually on practical training within the framework of lifelong education.

**Entrepreneurship Education** is teaching Students how to start and run their own businesses; it also help prepare students for self-employment by the time they leave schools. The practical training is focused on production (Industrialization) and trading (Commerce).

**Techno-preneurs** are entrepreneurs who used *TECHNOLOGY* as their driving factor in transforming resources into goods and services, creating an environment conducive to industrial growth. It is also regarded as a special type of entrepreneurship involved in delivering an innovative hi-tech product (e.g. Apple, Microsoft etc) or makes use of hi-tech in an innovative way to deliver its product to the consumer (e.g. amazon.com, ebay.com etc)

**Science, Engineering and Technology:** The three disciplines are so symbiotically linked that none can amply exist without the three to survive and flourish. In a simple definition, according to (Momah 1999) Science simply tells us WHY things happen, Engineering tells us HOW things happen while Technology makes things happen.

**Engineering** is the branch of science and technology concerned with the design, building, and use of engines, machines, and structures. An engineer

is a person who designs, builds, or maintains engines, machines, or a person, who qualified in a branch of engineering.

### **ENTREPRENEURIAL OPPORTUNITIES**

Technology presents unique opportunities to entrepreneurs within a business environment. In fact, it is only real entrepreneurs that see opportunities as result arising from technological development. Opportunities present are present in following forms:

- a) **Adaptation:** A prospective entrepreneur/industrialist can adapt or imitate other business innovators. This is easily done when there is no patent right for a particular invention or when the rights have lapsed.
- b) **Rapidly expanding market:** Existing firms may not be able to serve adequately a market which is rapidly expanding as such a prospective entrepreneur/industrialist may take advantage of such technology and venture into business thereby taking up market niches that may be left as a result of expansion.
- c) **Government/Private Patent:** That is taking advantage of either government or private patent that may be available either on royalty or royalty free basis.
- d) **Research results:** Results of both applied or development research can be acquired (sometimes free) for a starter either for a pilot plant project or try and error basis from government agencies, research institutes and tertiary institutions.
- e) **Analysis of Government policy statements:** opportunities may arise from government budgets and plans especially in respect of areas of policy change in favour of technology support or new investment. Also, business ideas can arise from analysis of private companies' annual reports with regards to areas of linkages with Small and Medium Scale Enterprises.
- f) **Visit/inquiring from Government agencies:** (NDE, NAPEP, SMEDAN, TIC, etc.) and marketing research and consultancy firms, constant readings of industrial columns and publications
- g) **Franchising with business association:** such as NASSI, NASME, NACCIMA, and MAN etc.
- h) **Failed Company or product:** The failure of certain companies or products gives room for a prospective entrepreneur/industrialist to venture into serving the unserved market that has been left behind due to the failure of such company or product.
- i) **Brainstorming:** Business ideas can be stimulated through brainstorming techniques; it could be group of friends, colleagues or relations. The usual brainstorming group consists of (2-5 or 5-10) and the brainstorming session should not last more than 1-2 hours. During the session as many ideas as possible should be encouraged and there should be no room for evaluation yet until many ideas have been generated before then another day for evaluation will be fixed. It is



always better for the prospective entrepreneur/industrialist to lead and moderate the discussion during the brainstorming session

- j) **Inquisitive/seeking for information:** The prospective entrepreneur/industrialist is encouraged to be inquisitive and ask as many questions as possible.

## **TECHNOLOGICAL ENVIRONMENT AND BUSINESS**

This consist of those factors relating to knowledge being applied, the materials and machines used in the production of goods and services that have impact on the business of an organization. These include:

- a. **Sources of Technology:** the company sources, external sources, foreign sources, cost of technology, acquisition, collaboration in and transfer of technology.
- b. **Technological Development:** stages or changes in the rate of technological development, rate of research and development.
- c. **Impact of Technology on Human Being:** the man-machine system and the environmental effects of technology e.g. pollution.
- d. **Technology infrastructure:** Communication, transportation, energy technology, training and management institutions.

Technological changes involve invention and innovation and how it affects, alters and modifies business operations. Entrepreneurs should therefore not be concerned with technology per se, but with technological changes and its accelerated pace. The Entrepreneur must always be in search of ways of improving his goods and services. Thus, technological changes may lead to capital saving or labour saving, cost reducing or demand creating innovations which according to Schumpeter, can be achieved in one of the following ways:

- a) Introduction of a new production method
- b) Utilization of a new source of raw material
- c) Introduction of a new product including quality improvement
- d) Opening up of new markets

Technological environment has direct impact on the general business environment. Business analysis can be done to identify the Key Factors for Success (KFS) in the sector and then use these to focus the analysis on particular environmental concerns.

- a. The Key Factors for Success are those resources, skills and attributes of the business in the sector that are essential for delivering success in the market place.
- b. When undertaking analysis of the business, the identification of the KFS for the sector may provide a useful starting point e.g. KFS of “low labour costs” would suggest an environmental analysis of the following areas:
  - i. General wage level in the country

- ii. Government's regulation towards labour
- iii. Labour militancy
- c. To identify the KFS in a particular business sector, it is normal to examine the type of resources and the way they are employed
- d. The stratification of the specific functional areas for analysis of any business depends on the product type, business size and age. Most a time the functional areas are:
  - i. Operations
  - ii. Personnel
  - iii. Market
  - iv. Finance
  - v. General Management

## **HAND OUT 4**

### **NEW TECHNOLOGY AND ENTREPRENEURSHIP OPPORTUNITIES**

NEW means not existing, before introduction or discovered recently or now for the first time; New ideas means novel, original, imaginative, creative, experimental, contemporary or futuristic thoughts and concepts while New technology means recently developed, up to date, latest, current, state-of-the-art, advanced, modern, cutting-edge or leading-edge practical application of science and technical knowledge.

The emergence of new technologies, inventions and innovations to a large extend depend on the effort and sacrifices of researchers who worked day and night brainstorming on new ideas, concepts and inspirations resulting in the creation of new entrepreneurship opportunities. The researchers do a lot of research to arrive at the desire results, what then is RESEARCH?

**Research** is the systematic investigation into and study of materials and sources in order to establish facts and reach new conclusions through experimentation, testing, analysis, fact-finding, fieldwork, examination etc. Development is the process of developing new and refined product or idea through forming, establishment, initiation, instigation, origination, innovation, and generation from one stage to another. It is the development of the established facts based on research that ultimately resulted in the new technologies that created that envisaged entrepreneurship opportunities.

Some of the new technologies are:

**a) Information Communication Technology:** the study or use of systems (esp. computers and telecommunications) for storing, retrieving, and sending information. The proliferation of the availability of information and the accompanying changes in its storage and dissemination owing to the use of computers and the communication over a distance by cable, telegraph, telephone, or broadcasting is severally referred to as information revolution, computer age, jet age etc. This new information communication technology created entrepreneurial opportunities in the marketing, cloning and processing of hardware and software. The youths all over the world have since taken advantage of this entrepreneurial opportunity.

- b) **Biotechnology:** the exploitation of biological processes for industrial and other purposes, especial, the genetic manipulation of microorganisms for the production of antibiotics, hormones, etc. this biological processes of exploitation and manipulation are equally used for small scale farming of all sorts to produce genetically modified produce like mushroom, cassava, yam, legumes, apples etc. These are new entrepreneurship opportunities for students and young graduates.
- c) **Nano technology:** the branch of technology that deals with dimensions and tolerances of less than 100 nanometers, especially the manipulation of individual atoms and molecules. Nano technology present a new frontier for entrepreneurship opportunities in the areas of nano second measurement, nano robots development, nano bacteria identification, nano structure formation, laser ray usage in the medical sciences etc.

#### **HAND OUT 5: INSTITUTIONS SUPPORTING TECHNOLOGICAL ENTREPRENEURSHIP**

There are various organizations in Nigeria that support technological entrepreneurship. Among them are:

- a) **TECHNOLOGY INCUBATION CENTERS (TIC):** Established across the country to facilitate scale-up and commercialization of R&D results, technologies and Inventions through provision of integrated facilities, infrastructures and other business support services for a period of three years to over come some initial challenges in start-up enterprises.
- b) **NATIONAL OFFICE FOR TECHNOLOGY ACQUISITION AND PROMOTION (NOTAP)** Established in 1979 with headquarter in Abuja to primarily strengthen national capabilities for the negotiation, acquisition and promotion of technology. To also guide intellectual property right and patenting of new technologies, inventions and innovations through monitoring of technology acquisitions and transfer agreements
- c) **RAW MATERIAL RESEARCH AND DEVELOPMENT COUNCIL (RMRDC):** Established in 1987 to facilitate research, promote the development and use of local raw materials in the country. General supports and expedites industrial development and self- reliance through the maximum utilization of local raw materials as inputs for industries operating in the country.
- d) **FEDERAL INSTITUTE OF INDUSTRIAL RESEARCH, OSHODI (FIRRO):** Located in Lagos was established to conduct research into food processing, Agro-allied, Textiles, Pulp and paper design and fabrication of prototypes and microelectronics.

## **CONCLUSION**

Consistency, technological development over the years has systematically increased technological entrepreneurship and subsequently increased entrepreneurship opportunities. The success of technological entrepreneurship is through innovation and commercialization. Innovation and commercialization of technologies is an opportunity for Technopreneurs. Today, many new small firms are in the business of providing information services. A key area in the formation of new ventures in the 1980s has been in computer and business services. Since the industry is relatively young, the enterprises involved tend to be small. There was an upsurge in the numbers of companies supplying and servicing the new products of that era which include motor cars, radios and other electrical/electronic goods, chemical and pharmaceutical products. As these industries matured and consolidated into fewer, larger organizations in the later part of the century, new technology provided the opportunity for new enterprise to develop and spread once again. This cyclical view of industrial development infers that the new businesses of today will tend to amalgamate into larger units as markets mature. New technologies developments give rise to new market, which shift the balance towards small businesses again. Finally, it is instructive to note that a sound foundation for education is critical to exploiting technological opportunities. Hence, Nigeria should address the weaknesses in its educational sector in order to be in the position to benefit from the globalize world which is powered by technology and innovation.

## **QUESTIONS**

1. Define technology and briefly discuss the three components of technology
2. Briefly discuss any technological development and the entrepreneurial opportunities it present for techno-preneurs.
3. What is the importance of technological environment to a technology based business?
4. What are the opportunities presented by ICT as a new field of technology?

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