

DEVELOPMENT OF TECHNOLOGY

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TECHNOLOGY AND SOCIETY

Yet in no other time in history has technology been as pervasive in human lives as it is today. To an ever-increasing extent, it has invaded every aspect of human endeavor.

Technology society and life or **technology and culture** refers to the inter-dependency, co-dependence, co-influence, and co-production of technology and society upon one another. Evidence for this synergy has been found since humanity first started using simple tools. The inter-relationship has continued as modern technologies such as the printing press and computers have helped shape society.

all the knowledge, products, processes, tools, methods, and systems employed in the creation of goods or in providing services.

technology is the way we do things. It is the means by which we accomplish objectives.

Technology converts the realm of possibilities into realities.

DEFINITION OF TECHNOLOGY



TECHNOLOGY Components



Techno-Ware

physical artefact
necessary for production
systems



Human-Ware

skills, proficiencies,
knowledge, experiences, and
labor forces that directly
involved in the physical
production of products



Info-Ware

all kinds of data, statistics,
records, and information in
relation to product
specifications, designs,
manuals, and instructions for
production and
communications



Orga-Ware

all kinds of internal and
external practices, procedures,
policies, requirements,
regulations, and structures
that influence the decisions
and actions made by the firms

TECHNOLOGY Components

01

Hardware

The physical structure and logical layout of the equipment or machinery

03

Brainware

The reasons for using the technology in a particular way. This may also be referred to as the know-why.

02

Software

The knowledge of how to use the hardware

04

Know-how

The learned or acquired knowledge of or technical skill regarding how to do things well.

Knowledge and Technology

Knowledge is not information, but it is based on the amount of information available. Knowledge is all that has been perceived or grasped by the mind from the range of information available.

It is only when knowledge is practically implemented to create new things, operate a system, or provide a service that we enter the realm of technology.

Technology is knowledge applied to the creation of goods, provision of services, and improvement of our stewardship of precious and finite resources. advancement of technology follows expansion of knowledge.

Technology and Business

The growth of a business
and its efficiency can be
determined by the
technological approach

New culture for business

inflow of business
information

COMPATATIVE ADVANTAGE

The growth of a business

Technology has created a
new culture for business
and countless benefits

Information

organizations to manage
its technological
fundamentals to
create competitiveness

CLASSIFICATION OF TECHNOLOGY

New Technology
any newly introduced or implemented technology in a new situation.

High Technology
refers to advanced or sophisticated technologies.



Emerging Technology

any technology that is not yet fully commercialized but will become so within about five years

Low Technology

refers to technologies that have permeated large segments of human society.

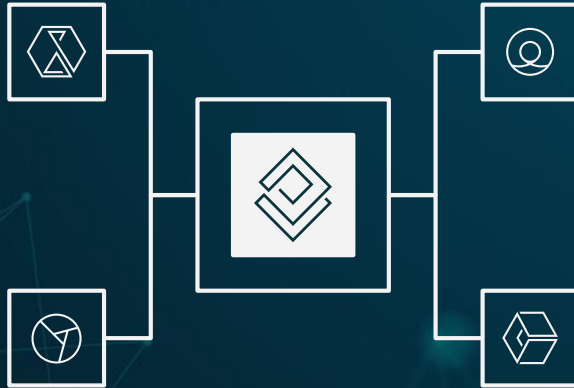
CLASSIFICATION OF TECHNOLOGY

Medium Technology

fall between high and low technologies

Codified Technology

allows people to know how technology works but not necessarily why it works in a certain way.



Appropriate Technology

good match between the technology utilized and the resources required for its optimal use.

Tacit Technology

Non-articulated knowledge. It remains within the minds of its developers.

MANAGEMENT OF TECHNOLOGY



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 of living and quality of life.

Managing technology implies managing the systems that enable the creation, acquisition and exploitation of technology to aid human endeavors and satisfy customers' needs.

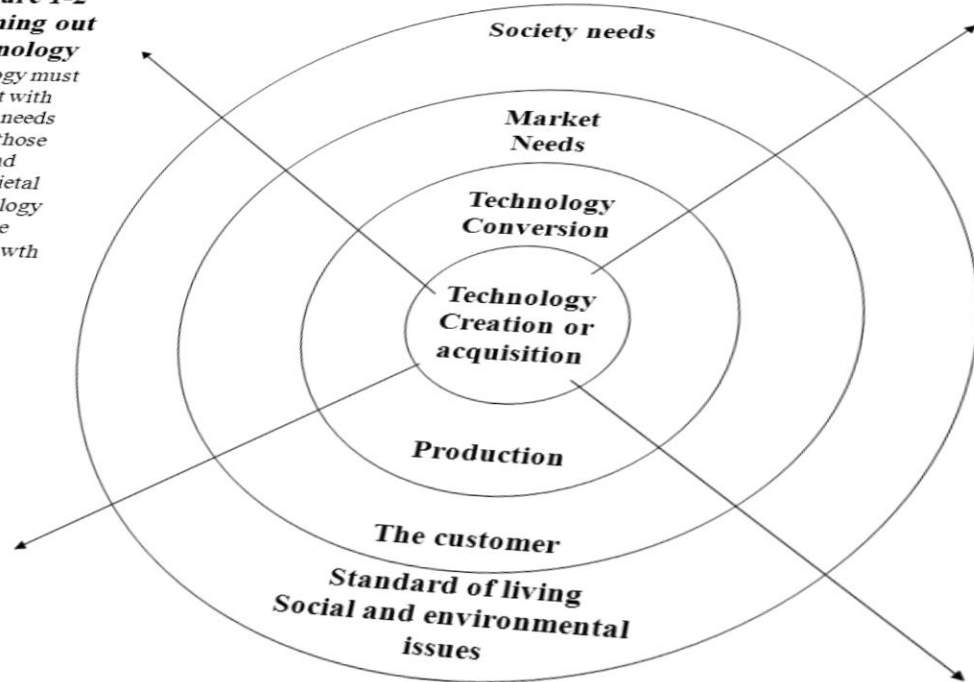
Technology generates wealth when it is commercialized

when technology is connected with a customer, it's benefits are realized(Figure 1-2). A customer is a beneficiary and could be an individual, a corporation, or a government entity.

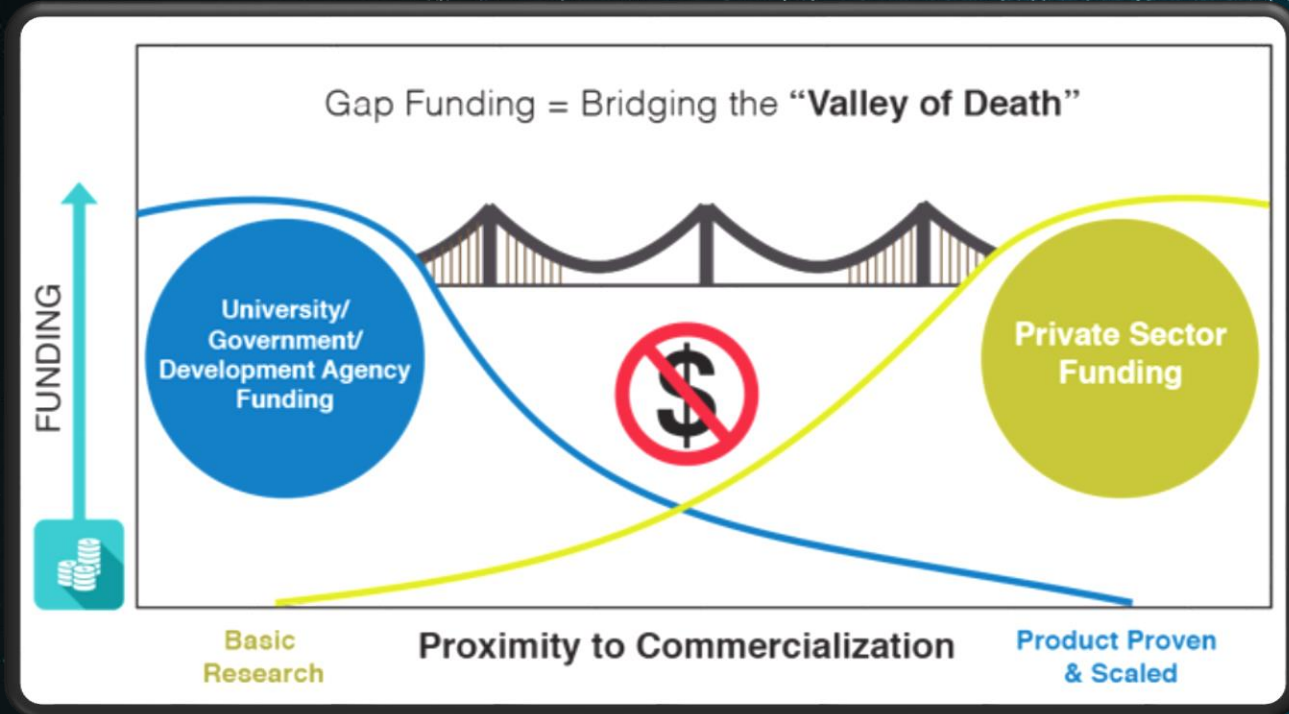
Technology is the engine of economic growth.

Figure 1-2
Spinning out
Technology

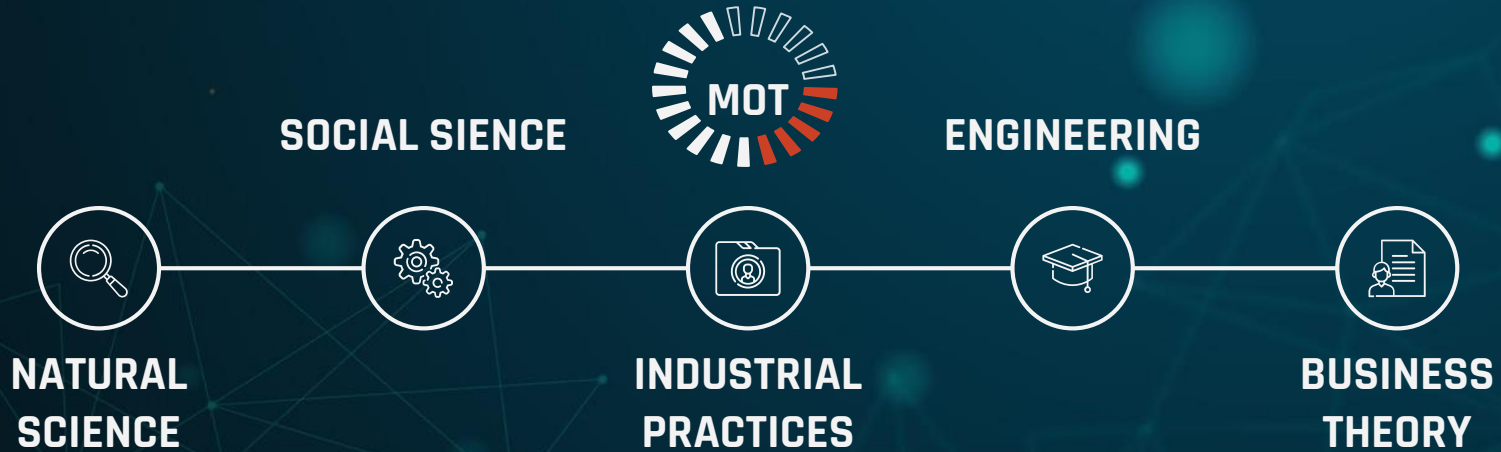
Technology must connect with customer needs to satisfy those needs and achieve societal goals. Technology is the Engine of economic growth



VALLEY OF DEATH



the MOT field is that technology is the most influential factor in a wealth-creation system, there are other factors that contribute to the system



MOT treats technology as the seed of the wealth-creation system. With proper nourishment and a good environment, a seed grows to become a healthy tree.

Factors contributing to wealth creation



MOT DIMENSIONS

NATIONAL/ GOVERNMENTAL LEVEL(MACRO)

it contributes to shaping public policy



ORGANISATIONAL/ FIRM LEVEL(MICRO)

it contributes to the creation and sustainability of competitive enterprises.

INDIVIDUAL LEVEL

it contributes to the enhancement of one's worth in society.

some of the importance's of MOT

As companies grow, they are required to store large amounts of data and inventory. With technology, this process can be automated, **boosting productivity and cutting costs.**

MOT also permits companies to bury information with layers upon layers of encryption, securing the integrity of their business.

create maximum value for the organization and customers.

COUNTRIES R&D EXPENDITURES LIST

01 USA	02 CHINA	03 JAPAN	04 INDIA
612.714 B US \$	514.798 B US \$	172.614 B US \$	158.691 B US \$
3.1% GDP PPP	2.2 % GDP PPP	3.2 % GDP PPP	1.3% GDP PPP



Science and technology policies have a major impact on a nation's competitiveness; therefore, the process of technological innovation must be well understood ...

Infrastructure and management of R&D is a key aspect, and entrepreneurship is vital for the development of new technologies.

THE CONCEPTUAL FRAMEWORK FOR MOT

SCIENCE AND ENGINEERING DISCIPLINE



Discipline-based Knowledge Science
Disciplines Material Technology
Product Technology
Production/Process Technology
Information Technology
Environmental Technology

MOT



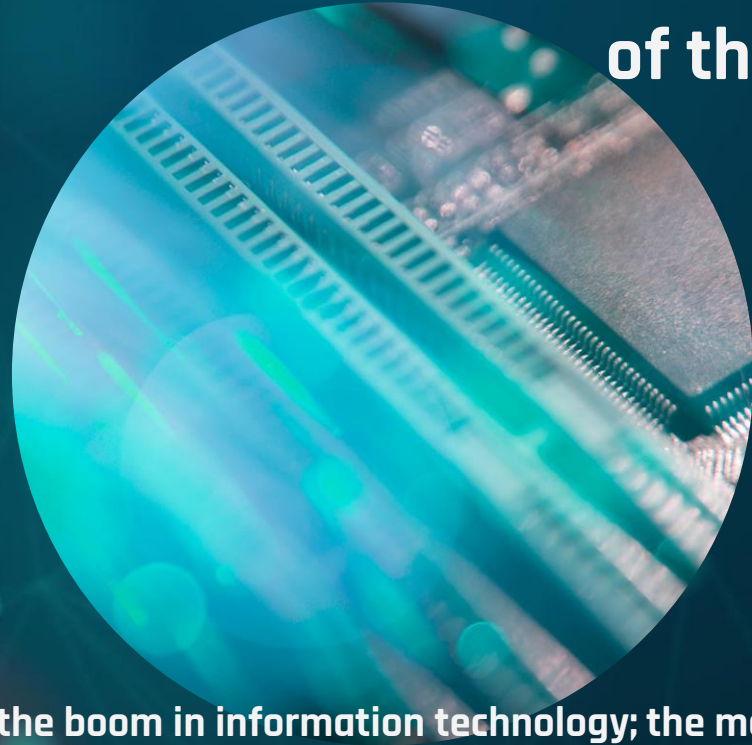
Strategic/Long-Term Issues
Relating Technology Science and
Technology Policy Process of
Technological Innovations R&D
Management R&D Infrastructure
and Technological Change

Business Administration Disciplines



Discipline-based Knowledge
Accounting /Finance
Management Marketing/
Economics /Business Law

All these topics are interwoven to form the fabric of the MOT field.



technological forecasting is assuming a much greater importance in planning for technology. Other pertinent subjects include technology transfer; the role of multinational corporations; the risks associated with technology; economic analysis; human, social, and cultural issues; education and training aspects; productivity and quality; organizational structure; management of technological projects;

the boom in information technology; the marketing of technologies; financial issues related to technological development; and environmental sustainability and eco-efficiency.

WHY MANAGEMENT OF TECHNOLOGY NOW?

The world is changing –
21TH CENTURY

**New technologies
emerge**

inflow of business
information

**new paradigm
for business**

**the pace of
change
continues to
increase**

the high dynamics of
trade shifts

Information

These shifts create
sweeping change

MOT(new paradigm)

GUIDING PRINCIPLES FOR MANAGING ENTERPRISES

1 Value creation:

long-term survivability of the enterprise.

2 Quality:

influencing competitiveness

3 Responsiveness:

respond to external environmental changes and customer demands promptly.

4 Agility:

flexible changes within an organization's structures to meet changing demands.

5 Innovation:

use innovation to gain competitive advantage. Competing through technology is a fact of life today.



MOT(new paradigm)

GUIDING PRINCIPLES FOR MANAGING ENTERPRISES

6 Integration:

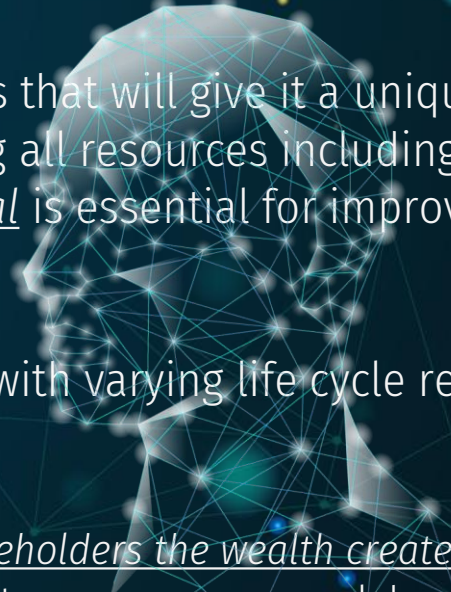
to acquire and integrate a portfolio of technologies that will give it a unique and defined advantage over its competitors. Integrating all resources including technology, people, energy, information, and capital is essential for improving productivity and increasing effectiveness.

7 Teaming:

The complexity of integrating mixed technologies with varying life cycle requires a workforce with high levels of training.

8 Fairness:

A firm must develop a fair way to distribute to all its stakeholders the wealth created by a successful production operation. Fairness reduces conflicts among managers, labor, government, and the public. It leads to long-term survival of the enterprise.



The World: Post World War II

World War II created a new order in the world



The industrialized countries dominated the scene. They had the major share of the world's productive capacity. Technology-based products were sold at home and all over the planet, creating great wealth for countries such as the United States, Britain, and France.

The postwar era was a period of relative technological stability. Labor was divided mainly into blue-collar and white-collar workers. Industry owners and managers created management systems. Increasing productivity through the fine-tuning of operations was adequate

The World Today

The most pronounced difference between the world today and the world of yesteryear is the rapid pace of technological change.

The Pace of Technological Change

making it imperative to consider technology as the primary factor influencing economic growth and prosperity.

Trade Blocks

Countries are entering into agreements that create trade blocs, such as the European Union (EU)



The Change in Scope

a change in market behavior. Customers are now demanding choice and expect high-quality products.

Changes in Competition

Relatively new global competition is intensifying each day. The economies of Germany and Japan have been revitalized since World War II. New countries are entering the game

Creating a national competitive strategy depends on the harmonious integration of economics, technology, and trade systems

01 | **Economic System**

02 | **Technological Capabilities**

03 | **Trade**



04 | **Competitive Enterprises Sustainable Economic Growth**

Effective public policy that addresses these issues is critical for the creation of sustainable economic growth and an improved standard of living.

Characteristics of LDCs

- **Capital Deficiency**
- **Natural Resources:** In various poor countries natural resources are available but they remain un- utilized under-utilized and miss- utilized due to capital shortage, less efficiency of labor, lack of skill and knowledge and limited home market.
- **Out Flow of Best Brain**
- **Market Imperfections:** the productive efficiency in these countries is low and resources are misallocated.
- **Inflation:** High rate of inflation in poor nations causes economic backwardness.
- **Control of Government(more regulation)**

Characteristics of LDCs

- **Low level of Capital formation:** Due to low savings and investments capital formation rate is also low.
- **High Degree of Illiteracy:** Pakistan literacy rate is 57% while in advanced countries; it is near to 100%.
- **Rapid Population Growth:** An increasing population growth rate adds to low per capita income and low rate of capital formation and there is no marked improvement in the living standards of masses.
- **Consumption pattern:** The major portion of their income is spent on basic necessities of life i.e. food, fruits, meat, eggs, milk etc.
- **Technical backwardness:** high cost of production, low productivity, unskilled and untrained workers.

Characteristics of LDCs

- **External Resources dependence:** poor nations are loans and grants receiving nations. to serve the interests of foreign countries.
- **Inadequate infrastructure:** In these nations: roads, transport, telecommunication, sanitation, health and education facilities are not at their best level.
- **Social Aspects:** cultural and religious views, beliefs and values that badly affect their economic development.
- **Trade deficit:** Undeveloped countries usually exports raw material but import finished goods. The price of raw material is low but the price of finished goods is high. So, balance of payment is unfavorable.

Problem of transferring technology to LDCs

It does not make sense, for example, to use high technology when there is a lack of necessary infrastructure or skilled personnel. This is a dilemma faced by many developing countries that want to transfer technology used in more industrialized countries. They may push for the acquisition of high technology in cases where a medium-level technology would be more effective. Utilizing the appropriate level of technology results in better use of labor resources and better production efficiency.

1. Lack of pool of scientists and researchers in specific domains.
2. Brain drain.
3. Small market size.
4. Bureaucratic climate.
5. Inability to make public investments in appropriate research and infrastructure.

World Bank country classification by income level

GNI per capita in US\$ (Atlas methodology)

GNI per capita is the gross national income, converted to US dollars using the World Bank Atlas method, divided by the mid-year population. GNI is the sum of value added by all resident producers plus any product taxes (less subsidies) not included in the valuation of output plus net receipts of primary income (compensation of employees and property income) from abroad. To smooth fluctuations in prices and exchange rates, the World Bank uses a special Atlas method of conversion to express national currency values in US dollars.

The World Bank assigns the world's economies to four income groups—

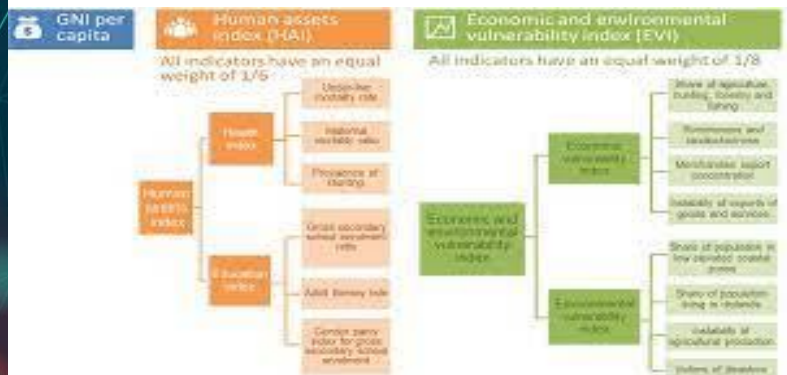
1. **low,**
2. **lower-middle,**Iran Islamic Rep.....2021...**Lower Middle Income**
3. **upper-middle,**
4. **high income.**

The classifications are updated each year on July 1 and are based on the GNI per capita of the previous year (2021). GNI measures are expressed in United States dollars (USD), and are determined using conversion factors derived according to the Atlas method.

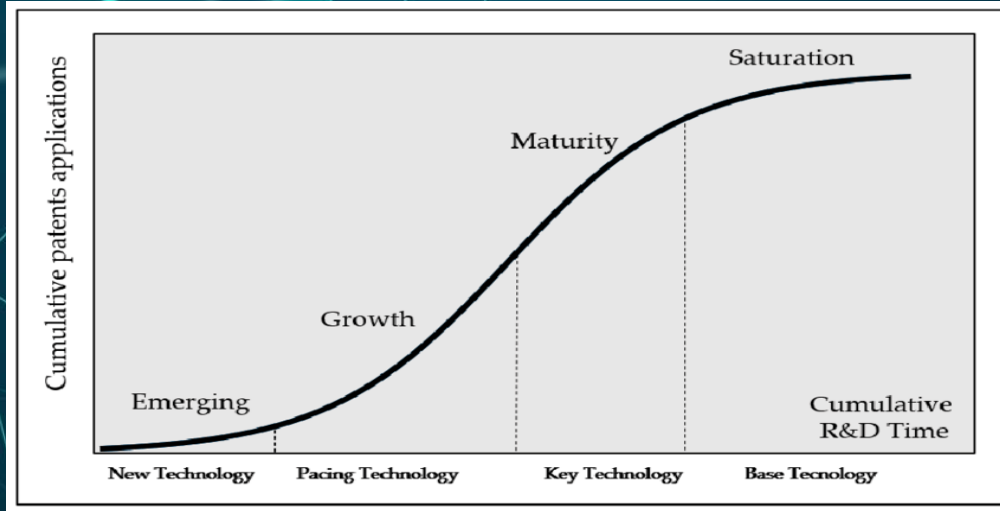
World Bank country classification by income level

GNI per capita in US\$ (Atlas methodology)

Group	July 1, 2022 for FY23 (new)	July 1, 2021 for FY22 (previous)
Low income	< 1,085	< 1,045
Lower-middle income	1,086 – 4,255	1,046 – 4,095
Upper-middle income	4,256 -13,205	4,096 -12,695
High income	> 13,205	> 12,695

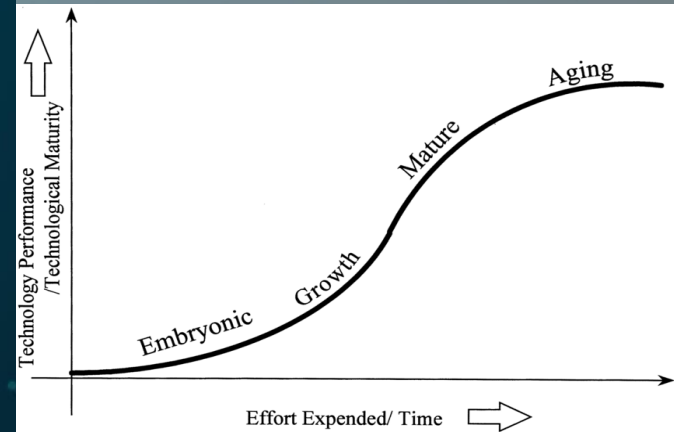


THE S-CURVE OF TECHNOLOGICAL PROGRESS



The technology becomes vulnerable to substitution or obsolescence when a new or better-performing technology emerges. The new invention period is characterized by a period of slow initial growth. This is the time when experimentation and initial bugs are worked out of the system. The technology improvement period is characterized by rapid and sustained growth. The mature-technology period starts when the upper limit of the technology is approached and progress in performance slows down. This is when the technology reaches its natural limits as dictated by factors such as physical limits.

- (1) the new invention period, also known as the embryonic stage;
- (2) the technology improvement period, also known as the growth stage;
- (3) the mature-technology period.



a very important concept in MOT: When a technology reaches its natural limits it becomes a mature technology vulnerable to substitution or obsolescence.

COMPETITION AT DIFFERENT PHASES OF THE TECHNOLOGY LIFE CYCLE

1) The embryonic or emerging technology stage

In the early stage of the technology life cycle, also known as the embryonic or emerging technology stage, competition is based on innovation. In this stage, the technology is still developing and has not been fully accepted. Companies depend on their innovation to add value to products and services they bring to their customers. The introduced technology has not yet demonstrated its potential for changing the basis of competition.

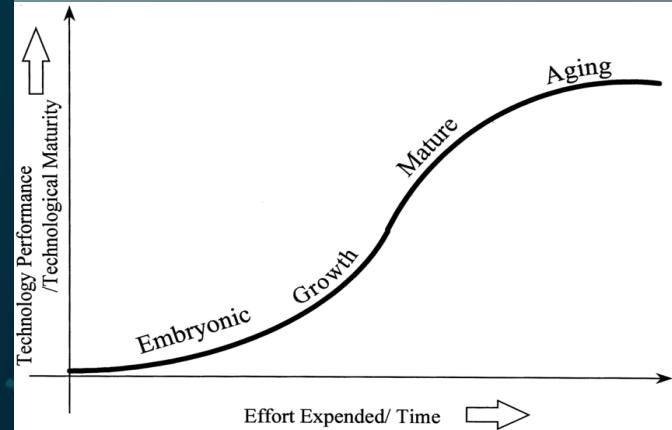
2) In the early phase of the growth stage

the introduced technology helps expand the market size for the product or service offered. The technology becomes a pacing technology in that it has the potential for changing the basis of the competition. In this stage a company must be able to balance its growth strategies with its marketing strategies. Attention to growth must not distract the company from continuing innovation.

3) stage of maturity

the rate of innovation declines, it becomes a commodity, available to all competitors. Technologies in this category are also recognized as base technologies and have little ability to give a company a strong competitive edge. A dominant design of the product emerges, and the technology has a major impact on the value-added stream of performance, cost, and quality. Technology in this phase of the growth stage is known as key technology, and a company should increase its capabilities in this area to compete.

(1) the new invention period, also known as the embryonic stage; (2) the technology improvement period, also known as the growth stage (3) the mature-technology period.

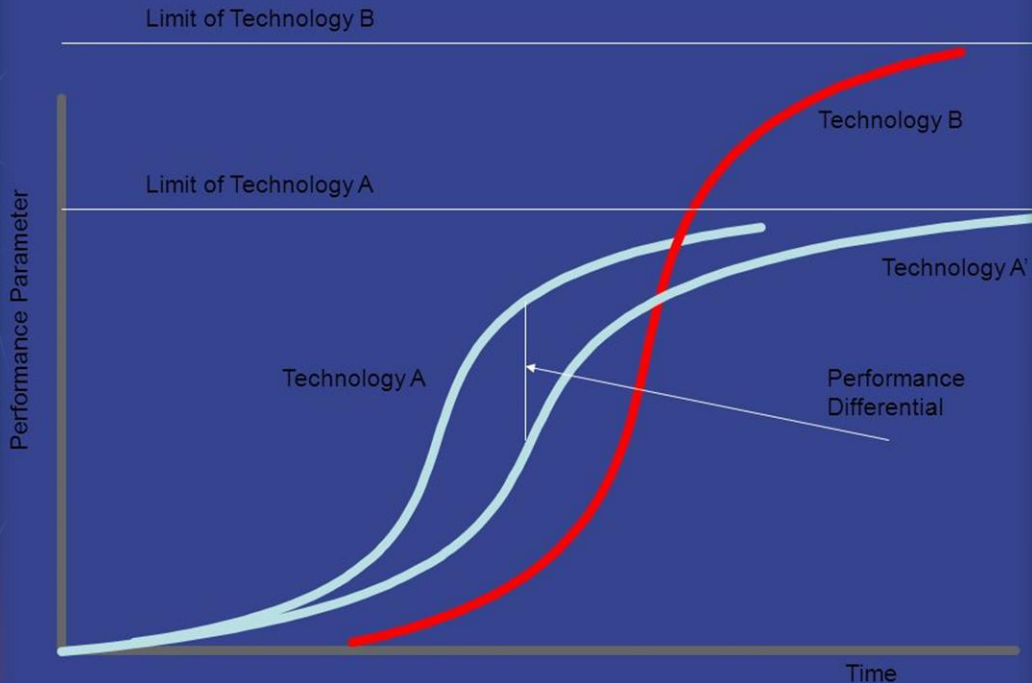


a very important concept in MOT: When a technology reaches its natural limits it becomes a mature technology vulnerable to substitution or obsolescence.

CHANGES IN NATURAL LIMITS OF TECHNOLOGY

The rate of performance improvement is shown for two technologies.

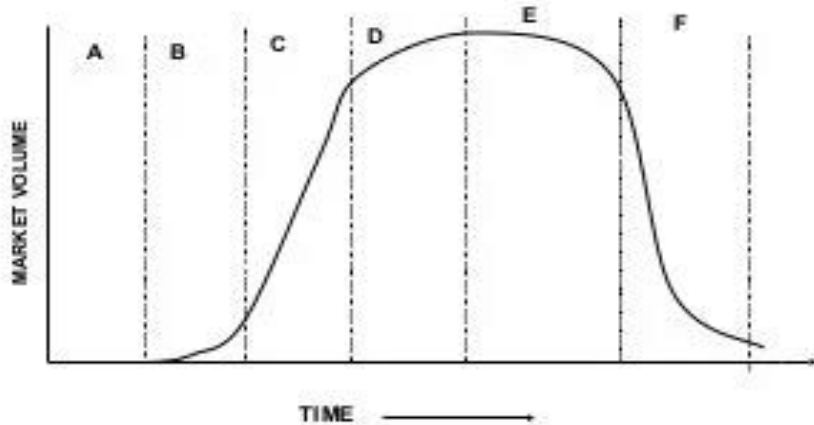
Changes in Natural Limits for Old and New Technologies



a technology may progress on curve A or A', depending on a number of factors, including the type of the technology itself and the cost and time devoted to its development. A newer technology (B) has a higher limit of performance for the same parameter. It may progress at a faster rate and will influence the progression of the older technology. At a certain point in time it will replace the earlier technology (A).

MARKET GROWTH AT DIFFERENT STAGES OF THE TECHNOLOGY LIFE CYCLE

MARKET GROWTH AT DIFFERENT STAGES OF THE TECHNOLOGY LIFE CYCLE



- A) Technology development
- B) Application launch
- C) Application growth
- D) Mature technology
- E) Technology substitution
- F) Technology obsolescence

During the technology development phase

the market does not recognize the technology at all; it has zero response.

The new technology application is launched into the market, the market volume follows the path of technological progress. This is characterized by slow initial growth during the launching period.

During the growth phase of the technology, penetration into the market will depend on the rate of innovation and the market needs for the new technology.

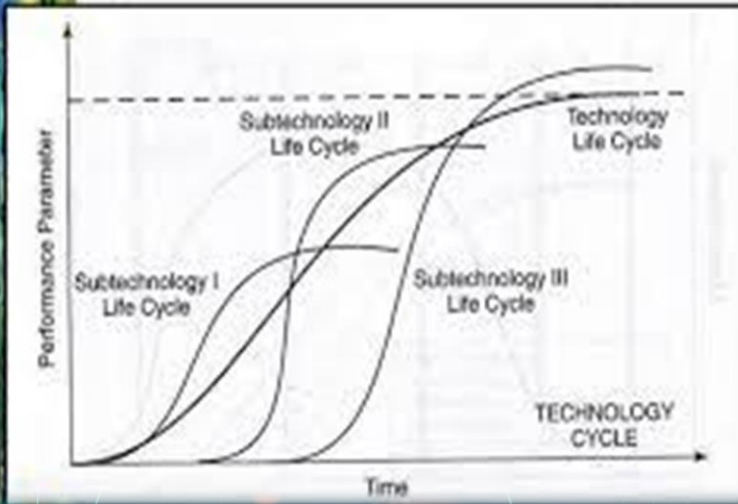
The growth rate slows down as the technology approaches its maturity. At some point, the market volume will peak and then start to decline. This will happen when the technology matures and **enters its substitution phase**. Companies that continue to use the old technology in this phase will be faced with a shrinking market share and a fall in revenues.

The final phase is technology obsolescence, during which the technology has little or no value.

MULTIPLE-GENERATION TECHNOLOGIES

Sub technology life cycles in multiple generations of innovation shape the overall technology life cycle.

Multiple-Generation Technologies



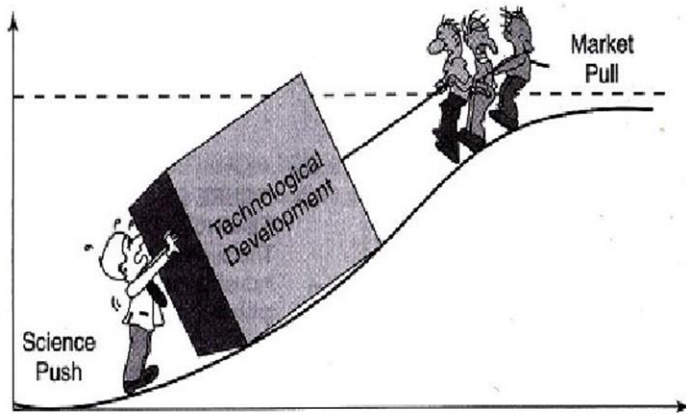
Technology, like all systems, has a hierarchy.

A system can consist of a number of subsystems, and each subsystem may have a number of components. Technology need not consist of a single component or derive from a single innovation. **Technology can consist of multiple technologies and derive from different generations of innovation.** The personal computer is a technology and has a technology life cycle. It consists of several sub technologies. One such sub technology is the micro-processor

TECHNOLOGY AND MARKET INTERACTION

Technology and Market Interaction

Combined Effect of Technology Push and Market Pull



Science-Technology Push

Science provides the base for the technological push. the push opens new vistas for industrial development and economic growth.

Market Pull

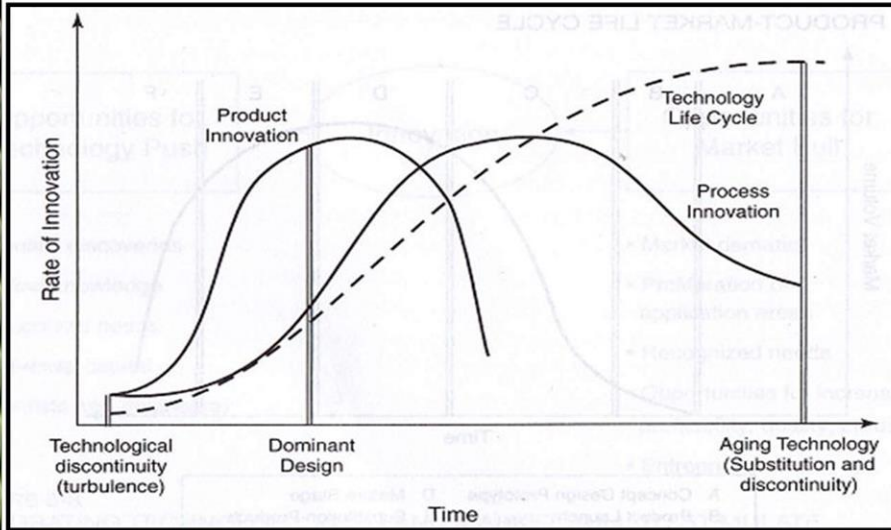
The pull stimulates incremental technological improvements.

Technology is often developed to meet a market need or demand. When there is a strong collective demand for a solution to a specific problem (such as a vaccine for AIDS), market pull may provoke major breakthroughs.

TECHNOLOGICAL PROGRESS

The progress of technology is shown in relation to product and process innovation.

TLC with Process Innovations



Progress of technology is shown in relation to product and process innovation

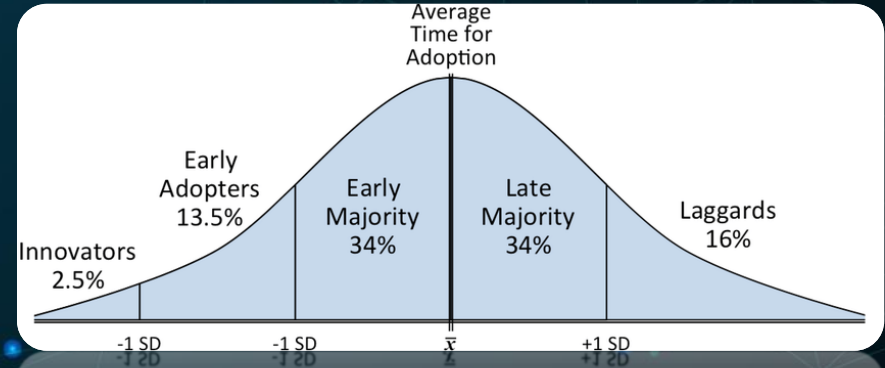
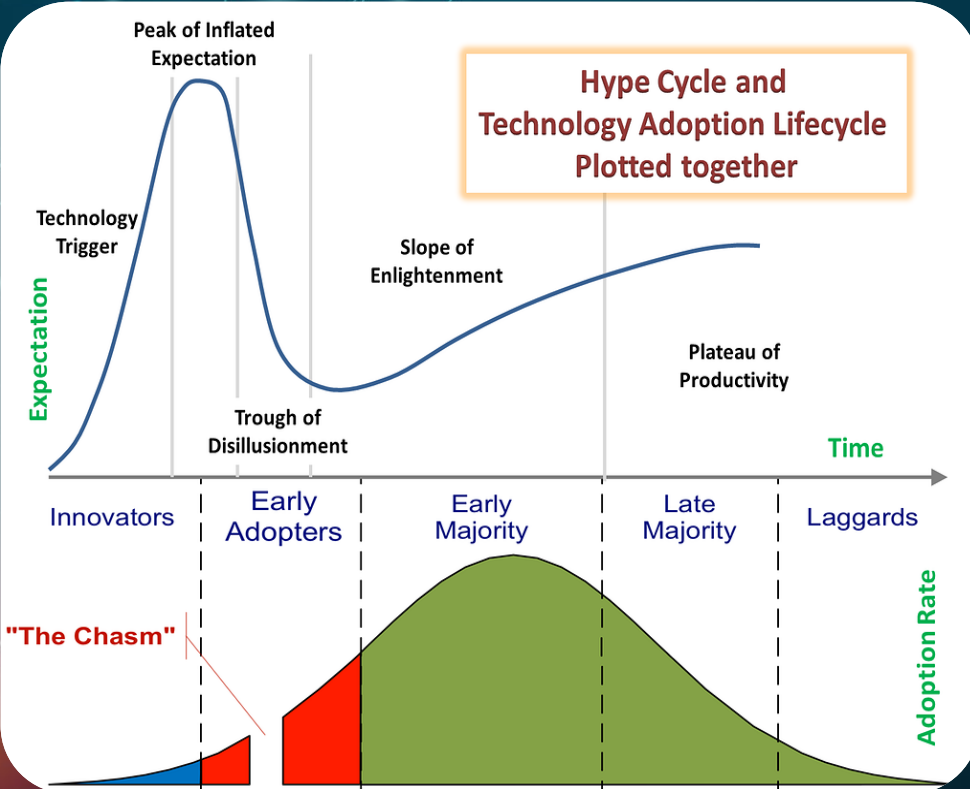
When a new product or process is introduced to the market, it creates certain energy within the innovation community, triggering a series of changes to the product or process. Over time, the rate of innovation of new products or processes increases, reaches a plateau, and then decreases, creating the inverted U-shaped curve shown in Figure . At the early stages of product development, competition in innovation and improvement delays agreement on a standard design. A leader in innovation has the opportunity to set the standard. A company should strive to be in such a position because once a dominant design is established in the market by another company, it will be too late for the company to set a different industry standard based on its own product. It may have to settle for being a follower, in which case it will have to develop another strategy to obtain a leading position in the marketplace. One approach is to rely on process innovation to reduce cost. Another is to rely on complementary assets, such as name recognition, to increase market share. Yet another is to use marketing innovation and improve customer service to lure customers away from competitors.

DIFFUSION OF TECHNOLOGY

A technological innovation, a new idea, or a new system is considered to be successful when it is adopted by users and diffused through the user population. Diffusion is the process by which an innovation is communicated, over time, through certain channels to members of a social system.

type of technology is usually based on the possible efficacy of that technology in solving a perceived problem. Information about an innovation reaches a potential adopter through communication channels. There are many channels for communicating new ideas to potential users, including interpersonal channels and mass media.

Hype Cycle and Technology Adoption Lifecycle Plotted together

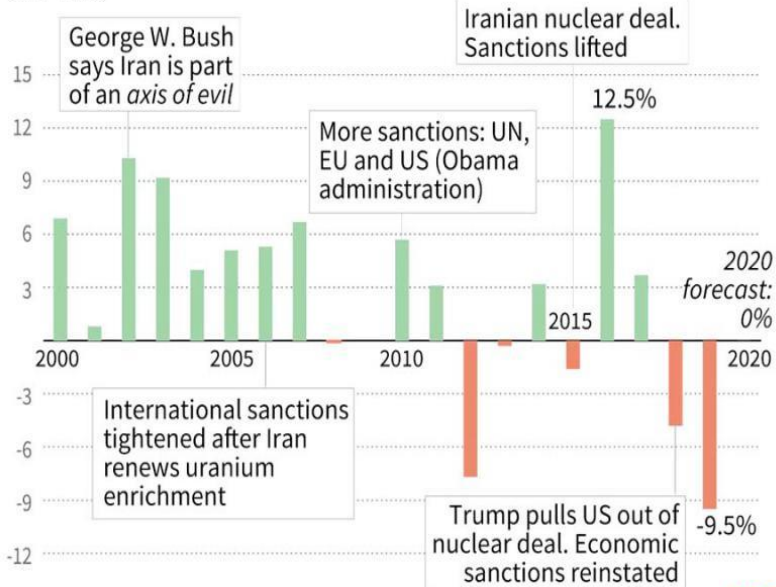


CASE STUDY: IRAN as a Lower Middle Income country

Impact of sanctions on Iran's economy

Sanctions and the Iranian economy

GDP in %

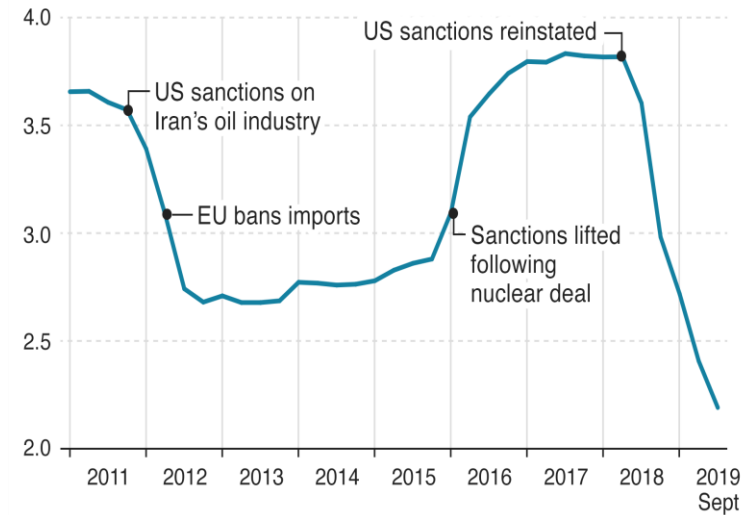


Source: IMF

© AFP

Iran's oil output

Production in millions of barrels per day



Data to September 2019

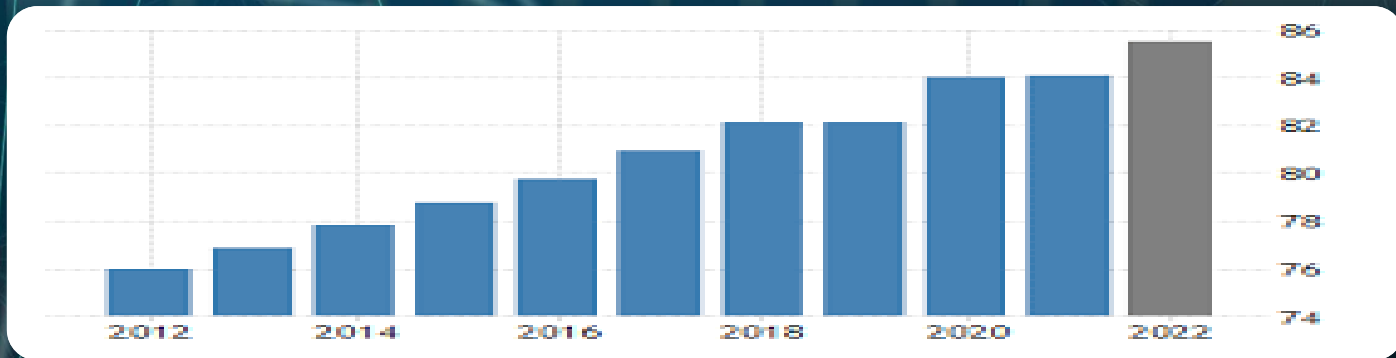
Source: OPEC

BBC

1) Iran's inflation rate chart



2) Iran's population growth rate chart

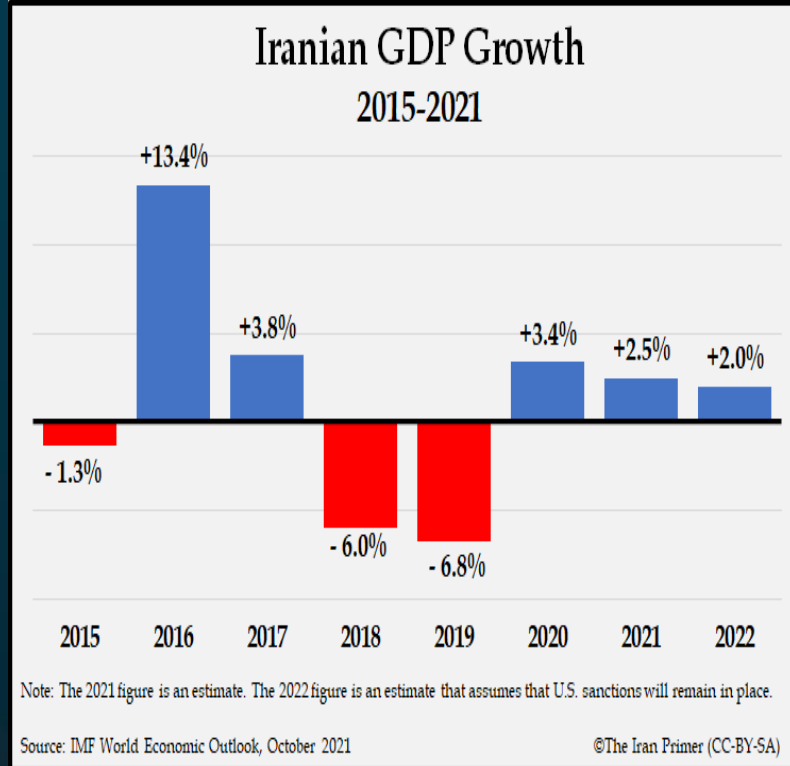


Impact of sanctions on Iran's economy

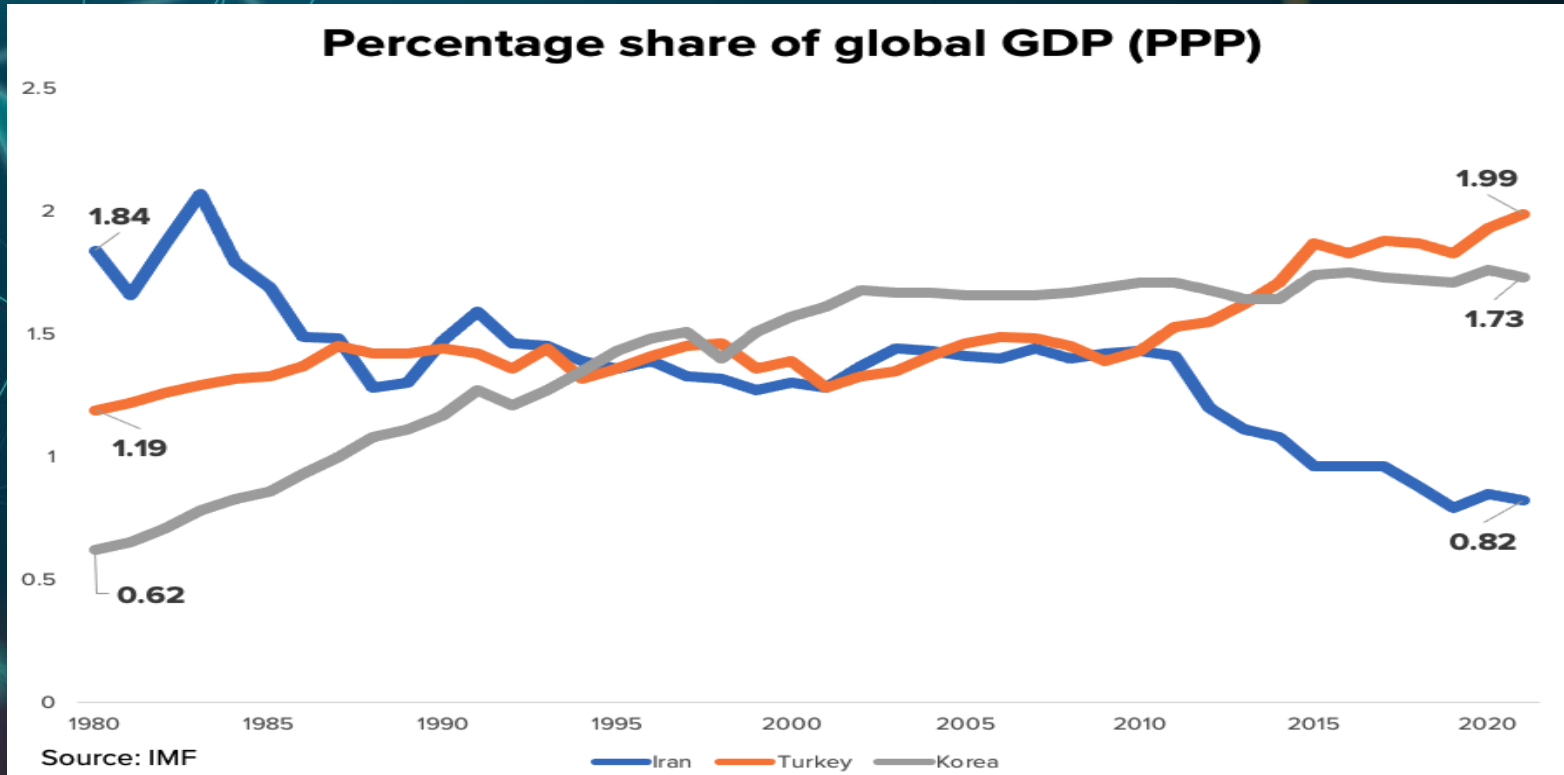
In 2021, U.S. restrictions continued to:

- 1) block Iran's access to the global financial system
- 2) force Iran to sell oil at discounted prices to a limited set of customers willing to violate the sanctions
- 3) limit Iran's access to foreign exchange reserves held abroad
- 4) discourage foreign investment
- 5) constrain trade

The primacy of the U.S. dollar and the threat of enforcement actions made it difficult for Iran to find countries and companies with which to conduct business. But sanctions were not the only cause of Iran's economic woes. Domestic mismanagement, corruption, and the ongoing pandemic also led to another “lost year” for Iran's economy.



Iran has lost considerable economic power on the global stage in comparison to where it was in 1980



Research and development expenditure (% of GDP) - Iran, Islamic Rep.

Gross domestic expenditures on research and development (R&D), expressed as a percent of GDP. They include both capital and current expenditures in the four main sectors: Business enterprise, Government, Higher education and Private non-profit. R&D covers basic research, applied research, and experimental development.

Development Relevance: Expenditure on research and development (R&D) is a key indicator of government and private sector efforts to obtain competitive advantage in science and technology.

Research and development expenditure (% of GDP) - Iran, Islamic Rep.

2012	2015	2017	2019
0.32	0.41	0.83	0.88

Turkey

2012	2015	2017	2019
-	0.87	0.95	1.06

Republic of Korea

2012	2015	2017	2019
-	3.97	4.29	4.62

The image features a dark teal background with a network of glowing lines and nodes. On the left, a stylized human face is rendered in a low-poly, teal, faceted style, surrounded by white corner brackets. In the center, a white-outlined computer monitor displays the word "THANKS" in a bold, white, sans-serif font. To the right of the monitor, a glowing brain is depicted as a complex circuit board with various lines and nodes, suggesting artificial intelligence or digital processing.

THANKS