Technology and Technological systems

Technology can been defined as the purposeful application of scientific knowledge or information in the design, production, and utilization of goods and services, and in the organization of human activities. The words "Technology" and "Innovation" are inextricably interrelated to the point where people tend to think of the two as being synonymous, yet they are not the same as one depends on the other. Technologies can be categorized in the following ways:

1. Tangible technologies: Such as blueprints, models, operating manuals, prototypes.
2. Intangible technologies: in terms of consultancy, problem-solving, and training methods.
3. High technology: Those that are entirely or almost entirely automated and intelligent technologies that manipulate ever finer matter and ever powerful forces that operate at the micro process level not easily seen by the naked eye. Such examples include the computer system, the internet, the mobile phone, the spacecraft etc
4. Intermediate technologies: Those that are semi automated and partially intelligent, that manipulates refined matter and medium level forces. These include the television, radio, locomotives
5. Low technology are those that manipulates only coarse or gross matter and weaker forces such as the pen or pencil, which write but involve some level of manual labor or the bicycle which use gross matter and a great level of manual manipulation.

Technologies are either invented or improved upon to solve existing human problems and make life easier. For example the aircraft made movement between countries possible within a short time, while the internet connected the world in real-time way that was never even remotely

thought to be possible, thus making the world a global village. The invention of new technology can be applied in many fields. Technology makes production factors more efficient. For example, technology in painting can make painters paint more spaces in a given time period which shifts production function and makes them more money. The same technology can make more interesting patterns that attract more customers which translates to greater value, more revenue and higher profits.

scholar Teece David (1985) notes that when we think about 'great inventions' or 'great innovations' we tend to think primarily about the impact of the innovation, but that impact was rarely if ever fully anticipated at the time the innovation was first introduced. There are many examples of inventors failing to recognize the potential of their ideas in terms of their potential impact in the market or society, which means that they never really benefited from the full value of the inventions. Alexander Graham Bell, for example, is reported to have thought that the telephone can be used to call ahead to the next town to tell them that a **telegram** was coming (how funny!). This seems absurd, but largely because we think of technology as unchanging – Bell's telephone should not be compared with the telephone systems of today. By then it was a rudimentary product that formed the basis of the telephone that we know today

Another reason why some notable technological advances are not adopted to any great extent is because 'mainstream technologies' are often cumulative and 'path dependent' - they build upon one another due to the evolving human problems. For example, consider why Vodafone decided to launch Mpesa in Kenya instead of the UK where their head office is. Or the reason why mpesa failed to take off in many countries in Africa, yet took off so well in Afghanistan some radical technologies are overlooked initially because they imply too much disruption to the existing systems or because supportive infrastructures are missing at that point in time. For example, the idea of the Mpesa could have been conceived much earlier than thought but could not be developed fully until the mobile phone system was functional as that is the platform upon which it rests. And Kenya would not rank among the technological giants in Africa if it wasn't for the entrepreneurial intuition of Michael Joseph and his team, or the mobile wars of the early 2000s.

Application of technology

Technology is applied daily on almost everything we do in our lives, we use technology at work, we use it to extract materials , we use technology for communication, transportation, learning, manufacturing, creating artifacts, securing data, scaling businesses and so much more. In this applied form, technology becomes human knowledge which involves tools, materials and systems; the application of technology results in artifacts or products with far reaching effects and impacts on the society. If technology is well applied, it can benefit humans, but if it is wrongly applied, it can cause harm to human beings as well.

Many businesses today use technology to stay competitive; they create new products and services using technology, and they also use technology to deliver those products and services to their customers on time. A good example is the internal email system or the intranet that allows organizations to reach all its members without leaving their desks to attend meetings or to send messages to their customers faster and efficiently. Or advertising in social media which today allows many companies to cut advertisement costs by reaching their customers on their own desks or in their homes. To gain competitive edge, some companies such as Apple & Samsung, use high end technology to create new smart phones and other electronic devices that change lives in very radical ways and make them stay competitive. This competitive edge is gained through employing advanced technology.

Advantages and disadvantages of technology

Technology can be as simple as the way we do things in our daily lives at home to advanced systems that allow us to observe the moon and the universe at large. However useful and interesting, if technology is wrongly applied, it can be harmful in so many ways. Technology is developed by humans, so we can use it to accomplish almost every task but is also subject to human error, often with disastrous results like in the case of a plane crash or a faulty lift.

Advantages to business

- **Increases production:** Technology helps businesses automate most tasks and this process results into increased production and efficiency. Business can automate tasks in the accounting department by using accounting software like QuickBooks. Bakeries can automate the temperature room by using temperature sensors to detect a drop or an increase in temperature while those who operate cold rooms can use insulation technology to greatly reduce electricity costs.

- **Technology can help small business gain competitive advantage**: When well implemented, technologies can help small business to gain and maintain competitive positions in a competitive market. Some of the ways small businesses use technology to scale out and gain a good position in the market are; improving customer care services through internet technologies like social media and electronic mail, or creating new products and services tailored based on customers' needs and wants acquired online

- **Saves time:** Since most of the activities in the business are automated, time is saved during all the processes including production, delivery and even billing leading to consumer satisfaction and saving on general operational costs.. Computers can be used to perform various business tasks like recording data which makes future operations more efficient or in video conferencing thus saving time for travel and costs

- **Technology accelerates innovation**: The only way small businesses can succeed in today's competitive world is by using technology to create new products or services. Small businesses are known to be more creative due to their small agency cots and lack of bureaucracies inherent in the vertical structures of large organizations so decision making is faster with faster implementation, which is very important in innovation. For example they can use internet technology to collect information about targeted consumers, so that they understand their needs and wants; this information can be used when tailoring new products or services that meet consumer needs in a more accurate way.

- **It improves sharing of information**: Many businesses use internal networks to facilitate the flow of information within the organization. This internal network can help in the transfer of information among different departments at work. Also employees can share different technologies like printers, fax machines and internet via an internal network. This easy flow of information also improves on the speed at which decisions are made in a business.
- **It improves on data storage**: It is very important to keep business data secure and easier to retrieve. The use of databases and remote storage facilities helps in keeping business information and data secure and accessible from anywhere.
- **Technology simplifies business communication**: Every business survives on communication; you need to communicate with your suppliers, business partners and employees, so technology will make this all process simple. Many businesses use communication technologies like mobile phones, video conferencing applications like Skype, text messaging services and electronic mail to exchange important business information.

Disadvantages of technology

However there are also disadvantages of technology:

- **It can be expensive**: Technology comes at a price and not everyone can every small business can manage to use advanced technologies. After the buying and integrating costs, there is alo the cost of maintaining the technology including electricity and servicing costs which must be taken into account before installing any type of technology.
- **Safety considerations:** Technology is not always safe; it is very easy to lose business data through internet technology both due to outages and viral attacks or even through cybercrime. Hackers can easily access your remote database and use your business data

for their own personal needs therefore it is very important to install safety measures like antivirus and proper use of passwords.

- **Disconnectedness:** Over-dependence on technology has killed workplace relationships; employees and business managers communicate through email, phones, text messages and video conferences, this reduces face-face communication which can sometimes result in loss of interpersonal skills and loneliness. The fact that most tasks are being automated, so you find that employees have less involvement in the final product which can lead to dissatisfaction and workplace boredom which leads to high staff turnover and loss of valuable skills.

Types and examples of technologies in a business

Technology can be used to accomplish various tasks and therefore technological systems come in different types depending on use:

1. Communication Technologies: Are technological systems that use technical means to transmit information or data from one place to another or from one person to another. Communication is used for many purposes; it is used to convey ideas, exchange information and express emotions. Humans use communication technology tools like phones, computers, emails, fax, text messaging tools to stay in touch with others like friends and family or colleagues while businesses use communication technology like HRM tools to facilitate the flow of information in and around the workplace; to help in decision making, to serve customers needs and requests, to promote new products or services to targeted consumers and so much more.

2. **Construction Technology:** These are advanced methods and equipments which can be used to design and build structures of two types; livable buildings and heavy engineering structures like bridges on road constructions. Construction uses various technological

actions to erect a structure on the site where it will be. The world has of late seen great advances in building and architectural designs including the tallest buildings in Dubai and the longest bridges in china some of which are made to pass across the entire town or across river bodies. The use of construction technological tools like heavy tractors to prepare land where the construction will be, computer design software to create designs for structures on computers and in 3D format, use of various construction technologies to enclose structures and install utilities has helped in advancing residential buildings ,commercial and all other types of constructions including roads today.

3. **Information Technology**: Information Technology is a set of hardware and software tools used to store information for future use. Information technology tools in a business help in providing the right people with the right information at the right time. Workers in these organization use information technology to complete various tasks and these can include; transferring of information which facilitates decision making within and without an organization, improve customer service, and so on. In this information age, it is very important to manage information systems to ensure accuracy and efficiency in all business operations and the IT department ensures this happens. Others like the Management information systems (MIS) involves planning for, development, management, and use of information technology tools to help workers perform all tasks related to information processing and management. Big financial institutions like banks have embraced information technology to operate their entire businesses including managing the queues as well as serve their customers in the hall and even at their own homes through mobile banking thereby saving huge costs in reduced branch operations.

The above are only a few of technological systems found in the world today.

ADVANCES IN TECHNOLOGY

Technology is dynamic; it keeps on changing and improving from one era to another, because the human needs and demands to be addressed also keep on changing. For example initially just having fire to cook food was enough for human beings, however today the sources of the fire mater to us more than the fire itself eg use of charcoal, gas or electricity. These changes are due to issues to do with changing customer preferences, global concerns for the environment and even changing technology and even contemporary issues to do with pollution and environmental degradation such as carbon footprint.

The world has moved from the industrial age (industrial revolution) where industries were the drivers of economic growth to the knowledge based economy or an information age where having new/ novel knowledge is your greatest competitive advantage. During the industrial age, companies with large sums of capital had the potential of employing expensive technological tools to gain competitive advantage; small businesses had less potential because they could not afford expensive manufacturing or processing technological tools. But, the advancement in technology has created a new economic environment which depends on information or knowledge as the main differentiator, which has helped small businesses gain position in highly competitive markets .Some have even dislodged the former giants to take their place. The same can be said about countries that have embraced the use of new knowledge in innovations to take over world trade eg the case of china.

Technology and the Global Business Environment

In 2010, the global financial system remained fragile, but economies around the world began moving toward recovery. Some especially those in emerging markets and developing countries hardly broke stride, continuing their rapid growth. What could be the explanation for this?

The report, *tracking global trends*, looks at six broad, long-term developments that are shaping our world today that that have consequences for the competitiveness and the wealth of nations. Most of these trends have an aspect of technology and entrepreneurship

1. Emerging markets increase their global power and presence e.g. the Asian tigers.... India, china , Taiwan
2. Cleantech becomes a competitive advantage – due to climate change worries

3. Global banking seeks recovery through transformation – a formerly bureaucratic field that has been forced to embracing change or die off eg opening hours, having branches in far flung areas etc.

4. Governments enhance ties with the private sector- innovative partnerships for impact

5. Rapid technology innovation creates a smart, mobile, interconnected world

6. Demographic shifts transform the global workforce- global mobility, rapidly expanding middle class that is more consumerist, rapid expanding youth population in developing countries versus a rapidly expanding old population in developed economies brought about by improved family planning, improved health systems and work dynamics.

Today global economies are so tightly interconnected that companies, governments and industries will soon be forced to cooperate in ways they could not have imagined just a few years ago. In fact, Ernst & Young believes the six trends are themselves connected by three underlying drivers that have helped establish each trend and perpetuate it.

1. **Demographic shifts.** Population growth, increased urbanization, a widening divide between countries with youthful and quickly aging populations and a rapidly growing middle class are reshaping not only the business world, but also society as a whole.

2. **Reshaped global power structure.** As the world recovers from the worst recession in decades, the rise of relationships between the public and private sectors has shifted the balance of global power faster than most could have imagined just a few years ago.

3. **Disruptive innovation.** Innovations in technology continue to have massive effects on established business and society. We're now seeing emerging markets become hotbeds of innovation, especially in efforts to reach the growing middle class and low-income consumers around the globe.

Six global trends, interconnected by three key drivers of change

Winner and losers

As these trends change the ways in which businesses operate, grow and compete; winners and losers inevitably will emerge. The winners will be easy to spot:

1. They will be the organizations that constantly monitor broad trends in the external environment, embrace technology and look for talent everywhere, especially among previously neglected segments of the workforce such as women, minorities and older workers.

2. Regardless of what industry they are in or where they are headquartered, these organizations are looking outward. In so doing, they are navigating multiple jurisdictions and regulatory frameworks while adapting to local environments and attempting to create global workforces.

3. They are modifying supply chains to leverage shifting labor cost structures and mitigate raw materials' price fluctuations.

4. They are figuring out how cleantech fits into their growth plans and making it an integral part of their future strategy.

5. National governments, meanwhile, are seeking ways to meet growth agendas while reducing cost structures and future debt obligations.

Shaping the future

As businesses and governments look to the future, they would do well to remember that executing on their existing strategy may no longer be good enough. They must think more deeply about the opportunities and risks presented by the evolving trends, and the driving forces behind them, especially as the world shuttles towards the 4th industrial revolution.

With a different mindset, they can re-imagine what is possible, discovering what they can do that is new, and how best to do it. Those that succeed may find themselves not just navigating tomorrow's global trends, but actually shaping them.

Innovation, Technology and Knowledge transfer

Where do innovations come from?

In general, out of the entrepreneurship field, innovation arises from organizing circles of knowledge exchange; where information/ knowledge is not just accumulated or stored by an individual or organization, but is continuously created and transferred. Innovation is fed by information gathered from a variety of sources;

-from new connections and interactions with others,

- From insights gained by journeys into other disciplines or places,

- from research, both in university libraries and basic research in high tech R&D labs as seen in most developed countries

- From active social networks and fluid open boundaries of businesses and countries which encourage free flow of people and information.

-Learning: education and training among others.

Thus in order to stimulate innovation, intensive interaction is desirable between various actors such as businesses, the academic institutions, research institutes and availability of other factors like technological infrastructure and human capabilities, technological knowhow etc. . Therefore the main ingredient for innovation is new knowledge.

The process of innovation is seen as a systematic and managed process that is focused on the ability to learn and adapt to new changes and find new solution to existing human problems. The fact that innovation depends on acquisition and effective assimilation of new knowledge is the reason why regions that are more innovative like the western economies are often involved in large scale basic research in large R& D labs to come up with new knowledge that often leads to

more radical, cutting edge innovations. However, the poorer nations in sub Saharan Africa are more likely to undertake adaptive/ incremental innovations that build upon ideas already established in the west due to lack of resources and technological skills. They often depend on knowledge transfer/ technology transfer from developed countries that are able to create the Knowledge.

Importance of knowledge transfer

Knowledge transfer is the process of by which knowledge is transferred from one part of the organization to another or from one individual, organization or region to another. The process of knowledge transfer distributes knowledge to ensure its availability for use by those who require it. Knowledge has been found to have different properties than other economic goods:

- It is subject to increasing returns, unlike all other goods that are subject to diminishing returns. This means that the value of knowledge increases with its use rather than diminish. knowledge can be infinitely reused at zero marginal cost
- It a non- rival product. Having an additional consumer of knowledge deprive others of its value.
- Non excludable — Its use by one individual / organization or entity does not limit its use by another. No one can exclude others from using it once it is in the public domain(Hence the rise in the use of intellectual property rights).

However knowledge transfer is itself a complex process since knowledge often resides in organizational members, tools, tasks, and their sub networks and thus can often only be transferred with the physical movement of people or the tools, machines and artifacts. Secondly, more useful knowledge is often tacit or hard to articulate as compared to explicit knowledge.

Knowledge innovation and growth

The ability to grow the economy by increasing knowledge rather than labor or capital creates opportunities for nearly boundless growth in the world of today; be it at individual, corporate or national and even global level. The individual or organization utilizes the new knowledge acquired for creation of useful new product, services of new processes (innovation) for a ready market, which increases its economic value, resulting in growth. And because knowledge can be infinitely reused at zero marginal cost, firms that use knowledge in production processes can earn quasi-monopoly profits, which further increase their economic value. All forms of

knowledge, from big science to better ways to sew a shirt exhibit these properties and contribute to growth of individuals, firms or nations. This is thought to be the main reason for China's rapid economic growth in recent years. For those who have less capabilities for creation of new knowledge e.g. through science or basic research, the only way is to acquire knowledge from others through knowledge transfer.

Types of Knowledge

There are two types of knowledge that are addressed by knowledge transfer:

- Explicit Knowledge
- Tacit Knowledge

***E**xplicit Knowledge*

Explicit knowledge can be expressed in words and numbers and can easily be communicated and shared in the form of hard data. Examples of explicit knowledge are:

- Knowledge that has been formally expressed and transferred
- Comes in the form of books, documents, white papers, databases, and policy manuals.
- Knowledge that can be readily expressed and recorded within information systems.

***T**acit Knowledge*

Tacit Knowledge is not easy to visualize and expressed. It is highly personal and hard to express in a formal way. This is the knowledge that "resides in people's minds" hence very important for creativity. This includes:

- Know-how and information possessed by an individual that has not been made available to others and can therefore be called his intellectual property.
- Knowledge which we acquire through our experience of acting in the world like at work or in a technical field. This is different from book knowledge acquired through formal education.
- Content that exists within an individual or organization but has not been recorded or exchanged with others
- Cannot be communicated or passed to others easily as it is often difficult to put into words (e.g. how to ride a bike or how to swim. You can only acquire this knowledge by

learning from those with the ‘knowhow’. Learning it from a book would be the ‘know what’.

- Is most effectively transferred only in a person to person basis through close social interactions like hands on on- the- job training, apprenticeships, peer mentoring (e.g. why doctors and other professionals like lawyers must undertake some period of apprenticeship before being licensed to operate on their own; despite having spent years in classroom education and passed with flying colors.
- This is the knowledge that is often more useful for innovation, in other words you do not learn to innovate by reading books but more by using your intellectual capacity to think out of the box or learning directly from others .