BASIC DEFINITIONS/CONCEPTS

A. **Development**

Dudley Seers (1969) explanation of Development; the questions to ask about a country's development are (therefore); what has been happening to **poverty?** What has been happening to **unemployment?** What has been happening to **inequality?** If all three of these have declined from high levels, then beyond doubt this has been a period of development for the country concerned. If one or two of these central problems have been growing worse, especially if all three have, it would be strange to call the result "development", **even** if per capita income doubled.

Sen (1983) considers the process of economic development as the process of expanding the **capabilities** of people. In other words development is mainly concerned with what people are capable of doing or being.

Economic development therefore, involves:

(1) **increases in per capita income;**
(2) **changes** in the **techniques** of production which lead to efficiency and increased output per head;
(3) **changes** in the **composition** of **output**
(4) **changes** in the **pattern of demand**
(5) **changes** in the **distribution** of **income;**
(6) **Changes** in the **values, attitudes and institutions.**
(Simply, economic development means economic-growth plus change).

NB. Poverty reduction is a political choice core value of development

(a) sustainance (life)
(b) self esteem – dignity & respect
(c) freedom – freedom of choice

NB. An economy that does not learn is an undeveloped economy.

NB. When you are poor you choice set is limited.

Objectives of Development

Goulet (1971) distinguishes three basic components/core values of development, which he calls **life-sustenance, self-esteem and freedom.**

The three main objectives of development are:

1. to increase the **availability and widen** the distribution of basic life-sustaining goods such as **food, shelter, health and protection;**
2. to raise the levels of living – for example higher incomes, provision of more jobs, better education to enhance material well-being and generate **greater individual and national self-esteem;**
3. to expand the range of economic and social choice of individual and nations by freeing them from **servitude** and dependence not only in relation to other people and nation-states but also to the forces of ignorance and human misery.

B. Science

This refers to the pursuit of **objective knowledge** gleaned from **observation.** Thus, the term refers to a **method** (systematically acquiring and evaluating information) and a **goal** (identifying

the nature or governing principles of what is being studied) rather than to any particular phenomenon. **(Neale and Liebert, 1980).**

The foundation of the scientific approach refers to any activity that systematically attempts to gather evidence through observations and procedures that can be separated and verified by others.

C. Technology

Technology simply refers to the "method for transforming inputs into

(1) Products and the proceduring and organizational arrangement for carrying out the transformation" (**Sahlman, Bruce-Larsen and Westphal, 1985).**
The three basic elements are: information about the **method;** means of using the method to undertake the transformation and understanding **how and why** the method works.

(2) The Technology Atlas Project Team **(1984)** disaggregates a firm's technology into your interlocking-disembodiment – disembodiment forms;
   (a) Object – embodied form ("technoware") which includes tools, intermediate goods, products, physical equipment, machinery etc.
   (b) People – embodied form – "humanware" which refers to understanding, capacity for systematic application of knowledge, know how, specialized ideas, problem-solving capacity etc.
   (c) Document-embodied form – "infoware" dealing with knowledge about physical relationship, scientific/or other form of organized knowledge, principles of physical and social phenomenon, technical information, specifications, standards, computer software etc.
   (d) Institution-embodied form – "orgaware" includes organization of work assignment, day-to-day operations of production, social arrangement, organization of product, tools and devices for use by people, inter-and-intra firm networking, linkages etc.

(3) Technology refers to the **"skills, knowledge and procedures for making, using and doing useful things". (Mernill, 1968).**

(4) What is technology? **Smith (2002).**

Answers as follows: Firstly, technology involves **knowledge** related to production: It implies **understanding** and **competence** relevant to material transformation. This knowledge can range from abstract scientific knowledge – codified and widely available – concerning the properties of nature, through to engineering "know-how" or operative skills. Secondly, technology involves **organization:** at the most direct level, this means the management and coordination systems which integrates individual activities and through which production takes place, or through which pubic-sector-activity is organized. Thirdly, technology involves **techniques:** i.e., machines, tools or other equipments with their rules and procedures of operations and their ancillary activities such as maintenance, repair, training etc.

Technology can therefore be though of as the integration of **knowledge, organization** and **technique.** However, there is a further essential aspect; technology is produced by and exists within **social framework.** The social system makes economic and political choices which

influence the development and spread of technologies, and which – through education and general culture – develop the skills needed to operate technologies. (Social values and decisions thus shape the path of technological development. It seems apparent that differences in technological performance between societies have at least some of their roots in social structure and cultural forms, although how these differences operate is as yet far from clear).

Classification of Technology

This is based on **Khalil, T. (2000).**

1. **New technology:** A new technology is any newly introduced or implemented technology that has an explicit impact on the way a company produces products or provide service, e.g.
   - **(a)** a new computer software introduced to develop engineering drawings and this replace manual drafting;
   - **(b)** an internet website designed to market the company's product. The technology does have to be new to the world, only new to the company. It could have been developed years ago and used by others. But it is classified as new whenever introduced for the first time in a new situation.

2. **Emerging Technology:** An emerging technology is any technology that is not yet fully commercialized but will become so. It may be currently in limited use but it is expected to evolve significantly, e.g. genetic engineering.

3. **High Technology:** The term "high tech. (Hi-Tech) refers to advance or sophisticated technologies. A company is classified as Hi-tech if:
   - **(a)** it employ a highly educated people (scientist and Engineers),
   - **(b)** its tech is changing at a fast rate,
   - **(c)** it competes with tech. innovation.
   - **(d)** It has high levels of research-and-development expenditure (R&D exp.) (A general guide is that, the ratio of R & D expenditures to sales is 1:10 or twice the average for the industry).
   - **(e)** It has the potential to use tech. for rapid growth and its survival is threatened by the emergence of competing tech.

   Some Hi-Tech companies may be working with tech. that are "pushing the envelop". These technologies may be refer to as "SUPER-HI-TECHS"

4. **Low Technology:** the term "low tech" refers to technologies that have permeated large segments of human society. Low technology are utilized by a wide variety of industries having the following characteristics:
   - **(a)** they employ people with relatively low levels of education and skills.
   - **(b)** They use manuals or semi-automated operations.
   - **(c)** They have low levels of R&D expenditure (below industry average)
   - **(d)** The technology used is stable with little change.
   - **(e)** The products produced are mostly of the types that satisfy basic human need, such as food, shelter, clothing and basic human services.

5. **Medium Technology:** Medium technology comprises a wide set of technologies that fall between high and low technologies. It usually refers to mature technologies that are more amenable than others to technology transfer. Examples of industries in this category are consumer products and automotive (automobile).

6. **Appropriate Technology:** The term "Appropriate Technology" is used to indicate a good match between the technology utilized and the resources required for its optimal use. The technology could be of any level-low, medium or high. Using the appropriate level of technology results in better use of labour resources and better production efficiency.

7. **Codified Vrs Tacit Technology:** technology can be preserved and effectively transferred among users if it's expressed in a coded form. An engineering drawing is a coded form. **Tacit knowledge** is non articulated knowledge. It is usually based on experiences and therefore remains within the minds of its developers. The tech. developers are the ones who have the know-how in question. Tacit knowledge is transmitted by demonstration or observation, followed by assimilation by those who seek the knowledge.
   Transfer of Tacit tech. occurs by close contact and interaction between the source and the host. E.g. apprenticeship programmes. **Codified technology,** on the other hand, allows people to know how technology works but not necessarily why it works in a certain way. Transfer of technology is easier when the technology is in a codified form. It is harder, less precise, and more time-consuming to transfer tacit technology. A complete mastery of the technology requires an understanding of both the explicit codified knowledge and the non explicit tacit knowledge.

Technology Evolution (characteristics)

It is important to present at the outset, the broad continuum of conceptualizations of technology. It emphasizes that technology cannot be separated from the economic and social context out of which it evolves, and which is respectively for its production and its use. In turn, the social and economic context is shaped by the technology that are produced and used. And through technology humans have acquired powerful capabilities to transform their natural environment locally, regionally and more recently globally.
The circular nature of the feedback loops affecting technological development cannot be stressed too much. All the numerous technology studies of (20^{th} share one conclusion: it is simply wrong to conceptualized technical evolution according to a simple linear model, no matter how appealing the simplification. Technical evolution is neither simple nor linear.
Following **Grübler (1998),** its form most important distinctive characteristics instead that it is **uncertain, dynamic, systemic and cumulative.**

(i) **Uncertainty** is a basic fact of life, and technology is not exception. The first source of technological uncertainty derives from the fortunate fact that, there always exists a variety of solutions to perform a particular task. It is always uncertain which solution might be **"**best**"**, taking into account **technical criteria, economic criteria and social criteria.** Uncertainty prevails at all stages if

technological evolution; from initial design choices through success or failure in the market place, to eventual environmental impact and spin-off effects. The technical and management literature labels such uncertainly **"a snake pit"** problem.

It is like trying to put a particular snake out of a pit of hundreds that all looks alike. Others use the biblical quote **"many are called, but few are chosen".** Technical uncertainty continuous to be a notorious embarrassment in efforts to forcast technical change. But there is also nothing to be gained by a strategy of **"waiting until the sky clears".** It will not clear until, uncertainty will persist, and the correct strategy is experimentation with technological variety. This may seem an **"inefficient".**

(ii) **Technology is dynamic:** it keeps changing all the time. Change includes a continuous introduction of new varieties or "species" and continuous subsequent improvement and modifications. The varying pace of these combined changes is a constant source of excitement (an over optimism) on the one hand, and frustration (or pessimism) on the other. As a rule, material component of technology changes much faster and more easily than either its non-material component or society at large. The main factors governing technology dynamics are: first, the **continuous replacement of capital** stock as it ages and economies expand and second, the most important, **new inventions.**

(iii) Technology **evolution is systematic:** it cannot be treated as a discrete, isolated event that concerns only one artifact. A new technology needs not only to be invented and designed, but it needs to be produced. This requires a whole host of other technologies. And it requires infrastructures. A telephone needs a telephone network; a can needs both a road network and a gasoline distribution system and each of these consist of whole bundles of individual technologies. This interdependence of technology causes enormous difficulties in implementing large-scale changes. But it's also what causes technical changes to have such pervasive and extensive impacts **once** they are implemented.

(iv) **Technology Change is Cumulative:** changes built on previous experiences and knowledge. Only in rare cases is knowledge lost and not reproducible. A new artifact like a new species is seldom designed from "scratch". (The beginnings of the space programme are notable exceptions), hence, technical knowledge and the stock of technology in use grow continuously.

Invention, Innovations and Diffusion

Schumpeter distinguished three important phases in technology development; **invention, innovation and diffusion.**

Invention: This is "wither a concept or the creation of a novel technology. It could be a product, a process, or a previously unknown system" (**Khalil, 2000: 32).** The steam engine, the transistor and the Xerox (photocopying) machine are examples of important inventions. A new composite material, a newly manufactured product and a new process, constitute inventions. The word

"new" here implies new to the world. Inventions occur as a result of human ingenuity and imagination. They occur only sporadically, sometimes happening by chance or through trial and error to satisfy a need. In modern times, most inventions have followed scientific discoveries e.g. inventions in the nuclear field followed Einstein's discovery of the relationship between mass and energy in the early 1990s. There is usually a time-lagg between scientific discoveries and inventions. Even though many inventions are generated by creative people and many of them are patented, only few reach the market place.

Innovation: This is defined as the point when "a newly discovered material or a newly developed technique is being put into **regular production** for the first time, or when an organized market for the new product is first created" **(Mensah, 1979:123).** Innovation involves "the creation of a product, service or process that is new to an organization" **(Khalil, 2000:33)**. It is the introduction into the market place, either by utilization or by commercialization of a new product, service or process. It does not have to be new to the world; rather, it is viewed as the first use of an idea within an organization, whether or not the ideal has been adopted by other organizations ahead. The technology (or the product) need not be novel or ground-breaking. An innovation may be a change in industrial practice, which improves productivity **Schumpeter (1928)** defined successful innovation as "a task sui generic", a feat not of intellect but of will. The innovation process involves integration of existing technology or inventions to create a new or improved product, process or system.
Inventions and innovations are intimately related; however, they are not the same. An invention can be thought of as an **invent,** while innovation can be thought of as **process.** Inventions are not as common and are invention usually precedes a number of innovations. Innovation represents the important between an ideal and its exploitation or commercialization.

Types of Innovation
A distinction is frequently made between **process and product innovation.** The former refers to new methods of production, e.g. The Bessemen process of raw steel production. The latter refers to directly useable technical handware, e.g. consumer products such as video recorders and CD-players.
Innovations can be classified either on **radial or revolutionary; or as incremental or evolutionary; innovations.** Radical break through innovations are usually based on an invention. They change or create new industries. They are relatively rare and typically start outside the boundaries of a firm. When they are developed within the boundaries of a firm, they signify the introduction of something that is not only new to the organization but drastically different from its existing practices. (An invention such as the transistor, which was invented at Bell Laboratories, was the starting point of a phenomenal development in the electronics industry triggering radical innovations in many companies).
The other category of innovation comprises the **incremental or evolutionary** innovation. These are small but important in a product, process or service. They are relatively common and are created within the firms of an industry. They help companies maintain a competitive position n the market place. **Japan's Kaizen philosophy;** a process of continuous improvement is applicable to this type of innovation, which can bring a significant improvement in the operations of existing enterprises.
Routine innovation is another term sometimes used to refer to the introduction of something that is new to an organization but very similar to what it had in the past.

Diffusion is the process by which an innovation is communicated overtime, through certain channels to members of a social system **(Rogers, 1995).** The term "innovation" is frequently used in the diffusion literature as been synamous with "technology". Adoption of a certain type of technology in solving a perceived problem….. Information about an innovation reaches a potential adopter through communication channels. There are many channels for communicating new ideas to potential users, including **inter-personal channels and mass media.** The rate of adoption of an innovation by a social system is dependant on the following factors;

(1) **The degree** to which the innovation is perceived to be offering **better advantage** than does existing practice; an example is an innovation that offers a less expensive method of producing a product.
(2) The degree to which the innovation is **compatible** with the **values and needs of users:** e.g. of an incompatible innovation is a new product that may produce pollution in an environmentally sensitive community.
(3) The degree to which the innovation is considered **complex and difficult to use:** eg. A new process that requires a great deal of effort in re-training employees and has a high cost of implementation.
(4) The degree to which the innovation can be **introduced on a trial bases** fore users must fully commit to its adoption: e.g. a new drug that physicians can use on a limited trial bases before prescribing it to all patients. Free samples of drugs given to physician's permits them to do so.
(5) The degree to which the innovation is seen and its **results** are observed by **potential users:** e.g. a small satellite dish for T.V. viewing. As people see it in use and observe their neighbours satisfaction, with its performance, they are more likely to be willing to use it.

NB: **Innovations that are perceived** by individual as having greater **relative advantage, compatibility and less complexity and that can be tried and observed** will be adopted more rapidly than other innovations **(Rogers, 1995)**

Technology: History/Technology Clusters: This section provides a historical overview using an organizing concept of technology, "families" or "clusters".

NB. **A technology cluster** is a bet of interrelated technological and organizational innovations whose pervasive adoption **drives** a particular period of economic growth; **productivity increases, industrialization trade, and associated structural changes.**

At any given time economic growth is driven primarily by the dominant technology cluster, which is frequently associated with the most visible technological artifact or infrastructural system of the time. But is impossible for a single leading sector, or a few individual industrial or infrastructural innovations to account fully for growth, important as they might be. Only the combination of many innovations in many sectors and technical fields into entire technical fields into entire technical families/clusters can adequately account for overall economic growth and the expansion of human activities. Thus, we emphasize the concept of technology clusters because any dominant individual technology or infrastructure studies under the leading sector hypothesis can explain only a fraction of economic growth.