BAOU
Education for All

Dr. Babasaheb Ambedkar
Open University
(Established by Government of Gujarat)

NAAC ACCREDITED A++ GRADE 3.55/4

MBA
SEMESTER - 3
MBA03C302
Technology Management

Message for the Students

Dr. Babasaheb Ambedkar Open (University is the only state Open University, established by the Government of Gujarat by the Act No. 14 of 1994 passed by the Gujarat State Legislature; in the memory of the creator of Indian Constitution and Bharat Ratna Dr. Babasaheb Ambedkar. We Stand at the seventh position in terms of establishment of the Open Universities in the country. The University provides as many as 54 courses including various Certificate, Diploma, UG, PG as well as Doctoral to strengthen Higher Education across the state.

On the occasion of the birth anniversary of Babasaheb Ambedkar, the Gujarat government secured a quiet place with the latest convenience for University, and created a building with all the modern amenities named 'Jyotirmay' Parisar. The Board of Management of the University has greatly contributed to the making of the University and will continue to this by all the means.

Education is the perceived capital investment. Education can contribute more to improving the quality of the people. Here I remember the educational philosophy laid down by Shri Swami Vivekananda:

> ***"We want the education by which the character is formed, strength of mind is Increased, the intellect is expand and by which one can stand on one's own feet".***

In order to provide students with qualitative, skill and life oriented education at their threshold. Dr. Babaasaheb Ambedkar Open University is dedicated to this very manifestation of education. The university is incessantly working to provide higher education to the wider mass across the state of Gujarat and prepare them to face day to day challenges and lead their lives with all the capacity for the upliftment of the society in general and the nation in particular.

The university following the core motto 'स्वाध्यायः परमम् तपः' does believe in offering enriched curriculum to the student. The university has come up with lucid material for the better understanding of the students in their concerned subject. With this, the university has widened scope for those students who
are not able to continue with their education in regular/conventional mode. In every subject a dedicated term for Self Learning Material comprising of Programme advisory committee members, content writers and content and language reviewers has been formed to cater the needs of the students.

Matching with the pace of the digital world, the university has its own digital platform Omkar-e to provide education through ICT. Very soon, the University going to offer new online Certificate and Diploma programme on various subjects like Yoga, Naturopathy, and Indian Classical Dance etc. would be available as elective also.

With all these efforts, Dr. Babasaheb Ambedkar Open University is in the process of being core centre of Knowledge and Education and we invite you to join hands to this pious *Yajna* and bring the dreams of Dr. Babasaheb Ambedkar of Harmonious Society come true.

Prof. Ami Upadhyay
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Ahmedabad.

MBA
SEMESTER-3 CORE
TECHNOLOGY MANAGEMENT
BLOCK: 1

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Edition: 2024 (First Edition)

ISBN: 978-93-5598-713-6

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TECHNOLOGY MANAGEMENT

MBA03C302

SEMESTER-3

BLOCK-1

BLOCK-2

UNIT – 1

INTRODUCTION TO TECHNOLOGY MANAGEMENT (ASPECTS AND ISSUES)

1.1 Introduction

Technology is the primary source of economic development. Technology plays very crucial role in the development of the nation. The development of various technologies is very essential for the growth of underdeveloped as well as developed countries. It helps to get knowledge about the use of economic resources to produce goods and services more efficiently. The economic growth has increased, and is becoming efficient due to the advancement and improvement of technologies. In business, starting from production to the profit of the business got advanced due to technologies. It has also helped in spreading the business all over the world. Economic development also deals with the social well-being of people and the economic growth of market production.

Technological advancement brings a change in the total production and productivity of resources of the business. A positive change is good for the business for the productivity and the profit of the business. An improvement in technology results in a requirement for less costly inputs. Hence, it can be said that rapid growth can be achieved through high technology levels. Due to rapid change in the technology, customer expects the same kind of experience in a professional environment that they have with technology in their personal lives. Technology is having various effects on labor markets which also influences the business environment. Automation and digital advances are shifting labor demand away from routine low- to middle-level skills to higher-level and more sophisticated analytical, technical, and managerial skills. On the supply side, however, equipping workers with skills that complement the new technologies has lagged, hindering the broader diffusion of innovation within economies.

Consequently, Digital transformation in the world provides a more opportunity for business functions, such as finance and Human Resource, to move away from manual

processes and automate key areas like payroll, enabling to focus on wider business opportunities.

1.2 Definitions of Technology

The word "Technology" comes from two Greek words: techne (the skill or craft needed to make something) and loges (discussion or knowledge of something). So Technology means the knowledge of how something is made. An economist or a planner considers technology as a knowledge used in production, commercialisation and distribution of goods and services. Technology is embodied in various forms, such as, machinery, equipment, documents, processes and skills and as such it conveys-different meanings to different specialists under different contexts.

Technology is man-made; it is a means to enhance the physical and mental capability of human beings, it is also an instrument to transform natural resources into useful goods; a tool for conditioning the environment; it is a resource for creating more wealth; a factor affecting development. Technology is also a commodity, which is bought and sold. Innumerable technological developments have taken place in society during the last two centuries and it is difficult, if not impossible, to enumerate all of them.

1.3 Meaning and Importance

Technology can be defined as all the knowledge, products, processes, tools, methods, and systems employed in the creation of goods or in providing service. In simple term, technology is the way we do things.

Technology is generally a combination of hardware and software with relative proportions varying from one extreme to the other. Hardware is any physical product, component or means, while software is the know-how, technique or procedure. Hardware technology again can 'be of two types, namely: the end-use product type such as automobiles, computers, televisions, and the production tool type such as instruments, equipment and machinery. Software technology can also be considered as being of two types, namely: the "know-how" type technology such as processes, techniques, methods; and the. “know-why" type technology such as knowledge, skills and experience. Technology is neither merely a product nor a process. It is now recognised as a means for the survival, order and progress of the human world. Technology does not exist in isolation. It exists in human surroundings. Every technology when applied causes some alterations in its human surroundings. Most of these alterations have been beneficial to the mankind. However, there have been some harmful effects as well. Technology is only a means for development and not an end in itself. It is, therefore, essential that while determining strategies for technological advancements, one must adopt an optimum approach of maximising the positive or beneficial effects while at the same time minimising the negative effects of technology, especially relating to atomic energy, deforestation and ecological balance, total automation, artificial intelligence, etc.

According to Nawaz Sharif,' "Technology" is a "game" for the rich, a "dream" for the poor, and a "key" for the wise.

Technology has been viewed differently by different people. Some view technology as a source of wealth, well-being, and above, all, as an instrument of power to dominate nature and societies. Others view technology as something that has enslaved human beings and

destroyed jobs, environment and social values. While there is a considerable concern that the use and abuse of technology is leading our societies towards disaster, there is also considerable agreement that further development of human society is possible only through the application of technology. If we can master its use, technology can be the "key" to a prosper society for all human belongs including the poorest of the poor. Most of the poor countries, in fact, are rich in natural resources. However, they have their basic problems: (i) they have a relatively large population, which is increasing very rapidly; (ii) their technological base is very small and ineffective; and (iii) their natural resource base is being depleted due to inefficient use and indiscriminate export. To acquire and master the use of technology for development, it is essential to understand the basic concepts of technology and the process of effective technology management. The fact that we now live in a technological world can be seen very easily by observing the ways and means of satisfying "human needs" in various societies.

1.4 Technology Component

The components of technology can be defined in the following ways:
a) Hardware: The physical structure and logical layout of the equipment or machinery that is to be used to carry out the required tasks.
b) Software: The knowledge of how to use the hardware in order to carry out the required tasks.
c) Brainware: The reasons for using the technology in a particular way. This may be referred to as the Know-Why.
d) Know-How: The learned or acquired knowledge of or technical skill regarding how to do things well. Know-how maybe a result of experience, transfer of knowledge, or hands on practice. People acquire technical know-how by receiving formal or informal education or training or by working closely with an expert in a certain field. Know-how can also be acquired through a recognized method of technology transfer.

1.5 Classification of Technology

Technology is making dynamic changes in various sectors. It changes very frequently and having a profound impact on all sectors and businesses in the economy. Generally, the advancement in technology has classified into various sectors in the world.

1. Technology in Communication area: Communication Technology is one of the most common technologies which is used in our daily life. The recent advancement in the sector of communication technology helps us to communicate with each other without any disturbance. Through this technology, we can share information and even exchange ideas from any person in the world in very little time and with greater accuracy.

2. Technology in Construction Sector: Construction technology includes the building of advanced and basic building structures through innovative equipment and methods such as heavy tractors, drilling machines, computer software to design the layout of the buildings, houses and bridges. With the help of technology in construction sector enhance the efficiency of operational activities and avoid the issues of accidents.

3. Technology in Healthcare Sector: Technology in the Healthcare sector is the most effective and beneficial type of technology in the society as it mainly concerns health issues as well as providing a healthy life of each and every individual. These technology areas such as pharmaceuticals and Biotechnology helps to provide the most effective way to diagnose and treat severe diseases. The major innovation of healthcare technology is advanced machine, tools and equipment such as MRI machines, CT-Scan, minimally invasive devices and many more. All this equipment made an impact on the field of science. Also recent developments in healthcare technology include telemedicine, robotic arm, cam pill, electronic health recorder, genome sequencing, real-time PCR, augmented reality and virtual reality.

4. Technology in the area of Education: The main motive of Education technology is to enhance and improve the quality of learning of students by the use of various technological resources. The advancement in the education sector helps students to know about the, facts, correct information, deeper knowledge and understandings of the subjects. Through smart classrooms, students can evaluate their knowledge. It also helps to learn new languages, recent change in the world economy and subjects with the help of educational materials.

5. Information Technology: Information Technology is one of the most important and valuable technologies. This technology consists of software and hardware sets that help to utilise, store and transfer information from one place to another. The IT sector includes a management information system which is used to plan the management and development of informative tools to enhance the work performance of the workers. All the sectors in the economy using the technology such as Banks also utilise information technology for operating and providing high-quality services to their clients. Artificial intelligence (AI), robotics technology, and super intelligence are the parts of information technology.

6. Space Technology: Space technology is developed by the aerospace sector. Space technology is mainly used in satellites, space exploration and space rockets. Space is an environment that requires special techniques and tools as numerous services such as GPS systems, weather forecasting are dependent on this technology. Space technology includes space stations, space crafts, and satellite and space support equipment.

7. Technology in the area of Business: Business Technology is mainly associated with the increment in the business. This technology helps to gather data and achieve the goal of the organisation. Business technology consists of hardware and software for enhancing business function and operations. The technology sector offers a wide range of products and services for both customers and other businesses. Consumer goods like personal computers, mobile devices, wearable technology, home appliances, televisions, and so on are continually being improved and sold to consumers with new features. On the business side, companies are dependent on innovations coming out of the technology sector to create their enterprise software, manage their logistics systems, protect their databases, and generally provide the critical information and services that allow companies to make strategic business decisions. The term "technology sector" is

frequently shortened to tech sector and is used interchangeably with the term "technology industry or tech industry.

8. Agriculture Technology: Agriculture Technology consists of the equipment and machinery which are used to increase the production and productivity of farming. This includes tractors, pesticides, fertilisers, and soil tilling machines, irrigation systems and many more. Through the advancements in agriculture technology, farmers can enhance the productivity level of the crops and meet the requirements of the people.

1.5.1 Definition of Technology Management

Technology is defined as the practical implementation of learning and (knowledge, individuals and organisations to aid human endeavour. Technology is the (knowledge, products, processes, tools and systems used in the creation of goods or in the provision of services.

Technology is most widely used word today in industrial world and several words / nomenclatures connected with technology are in vogue. It include Research & Development, invention, innovation, technology development, technology strategies, technology absorption and adaptation, technology transfer, technology forecast, technology' assessment, technology planning, technology information, industrial property systems, code of conduct, and technology management.

The definition identifies technology as an application of knowledge that leads to production and marketing of goods and services. According to Betz, the Technology develops business by providing technical knowledge for the goods and services that a firm produces." Technological innovation implies new technology, creating new products and services- business opportunities.

Managing technology means using new technology to create competitive advantages which is quite a difficult job, partly due to differing cultures in a company. Yet, successful business use of technology requires strategic decisions about technology by personnel in other functional areas, such as production, marketing, sales, finance, and so on. Thus, the two cultures-technical and functional-need to be bridged, and management should integrate technology strategy with business strategy. This is the essence of technology management.

Innovation and Invention: Invention is an idea for a novel product or process. Innovation is the introduction of new products, processes or services into the market place. Technological innovation is a sub-set of innovation i.e. the introduction of new products, processes or services based on new technologies. The technological innovation begins with invention. The first step is the idea of the invention and the research to reduce the idea to practice. This often results in a functional proto-type, which can be used for filing a patent. The next step is the research and development of the pro to-type into a commercially designed product. Finally, the product is produced and sold. The distinction between invention and innovation is an important one, for the transformation from ideas into a successful product is actually difficult. The hard fact is that only a few inventions are successfully innovated, with fewer inventions developed into new products, and still fewer new products succeed commercially. The problem of managing technology thus

can be divided into two parts: (i) encouraging invention, and (ii) managing successful innovation. Encouraging invention falls in the area of corporate research and managing successful innovation falls in the area of managing technology.

1.5.2 Meaning of Technology:

According to Solomon, Technology Management is the capacity of a firm, a group or society to master management of the factors that condition technical change so as to improve its economic, social and cultural environment and wealth.' That technology management is important becomes obvious if one considers both what the economists call the "input" and the "output" aspects of technical change, namely, sources of modern technology on one side and its pervasive impact on society on the other. These facts are obvious for all countries. However, technology management is more important for those countries which do not participate directly in the "input" aspects, or do so less intensively than the industrialised countries, and are therefore necessarily less well-prepared to adjust to and master the "output" aspects. This is the case today in most developing countries.

Management of technology (MOT) is an interdisciplinary field that integrates science, engineering, and management knowledge and practice. The focus is on technology as the primary factor in wealth creation. Wealth creation involves more than just money; it may encompass factors such as enhancement of knowledge, intellectual capital, effective exploitation of resources, preservation of the natural environment and other factors that may contribute to raising the standard and quality of life. Managing technology implies, managing the systems that enable the creation, acquisition and exploitation of technology. It involves assuming responsibility for creating, acquiring, and spinning out technology to aid human endeavors and satisfy customer needs. Research, inventions, and development are essential components in technology creation and the enhancement of technological progress. However, more important for the creating of wealth is the exploitation or commercialization of technology. It is only when technology is connected with a customer that its benefits are realized. A customer is a beneficiary and could be an individual a corporation, or a government entity such as defense establishment. Technology generates wealth when it is commercialized or used to achieve a desired strategic or operational objective for an organization

1.6 Concept of Technology Management

The concept of technology management includes following technology strategy, Technology governance Technology operations and technology innovation.

1. Technology strategy: It implies to a set of plans, decisions, and actions to manage its technology resources and align them with its objectives. It should support the overall business strategy and provide a roadmap for technology-related decisions and investments. It involves assessing the current state of technology, identifying gaps and opportunities, and formulating a plan to acquire, develop, deploy, and manage technology resources to create competitive advantage and value for the organization.

I. Technology forecasting: Technology forecasting is a process of predicting future technology trends and developments. It involves analyzing data, identifying patterns, and predicting technology in a particular industry or field. It can help enterprises identify emerging trends, anticipate disruptions, and remain competitive in a rapidly evolving technological landscape. The decision-making

process can consider cost, compatibility with existing IT systems, scalability, security, and performance.

II. Technology roadmap: The technological roadmap is a strategic plan that outlines how a company plans to implement and adopt new technologies over a specified period. It helps organizations prioritize and plan technology initiatives, allocate resources and budget, and ensure alignment with strategic aims.

III. Technology project portfolio: The portfolio usually overviews each project's scope, timeline, resources, and goals. It includes a list of all the tasks the organization is currently undertaking and the ones planned for the future, and also budgets, risks, and benefits.

2. Technology governance: It provides a foundation for developing and implementing technology strategy. By establishing transparent governance processes and decision-making structures, organizations can ensure that technology investments are aligned with current goals, risks are managed effectively, and resources are allocated efficiently.

I. Standards and policies: These policies define the standards, best practices, and procedures for technology use and management, including security, data management, and privacy, compliance, and risk management.

II. Performance management: This measures and evaluates the performance of technology resources, assets, and services in alignment with the organization's objectives. It involves establishing metrics, monitoring performance, identifying areas of improvement, and implementing changes to optimize performance.

III. Vendor management: It includes identifying potential vendors, negotiating contracts, monitoring their performance, and ensuring providers comply with established standards and policies.

3. Technology operations: Technology operations encompasses the day-to-day activities involved in managing and maintaining an organization's technology infrastructure. It ensures that technology systems function correctly and efficiently, providing technical support to users, managing data centers, and overseeing the organization's network security. Technology operations also include operating hardware and software upgrades, performing backups, and disaster recovery planning.

I. Infrastructure management: It involves planning, designing, implementing, and maintaining the physical and virtual technology infrastructure components such as servers, storage, clouds, network devices, databases, operating systems, and other related software.

II. Data management: It refers to the set of processes, policies, and procedures governing the creation, storage, and disposal of an organization's data assets.

III. Application management: It includes installation, maintenance, troubleshooting, upgrades, and support for the applications throughout their lifecycle. Effective application management helps to improve productivity, reduce costs, and increase the value of technology investments.

IV. Security management: It involves designing, implementing, and maintaining security measures such as firewalls, intrusion detection and prevention systems, access controls, and encryption to safeguard against cyber-attacks, data breaches, and other security risks. Security management is critical for ensuring the

confidentiality, integrity, and availability of a company's technology infrastructure and assets.

4. Technology innovation: It refers to the processes and activities involved in identifying, developing, and implementing new and innovative ways to create additional value for the enterprise. It helps rationalize the process of developing new software products and services with increased customer satisfaction using technology to gather customer feedback and insights, optimize product development processes, and ensure that new products and services meet or exceed customer expectations. It usually includes exploring emerging technologies, conducting research and development, and experimenting with new approaches and techniques to solve current business problems or create new opportunities.

I. R&D includes exploring emerging technologies, conducting feasibility studies, prototyping, and testing new products or services.
II. Intellectual property management protects a company's intellectual property, including patents, trademarks, copyrights, and trade secrets. It is essential in technology innovation to safeguard the company's inventions, software, and other proprietary technologies. That involves conducting patent searches, filing patents and trademarks, licensing technology, and protecting the company's intellectual property rights.
III. Innovation culture: An innovation culture helps organizations stay leading by continuously generating new ideas, products, and services that meet customer needs and improve business processes.

1.7 Importance of Technology Management

Technology and management of technology are critical for an enterprise for its successful operation on long-term basis. Technology management is, however, a part of the total management system. There are three basic considerations for starting any new firm based on technological innovation.

a) The idea for a technological innovation;
b) A potential market;
c) Team work in both technological and business expertise.

The above points underline the need for interweaving the technology framework with other areas of business in an enterprise. The idea of a technological innovation should be based or linked with the potential market and the technology team should closely interact with the rest of the divisions of the enterprise leading to successful logical conclusions in terms of products/ processes to be developed as per the ' objectives set in the 'beginning. This strategy is best reflected in the form of a "Business Plan" of an enterprise which needs to be prepared and approved before starting the new business.

The Business Plan: The business plan is a strategic summary of a new venture. Its purposes are:
i) to ensure, by clear focus in strategy, that important points necessary to the success of any business venture have been considered; and
ii) to persuade financial investors to invest in the new venture. A new venture business plan could include the following:

a) Current business status
   - Business objectives
   - Management and organisation

b) Products or Services
   - Product description
   - Technological background
   - Competition

c) Benefits to customers
   - Market
   - Marketing strategy

d) Capitalisation
   - Capital requirements
   - Financial forecasts
   - Benefits to investors

It is thus clear from the above that technology and technology management are only a part of the total business activity or business plan of an enterprise.

1.8 Nature of Technology Management

The science is that form of human activity which is devoted to the production of theory-related knowledge of natural phenomena. Its root function is to attain an enhanced understanding of nature.
However, Technology is that form of human activity which is devoted to the Production of techniques or techniques related intellectual products. Its root function is to expand the realm of practical human possibility. It deals with human made world. Focuses on doing application oriented for finding solutions to present problems & future, Private or Public knowledge applications.
Technology development leads to innovation of new products services or processes.
Technology of product/service or processes undergo changes like the (biological concept of a life cycle (birth, growth, maturity & death).
Technology development is guided mostly by cost vs. benefit analysis.
Technology is useful for specific owners/users.

1.9 Classification of Technology Management

a) 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 services. One example is new computer software introduced to develop engineering drawings and thus replace manual drafting. A New Technology has a profound effect on improving productivity and maintaining a competitive business enterprise.

b) Emerging Technology: An emerging technology is any technology that is not yet fully commercialized but will become so within about 5 years. It maybe currently in limited use, but is expected to evolve significantly. E.g. Genetic Engineering, Nano Technology, Super Conductivity and the Internet as a replacement for the personal computer. Emerging technologies create new industries and may make

existing ones obsolete. They have the potential of triggering large changes in institutions and in society itself.

c) High Technology: The term high technology refers to advanced or sophisticated technologies. High technologies are utilized by a wide variety of industries having certain characteristics. A company is classifies as high tech if it fits the following descriptions:

1. It employs highly educated people.
2. Its technology is changing at a faster rate than that of other industries.
3. It competes with technological innovation.
4. It has high level of research – and development expenditure.
5. It has the potential to use technology for rabid growth, and its survival is threatened by the emergence competing technology.

d) Low Technology: The term low technology refers to technologies that have permeated large segments of human society. Low technologies are utilized by a wide variety of industries having the following characteristics;

1. They employ people with relatively low levels of education or skill.
2. They use manual or semi-automatic operations.
3. They have low levels of research expenditure (Below industry average).
4. The technology base used is stable with little change.
5. The products produced are mostly of the type that satisfy basic human needs such as food, shelter, clothing and basic human services.)

e) Medium technology: The term 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 such as Consumer products, automotive industry.

f) 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. i.e. To use high technology when there is a lack of necessary infrastructure or skilled personnel. Utilizing the appropriate level of technology results in better use of labor resources and better production efficiency.

g) Codified versus Tacit Technology: Technology can be preserved and effectively transferred among users if it is expressed in a coded form. An engineering drawing is a coded form expressing shape, dimension, and tolerances about a product. A computer program of an optimization algorithm is a codified form that preserves and transmits knowledge about that algorithm. Tacit technology is non – articulated knowledge. There is no uniformity in the way it is presented or expressed to a large group of people. It is usually based on experiences and therefore remains within the minds of its developers. The technology developers are the ones who have the know – how in question. Transfer of tacit technology occurs by close contact and interaction between the source and the host.

Codified technology, on the other hand, allows people to know how technology works but not necessarily why it works in a certain way. The brain ware maybe part of the tacit

knowledge kept in the minds of developers and shaped by their experiences during the development process. Transfer of technology is easier when the technology is a codified form. It is harder, less precise, and more time consuming to transfer tacit technology. A complete mastery of the technology requires an understating of both the explicit codified knowledge and the non- explicit tacit knowledge.

1.10 Responding to technology challenge

The technological challenges faced by management of organizations are as following:
The technological challenges of implementing new technology in the organization. Hence, management has to address this issues. It would be unrealistic to think that implementing new tech, even if it positively innovates, comes without any disadvantages. The ideas is making sure that the advantages outweigh the disadvantages. It's also necessary to understand that no one technology can solve every problem. Here are some points to address the disadvantages and get maximum advantages of new technology.

However, the major challenges organizations face, mostly when they move from one technology to a higher technology which includes the following: 1. Information security (including data privacy, storage and management): The management of organization faces problem of how to set polices and procedure for systematically managing an organization's sensitive data. The goal of an information security management is to minimize risk and ensure business continuity by proactively limiting the impact of a security breach. It includes the management of Cloud computing, Social Media (forms of expression through virtual communities and network) Regulatory Compliance., Risk Management and Governance (set of actions, processes and institutions by which authority is exercised and decisions are taken and implemented).

Moreover, it implies Technology Integration and Upgrading, Resource Management (financial resources, inventory, human skills, production resources, or Information Technology), Infrastructure Management(is the management of essential operation components, such as policies processes, equipment data, human resources, and external contacts for overall effectiveness), Fraud Monitoring and Business continuity/Disaster Recovery (processes that help organization prepare for disruptive events whether those events might include a hurricane or simply a power outage that can caused malfunctioning software caused by a computer virus).

1.11 How to Overcome Technological Challenges

There are various steps to overcome technological challenges.

- To identify the appropriate time to deliver new technology, training and the monitoring, implemented in institution. This associated with the timing of when to deliver technology changes, on fixing management issue.
- To provide effective training influences employee's acceptance and use of a new technology.
- The necessary awareness in all the sections of government-Executive legislative, Judiciary and the press.
- To create good investment environment, economy and infrastructure to support entrepreneurship and innovation in technology development.
- Government should provide training workshops seminars and courses in collaboration with local and international institutions.

- To take the initiatives for technological development, expansion and modernization of technology/communication infrastructures of active universal service as access to basic technological services.
- Creating and funding of scientific development and technological capability to the Research Development institutes to enhance advancement in overcoming the challenges faced.
- Government should encourage the effort of selecting and training of young scientists and youths in areas of technological advancement in the country
- Since government alone cannot fund technological advancement, the private sector should be encouraged through various scheme and policy such as tax holiday to support and finance this project.
- To provide the Supporting development programs aims at creating and promoting innovation and sustainable business models in technology. Also the promotion of academic and industry collaboration in enhancing technological development.
- Technological cities or villages should be created by Government partnership with the private sector and the international collaborators.

❖ Exercise

• Long Questions

1. What do you mean by Technology? Explain in detail.
2. Write a note on Classification of Technology.
3. What is Technology Management? Explain the importance of technology management.
4. Describe concept and nature of Technology Management.
5. Discuss the definition and meaning of Technology Management.
6. Write a note on technological challenges.

• Shorts Questions

1. What is the meaning of technology?
2. What is the meaning of technology management?
3. State the concept of technology.
4. Discuss the two areas of technology.
5. Describe some challenges of technology.
6. What is appropriate and new technology?
7. State the high and medium technologies.

• Short Notes

1. Write a note on technology governance.
2. Discuss the technology operation.
3. Describe the codified versus tacit technology.
4. How to deal with the technology challenges?

- **Multiple Choice questions**

1. _____helps to get knowledge about the use of economic resources to produce goods and services more efficiently.
   A. Technology
   B. Resources
   C. Land
   D. Money

2. Technological advancement brings a change_____;
   A. Production
   B. Productivity
   C. Resources of the business
   D. All of above

3. Technology is generally a combination;
   A. Hardware
   B. Software
   C. **Both A and B**
   D. None of above

4. The components of technology can be defined____
   A. Hardware
   B. Software
   C. Brainware
   D. All of above

5. The advancement in technology has classified into _____ in the world.
   A. Communication and Construction
   B. Healthcare and Education Sectors
   C. Information Technology and Business
   D. All of above

6. Innovation is the introduction of new _____into the market place.
   A. Products
   B. processes
   C. services
   D. **All of above**

7. The word "Technology" comes from _____ words;
   A. **Greek**
   B. Spanish
   C. English
   D. All of above

8. Management deals with _____
   A. internal environment
   B. external environment
   C. both internal and external environment
   D. None of the above

9. _____ is known as “the father of scientific management.”

A. Fredrick W. Taylor
B. Henry Fayol
C. Robert Owen
D. None of these

10. Strategic planning as a broad concept consists of _____
A. corporate strategy and business strategy
B. strategy formulation and strategy implementation
C. inputs and outputs
D. environmental analysis and internal analysis

11. The problem of managing technology thus can be divided into _____parts:
A. Encouraging invention,
B. Managing successful innovation
C. A and B both
D. None of above

12. Management of technology (MOT) is an interdisciplinary field that integrates….
A. science,
B. engineering,
C. management knowledge and practice
D. All of above

13. The Concept of Technology Management includes:
A. Forecasting
B. Governance
C. Operations & innovation
D. All of above

14. _____ helps organizations by new ideas, products, and services that meet customer needs and improve business processes.
A. Innovation culture
B. Roadmap
C. Patent
D. All of above

15. Technology of product/service or processes undergo changes like the_____.
A. birth,
B. growth,
C. maturity & death
D. All of above

16. The classification of technology management is associated with_____.
A. New Technology
B. Emerging Technology
C. High Technology
D. All of Above

17. The term _____is used to indicate a good match between the technology utilized and the resources required for its optimal use.
A. appropriate technology
B. New technology

C. Low technology
D. High technology

18. It usually refers to _____ technologies that are more amenable than others to technology transfer.
A. Medium Technology
B. New technology
C. Low technology
D. High technology

19. The technological challenges faced by management of organizations are _____.
A. Information security
B. Cloud computing, Social Media
C. Technology Integration and Upgrading, Resource Management
D. All of above

20. Resource Management is associated with financial resources, inventory and_____.
A. human skills,
B. production resources,
C. Information Technology
D. **All of above**

MCQ Answer

1) A	**2) D**	**3) C**	**4) D**	**5) D**
6) D	**7) A**	**8) C**	**9) A**	**10) B**
11) C	**12) D**	**13) D**	**14) D**	**15) D**
16) D	**17) A**	**18) A**	**19) D**	**20) D**

UNIT – 2 TECHNOLOGY STRATEGY AND COMPETITIVENESS

2.1 Introduction and Meaning of Technology Strategy

2.2 Reason for adopting Technology Strategy

2.3 How Technological Strategies reshaping the Industrial Structure

2.4 Benefit of adopting Technology Strategy

2.5 Examples of Impact of Technological adaption on firm's Competitiveness

2.6 Areas to be taken care for getting competitiveness with the adoption of technological Strategies

- **Exercise**

2.1 Introduction and Meaning of Technology Strategy

A technology strategy is a comprehensive plan that outlines the goals, values, and strategies that an organisation will employ to leverage technology. These approaches mostly concentrate on the technology themselves and, in certain circumstances, the people who are in charge of such technologies. The strategy may be expressed verbally in a document or indicated by the organization's actions regarding technological choices. In order for IT resources to be acquired, allocated, and managed in a way that supports organisational goals, the strategy contains a written vision.

Other technology-related generations of strategies primarily concentrate on: the effectiveness of the company's technology spending; how people, like customers and employees of the organisation, exploit technologies in ways that create value for the organisation; on the full integration of technology-related decisions with the company's strategies and operating plans, such that no separate technology strategy exists other than the de facto strategic principle that the or. The creation of success measures and the recording of planning assumptions are essential components of a successful technology strategy. These provide a mission-driven strategy that guarantees projects are in line with the aims and objectives of the organisation. This point emphasises that ensuring that the business strategy can be realised via technology and that technology investments are in line with business goals is the main goal of establishing a technology strategy. According to some experts, a good technology strategy is one that is incorporated into the organization's entire business plan, not just to support the company's goal and vision but also to contribute to them.

There are frameworks that may be used to develop technology roadmaps and budgets, analyse business-IT alignment on different criteria, identify gaps, and give insights into the existing and future business strategy. These draw attention to crucial details, such as the following:

- Information technology and strategic planning working together are key elements of information tech-strategy.
- IT functionality's capacity to both define and support company strategy is known as IT strategy alignment.
- The extent to which the business mission, goals, and plans support and are supported by the IT purpose, objectives, and plans.

A strategy must provide answers to the how-to questions of value creation, value delivery, and value capture in order to be successful. One has to understand the history of technology and make predictions about how it will develop in the future, as well as how to successfully organise and modify market penetration. Understanding how to obtain and maintain a competitive advantage as well as how to compete in situations where technological standards are crucial is necessary for value capture. Delivering value is the last phase, when businesses decide how to carry out their strategies, make important choices, and take decisive action. The Strategic Alignment Process is a step-by-step procedure that aids managers in maintaining their attention on a certain job in order to carry it out and produce value.

2.2 Reason for adopting Technology Strategy

A strategy must provide answers to the how-to questions of value creation, value delivery, and value capture in order to be successful. One has to understand the history of technology and make predictions about how it will develop in the future, as well as how to successfully organise and modify market penetration. Understanding how to obtain and maintain a competitive advantage as well as how to compete in situations where technological standards are crucial is necessary for value capture. Delivering value is the last phase, when businesses decide how to carry out their strategies, make important choices, and take decisive action. The Strategic Alignment Process is a step-by-step procedure that aids managers in maintaining their attention on a certain job in order to carry it out and produce value.

The same is true of how quickly other industries adopt technology developments. In reaction to disruption, some businesses adopt cutting-edge technology—think of how entertainment and media have gone digital. For instance, the FAANG (Facebook, Amazon, Apple, Netflix, and Google) and BAT (Baidu, Alibaba, and Tencent) corporations often raise the standard for how organisations interact with their clients and vendors. Other sectors often benefit from their impact on the commercial environment and customer behaviour.

The industrial sector is on the verge of unheard-of change as these tendencies spread throughout the commercial environment. The significance of making the appropriate strategic investments is often heightened during times of rapid change. A tech-enabled transformation may help industrial organisations to develop new income streams using various business models, as well as to enhance sales and profitability. Maximise your chances of capturing the value at stake by implementing aggressive and thorough methods for integrating technology into your operations. Companies who decide to stay out of the fray, however, are basically giving up their competitive edge.

2.3 How Technological Strategies reshaping the Industrial Structure

There are mainly three factors which are making the significant contribution in the reshaping the industrial structure is mentioned below:

- **Shifting at the Work Place due to Technological Changes:** The workforce's demographics are changing, and industrial organisations must adapt how they go about recruiting, keeping, and developing personnel as a result of shifting worker expectations and more automation. Millennials will make up 50% of the workforce in the US by 2020, and 75% worldwide by 2025. In various aspects, this generation of workers is different from earlier generations. Instead of employment requiring a lot of hard labour, millennials choose positions

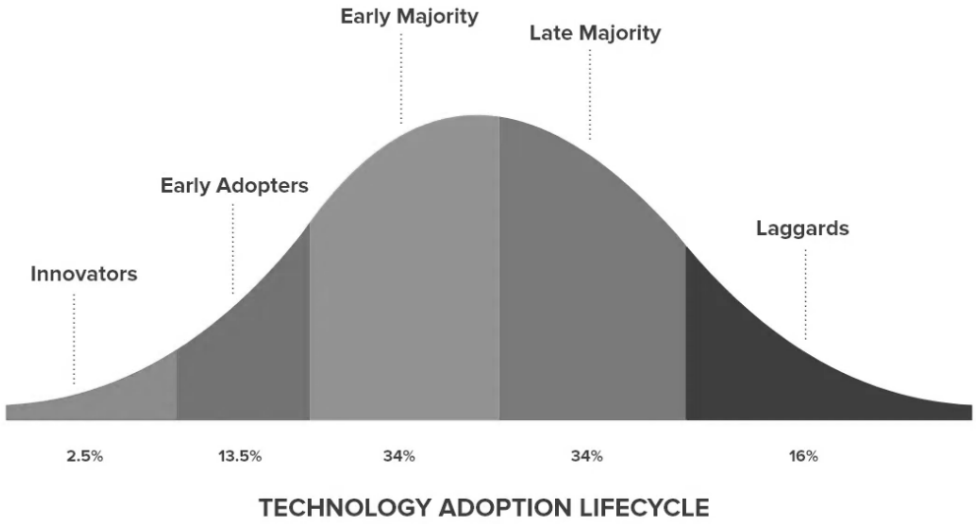
backed by digital technologies. Additionally, they actively look for opportunities to learn and develop at work and aren't averse to switching jobs in pursuit of progress. According to Gallup, 21% of millennial employees have changed employment in the last year, and 60% are interested in new career prospects. According to McKinsey study, technology can automate a significant portion of retail operations. Additionally, it is anticipated that by 2025, there will be more than 75 billion linked devices, up from less than 27 billion in 2019. Most employment will change and call for more tech-savvy workers as a result of how technology is affecting every aspect of the industrial sector, from the shop floor to distribution centres.

- **Fast moving Channel between the Customers and Suppliers in the Market:** Industrials now lag behind other industries in the use of digital technology in business processes, including retail and banking. Walmart has made investments in a variety of technology for the retail sector, including autonomous cleaning robots that free up employees' time and virtual reality headsets for associate training. Additionally, a few of businesses have at least partly digitised their storefronts to improve exposure and customization. Similar to other industries, banking is going through its own revolution, driven by digitization and the integration of technologies and procedures to increase staff productivity. One large bank created a new digital onboarding tool for online clients and sent a modified version to more than 4,000 sales representatives in branches. The bank made expenditures in frontline training and intense coaching to assist frontline adoption, which led to a 25% improvement in sales adviser productivity.
- **Digital Disrupter:** Companies may think they are protected from the influx of digital attackers due to the industrial sector's capital-intensive nature and reliance on R&D, but such assumption is unfounded. For instance, Amazon's B2B division generated $10 billion in sales last year. The reason for this is that Amazon has one edge over its rivals: the capacity to provide a wider range of items than established B2B enterprises. Additionally, quick-moving digital start-ups have started to penetrate complex industries like logistics and pharmaceuticals, often by forming alliances with well-established businesses. For instance, Fast Radius, which provides 3-D printing on demand, has partnered with UPS to expand its manufacturing capacity globally. The company's goal is to enable manufacturers to take advantage of a virtual inventory by providing a 24-hour turnaround on the creation and shipment of components.

2.4 Benefit of adopting Technology Strategy

The acceptance and integration of new technologies into already-existing systems or the development of brand-new ones are referred to as technology adoption in business. It involves using technology to the fullest extent possible while making adjustments to meet changing customer demands.

Startups and well-established organisations respond to innovation in various ways. They may embrace new technology with great enthusiasm or they may not think it is important enough. The traditional bell-shaped adoption or acceptance of a new product or innovation is described by the technology adoption lifecycle.



(Source: Yogesh Rawal Article)

The incorporation of technology in company, irrespective of its size, nature, and clientele, may be crucial for its development. The key is to pay close attention to how your present technology satisfies your company's demands. You should also be aware of whether investing now is a good idea given the state of technology and if it can benefit your company. Here are 5 advantages of using modern technology in your company.

- **Brings Better Efficiency in Process**

Numerous online polls demonstrate how startups and companies are failing, particularly during the epidemic period, as a result of inefficient technology. A recent poll found that 90% of participants couldn't accurately describe their clients without consulting several platforms. These may have a detrimental effect on company performance at this period. By introducing more adaptable methods to do jobs, technology helps speed up procedures. Better company and customer management may result from the introduction of cloud computing, ERP software, CRM solutions, and other technologies. They may also aid in performance monitoring and analysis for improved target attainment. Such systems may perform better and be more effective overall if they are implemented properly.

- **Competitive Advantage for the Organization**

For firms to remain ahead of the competition, digital transformation is essential. Startups have been more interested in technologies like AI, Big Data, and Blockchain. Businesses may provide clients with valuable services that no one else is giving and increase income streams by using new technology. Additionally, it positions businesses in the eyes of their clients and investors as risk-takers and innovators, offering new opportunities to a bigger market and more funding. Customers begin to see them as superior choices for teamwork. Additionally, it could boost a company's reputation.

- **Broad Work Challenges**

Due to the introduction of COVID-19, survival has increasingly become the only goal for many enterprises. Finding effective solutions to manage remote workforces is one of their largest current concerns. Since most IT businesses now operate remotely, the

industry has become a shining example for the rest of the globe. The pandemic's hurdles, however, are forcing a sizable number of enterprises to fight for survival.

Purchasing remote collaboration and communication solutions may make the transition to remote work simpler. Businesses may use technology to address a number of issues related to communication, teamwork, and the digitalization of routine chores that arise with remote employment. An excellent example would be how Microsoft utilised its own Microsoft Teams to let workers interact and communicate more easily, even when they were located in different parts of the world.

- **Robust Workflows**

Businesses may integrate interrelated processes and automate operations thanks to workflows, which boosts productivity and time management. Technology may be very important in creating automated workflows for many activities, including marketing, onboarding, advertising campaigns, buying and selling, reimbursements, and more. Businesses may continue operating even in these unpredictable times by using a workflow management system, which can assist simplify procedures. Such systems put a lot of emphasis on streamlining procedures, speeding up turnover, and requiring the fewest human efforts.

- **Better Opportunity for the Future**

A startup or company can only survive in this constantly shifting environment via innovation. It is deciding the course a company should follow and establishing the future. Technology's function is to equip companies with new and enhanced systems so they can provide better goods and services. By doing so, they will be able to speed up production, raise quality standards, and guarantee greater client happiness. The development of your company may be greatly aided by all of this. It won't be a quick victory, but rather long-term expansion.

- **Moving Ahead**

Adopting new technologies requires patience, skill, and effort over the long term. It is crucial to determine your organization's requirements and the goals you have in mind. In addition, many people would find the expense and time required for the move to be too much. In order to assist startups and companies in analysing their requirements and recommending the best technological solution, Akeo comes in. Akeo assists companies in identifying and achieving new technological opportunities.

2.5 Examples of Impact of Technological adaption on firm’s Competitiveness

Few Companies, who have received the tremendous benefits with the adoption of technology and are also called the FAANG are mentioned below:

- **Facebook:**

Facebook uses Linux but has optimized it for its own purposes (especially in terms of network throughput). Facebook uses MySQL, but primarily as a key-value persistent storage, moving joins and logic onto the web servers since optimizations are easier to perform there (on the “other side” of the Memcached layer). Facebook has used multiple technologies to create or maintain this huge social giant. Facebook has developed most of their services through open source some of them are listed below:

- React
- HHVM
- Hive
- HBase

- RDBMS
- Java Script
- Fb-Flo
- Origami
- Buck (Android Exclusive)
- Thrift Memcached

- **Amazon:**
  - One of the biggest online retailers in the world, Amazon has led the way in technical advancement for the sector. The business has strategically embraced technology to boost growth, streamline operations, and increase customer satisfaction.
  - Utilising data analytics is only one of the many ways that Amazon has benefited from technology. In order to personalise suggestions and marketing messages, the corporation gathers a tonne of information about client behaviour, including their search and purchase histories. This increases consumer happiness and encourages purchases.
  - The technologies of artificial intelligence and machine learning have also been used by Amazon early on. These technologies are utilised to power Amazon's voice-activated virtual assistant, Alexa, which is built into other goods and smart home gadgets. Customers may use Alexa to do a range of functions, including purchasing goods, playing music, and managing smart home appliances.
  - Through its supply chain and logistical activities, Amazon has also used technology. In order to optimise its fulfilment centres and delivery routes, the organisation has created advanced algorithms and software tools. Because of this, Amazon is now able to provide consumers with speedier and more dependable delivery times, helping to differentiate the business from rivals.
  - Through its Amazon Web Services business which is called AWS, Amazon has also made significant investments in cloud computing services. AWS offers companies and organisations all over the globe a variety of cloud-based services, such as database administration, processing, and storage. For Amazon, this has grown into a significant source of income and has assisted in expanding the company's product line outside its main e-commerce operation.
  - Overall, Amazon's successful use of technology has been largely attributed to this strategy. The firm has been able to keep up with the quickly changing e-commerce market by using data analytics, AI and ML technologies, logistics optimisation, and cloud computing.

- **Apple:**

Apple's success may be ascribed to its strategic choices and concentration on innovation, which helped the company grow from its modest beginnings in a garage to become one of the most valuable businesses in the world. This breakdown will look at some of the important components of Apple's approach and provide advice that small company owners may use.

  - **Focus on Users Experience:** Apple's success has been largely attributed to its unwavering emphasis on providing outstanding user experiences. Apple puts an emphasis on simplicity and usefulness, from the user-friendly designs of its devices to the seamless blending of hardware, software, and services. This teaches small company owners to continually put the wants and needs of their

clients first. Businesses that engage in user research, design, and usability testing may provide goods and services that please consumers and encourage loyalty.

- **Innovation with reference to market demand:** Apple has a history of creating ground-breaking goods and revolutionising markets. Every time it releases a new product, whether it's a Macintosh, iPod, iPhone, or Apple Watch, it brings a ground-breaking technology. By promoting an innovative culture inside their businesses, small company owners may acquire a similar attitude. Encourage your staff to be innovative, to experiment, and to remain on top of market trends. Assess market demands often, and spend money on R&D to create new goods, services, or procedures.
- **Proper integration of Hardware, Software and Prompt Services:** A crucial source of competitive advantage for Apple has been its capacity to seamlessly integrate its products' hardware, software, and services. Apple manages the whole ecosystem to provide a smooth and coherent consumer experience. Small company owners may benefit from this by thinking about how diverse aspects of their operations can coexist peacefully. A firm may differentiate itself from its rivals by integrating operations such as product development, marketing, customer service, and other areas.
- **Excellence towards the Branding and Marketing:** Apple constantly outperforms competitors in branding and marketing, forging a strong emotional connection with its audience. Its appealing advertising campaigns, elegant and simple designs, and consistent message have all helped to increase brand loyalty. Focus should be placed on creating a distinctive brand identity and communicating a compelling value proposition to potential customers. Make investments in efficient marketing tactics that highlight your company's distinctive selling propositions and foster a personal relationship with clients.
- **Long term goal and adaptability towards the technological changes:** Apple has shown to have a long-term perspective while staying flexible in the face of shifting market realities. The business has moved from PCs to portable music players, cell phones, wearables, and other technologies with success. Planning for the future and being flexible in the face of changing market circumstances are comparable mindsets that small company owners should embrace. Continually evaluate your company strategy, keep an eye on market changes, and be ready to change course as required.

- **Netflix**

There are few important strategies that Netflix has used during their success stories for the global market out of which the important strategies have been mentioned below which brings the competitiveness in the market.

- **High International Growth Rate:** The initiatives' main component is Netflix's emphasis on dubbing. Debra Chinn, the organization's head of international dubbing, stated, "We want to provide entertainment to everyone around the world, regardless of what you speak, where you live, where you're from, or what you eat." It has been a struggle for her team to release dubbed versions of Netflix's material in up to 27 languages, including English, since native English people aren't normally used to watching dubbed media. "We are taking this new initiative very seriously," Chinn said.
- **Going Short and Out of Order:** Yellin also cited the most recent episode of the business's animated sci-fi anthology "Love, Death & Robots" as an ideal illustration of a programme that can be viewed in any specific sequence, which is precisely what the company is experimenting with via a unique episode picker right on your TV home page. The varied, let's call them animated shorts for adults, from "Love, Death & Robots," will all be in one row for certain members, he added.
- **Making Shows and Movies and Sound best:** On a specific setting to restore accuracy, Netflix has been collaborating with a few display manufacturers. Last year, a few Sony TV models got the "Netflix Calibrated Mode" for the first time. The business will collaborate with other TV manufacturers this year to add it to their products as well, but company managers weren't yet ready to reveal the names of those TV manufacturers.

- **Google:**

According to Connexity, Google has a competitive edge that enables it to maintain its position as the world's most popular search engine, which accounts for about 90% of the global search market. In order to keep its competitive edge, Google has built an infrastructure that ensures a quick and effective search engine, as well as expanding its activities outside of search.

Let's look at the typical Google search's speed first. According to Gigaom, a random search takes 0.06 to 0.12 seconds. Google's competitive advantage may be attributed to their self-built infrastructure of servers, storage systems, bandwidth, and hardware, which enables the quickest online search.

This competitive approach creates a strong barrier for other general search engines, such as Bing (previously MSN Search), which is merging with Yahoo!, despite the significant expense for the firm as Google spends billions of dollars on research and maintenance. At the same time, Google is investing in the expense of developing the cutting-edge infrastructure to make sure that the cost of running a search continues to decline.

Google has an edge over rivals because to its quick speed, which attracts new users. The search may provide different results, but because of the great speed, a user may quickly search another key word and will be less likely to move to a rival. In addition to offering quick searches, Google also offers other tools and services including the Google toolbar, Google Maps, Google Earth, and Google News. Users may do searches using the toolbar without leaving their homepage. By listing the websites that each user has most often searched, it also makes navigating easier. Beyond the basic

search engine, services like Google Maps and Google News provide another kind of help.

The Android operating system, which offers Google services and functionality as mobile apps, has also allowed Google to extend to mobile devices. With the use of these tactics, Google can connect with customers and get a competitive edge. The fact that Google offers a lightning-quick search and tools to assist the primary search engine gives it a competitive edge. Competing search engines like Bing or Yahoo would need to upgrade their infrastructure to meet Google's level of efficiency and breadth.

2.6 Areas to be taken care for getting competitiveness with the adoption of technological Strategies

- **Inappropriate Use:** Technology won't provide a competitive advantage if it is employed inefficiently or is not adequately tailored to the demands of the company and its consumers. It's critical to comprehend how technology may enhance internal operations, customer experiences, and the value proposition of the business.
- **Absence of Differentiation:** Simply offering identical technology won't provide you a competitive edge if every company in a market is utilising it. The secret is to employ technology in creative ways to stand out from the competition and provide them with something special.
- **Lack of Integration:** All facets of the firm, from manufacturing to marketing and customer support, must successfully incorporate technology. Technology is less likely to provide a competitive advantage if it is applied in isolation or improperly integrated into current processes.
- **Lack of Training and adaption:** Employees must be prepared to use technology in their everyday job and be ready to do so. Lack of proper training or encouragement of technology adoption may restrict its ability to provide competitive advantage.
- **Differ in Customers Expectations:** The pace of technological advancement and the changes in client expectations are both fast. If a new company does not react to shifting consumer expectations and tastes, introducing technology may not be enough. To sustain a long-term competitive edge, one must be able to predict and address evolving technological demands.

❖ **Exercises**

- **Long Questions**

1. What is the meaning of Technology Strategy?
2. Explain the reasons for adopting the technology strategies for the organizations.
3. Define the impact of adoption on technology strategy on the Industrial Structure.
4. Describe the benefit of technology strategy.
5. Describes the real time examples of the firm who have adopted the technology strategy for the competitiveness.

6. Mention the area which needs to be taken care for getting competitiveness for the technological strategies adoption.

- **Multiple Choice Questions**

1. Technology provides _____ advantage if its installed appropriately.
   A. Non-Competitive B. Cheap Cost
   C. Competitive D. Discount
2. AI Stands for _____.
   A. Academic Integrity B. Academic Initiatives
   C. Artificial Ingredients **D. Artificial Intelligence**
3. _____Software/s that has/ve been used by the Facebook to maintain their customer giants.
   A. RDBMS B. Origami
   C. Hive **D. All of these**
4. Which is not the benefit associated with the adopting technology strategy by the firm?
   A. Increases Efficiency **B. Increases Burden on Employees**
   C. Decreasing Cost D. Broad Work Challenges
5. Out of the below mentioned countries, which is not the part of FAANG?
   A. Nippon B. Facebook
   C. Amazon D. Google

UNIT – 3 TECHNOLOGY ACQUISITION, ADOPTION AND DIFFUSION

3.1 Introduction

Information technology is an aid that can be used to search for solutions and to identify opportunities for innovation and development for any organization. In pursuit of remaining competitive in the market, organizations strive for technological changes. Organizations are rather compelled to have technological advancements in order to sustain the business. The entire chapter is divided into three parts: technology acquisition, adoption and diffusion. The objective is to understand significance of technological requirements from organizational perspective.

3.2 Technology Acquisition

It is the process by which a company acquires rights to use a technology with an aim to improve processes, products/services. There are three sources to have technology acquisition: internal technology sources, external technology sources, and combination of both. Technology acquisition helps organization to develop internal capability and it can become less dependent on others. Many companies rely on new technology in order to develop innovative products/services which may help the company to earn competitive advantage. Technology can be acquired in many different ways depending upon the firm's necessity of using that technology.

3.2.1 Purpose

The organization's purpose of wanting to acquire a technology will affect the kind of technology they are looking for. The motivation to acquire technology can be largely categorized into: developing new technological capabilities, increasing strategic options and gaining efficiency improvements. Technology acquisition that does not result into access to exclusive technology makes it impossible for the company to prevent competitors to have the same technology for their products.

- **Developing new technological capabilities:**

The central interest for the acquisition of external technologies is the necessity to develop new technological capabilities and to fill gaps in the R&D knowledge base. Many times these acquisitions are required in order to make modifications in an existing product line as well as to create and establish a new product. Need for developing new technological capabilities often arises as firms may not have knowledge based resources internally, technological knowledge is close to exhaustion and possible technological combinations are already optimized.

- **Increasing strategic options:**

Technological acquisitions enable a firm to improve its strategic flexibility. By increasing internal technological capabilities, firm ends up having more strategic options to select from. It helps improving R&D productivity, encourages innovation and reducing inertia and rigidity of people.

Acquisitions can encourage innovation, countering inertia and rigidity and increasing R&D productivity. Novel technologies offers opportunities for radical innovation, opens new markets, provides knowledge of new customers, channels, processes etc. Acquisitions may help to deal with uncertainty and risk. Companies operating in digital industries are more dependent on indeterminate future outcomes or developments. Investing in external technologies as a way of keeping the options opens until the risks and uncertainty diminish.

- **Gaining efficiency improvements:**

Technology acquisition can reduce product/service time to market which helps firm to be more responsive to market demands. The internal development of new capabilities may take more time and may not be cost efficient. And acquiring technologies externally may be cost advantageous. Acquiring technologies helps the firm to feel less vulnerable and more competitive. When there is rapid technological change and fierce competition in their market, firms may have greater use of partnerships, collaborations and outsourcing.

3.2.2 Process

Technology acquisition is a technology transfer where transaction cost is associated with external sources such as R&D activities, licensing, subcontracting, and hiring employees.
The process of technology is displayed (Figure I). Technology acquisition requires:

I) Identification of attractive technologies or partners with required technological Capabilities
II) Assessment of these opportunities, selection of the most promising ones
III) Negotiation of the terms of acquisition between acquirers and sellers
IV) Transfer of the technology to the acquirer after successful negotiations

Step 1: Acquisition Context

The organization begins with the detailed framework for the acquisition. This includes motives to acquire technology along with types of partners that can be involved (on the basis of their capabilities). The step also deals with understanding level of readiness of the company for the desired technology.

Step 2: Acquisition evaluation

The firm is required to assess whether there is a match between technological capabilities and market opportunities. It also is required to evaluate the capability of the firm to absorb and make great use of the technologies that other firms are developing.

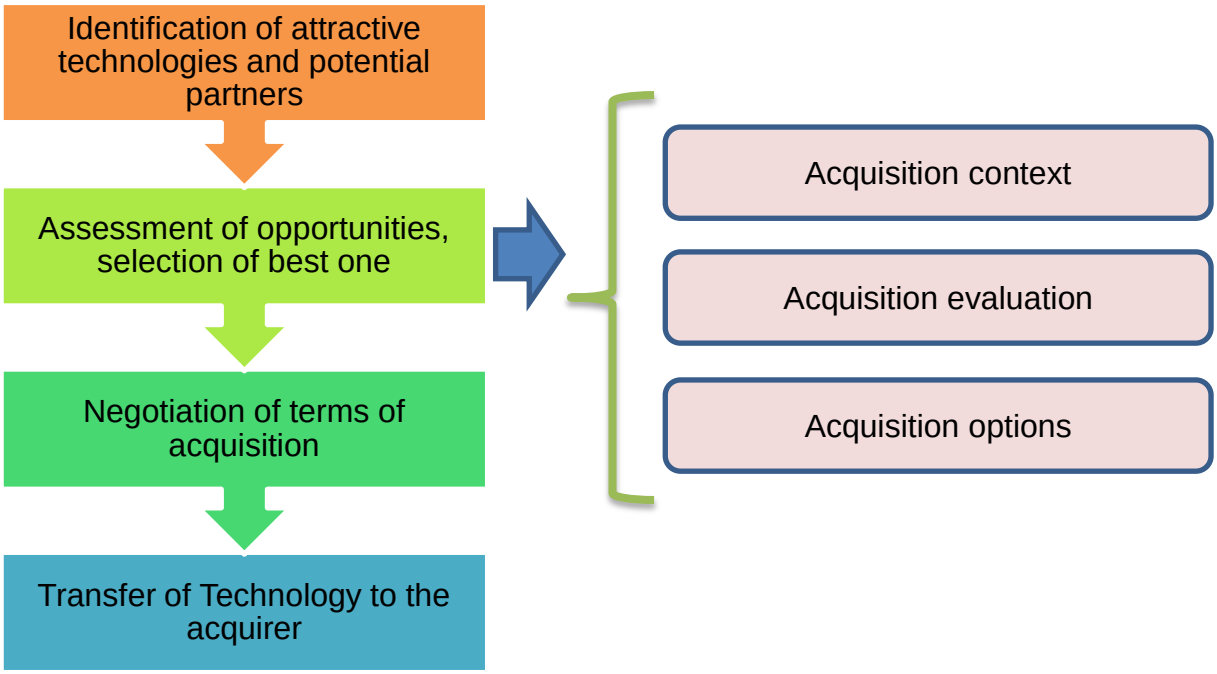


Figure I: Process of Technology Acquisition

Step 3: Acquisition options
After evaluation, if positive results turn up, the firm has to consider detailed terms for acquisition. During this phase, the firm evaluates different options such as future technological development, exploitation routes, protection strategies, the type of contract governing the relationship and the transaction 'currency'. It also provides evaluation of these options on the basis of advantages and disadvantages. It is suggested to have involvement of more members of the organization such as R&D managers, legal advisors, product managers, business managers, finance managers.

3.2.3 Factors Affecting Technology Acquisition Decisions

The decision to acquire technology depends on: availability and level of external sources, development time, development cost, familiarity with technology, and risk involved.

Availability and level of external sources: if the firm is deciding to acquire technology from external sources, alternative sources with required capabilities are to be considered.

Development time: as technological changes are dynamic, it is important to consider development time for the same. Firm has to strive in order to reduce the time as there is a risk of obsolescence of technology.

Development cost: cost always is a major consideration in acquiring a technology. Financial capability of the firm has to be taken care of. Also, cost should be considered on the basis of the long term output that it is going to offer.

Familiarity with technology: it is always easy to acquire familiar technology compared to obscure technology.

Risk involved: as technological changes are bound to happen in short duration, there is

obvious risk involved in acquiring technology. Risk could be in terms of finances, in terms of adoption/usage or diffusion of the same inside the firm and in the market.

3.2.4 Cost of Acquiring Technology

The cost of acquiring the technology deals with not only the payment made to the technology's owner. There are transaction costs associated that include an estimate of future costs, costs associated with any uncertainties relating to the acquisition, the need to acquire specific assets and how often it may be necessary to repeat such transactions.

- **Search cost:**

Cost of searching in terms of information related to technology to be acquired is to be considered here. Cost in terms of vendor search also is to be included.

- **System implementation**: It includes vendor cost and internal cost.
- **License fees**: for main system and ancillary systems such as separate report writers (costs may be ongoing, and/or there may be one-off charges)
- **Vendor implementation**: system configuration, customization, setting up reports, testing, data migration, training.
- **Infrastructure and hosting setup**: for main system and ancillary systems such as report writers.
  Travel and/or Related Expenses, Internal Cost and Vendor Cost
- **Implementation support**: to load information about clients into the system, support the setup of key forms and reports, assist with training, etc.

3.2.5 Benefits of Technology Acquisition

For businesses looking to gain a strategic edge, tech acquisitions are a game-changer. Following are the benefits sought by technology acquisition.

- **Rapid technological advancement**

By acquiring a technology, firm gains immediate access to cutting-edge innovations. This enables business to adapt swiftly to changing market conditions, stay ahead of competitors, and remain relevant in industry.

- **Expanded market presence**

Tech acquisitions provide an excellent opportunity to expand market presence. This can help to enter new market segments, reach a wider audience, and diversify revenue streams.

- **Enhanced competitive advantage**

Tech acquisitions help to gain competitive edge by consolidating resources and expertise.

- **Cost efficiency**

It's no secret that developing cutting-edge technology from scratch can be both time-consuming and expensive. Technology acquisitions offer a cost-effective alternative.

3.3 Technology Adoption

Technology adoption is the process of introducing, implementing and using new

technologies into present organizational practices. For successful technology adoption, proper planning and understanding regarding technology interaction with existing products and processes is required.

3.3.1 Implementation of technology adoption in an organization

Technology adoption process includes steps such as: assess organizational needs, identify suitable technologies, develop a strategy, pilot test and evaluate, training and change management, integration and support, data security and privacy, measure Success and ROI, assess organizational needs for technology adoption, before implementing any new technology, it is important to understand the current needs of the organization.

It is important to assess existing systems & infrastructure, processes, technology and financial resources. Also, the areas in which improvement is required are to be identified where new technology can help. This assessment will help to identify the right technologies to meet organizational needs. Once it is identified the areas of that could benefit from a technological solution, it is required to research and evaluate suitable technologies that would meet these needs. The firm shall identify how new technology will fit into existing processes and systems, as well as how it will be implemented and maintained. Creating a timeline and budget will help track progress and ensure the successful adoption of the technology in the organization. Before rolling out the new technology to everyone in the organization, it's important to have pilot testing. It helps in evaluating how well the technology works in practice and if required, makes any necessary changes before launch. After this, training needs for the employees of the organization are to be identified and training is to be imparted. Employees must understand how to properly use the system and how it is going to benefit them and at large to organization. In case of any issues, organization must have a dedicated team to manage and maintain the new technology. It is vital to have data security when introducing new technology in the organization. Unauthorized access or breaches are to be prevented using right talent and resources. Every new aspect introduced should be measured in terms of user satisfaction, system efficiency, cost savings, etc. This in turn may help to evaluate the return on investment (ROI) of new technology and decide whether it is worth continuing with the same in the long run.

3.4 Diffusion of Technology

Diffusion of technologies in organizations takes place in two ways: generation and adoption. In the case of generation, technologies are generated by organizations for their own use or for export to other organizations. In the case of adoption, technologies are imported into the organization.

The factors influencing diffusion of technology in organization are classified into three: factors related to attributes of technology, to adopters of technology, and to the social system.

Attributes of technology consists of relative advantage, compatibility, complexity, trial-ability, and observability. These include degree of uncertainty/risk associated, amount of investment required, benefits (including monetary and non-monetary), progress, profitability, flexibility of technology etc.

Factors related to the adopters of technology include: organizational strategy, organizational structure, and organizational culture. These include size of

organization, aggressiveness and innovativeness of the managers, level of information of organizations, learning readiness of organizations, degree of resistance to change, technical skills of the users of organizations.

Factors related to social system include the level of development of a society, communication channels in a society, social concerns, change agents, opinion leaders, and social norms.

❖ **Key words**

Technology acquisition, technology adoption, diffusion of technology,

❖ **Exercise**

- **Detail / Descriptive Answer**

1. What is technology acquisition? How an organization can acquire technology?
2. What are the benefits of technology acquisition?
3. Discuss costs associated with technology acquisition.
4. Discuss technology adoption.
5. How technology is diffused in any organization?

- **MCQ**

1. The technology acquisition deals with
A. Acquiring new technology B. Research
C. Production D. None of these

2. Cost of acquiring technology includes all of these except:
A. Vendor cost B. Search cost C. Maintenance cost D. Format

3. Last stage of technology acquisition process is_____
A. Acquisition Context B. Acquisition Evaluation
C. Acquisition Options D. Transfer

4. The decision to acquire technology depends on _____
A. Availability and level of external sources B. Development time
C. Development cost D. All of these

5. Competitive advantage is the benefit sought through technology acquisition:
A. True B. False

Answer

(1) A (2) D (3) C (4) D (5) A

Practical

1) A group of students may visit any organization which has recently acquired and adopted any new technology and understand the process and challenges.
2) Students may try to understand factors affecting technology diffusion in detail with respect to any organization of their choice.

UNIT – 4 TECHNOLOGY ASSESSMENT AND FORECASTING

4.1 Introduction

We make use of technology through many devices in our day-to-day life. Similarly, business organizations also make use of technology for various business functions. Some organizations invent new technology and enter into the market. Some organizations replace the existing or old or outdated technology with the latest and more efficient technology. Hence, technology assessment is required over a period of time. Assessment of technology is exhaustive and it covers analysis of its advantages and disadvantages as well as its financial, social, and environmental repercussions.

Over and above, assessment of technology, its forecasting is equally important because it focuses on forthcoming prediction of technological development, as well as improvements. Act of technology forecasting also plays a significant role in knowing potential impact of technological development and improvements on the operations and functions of the business organizations. It helps the business organizations to prepare for adaption of technological development. It also helps large business organizations to innovate new technology and replace the existing technology to save cost and thereby to increase the profitability. Technological changes are required to take competitive advantages.

4.2 Definition, Meaning and Importance

4.2.1 Meaning:

The crucial decision for any business organization is to accept or reject the technology for various business functions. Hence, the chief purpose of technology evaluation is to shed light on the implications of embracing or rejecting a certain technology. The term technology assessment has a wider scope as it also assesses the impact of technology. Hence, forecasting is a crucial aspect in technology assessment. It helps the business organizations to prepare not only for threats and challenges but also for grabbing opportunities.

In simple words, "Technology Assessment and Forecasting evaluates, forecasts not only technology but its potential effect on various functions of business organization and thereby helps in decision-making process, adapting changes, and staying competitive"

4.2.2 Definitions:

"Technology Assessment and Forecasting refers to not only assessment of potential advantages, disadvantages and various impacts such as economical, social, moral,

ecological impact of technology but also forecast of future of technology through analysis of existing facts, figures and trends pertaining to technology."

"Technology Assessment and Forecasting can be termed as process of projecting future technical advancements and analysing their present and possible effects so as to manage risk, plan strategies and take appropriate business as well as policy decisions."

4.2.3 Importance:

1. **Decision-Making Process:** Technology Assessment and Forecasting helps the management in knowing the present as well as potential state of technology comprehensively and thereby plays an important role in decision making process. It also helps the management to take decision whether to adopt technology or not, whether to purchase technology or not. It also helps the management in selection of the most profitable technology through various techniques such as capital budgeting.
2. **Prevention of Risk:** Through Technology Assessment and Forecasting, management comes to know about the potential risks allied with the technology adoption well in advance. Hence, it is possible for the management to identify and mitigate the potential risks by development of appropriate strategy and thereby to protect the organization from the adverse impact of technology.
3. **Allotment of funds:** Technology Assessment and Forecasting plays a key role in providing holistic information about the technology. Hence, the management gets an idea not only about the potential benefits to be received from the technology but also about the potential costs to be incurred. Hence, it is possible the business organization to estimate the requirement of funds accurately, optimum allocation of funds through cost-benefit analysis.
4. **Transparency:** Technology Assessment and Forecasting takes into account interest of all the stakeholders in the decision-making of the selection and implementation of the technology. It also involves participation of various stakeholders in the decision-making process and thereby Technology Assessment and Forecasting adds transparency and authenticity.
5. **Competitive:** Technology Assessment and Forecasting assesses as well as forecasts not only prospective trends in technologies but also design strategies that are in line with these technologies. As a result, Technology Assessment and Forecasting makes business organizations adaptable to changing market conditions and keep them competitive.
6. **Innovative:** Technology Assessment and Forecasting helps the business organizations to understand the required technology to be implemented. The big players in the market having research and development section, can develop innovative technology for them and thereby to keep them competitive in the market.
7. **Policy Designing:** Technology Assessment and Forecasting helps not only business organizations but apex monitoring bodies to get an idea about the potential threats and challenges allied with the technology. It also helps them to know the opportunities to be offered by the technology. Hence, Technology Assessment and Forecasting has a great significance in designing befitting policies for the overall development and growth of the sector and the nations.

4.3 Area Needing Attention in Technology Assessment and Forecasting

Though the Technology Assessment and Forecasting is a significant process of projecting future technical advancements and analysing their present and possible effects so as to manage risk, plan strategies and take appropriate business as well as policy decisions, the following areas which require attention, the competence as well as importance:

1. **Rules and Regulations:** Moral issues are embedded in technology assessment and forecasting. Hence, during the process of technology assessment and forecasting, it is difficult to get an idea about them. In such a situation, identification of moral issues pertaining to up-and-coming technology needs greater attention. Business organizations are required to frame rules and regulations for these issues so as to ensure ethical and equitable growth and development.
2. **Alliance:** In some industries, technologies are complicated and complex because they are based on more than one industry or function or subject. Hence, it is difficult to assess and forecast technology by the experts having knowledge of one industry or function or subject. Business organizations are required to implement alliance among such industries or functions or subjects to have thorough evaluation and forecast of the technology.
3. **Global Alliance:** Due to globalization, technology is also imported by the business organizations. As a result, business organizations also face difficulty in its assessment and forecast because of lack of knowledge and skill. Hence, Business organizations are required to gave global alliance for the effective and accurate assessment and forecast of the technology.
4. **Wider Perspective:** For technology assessment and forecast, perspectives of stakeholders are required. However, most of the industries faced difficulty in absorbing the perspectives and viewpoints of all the stakeholders as a result there are chances of faulty assessment and forecast of the technology due to narrow perspective. Hence. Business organizations are required to have wider perspective and have participation of representatives of Various stakeholders in the evaluation and forecast of the technology so as to have comprehensive assessment and forecast of the technology.
5. **Flexibility in assessment:** To have competitive advantage, business organizations make up-dation or invention or adoption of improved or new technology. However, methodology of technology assessment and forecast does not get updated or improved correspondingly. Hence, there are very much chances of the defective and faulty evaluation of the technology. Business organizations are therefore required to have flexibility in methodology of technology assessment and forecast so that there will be quick change in methodology to assess and forecast technology in correspondence with the change in technology.
6. **Flexibility in Rules and Regulations:** On one hand, Rules and regulations for assessment and forecast are framed by the regulatory bodies which take ample amount of time; while on the other hand, advances in technology take place very swiftly. Hence, it is difficult to have efficient regulatory framework for the assessment and forecast of the technology. Regulatory bodies should employ flexibility in framing as well as reframing rules and regulations for technology assessment and forecast with the changes in technology.

7. **Enduring Assessment:** Technology assessment and forecast is a process that effectively carries out the short-term impact of technology. However, it is difficult to study long-term effects of the technology as a result it is also difficult to design long-term policies, strategies to accomplish long-term goals and thereby to realize mission and reach vision of the organization. Hence, business organizations are required to innovate such methodology for the technology assessment and forecast as can study enduring effect of the technology, its trend, its impact on various functions of the organizations so as to achieve long-term goals over and above short-term goals of the organizations.

4.4 Skills and facilities for Technology Absorption

4.4.1 Meaning

"Organization's capacity to absorb the technology obtained from external stakeholders, such as partners or collaborators or research and development institutes or suppliers, through combination of various skills, facilities over and above organizational procedures, and infrastructure is referred to as technology absorption."

From the above meaning, it is clear that organizations, which do not have infrastructure to develop the technology at their own, have to obtain the technology from external sources. After obtaining the technology, they are required to absorb it so that they can make use of it. For absorbing the technology, they need to have adequate skills, facilities, infrastructure as well as methodology as listed below:

4.4.2 Skills and Facilities required for Technology Absorption

1. **Technical Expertise:** When technology is obtained, the business organizations should be capable to absorb it. The obtained technology should be installed, integrated and implemented timely and quickly for getting its benefits. For successful technology absorption, the business organizations should have workforce having technical expertise and skill so that new technology can be adapted quickly.
2. **Facilities of Training:** the business organizations should have adequate infrastructure to facilitate the workforce to absorb the technology. They should periodically give training to the workforce to get acquainted with the new technology and up dation of their skill because the trained workforce can quickly be absorbed and adjusted with the technology and able to install and implement the technology. Hence, it is essential to develop the training department with a view to have a culture for continuous up dation in skill, learning, and knowledge about the existing as well as latest and upcoming technology.
3. **Facilities of Research and Development:** In the competitive world, up dation or invention of technology is mandatory for any business organization. For the purpose, it is essential for the business organizations to have the facility of well-equipped research and development department where new technology can be invented over and above upgradation of the existing technology. Research and development should consist of the infrastructure having well-equipped laboratory to test, experiment and prototype (Prototype is a sample or model or design of product to be tested with a view to develop

concept or product or production process, while prototyping is a process which makes available requirement for an actual processing rather than theoretical concept.) It should also evaluate usefulness of the technology before its absorption.

4. **Skills for Risk Management:** Risks are associated with the technology absorption. They are required to be identified and reduced for successful absorption and execution of technology. Hence, business organizations should have workforce having expertise and skill in managing risks allied with technology absorption with a view to mitigate risk over and above skill in managing project with a view to planning and timely implementation of technology absorption.
5. **Skills for Communication:** In some industries, technologies are complicated and complex because they are based on more than one industry or function or subject. Due to globalization, technology is also imported by the business organizations. As a result, business organizations go for collaboration across functional domains to bring together experts and specialists of various industries or functions or subjects to for smooth technology absorption. Business organizations should also provide facilities to develop communication skill to the workforce for smooth technology absorption.
6. **Skills to Manage Transformation:** When new technology is obtained, it brings holistic transformation in the organization. It brings sense of hesitation and resistance to adopt and absorb new technology among various stakeholders. Hence, it is essential to manage this transformation through dynamic and effective leadership because if leadership is strong, it can easily manage this transformation and change as well as encourage the positive attitude among the employees towards technology absorption.
7. **Skills to Manage Intellectual Property:** When New technology is developed by any organization, it is considered as intellectual property of the said organization. The said organization get the new technology protected by patents so that it can commercialise the said technology. When such technology is obtained by the organization, it becomes essential and crucial to manage such intellectual property through development of strategies over and above managing licensing agreements or collaborations with the providers of technology. So, the business organization should have facilities as well as employees having skill in managing intellectual property.

4.5 User Involvement in Absorption

In order to effectively implement and integrate new technologies in an organization, user involvement is a crucial component of technology assimilation. New technology obtained in an organization brings many challenges such as resistance to change or transformation, risk, intellectual property, communication, training to staff etc, which can be addressed with the help of development of skills and creation of facilities. In addition, user involvement in technology absorption helps an organization to a great extent to manage challenges came before the organization due to absorption of technology. It also makes adoption and transition process smoother and simpler and quicker by improving their overall satisfaction. Following strategies would help the organization for effective participation of the users in technology absorption:

1. **Input from Users:** Before obtaining and absorbing technology, users should be involved in selection of the appropriate technology by taking their inputs regarding the problems with the existing technology, their needs and aspirations from the new technology. With a view to take users' inputs, various instruments such as surveys, questionnaires, interviews are used. Moreover, the users should be involved in pilot testing of the new technology to be adopted and their feedback would be of great importance for development, adoption and development of incremental enhancements in new technology.
2. **Development of Capabilities of Users:** For effective technology absorption, the users should be well-acquainted with the competencies and know-how needed for efficient utilization of the new technology. Users' capabilities to absorb new technology should be developed by designing the focused training programmes. Throughout as well as after the training programmes, users' reviews and responses should be gathered for developing their capabilities for effective absorption of technology and modifying the future training programmes.
3. **User-friendly Design:** New technology to be obtained and absorbed should be user-friendly. Hence, users should be involved in designing and testing of the new technology so that it would be user-friendly and comprehensive and free from challenges with its usability.
4. **Two-way Communication:** Users should be made conscious about the new technology and its pros and cons for its successful absorption. For the purpose, the organizations should develop communication strategies to make the users aware and conscious about the upcoming technology. The communication strategies should focus on two-way communication. The users should also be able to communicate with the organizations through various strategies such as feedback, questionnaire, report etc.
5. **User Participation:** Users should be participated in the decision-making process of the new technology to be adopted or developed. User participation plays a significant role not only in selection of the appropriate technology but also in making modification or customizing the technology. Hence, the organizations should constitute the committee consisting of the users and decision-makers so as to have regular interaction (pre and post technology absorption) between them. It would help the organizations to make unremitting enhancement in the technology by solving the complications faced in utilization of the technology and augmenting its effectiveness.
6. **Rewards and Recognition**: For active participation of the users in technology absorption, they should be given incentives for giving the recommendation or feedback or raising the requirement. The services of the users who have actively participated in the decision-making process of the technology absorption should be recognized or honoured. The users should also be rewarded or given incentives not only for active participation but also for effective and efficient utilization of the technology. Such rewards and recognition programmes would also motivate the users who are non-participating in the decision-making process.
7. **Perpetual Process**: User involvement in technology absorption process is perpetual process and hence it should be made mandatory part or component of technology absorption process. It should not be taken as an isolated event

or one-time occurrence. If users are involved perpetually in the technology absorption process, it would mitigate risk of technology absorption as well as the resistance of the users and thereby it would optimize the benefits of the new technology and accomplish the overall goals of the organization.

4.6 Technology Absorption & Adaptation Scheme

4.6.1 Meaning:

"A structured scheme to absorb and adapt technology successfully and smoothly with a view to accomplish organizational goals is termed as technology absorption & adaptation scheme."

"A flexible, effective and dynamic scheme that takes into account organizational requirements and accordingly makes changes in technology is known as technology absorption and adaption scheme."

4.6.2 Features of Technology absorption & adaptation scheme

1. **Analysis of requirements:** A good technology absorption & Adaptation scheme analyses the requirements and problems faced by the users over and above requirements and problems of the organization before absorption and adaption of the technology. On the basis of the such analysis, it strategically selects such a technology as fulfils the organizational requirements and objectives.
2. **Auditing:** Technology absorption & adaptation scheme has been implemented with a strategy not only to select the right technology but also such technology as accomplish the goals of the organization. Hence, the absorbed and adapted technology should be audited and reviewed periodically to ensure that it accomplishes the goals of the organization. For the purpose of audit and review of the technology, technology absorption & adaptation scheme should be designed with Key Performance Indicators (KPIs).
3. **Problem Solving:** Unser technology absorption & adaptation scheme, absorption and adaption of the technology is not covered only, but the problems faced during utilization of the technology are also solved. For the purpose, rapid assistance is provided through help kiosks or desks and support staff. Similarly, knowledge base is also established for offering quick solutions in case of prevalent problems.
4. **Mitigation of Resistance:** New technology absorption brings the sense of resistance among the users because they are unaware about the process of adoption and benefits of the technology. Technology absorption & adaptation scheme should make the users aware about the process of the technology absorption. It should also constitute the team or group of the workforce which can advocate the new technology with its benefits, its need to survive and sustain in the competitive world as well as its requirement in accomplishment of the users' and organizational goals.
5. **Dynamic:** Technology absorption & adaptation scheme should be flexible and dynamic. It should cover both pre-phase and post-phase of technology absorption and adaption. It should undertake the pilot study with a view to know the problems faced and requirements of the users, to know the areas for improvements in technology, make the required alterations, and thereby to finalize or customize the most suitable technology to be absorbed for the

accomplishment of the organizational goals. It should also design feedback mechanism on technology's performance for its improvement and increase its utility.

❖ **Exercise**

- **Theoretical Questions**

1. "Technology Assessment and Forecasting is of great importance for the business organization in Decision-Making Process, Prevention of Risk, to be Competitive and Transparent." – Do you agree with the statement? Discuss in detail.
2. Define Technology Assessment and Forecasting and discuss its significance of in detail.
3. Which Areas Need Attention in Technology Assessment and Forecasting? Also discuss the strategies to be implemented by the organization to address theses areas.
4. "For absorbing the technology, the business organizations need to have adequate skills, facilities, infrastructure as well as methodology." – Do you agree with the statement? Give your comments.
5. "New technology obtained in an organization brings many challenges such as resistance to change or transformation, risk, intellectual property, communication, training to staff." – Do you agree? How Users Involvement in technology absorption would help the organization to mitigate with theses challenges? Discuss in detail.
6. "A structured scheme is required to absorb and adapt technology successfully and smoothly with a view to accomplish organizational goals" – Do you agree? Give your comments in detail.
7. "A flexible, effective and dynamic scheme takes into account organizational requirements and accordingly makes changes in technology" – Is it true? Give your comments.

- **Short Notes**

1. Importance of Technology Assessment and Forecasting
2. Areas Needing Attention in Technology Assessment and Forecasting
3. Strategies for addressing the areas needing attention Technology Assessment and Forecasting
4. Skills and facilities for Technology Absorption
5. User Involvement in technology Absorption
6. Technology absorption & Adaptation scheme

- **MCQs**

1. Technology Assessment and Forecasting refers to ____
   a) assessment of potential advantages, disadvantages
   b) forecast of future of technology
   c) Both a) and b)
   d) None of above
2. Process of projecting future technical advancements and analysing their present and possible effects is known as ____.
   a) Technology Assessment and Forecasting
   b) Technology assessment and evaluation

c) Technology forecasting and budgeting
d) None of the above

3. Technology Assessment and Forecasting is Important in ____
a) Decision-Making Process
b) Decision-Making Process but not in Prevention of Risk
c) Decision-Making Process but not in Allotment of funds
d) Decision-Making Process but not for making the organization competitive

4. Technologies are complicated and complex because they are based on more than one industry or function or subject. Hence, business organization required to have ___

a) to have flexibility in methodology of technology assessment
b) to have wider perspective
c) to have wider perspective
d) to have alliance

5. In the competitive world, up dation or invention of technology is mandatory for any business organization. Hence, For the purpose, it is essential for the business organizations to have ___
a) Facilities of Training
b) Facilities of Research and Development
c) Skills to Manage Transformation
d) Skills for Communication

6. The services of the users who have actively participated in the decision-making process of the technology absorption should be__ .
a) recognized
b) discouraged
c) demotivated
d) demoted

7. Users' capabilities to absorb new technology should be developed by designing ___.
a) focused training programmes
b) rewards programmes
c) recognition programmes
d) honour programmes

8. A structured scheme to absorb and adapt technology successfully and smoothly with a view to accomplish organizational goals is termed as __ .
a) Technology assessment scheme
b) Technology forecasting scheme
c) Technology assessment and forecasting scheme
d) technology absorption & adaptation scheme

9. A flexible, effective and dynamic scheme that takes into account organizational requirements and accordingly makes changes in technology is known as ___.
a) technology assessment scheme
b) technology forecasting scheme
c) technology assessment and forecasting scheme
d) technology absorption & adaptation scheme

10. New technology absorption brings the ___ among the users because they are unaware about the process of adoption and benefits of the technology.
a) sense of achievement

b) sense of resistance
c) sense of rewards
d) sense of honour

- **Answer Key of MCQs**

Que No	Answers
1.	c
2.	a
3.	a
4.	d
5.	b
6.	a
7.	a
8.	d
9.	d
10.	b

UNIT – 5 MANAGEMENT OF TECHNOLOGY ABSORPTION AND GOVERNMENT INITIATIVE

5.1 Introduction and Meaning of Technology Absorption

Technology is considered assimilated if it is completely comprehended, allowing for further optimisation and advancement. Technology absorption includes 'know-why' activities and fundamental system, process, and product studies. An "unpacking" of a technological bundle will be necessary. Technology adoption necessitates R&D initiatives in know-why, optimisation, and enhancement of products, processes, systems, and associated machinery in order to prevent additional dependency. These efforts include design research, the use of alternative raw materials and components, changes to meet Indian standards, etc. Technology absorption skills will be attained through the completion of successful initiatives in these fields.

The methodical process through which businesses acquire, absorb, and incorporate new technologies into their current processes, goods, or services is referred to as management of technology absorption (MTA). This idea is especially important in today's fast-paced technology world, when a company's ability to remain competitive frequently rests on its capacity to follow or even pioneer technical innovations.

5.2 Key Aspects of Management of Technology Absorption

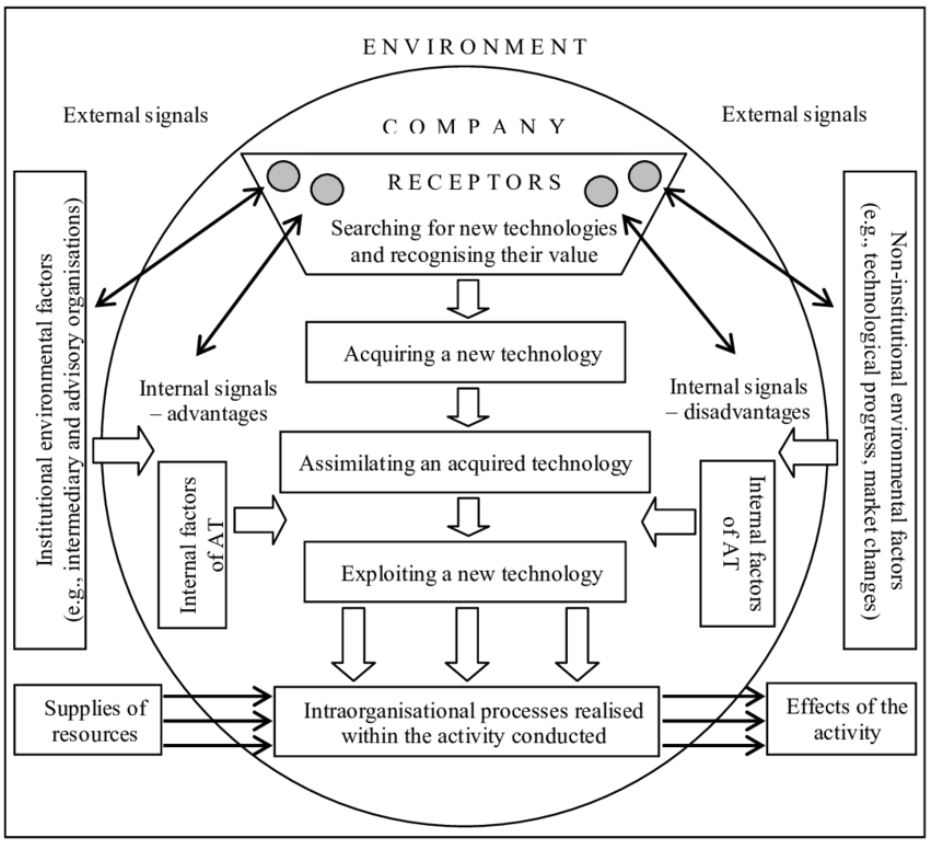
There are various parameters for the technology absorption that we need to take into the consideration for the management of technology for the improvement of the productivity in the organization worldwide. These important aspects for the technology absorptions are mentioned below:

1. **Assessing the Technology:** Organisations must assess and pinpoint pertinent technology that may help their operations. This entails evaluating the possible effects of these technologies on their offerings, operational methods, and competitiveness in general.
2. **Acquisition of Technology:** Organisations must choose whether to create a suitable technology internally, licence it from outside sources, work with other organisations, or purchase it via mergers and acquisitions.
3. **Assimilation of Technology:** Organisations must successfully incorporate new technology into their ongoing operations after purchasing it. This often entails integrating new technology with the business's current systems, procedures, and workforce.
4. **Adaption of Technology:** Organisations may sometimes need to adapt newly acquired technology to match their unique requirements or to achieve a competitive edge.

5. **Development of Skills:** In order to optimise the use of emerging technologies, it is essential to provide staff with comprehensive training and skill enhancement initiatives to guarantee the acquisition of the requisite competence.
6. **Constant monitoring and upgradation of technology:** Technological advancements progress at a rapid pace, necessitating organisations to consistently assess the efficacy of adopted technologies and make necessary updates to sustain competitiveness.
7. **Intellectual Property Management:** The management of intellectual property rights is of utmost importance when assimilating external technology since it encompasses legal and contractual dimensions aimed at safeguarding the interests of the organisation.
8. **Risk Management:** It is crucial to evaluate and address any risks related to the assimilation of technology, including financial risks, compatibility concerns, and market uncertainty.
9. **Strategic Integration:** The alignment of the process with the organisation's overarching strategic objectives is vital to ensuring that the assimilated technology effectively contributes to its sustained long-term success.
10. **Sharing of Knowledge:** Promoting information exchange and fostering cooperation within the organisation may effectively enhance the advantages derived from the absorption of technology.

The process of absorption has the potential to result in heightened levels of creativity, enhanced competitiveness, elevated product quality, and improved overall performance within organisations. This enables individuals to use external information and technology in order to remain relevant and flourish within a constantly evolving technological environment.

5.3 Model of Technology Absorption



The Management of Technology Absorption model encompasses a sequential process that organisations undergo while assuming the role of technology adopters. The aforementioned processes comprise a range of responsibilities and internal elements that play a significant role in facilitating the effective adoption and integration of technology within an organisation. In order to comprehensively analyse the Management of Technology Absorption (MTA) model, it is necessary to deconstruct it into its fundamental stages while also elucidating the respective duties and activities undertaken by the firm at each juncture.

Step 1: Technology Assessment: In this initial step, the company plays the role of an evaluator and assessor. The company tries to identify the need for new technology based on strategic goals and market demands. Assess the potential impact and benefits of the technology on the organization. Consider the alignment of the technology with the company's values and goals.

Step 2: Technology Acquisition: The company acts as a procurer or acquirer. Decide whether to develop the technology in-house, license it, collaborate with external partners, or acquire it through mergers or acquisitions. Finally, Negotiate and secure agreements, contracts, or partnerships with technology providers.

Step 3: Technology Assimilation: The company becomes an integrator and internalizer. Integrate the new technology into existing systems and processes. The company tries to align the technology with the company's internal culture and organizational structure and also customize or modify the technology as necessary to fit the company's specific needs and finally train employees to use the technology effectively.

Step 4: Exploration of New Technology: The company functions as an explorer and learner with the Continuously monitor the performance of the absorbed technology, Stay updated on technological advancements and trends in the industry and encourage a culture of innovation and experimentation within the organization.

Step 5: Intraorganizational Process Realization: The company serves as a coordinator and facilitator of internal processes with the Facilitate communication and collaboration among different departments or teams to leverage the technology effectively, develop workflows and procedures that incorporate the new technology seamlessly into daily operations and establish feedback loops for employees to share insights and improvements related to the technology.

Step 6: Supply of Resources: The company acts as a provider of resources and support. Allocate necessary financial, human, and technological resources to support the technology's implementation and growth and ensure that teams have access to the resources and tools they need to use the technology effectively.

Step 7: Effects on various operations: The company becomes an assessor of outcomes and impacts. Continuously assess the effects of the technology on various aspects of the organization, including productivity, innovation, cost efficiency, and customer satisfaction, adjust strategies and operations based on the results of the assessment and recognize and celebrate the value and benefits generated from the successful absorption and utilization of the technology.

The present model places significant emphasis on the dynamic and iterative characteristics of technology absorption, whereby the roles and actions of the firm

undergo evolution throughout the course of the process. The successful implementation of technology absorption requires the adoption of a strategic framework, a willingness to adapt, and a dedication to embracing the potential benefits and challenges that result from the incorporation of novel technologies into the operational processes of an organisation.

5.4 Advantages of Management of Technology Absorption

The proper implementation and integration of new technologies into organisational activities provide several benefits to organisations in terms of Management of Technology Absorption. These aforementioned benefits contribute to their enhanced competitiveness, propensity for innovation, and overall achievement. The following are few significant advantages associated with the implementation of Management of Technology Absorption:

- **Enhanced Innovation:** Management of Technology Absorption actively promotes the adoption of cutting-edge technical innovations, hence fostering a culture of enhanced innovation inside organisations. Through consistent adoption of emerging technologies, organisations have the ability to foster innovation, cultivate novel offerings, and establish a distinctive market position.
- **Competitive Advantage:** Enterprises that effectively assimilate and adapt to emerging technology often get a competitive advantage. Organisations have the capacity to enhance their product or service offerings, optimise operational efficiency, save expenses, and promptly adapt to dynamic market circumstances.
- **Enhanced Efficiency and Productivity:** Novel technologies are often developed with the intention of optimising workflows and augmenting productivity. By employing Management of Technology Absorption, organisations have the ability to streamline processes, minimise the need for human intervention, and enhance the overall efficiency of their operations.
- **Cost Reduction:** Certain technologies, when appropriately assimilated and efficiently deployed, have the potential to aid organisations in the reduction of costs. One such instance is the potential of automation and digitalization to result in decreased labour expenses, diminished rates of errors, and enhanced allocation of resources.
- **Market Expansion:** The Management of Technology Absorption (MTA) has the potential to explore and tap into untapped market segments, therefore creating new chances for growth and development. Organisations may enhance their market presence and augment their customer base by using technologies that are tailored to accommodate diverse client groups or worldwide marketplaces.
- **Enhanced Customer Experience:** The absorption of technology has the potential to enhance the customer experience, resulting in increased levels of customer service and satisfaction. The use of this technology enables organisations to provide more personalised experiences, expedited response times, and provide access to cutting-edge goods or services.
- **Mitigation of Risk:** Risk mitigation is the proactive approach of organisations to identify and address potential hazards by ensuring their technological knowledge and capabilities remain current. For example, the use of cybersecurity technology has the capacity to safeguard against unauthorised

access to sensitive information and mitigate the risks associated with cyber intrusions.

- **Talent Attraction and Retention:** It is often observed that employees exhibit a preference for organisations that actively adopt and integrate technological advancements. The implementation of Management of Technology Absorption inside a firm has the potential to enhance its appeal to highly qualified individuals, as well as foster the retention of competent people who value the opportunity to work with advanced tools and innovative solutions.
- **Environmental sustainability:** It is a crucial objective that may be facilitated by various technologies aimed at minimising resource use and mitigating environmental effect. The Management of Technology Absorption has the potential to assist businesses in the adoption of environmentally sustainable practises and goods.
- **Strategic partnerships:** It includes the pursuit of technology absorption, which may result in the establishment of collaborations and alliances with technology suppliers, research institutes, and other organisations. These relationships facilitate the exchange of information and the formation of strategic alliances.
- **Long term Growth:** The Management of Technology Absorption plays a significant role in fostering a company's long-term development and ensuring its sustainability. Organisations may maintain their relevance and resilience in the face of disruption by constantly adjusting and adapting to technological advancements.
- **Data-driven decision-making:** It is a prevalent practise in contemporary times, facilitated by several advanced technologies that provide important data collection and analysis capabilities. By using the Management of Technology Absorption methodology, organisations may effectively use data to make well-informed decisions, hence enhancing their strategic planning and overall performance.

It is essential to acknowledge that while the Metropolitan Transportation Authority has a multitude of benefits, it also presents some problems, including the need for financial commitment, the necessity to adapt to changing circumstances, and the effective management of possible hazards. However, when applied with efficacy, MTA may serve as a potent instrument for organisations seeking to flourish in the current swiftly changing technology environment.

5.5 Indian Scenario in terms of Management of Technology Absorption

India has seen substantial advancements across several industries as a result of proficient technology assimilation and management. Presented below are many instances of technology absorption projects and notable success stories in the context of India:

- **Information Technology (IT) and Software Services:** The IT business in India serves as a prominent illustration of technological assimilation. Indian IT firms have effectively assimilated and adjusted to state-of-the-art technology in the domains of software development, artificial intelligence (AI), cloud computing, and cybersecurity. The company has achieved global leadership in delivering information technology services and solutions to customers on a worldwide scale.

- **Pharmaceutical Industry:** The pharmaceutical industry in India has effectively incorporated and adopted technological advancements in several aspects, such as research and development, medication production, and quality control. The integration of automation, data analytics, and artificial intelligence (AI) within the domains of drug development and clinical trials has expedited the pace of innovation and enhanced the overall efficacy of pharmaceutical products.

- **Agriculture:** Indian agriculture has seen significant technological assimilation via the use of precision agricultural methods. Farmers are using contemporary technology, like satellite imaging, Internet of Things (IoT) sensors, and mobile applications, to oversee the well-being of crops, optimise irrigation practices, and augment production.

- **Renewable Energy:** India has successfully incorporated and assimilated renewable energy technologies, including solar and wind power, into its energy portfolio. The nation has made significant financial commitments towards solar photovoltaic and wind energy initiatives, therefore reducing dependence on fossil fuels and actively contributing towards the attainment of sustainability objectives.

- **Smart Cities:** The Smart Cities Mission initiated by the Indian government is a comprehensive endeavour aimed at integrating technology into the realms of urban planning and development. The aforementioned projects include intelligent traffic management systems, waste management solutions, and the implementation of Internet of Things (IoT) devices with the aim of improving the overall urban living experience.

- **Healthcare:** The healthcare industry in India has implemented telemedicine, electronic health records (EHRs), and diagnostic technology. The aforementioned advancements have effectively enhanced the accessibility and provision of healthcare services, particularly in geographically remote regions.

- **Fintech:** The financial industry in India has seen a significant transition as a result of the integration of financial technology (fintech) solutions. The widespread use of mobile payment applications, digital wallets, and online banking services has facilitated the promotion of financial inclusion and enhanced accessibility.

- **Manufacturing Sector:** The industrial sector in India has increasingly adopted automation, robots, and modern manufacturing technology. These technological advancements have resulted in enhanced productivity, improved product standards, and heightened competition within industries such as automotive, electronics, and textiles.

- **Space Research:** The Indian Space Research Organisation (ISRO) has assimilated and enhanced sophisticated technology for the purpose of space exploration, including activities such as satellite deployments, lunar expeditions, and missions to explore Mars. The cost-effective approach to space technology used by the Indian Space Research Organisation (ISRO) has garnered significant worldwide acclaim.

- **Education:** Indian educational institutions have used e-learning platforms and digital classrooms as a means to augment the educational experience. The National Digital Library of India and Massive Open Online Courses (MOOCs) are educational endeavours propelled by technology.

The aforementioned examples exemplify India's use of technology absorption as a catalyst for fostering growth, innovation, and advancement across diverse industries. The ongoing process of technology adoption and adaptation is of paramount importance for the nation's economic and social development.

5.6 Different Countries Government Initiatives for the Technology Absorption

Meaning:

A government initiative aimed at technology absorption management encompasses a comprehensive framework of measures, policies, initiatives, and approaches implemented by a government to facilitate and supervise the efficient assimilation, integration, and application of novel technologies across various sectors of the nation's economy, organisations, and broader societal context. The main aim of these efforts is to use technology in order to promote economic growth, foster innovation, enhance competitiveness, and tackle social issues. The following is an analysis of the fundamental components and objectives of a governmental endeavour aimed at facilitating the assimilation of technology.

- Technology Adaption and Adaption
- Promoting Innovation within the organization
- Focus on Economic Growth
- Developing Global Competitiveness
- Consideration of Sustainability and Economical Goals
- Development of Education and Workforce
- Infrastructure Development
- Regulation and Standards
- Support for Startups and Small Enterprises
- International Collaboration
- Digital Inclusion
- Monitoring and Evaluation

These are the basic considerations from every country's government side to take the initiative for the promotion of technology absorption among the various industries that are running their operations within the nation. The scenarios of the various nations across the world in terms of the management of technology absorption with successful government intervention are mentioned below:

Numerous nations throughout the globe have implemented diverse initiatives and strategies aimed at fostering efficient governance and the assimilation of technology across various industries. These efforts often target the promotion of innovation, the enhancement of competitiveness, and the resolution of social concerns. Presented below are examples of technology absorption projects implemented by different nations:

- **United States:** The United States has a complex national innovation system, including several components such as government research funding, technology transfer offices situated inside institutions, and dedicated assistance for startups facilitated by entities like the Small Business Innovation Research

(SBIR) programme. The primary objective of the Advanced Research Projects Agency-Energy (ARPA-E) is to concentrate its efforts on the development and subsequent commercialization of cutting-edge energy technology.

- **China:** China's "Made in China 2025" project is a strategic strategy designed to enhance the manufacturing capacity of the nation by means of technological assimilation. The primary areas of concentration included in this initiative are robots, artificial intelligence, and green energy.

- **South Korea:** The Creative Economy Project in South Korea aims to foster economic development by facilitating the integration of technology and creativity. The initiative encompasses the provision of assistance to nascent businesses, the cultivation of centres for innovative activities, and the promotion of entrepreneurial endeavours within burgeoning sectors.

- **Germany:** The Industry 4.0 programme in Germany aims to facilitate the incorporation of digital technology, automation, and the Internet of Things (IoT) into industrial operations. The objective is to augment the industrial competitiveness of the nation.

- **Japan:** The Society 5.0 vision in Japan aims to establish a highly advanced society by incorporating state-of-the-art technology such as artificial intelligence (AI), the Internet of Things (IoT), and robots into many domains such as healthcare, transportation, and education.

- **Israel:** Israel has a flourishing innovation environment that places a strong emphasis on the assimilation of technology. The nation actively fosters the establishment of new enterprises, facilitates the acquisition of venture capital, and facilitates collaborative research and development (R&D) initiatives between academic institutions and the private sector.

- **Singapore:** The Smart Nation effort in Singapore endeavours to use technology in order to enhance several aspects of societal well-being, environmental sustainability, and economic advancement. The scope of this initiative includes initiatives pertaining to intelligent infrastructure, healthcare, and transportation.

- **Sweden:** It places a significant focus on the adoption of technology and fostering innovation within its industrial strategies. Government institutions such as Vinnova play a crucial role in providing financial resources and assistance to facilitate the progress of research, development, and innovation endeavours.

- **United Kingdom (UK):** The Industrial Strategy of the United Kingdom places emphasis on the use of technology as a means to augment productivity and boost competitiveness within several industries, including artificial intelligence, renewable energy, and life sciences.

- **India:** The Digital India campaign in India aims to facilitate the use of technology in order to revolutionise government, improve accessibility to digital services, and foster innovation and entrepreneurship. The aforementioned projects include Skill India and Startup India.

- **Brazil:** It has recently introduced an effort known as Industry 4.0 with the objective of enhancing and modernising its industrial sector by means of technological assimilation. The endeavour encompasses initiatives aimed at fostering the use of automation, data analytics, and Internet of Things (IoT) technologies among many businesses.

- **European Union:** The Horizon 2020 programme, initiated by the European Union, is a significant research and innovation endeavour that provides funding for projects focused on the absorption of technology and innovation across diverse sectors such as energy, healthcare, and digital technologies.

These programmes demonstrate the many strategies that nations use to promote the assimilation of technology and encourage innovation, frequently customised to align with their own economic and social objectives. The objective is to use technology in order to stimulate economic growth, enhance the standard of living, and tackle urgent issues.

5.7 Constraints in Management of Technology Absorption

- The selection and use of imported technology by a majority of Indian firms have not met international standards. Establishing scale-sensitive high technology enterprises is influenced by several factors, one of which is the aspect being discussed here.

- The current demand for goods in our country, which are produced using advanced technologies that are impacted by scale factors, is typically not substantial. Currently, this need is being fulfilled by a number of units that are of sub-optimal sizes in comparison to international standards.

- The aforementioned limitation serves to widen the gaps that must be overcome via the process of technology absorption. The industry lacks the capacity to allocate comparable research and development resources as foreign counterparts, hence limiting the potential for product and process enhancements.

❖ **Exercises**

- **Long Questions**

1. Explain the meaning of technology absorption.
2. Discuss the key aspects of management of technology absorption.
3. Define the model of technology absorption.
4. Discuss the advantages of management of technology absorptions.
5. Discuss the Indian Scenario in terms of Management of technology Adsorption.
6. Discuss any two countries initiative for technology absorption.
7. Discuss the constraints of management of technology absorption.

- **MCQ**

1. Which is/are the parameters for the management of technology absorption?
   A. Assessing Technology B. Acquisition of Technology
   C. Assimilation of Technology **D. All of these**

2. _____ Promoting information exchange and fostering cooperation within the organisation may effectively enhance the advantages derived from the absorption of technology.
   A. Strategic Integration B. Risk Management
   C. Sharing Knowledge D. Intellectual Property Management

3. MTA stands for _____.
   A. Management of Technology Absorption B. Management of Tricky Absorption
   C. Management of Tidy Absorption D. All of these

4. Technology absorption skills will be attained through the completion of successful initiatives in fields of _____.
   A. Know why B. Optimism
   C. Enhancement of Products **D. All of these**

5. Advantages of management of technology absorption is/are _____.
   A. Enhanced Innovation B. Competitive Advantages
   C. Cost Reduction **D. All of these**

MBA
SEMESTER-3 CORE
TECHNOLOGY MANAGEMENT
BLOCK: 2

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Publisher's Name: Dr. Ajaysinh Jadeja
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Edition: 2024 (First Edition)

ISBN: 978-93-5598-715-0

978-93-5598-715-0

UNIT – 6	SELECTING AND IMPLEMENTING NEW TECHNOLOGY

6.1 Introduction

Selection and implementation of the cutting-edge or new approaches or technologies with of great significance to boost efficiency, productivity and competitiveness of the variety of business sectors**.** it is also required to select the right technology partner for its effective implementation because it is sometimes not possible for the organization to adopt the technology due to lack of expertise and experience in its effective and successful implementation. The selection of the potable technology is of great significance as compared to the old technology because it is more valuable in many aspects.

Each and every organization faces the problem of downtime due to failure in power, system over and above breakdowns in machines or equipment. Due to downtime, organization faces not only operational consequences but also financial effects. Hence, downtime has significant effect on operational as well as financial performance of the organization and therefore each and every organization designs the strategies to avoid downtime.

The business organization has an objective of maximisation of the return on investment made in technology. To maximise the return on the technology investment, the organization should augment the technology adoption and implementation. It should also promote the environment of the innovation. Hence, the organization has to employ technology champion or make group of technology champion for smooth adoption of the technology or augmentation of innovation.

6.2 Meaning and Importance

6.2.1 Meaning:

"A critical process of selecting and implementing the cutting-edge or new approaches or technologies with a view to boost efficiency, productivity and competitiveness of the variety of business sectors is termed as selecting and implementing new technology."

"A strategic approach of making optimum use of innovation or new technology so as to accomplish business goals is also termed as selecting and implementing new technology."

"A broader approach of making optimum utilization of the new technology with a view improve operational effectiveness and give maximum return to the consumers is also known as selecting and implementing new technology."

From different perspective, “A strategic approach to realize the full potential of new technology through meticulous planning, departmental cooperation so as to accomplish organizational business goals and success is also known as selecting and implementing new technology.”

6.2.2 Importance:

1. **Supports to survive in competition:** Now-a-days, likes or preferences or desires of the customers change frequently. Even business environment also changes frequently. The business organization has to make changes in its products corresponding to these changes with a view to survive. If the business organization fails to alter changes, it will lose its market and the customers will switch to the rival organizations which adopt these changes and make corresponding changes in its technology or product or strategy or way of functioning. Hence, the business organization is required to select and implement the new or innovative technology which meets the various changes taking place in the business environment and helps to survive in competition by not only by maintaining the market share but enhancing it also by attracting the customers of the rival organizations.
2. **Streamlines the operations:** If the business organization produces its products manually with the help of the workforce, it will result into high cost of production, more wastage, more consumption of resources, longer production process. However, if the operations are streamlined with the automated technology, it enhances productivity and overall efficiency of the organization. Hence, selection and implementation of the new technology helps the business organization to streamline its processes or operations and thereby helps in reduction of the cost and increase in productivity.
3. **Satisfies the consumer demand:** To retain the customers, it is essential to satisfy their needs, expectations and their overall consumption experience and to enhance their experience, they should be provided with the customized products or services along with unified buying experience. Implementation of new technology helps to produce customized products or services and thereby to satisfy customers demand and expectations as well as their consumption experience.
4. **Augments market share**: Selection and implementation of new or innovative technology helps to launch new or innovative or improved products or services which satisfies consumer needs by giving unified buying and consumption experience to the consumers. Introduction of the innovative products or services results into entering into new markets or opening up of new market segments, and thereby increase in the consumer base and ultimately market share of the organization.
5. **Solves problems:** Use of old or outdated technology creates the problems or issues for the organization such as inferior quality of goods, high cost of production, risk of security, longer production cycle as well as supply chain. Introduction and implementation of new technology is of great significance in solving these prevalent problems or challenges faced by the organization by producing quality products, lowering cost, shortening the production cycle and supply chain.
6. **Enhances productivity:** If old or outdated technology of production is used by the organization, it results into less production, more labour hours, low productivity. Hence, introduction of the new technology on one hand reduces labour hours as well as wastage, on the other hand it also helps to enhance production and thereby productivity of the workers.
7. **Accomplishes organizational goals:** Selection and implementation of the new and innovative technology is of great importance to enhance the productivity

of the organization by solving various problems associated with the production and operation. It is also vital in providing new or innovative or improved products or services which satisfies consumer needs by giving unified buying and consumption experience and thereby satisfies their demand as well as enhances market share of the organization by opening up new market or market segment. It ultimately results into increase in profitability of the organization through development and growth. Hence, implementation of the new technology is of great significance to accomplish overall organizational goals.

6.3 Consider the right Technology Partner

When new technology is selected and implemented by the organization, it is also required to select the right technology partner for its effective implementation because it is sometimes not possible for the organization to adopt the technology due to lack of expertise and experience in its effective and successful implementation. The following points to be considered by the organization while considering the right technology partner:

1. **Awareness about organizational vision, mission, and objectives:** If the technology partner is aware about the vision, mission and objectives of the organization, it is easy for the partner to align the technology as well as their solutions for easy, quick implementation of the new technology in the organization. Hence, for successful implementation of the new technology, the technology partner should be aware about the organizational vision, mission and objectives.
2. **Selection of the right technology partner:** For successful implementation of the new technology, such technology partner should be selected as has proficiency, experience, skill, knowledge about the latest developments and trends in the pertinent field, industry, technology. Hence, before selecting the technology partner, the organization should verify the past history or past performance of the technology partner, client's feedback or opinion about the technology partner about the technology partner so that the right technology partner should be selected for the implementation of the new technology.
3. **Research and Development Infrastructure:** Such technology partner should be selected as has established research and development infrastructure because if the technology partner has adequate investment in research and development, it would be able of great significance to the organization not only in selecting the best technology but also in its smooth implementation. Moreover, it would also help the organization in providing the innovative solutions in case of the problems which occur during implementation of new technology as well as during its normal or regular operation because such technology partner has sound background of the latest developments in the pertinent industry, field and technology. As a result, the organization would easily reach the highest position in the industry.
4. **Customization of Solutions:** Need for the technology used by the business organization changes with the change in the need of the organization. It also changes with the growth and development of the organization. It also requires customization with the change in the life cycle of the organization i.e. introduction stage, growth stage, maturity stage and decline stage. Hence, it is required to select such a technology partner as can customize the technology or solutions with the change in the need of the technology. Such solutions should be elastic enough to house such changes or requirements.
5. **Participation in Decision-making Process:** Such technology partner should be selected as can comprehend the problems or challenges or threats of the

business organization and find their resolutions. For the purpose, the technology partner should be able to have candid exchange of ideas between the organization and the technology partner itself. To find the best resolution of the problem, the partner should cultivate the atmosphere of cooperation and share the expertise by taking active part in the decision-making process.

6. **Value Maximization:** The technology partner should make continuous efforts to maximise the value of the investment made in the new technology by the organization. With a view to maximise the value of the investment, the technology partner should offer the real time support as and when the problem rises. It should also keep the skill of the staff up-to-date by giving them continuous training so that they can demonstrate their best efforts in enhancing the productivity and thereby maximising the value of the firm or organization.
7. **Upholding Industry Standard:** The technology partner should not only be aware about the industry standards, rules and regulations, regulatory requirements of the industry or sector but also novel or innovative practices performed by the various players in the industry or sector. If the technology partner has sound knowledge about the industry standards, it will help the organization to uphold such industry standards and thereby to provide security and observe privacy and fulfil all regulatory compliances.
8. **Perpetual Alliance:** The technology partner should develop such strategies for the organization as accomplishes organizational goals and mission. To achieve the goals and mission of the organization, the organization should maintain perpetual alliance with the technology partner. For perpetual alliance with the technology partner, technology partner should also grow, develop along with the growth and development of the organization.

6.4 Portable Technology is More Valuable

Comparing portable technology to standard or old or static technology, following features that make it more valuable:

1. **Agility:** The main feature of the portable technology is its agility or mobility. As portable technology is agile, it can be accessible from any location. The workers or employees can make use of the technology and perform their duties irrespective of their location. Agility also helps the employees to make communication at any time from any location and thereby to accomplish task assigned to them.
2. **Adaptability:** Fixed technology limits its accessibility to the limited location or in-house or single location and hence workers do not have adaptability to changing work requirements. On the contrary, portable technology delivers more elasticity as far as location and method of task accomplishment are concerned and hence the portable technology offers the greater adaptability to the users or workers.
3. **Efficiency:** Static technology fails to offer the multitasking, efficiency in managing roadmap of the work and hence it also limits the productivity of the organization. On the contrary, portable technology offers appropriate resources and tools to the users so that they can do multitasking, work quicker, enhance their productivity and also accomplish their target efficiently.
4. **Synergy:** The main feature of the portable technology is its agility or mobility. As portable technology is agile, it can be accessible from any location. The workers or employees can make use of the technology and perform their duties irrespective of their location. As a result, it is possible for the workers to make the real time communication among one another and also enhance the collaboration and synergy among them.

5. **Lower Capital Expenditure:** Fixed technology requires the specialised infrastructure such as land and building, furniture and fixtures etc. Hence, it requires high capital expenditure over and above maintenance cost associated with the infrastructure. On the contrary, portable technology does not require such infrastructure and hence it lowers the capital expenditure significantly.
6. **Lower Revenue Expenditure:** Fixed technology consumes more energy and requires more maintenance and as a result overall revenue expenditure of the organization rises. On the contrary, the portable technology uses less energy and requires less maintenance and as a result overall revenue expenditure of the organization also reduces.
7. **User-friendly:** Static technology is based on the complicated set-up as well and hence it requires specialised technical know-how. On the contrary, portable technology focuses on features like efficacy and uncomplicatedness. Hence, the users of the technology find it easy to use and perform their task quickly and accurately.

6.5 Avoid Costly Downtime

Each and every organization faces the problem of downtime due to failure in power, system over and above breakdowns in machines or equipment. Due to downtime, organization faces not only operational consequences but also financial effects. Hence, downtime has significant effect on operational as well as financial performance of the organization and therefore each and every organization designs the strategies to avoid downtime and a few of them are mentioned as under:

1. **Backup system:** Organization should develop backup system to have smooth or uninterrupted business operation or production process. If well-designed backup system is implemented, it will be possible for the organization to avoid or minimize the downtime and have continuous operation and thereby fulfil the orders in time.
2. **Proactive repairs and maintenance:** To avoid the costly downtime, the organization should also implement the strategy of proactive repairs and maintenance. The organization should take Annual Maintenance Contract (AMC) to avoid downtime by detection the problems at the early stage and resolve them. It not only helps in up dation of the machines but also periodic repairs and maintenance and thereby it solves the problems before they result into costly downtime.
3. **Superior equipment and machinery:** If the equipment and machinery used in the production process are inferior, there are high chances of downtime. Hence, the organization should purchase equipment of superior quality with a view to avoid downtime. The organization should identify producers of the superior equipment and machinery for their buying or installation.
4. **Skilful Staff or workers:** The organization should train its staff to make them skilful so that the downtime can be averted. If the workers are skilled, they can also quickly fix normal or routine breakdowns or problems. Hence, the organization should employ trainer or develop training and development department to make the workers skilled to avoid or minimize downtime so that the production process can be flawless.
5. **Hands-on Notifying System:** The organization should instal hands-on notifying system with a view to spot the problems at the early stage and resolve them swiftly so as to avoid downtime. Such system also keeps eye on tendencies and patterns of the operation of the production which helps in identifying the possible factors that cause downtime.
6. **Learning from mistakes:** The organization should also design strategy to learn lessons from mistakes. It means that although all the precautions have

been taken, downtime occurs. The organization should identify the causes of the downtime and undertake corrective measures and ensure that such downtime should not take place again.

7. **Holistic approach**: The organization should adopt holistic approach to avoid downtime, maintain operation or production process flawless so that adverse effect of the downtime on the productivity, profitability of the organization can also be avoided. The strategy should be comprehensive which should not only prevent but also reduce the risk of downtime. If the organization has implemented the holistic approach, organization steadiness or continuity in production process should be protected over and above costly effect of the downtime should also be prevented.

6.6 Rely on a Technology Champion

The business organization has an objective of maximisation of the return on investment made in technology. To maximise the return on the technology investment, the organization should augment the technology adoption and implementation. It should also promote the environment of the innovation. Hence, the organization has to employ technology champion or make group of technology champion for smooth adoption of the technology or augmentation of innovation. Hence, it has to rely on the technology champion.

In simple words, an employee or a group of employees inside the organisation not only having the thorough knowledge and expertise about the technology but also making maximum utilization of the technology to maximise the return made after the technology is termed as technology champion.

Need or significance of the technology champion can be highlighted as under:

1. **Creation of Strategy:** The technology champion makes the strategy to maximise the technology investment. The strategy involves the assessment of the emerging trend of the industry or sector. It also assesses the new technologies available in the industry. Based on the assessment, the strategy helps to select the best available and suitable technology for the organization by justifying the need for innovation for the growth and development of the organization. Hence, the technology champion visualizes and leads the organization and its employees to accomplish the organizational goals and objectives.
2. **Knowledge and Proficiency:** Technology champion possesses the required knowledge and proficiency about technology. It also possesses the sound experience and expertise about the required technology as required to make the organization competitive in the sector or industry. Hence, it advises the organization to select the right the technology. It also helps the organization to design the right technology strategy which can be of great significance to the organization to get competitive advantage in the market.
3. **Advisor:** Technology champion is skilled and expert as far as technology is concerned. Hence, it advises the decision -makers not only about the selection of the right technology but also about the future return on investment made in technology. It also advocates the organization about the strategic significance of the technology investment.
4. **Successful Implementation of Technology:** Whenever any change in organization is introduced or old technology is replaced with the new technology, there is resistance from various stakeholders of the organization or the users of the technology. As the technology champion is an individual or team within the organization, it is possible for the technology champion to understand the reasons behind resistance and hence technology champion can

easily mitigation their resistance by explaining the importance of change, providing necessary training, offering the required resources, assistance and infrastructure. Hence, it makes the smooth implementation of new technology.

5. **Culture of Research and Innovation:** Technology champion not only helps in the successful implementation of the new technology but also creating in culture of research and innovation. It provides necessary environment as well as infrastructure to the employees having creative idea, solution to the routine problems. It offers the facilities of conceptualization of the innovative ideas, development of these ideas and thereby it helps to meet challenges and create new opportunities and thereby helps in gaining competitive advantage.
6. **Variance Analysis:** Technology champion benchmarks the key performance areas such as return on investment. It also compares the actual data about the Key Performance Areas with the benchmarks set and thereby determines the variances and finds the reasons for the negative variances so that corrective measures can be suggested to nullify the negative effect.
7. **Ongoing Improvement:** Technology champions put the stress on the continuous improvement in the technology. To make them updated, they carry out continuous efforts to know emerging technology available in the market, trend of market, expand their skill by continuous training and development. They also join the allied courses to update their knowledge about the technology.

❖ **Exercise**

- **Theoretical Questions**

1. "A strategic approach of making optimum use of innovation or new technology so as to accomplish business goals is also termed as selecting and implementing new technology." Do you agree with the statement? Give your opinion justifying importance of innovation-based technology.
2. Define the meaning of the Selection and Implementation of New Technology and also discuss its importance in detail.
3. "When new technology is selected and implemented by the organization, it is also required to select the right technology partner for its effective implementation." Which points do you take into account selection of the right technology partner.
4. Do you Compare portable technology to standard or old or static technology, while taking the decision? Which features do you take into account that make the portable technology more valuable?
5. "Downtime has significant effect on operational as well as financial performance of the organization and therefore each and every organization designs the strategies to avoid downtime." Which strategies do you design to avoid costly downtime?
6. "The business organization has an objective of maximisation of the return on investment made in technology." How is the technology champion significant in accomplishing this objective?

Short Notes

1. Importance of Selection and Implementation of New Technology
2. Points to be Considered while selecting the right Technology partner
3. Significance of selection of Portable Technology
4. Strategies to Avoid costly Downtime
5. Significance of Technology champion

- **MCQs**

1. A strategic approach of making _____ use of innovation or new technology so as to _____ business goals is also termed as selecting and implementing new technology
   a) Accomplishment, optimize
   b) Minimum, optimize
   c) Minimize, achieve
   d) Optimum, accomplish
2. When new technology is selected and implemented by the organization, it is also required to select _____ for its effective implementation because it is sometimes not possible for the organization to adopt the technology due to lack of expertise and experience.
   a) the right technology innovator
   b) the right technology developer
   c) the right technology partner
   d) the right technology implementer
3. _____ is not to be considered by the organization while considering the right technology partner.
   a) Research and Development Infrastructure
   b) Customization of Solutions:
   c) Participation in Decision-making Process:
   d) Lower Capital Expenditure
4. Portable Technology is more valuable because it is not
   a) Agile
   b) Adaptable
   c) Inefficient
   d) Synergy
5. Each and every organization faces the problem of _____ due to failure in power, system over and above breakdowns in machines or equipment.
   a) Downtime
   b) Uptime
   c) Idle time
   d) Waste Time
6. ____ is not required to avoid downtime.
   a) Backup system
   b) Proactive repairs and maintenance
   c) Superior equipment and machinery
   d) Unskilful Staff or workers
7. An employee or a group of employees inside the organisation not only having the thorough knowledge and expertise about the technology but also making maximum utilization of the technology to maximise the return made after the technology is termed as _____ .
   a) technology champion
   b) technology player
   c) technology developer
   d) technology designer
8. Need or significance of the technology champion is not for _____.
   a) Creation of Strategy
   b) Unsuccessful Implementation of Technology

c) Creation of Culture of Research and Innovation
d) Variance Analysis

9. Under _____, technology champion develops the benchmarks of the key performance areas and compares the actual data with the benchmark.
   a) Creation of Strategy
   b) Unsuccessful Implementation of Technology
   c) Creation of Culture of Research and Innovation
   d) Variance Analysis

10. "Downtime has significant effect on operational as well as financial performance of the organization and therefore each and every organization designs the strategies to avoid downtime." Which strategy do you design to avoid costly downtime?
   a) Zero Backup system
   b) Inactive repairs and maintenance
   c) Superior equipment and machinery
   d) Unskilful Staff or workers

Answer Key of MCQs

Que No	Answers
1.	d
2.	c
3.	d
4.	c
5.	a
6.	d
7.	a
8.	b
9.	d
10.	c

UNIT – 7 TECHNOLOGY GENERATION AND DEVELOPMENT

7.1 Introduction

- Technology generation and development is a multifaceted process that involves a number of processes, from concept or idea to basic research to technology application, all while taking into consideration the social, economic, and political environments at the national and worldwide scales. Technologies are created in labs through research and development.
- They underwent multiple rounds of development to become usable items. On a large scale, the national governments create laws, regulations, and other frameworks to infrastructure and facilities that facilitate the creation and "development of" at the micro level industrial technologies as well as those that are strategically significant and need substantial investments.
- The international organisations, such as the United Nations agencies, additionally encourage these initiatives. On a smaller scale, the creation and advancement of Technology are mostly connected to an enterprise's business operations.
- It is anticipated that the activities at the macro and micro levels will complement one another. The two interests, however, occasionally have a tendency to clash in real life. For instance, even though the government wants to promote environmentally technologies that serve society as a whole and where potential profits are the main goal, a business might want to investigate solutions that yield the highest profits' or further its commercial objectives over the long or near term.

7.2 Need of Technology Generation and Development:

Many demands and variables influence the generation and development of technology, which reflects the changing nature of society, the economy, and human desires. The following essential needs support the generation and development of technology:

1. Problem-Solving: Technologies frequently appear as answers to issues or difficulties that already exist. The creation of novel technologies is fuelled by the need to solve problems including inefficiency, resource shortages, environmental issues, healthcare difficulties, and social inequity.
2. Increasing Productivity: Organisations and sectors are always looking for methods to increase output, cut expenses, and improve efficiency. In order to accomplish these goals, technological innovations like automation and artificial intelligence are essential.
3. Improving Communication: The development of technology that allow for faster, more dependable, wider communication is driven by the desire for better communication. This covers developments in social media, the internet, and telecommunications.
4. Overcoming Global Challenges: Technologies are being created to address global issues like food security, poverty, public health crises, and climate change. Addressing these concerns is made possible by innovations in sustainable agriculture, clean energy, and healthcare technologies.
5. Enabling Scientific Discovery: Scientific investigation and research depend heavily on technology. Scientific advances are facilitated by sophisticated apparatus and tools and data analysis methods.
6. Fulfilling Customer Demands: Technological innovation is mostly driven by the requirements and preferences of consumers. Modern communities are always in need of new and better goods and services, which drives the creation of cutting-edge technologies.
7. Advancing Education: Technology helps the education sector by offering new resources and learning environments. E-learning, digital instructional resources, and interactive technologies lead to improved educational experiences.
8. Ensuring National Security: Military technology, cybersecurity, surveillance systems, and intelligence collection are all driven by the need for defence and security.
9. Promoting Economic Growth: To promote economic growth, firms and governments make technological investments. Technological advancement and innovation support economic growth generally, competitiveness gains, and employment creation.
10. Cultural and Social Influences: The development of technology is also influenced by cultural and social aspects. Innovations in fields like gaming, social media, and digital content creation are driven by the need for entertainment, cultural expression, and social interaction.
11. Health and Well-being: The need for enhanced healthcare services and technologies to increase well-being is a significant driving. This covers advancements in telemedicine, health information technologies, medications, and medical devices.
12. Environmental Sustainability: As environmental challenges gain more attention, technologies that support sustainability are becoming more and more necessary. This covers trash minimization technology, eco-friendly production techniques, and clean energy solutions.

The interaction of these requirements with technological advancements and social ideals results in the continuous generation and development of technology. New needs will arise as the world changes, influencing the course of technological development.

7.3 Recognition in Technology Generation and Development:

In the generation and development of technology in many different fields, recognition is essential. It entails spotting, recognising, and comprehending patterns, trends, or inventions that have the potential to spur developments and enhancements. In the context of the generation and development of technology, recognition can take several forms.

1. Finding Issues and Possibilities:
Recognition facilitates the identification of current issues, difficulties, or inefficiencies that call for technological fixes. New developments might be sparked by recognising gaps in current technologies, market needs, or upcoming prospects.

2. Recognition of Innovation:
The development of new technologies depends critically on the acceptance and recognition of creative notions and ideas. Fostering technical innovations requires communities and organisations to cultivate an innovative culture.

3. Market Recognition:
It is essential to comprehend consumer preferences, market trends, and rival advancements in order to design solutions that address practical requirements. Recognising market dynamics makes it easier to match technological advancements with commercial and financial objectives.

4. User Experience Recognition:
Recognising the value of user experience is essential to creating technologies that are simple to use, intuitive, and effectively meet the needs of users. Iterative advancements in technology are facilitated by user feedback and the identification of usability problems.

5. Recognition by Science:
Recognition of innovations and successes in science research encourages additional investigation and advancement of technology. Recognising the importance of fundamental research frequently results in the creation of applied technologies with real-world uses.

6. Recognising the Effect on the Environment:
Determining how technologies affect the environment is essential to sustainable development. Innovation in clean energy, waste reduction, and conservation can be stimulated by acknowledging eco-friendly activities and technologies.

7. Recognition of Ethical Issues
Recognising ethical issues and possible societal effects is crucial as technology develops. Responsible technology development involves recognising and resolving ethical difficulties, such as privacy concerns with surveillance technology.

8. Recognition of Multidisciplinary Associations:
Technology development benefits from the integration of information and experience from other sectors due to the recognition of the interdisciplinary character of many difficulties. More comprehensive and successful solutions are frequently the outcome of collaboration and recognition of different viewpoints.

9. Regulatory and Legal Framework Recognition:
Technology developers must be aware of and comprehend the regulatory environment in order to guarantee legal compliance. Recognising moral and legal bounds aids in averting unforeseen events and detrimental effects on society.

10. Recognition of Technology for Adoption:
Widespread adoption of new technology depends on people realising their worth and advantages. Technologies that have a good impact on society and solve actual problems have a higher chance of being adopted by the market.

11. Recognition of Risks and Limitations:
Responsible development necessitates acknowledging the limitations and potential risks connected with technologies. Recognising unexpected consequences facilitates the installation of safety measures and risk reduction.

To summarise, recognition in the generation and development of technology entails being cognizant of obstacles, prospects, advancements, and the wider societal consequences of technology. It's a continuous process that calls for cooperation, flexibility, and a dedication to moral principles.

7.4 Knowledge Advances in Technology Management:

As of the January 2022 update, there have been a number of knowledge advancements in technology generation and development under technology management. Remember that this response might not address developments that occur after this date. The following noteworthy developments in technology generation and development fall within the category of technology management:

1. Machine learning (ML) and artificial intelligence (AI):
Pattern recognition, computer vision, and natural language processing have all advanced as a result of AI and ML advances. Numerous industries, including healthcare, banking, and manufacturing, are utilising this technology.

2. Computing in Quantum:
Considerable advancements have been achieved in the realm of quantum computing. Scholars are investigating the possibility of using quantum computers to resolve intricate issues that are presently beyond the scope of classical computers.

3. 5G Technology:
Wireless communication is now faster and more dependable thanks to the rollout of 5G networks. The Internet of Things (IoT), smart cities, and improved mobile experiences are all made possible in large part by this technology.

4. Distributed ledger technology with blockchain:
The uses of blockchain technology have grown beyond cryptocurrency thanks to its advancements. Supply chain management, decentralised finance, and safe and transparent transactions are all using blockchain.

5. Cutting Edge Computing
With the rise in popularity of edge computing, data processing can now take place nearer to the location where the data is generated. This is especially crucial for low-latency applications like industrial automation and driverless cars.

6. Innovations in Cybersecurity:
The sophistication and frequency of cyberattacks have increased, leading to breakthroughs in cybersecurity systems. This covers advancements in secure software development methodologies, encryption, and threat detection.

7. IoT, or the Internet of Things:
Knowledge advancements in the Internet of Things have enhanced connectivity, interoperability, and security in the use of smart devices. Applications for IoT are found in many industries, such as smart homes, agriculture, and healthcare.

8. Genomics and Biotechnology:
Developments in gene editing technologies (e.g., CRISPR), personalised medicine, and biopharmaceuticals have all been made possible by advances in biotechnology and genomics.

9. Technologies for Renewable Energy:
The advancement of renewable energy technologies, such wind and solar energy, has resulted in higher cost-effectiveness and efficiency. Smart grid technologies and energy storage solutions are also developing.

10. Enhancement of Humans:
Wearable technology, virtual reality (VR), augmented reality (AR), and other technologies that improve human capabilities are constantly developing. These find use in the training, entertainment, and healthcare sectors.

11. Eco-friendly and sustainable technologies:
Environmentally friendly and sustainable technologies are receiving more attention. This covers advancements in waste management, renewable energy, and ecologically friendly industrial techniques.

12. Automation of robotic processes (RPA):
By automating repetitive work, RPA has progressed and is now able to streamline normal corporate procedures. Across all industries, this technology is being used to boost productivity and efficiency.

13. Advanced Science of Materials:
The fields of electronics, aircraft, and healthcare have all been impacted by the development of novel materials with improved qualities brought about by advances in materials science.

14. Neurotechnology
Neuroscience research, brain-computer interfaces, and neurostimulation devices are examples of advances in neurotechnology that open up new avenues for human-machine interactions, study, and healthcare.

15. Space Technology:
Along with advancements in propulsion systems, satellite miniaturisation, and ambitions for human expeditions to Mars, space exploration and satellite technology are still evolving.

These developments in knowledge demonstrate the dynamic character of technology generation and development under technology management, with continuous attempts to solve societal issues, enhance productivity, and push the limits of technological capability. To learn about the most recent advancements in these fields, see more recent sources.

7.5 Idea Generation on Technology Generation and Development under Technology Management

Idea generation in technology management refers to the process of systematically generating, identifying, and developing new and innovative ideas for technological advancements, solutions, or improvements within an organization. This process is a critical aspect of the innovation and technology development lifecycle. Idea generation is not limited to any specific phase but is ongoing, allowing organizations to stay competitive and adapt to changing environments.

Key aspects of idea generation in technology management include:

1. Creativity and Innovation:
Idea generation involves fostering a creative environment that encourages employees to think outside the box. It's about exploring novel concepts, methods, and solutions to address challenges or capitalize on opportunities.

2. Problem Solving:
Often, idea generation is driven by the need to solve specific problems or overcome challenges. Teams brainstorm and ideate to find innovative ways to address technological or business issues.

3. Opportunity Exploration:
Beyond problem-solving, idea generation also involves exploring opportunities for technological advancements or improvements. This could include identifying emerging trends, market gaps, or areas where technology can bring added value.

4. Cross-Functional Collaboration:
Successful idea generation often requires collaboration among individuals with diverse skills and backgrounds. Cross-functional teams can bring different perspectives and expertise to the table, fostering a more comprehensive approach to innovation.

5. Continuous Improvement:
Idea generation is not a one-time event but a continuous and iterative process. Organizations must have mechanisms in place to encourage ongoing ideation and to refine and build upon existing ideas.

6. Technological Forecasting:
Idea generation is informed by technological forecasting and awareness of industry trends. Understanding where technology is headed helps organizations anticipate future challenges and opportunities.

7. Market Research:
Idea generation is closely linked to market research. Understanding customer needs, preferences, and pain points provides valuable insights that can guide the development of technology solutions.

8. Risk-Taking:
Idea generation involves a degree of risk-taking. Organizations must be willing to experiment with new ideas, even if they do not guarantee immediate success. This requires a culture that accepts and learns from failure.

9. Technology Road mapping:
The generated ideas are often part of a broader technology roadmap that outlines the strategic direction for technology development over time. This helps align the ideas with organizational goals and objectives.

10. Intellectual Property Considerations:
Organizations engaged in idea generation often need to consider intellectual property aspects. This includes assessing the patentability of ideas and protecting innovations through patents or other means.

11. Feasibility Analysis:
Before moving forward with an idea, organizations conduct feasibility analyses to assess the technical, economic, and operational viability of implementing the proposed technology.

12. Feedback Mechanisms:
Establishing feedback mechanisms is crucial in the idea generation process. This involves gathering input from various stakeholders, including employees, customers, and industry experts, to refine and validate ideas.

By systematically managing the idea generation process, organizations in technology management can foster a culture of innovation, stay ahead of the competition, and contribute to the advancement of technology within their industry.

Certainly! Here are several idea prompts related to technology generation and development under technology management:

1. Sustainable Technology Solutions:
Develop innovative technologies that promote sustainability and address environmental challenges. This could include advancements in renewable energy, waste management, or eco-friendly manufacturing processes.

2. Health Tech Innovations:
Explore opportunities in healthcare technology, such as the development of wearable devices for health monitoring, telemedicine solutions, or AI-driven diagnostics.

3. Smart Agriculture Solutions:
Propose technologies that enhance efficiency in agriculture, like precision farming, IoT-based crop monitoring, or automated farm equipment with AI capabilities.

4. Blockchain Applications:
Identify new applications for blockchain technology, such as supply chain transparency, secure data sharing, or decentralized finance solutions.

5. Urban Mobility Solutions:
Develop technologies that improve urban mobility, including smart transportation systems, electric and autonomous vehicles, or solutions for traffic management.

6. Education Technology (EdTech) Innovations:
Explore ways to leverage technology for education, such as AI-driven personalized learning platforms, virtual classrooms, or interactive educational content.

7. Data Privacy and Security Solutions:
Devise technologies that enhance data privacy and security, including advanced encryption methods, secure communication protocols, or innovative authentication systems.

8. Human-Machine Collaboration:
Explore technologies that facilitate seamless collaboration between humans and machines, such as augmented reality interfaces, collaborative robotics, or brain-computer interfaces.

9. Space Exploration Technologies:
Propose advancements in space exploration, such as improved propulsion systems, satellite technology for Earth observation, or innovations in extraterrestrial habitats.

10. Circular Economy Technologies:
Develop technologies that contribute to a circular economy, focusing on the efficient use of resources, recycling innovations, or sustainable product design.

11. Inclusive and Accessible Technologies:
Design technologies that are inclusive and accessible to diverse populations, including solutions for people with disabilities, language barriers, or limited access to technology.

12. Disaster Response Technologies:
Explore technologies that aid in disaster response and recovery, such as AI for predicting natural disasters, robotics for search and rescue, or communication tools for emergency situations.

13. Cognitive Computing Applications:
Investigate applications for cognitive computing, including natural language processing, image recognition, or decision support systems for various industries.

14. Remote Work Solutions:
Propose technologies that enhance remote work experiences, such as virtual collaboration tools, cybersecurity solutions, or technologies supporting work-life balance.

15. Advanced Materials Development:
Explore the creation of new materials with enhanced properties, such as lightweight and durable materials for aerospace, biodegradable alternatives, or smart materials with unique functionalities.

16. Blockchain for Social Impact:
Investigate how blockchain technology can be harnessed for social impact, such as transparent donation tracking, secure identity solutions for refugees, or decentralized social platforms.

17. Augmented Reality for Training:
Develop AR-based training solutions for industries like healthcare, manufacturing, or maintenance, providing immersive and interactive learning experiences.

Remember to consider the ethical implications, societal impact, and potential challenges associated with the proposed technologies. These ideas can serve as starting points for more in-depth exploration and development within the field of technology management.

7.6 Objectives of Corporate Research and Development in Technology Management

Corporate research and development (R&D) in technology management has many different purposes that are in line with the organization's overarching objectives and

plans. The following are the main goals of corporate R&D when it comes to technology management:

1. Technological Innovation and Progress:
Encourage an innovative culture within the company and push for technology improvements to keep it at the forefront of its sector and competitive.

2. Development of Products and Services:
Create fresh, enhanced goods and services that satisfy consumer demands, foresee market trends, and boost sales.

3. Improving Efficiency and Cutting Costs:
Determine which technology and procedures can help the company cut costs, increase operational effectiveness, and better use its resources.

4. Market Diversification and Expansion:
Investigate and create technologies that let the company expand into new markets, broaden the range of goods and services it offers, and take advantage of new opportunities.

5. Taking a competitive stance:
Leverage R&D to differentiate products or services, develop original value propositions, and gain a competitive advantage in the market to strengthen the organization's competitive position.

6. Risk Reduction and Flexibility:
Reduce the risks connected with technology obsolescence by keeping an eye on developments in the field and making necessary adjustments. This aids in the company's ability to withstand changing market conditions.

7. Development of Intellectual Property:
Produce important intellectual property (IP) through research and development (R&D) activities, such as trade secrets, copyrights, and patents, to safeguard inventions and obstruct competitors' access.

8. Talent Acquisition and Retention:
Provide a stimulating R&D environment that motivates staff members to apply their knowledge, abilities, and creativity to creative projects in order to draw in and keep top talent.

9. Partnerships and Alliances Strategic:
Work together with outside partners to utilise complementary skills, pool resources, and hasten the development of new technologies. Examples of these partners include startups, research institutes, and other industry players.

10. Customer loyalty and satisfaction:
By offering cutting-edge solutions that address customer pain points, improve user experiences, and offer value beyond competition, you may increase customer happiness and loyalty.

11. Adherence to Regulations:
Ascertain that goods and services created by research and development (R&D) abide by pertinent laws, rules, and guidelines in order to prevent legal problems and guarantee market acceptance.

12. Social and Environmental Responsibility:
Research and development (R&D) endeavours should incorporate sustainable and socially conscious approaches, taking into account the environmental impact of technology and conforming to corporate social responsibility (CSR) objectives.

13. Reduced Time-to-Market:
Simplify the research and development process to speed up the time it takes to launch new goods or technology, allowing the company to seize opportunities faster.

14. Acceptance of New Technologies:
Keep up with new developments in technology and evaluate how they relate to the company's business plan. Be sure to implement disruptive ideas in a proactive manner.

15. Extended-Term Strategic Planning:
Assist with long-term strategic planning by coordinating research and development efforts with the overarching business plan and making sure that technology management advances the mission and objectives of the company.

Generally, the organization's strategic vision and the goals of corporate R&D in technology management are integrated, with a focus on innovation, growth, and sustainability in a dynamic business environment.

7.7 Research & Development Projects in Technology Management:

Technology management research and development (R&D) projects undoubtedly span a wide range of sectors and domains. Here are some instances of technology management R&D projects from various industries:

1. **Medical Care:**
   - Creation of cutting-edge medical imaging technology to identify diseases early.
   - Deployment of telemedicine programmes for patient monitoring from a distance investigation into health sensors and wearable technology for ongoing health monitoring.
2. **Automobiles:**
   - R&D on autonomous and electric car technologies.
   - Creation of intelligent transportation networks and traffic control systems.
   - IoT and networking technologies are integrated into cars.
3. **Technology of Information:**
   - Investigation of threat intelligence and cybersecurity technology.
   - Creation of artificial intelligence and sophisticated data analytics for business insights.
   - Blockchain solutions being put into practice for safe and open transactions.
4. **Energy:**
   - Investigation of technology and sources of renewable energy.
   - R&D for better grid management through energy storage systems.
   - Creation of smart grid technologies to distribute energy more efficiently.
5. **Airspace:**
   - Research on new materials for lightweight and durable aeroplanes.
   - Creation of propulsion systems for aeroplanes that are greener and use less fuel.
   - Investigation of space technology, encompassing exploration expeditions and satellite developments.

6. **Production:**
   - Utilising Industry 4.0 technology to enable intelligent manufacturing.
   - R&D on automation and robotics to enhance industrial procedures.
   - Creation of 3D printing technologies for customised manufacturing and quick prototyping.

7. **Communications:**
   - Studying 5G and beyond-5G technologies to improve communication speed and dependability.
   - Creation of network designs for the future.
   - Deployment of network function virtualization (NFV) and software-defined networking (SDN).

8. **Sustainability of the Environment:**
   - Investigation of recycling and waste management methods.
   - R&D on precision farming technologies and sustainable agriculture techniques.
   - Creation of environmentally friendly goods and materials.

9. **Pharmaceuticals and Biotechnology:**
   - Research on personalised medicine and gene editing technology.
   - Development of novel drug delivery methods and biopharmaceuticals.
   - Application of AI and machine learning to enhanced diagnostics.

10. **Technology for Education (EdTech):**
    - R&D on solutions for personalised learning that are adaptive.
    - Creation of instructional content for augmented reality (AR) and virtual reality (VR).
    - Deployment of tools and systems for online learning.

11. **FinTech, or financial technology:**
    - Investigation of the use of blockchain technology in settlements and transactions in finance.
    - Creation of user-friendly and safe mobile banking apps.
    - Application of AI-driven fraud detection and risk management systems.

12. **Automation and Robotics:**
    - Investigation of cutting-edge robotic systems for use in services and industry.
    - R&D on collaborating humans and robots to increase efficiency.
    - Creation of autonomous systems for jobs like self-driving cars and drone delivery.
    - The variety of R&D projects in technology management is demonstrated by these instances. Every initiative strives to solve particular problems, stimulate creativity, and further the general progress of technology in its field.

7.8 Technology Development Approaches:

Technology development approaches are a collection of tactics and procedures that companies use to develop, enhance, or use technology. These strategies frequently rely on the industry, the organization's objectives, and the type of technology. Here are a few approaches for technological development:

1. **Agile Methodology**
   - Agile is a fluid, iterative methodology that prioritises client feedback, teamwork, and adaptation throughout the development process.
   - Use Case: Often utilised in software development, but may also be applied to other types of technological endeavours.

2. **The Waterfall Model**
- A methodical and linear technique in which every stage needs to be finished before going on to the next. Usually, progression occurs in a downward direction, as to a waterfall.
- Use Case: Ideal for clearly defined projects where development is anticipated to involve few adjustments.

3. **Iterative Design:**
- With longer development cycles, this approach is comparable to agile. It entails reiterating testing and development cycles until the desired end product is reached.
- Use Case: Fit for projects in which requirements might change, but not as quickly as they would in an agile project.

4. **Model Spiral:**
- This is an iterative paradigm that blends elements of iterative development and waterfall processes. It allows for progressive development and refinement and incorporates risk analysis.
- Use Case: Fit for sizable, intricate projects with dynamic specifications.

5. **Development of Prototypes:**
- Entails building a preliminary, basic version of the product in order to get user input and adjust features prior to building the final version.
- Use Case: Beneficial when specifications are ambiguous or require verification.

6. **Development and Operations, or DevOps, is:**
- Description: Combines IT operations and development to improve teamwork, automate procedures, and produce goods more quickly.
- Use Case: Perfect for quick and ongoing software and technology solution deployment.

7. **Agile Software Development:**
- Description: Utilises lean manufacturing concepts as inspiration to consistently generate value, reduce waste, and boost efficiency.
- Use Case: Suitable for economical and resource-efficient technological development.

8. **Thinking Design:**
- Description: Uses empathy, iterative prototyping, and human-centered design to tackle challenging issues and provide solutions that are centred around the needs of users.
- Use Case: Applied to creative product development and user experience (UX) design.

9. **Unrestricted Innovation:**

- involves working together with other partners to bring outside expertise and ideas into the development process, such as suppliers, customers, or research institutes.
- Use Case: Beneficial for gaining access to a range of knowledge and viewpoints.

10. Labs and Incubators for Innovation:
- Creating programmes or areas specifically designed to encourage innovation, trial and error, and the creation of new technology.
- Use Case: Typical in sectors like technology and healthcare where ongoing innovation is essential.

11. Scouting for technology:
- Description: Methodical search for innovations or technology from outside the organisation that can be integrated or modified to suit its needs.
- Use Case: Helpful for quickening the adoption of new technologies and keeping up with outside advancements.

12. Rapid Application Development, or RAD, is:
- The focus is on utilising swift feedback loops and rapid prototyping to expedite development cycles.
- Use Case: Suitable for projects requiring quick delivery and clearly defined specifications.

13. Togetherness in Creation:
- The process entails working together with stakeholders or end users to build a product that closely meets their demands.
- Use Case: Beneficial for developing solutions that directly address the needs of users.

14. Technology Acquisition and Licencing:
- The act of obtaining current technology or obtaining intellectual property licences to fulfil particular requirements or improve current capacities.
- Use Case: Relevant when internal development is impractical or when time-to-market is crucial.

The organization's overall strategic goals, resource limits, project complexity, and flexibility requirements all play a role in selecting the best technology development approach. A hybrid strategy that incorporates components from several approaches may prove to be the most successful in numerous instances.

7.9. Contract Research

In the field of technology generation and development, contract research refers to the process by which companies or organisations hire outside parties, usually research institutes, universities, or specialised research and development (R&D) firms, to carry out research activities with the aim of developing new technologies or improving ones that already exist. In technology management, this strategy is frequently employed to capitalise on outside knowledge, assets, and capacities. An outline of contract research in the creation and development of technology is provided below:

Contract Research's Principal Features in Technology Management

1. Goals of the Research: Make sure the research project's goals are well stated. This could involve creating brand-new technology, enhancing current ones, finding creative solutions to particular issues, or fixing particular challenges.

2. Knowledge Alignment: Choose a research collaborator who possesses knowledge and experience pertinent to the area of interest in technology. Verify that the partner has a team with the required expertise and a history of successful research initiatives.
3. Project Schedule and Scope: Provide a precise description of the research project's objectives, deliverables, deadlines, and realistic schedule. This guarantees that everyone is in agreement with the project's goals and helps control expectations.
4. Considering Intellectual Property (IP): Clearly state who owns what intellectual property created during the research and what rights they have. Creating a thorough intellectual property agreement is necessary to prevent disputes later on.
5. Finances and Planning: Establish the contract research's funding framework. This include setting a project budget, defining the terms of payment, and noting any potential extra expenses.
6. Interaction & Cooperation: Encourage candid dialogue and cooperation between the research partner and the contracting organisation. Frequent updates, reports on progress, and meetings for input all contribute to alignment and keep the project moving forward.
7. Risk Control: Determine any possible dangers connected to the research project and create plans to reduce them. This entails dealing with ambiguities surrounding resource availability, unanticipated roadblocks, and technical difficulties.
8. Adherence to Regulations: Make that the study project conforms with all applicable laws and ethical guidelines. This is especially crucial in sectors like aerospace and healthcare that have tight regulations.
9. Transfer of Technology: Make plans for the contracting organisation to receive technologies from the research partner. Knowledge transfer, paperwork, and any required internal team training are all included in this.
10. Metrics of Performance: Determine the key performance indicators (KPIs) that will be used to assess the contract research project's effectiveness. This could involve reaching goals, developing technologies, and sticking to the schedule that was set forth.
11. Protection and Confidentiality: Put strong confidentiality safeguards in place to safeguard private data exchanged during the research partnership. Signing non-disclosure agreements and using safe data handling procedures may be necessary for this.

Advantages of Contract Research for Technology Management:

1. Specialised Expertise Access: Companies might benefit from the experience of outside researchers with specialised knowledge in particular technology areas.
2. Economy of Cost: Potential cost savings are possible since contract research gives businesses access to research capabilities without requiring them to create and manage an internal research team.
3. Quick Timelines: Research and development timescales can be accelerated by enlisting the help of external research partners, who can frequently commit more resources to a project.
4. Sharing of Risks: The research partner and the contracting organisation can share risks related to the project, including technical difficulties or uncertainty.
5. Adaptability and Quickness: Flexibility is offered by contract research, which enables businesses to hire outside experts on an as-needed basis for particular projects without making a long-term commitment.
6. International Cooperation: Companies might work with international research institutes or specialists to gain access to a variety of viewpoints and methods.

7. Emphasis on Fundamental Skills: Businesses can concentrate on their core skills and outsource certain research tasks to outside partners who are experts in those fields.

Challenges & Things to Consider:

1. Integration Difficulties: There may be difficulties in ensuring a seamless integration of the study findings into the company's current systems and procedures.
2. Barriers to Communication: The efficiency of collaboration may be impacted by variations in time zones, cultural norms, and communication styles.
3. Intellectual Property Administration: To handle intellectual property rights and guarantee a just and mutually beneficial arrangement, much thought and negotiation are needed.
4. Quality Assurance: Careful supervision and quality control procedures may be necessary to maintain a constant level of quality in research outputs.
5. Risks associated with Dependency: Risks can arise from relying too much on outside partners for crucial research tasks, particularly if there are problems with the partner's performance or availability.

Technology management contract research is a strategic method that, with proper planning and execution, may give organisations important technological developments, insights, and innovations without requiring large internal investments. Effective project management, unambiguous communication, and a well-defined agreement between the research partner and the contracting organisation are frequently necessary for such collaborations to succeed.

7.10 R & D Collaboration

In order to pool resources, expertise, and capabilities with the aim of advancing technology, research and development (R&D) collaboration in technology generation and development involves partnerships between various entities, such as companies, research institutions, universities, and government agencies. Technology managers frequently engage in these kinds of partnerships to spur innovation, exchange information, and tackle difficult problems. The following are important components of R&D cooperation in the generation and development of technology.

Key Components of R&D Collaboration:

1. Strategic Alignment:
Objective: Ensure that the goals of the collaboration align with the strategic objectives of all participating entities.
Action: Clearly define the shared vision, objectives, and expected outcomes of the collaboration.

2. Identifying Partners:
Objective: Select partners with complementary strengths, expertise, and resources.
Action: Conduct a thorough assessment of potential collaborators' capabilities, track records, and areas of specialization.

3. Defining Roles and Responsibilities:
Objective: Clearly outline the roles and responsibilities of each partner in the collaboration.
Action: Develop a collaborative framework that specifies the contributions, tasks, and commitments of each entity.

4. Intellectual Property (IP) Management:
Objective: Address concerns related to the ownership and use of intellectual property generated during the collaboration.
Action: Establish a comprehensive IP agreement that outlines rights, licensing, and potential commercialization strategies.

5. Resource Sharing:
Objective: Optimize the use of shared resources, including funding, facilities, equipment, and human capital.
Action: Develop a resource-sharing plan that ensures equitable contributions and benefits for all partners.

6. Project Governance:
Objective: Establish a governance structure to oversee the collaboration and decision-making processes.
Action: Form a steering committee or project management team with representatives from each collaborating entity.

7. Communication and Coordination:
Objective: Foster open and effective communication among collaborators to ensure alignment and transparency.
Action: Implement regular meetings, progress updates, and feedback sessions to maintain a collaborative atmosphere.

8. Data Sharing and Confidentiality:
Objective: Define protocols for sharing research data while maintaining confidentiality where necessary.
Action: Develop data-sharing agreements and confidentiality measures to protect sensitive information.

9. Risk Management:
Objective: Identify potential risks and establish strategies for risk mitigation.
Action: Conduct a risk assessment and develop contingency plans to address challenges that may arise during the collaboration.

10. Project Timelines:
Objective: Define realistic timelines for the different phases of the collaborative project.
Action: Establish milestones, deadlines, and a project timeline to guide the progression of the collaboration.

11. Budgeting and Funding:
Objective: Clearly outline the financial commitments of each partner and establish a funding structure.
Action: Develop a budget, identify funding sources, and establish financial responsibilities for the collaborative project.

12. Evaluation Metrics:
Objective: Define key performance indicators (KPIs) to measure the success of the collaboration.
Action: Establish metrics for assessing project outcomes, impact, and the achievement of collaborative goals.

Types of R&D Collaboration Models:

1. Public-Private Partnerships (PPP): Involves collaboration between public entities (government agencies, research institutions) and private companies.
2. Industry-Academia Collaboration: Partnerships between industry players and academic institutions to bridge the gap between theoretical knowledge and practical applications.
3. Consortiums and Alliances: Multiple entities come together to form a consortium or alliance to jointly work on a specific R&D project.
4. Cross-Sector Collaboration: Collaboration between entities from different sectors (e.g., technology, healthcare, energy) to address multidisciplinary challenges.
5. Global Collaborations: Involves collaboration between entities from different countries, leveraging global expertise and perspectives.
6. Precompetitive Collaboration: Collaboration on research activities that are considered precompetitive, with outcomes intended to benefit the broader industry.

Benefits of R&D Collaboration in Technology Management:

1. Access to Diverse Expertise: Collaboration allows organizations to tap into the diverse expertise of multiple partners.
2. Cost Sharing and Efficiency: Shared resources and costs can lead to more efficient R&D processes and reduced financial burdens on individual entities.
3. Accelerated Innovation: Collaboration can expedite the innovation process by leveraging combined knowledge and resources.
4. Risk Mitigation: Partnerships allow entities to share risks and responsibilities, reducing the impact of potential setbacks.
5. Market Access and Commercialization: Collaboration facilitates access to new markets and increases opportunities for the commercialization of research outcomes.
6. Enhanced Problem-Solving: Bringing together different perspectives and skills enhances problem-solving capabilities.
7. Workforce Development: Collaboration provides opportunities for skills development and knowledge transfer among participating entities.
8. Increased Funding Opportunities: Joint projects may attract funding from various sources, including government grants and private investments.
9. Technology Transfer: Successful collaboration can lead to the transfer of technologies from research settings to practical applications.
10. Global Impact: Collaborations with entities from different regions contribute to global knowledge advancement and societal impact.

R&D collaboration in technology management is a dynamic and strategic approach that requires careful planning, effective communication, and a commitment to shared goals. Successful collaborations contribute significantly to the advancement of technology and the achievement of mutual benefits for participating entities.

7.11 Research Societies

Under the general heading of technology management, research societies are essential for promoting cooperation, information sharing, and breakthroughs in the generation and development of technology. These organisations bring together academics, professionals, researchers, and industry specialists to exchange ideas, talk about new developments, and advance the fields of technology as a whole. In the field of

technology generation and development, the following prominent research societies have been mentioned with their focus area.

1. **Electrical and Electronics Engineers Institute, or IEEE:**
Focus: IEEE is an international organisation that works to advance technology across a range of disciplines, such as electronics, computer science, and electrical engineering. It produces journals, holds a lot of conferences, and provides support for a lot of different technical committees.

2. **ACM (Association for Computing Machinery):**
Focus: ACM is a leading organization in the field of computing and technology. It provides a platform for researchers, practitioners, and educators to exchange ideas and contribute to the development of computing-related disciplines.

3. **ASME (American Society of Mechanical Engineers):**
Focus: ASME focuses on mechanical engineering and related technologies. It supports research and development in areas such as robotics, manufacturing, and materials science.

4. **SPIE (International Society for Optics and Photonics):**
Focus: SPIE is dedicated to optics and photonics technologies. It organizes conferences and publishes journals that cover a wide range of topics, including imaging, lasers, and sensors.

5. **INFORMS (Institute for Operations Research and the Management Sciences):**
Focus: INFORMS brings together professionals interested in operations research, analytics, and management sciences. It covers areas such as optimization, data analytics, and decision sciences.

6. **ISACA (Information Systems Audit and Control Association):**
Focus: ISACA is known for its focus on information technology governance, risk management, and cybersecurity. It provides resources and forums for professionals involved in technology management and security.

7. **AITP (Association of Information Technology Professionals):**
Focus: AITP is a professional association for individuals involved in information technology. It supports networking, professional development, and knowledge sharing in various IT disciplines.

8. **ASTM International (formerly American Society for Testing and Materials):**
Focus: ASTM develops and publishes technical standards for a wide range of industries, contributing to the standardization of materials, products, systems, and services.

9. **IET (Institution of Engineering and Technology):**
Focus: IET is a global organization promoting engineering and technology. It covers a broad spectrum of disciplines, including electronics, communications, and energy.

10. **AIChE (American Institute of Chemical Engineers):**
Focus: AIChE is dedicated to chemical engineering and related fields. It supports research and advancements in areas such as process engineering, materials, and environmental technologies.

11. **SME (Society of Manufacturing Engineers):**

Focus: SME focuses on manufacturing and provides resources for professionals in areas such as additive manufacturing, automation, and advanced materials.

12. AITPM (Australian Institute of Traffic Planning and Management):

Focus: AITPM specializes in traffic planning and management, bringing together professionals to discuss and advance transportation-related technologies and strategies.

13. IADR (International Association for Dental Research):
Focus: IADR supports dental research and technology development in oral health. It promotes collaboration among researchers, clinicians, and industry professionals.

14. CSTA (Computer Science Teachers Association):
Focus: CSTA is dedicated to promoting computer science education. While primarily focused on education, it plays a role in influencing the development and adoption of educational technologies.

15. HIMSS (Healthcare Information and Management Systems Society):
Focus: HIMSS is dedicated to the advancement of healthcare information and technology. It brings together professionals to discuss and develop solutions for healthcare technology management.

Participation in these research societies provides individuals and organizations with opportunities for networking, staying informed about the latest advancements, and contributing to the development of technologies within their respective fields.

7.12 Research Companies in Technology Generation and Development under Technology Management

Several companies are at the forefront of technology generation and development, contributing to developments in various industries under the umbrella of technology management. These companies engage in research and development (R&D), innovation, and the creation of cutting-edge technologies. Here some notable research companies have been mentioned with their focus in technology generation and development:

1. IBM (International Business Machines Corporation):
Focus: IBM is a global technology and consulting company with a strong emphasis on research and innovation. Its research division, IBM Research, is known for groundbreaking work in areas like artificial intelligence, quantum computing, and blockchain.

2. Google Research:
Focus: Google is a leading technology company with a dedicated research division. Google Research works on a wide range of projects, including machine learning, natural language processing, and computer vision.

3. Microsoft Research:
Focus: Microsoft's research arm, Microsoft Research, conducts cutting-edge research in various areas, such as artificial intelligence, human-computer interaction, and quantum computing.

4. Amazon Web Services (AWS):
Focus: AWS, a subsidiary of Amazon, is a cloud computing platform that invests heavily in technology research and development. AWS supports a broad range of technological innovations and services.

5. Apple Inc.:
Focus: Apple is known for its innovation in consumer electronics, software, and services. The company invests significantly in R&D to develop new products and enhance existing technologies.

6. Tesla, Inc.:
Focus: Tesla is a pioneer in electric vehicles, renewable energy, and energy storage. The company engages in continuous research and development to advance electric vehicle technology and sustainable energy solutions.

7. Intel Corporation:
Focus: Intel is a major player in semiconductor manufacturing and technology development. The company invests in R&D to advance microprocessor technology, memory solutions, and other semiconductor innovations.

8. Samsung Research:
Focus: Samsung, a global conglomerate, has a dedicated research division known as Samsung Research. It focuses on a wide array of technologies, including mobile devices, artificial intelligence, and semiconductor technology.

9. NVIDIA Corporation:
Focus: NVIDIA is a leading company in graphics processing units (GPUs) and artificial intelligence. It invests in research and development to advance GPU technology and drive innovations in AI and deep learning.

10. Siemens AG:
Focus: Siemens is a multinational conglomerate with a focus on electrification, automation, and digitalization. The company invests in R&D to develop solutions in areas like industrial automation, smart infrastructure, and healthcare.

11. Qualcomm Incorporated:
Focus: Qualcomm is a leading player in wireless technology and semiconductors. The company's R&D efforts contribute to the development of mobile technologies, 5G, and internet of things (IoT) solutions.

12. Alphabet Inc. (Waymo):
Focus: Waymo, a subsidiary of Alphabet, is a pioneer in autonomous vehicle technology. It engages in research and development to advance self-driving car technologies.

13. SpaceX:
Focus: SpaceX, founded by Elon Musk, is known for its work in space exploration and transportation. The company invests in research and development to advance space technologies, including reusable rocket systems.

14. Facebook Reality Labs:
Focus: Facebook Reality Labs, a division of Meta (formerly Facebook), focuses on virtual reality (VR) and augmented reality (AR) technologies. It engages in R&D to develop immersive experiences and advanced computing interfaces.

15. Cisco Systems, Inc.:
Focus: Cisco is a global leader in networking technologies. The company invests in R&D to advance networking solutions, cybersecurity, and technologies related to the internet of things (IoT).

These companies demonstrate a commitment to technological innovation through their substantial investments in research and development. Their contributions span various industries, including information technology, electronics, automotive, healthcare, and more.

❖ **Key Words:**

Need, Recognition and knowledge advances in technology Management, Research and development Projects, Research Companies in Technology Management.

❖ **Exercise**

- **Give answers of the following questions in detail.**

1. What are the needs of technology generation and development?
2. Explain the forms of recognition in technology generation and development.
3. Write a note on knowledge advances in technology management.
4. Give the meaning of idea generation and explain key aspects of idea generation in technology management.
5. Write a note on idea prompts related to technology generation and development under technology management.
6. Write objectives of corporate research and development in technology management.
7. Describe about research & development projects in technology management.
8. Discuss about technology development approaches.
9. Narrate the principal features of contract research in Technology Management.
10. Discuss advantages and challenges of contract research for technology management.
11. Discuss types of R & D Collaboration.
12. Write benefits of R & D Collaboration.
13. Mention research societies that focus on the generation and development of technology. in the field of technology generation and development.
14. Mention about research companies in the field of technology generation and development under technology management.

- **Multiple Choice Questions:**

(1) Which of the following point does not support to Need of Technology Generation and Development.
   a. Problem-Solving
   b. Improving Communication
   c. Increasing Productivity
   d. Finding Issues and Possibilities
   Ans: d. Finding Issues and Possibilities

(2) _____ in technology management refers to the process of systematically generating, identifying, and developing new and innovative ideas for technological advancements, solutions, or improvements within an organization.

a. Idea Generation
b. Innovation
c. Improvements
d. Solution
Ans: a. Idea Generation

(3) Which one of the following is not objective of corporate research and development in technology management
a. Improving Efficiency and Cutting Costs
b. Development of Products and Services
c. Improving Efficiency and Cutting Costs
d. None of these

(4) Medical Care, Automobiles, Technology of Information are the example of _____ in technology management.
a. Research & Development Projects
b. Technological Innovation and Progress
c. Development of Products and Services
d. Idea Generation
Ans: a. Research & Development Projects

(5) _____ approaches are a collection of tactics and procedures that companies use to develop, enhance, or use technology.
a. Technology development.
b. Social development
c. Cultural development
d. Economic development
Ans: a. Technology development.

(6) Which is not the principal features of Contract Research.
a. Goals of the Research
b. Knowledge Alignment
c. Considering Intellectual Property (IP)
d. To develop software
Ans: d. To develop software

(7) Which is not advantage of contract research for technology management?
a. Specialised Expertise Access
b. Economy of Cost
c. Quick Timelines
d. None of these

(8) Integration Difficulties, Barriers to Communication, Quality Assurance are challenges and things to consider for contract research.
a. True
b. False
c. Not certain
d. None of these
Ans. a. True

(9) _____ involves collaboration between public entities (government agencies, research institutions) and private companies.
a. Public-Private Partnerships
b. Community
c. Culture

d. Society

Ans a. Public-Private Partnerships

(10) _____ involves collaboration between entities from different countries, leveraging global expertise and perspectives.

a. Global Collaborations
b. Agriculture sector
c. Regional Collaborations
d. Partial Collaborations

Ans a. Global Collaborations

(11) Full form of AITP?

a. Atal Institute Telegram Project
b. Association of Information Technology Professionals
c. Association of Information Telegram Project
d. Atal Institute Technology Professionals

Ans b. Association of Information Technology Professionals

UNIT – 8 TECHNOLOGY TRANSFER

8.1 Introduction

Technology represents a vast reservoir of knowledge and tools that streamline the efficient and innovative utilization of economic resources for the production of goods and services. The progression of technology is pivotal for economic growth and development. The more advanced our technology becomes, the swifter the enhancement of local and global economies.

Expanding this concept on a global scale, we enter the realm of international technology transfer. In this context, knowledge traverses borders, encompassing not only information but also skills, manufacturing techniques, physical assets, know-how, and various technical facets. This transfer process fuels the evolution and innovation of technology.
International technology transfer serves as a conduit for knowledge to move from laboratories to industries, from one application to another, and from developed nations to developing ones. In particular, it plays a significant role in aiding developing countries in gaining access to technologies that are prevalent in more developed nations. This bridge to advanced technology and inventions, typically originating in developed countries, is instrumental in propelling progress and development in less developed or developing regions.

In technology, limits are set by natural laws, like the structure of materials, but most industries are far from these limits. They face practical barriers. For example, car engine efficiency can improve with higher temperatures, but current materials can't handle it. Ceramics can, but they lack strength. Researchers bridge the gap between current technology and its potential, whether practical or physical, known as technical potential. The technology with the most potential often dominates the market. Advancement comes from improving existing technology and developing new technology. The gaps between them can be challenging to bridge, sometimes making it hard to see the benefits of new technology. Barriers to adopting new technology include incorrect perspective on limits, measuring progress, interpreting market signals, understanding customer needs, and cultural factors.

8.1.1 Definition of Technology Transfer: Technology transfer refers to the process of sharing, disseminating, or exchanging technological knowledge, innovations, or capabilities from one entity to another. It involves the movement of technology, expertise, or intellectual property rights (IPR) from the source or originator (such as a research institution, corporation, or government agency) to the recipient (typically a company or organization that can apply and commercialize the technology).

8.1.2 Meaning of Technology Transfer:
Technology transfer involves the transmission of not just tangible technology but also the intangible aspects like know-how, research findings, and best practices. It can encompass various forms, including licensing agreements, joint ventures, partnerships, and collaborations.

Technology transfer is the process of sharing or disseminating knowledge, innovations, technologies, or intellectual property from one entity or organization (often the source) to another (typically the recipient) for the purpose of commercialization or application. It involves the movement of both tangible and intangible assets, such as patented inventions, research findings, manufacturing processes, or expertise.

8.2 Importance:

- **Innovation and Competitiveness:** Technology transfer is critical for driving innovation and enhancing competitiveness in industries. Access to new technologies enables organizations to stay at the forefront of their respective fields.
- **Economic Growth:** It contributes to economic growth by fostering the development of new products, services, and industries, thereby creating jobs and increasing revenue.
- **Efficiency:** It helps avoid duplication of research and development efforts. Instead of reinventing the wheel, organizations can build upon existing technology.
- **Global Development:** Technology transfer can play a role in international development by sharing advancements in areas like healthcare, agriculture, and clean energy with countries that may lack the resources or expertise to develop such technologies independently.

- **Knowledge Dissemination:** It serves as a bridge between academic research and practical applications. Universities and research institutions often engage in technology transfer to bring their discoveries into the commercial sector.

8.3 Management Process

In the context of technology transfer, the management process involves several stages:

1. **Identification:** This stage involves identifying valuable technologies or innovations that have potential for transfer. These technologies could originate from internal research and development (R&D) efforts, external sources, or partnerships.
2. **Assessment:** In this phase, an in-depth evaluation of the technology's feasibility, market potential, risks, and strategic fit is conducted. Legal and regulatory considerations are also examined.
3. **Negotiation:** Negotiations between the technologies source (the entity owning or providing the technology) and the recipient (the organization seeking to acquire or license the technology) take place in this step. The key elements like licensing terms, funding arrangements, and intellectual property rights are defined.
4. **Transfer:** The actual transfer of technology occurs in this stage. Depending on the nature of the technology, this might involve physical transfer, knowledge sharing, or collaborative research and development projects.
5. **Adoption and Implementation:** The recipient organization integrates the transferred technology into its operations and begins applying it to achieve its strategic objectives, whether that involves developing new products, improving processes, or enhancing services.
6. **Monitoring and Evaluation:** Continuous assessment of the technology's performance and impact is essential to ensure it meets the intended goals and provides value to the recipient organization.

8.4 People

People play a crucial role in technology transfer. The role of people in technology transfer is pivotal, as individuals play various crucial roles throughout the process. Technology transfer involves the exchange of knowledge, innovations, and technologies from one entity or organization to another for commercialization or practical application. Here are some key roles that people play in technology transfer:

1. **Technology Managers:** These professionals are responsible for overseeing and managing the entire technology transfer process. They identify valuable technologies, assess their potential, negotiate agreements, and ensure that the transfer is executed smoothly.
2. **Researchers and Innovators:** The individuals who have developed or contributed to the technology being transferred often play a central role. They possess the technical expertise and knowledge needed to explain the technology, its applications, and its potential benefits.

3. **Legal and Intellectual Property Experts:** Technology transfer involves complex legal aspects, including intellectual property rights, licensing agreements, and regulatory compliance. Legal experts are essential for drafting and negotiating agreements to protect the interests of all parties involved.
4. **Business Development Professionals:** These individuals are skilled in identifying commercial opportunities and potential partners for technology transfer. They often facilitate connections between technology providers and potential recipients.
5. **Executives and Decision-Makers:** Senior leaders within organizations make strategic decisions regarding technology transfer. They allocate resources, set priorities, and ensure that technology transfer aligns with broader business goals.
6. **Mentors and Advisors:** Experienced professionals can serve as mentors and advisors to guide start-ups and entrepreneurs in technology transfer processes, offering insights, connections, and support.
7. **Scientists and Engineers:** Technical experts are essential for the adaptation and implementation of technology. They may be involved in adapting technology to specific applications, troubleshooting issues, and ensuring successful integration.
8. **Project Managers:** In larger technology transfer initiatives, project managers are responsible for planning, coordinating, and executing the various stages of technology transfer, ensuring that timelines and budgets are met.
9. **Educators and Trainers:** Training and education may be required to ensure that the recipient organization or individuals have the knowledge and skills to effectively use the transferred technology.
10. **Communication Specialists:** Effective communication is crucial throughout the technology transfer process. Communication specialists can help convey complex technical information to non-technical stakeholders and the public.
11. **Quality Assurance Experts:** Ensuring the quality and reliability of the transferred technology is essential. Quality assurance experts can help establish and maintain standards and quality control processes.
12. **Evaluation and Monitoring Teams:** Teams responsible for monitoring and evaluating the performance and impact of the transferred technology help ensure that it meets the intended goals and provides value.
13. **Ethics and Compliance Officers:** In cases where technology transfer involves ethical considerations or regulatory compliance, ethics and compliance officers help navigate these aspects.

Here, people involved in technology transfer serve various roles, from identifying valuable technologies to ensuring that they are successfully integrated and applied in their new context. Effective collaboration, communication, and expertise from these individuals are essential for the successful transfer of technology and its benefits to society and the economy.

8.5 Obstacles of Technology Transfer:

Obstacles in technology transfer can include legal barriers, cultural differences, lack of trust, and financial constraints. Overcoming these obstacles involves careful planning, effective communication, and building relationships between technology providers and recipients. It may also require addressing regulatory and compliance issues.

8.5.1 Identifying obstacles of Technology Transfer:

Technology transfer can face various obstacles, including:

1. **Legal Barriers:** Complex intellectual property laws and regulations can hinder the smooth transfer of technology. Proper legal expertise is crucial to navigate these challenges.
2. **Cultural Differences:** Differences in organizational cultures and practices between the technology source and recipient can lead to misunderstandings and hinder effective collaboration.
3. **Financial Constraints:** Insufficient funding or resources can impede the technology transfer process. The securing adequate financial support is essential.
4. **Lack of Trust:** Building trust between the parties involved is essential. Trust issues can arise due to concerns about intellectual property protection, equity in partnerships, or the sharing of proprietary information.
5. **Regulatory and Compliance Issues:** Technologies may need to comply with specific industry regulations or standards. Overcoming regulatory hurdles is vital.
6. **Communication Challenges:** Effective communication is critical. The misunderstandings or miscommunications can lead to delays or breakdowns in the transfer process.
7. **Resistance to Change:** People within organizations may resist adopting new technologies due to a fear of change or a preference for existing practices.

8.5.2 Removing obstacles of Technology Transfer

To address these obstacles, a well-structured and managed technology transfer program should include clear communication, risk mitigation strategies, legal support, and a focus on building trust among the parties involved.

1. Clear Communication:

- **Needs Assessment:** The first step in addressing resistance to change is to conduct a comprehensive needs assessment. This involves engaging with all stakeholders, including those who might be hesitant about adopting new technology. Listen to their concerns and understand their preferences.
- **Transparency:** Transparent communication is crucial. It should clearly articulate the reasons for the technology transfer. For that expected benefits, how it aligns with the organization's goals. Address concerns and doubts openly.

- **Engagement and Involvement:** It involve key stakeholders in the decision-making process. Their participation can help them feel a sense of ownership and reduce resistance. The regular updates and progress reports should be part of the communication strategy.

2. Risk Mitigation Strategies:

- **Risk Assessment:** Identify potential risks and challenges associated with the technology transfer process. This should include not only technical risks but also those related to organizational change and adoption.
- **Risk Mitigation Plans:** It develops detailed risk mitigation plans that outline how each identified risk will be addressed. This could involve contingency plans, resource allocation, and problem-solving strategies.
- **Pilot Testing:** Consider conducting a pilot phase where the new technology is tested on a smaller scale. This allows for real-world feedback and adjustments before full-scale implementation, reducing the fear of the unknown.

3. Legal Support:

- **Contracts and Agreements:** Ensure that the technology transfer program is supported by clear and legally binding contracts and agreements. These documents should outline the terms, conditions, responsibilities, and rights of each party involved.
- **Intellectual Property Protection:** Address concerns related to intellectual property rights and confidentiality. Protect the interests of both the technology provider and recipient through well-crafted agreements.
- **Dispute Resolution:** It Includes clauses for dispute resolution in case disagreements arise during or after the technology transfer. Having a predetermined process for resolution can prevent conflicts from escalating.

4. Building Trust:

- **Relationship Building:** Technology transfer often involves multiple parties, such as technology providers, recipients, and possibly intermediaries. Building trust among these parties is essential. This can be achieved through transparency, integrity, and consistency in actions.
- **Long-Term Perspective:** Emphasize the long-term benefits and relationships that can be built through successful technology transfer. Highlight how the transfer will contribute to mutual growth and success.
- **Support Mechanisms:** Offer ongoing support and guidance to the technology recipient. This can include technical assistance, training, and access to resources that ease the transition.

Addressing resistance to change or a preference for existing practices during technology transfer requires a multi-faceted approach. By prioritizing clear communication, risk management, legal safeguards, and trust-building efforts, organizations can navigate these obstacles more effectively. Additionally, a well-managed technology transfer program

should remain flexible and adaptive, ready to address new concerns or challenges as they arise during the process.

8.6 Forms of Technology Transfer

The forms of technology transfer in detail, particularly focusing on vertical and horizontal technology transfer:

1. Vertical Technology Transfer:

Definition: Vertical technology transfer involves the transmission of new technologies from their generation during research and development programs to science and technology organizations, followed by application in industrial and agricultural sectors. It represents the transfer of knowledge and technology along a linear progression from basic research to applied research, from applied research to development, and finally, from development to production.

Process:

- **Basic Research:** This is where new ideas and concepts are explored in laboratories and academic institutions. It involves fundamental scientific exploration.
- **Applied Research:** Once promising concepts are identified, they move to applied research, where scientists and engineers work on practical applications and feasibility.
- **Development:** In this phase, the research is further refined into prototypes and tested in real-world scenarios.
- **Production:** After successful development, the technology is scaled up for commercial production.

2. Horizontal Technology Transfer:

Definition: Horizontal technology transfer involves the movement of well-established technologies from one environment to another. It refers to the transfer and application of technology from one organization, company, or industry to another, often across different sectors or fields.

Process:

- **Research:** Unlike the vertical approach, horizontal technology transfer typically begins with research that has already been conducted and proven effective.
- **Development:** The technology is adapted and refined for use in the new environment or industry. This may involve modifying processes, design, or materials.
- **Design:** The technology is tailored to meet the specific needs and requirements of the receiving organization or industry.
- **Production:** Finally, the adapted technology is integrated into the production process of the receiving organization or industry.

8.6.1 Differences between Vertical and Horizontal Technology Transfer:

1. **Direction:**
   - Vertical Transfer: The progresses from basic research to production.
   - Horizontal Transfer: It moves from one equipped environment or organization to another.

2. **Initiating Point:**
   - Vertical Transfer: It starts with the generation of new technology.
   - Horizontal Transfer: It begins with an existing, well-established technology.

3. **Path in Developing Countries:**
   - Vertical Transfer: Often, it involves the adoption of technologies generated externally.
   - Horizontal Transfer: It can entail adapting technologies from one sector or organization to another within the country.

4. **Trends in Developing Countries:**
   - Vertical Transfer: The developing countries may follow a reverse trend by focusing initially on production and gradually progressing to research.
   - Horizontal Transfer: It involves adapting existing technologies to meet local needs and requirements.

In summary, technology transfer plays a crucial role in bridging gaps between different levels of technological development. The vertical transfer encompasses the progression from research to production, while horizontal transfer involves the adaptation of established technologies across various domains. The choice between these forms of transfer depends on the specific needs, capabilities, and goals of the recipient organization or country.

8.6.2 Various channels of Technology transfer

Technology transfer can occur through various channels, each serving specific purposes and involving different stakeholders. Here, we'll discuss the primary channels of technology transfer, which include commercial channels, government channels, international organizations, and scientific exchange/publications:

1. Commercial Channels:

a. Licensing Agreements: Companies often transfer technology through licensing agreements. In this arrangement, the owner of the technology (licensor) grants another party (licensee) the right to use, produce, or sell the technology in exchange for fees, royalties, or other financial arrangements.

b. Joint Ventures: Companies may form joint ventures with other organizations to develop and share technology. This collaborative approach allows multiple entities to pool their resources and expertise for mutual benefit.

c. Mergers and Acquisitions: Technology transfer can occur when one company acquires or merges with another. This can lead to the integration of technologies and expertise from both entities.

d. Technology Incubators and Accelerators: These are organizations that nurture start-ups and provide them with resources, mentorship, and networking opportunities. Start-ups often receive technology transfer support in such environments.

2. Government Channels:

a. Research Grants and Funding: Governments often provide funding for research and development activities. These grants can facilitate technology transfer by supporting innovative projects and collaborations.

b. Public-Private Partnerships: Governments collaborate with private sector entities to fund and promote technology transfer initiatives. These partnerships can focus on areas like infrastructure development, healthcare, and renewable energy.

c. Regulatory Policies: Governments can establish policies and regulations that facilitate or mandate technology transfer in specific industries, such as environmental protection or healthcare.

d. Technology Parks: Governments may establish technology parks or special economic zones to attract businesses and promote technology transfer. These zones offer incentives and infrastructure for technology-focused companies.

3. International Organization Channels:

a. United Nations (UN): UN agencies, such as UNIDO (United Nations Industrial Development Organization) and WIPO (World Intellectual Property Organization), work to facilitate technology transfer, especially to developing nations, in areas like industrialization and intellectual property rights.

b. World Bank: The World Bank provides financial and technical assistance for development projects, which can involve technology transfer components, particularly in infrastructure and sustainable development.

c. WTO (World Trade Organization): WTO agreements address aspects of technology transfer related to international trade, intellectual property rights, and market access.

4. Scientific Exchange and Publications:

a. Scientific Conferences: Academic and industry conferences provide opportunities for scientists, researchers, and experts to share their findings and network. These interactions can lead to informal technology transfer.

b. Research Journals: Peer-reviewed scientific journals publish research findings and innovations, making them accessible to a global audience. Researchers can disseminate their technology-related discoveries through these journals.

c. Books and Publications: Books, reports, and other publications serve as valuable resources for disseminating knowledge and technology. The authors and institutions publish their research and findings in written form, making it accessible to a wide audience.

These channels of technology transfer are interconnected and can be complementary. Effective technology transfer often involves a combination of these channels to ensure

that knowledge and innovations reach their intended beneficiaries, whether they are businesses, governments, research institutions, or the general public.

8.7Alternative Approaches of Technology Transfer:

Alternative approaches to technology transfer can include open innovation models, where organizations collaborate with external partners, or creating technology spin-off companies to commercialize innovations. Additionally, technology parks and incubators can facilitate technology transfer by providing a supportive environment for startups and entrepreneurs.

Alternative approaches to technology transfer involve innovative methods and strategies for sharing knowledge, innovations, and technologies among different entities. These approaches aim to promote collaboration, innovation, and the effective dissemination of technology. Here are some alternative approaches to technology transfer:

1. **Open Innovation:**
    - **Concept:** Open innovation is a collaborative approach where organizations actively seek external sources of technology, ideas, and expertise to complement their internal resources.
    - **How it Works:** The companies engage in partnerships, collaborations, and open innovation platforms to access external technologies and co-develop innovations.
    - **Benefits:** It allows organizations to tap into a broader pool of ideas and expertise, accelerating innovation and reducing the time and cost of technology development.
2. **Technology Parks and Incubators:**
    - **Concept:** Technology parks and incubators provide a supportive environment for start-ups, entrepreneurs, and researchers to develop and commercialize technology.
    - **How they Work:** These facilities offer infrastructure, resources, mentorship, and networking opportunities to foster technology development and transfer.
    - **Benefits:** They facilitate the growth of technology-driven start-ups and innovations, supporting the transfer of technology from the research stage to commercialization.
3. **Technology Spin-offs:**
    - **Concept:** Technology spin-offs are new companies created to commercialize specific technologies or innovations developed within existing organizations or research institutions.
    - **How they Work:** Researchers or entrepreneurs establish spin-off companies to focus exclusively on developing, marketing, and licensing the technology.
    - **Benefits:** Spin-offs can accelerate the transfer of technology by leveraging specialized expertise and resources, often leading to faster market adoption.

4. **Cross-Industry Collaboration:**
    - **Concept:** Collaboration between industries that may not typically interact can promote the transfer of technology across sectors.
    - **How it Works:** Organizations from different industries join forces to explore new applications of existing technologies.
    - **Benefits:** This approach can lead to innovative uses of technology, expanding its reach and impact.
5. **Technology Licensing and Royalties:**
    - **Concept:** Licensing agreements allow technology owners to grant others the right to use, produce, or sell their technology in exchange for royalties or fees.
    - **How it Works:** Organizations with proprietary technology can license it to other parties, generating revenue from its use.
    - **Benefits:** It enables technology owners to monetize their innovations while allowing others to access and use the technology.
6. **Technology Transfer Offices (TTOs):**
    - **Concept:** Technology Transfer Offices **(**TTOs) are units within universities, research institutions, or organizations dedicated to facilitating the transfer of technology to industry and commercial partners.
    - **How they Work:** Technology Transfer Offices (TTOs) help identify valuable technologies, negotiate licensing agreements, and manage the technology transfer process.
    - **Benefits:** Technology Transfer Offices (TTOs) streamline the technology transfer process and bridge the gap between academia and industry.
7. **Public-Private Partnerships (PPPs):**
    - **Concept:** PPPs involve collaborations between public sector entities (e.g., government agencies, research institutions) and private sector companies to jointly develop and commercialize technology.
    - **How they Work:** Public and private entities pool resources, expertise, and funding to advance technology projects.
    - **Benefits:** PPPs can expedite technology development, especially in areas with high societal impact, such as healthcare and renewable energy.

These alternative approaches to technology transfer promote flexibility, innovation, and collaboration, enabling organizations to access, develop, and apply technology more effectively while fostering economic growth and innovation.

8.8 Raising Awareness:

Raising awareness in the context of technology transfer involves educating stakeholders about the benefits and opportunities associated with transferring and adopting new

technologies. This can be done through marketing, training programs, workshops, and networking events to connect technology providers with potential recipients. Technology transfer can be a beneficial process, but it can also present several challenges and problems. Here, we'll discuss the key problems associated with technology transfer:

1. **Technological Dependence:** When a country or organization heavily relies on technology transferred from external sources, it can lead to technological dependence. This reliance on foreign technology may limit independence, innovation, and the ability to adapt to changing circumstances.
2. **High Cost:** Acquiring and implementing new technologies can be expensive. The costs involved in licensing, training, infrastructure upgrades, and maintenance can strain the financial resources of recipient organizations or countries.
3. **Hindrance to Local Entrepreneurship:** The availability of foreign technology may discourage the development of local entrepreneurship and industries. The local businesses may struggle to compete with foreign counterparts that have access to more advanced technologies.
4. **Price Manipulation:** In some cases, technology providers may manipulate prices for licensing, maintenance, or support services, which can lead to inflated costs for the recipient.
5. **Tax Evasion:** In technology transfer deals, there can be instances of tax evasion or tax avoidance, which can harm the economy of the recipient country.
6. **Exploitation of Workers:** In cases where foreign technology is associated with labor-intensive industries, there may be concerns about the exploitation of workers, including poor working conditions and low wages.
7. **Social Tensions:** The rapid technological change and the influx of new technologies can create social tensions and disparities, as not everyone may benefit equally from the transfer of technology.
8. **Limited Labor Absorption:** When technology transfer results in the automation of certain processes, it can lead to reduced job opportunities, particularly for lower-skilled workers.
9. **Problems in Balance of Payments:** Technology imports can contribute to trade deficits and problems in the balance of payments, as payments for technology licenses and equipment may outweigh income from technology exports.
10. **Outmoded Technology:** In some cases, the technology transferred may be outdated or insufficiently adapted to the local context, making it less effective or unable to meet specific needs.

Addressing these problems in technology transfer requires careful planning, policy development, and international cooperation. It's essential for both technology providers and recipients to ensure that technology transfer agreements are fair, transparent, and mutually beneficial. Moreover, efforts should be made to promote the sustainable development of local industries, the protection of workers' rights, and the responsible use of technology to minimize negative social and economic impacts.

8.8.1 Initiatives of Technology Transfer in India:

India has actively pursued a range of initiatives to facilitate technology transfer and promote innovation. These initiatives span across government programs, institutions, and policies, playing a vital role in the country's economic development and technological advancement. Here are some key initiatives:

1. **National Science and Technology Entrepreneurship Development Board (NSTEDB):** NSTEDB, under the Department of Science and Technology, supports technology-based entrepreneurship. It provides financial assistance, training, and mentoring to entrepreneurs and start-ups to promote technology commercialization.

2. **Technology Business Incubators (TBIs):** India has established numerous TBIs, often affiliated with academic institutions and research organizations. These incubators provide infrastructure, mentoring, and financial support to technology-based start-ups, fostering innovation and entrepreneurship.

3. **Make in India:** The launched by the Government of India, the "Make in India" initiative aims to encourage domestic manufacturing and technology adoption. It attracts foreign investments and collaborations to boost the manufacturing sector's growth and reduce technology dependence.

4. **Atal Innovation Mission (AIM):** The AIM is a flagship initiative that focuses on creating a culture of innovation and entrepreneurship among Indian youth. It provides support through a network of Atal Tinkering Labs, Atal Incubation Centers, and Atal Community Innovation Centers.

5. **National Innovation Foundation (NIF):** NIF promotes grassroots innovations and provides support to innovators to transfer their technologies to the market. It recognizes and rewards innovations that have societal impact.

6. **Technology Acquisition and Development Fund (TADF):** TADF was established to support technology acquisition and development, especially for Micro, Small, and Medium Enterprises (MSMEs). It aims to enhance the competitiveness of these enterprises through technology transfer.

7. **National Research Development Corporation (NRDC):** NRDC plays a pivotal role in technology transfer and commercialization by licensing technologies developed in national laboratories and institutions. It connects technology developers with businesses and industries.

8. **Public-Private Partnerships (PPPs):** India actively engages in PPPs in various sectors, including infrastructure, healthcare, and education. These collaborations facilitate technology transfer by leveraging both public and private resources for joint projects.

9. **Intellectual Property Rights (IPR) Initiatives:** India has strengthened its intellectual property protection regime to encourage innovation and technology transfer. Initiatives like Start-up India also offer incentives for startups to protect their intellectual property.

10. **International Collaboration:** India collaborates with various countries and international organizations to access and share technologies. Initiatives like the Indo-U.S. Science and Technology Forum promote bilateral technology transfer and research collaborations.

8.8.2 Initiatives of Technology Transfer in India on Business Perspective:

Including above all, India has implemented various initiatives to promote technology transfer in the business sector:

Skill Development Programs: Skill development initiatives ensure that the workforce is skilled and equipped to effectively use transferred technologies, benefiting businesses.

Government Funding: Various government schemes and grants are available to support technology transfer and innovation in businesses, especially in research and development.

International Collaboration: Bilateral and multilateral agreements with other countries and international organizations provide opportunities for technology exchange and transfer.

These initiatives collectively support businesses in India in adopting, developing, and utilizing technologies to enhance their competitiveness, drive economic growth, and contribute to the country's technological advancement.

❖ **Exercise**

- **Long Question**

1. What is the technology transfer? Explain in detail.
2. Describe the technology transfer initiatives in India taken by the government.
3. Discuss the importance of technology transfer.
4. What are the key steps of the technology transfer management process?
5. How do individuals and teams play a role in facilitating successful technology transfer?
6. What are some common obstacles and challenges encountered during technology transfer?
7. Explain the differences between vertical and horizontal technology transfer?

- **Short Question**

1. What does the term "technology transfer" mean to you?
2. Why is technology transfer important in today's world?
3. What are the main steps in the technology transfer management process?
4. How do individuals and teams contribute to successful technology transfer?
5. What are common obstacles in technology transfer?
6. What strategies can be used to remove obstacles in technology transfer?
7. What are different forms or methods of technology transfer?
8. What are some channels or avenues for technology transfer?
9. How can organizations raise awareness about technology transfer?
10. What are some notable technology transfer initiatives in India?
11. How do businesses in India view and engage in technology transfer initiatives?

- **Multiple Choice Questions**

1. Which type of technology transfer involves the movement of well-established technologies from one environment to another?
A) Vertical transfer
B) Horizontal transfer
C) Diagonal transfer
D) Circular transfer

2. What is the role of technology managers in the technology transfer process?
A) Developing new technologies
B) Ensuring legal compliance
C) Managing financial transactions
D) Conducting market research

3. Which international organization is known for its efforts in facilitating technology transfer for industrial development?
A) WHO (World Health Organization)
B) UNICEF (United Nations Children's Fund)
C) UNIDO (United Nations Industrial Development Organization)
D) UNHCR (United Nations High Commissioner for Refugees)

4. What is one benefit of open innovation in technology transfer?
A) Reduced collaboration
B) Slower innovation
C) Limited access to external ideas
D) Faster innovation through external collaborations

5. What can be a potential drawback of technology spin-offs?
A) Slow development of technology
B) Limited access to expertise
C) Lack of financial support
D) Disruption of existing operations

6. In technology transfer, what is meant by "technological dependence"?
A) Overreliance on technology from external sources
B) Rapid technological advancements
C) Efficient technology utilization
D) Technology ownership

7. What do TTOs (Technology Transfer Offices) typically do in universities and research institutions?
A) Develop new technologies
B) Manage intellectual property rights
C) Conduct market research
D) Provide venture capital

8. Which channel of technology transfer involves cross-industry collaboration?
A) Licensing agreements

B) Public-Private Partnerships (PPPs)
C) Joint ventures
D) Open innovation

9. What is the primary purpose of a technology park or incubator?
A) Technology licensing
B) Infrastructure development
C) Intellectual property protection
D) Tax evasion

10. What role do quality assurance experts play in technology transfer?
A) Legal compliance
B) Ensuring technology is outdated
C) Maintaining standards and quality control
D) Monitoring market trends

11. Which organization is known for providing financial and technical assistance for development projects, including technology transfer initiatives?
A) WHO
B) UNICEF
C) WTO
D) World Bank

12. Which organization is responsible for addressing aspects of technology transfer related to international trade and intellectual property rights?
A) UNICEF
B) WIPO
C) UNIDO
D) World Bank

13. What is the primary purpose of technology transfer in the context of international development?
A) Generating profit for developed countries
B) Facilitating knowledge sharing and development in developing nations
C) Limiting access to technology
D) Supporting tax evasion

14. Technology transfer involves the exchange of:
A) Physical goods
B) Currency
C) Knowledge, innovations, and technologies
D) Services

15. Which of the following best defines technology transfer?
A) The process of selling technology to the highest bidder
B) The process of adapting technology for personal use
C) The process of sharing technology knowledge and innovations from one entity to another

D) The process of hoarding technology for competitive advantage

16. What role does technology transfer play in fostering innovation?
A) It hinders innovation by restricting access to technology.
B) It accelerates innovation by sharing knowledge and expertise.
C) It promotes innovation through tax evasion.
D) It has no impact on innovation.

17. Which phase of technology transfer involves adapting research into practical applications?
A) Basic research
B) Applied research
C) Development
D) Production

18. India's collaboration with other countries and international organizations for technology exchange and transfer is primarily facilitated by:
A) National Innovation Foundation (NIF)
B) National Research Development Corporation (NRDC)
C) Intellectual Property Rights (IPR) initiatives
D) Bilateral and multilateral agreements

19. Which program under the Department of Science and Technology provides financial assistance, training, and mentoring to technology-based startups in India?
A) Make in India
B) National Innovation Foundation (NIF)
C) Technology Business Incubators (TBIs)
D) National Research Development Corporation (NRDC)

20. Which organization plays a pivotal role in technology transfer and commercialization by licensing technologies developed in national laboratories and institutions?
A) National Innovation Foundation (NIF)
B) National Research Development Corporation (NRDC)
C) Atal Innovation Mission (AIM)
D) National Science and Technology Entrepreneurship Development Board (NSTEDB)

21. What is the primary objective of the Technology Acquisition and Development Fund (TADF) in India?
A) Supporting technology-based startups
B) Enhancing the competitiveness of MSMEs
C) Promoting grassroots innovations
D) Facilitating international collaborations

22. Which type of collaborations facilitates technology transfer in India by leveraging both public and private resources for joint projects?
A) Intellectual Property Rights (IPR) initiatives
B) Technology Business Incubators (TBIs)
C) Public-Private Partnerships (PPPs)

D) Atal Innovation Mission (AIM)

23. Which organization promotes grassroots innovations and supports innovators in transferring their technologies to the market?
A) Make in India
B) Atal Innovation Mission (AIM)
C) National Innovation Foundation (NIF)
D) Technology Business Incubators (TBIs)

- **Answers**

1) B	**2) B**	**3) C**	**4) D**	**5) D**
6) A	**7) B**	**8) D**	**9) B**	**10) C**
11) D	**12) B**	**13) B**	**14) C**	**15) C**
16) B	**17) B**	**18) D**	**19) C**	**20) B**
21)B	**22) C**	**23)C**		

UNIT – 9 INNOVATION BASED TECHNOLOGY AND PRODUCT TECHNOLOGY

9.1 Introduction

Now-a-days, innovation in technology is seen in almost every instrument, product or service we consume. The reason why the innovation in technology is required is each and every organization wants to survive in competitive world, to provide innovative solution to the problems presently faced by the consumers, to make the product or service efficient and improved and to bring overall transformation in the society. Innovation-based technology is outcome of the collaboration among various fields because innovation requires expertise of multiple fields such as science, engineering, commerce etc. With a view to make successful innovation-based technology, the organization should develop user-centric technology. Moreover, with a view to have powerful technology, the organization should take into account different modern-day technologies such as biotechnology, artificial intelligence, advanced materials science, quantum computing, and renewable energy over and above their consequences. As consumers' wants and preferences, market conditions change over a period of time, the organizations should be flexible and adaptive in innovation in technology.

As far as product technology is concerned, it is a technology or technological element integrated within a product to carry out its basic utility. Product technology covers not only technological element of the product but also its design, mechanism, components over and above technological innovation to have competitive advantage. It also comprises of user interface and experience to interact with the product. It includes all such aspects as are necessary to safeguard product's credibility and enhance its quality by upgrading and updating during each and every stage of its lifecycle. Hence, it can be said that it is ongoing process and therefore it also includes research, feedback from the end-user and other stakeholders.

9.2 Innovation Based Technology: Meaning and Importance

9.2.1 Meaning:

"Technology, which is stimulated by innovation, at the centre of research and development and intends to develop convert feasible thought into innovative standard or solution to problem, is termed as innovation-based technology."

In other words, "Technology which incorporates innovative research or method or idea to address challenges or create opportunity or enhance competence or alter the industry is known as innovation-based technology."

9.2.2 Importance:

Innovation-based technology is important and essential for any organization as it promotes growth and encourages innovation. With the help of innovation-based technology Organisation can overcome difficult problems, grab new opportunities,

and thereby accomplish organizational goals. It is a stimulant for growth and development and overall transformation in the organization, following points represent importance of innovation-based technology:

1. **Fosters growth in economy:** Innovation-based technology not only innovation but entrepreneurial or business empire-building activity and thereby it brings investment and results into establishment of new businesses. Establishment of new businesses or industries result into generation of employment opportunities. Eventually, technology based on innovation is of great significance to foster growth in economy and thereby to foster growth and development of the nation.
2. **Resolves challenges:** There are many challenges or problems in our day-to-day life. As a result, there is huge scope for innovation. Hence, innovation-based technology is vital in developing innovative technology which meets challenges faced by different organizations or different segments of society or different sectors or industries.
3. **Enhances competitiveness:** Business organizations face cut-throat competition from their rival companies. To gain competitive advantage, to enhance market share and to attract customers, they have to satisfy customers' needs with the distinguished products or services. Innovation is vital in developing such products or services that enhances competitiveness of the business organizations.
4. **Promotes alliance:** Innovation is mandatory for any organization to survive in the competitive world. However, it is not possible for each and every organization to afford innovation. Only the large-scale business organization can afford innovation. To reap the benefits of the innovation-based technology, it is required to have alliance or collaboration among the business organizations. Hence, innovation-based technology is vital in promoting culture of collaboration and thereby to innovate, create share knowledge and ultimately to promote shared growth and development.
5. **Enhances standard and quality of living:** At present, innovation takes place almost in all the sectors such as manufacturing, service, healthcare, education, communication and information technology, infrastructure etc. as a result, consumers can enjoy quality products or services. Hence, innovation-based technology is of great importance to enhance standard and quality of living not only of individuals but also for community as a whole.

9. 3 Meaning and Importance: Product Technology

9.3.1 Meaning:

"Technological characteristics or components or parts or designs required to manufacture a product with a view to make it usable, increase its utility and satisfy consumers' expectations are termed as product technology."

In other words, "Product technology can be termed as the mixture of software and hardware elements of product over and above components used in design, development and improvement of products to make up the final value or price of the product."

"Product technology is nothing but the creation of the innovative or different product with an objective to fulfil customers' needs and requirements by utilising innovative technology and design and thereby to achieve the organizational objective of value creation."

9.3.2 Importance:

An organization has to make efforts to survive in the competitive world. it has to offer well-designed, innovative product that can satisfy customers' expectations. It has to make constant efforts to increase product performance with the help of advanced technologies. As the consumers' needs, preferences, expectations change over a period of time, it has to make frequent customization, alteration in the product so as to cop with the such situations as well as to enhance customer loyalty towards the product. It has to take CSR initiatives over and above making optimum use of resources. To carry out all above activities, product technology is of great importance for any organization as described below:

1. **Develops Competency:** The reason why an organization has to offer a product having better utility, efficiency, and utility as compared to its rivals is to be viable or competent to survive in the cut-throat competition. Hence, the product of the organization should be innovative, distinct in many aspects as compared to the products of the rival organizations. Product technology plays significant role in making product unique and novel by adding unique features and thereby helps the organization to gain competence over its competitors.
2. **Increases Revenue:** With a view to develop brand loyalty and advocacy, it is essential to meet consumers expectations and to fulfil consumers' expectations, it is mandatory to develop consumer-friendly interface or feedback mechanism for smooth sharing of information about their needs or requirements or expectations. Product technology plays a significant role not only in customization and alteration in product as per the requirements or expectations of the consumers but in development of brand loyalty and advocacy also. It ultimately results into the creation of value for consumers, opening up of the new market and segment, enhancing revenue and developing the organization.
3. **Increases productivity:** Product technology makes use of the latest innovative technology such as artificial intelligence, machine learning. Hence, product technology enhances efficiency or capabilities and overall performance of the organization by systematizing the product processes and making the optimum use of resources. Hence, product technology plays a key role in the reduction of wastage and thereby in the increase of the productivity.
4. **Fulfils environmental and Corporate Social Responsibility:** Business organization makes use of different types of resources such as natural resources, human resources, financial resources, infrastructural resources to manufacture the product and therefore it has a responsibility towards the society. Product technology, by playing a key role in the reduction of wastage and increase in the productivity, shoulders environmental responsibility. It also innovates and makes use of sustainable materials and design of the product and thereby it also shoulders corporate social responsibility. Hence, it is of great significance in fulfilling environmental and corporate social responsibility.
5. **Focuses on perpetual improvement:** Business organization runs on going concern concept and hence it carries on its operations for unspecified amount of time. Based on this concept, business organization focuses on perpetual improvement in its product through continuous innovation. Hence, product technology has a significant role to play in making perpetual improvement in product, its features, its quality, its uses so that the business organization can have perpetual existence in the market.

9.4 Product Life Cycle Design

9.4.1. Meaning:

"The process of designing product throughout its life starting from acquisition of raw material to its conversion into final product including its sales, usage by the consumers, disposal of wastage or recycling is termed as product life cycle design."

"Product life cycle design is a broader concept that consists of the aspects pertaining to not only designing of the product but its production, sales, after sale service, usefulness by the consumers also with a view to make optimum utilization of the resources, enhance productivity and sustainability as well as reduce impact on environment."

"Design and production of product having features such as eco-friendly or environment-friendly or resource-efficient or economy-oriented or consumer-friendly is termed as product life cycle design."

"Product life cycle design not only minimizes negative impact on environment but also produces consumer-friendly or environment-friendly or socially conscious product."

9.4.2 Elements:

1. **Evaluation of environmental effect:** A business organization makes use of various resources in raw form from the environment or society for the production of the goods. Material obtained in raw form is converted into consumable goods with the help of undertaking various processes. This production process affects environment or nature through exhaustion of resources, consumption of energy, water pollution, soil pollution, air pollution, generation of wastage. Hence, a business organization has to evaluate the environmental effect before designing the product life cycle.
2. **Production of the eco-friendly product:** The business organization should select such material and manufacturing process as minimize the negative effects on environment or nature. The product life cycle design should be designed in such a way that raw material or component selected for the production should be less harmful to the environment means it should be eco-friendly and free from harmful chemicals. Hence, product life cycle design should be as such that it should be risk-free not only from environmental point of view but also from the viewpoint of human health.
3. **Production of energy-efficient product:** Over and above eco-friendly product, the business organization should design product with energy-saving characteristic and produce energy-efficient product. Production of energy-efficient product would help the business organization to reduce or control its manufacturing cost because it results into energy efficiency at each and every stage of product life cycle, and thereby reduction of the energy consumption and thereby reduction into electricity expenses.
4. **Production of robust product:** The business organization should also innovate and design product which is robust. Production of robust or long-lasting product makes it durable and sustainable because it results into easy repair and maintenance and no or rare incidence of obsolesce. With the addition of feature of durability and sustainability, lifespan of the product increases but incidence of replacement of the product decreases.
5. **Production of recyclable product:** The business organization should design the product as is recyclable or biodegradable or decomposable because it would be helpful to the organization for easy management of the product at the

end of its useful life. In other words, if the product is recyclable, it would be easy for dismantling, disposal of the product safely and easily at the of its useful life. The business organization should also design the product in such a way that it should use recyclable components or raw materials or elements in the production of the final product because it would also be helpful in easy waste management.

6. **Production of user-friendly product:** The business organization should design the product which is user-friendly. In other words, it would satisfy the consumers wants, needs and desires and thereby optimising consumer satisfaction. Hence, the business organization should design the product in such a way that it should take into account consumers' likes and preferences over and above their behaviour. With a view to make the product more user-friendly, the business organization should also provide user manual or instructions on the product consisting of usage or consumption, upkeeping and discarding of the product.

9.5 Life Cycle Assessment

9.5.1 Meaning:

"A holistic approach of assessing ecological influence at every stage of product life cycle is termed as life cycle assessment."

"A systematic methodology that assesses impact of manufacturing and waste generated due to manufacturing of product on energy consumption, natural resources such as air, water, soil."

In other words, "Process of assessing adverse or negative impact during the entire product life cycle i.e., right from the attainment of raw material, production, sales and distribution, consumption and recycling of final product is termed as life cycle assessment."

9.5.2 Stages:

1. **Raw material attainment:** In the first stage of the life cycle assessment, material is attained in the raw form from the natural resources Hence, it becomes necessary to assess the impact on the environment in terms of consumption of energy, water and land. It also requires to assess the damage caused to natural resources due to extraction of the raw material from them. Moreover, assessment of damage caused to habitat of the animals should also be made at this stage.
2. **Conversion of raw material into finished goods:** In the second stage, raw material is converted into the finished goods by carrying out necessary process. To carry out the production process, consumption of energy is made. Even during the production process, air, water and soil pollution is also caused. Wastage of raw material also takes place. Hence, at this stage, the assessment of the effect on energy, various types of pollution and wastage is considered under life cycle assessment.
3. **Sales and distribution:** At this stage, final product is sold and distributed to the customers. For distribution of the goods, different forms of transportation are used which results into consumption of fuel, air pollution. Hence, at this stage, the assessment of the effect on fuel, pollution is carried out under life cycle assessment.
4. **Consumption:** At this stage, consumption of the final product takes place at the end of the customers or consumers. During the consumption of the final product, consumption of the energy takes place. It also becomes mandatory to undertake repair and maintenance of the product. Consumption and disposal of the

consumables used in the usage of the final product also take place at this stage. Hence, at this stage, the assessment of the effect on the energy, maintenance and disposal of the consumables is carried out under life cycle assessment.

5. **Recycling of final product:** In the last stage, the estimated or useful life of the product gets over and it is to be discarded or recycled or reprocessed. At this stage, assessment of the various ways or options for disposal of the final product is considered. Hence, at this stage, assessment of various waste management options such as recycling or reprocessing or disposal is made and effect of each of the option on the environment is also assessed.

❖ **Exercise**

Theoretical Questions

1. "Innovation-based technology is important and essential for any organization as it promotes growth and encourages innovation." Do you agree with the statement? Give your opinion justifying importance of innovation-based technology.
2. "Product technology is nothing but the creation of the innovative or different product with an objective to fulfil customers' needs and requirements by utilising innovative technology and design and thereby to achieve the organizational objective of value creation." Justify the statement in the light of the importance of the product technology form the viewpoint of the business organization.
3. "Product life cycle design not only minimizes negative impact on environment but also produces consumer-friendly or environment-friendly or socially conscious product." Justify the statement highlighting major element of the product life cycle design.
4. "A holistic approach of assessing ecological influence at every stage of product life cycle is termed as life cycle assessment." Elaborate the statement by discussing in detail the stages of life cycle assessment.

- **Short Notes**

1. Importance of Innovation based technology
2. Importance of Product technology
3. Elements of Product Life Cycle Design
4. Stages of Life Cycle Assessment

- **MCQs**

1. Technology which incorporates innovative research or method or idea to address challenges or create opportunity or enhance competence or alter the industry is known as _____.
   a) innovation-based technology
   b) product-based technology
   c) service-based technology
   d) outcome-based technology
2. Technological characteristics or components or parts or designs required to manufacture a product with a view to make it usable, increase its utility and satisfy consumers' expectations are termed as ___
   a) innovation-based technology
   b) product-based technology
   c) service-based technology
   d) outcome-based technology
3. _____ not only minimizes negative impact on environment but also produces consumer-friendly or environment-friendly or socially conscious product.
   a) innovation-based technology
   b) product-based technology
   c) Product life cycle design

d) outcome-based technology

4. "A holistic approach of assessing ecological influence at every stage of product life cycle is termed as ____ ."
   a) innovation-based technology
   b) Product-based technology
   c) Product life cycle design
   d) life cycle assessment

5. ___ is the correct sequence of the stages for life cycle assessment
   a) Attainment of raw material, production, consumption, recycling of final product, sales and distribution
   b) Attainment of raw material, production, sales and distribution, recycling of final product, consumption
   c) Attainment of raw material, recycling of final product, production, sales and distribution, consumption
   d) Attainment of raw material, production, sales and distribution, consumption, recycling of final product

6. In the ___ stage of the life cycle assessment, material is attained in the raw form from the natural resources.
   a) Attainment of raw material
   b) Production
   c) Consumption
   d) Recycling of final product, sales and distribution

7. Assessment of various waste management options is made in ___ stage of the life cycle assessment.
   a) Attainment of raw material
   b) Production
   c) Consumption
   d) Recycling of final product, sales and distribution

8. At _____ stage, the assessment of the effect on energy, various types of pollution and wastage is considered under life cycle assessment.
   a) Attainment of raw material
   b) Production
   c) Consumption
   d) Recycling of final product, sales and distribution

9. ____ is of great significance to foster growth in economy and thereby to foster growth and development of the nation.
   a) innovation-based technology
   b) product-based technology
   c) Product life cycle design
   d) life cycle assessment

10. ____ plays significant role in making product unique and novel by adding unique features and thereby helps the organization to gain competence over its competitors.
    a) innovation-based technology
    b) product-based technology
    c) Product life cycle design
    d) life cycle assessment

Answer Key of MCQs

1	2	3	4	5	6	7	8	9	10
a	b	c	d	d	a	d	b	a	b

UNIT – 10 SOCIAL ISSUES IN TECHNOLOGY MANAGEMENT

10.1 Introduction

In the contemporary interconnected world, technology plays a vital role in shaping our economy, culture, and society. The effective use of technology has various benefits as discussed in the earlier chapters; however, it also poses a myriad of social issues that must be addressed. This chapter delves into various challenges and issues associated with effective technology management along with the meaning and importance of addressing these issues.

10.2 Meaning

Before addressing various types of social issues in technology management, it is imperative to understand what these social issues refer to. Social issues or societal challenges in technology management refer to the numerous concerns, problems, and dilemmas that arise from the integration and use of technology within society and by organizations. It covers an understanding of the relationship that exists between technology and society and the impact of these complex interactions between the two on individuals, organizations, and society at large. It entails both, the potential benefits of leveraging technology for organizations and society, as well as the potential drawbacks to the stakeholders involved due to its application. Addressing these social issues in technology management necessitates a holistic approach that considers not only the technological facets but also the economic, social, cultural, as well as ethical dimensions of the use of technology in organizations.

A few of these social issues in technology management addressed in this chapter includes: Acceptable Use Policies, Netiquette, Cyber Building, Student Data, Internet Privacy, Social Economic issues, Race, and Resource Equity.

10.3 Importance:

Addressing the social issues in technology management is imperative for organizations for numerous compelling reasons a few of which are discussed underneath:

- **Fostering Customer Trust & Loyalty:** By addressing social issues such as data privacy and security, organizations can build trust and confidence among customers, enhancing loyalty and driving sustainable growth. For instance, according to an article by Harward Business Review, trust is an important competitive differentiator as firms that are perceived untrustworthy will find it difficult to collect data from the customers compared to the ones that are

considered trustworthy, despite of the value offered by these firms in exchange of the data[1].

- **Fostering trust among other stakeholders:** Addressing these social issues in technology management will also enable organizations to uphold their credibility, goodwill, and reputation amongst its other stakeholders such as suppliers, distributors, retailers, partners, and others, by reflecting its ethical and responsible practices.
- **Mitigating risks:** By addressing these social issues, organizations can ensure adherence to legal/ regulatory compliances and ethical code of conduct, thereby mitigating financial losses, fines, penalties, legal liabilities, and reputational damages resulting in long-term resilience and sustainability.
- **Engaging and Retaining Employees:** Organizations that effectively address the social issues in managing technology, foster a positive and ethical work environment, attract and retain the best talents, and leads to higher job engagement, productivity, and satisfaction amongst employees.
- **Brand differentiation and Competitive Advantage:** This enhanced goodwill, employee commitment, and customer and stakeholder support differentiate the brands managing social issues related to technology management effectively, thereby providing them a competitive edge.

10.4 CASE

Privacy-Centric Innovations:
Apple's Approach to Addressing Social Issues in Technology Management[2]

Apple introduced updates to its operating systems on June 7, 2021, showcasing a significant shift towards prioritizing privacy which was highlighted in nearly every new feature. This emphasis on privacy has evolved beyond being just a corporate ideal or marketing gimmick; it has become a major initiative across Apple, setting its products apart from competitors like Android and Window. Since Apple CEO Tim Cook's open letter on privacy in 2014, the company has consistently positioned itself as a leader in privacy sensitivity. This commitment has been reinforced through the introduction of various iPhone features that limit app access to personal data and extensive privacy-focused advertising campaigns.

The new privacy-focused features and apps announced by Apple for its operating systems, iOS 15 and MacOS Monterey, included:

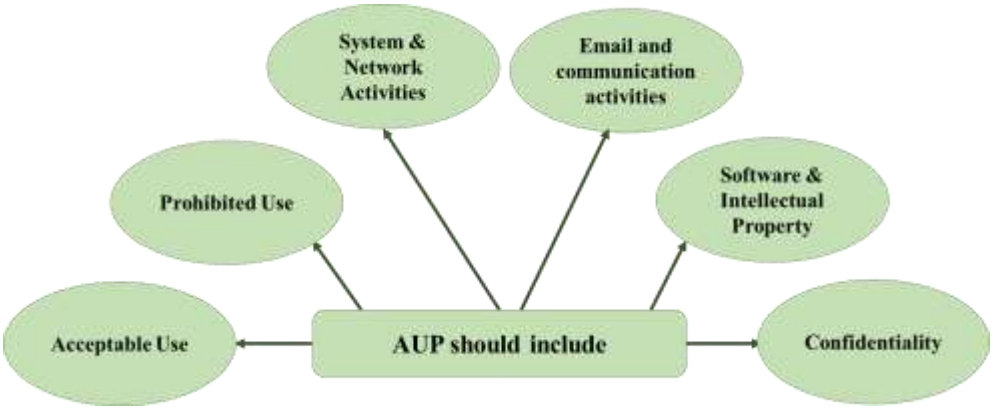
- *No tracking pixels: The Mail app will now route images through proxy servers to counter-tracking pixels used by email marketers to monitor message opens.*
- *Private Relay: Available to iCloud+ subscribers, this feature hides user IP addresses, which can be used to determine location, by routing web traffic through Apple and third-party proxy servers.*
- *Hide My Email: iCloud subscribers can generate and use temporary, anonymous email addresses within the Mail app.*
- *App Privacy Report: Users can see which servers' apps connect to, shedding light on data collection practices and informing users about microphone and camera usage.*

Apple's robust privacy infrastructure not only enhances user trust but also enables the company to expand into new markets like online payments, identity, and health. By adhering to best practices and regulations such as the General Data Protection Regulation (GDPR), Apple can develop new products with confidence, knowing they prioritize user privacy. Furthermore, users may feel more at ease with features involving sensitive data, such as finance or health, due to their trust in Apple's approach to privacy and data protection. This trust contributes to Apple's continued success in both product development and marketing endeavors.

In a nutshell, Apple's unwavering commitment to privacy not only differentiates its products but also fosters user trust, enabling the company to venture into new markets while maintaining its reputation for privacy excellence.

Acceptable Use Policies

Acceptable Use Policies (AUPs) are the guiding principles to ensure the ethical and responsible use of technology resources in organizations including hardware, software, and networks. AUPs are like instruction manuals for the users that describe the permissible use of various technological resources of the organization, what is prohibited, and the disciplinary actions in case of any policy violations. Various social issues such as privacy breaches, cyber threats, and other ethical dilemmas can be effectively addressed with systematic AUPs in place. AUPs help in facilitating a culture of responsible use of technology by reducing the risks associated with managing technology. They help protect privacy rights and sensitive information, and enable organizations adhere to the laws.



Source: https://resources.workable.com/acceptable-use-policy-template

A sample template for designing the AUP can include the below-mentioned steps:

- **Defining the purpose** why the organization needs an AUP, which could be protecting the company's digital assets, legal and regulatory compliances, ensuring an ethical and responsible work environment, or creating a productive work environment
- **Determining the scope** implies deciding which information technology assets are required to be covered in the policy (e.g. which hardware, software, networks) and whom the policy applies to (e.g. employees, suppliers, distributors, partners, contractors, visitors, etc.).
- **Research** and compare the AUP of similar organizations to know the best practices in the industry, and mandatory legal and regulatory requirements that should be enforced through the AUP.

- **Specify acceptable uses**, by outlining in detail what includes acceptable use of the technology resources of the organization by explaining and clarifying with examples where necessary.
- **Outline prohibited uses** clearly by specifying actions that are not permitted regarding the use of technology in the organization.
- **Specify system and network activities** by setting guidelines for accessing and using the company's systems and networks covering rules about unauthorized access, password security, and installation of software.
- **Establish guidelines for email and communication** covering appropriate usage of emails, standards for the content of emails, data sharing, sending bulk emails, and similar.
- **Address software and intellectual property** by mentioning the eorganization's stand on software licensing, intellectual property rights, and unauthorized software.
- **Emphasize confidentiality** by highlighting the significance of protecting confidential and sensitive information assets of the organization and providing guidelines suggesting the ways to store, share, and manage such information.
- **Specify enforcement methods** by detailing the consequences of violating these policies which can be extended to warnings, job termination, to legal actions.
- **Review and update procedures** and frequency should be mentioned in the AUP.
- **Obtain legal assistance** before finalizing the AUP to ensure that it complies with the local, state, and central laws.
- **Communicate and train** all the stakeholders regarding the effective understanding and implementation of the AUP.
- **Receive acknowledgment** from all the stakeholders that they have read, understood, and agreed to adhere to the AUP.
- **Timely review and update** the AUP as per the changes in technology, legal regulations, and organizational needs.

Exercise 2: *Refer to the AUPs of at least two companies, and relate to the points covered in this section.*

Examples:

1) *AUP of Google Business Communication: https://developers.google.com/business-communications/support/aup*
2) *Somerville College, University of Oxford, London: https://it.some.ox.ac.uk/aup/*
3) *Carleton University Library, Canada :https://library.carleton.ca/about/policies/electronic-resources-acceptable-use-policy*

Exercise 3: *Prepare the AUPs for your educational institute.*

Netiquette

The way social etiquette in physical communication is crucial to ensure effective and considerate communication, develop an environment of mutual trust and harmonious relationships, similarly netiquette is important in today's contemporary technologically interconnected world to maintain harmonious digital relationships. Netiquette can be defined as etiquette on the internet which is a collection of widely

accepted norms for appropriate online behavior. These norms are derived from the shared experiences of those who have explored the strengths and limitations of the internet in various communication situations.

Though the netiquette in specific may to some extent vary depending upon the company and organizational culture, the fundamentals of courtesy, respect, ethics, and consideration of others should be the major guiding principles to be followed in virtual communication. A few useful tips for netiquette common to various modes of virtual communication include:

- Recognize others' opinions and express constructively even if you disagree or have negative feedback.
- Use polite and professional language.
- Use a respectful tone.
- Keep the conversation clear and concise.
- Avoid personal attacks and language that can create conflict and discourage productive discussions.
- Avoiding the usage of excessive punctuation.
- Avoiding content written in "all caps (all capital letters, which may sound impolite or shouting)
- Avoiding the usage of ambiguous, offensive, or slang language
- Acknowledging the personal space of people and respecting their right to privacy.
- Consider the priorities and schedules of others while sending messages or emails.
- Avoid sharing personal details or sensitive data of others without their explicit consent.
- Take more caution and use secure channels when confidential matters are discussed in digital communication.
- Avoid sharing content that may harm the reputation of self or others.
- Avoid spamming or sending too many, long, and unnecessary messages.
- Avoid using emojis in professional communication.
- Proofread your content for accuracy and clarity before communicating.
- Reply promptly to important communications.

A few of the important general guidelines specific to a particular medium of communication include:

- In the context of ***email communication***, the subject lines should be clear and descriptive; use Blind Carbon Copy (BCC) to respect the privacy of the recipients in case of mass emails.
- In the context of ***social media communication***, when sharing personal information or photos of others, take their consent; and report abusive content or behavior to the platform moderators.
- In the context of ***online forums and discussion boards***, follow the forum rules before posting; share relevant information and stay on topic during discussions; avoid spamming the forum with excessive links; use appropriate formatting to ensure readability; report unsuitable content or behavior to the moderator.
- In the context of ***instant messaging***, avoid messaging excessively; respect the timings and availability of others; keep messages short and to the point by focusing on the agenda; use negligible use of emoticons and emojis, and use appropriately only if required and relevant.
- In the context of ***video conferencing***, test your internet connection and devices before the commencement of the meeting; join the meeting a few minutes early to the scheduled time to keep your presentation/documents/etc. to be shared ready and

get comfortable; when not speaking, keep your microphone muted to avoid any disturbances to the speaker; make sure your video and screen are shared only if required; avoid any kind of distractive behavior during the meeting; use hand raise feature/ chat feature / etc., as required and respectfully; contribute meaningfully to the meeting discussions by staying on the agenda only; dress appropriately to maintain a professional decorum; at the end of the meeting thank the host and the participants.

- In the context of ***blogging***, for ease of navigation for the readers, organize content by using categories and tags; if you include somebody else's content in your blogs, duly acknowledge the source with proper citation; seek permission of others before using their content; follow copyright laws; responsibly manage reader comments; appropriately engage with your readers; privacy of the persons stated in the blog posts and comments should be respected.

Adhering to these netiquettes in digital communication can facilitate a culture of respect and trust, foster harmonious relationships, and enhance work productivity in organizations.

Exercise 4: *Self-introspection*
Refer to your previous digital communications and self-introspect whether the netiquettes discussed above were followed, and how this communication could have been improved by following netiquettes.

Cyber Building
Ever since the rise of online technology, the world is witnessing cyber-attacks in different forms and scales. However, with individuals, organizations, and governments increasingly using the internet and online technology, cyber-attacks are becoming more common and lethal than ever. A few of the alarming statistics of cybercrime are listed here[3]:

- Cybercrime is projected to cost the world USD $9.5 trillion in 2024.[4]
- Global cybercrime damage costs are expected to grow by 15% per year over the next two years, reaching USD $10.5 trillion annually by 2025.[5]
- The global average cost of a data breach in 2023 was $4.45 million, a 15% increase over three years, highlighting the growing financial burden on organizations.[6]
- Globally, 72.7% of all organizations fell prey to a ransomware attack in 2023.[7]
- Phishing continues to be the most common email attack method, accounting for 39.6% of all email threats.[8]
- Phishing was identified as the primary infection vector in 41% of cybersecurity incidents. The Asia-Pacific region was the most targeted by cyberattacks, representing 31% of all reported incidents, with Europe and North America

following at 28% and 25%, respectively.

With the increasing cyber-crimes, governments, organizations, and individuals need to be more cyber-threat resilient by cyber (security) capacity building. Equipping individuals, organizations, and governments with the required knowledge, skills, and tools to secure their digital assets is known as cyber (security) capacity building. These digital assets can further be safeguarded through cyber building, which are dedicated facilities with advanced technologies and infrastructure to continuously monitor, project, defend, respond to, and manage cyber threats. These buildings serve as a hub for organizations' cyber security which is equipped with a team of specialized cyber security experts who can address various cyber issues in real time. The core functions of the cyber building and its teams are:

- **Monitoring and Surveillance:** The security team continuously monitors the network activities and detects early signs of potential attacks, responds to them in a timely manner as the cyber buildings are built with modern monitoring technologies and tools comprising intrusion detection and prevention systems, security event information management (SIEM) technologies, and network behavior analysis tools.
- **Incident Response and Management:** In cases of cyber-attacks these cyber buildings act as nerve centers coordinating responses to incidents. The security teams can assess what is happening using the communication systems in these facilities alongside other collaborative tools or incident response procedures applied to respond to these threats and mitigate risks on critical digital assets.
- **Data Analysis and Threat Intelligence:** Cyber buildings contain sophisticated analytical software that enables them to process huge amounts of data in real time through which they can recognize patterns and exceptions that may indicate potential security breaches. This offers valuable insights to the security teams for taking holistic decisions regarding various proactive measures such as threat elimination strategies like troubleshooting for potential vulnerabilities and security awareness training.

- **Physical security:** Cyber buildings ensure the safety of sensitive data and infrastructure within the facility by using surveillance cameras, access control systems, and secure server rooms; and are resilient even in the cases of power outages or natural disasters.

Cyber buildings hence play a vital role as a central system, equipped with technologies and teams to secure firms' digital assets by monitoring, detecting, responding, and mitigating cyber threats thereby making organizations resilient to cybercrimes and adversity.

CASE
Indian Cybercrime Coordination Centre (I4C)[9]

The Ministry of Home Affairs, Government of India, launched the Indian Cybercrime Coordination Centre (I4C) as an initiative to address cybercrime in the nation in a coordinated and comprehensive way. Launched on 10th January 2020 by Hon'ble Home Minister, Shri Amit Shah, it has focused on handling all the issues associated with cybercrime for the citizens.

It has improved coordination between stakeholders and various Law Enforcement Agencies and enhanced the overall capability of India to tackle cybercrime. The aims of I4C are:

- *To serve as a central hub to curb cybercrime in India.*
- *To reinforce the fight against cybercrime directed against children and women.*
- *Enable ease of filing complaints related to cybercrime.*
- *Identifying the patterns and trends in cybercrime.*
- *To serve as an early warning system for Law Enforcement Agencies for the detection and prevention of cybercrime proactively.*
- *Creating cybercrime prevention awareness among the public.*
- *Support States/UTs in capacity building of Police Officers, Judicial Officers, and Public Prosecutors in the domain of cyber forensisc, cyber-criminology, cyber hygiene, investigation, etc.*

I4C has seven verticals to achieve its objectives:

- ***National Crime Reporting Portal [NCRP]:*** *It allows reporting of all types of cybercrime incidents from anywhere. It has National/ State/ District-level monitoring dashboards. Though it emphasizes online child sex abuse material/ rape-gang rape incidents, it also provides other features such as online status tracking by the complainant, registered cyber volunteers as cyber awareness promoters, automated chatbots with pre-defined features, citizen financial cyber fraud reporting and management system, 1930 National Helpline number.*
- ***National Cybercrime Threat Analytics Unit [NCTAU]:*** *It is a collaborative platform for Law Enforcement Agencies (LEAs), individuals from the private sector, academic circles, and research organizations to analyze all information about cybercrime. The cybercrime feeds from open sources, CERT-In, National Cybercrime Reporting Portal, and other agencies working in these areas are collected, analyzed, and shared with the concerned agencies for taking further suitable actions.*
- ***National Cybercrime Ecosystem Management Unit [NCEMU]:*** *Its purpose is to develop an ecosystem favorable for effective mitigation of threats from cyber*

criminals by the collaborative efforts of the Governments, industry, and academia to fight cybercrime with multi-pronged and multi-stakeholder efforts.

- ***Joint Cybercrime Coordination Team [JCCT]:*** *It is set up to foster close coordination and cooperation among Law Enforcement Agencies (LEAs) during interstate cybercrime investigations by sharing information like names, mobile numbers, residence address, case details, etc. of cybercriminals among LEAs of States/ UTs.*
- ***National Cyber Forensic Laboratory (NCFL):*** *It is a facility that uses contemporary digital technology for forensic analysis and investigation of cybercrime to assist the LEAs in their investigations. It comprises units such as Image Enforcement Lab, Memory Forensics Labs, Malware Forensics Lab, Network Forensics Lab, Damaged Hard Disk Labs, Cryptocurrency Forensics Lab, and Advanced Mobile Forensics lab, to name a few. It provides online forensics services to Investigating Officers of Central and State LEAs to proactively address the issues of Digital Forensics.*
- ***National Cybercrime Training Centre [NCTC]:*** *It was set up to create a standardized course curriculum for handling the effects of cyber incidents, investigating cybercrimes, and offering training in detecting, managing, and reporting cybercrimes in a simulated online setting. It emphasizes on Capacity Building of LEAs, Judges, and Public Prosecutors in the field of cybercrime. The Massive Open Online Courses (MOOC) platform named 'CyTrain' portal was developed for the same.*
- ***National Cybercrime Research & Innovation Centre [NCR&IC]:*** *It was established at the Bureau of Police Research & Development (BPR&D), New Delhi to track evolving technological advancements and proactively envisage the potential vulnerabilities for cyberattacks. It is also involved in developing strategic partnerships with academia, private sector companies, or inter-governmental organizations for leveraging the strengths of all the stakeholders in the fields of research and innovation focused on cybercrime, cybercrime effect control, and investigations.*

Indian Cybercrime Coordination Centre (I4C) hence facilitates cyber (security) capacity building for the Indian Government to be more proactive as well as responsive in detecting, responding, mitigating the risks, and overall, effectively managing cybersecurity by empowering all the stakeholders through a collaborative and comprehensive approach of people and technology.

Student Data

In the era of technological advancement, educational institutes are widely collecting and analyzing student data such as their demographic and contact details, attendance logs, academic records, and behavioral assessments, to name a few. This student data can be utilized effectively for improving the overall teaching-learning experience as well as enhance academic management. However, digital collection and management of student data should be guided by the below ethical and social principles:

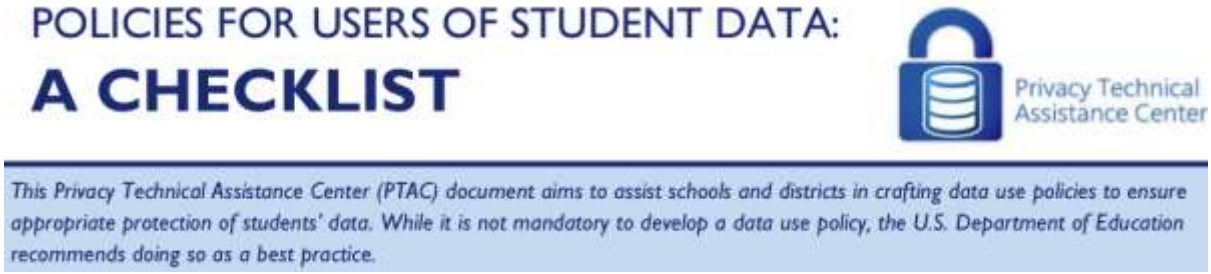
- **Privacy and Security:** Educational institutions should emphasize the protection of student data from unauthorized access, use, misuse, disclosure, or security breaches. This requires institutes to:
  - Collect and retain minimal and only necessary student data.
  - Develop and implement data privacy and security policies.
  - Train and motivate the stakeholders to adhere to these policies and the potential consequences for violating them.

- Confidentiality agreement with the concerned staff.
- Undertake technology measures such as access control, encryption, network security, data masking and anonymization, data loss prevention, etc.
- Conduct regular drills and security audits to ensure effective compliance.

- **Transparency and Consent:** To foster trust and cooperation amongst students, educational institutes should take the informed consent of students and parents on how and why their personal information is collected, stored, used, and disseminated, and actions taken to protect it; especially in case of sensitive information. For its effective implementation, educational institutes should have a proper policy and consent form in place, which should even be timely audited and updated.

CASE

Policies for users of Student Data: The U.S. Department of Education[10]



What is a data use policy?

Data use policies outline acceptable and prohibited activities for all categories of authorized data users (teachers, administrators, researchers, etc.). Effective policies clarify acceptable data use, define staff access, and outline compliance monitoring procedures along with consequences for noncompliance.

A data use policy is different from the policies that districts and schools typically develop to define acceptable student behavior online. Both types of policies are needed; students need guidance on appropriate and safe online behavior, and districts and schools need to regulate their use of student data.

Why should schools and districts have student data use policies?

From detailed records in student information systems, to personally identifiable information (PII) in online software used by teachers to enhance learning, to de-identified data provided to researchers for evaluating educational programs, students' personal information is collected and stored in many forms. Without the necessary data governance policies for all users of student data (see the PTAC document on Data Governance and Stewardship), the privacy and confidentiality of that information is at risk, leaving agencies exposed to complaints and investigations. While the Family Educational Rights and Privacy Act (FERPA) does not require a policy to be in place, it is a best practice to do so. Often districts develop data use policies for their schools, while occasionally individual schools develop these policies.

Best Practices

- ***Prepare data access and use policies for:***
  - *Authorized user groups, such as teachers, administrators, IT staff, and researchers. Policies should acknowledge the differentiated access and responsibilities for each group.*
  - *Device types, such as desktop machines, portable memory devices, district-issued mobile devices, and the users' own devices that access student data in*

any system. These include district-owned devices and those owned and operated by third parties on behalf of the school district.

- ***A data use policy should include information on:***
  - *Acceptable and prohibited data use and related online activities.*
    - ✓ *Clarify acceptable and prohibited use for the various types of student data, such as student directory information, PII, and de-identified data.*
    - ✓ *Provide examples of permitted and prohibited uses and activities. Consider including "use cases" to illustrate complex scenarios.*
    - ✓ *Institute role-based permissions by job function so users may only access necessary student data; specifically prohibit data "browsing."*
  - *Acquisition and use of third-party apps and services that use student data in any capacity. If only specific programs or apps are approved for school and teacher use, make that list widely available.*
  - *Plans for monitoring policy compliance (e.g., passive network monitoring, regular audits of access logs, etc.).*
  - *Clear and enforceable consequences for non-compliance.*
  - *Information on legal protections that may apply to the students' data.*
    - ✓ *Federal laws, such as the Family Educational Rights and Privacy Act (FERPA), the Protection of Pupil Rights Amendment (PPRA), and the Confidentiality Provisions in the Individuals with Disabilities Education Act (IDEA) protect students' education records and personal information.*
    - ✓ *Other federal, state, or local laws may apply as well. Consult your legal counsel about any other laws that may extend additional student privacy protections.*
- *Keep the policy as short and simple as possible to ensure users can recognize any violation. Use clear language and define legal and technical terms.*
- *Require a documented acknowledgement to access student data. Even if such an acknowledgement is not legally required, it is a best practice to have staff with access to students' PII acknowledge the district policies guiding student data use.*
- *Periodically review your data use policy, updating it as needed in response to changes in laws, regulations, software, or hardware.*
- *Regularly train staff on data use policies. These trainings could be paired with other trainings or offered ad hoc, but everyone with access to students' PII should be regularly reminded of their responsibilities with respect to this information.*
- *To promote transparency, post the policies online in an easily accessible location for staff to review as needed.*

The U.S. Department of Education established the Privacy Technical Assistance Center (PTAC) as a "one-stop" resource for education stakeholders to learn about privacy, confidentiality, and security practices related to student-level longitudinal data systems. PTAC provides timely information and updated guidance on privacy, confidentiality, and security practices through a variety of resources, including training materials and opportunities to receive direct assistance with privacy, confidentiality, and security of information in longitudinal data systems. Additional PTAC information and resources are available at http://ptac.ed.gov.

Internet Privacy

Privacy, a fundamental right of an individual is important for autonomy, dignity, and freedom of expression. In the context of the digital world, internet privacy can be said as the right to determine when, how, how much, and with whom an individual's personal data will be shared and used. In the contemporary digital world, individual privacy challenges are increasing due to a few of these reasons:

- Data are now accessible online for longer durations attributed to low-cost data storage.
- Contemporary technologies make data sharing faster, leading to data being disseminated easily.
- Individuals can be monitored and tracked easily over the internet due to advanced tools that can recognize faces, voice, sounds, images, movements, demographic details, web-usage behavior, locations, etc.
- Advanced tools are being developed and used to aggregate, correlate, link, and comprehend data which also includes data about the users on the internet.
- Personal data is easily sensed and transferred using the internet-of-things and devices using this technology.
- Users share data to various internet and mobile applications every day in some or the other way knowingly or unknowingly.

The Information Technology Act (ITA) 2000 currently has the most extensive set of laws in India regarding online privacy. Several clauses in the ITA may protect online privacy in certain situations or may weaken it in other situations. Clauses that expressly safeguard user privacy include those that define corporate data protection requirements, penalize child pornography, and punish hacking and fraud. Clauses that compromise user privacy refer to how law enforcement can access personal data that users have stored with a corporate entity, gathering and tracking of data on internet traffic as well as real-time tracking, intercepting, and decoding of communications conducted online.

These rules were reinforced in 2011 under the Information Technology "Reasonable security practices and procedures and sensitive personal data or information" Rules 2011. The purpose of the Rules is to give individuals rights to their information and to require corporations to take action to safeguard the privacy of consumer data. The Rules specify what constitutes "sensitive personal information" and mandate that corporate bodies, among other things, publish an online privacy policy, grant people the ability to access and correct their information, obtain consent before disclosing sensitive personal information—with the exception of law enforcement—allow people to withdraw consent, set up a grievance officer, and mandate that businesses ensure comparable levels of protection when transferring information. Despite being India's most rigorous data protection laws, the European Union has not acknowledged the Rules as satisfying its requirements for being "data secure", and there are still several gaps in the law.

To comply with the legal norms, organizations are required to have a proper internet privacy policy in place, which should be implemented effectively. A privacy policy can be said as a legal statement from an organization comprising terms and conditions that describe how it manages users' data. Organizations need to develop and implement internet privacy policies for a few of the following reasons:

- For legal compliance and avoiding non-compliance consequences like fines, lawsuits, or other regulatory penalties.
- Be a responsible corporate citizen by fulfilling ethical and social responsibilities by providing a safer environment to the stakeholders.
- Mitigate risks in case of any unauthorized access, data breaches, or similar issues.
- Enhance the goodwill of the company by fostering transparency, trust, and harmonious relationship with the customers.
- It is important for companies operating internationally to align their internet privacy policy with international regulations and standards for seamless cross-border business operations.

A robust privacy policy may include the following elements clearly explaining to consumers the privacy of their personal data in the context of:

- Purposes of collecting user data
- Types of personal data collected
- Sources of data collection
- Duration for which data is stored and methods of storing
- Purposes for which data is analyzed
- Whether and under what situations data may be disclosed or shared with other parties
- User rights regarding their personal data
- Updates and changes in the privacy policies
- Cookies and other tracking technologies used
- Measures to secure the collected data
- Contact information in case users intend to reach out for requests, queries, or concerns.

Exercise 5: *Refer to the Internet Privacy Policies of any two organizations and relate to the content discussed in this section.*

Sample reading:

1) *https://www.amazon.in/gp/help/customer/display.html?nodeId=GX7NJQ4ZB8MHFRNJ*
2) *https://www.axisbank.com/online-privacy-policy*
3) *https://policies.google.com/privacy?hl=en-US*
4) *https://www.apple.com/legal/privacy/en-ww/*

Social Economic, Race, and Resource Equity

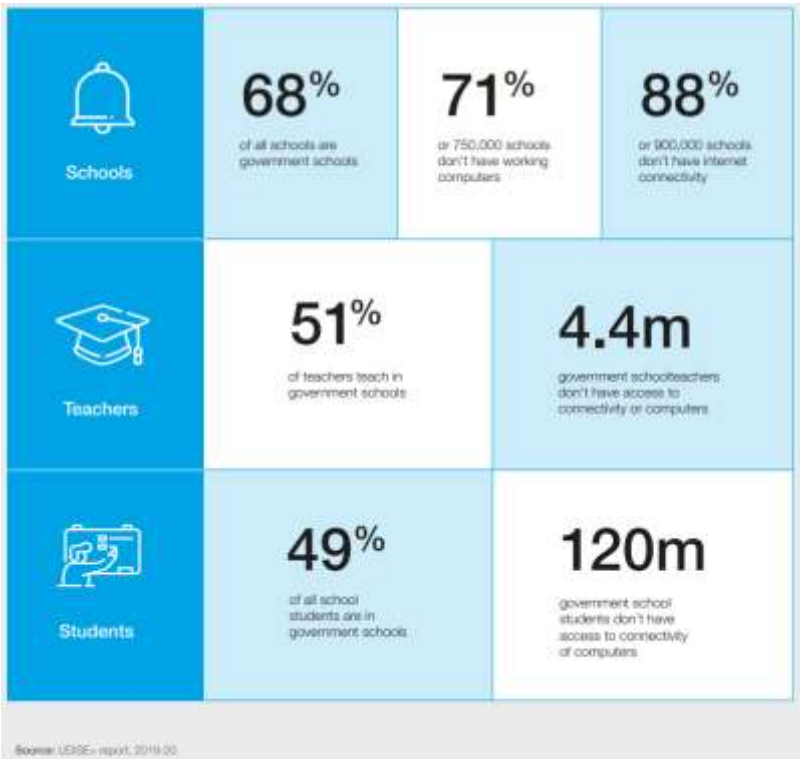
In today's digital era, technology has become a part of our daily lives impacting all facets of our lives be it education, employment, entertainment, healthcare, shopping, and staying connected in personal and professional lives, to name a few. Still, the benefits of technology in not accessible to all due to social, economic, and racial inequalities acting as barriers to its access and use. Hence, while discussing the social issues in technology management, it is imperative to address the challenges posed by digital literacy, the digital divide, and access to digital tools and resources. This emphasizes the need for policies and programs to address these inequalities and foster an inclusive technological landscape.

CASE

The Education 4.0 India: An Initiative by World Economic Forum and UNICEF to address the digital divide in India[11]

Digital learning has become an integral part of education worldwide due to the COVID-19 pandemic but, it has also increased the digital divide, pushing people without access to computers and the internet far behind. According to Education 4.0 India report, The COVID-19 pandemic has highlighted the extent of the digital gap caused by unequal access to and affordability of technology infrastructure (such as electricity and internet connectivity) and devices (such as computers and mobile devices). This gap was stated to differ across geographies, gender, and communities. Inequitable access to and use of technology was reported as the crucial challenge for expanding and leveraging the benefits of digital learning. Children with disabilities, living in remote areas, from migrant families, from scheduled tribes and scheduled castes, and girls in particularly were stated to face these inequalities more severely. A few of these resource inequality statistics reported were:

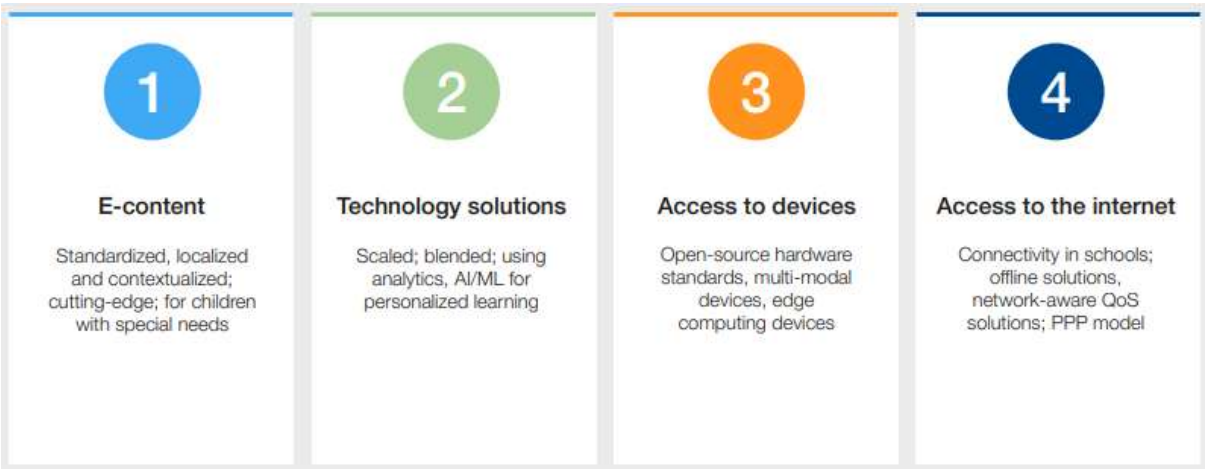
- *In six select states, only 68% of youngsters in urban areas were found to use technology-enabled learning tools, and only 47% in rural areas.*
- *Only around 41.3% of schools had access to computers and 24.5% to the internet in 2020-2021.*
- *A digital divide exists in terms of gender regarding access and use of mobile phones in India as in other places in the world; especially women in low and middle-income nations were found to be 7% less likely than men to own a mobile phone, and 16% less likely to use mobile internet. This gap was even wider for rural areas.*



Hence, the Education 4.0 India initiative was launched by WEF and UNICEF in May 2020, to leverage the technologies of the Fourth Industrial Revolution to augment the learning experience and reduce educational access inequalities among children in India. Under this initiative to connect the unconnected, schools were categorized on

the basis of their access to digital infrastructure, and recommendations were provided to empower schools at each level to become more connected.

A few solutions provided in this report for reducing inequalities and the digital divide, to connect the unconnected were:



For instance, the free-of-cost Massive Open Online Courses provided by the Government of India, require only nominal internet connectivity and a minimal of INR 1000/- for appearing for the exam, which can be said as an initiative for inclusivity and equity by making education accessible for all.

A few imperative steps that can be taken to tackle the digital divide due to social, economic, racial, and resource scarcity can be described below:

- Governments, non-profit and philanthropic organizations, and private organizations under their Corporate Social Responsibility (CSR) activities should undertake digital infrastructure affordability initiatives, and digital literacy programs to train the underserved communities/people about necessary digital technologies.
- Organizations should build and promote an organizational culture of equity and inclusion in the workforce, effectively address the biases in the system, and provide support and resources for underserved communities.

Summary

Overall, it can be summarized that in this interconnected digital world, social issues in technology management are inevitable; however, addressing these issues would require a comprehensive and collaborative multi-stakeholder approach involving global voluntary organizations like UN, WEF, UNICEF, etc.; government bodies; other non-profit and philanthropic organizations; tech companies; private organizations as a part of their CSR activities; educational institutes; parents; and students.

Keywords

AUPs - Acceptable Use Policies (AUPs)
BCC - Blind Carbon Copy
I4C - Indian Cybercrime Coordination Centre
NCRP - National Crime Reporting Portal
NCTAU - National Cybercrime Threat Analytics Unit
NCEMU - National Cybercrime Ecosystem Management Unit
JCCT - Joint Cybercrime Coordination Team
NCFL - National Cyber Forensic Laboratory
NCTC - National Cybercrime Training Centre
NCR&IC - National Cybercrime Research & Innovation Centre

LEAs - Law Enforcement Agencies
MOOC - Massive Open Online Courses
BPR&D - Bureau of Police Research & Development
PII - Personally Identifiable Information
PTAC – Privacy Technical Assistance Center
FERPA - Family Educational Rights and Privacy Act
PPRA - Protection of Pupil Rights Amendment
IDEA - Individuals with Disabilities Education Act
ITA - Information Technology Act
WEF - World Economic Forum
UNICEF - United Nations International Children's Emergency Fund
CSR - Corporate Social Responsibility

Exercise 6: Attempt the sample questions

6.1. Discuss the importance of addressing social issues in technology management. Identify the relationship between these issues with ethical and legal considerations.

6.2. Describe the purpose of Acceptable Use Policies (AUPs) and their role in effective technology management by relating them with the AUPs of any one company of your choice.

6.3. Examine how netiquette can help foster appropriate online conduct and reduce conflict in digital communication. How can businesses and educational institutions train people in the fundamentals of Netiquette and enforce its guidelines to develop a respectable and harmonious digital environment?

6.4. Discuss the opportunities and challenges related to cyber building in technology management and the need for social interaction, collaboration, and community building for its effective implementation and results.

6.5. What are the benefits of collecting, storing, analyzing, using, and disseminating student data? What are the legal and ethical considerations regarding student data? What can educational institutions do to leverage the benefit of student data to enhance student experience, thereby addressing the legal and ethical considerations effectively?

6.6. Develop a detailed Internet Privacy Policy for any small business e-commerce retailer.

6.7. Study how governments, non-profit organizations, and private organizations in other countries attempting to reduce the inequalities in access and use of technology arising due to socio-economic, racial, gender, location, or other disparities. Propose initiatives to reduce the digital divide in India.

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Education for All

યુનિવર્સિટી ગીત

સ્વાધ્યાયઃ પરમં તપઃ
સ્વાધ્યાયઃ પરમં તપઃ
સ્વાધ્યાયઃ પરમં તપઃ

શિક્ષણ, સંસ્કૃતિ, સદ્‌ભાવ, દિવ્યબોધનું ધામ
ડૉ. બાબાસાહેબ આંબેડકર ઓપન યુનિવર્સિટી નામ;
સૌને સૌની પાંખ મળે, ને સૌને સૌનું આભ,
દશે દિશામાં સ્મિત વહે હો દશે દિશે શુભ-લાભ.

અભણ રહી અજ્ઞાનના શાને, અંધકારને પીવો ?
કહે બુદ્ધ આંબેડકર કહે, તું થા તારો દીવો;
શારદીય અજવાળા પહોંચ્યાં ગુર્જર ગામે ગામ
ધ્રુવ તારકની જેમ ઝળહળે એકલવ્યની શાન.

સરસ્વતીના મયૂર તમારે ફળિયે આવી ગહેકે
અંધકારને હડસેલીને ઉજાસના ફૂલ મહેંકે;
બંધન નહીં કો સ્થાન સમયના જવું ન ઘરથી દૂર
ઘર આવી મા હરે શારદા દૈન્ય તિમિરના પૂર.

સંસ્કારોની સુગંધ મહેંકે, મન મંદિરને ધામે
સુખની ટપાલ પહોંચે સૌને પોતાને સરનામે;
સમાજ કેરે દરિયે હાંકી શિક્ષણ કેરું વહાણ,
આવો કરીયે આપણ સૌ
ભવ્ય રાષ્ટ્ર નિર્માણ...
દિવ્ય રાષ્ટ્ર નિર્માણ...
ભવ્ય રાષ્ટ્ર નિર્માણ

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