African Higher Education Leadership in Advancing Inclusive Innovation for Development / **AHEAD**

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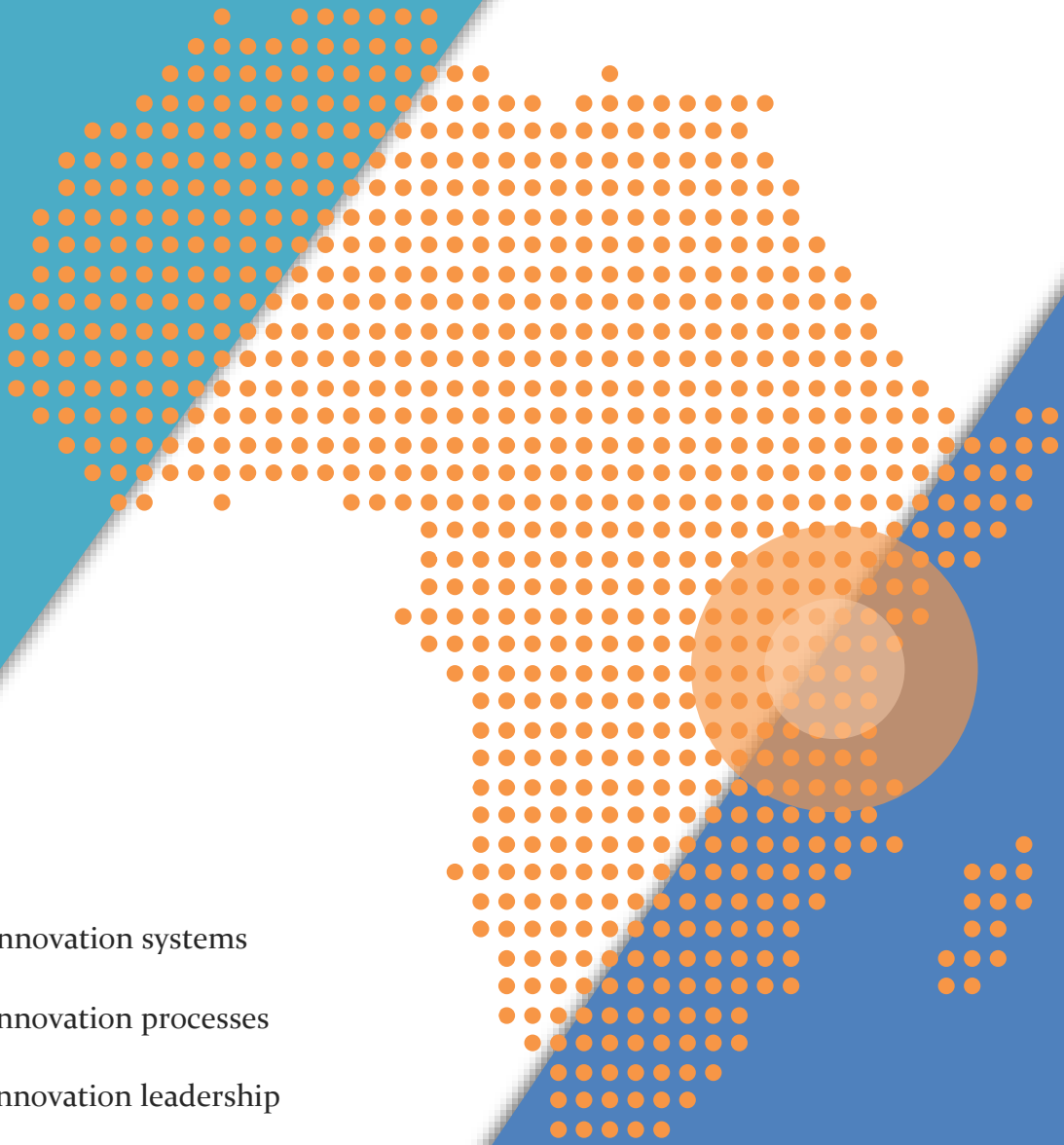

- Innovation systems
- Innovation processes
- Innovation leadership
- Types of innovation
- Knowledge transfer
- Exploitation of innovations

Innovation Management in Low- and Middle-Income Countries

Work Package 2.1

Co-funded by the Erasmus+ Programme of the European Union

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Capacity Building in Higher Education

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"Innovation Management in Low- and Middle-Income Countries"

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Contents

Introduction to Module "Innovation Management in Low- and Middle-Income Countries"

Overview

We are living in the period of accelerated transition, marked by complex and profound transformations in all areas of activity. The scale of innovation is primarily reflected in the high pace of development of new products and technologies, but the changes are not just about tangible things. Within organizations, there are more and more innovation actions oriented towards business management methods, organization and configuration, which contribute to obtaining sustainable competitive advantages.

At the same time, innovation manifests itself in society in general, materializing in new strategies, concepts, ideas and organizations that address social needs - from the labour market and working conditions, to education, health and community development.

The current importance of the activities of introducing the new can be explained from the perspective of the transformations in the economy and society, determined by the increase of competition, by the technical progress and, especially, by the unimaginable development of information technologies. The new context corresponds with fundamental changes in economic models that are an important support for the development of low- and middle-income countries.

The character of the economies in these countries is traditional, production-oriented, prosperity being planned through extensive measures to increase agricultural production, housing construction, the establishment of traditional factories.

In the current context of economic globalization, it is necessary for these countries to focus on the real sources of prosperity and capital in the new era, which are not represented by material goods, but by human thinking, knowledge and innovation. This is a fundamental change in the economic model, in which the emphasis is on the development of intangible resources, inventions and know-how, and on their transformation into sources of innovation. The phrase "knowledge-based society" emphasizes this new orientation.

From this perspective, innovation management is a new paradigm of approaching innovation, characterized by the application of specific models and rules. This module "Innovation Management in Low- and Middle-Income Countries" is composed of 8 lectures that describe specific aspects of innovation management in these economies.

Learning outcomes

As a result of engaging with the learning materials in this module, learners are expected to develop the following knowledge, skills and competences:

Knowledge	▶ Structure and elements of innovation system at national, regional, sectoral and technological level ▶ Features, elements, phases and models of innovation process (supply model, demand model, coupled model, network model and open innovation model) ▶ Types of innovation: product innovation, process innovation, marketing innovation, organizational innovation; radical innovations vs incremental innovations; sustaining innovations vs disruptive innovations; open innovation vs closed innovation ▶ Benefits and tactics of open innovation ▶ Qualification, behavioural and situational approaches to leadership, characteristics of transactional and transformational leadership, and leadership for innovation ▶ Concept of knowledge transfer and common approaches and techniques used for knowledge transfer ▶ Processes of technological learning, technological catch-up and technological leapfrogging ▶ Innovation exploration and innovation exploitation processes; management innovation
Skills	▶ Explain interdependence and interconnection among the elements constituting the innovation systems ▶ Compare and contract different models of the innovation process ▶ Explain the specifics of innovation (driving factors and constraints) in low- and middle-income countries ▶ Argue for benefits of open innovation for an enterprise ▶ Relate the processes of innovation leadership, knowledge management and management of learning organisations ▶ Analyse the specifics of knowledge transfer in low- and middle-income countries ▶ Identify and explain key factors supporting technological learning, catch-up and leapfrogging at country and enterprise level ▶ Relate the priorities of the EASTECO Strategic Plan 2017/18 – 2021/22 to the developmental challenges faced by East African countries
Competences	▶ Systemic understanding of innovation (incl. innovation systems at different levels, innovation process, innovation types, impact of science, technology and innovation policies on the uptake of innovation in low- and middle-income countries) ▶ Awareness of the value of innovation for sustainable and inclusive development in low- and middle-income countries

Module structure

Lecture.1	National, regional, sectoral and technological innovation system
Lecture.2	Innovation processes and structures
Lecture.3	Innovation leadership
Lecture.4	Types of innovation
Lecture.5	Open innovation
Lecture.6	Knowledge transfer
Lecture.7	Technological learning, technological catch-up, technological leapfrogging
Lecture.8	Exploiting innovations

Lecture 1.

National, regional, sectoral and technological innovation systems

Annotation

Lecture 1 "National, regional, sectoral and technological innovation system" is aimed at analysis and evaluation of the role of innovation system at national, regional, sectoral and technological levels. The Lecture is divided into three parts. The first one studies national innovation system, the second – regional innovation system and the third - sectoral and technological innovation systems. Each part of the lecture describes the innovation system at the respective level in terms of its structure, elements and factors that determine its functioning.

Key words

National innovation system, Regional innovation system, Sectoral innovation system, Technological innovation system, Scientific sector, Production services sector, Institutional sector.

Learning outcomes

- Ability to describe the structure and elements of innovation system at national, regional, sectoral and technological level;
- Ability to explain interdependence and interconnection among the elements constituting the innovation systems.

Structure of the learning content

- National Innovation System
- Regional Innovation System
- Sectoral and Technological Innovation Systems

Learning content

National Innovation System

National Innovation System (NIS) is aimed at creating an environment that supports the development of innovation in a specific country. Such an environment should create favourable conditions for achieving a high level of innovation in a specific national economy, thus increasing its competitiveness in relation to other economies (Głodek, Jasiński & Jurczyk-Bunkowska, 2019). A well-organized and correctly functioning NIS is an extremely important factor in supporting and coordinating innovation activities, especially in low- or middle-income countries. However, it requires active intervention of the state authorities, as market mechanisms are still too weak in those economies.

The national innovation system consists of four sectors (Fischer, 2001):

- Production sector
- Scientific sector
- Production services sector and
- Institutional sector

The production sector includes manufacturing companies, along with their R&D base, which plays a key part in research activities and technological progress.

The scientific sector consists of 1) education and training system and 2) research and development system. The education and training system comprises educational and other training institutions that employ qualified staff, such as scientists, engineers and technicians. The research and development system includes higher education institutions and R&D organizations that generate and popularize knowledge through scientific publications.

The production services sector consists of organizations that function either independently or as organizational units of larger institutions and offer support or other specific services to manufacturing companies as part of creation of new products and implementation of new processes.

The institutional sector consists of formal and non-formal institutions that regulate the relationships between the participants of the National Innovation System with a view to fostering their innovation potential. The formal institutions include state and local government units, along with the system of legal regulations. The non-formal institutions include a set of established rules, conventions and standards that influence the social roles adopted by formal institutions/organizations and people, as well as their expectations (Głodek, Jasiński, Jurczyk-Bunkowska, 2019).

The countries that are global innovation leaders went through a three-stage process involving of the following activities:

- Diagnosing the necessity of systematic innovation implementation;

- Presenting an inspiring vision and strategy of actions, including clearly set goals, followed by developing a national innovation strategy specifying the methods of pursuing those goals;
- Taking (difficult) decisions necessary to 1) introduce institutional reforms required for implementation of the innovation strategy and 2) provide appropriate funds for putting the plan into action (including tax incentives aimed at stimulating the development of innovative economy) (Stryjek, 2015).

The structure of the National Innovation System consists of three components (planning, infrastructure and resources) and three factors that determine the way these components function (supply of technology, linking mechanisms and demand for technology) (Table 1.1). The success of a National Innovation System depends to a large extent on integration and interconnection among these components and connecting mechanisms, as some of them are responsible for generating knowledge and innovations, while others - for their dissemination, and still others - for utilizing the developed innovations (Kayal, 2008).

	Drivers		
Components	*Supply of technology*	*Linking mechanisms*	*Demand for technology*
Planning	- Science and technology policies - Innovation strategies	- Technology foresights - Technology transfer polices	- Import substitution policies - Technology roadmaps
Infrastructure	- Public and private research and technology organisations (RTOs) - Higher education institutions	- Intellectual property protection - Technology parks - Technology incubators - Industry associations - R&D consortia - Technology transfer organisations - ICT infrastructure	- R&D culture - International markets for products and services
Resources	- Public R&D funding - Qualified scientists, engineers, and technicians	- Seed capital - National invention support programs - National industrial support programs - Mobility of people and expertise	- Entrepreneurs - Venture capital - Specialised credit facilities

Table 1.1. *Components of the framework for NIS for developing countries*
(Source: Kayal, 2008, p. 81)

In a broad sense, a National Innovation System consists of various elements of economic and institutional structure, either located in a specific country or originating from it, along with the interrelations among them arising as part of the processes of creation, dissemination and

implementation of new, economically useful knowledge. In a narrower sense, NIS is a system of relationships and organizations (Waresa, 2012) that:

- Establish the laws and other regulations concerning innovation activity;
- Influence the decisions concerning the creation of new knowledge, its commercialization and use/consumption;
- Decide on the manner and scope of protection of intellectual property developed as part of innovation activity.

The functioning of a National Innovation System is affected by many factors (Kukliński, 2005; Nowakowska, 2011), including:

- Economic factors that mostly depend on the economic situation in the country;
- Legal and statutory factors, i.e. legal and institutional solutions that determine the framework and structure of entities shaping the innovation policy;
- Institutional factors related to the previous "path" of development (including innovation awareness and culture, and entrepreneurship mindset in the society);
- Social and cultural factors - the system of values characterizing a specific country, i.e., the so-called national specificity, traditions or social behaviour patterns;
- Technological factors generated, for example, by the strength and structure of research institutions or technical capabilities of business entities to create, absorb and spread innovation.

An important characteristic of a National Innovation System is its open character. It concerns both the system's changeability in the course of time and the impossibility of clearly defining its boundaries. National Innovation Systems of different countries can have some shared elements, such as transnational corporations that operate on several markets simultaneously and thus have influence on processes of implementation and dissemination of innovation in several national systems. Considering the ever-progressing globalization and increasing activity of enterprises on foreign markets, the development of a NIS as a result of the processes of dissemination of knowledge and innovation in connection with the presence of international enterprises on a specific national market plays an increasingly important role. Hence, one of the key elements of a national innovation policy should be actions aimed at "attracting" direct foreign investments to such sectors of economy as high-tech industry or knowledge-intensive services (Stryjek, 2015).

Regional Innovation System

Regional Innovation System (RIS) is a National Innovation System narrowed down to a specific region/province. Regional Innovation System is a comprehensive, territorial and systemic approach to innovative economy. It promotes reduction of investment risk taken by business entities, facilitates absorption of various types of knowledge and provides an opportunity for interactive learning and exchange of experience (Nowakowska, 2011; Świadek 2017). It also constitutes a basis for increasing the competitiveness of the region in the face of globalizing economy where innovation and learning are key factors behind the economic success.

Regional Innovation System is a group of various entities that influence innovation processes, along with relationships among them. It is a system of entities, interactions and events that are generated in a specific territory as a result of the synergy effect, which leads to an increase in the potential for creation, absorption and dissemination of innovation in the region (Innovation Dictionary, 2011). The entities creating that system include enterprises, representatives of the scientific sector, R&D, industry, education and local government. The functioning of the system is based on networking. RIS consists of 4 subsystems (Nowakowska 2011):

- Production and services subsystem created by business entities involved in technological and industrial activity, along with implementation and commercialization of new solutions;
- Research subsystem consisting of research and development entities, higher education institutions and scientific institutions operating in the field of innovation and technology transfer;
- Institutional subsystem created by entities supporting the innovation processes, including technological parks, incubators, and technology transfer centres;
- Social and cultural subsystem consisting of cultural elements (tradition, history), systems of values, forms and channels of communication and the level of trust - a set of specific patterns of behaviour and unique cultural and structural characteristics of a given region.

The basis for functioning of a Regional Innovation System and an element connecting its subsystems are local and regional authorities adopting effective innovation policy, defined by regional innovation strategies. RIS allows to adapt regional economies to the globalization process.

Regional Innovation System prioritizes spatial proximity that allows for the establishment of relationships between its individual elements. The RIS model also emphasizes self-organization skills, grassroots character of the processes occurring within the system and networking between participating entities, with particular focus on business entities, especially small and medium-sized enterprises (Głodek, Jasiński, Jurczyk-Bunkowska, 2019).

The important functions of RIS include (Boguski, 2010):

- Integration function based on encouraging independent business entities and both public and private institutions to enter into cooperation in order to establish partnerships providing mutual benefits;
- Information function based on delivering information on the outlet market, supplies, etc. to small and medium-sized enterprises, thus providing them with access to the innovation market;
- Innovation function based on creating favourable conditions for a constant increase in the level of innovation introduced in business entities, especially those representing the SME sector, as well as in public and private institutions, for example by popularization of modern technologies;

- Educational function based on increasing the level of technical education of the residents and promoting entrepreneurship and innovation-focused mindset among school and university students, academics and representatives of the business sector;
- Social function aimed at reduction of social inequalities in the region by means of creating new, modern jobs, increasing the resident's living standard and engaging them in social activities;
- Economic function allowing to spur the development of regional economy by means of appropriate mechanisms that foster creation of new companies and inflow of direct foreign investments.

A Regional Innovation System puts special emphasis on the significance of small and medium-sized enterprises (SMEs), in particular their structure and functioning due to the following three assumptions:

- RIS is created mostly as a results of SMEs' business activity;
- RIS is the main "area of activity" for the existing SMEs;
- RIS should stimulate the establishment of new SMEs.

In low- and middle-income countries, Regional Innovation Systems are very poorly developed. An important step towards the creation of such systems is the process of developing regional innovation strategies. The underdevelopment of Regional Innovation Systems in low- and middle-income countries concerns in particular organizational, institutional, social and cultural aspects. National and regional policy, due to its immaturity and lack of transparency, still remains an important obstacle for the development of those systems.

When narrowing down a Regional Innovation System geographically, some compact spatial clusters can be noticed. These are large urban agglomerations whose specific characteristics create favourable conditions for innovations. It allows to distinguish metropolitan/innovation subsystems where the distance to the nearest urbanized area impacts the enterprises' behaviour concerning creation and acquisition of new technologies. In other words, urban agglomerations act like magnets: they attract new technologies and new companies within a specific, limited radius (Waresa, 2014; Świadek, 2017).

Sectoral and Technological Innovation Systems

Sectoral Innovation System (SIS) is a trade expression for narrowing down a Regional Innovation System, as individual industries/sectors differ in many aspects, both from one another and in relation to the regions of operation. The boundaries of a trade/sectoral system are endogenic, i.e. they depend on the occurrence of specific conditions conductive for the development of each individual sector. The development of various industries can be constrained due to different conditions concerning competition, interaction and organization, which are not necessarily have national character, as companies operating in some of those sectors compete on a global scale. On the other hand, other industries offer opportunities for competing on a regional scale, even though the enterprises are supplied with machines and other equipment by foreign companies (Głodek, Jasiński, Jurczyk-Bunkowska, 2019).

The subject literature usually mentions seven types of industries that make up the sectoral system (Weresa, 2012):

- Traditional industries (e.g. farming, textile industry, retail trade, hotel industry);
- Engineering and machine industries;
- Industries relying on assembly of components, e.g. the automotive industry;
- High-tech industry, e.g. manufacture of computers;
- Modern industries, e.g. software development, manufacture of microelectronics and biotechnologies;
- Knowledge-intensive service industries (IT services, designing, consulting, educational and R&D services);
- Services offered to customers from the whole country, as well as internationally, e.g. logistics, transport and tourist services - so-called shared business services.

A Sectoral Innovation System is constituted by three basic elements (Malerba, 2004):

- ***Knowledge and technologies*** that are specific for individual areas, but their application and origins can vary. Knowledge can be directly connected with a particular area of specialization within a given sector, or it can concern customers and the current demand. Its availability both within the sector and outside it is taken into account. Some crucial factors are the existing technological capabilities of the sector and the opportunities for generating new knowledge on the basis of the knowledge that is currently available;
- ***Participants and networks*** - the participants of a Sectoral Innovation System are both organizations and individuals. Organizations include enterprises (suppliers, competitors and consumers) and non-production organizations (universities, research and development units, business support institutions, local government units, associations, etc.). Each of those agents is characterized by a specific manner of acquiring knowledge, as well as unique competences and behaviours. As a result of their mutual influence, the knowledge is transferred and the process of learning occurs;
- ***Institutions*** (as individual entities) - universities, research and development units, business support institutions.

The effectiveness of that system depends on the strength and quality of connections between its elements.

Technological Innovation System is a network of actors interacting within a specific technological area, on the basis of a specific institutional infrastructure, in order to create, popularize and use technologies, while focusing on knowledge, information and competence transfer. That innovation system consists of the following elements (Carlsson, Stankiewicz, 1991):

- ***Business competences*** - the sum of all capabilities of companies to generate and use the emerging business opportunities;
- ***Clusters and networks*** - success in innovation activities requires interaction between actors/agents of the system that have various competences;

- ***Institutional infrastructure*** - a set of institutional solutions that directly or indirectly regulate innovation processes and popularization of new technologies;
- ***Development blocks*** - that are characterized by their dynamic nature and lack of balance, thus generating tension within the technological system, which is very beneficial for its development.

The effectiveness of that system depends on the following types of interactions:

- Relationships between producers and consumers;
- Contacts focused on solving technical problems;
- Non-formal relationships.

Sectoral and technological innovation systems are closely related, as some of the sectors of industry consist of several companies having their seats in specific geographical locations. Those enterprises cooperate in the innovation process, but compete with other regions of the country or on the international scale, thus creating clusters. In other sectors, it turns out that several large companies compete on the global market, but locally, they directly cooperate with several specialized manufacturers. Thus, the sectoral or technological approach to innovation systems suggests that various sectors of industry can be characterized by different competitive, interactive or organizational limitations that go beyond national borders (Głodek, Jasiński & Jurczyk-Bunkowska, 2019).

Further reading and learning material

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2. Lecture on Technological Innovation System. URL: https://www.youtube.com/watch?v=WYY1eeAmXwE

3. Discussion on National Innovation System led by Professor Joe Tidd. URL: https://www.youtube.com/watch?v=ivXeGiibQVs

4. Definition of Regional Innovation System. URL: https://www.youtube.com/watch?v=LGNyHEZqFHg

Summary of key points

- National Innovation System aims at creating environment that supports the development of innovation in a specific country.
- The structure of the National Innovation System comprises three components (planning, infrastructure, and resources) and three factors that determine the way these

components function (supply of technology, linking mechanisms and demand for technology).

- Regional Innovation System is a group of various entities and relationships among them, that influence innovation processes in a specific region.
- Subsystems of the Regional Innovation System include: Production and services subsystem; Research subsystem; Institutional subsystem; and Social and cultural subsystem.
- Functions of the Regional Innovation System include: Integration function; Information function; Innovation function; Educational function; Social function; and Economic function.
- Sectoral Innovation System is a trade expression for narrowing down a Regional Innovation System to an individual industry/sector, as industries/sectors differ in many aspects, both from one another and in relation to the regions of operation.
- Elements of the Sectoral Innovation System include: Knowledge and technologies; Participants and networks; and Institutions.
- Technological Innovation System is a network of actors interacting within a specific technological area, based on a specific institutional infrastructure with a view to creating, popularizing, and using technologies, while focusing on knowledge, information, and competence transfer.
- Components of the Technological Innovation System include: Business competences; Clusters and networks; Institutional infrastructure, and Development blocks.

Self-assessment test

Please mark the answers that you think are correct. There may be more than one correct answer for each question.

Q1: The elements of Technological Innovation System include:

1. Business competences
2. Internal marketing
3. Traditional industries
4. Institutional infrastructure
5. Social and cultural subsystem

Q2: Some of the important functions of Regional Innovation System include:

1. Integration function
2. Information function
3. Social function
4. Economic function
5. All answers are correct

Q3: Regional Innovation System consists of the following subsystems:

1. Production and services subsystem
2. Integration subsystem
3. Social and cultural subsystem
4. Organizational subsystem
5. Research subsystem

Q4: National Innovation System consists of the following sectors:

1. Enterprises sector
2. Production sector
3. Production services sector
4. Institutional sector
5. Research and development sector

Q5: The structure of National Innovation System consists of such components as:

1. Planning
2. Supply of technology
3. Infrastructure and resources
4. Demand for technology
5. All answers are correct

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Glossary

Innovation system	is a system consisting of organizations that, through their activities and resources, impact the speed and direction of innovation processes, for example in a specific region or country
National Innovation System	is aimed at creating an environment that supports the development of innovation in a specific country
Production sector	includes manufacturing companies, along with their R&D base, which plays a key role in their research and innovation activities
Production services sector	consists of organizations that function either independently or as organizational units of larger institutions and offer support or specific services to manufacturing companies as part of creation and implementation of new products or processes
Regional Innovation System	is a comprehensive, territorial and systemic approach to innovation economy. It promotes reduction of investment risk taken by business entities, facilitates absorption of knowledge and provides an opportunity for interactive learning and exchange of experience
Sectoral Innovation System	Sectoral Innovation System is a trade expression for narrowing down the Regional Innovation System. It usually consists of the following seven types of industries: the so-called traditional industries, engineering and machine industries, industries relying on assembly of components, high-tech industries, modern industries, service industries and shared business services
Technological Innovation System	is a network of actors interacting within a specific technological area, on the basis of a specific institutional infrastructure, in order to create, popularize and use technologies, while focusing on knowledge, information and competence transfer

Lecture 2.

Innovation processes and structures

Annotation

Lecture.2 “Innovation processes and structures” aims to discuss the essence of the innovation process. The first part provides the definition of the innovation process in a narrow and broad sense; it also describes the elements of the innovation process, i.e. basic research, applied research, development research, implementation work and commercialization. The second part presents different models of the innovation process, including linear models (“Technology push” and “Market pull” models), coupled or conjugated model, network model and open innovation model. The last part of the lecture concerns the management of the innovation process and puts a particular emphasis on the elements of this process.

Key words

Innovation process, Models of the innovation process, Liner models, Coupled model, Network model, Open innovation model, Management of the innovation process.

Learning outcomes

- Ability to define the process of innovation and describe its features and elements
- Ability to distinguish and describe different models of the innovation process
- Ability to explain the scope of the innovation process management

Structure of the learning content

- The essence of the innovation process, its features and elements
- Models of the innovation process
- Management of the innovation process

Learning content

The essence of the innovation process, its features and elements

Innovation is a result of the innovation process. The innovation process is a sequence of activities that are necessary in time to realize a specific innovation concept and transform it into a new product, service or a new production technology. During this process, changes are made that range from the first idea to the first practical implementation. It is a series of events that are to lead to the creation of innovation (Janasz, 1999). This process is similar to the way a funnel works: at the entrance there are usually a few ideas, and at the exit there is only one idea that is confronted with the market.

According to McGowan (1994), the innovation process is a creative activity, in which more emphasis is put on the implementation of the idea. This process begins with the perception of the opportunity, the need to satisfy or the problem to be solved, and it ends with the moment of making the decision to implement and starting the implementation of a specific idea chosen from many considered.

The innovation process can be described from the perspective of subjects and objects of this process. If subjects are considered, the essence of the innovation process is in its participants, including -as the main player- an innovatively oriented entrepreneur who decides to introduce an innovation in his/her enterprise and effectively manages the entire process. Co-operators and inter-organizational relations with other companies, clients, scientific and research institutions, universities, local government units, business environment institutions, among others, are also important for the innovation process (Tidd & Bessant, 2011).

On the other hand, if considered from the perspective of its objects, the innovation process consists of (GUS, 1999):

- ***Basic research*** - theoretical and experimental work, undertaken mainly to acquire or broaden knowledge about the causes of phenomena and facts that are not of application character;
- ***Applied research*** - work undertaken to acquire new knowledge applicable in practice. Such research involves the search for practical applications for the results of basic research or the search for new solutions that allow to achieve predetermined practical goals. The results of these tests are usually trial models of products or processes;
- ***Development research***, based on the use of existing knowledge, obtained through scientific research or as a result of practical experience that will be used to develop new or improved products / services with the preparation of a prototype or pilot installation;
- ***Implementation work,*** which includes work related to preparation of technical documentation, development of designs, implementation of the first set of instrumentation tools, completion of technological devices and implementation of a trial series of a new product, testing and corrections on tests;
- ***Commercialization*** - introducing a new product / service to the market.

The innovation process can be analysed both from narrow and from broad perspective. In the narrow sense, the innovation process is the research - development - implementation triad. In a broad sense, the innovation process begins before the start of applied research, and ends with a practical implementation of the idea (Pavitt, Tidd & Bessant, 1999). The innovation process consists of five phases:

- ***Analysis of the environment*** to identify market and other signals (analysis of general external factors, for example, institutional, organisational and informational solutions, state innovation policy, infrastructure and education and training system, and analysis of external operational factors, for example, market relations, consulting, competition);
- ***Strategic choice of options / variants*** to respond to identified market signals and signals (choosing the best solution for implementing the innovation process);
- ***Provision of resources*** to respond to these signals (selection of resources, i.e. human, material, financial, knowledge and relational resources to implement the innovation process);
- ***Project implementation from an idea to launch*** (implementation of the entire innovation process from the idea/concept for innovative activity through preparation of prototypes/pilot lines to their commercialisation);
- ***Learning from this experience***, which is to lead to refinement or possibly to re-innovation; this could be, for example, an incremental innovation. The authors treat this phase as optional, but recommended.

The innovation process has the following characteristics (Janasz & Kozioł-Nadolna, 2011):

- ***Phases*** - this process consists of more or fewer phases (stages), depending on the model of innovation process adopted;
- ***Interactivity*** - the phases are related to each other by various interactions;
- ***Complexity*** that makes a single entity unable to complete all stages of the process from the idea up to its confrontation with the market;
- ***High risk of failure*** at every stage of the process;
- ***High costs***.

For the implementation of the innovation process, it is also important to cooperate with external partners, e.g. other companies, clients, scientific and research institutions, universities, local government units, business environment institutions, which allows for networking, exchange of knowledge, experience and information, access to diversified resources, joint projects (e.g. R&D projects), acquiring specialists and qualified employees (Głodek, Jasiński & Jurczyk-Bunkowska 2019). Knowledge exchange during the innovation process is often accompanied by the creation and use of knowledge:

- ***Inflow of knowledge*** - as a technology transfer resulting from cooperation;
- ***Outflows of knowledge*** - if there is a diffusion of innovation after the completion of the innovation project;
- ***Spillovers*** - as positive external effects that may appear after the application of new technology, usually foreign; spillover effects arise as a result of the spread of the benefits

of innovation among enterprises that were not direct partners in a given innovation project;

- ***Protection of knowledge*** - legal protection of inventions and other technical solutions.

Models of the innovation process

A model is a set of assumptions made in a given science to help solve a given research problem. It is a hypothetical thought structure, which is a simplified picture of the examined fragment of reality. The models facilitate the understanding of past phenomena and enable prediction of future ones. Its aim is to capture the most important features and dependencies occurring in a given innovation process.

Linear models

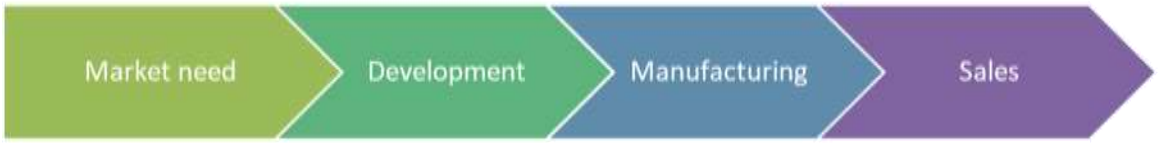
The first models of the innovation process were linear. They represented a system, in which the creation of innovations involved a series of consecutive activities. The linear model is most often interpreted in two variants: 1) the model of innovation "pushed" by science and called the supply model; and 2) the model of innovation "pulled" by the market - otherwise demand model.

The supply model consists of four phases: basic research, applied research, development (production) and marketing. The main initiator of innovation in this model is an R&D centre located either in an enterprise or outside of industry, for example, in a university or research and scientific unit. Therefore, according to the supply model, a company's success in innovation is preconditioned by dynamic R&D activities implemented on the basis of scientific discoveries. This model is static and does not take into account feedbacks from individual stages of the innovation process (see Figure 2.1).

According to the technology driven Linear model of innovation:
R&D = Technological Innovation = The whole Innovation

Figure 2.1. *Linear Model of Innovation "Technology Push"*
(Source: Own study)

As the years went by, it became increasingly difficult for companies in the saturated market to sell products that were manufactured without the acceptance of customers. The change of market conditions caused the modification of the linear model of the innovation process from supply to demand. The demand model consists of the same number of phases as the supply model, but the main difference is the location of the sphere of market needs in the first place as a stimulus for the emergence of innovation. The clients' needs are linearly connected with development works, production and sales (see Figure 2.2).



Market need is the starting point in
the market driven Linear model of innovation

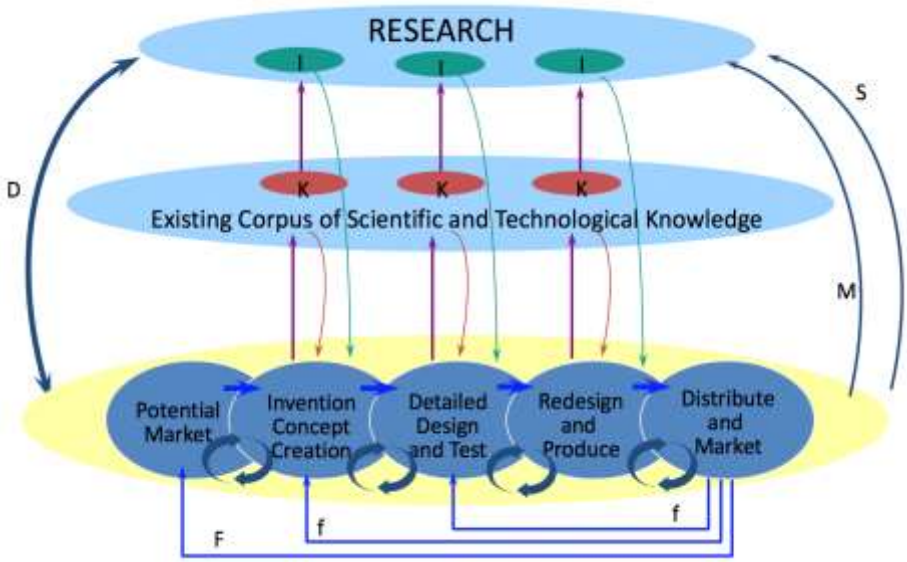
Figure 2.2. *Linear Model of Innovation "Market pull"*
(Source: Own study)

Replacement of the supply model by the demand model did not mean a complete negation of the former. It indicated the need for parallel occurrence of both forms of innovation processes. The demand and supply model ensures the proper supply of innovation shaped by the demand on the part of the market. The fact that the demand for innovation is inspired by market circumstances means their authenticity. Summing up, the following characteristics can be outlined in the linear models of innovation:

- *Phasedness (stagedness)*: it means that the innovation cycle consists of many successive stages, in which specific tasks and activities are carried out in a sequential arrangement;
- *Limited cycle*: it assumes that the cycle exists between two specific events - the concept of innovation and its practical implementation;
- *Variety of tasks performed*: it means that the content of tasks in individual stages is different and unique;
- *Logical consequence*: it assumes that despite the variety of tasks, all can be ranked and subordinated to the main goal, which is the creation of innovation.

Coupled / Conjugated models

The next generation of models of the innovation process includes the so-called conjugated (or coupled) models. The creation of innovations is seen here as a logically ordered, but not necessarily continuous process consisting of functionally separate but coupled and interdependent phases (Rothwell, 1992). The essence of this model is that the company integrates technical capabilities with the needs of the market from the earliest stages of the work on innovation. Coupled models were used to build dynamic interaction models, in which the creation of innovations is perceived as a result of feedback between the technical capabilities of the enterprise and market needs, as well as a rich set of interactions covering the R&D sphere, production and marketing and its surroundings. Thus, interactions occur both within the enterprise itself (e.g. communication and coordination between departments), and between the company and its environment (clients, suppliers, competitors, institutions). Flows in communication are not necessarily linear here, as there are numerous loops in the model (check the links) (see Figure 2.3).



Legend:

c	=	Central-chain-of-innovation
f	=	Feed-back loops
F	=	Particularly important feedback
K ⟶ I	=	Links from knowledge to research and return paths
D	=	Direct link to and from research problems in invention and design
M	=	Contribution of manufacturing sector to scientific research (machines tools and procedures of technology)
s	=	Financial support of research by firms in science underlying products

Figure 2.3. *The Chain-Linked Model of Innovation*
(Source: Kline and Rosenberg, 1989)

Network model

Another approach to the innovation process is the network model, in which innovation is perceived as a process involving many participants, requiring a high degree of integration inside and outside the company, which is increasingly supported by contacts based on information and communication technologies (Głodek, Jasiński & Jurczyk-Bunkowska, 2019). The network innovation model assumes:

- Increase in the importance of horizontal relationships (with key clients, main suppliers, as well as intermediaries, sometimes even with competitors);
- Mutual learning based on rapid flows of knowledge;
- Important role of network resources, effects and alliances - the so-called knowledge alliances;
- Integration of knowledge resources, contacts and activities in innovative environment.

Open innovation model

The model of open innovation is the continuation of the network model, which is characterized by wide cooperation of external entities with the enterprise, as well as the use of many paths of introducing innovations to the market and integrating external and internal knowledge. The open innovation model does not imply the complete abandonment of own research by innovative enterprises. Its task is not to eliminate internal R&D departments, but to support the enterprise by making the best use of innovation sources, involving their inclusion in the processes of creating innovation. The open innovation model assumes a two-sided openness of the innovation process: the enterprise not only draws the necessary knowledge from outside, but also shares its knowledge with the environment. The core of this model is the use of relatively cheaper and available scientific and technical information as well as links and interactions with other entities or persons outside the company. This model assumes that (Chesbrough, 2003):

- A company is not able to hire all the best specialists; therefore, it should seek partners from various backgrounds and areas;
- External R&D is important;
- An enterprise does not have to initiate research itself to be able to benefit from it; it can be derived from external ideas;
- It is more important to build an effective business model than to be the first;
- Success can be achieved thanks to the combination of internal and external ideas;
- You can benefit from the use of intellectual property outside the company, as well as use external knowledge if it improves the company's operations.

The benefits of using the open innovation model by a company include: reduction of costs of obtaining new knowledge, access to missing knowledge resources, shortening the time of implementation of an innovative project. The disadvantages include: uncontrolled leakage of knowledge to competitors and violation of rights to their inventions and other scientific achievements. Therefore, the need to protect the intellectual property rights of an enterprise is crucial.

Summing up the considerations regarding the innovation process models, it should be stated that the understanding of the innovation process as a sequence of events making up subsequent phases forming an ordered whole is inadequate. In modern enterprises, innovation is rather a collection of various processes that create a specific value, than a few-phase innovation process. Therefore, a modern company should be able to manage a multiprocessing innovation model including idea generation, R&D, transfer of knowledge, implementation, commercialization and diffusion of innovation (Głodek, Jasiński & Jurczyk-Bunkowska, 2019).

Management of the innovation process

The management of the innovation process is aimed at transforming the traditional organization into an innovative one. The creation and accumulation of ideas, regardless of their place of origin, should be accepted as the beginning of the innovation process. The next stages are the selection of ideas that have a chance of success, making a decision on how to implement them and implementing them. These are activities that enable the introduction of innovations to the

company. Innovation management comprises all the activities that are necessary to develop modern and practical technical solutions. The choice of a new technique, work organisation and any other innovative solution should be made taking into account financial, social, legal, administrative, environmental, strategic and structural-process aspects. Appropriately selected innovative strategy allows to gain recognition in the market, which makes the company more and more competitive among other companies, and also brings profits. The management of the innovation process includes the following elements (Francik & Kosalka, 2011):

- *Optimal selection of innovations*, allowing the company's assets to be expanded and strategic goals to be achieved. The optimal choice of innovation consists in choosing the best solution for creating innovation in the area of new technology, management methods, knowledge or work organization. It also refers to the choice of the goal of innovative activity and answers such questions as "what should be achieved" and "how to achieve it".

- *Optimization* based on the integration of human, financial, material and knowledge resources. Optimal use of resources consists in providing appropriate resources for creating innovative solutions and conducting innovation activities. For example, using market knowledge to make decisions related to creating innovations and building a company's competitive advantage. Using creativity and ideas of employees to develop new solutions in the area of product, process, marketing and organizational activities.

- *Internal marketing*. It includes involving and preparing participants of the innovation process, seeking approval for developing innovations, setting up communication arrangements and forms of cooperation. All these allow to understand the entry situation related to the involvement of managers, who from the employees can be counted on, what are the aspirations of the staff, and what are the expectations of the organization.

- *Protection of innovation* from external and internal pressures that inhibit the implementation of innovations, conducting information piloting, facilitating the adaptation and formalization of the process.

- *Assessment of current status and modification of goals*. This implies the analysis of the company's internal and external environment, focused on introducing innovations and including: analysis of the competition, suppliers, customers, strategic allies and legal, technological and economic conditions. The goal of these activities is to build a competitive advantage of an enterprise oriented to introduce product innovations and/or new business processes. This analysis may lead to reconfiguration of strategies as well as long-term and short-term goals.

- *Control and monitoring* of the environment in order to seek opportunities and overcome barriers. This includes: controlling the innovation implementation process at every stage; taking corrective actions if activities do not comply with the assumed plan;

monitoring the environment with a view to finding opportunities that can be used in designing future and ongoing activities of an innovative enterprise.

Further reading and learning material

1. Innovation Portal – a resource for those who are involved in the teaching, learning or practice of managing innovation. URL: http://www.innovation-portal.info/ and http://johnbessant.org/the-innovation-portal/

2. OECD publications, statistics and databases in the field of innovation. URL: https://www.oecd.org/innovation/

3. Business Innovation Observatory of the European Commission – a resource providing evidence on the latest innovative trends in business and industry. URL: https://ec.europa.eu/growth/industry/policy/innovation/business-innovation-observatory_en

4. Short video "Innovation 5 Step Process". URL: https://www.youtube.com/watch?v=N70RK3_zXhc

5. Short video "Business model innovation". URL: https://www.youtube.com/watch?v=B4ZSGQW0UMI

Summary of key points

- Innovation process is a sequence of activities that are necessary in time to realize a specific innovation concept and transform it into a new product, service or a new production technology.
- If considered from the perspective of subjects (participants) of the innovation process, it includes: innovating entrepreneur, his/her co-operators and inter-organizational relations with other companies, clients, scientific and research institutions, universities, local government units, business environment institutions, among others.
- If considered from the perspective of objects of the innovation process, it includes: Basic research; Applied research; Development; Implementation works; and Commercialization.
- Innovation process consists of five phases: Analysis of the environment; Strategic choice of options / variants; Provision of resources; Project implementation from an idea to launch; Learning from this experience.
- Supply model –"Technology push" and Demand model – "Market pull" are linear models of innovation process. The former assumes that technological advances drive the process of innovation, and the latter assumes that innovative ideas are drawn from the market place. Both models imply sequential phases of the process that do not overlap.
- Coupled model implies that innovation process is a logically ordered but not necessarily continuous process consisting of separate but interdependent phases. In this model,

technology, market trends and customer satisfaction are equally important. It relies on feedback loops, which make it interactive and efficient.

- Network model of innovation process puts emphasis on knowledge accumulation and external linkages. It is characterized by the integration of a company's internal innovation ecosystem with external factors in the National and Regional Innovation System.
- Open innovation model implies wide cooperation of an innovating firm with external environment and integration of external and internal knowledge in the process of innovation.

Self-assessment test

Please mark the answers that you think are correct. There may be more than one correct answer for each question.

Q1: Which of the following is true about innovation process?
(more than one answer is possible)

1. Innovation process represents a sequence of activities that are necessary in time to realize a specific innovation concept.
2. Innovation process include internal marketing, i.e. obtaining and preparing of employees.
3. Innovation process includes such activities as basic research, applied research, development, implementation work and commercialization.
4. Innovation process is the process of building a business model.
5. Innovation process begins before the start of applied research and ends with a practical implementation of the idea.

Q2: Linear innovation models are characterized by:
(one answer)

1. Increase in the importance of horizontal links
2. Phase-nature, which means that the innovation cycle consists of many successive stages
3. Protection of innovation from external and internal pressures hampering its implementation
4. Monitoring of the environment to search for opportunities
5. All the answers are correct

Q3: The open innovation model is:
(one answer)

1. Continuous, as it represents a process consisting of functionally separate, but coupled and interdependent phases.
2. Optimization based on the integration of human, financial and material resources.

3. Bilateral openness of the innovation process, i.e. the enterprise not only draws the necessary knowledge from outside, but also shares its knowledge with the environment.
4. Assessment of current status and modification of goals.
5. All the answers are correct

Q4: Which of the following is true about management of the innovation process: (more than one answer is possible)

1. It ensures the optimal choice of innovations, allowing to increase the company's assets and achieve strategic goals.
2. It allows for control and monitoring of the environment with a view to identifying opportunities and overcoming barriers.
3. It is focused on transforming a traditional organization into an innovative one.
4. It implies mutual learning based on rapid flows of knowledge.
5. It is external outsourcing of research and development works.

Q5: Which of the following is true about the supply model of innovation: (more than one answer is possible)

1. It consists of four phases in the sequential system: basic research, applied research, development (production) and marketing.
2. It is static and does not take into account feedbacks between individual stages of the innovation process.
3. It assumes that the main initiator of innovation is the R&D centre.
4. It assumes that the market is the main initiator of innovation.
5. It is an innovative cycle consisting of many parallel stages.

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Glossary

Innovation process	The phenomenon of the creation and dissemination of new ideas in the form of innovations
Basic research	Theoretical and experimental works undertaken in order to acquire or expand knowledge about the causes of phenomena and facts that are not of application character
Applied research	The work undertaken to acquire new knowledge consisting in the search for practical applications of the results of basic research
Development research	The work relying on the use of existing knowledge gained through basic research in order to develop new or improved products / services with the preparation of a prototype
Supply model of innovation	"Technology push" model, in which innovations are a derivative of the development of science
Demand model of innovation	"Market pull" model, in which innovation is a response to the market demand
Coupled (conjugated) model	The model of the innovation process, in which creating innovation is a logically ordered but not necessarily continuous process consisting of separate but coupled and interdependent phases
Network model	The model of the innovation process, in which network links, e.g. with clients, suppliers, competitors, are important, as they allow for mutual learning based on rapid flows of knowledge
Open innovation model	The model of the innovation process characterized by wide cooperation of external entities with the company, as well as by the use of many paths of introducing innovations to the market and integrating external and internal knowledge
Managing the innovation process	Actions aimed at transforming a traditional organization into an innovative one

Lecture 3.

Innovation leadership

Annotation

Lecture.3 "Innovation leadership" explores different approaches to leadership and discusses in more detail the qualification, behavioural and situational approaches. It explains differences between transactional and transformational leadership. Knowledge management is emphasised as one of the key functions of an effective leader. Such issues as management of learning organisations and leadership for innovation are also discussed.

Key words

Leadership, Leadership traits, Behavioural approach to leadership, Situational approach to leadership, Transformational leadership, Transactional leadership, Knowledge management.

Learning outcomes

- Ability to describe qualification, behavioural and situational approaches to leadership and identify strength and weaknesses of each approach
- Ability to compare and contrast transactional and transformational leadership models
- Ability to relate innovation leadership, knowledge management and management of learning organisations

Structure of the learning content

- Qualification, behavioural and situational approaches to leadership
- Transactional and transformational leadership
- Leadership and knowledge management
- Management of learning organisations
- Innovative leadership and leadership for innovation

Learning content

Leadership as a process involves using influence, without resorting to coercive measures, for shaping the goals of the group or organization, motivating behaviours aimed at achieving these goals and helping to define the culture of the group or organization. Leadership is associated with other people. The leader influences on the behaviour of his/her followers, motivates them, arouses enthusiasm and devotion (Stoner, Freeman & Gilbert, 2002). Leadership as a property is a set of attributes belonging to individuals who are perceived as leaders. Hence, a leader is a person who is able to influence the behaviour of others without using force and who is accepted in this role by other people.

There are three main approaches to leadership:

- Qualification (theory of leadership traits)
- Behavioural (behavioural theories)
- Situational (situational theories) (Wachowiak & Winch, 2014)

Recently, critical approaches to researching and conceptualizing leadership have emerged. However, they are still outnumbered by the mainstream ideas (Ford, 2006; Ford, Harding & Learmonth, 2008; Jackson & Parry, 2011). Discourses emerging from the more critical approaches have not yet had time to be absorbed into leadership learning and development activities (Ford, Cunliffe, Raelin, Crevani, Harding, 2012).

Qualification approach

The qualification approach (the theory of leadership traits) was one of the first systematic efforts to study leadership. It is derived from the research into leadership traits and presupposes the existence of certain basic features or sets of them that distinguish leaders from non-leaders and leaders that are effective from those that are ineffective. The most frequently mentioned leadership traits include:

- Charisma
- Self-confidence
- Enthusiasm
- Openness
- Perseverance
- Intelligence
- Honesty
- Empathy
- Assertiveness
- Communication skills
- Ability to influence others
- Courage
- Speed of decision making

Anti-leadership features can include:

- Excessive ambition and concentration on the struggle for power
- Excessive supervision and non-use of delegating decision-making powers
- Lack of sensitivity towards others (harshness, repulsive lifestyle)
- Coldness, restraint and arrogance
- Ignoring trust and secrets
- Inability to build a team
- Selection of weak and ineffective subordinates
- Difficulties with strategic thinking
- Lack of flexibility in adapting to different bosses
- Excessive reliance on your mentor

When it became obvious that effective leaders do not distinguish themselves with a specific set of traits (who leaders are), researchers started to look for information about the behaviour of effective leaders (what they do) - how they communicate, how they motivate, how they do their work.

Behavioural approach

Behavioural approach to leadership differentiates effective leaders from ineffective leaders. It is based on the assumption that effective leadership is not preconditioned by a set of certain inborn traits; on the contrary, people can learn to become leaders through training and observations. According to this approach, leadership implies a combination of two types of behaviour: task behaviour and relationship behaviour. Task behaviour is oriented towards achieving a goal; it involves planning, organising and coordinating the work of subordinates. Relationship behaviour is oriented towards helping subordinates to feel comfortable at workplace; it implies being supportive, recognizing accomplishments of subordinates and taking care of their wellbeing. The main focus of the behavioural approach is to explore ways of how leaders can combine these two types of behaviour to make their subordinates to achieve a goal (Northouse, 2013). However, empirical research has shown no significant association between leader's behaviour and leader's effectiveness. This limitation shifted the focus of leadership studies on the analysis of situational factors that might explain the relationship between leader's behaviour and effectiveness.

Situational approach

The basic premise of the situational approach is that different situations demand different types of leadership. An effective leader or manager should adjust his/her leadership style to fit the level of competence and commitment of those who he/she is trying to influence. In this approach, a leader should change his/her style to meet the needs of subordinates; not subordinates should adapt to it. The following leadership styles are distinguished:

- ***Directing***: this is a top-down style which implies that a leader takes decisions and informs subordinates about it. Employees are expected to do exactly what they are told to do and how they are told to do it.
- ***Coaching***: this style implies that employees are supervised in a coaching manner, and the leader takes care of socioemotional needs of his/her subordinates. It is still the leader

who takes decisions about what and how to accomplish, but he/she asks employees for input before this decision is made.

- ***Supporting***: the leader using this style gives more freedom to employees to take day-to-day decisions, but facilitates problem solving whenever necessary. The leader is supposed to provide feedback and praise employees for task accomplishment.
- ***Delegating***: this style implies that the leader's involvement in goal accomplishment, planning and control is limited. This approach allows employees to take responsibility to implementing the tasks in the way they find most suitable.

Entrepreneurs who bear the risk of introducing product, process, organizational or marketing innovations are of key importance from the point of view of the innovation process. Entrepreneurs rarely, however, implement innovation processes on their own and increasingly cooperate with universities, research institutes, scientists and other external partners. That is why multifaceted interactions between various entities play an increasingly important role in the innovation processes, and the importance of cooperation and networking is also increasing. Entrepreneurs create an innovation ecosystem through employed managers and leaders. Since it is a slow process based on trust and values, the role of innovation leaders in establishing these long-term relationships becomes a priority (Biała Księga, 2016).

Transactional and transformational leadership

Leadership styles can be classified into transactional and transformational. Transactional leadership is focused on existing organisational structures and goals. It is task- and result-oriented, and promotes goal accomplishment through supervision, rewards and punishments. Transformational leadership, on the other hand, is conceptualized as a change- and innovation-oriented leadership (Bass & Riggio, 2006). It focuses on emotions, ethics, values, and long-term goals. It stimulates the learning process and inspires new ways of thinking, and leads people to greater achievements in the pursuit of high efficiency. Transformational leaders exert a profound influence on their subordinates that motivates employees to accomplish more than is expected of them. Transactional leaders are concerned with how to get job done, and transformation leaders – with how to motivate people to do it. The difference between transactional and transformational leadership is summarized in Table 3.1.

Transactional leader	Transformational leader
Builds on the human need to work and earn a living	Builds the sense of action on human need
Fights for power and position	Guided by goals, values, morals and ethics
Deals with the current moment	Goes beyond everyday life
Sets short-term goals	Sets long-term goals
Fixes	Prevents
Improves work through people	Triggers all human possibilities

Supports structures and systems	Adapts structures and systems
Defines tactical tasks	Sets mission, vision and strategy for implementation

Table 3.1 *Transactional vs Transformational leader*

Transactional leadership may be effective when hierarchy is critical, rules should be followed, and when there is no focus on innovation. For example, this leadership style can be used by front-line supervisors of low-paid employees. Transformational leadership is more effective when strategic development and innovation are emphasised. Transformational leaders aim to initiate, develop and implement significant changes in the organisation. They empower their subordinates and lead them through the process of change. They are able to create a vision and motivate employees to work to achieve it.

Leadership and knowledge management

An important trend that impacts the work of a leader is knowledge management. It is driven by the wide use of personal computers, along with exponential development of the Internet, which has revolutionized ongoing collection, processing and access to information. Due to entering the age of knowledge-based economy, leaders are faced with new challenges, as success is now increasingly more dependent on intangible assets and innovations, as well as human resources and intellectual capital. A member of an organization "generates" for his/her employers not only physical items, but also knowledge, which can be re-used, as it is a material resource subject to the process of mobilization and capitalization (Davenport & Prusak, 1998: 7, cited in Olejniczak, 2012). Christian Evans (2003: 14–15) suggests the following division of knowledge, based on four different perspectives:

- Knowledge "*about*", which concerns with facts and everyday activity of an organization;
- Knowledge "*how*", which concerns with the methods of achieving specific goals or knowing how certain phenomena occur;
- Knowledge "*why*", which defines the reasons behind those phenomena;
- Knowledge "*who*", which allows for identifying subjects that have the desired knowledge.

Another approach is adopted by Ikujiro Nonaka (1995), who, as part of his analysis of the unique method of managing Japanese companies, divides knowledge into two types:

- ***Tacit knowledge***, i.e. experiential and subjective knowledge, observations and skills of individual employees that are hard to express in words, numbers, formulas, etc. (e.g. beliefs, values, perspectives, know-how), and
- ***Explicit knowledge***, i.e. rational and objective knowledge that can be easily codified (e.g. theoretical approach, manuals, database).

Nonaka's model of knowledge creation is visualized in the form of a spiral that reflects the continuity of the knowledge growth process (Figure 3.1). The model is known as SECI. This

acronym stands for Socialization, Externalization, Combination and Internalization processes of knowledge transformation:

- ***Socialization***: tacit to tacit knowledge. Knowledge is passes on through sharing of experience, observation and imitation.
- ***Externalization***: tacit to explicit knowledge. Tacit knowledge is written down and expressed in documents and manuals that helps to facilitate its spread throughout the organisation. Since tacit knowledge is hard to codify, creating metaphors and analogies are important mechanisms of transforming tacit knowledge to explicit.
- ***Combination***: explicit to explicit knowledge. Here, explicit, written knowledge is combined to create new knowledge.
- ***Internationalization***: explicit to tacit knowledge. When explicit knowledge is used and learned, it gets internalized thus changing the tacit knowledge of the person.

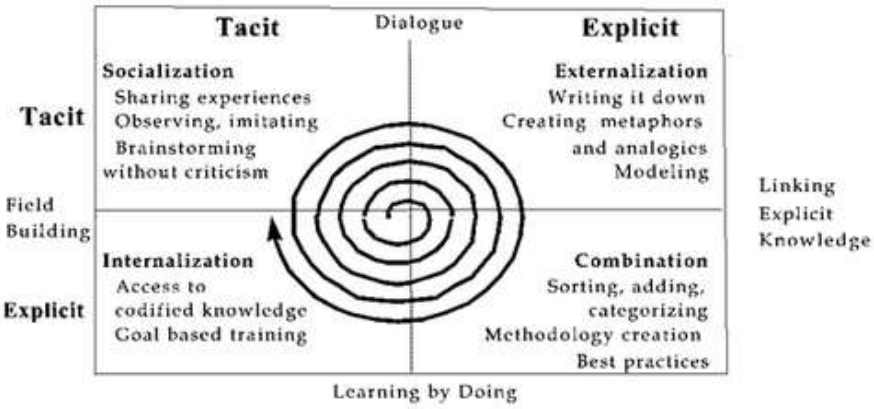

Figure 3.1 *Nonaka's model of knowledge creation*
(Source: https://colinkmprocesses.wordpress.com/km/tacit-and-explicit-knowledge/)

SECI model is based on two key assumptions:

- Behavioural: knowledge creating companies continuously encourage the knowledge flows between individuals to improve both tacit and explicit knowledge stocks,
- Knowledge management: knowledge is created and enhanced as it is transmitted through different organisational levels and between staff members and groups.

Thus, supportive organisational context and interactions between employees (e.g. merging of various tasks, team work and freedom of action) can foster the process of knowledge creation. However, the active role of middle management is also of great importance in this case.

Management of learning organisations

Another challenge for leaders is management of a learning organization. It arises from the constant need of adapting the methods of management to changes occurring in the market environment in order to gain competitive advantage. The learning organization concept is based on the following assumptions (Mikuła, 2001: 25):

- Firstly, organizations, just like living organisms, are able to learn and learning is a strategic value.
- Secondly, future of an organization depends on all its members who are aware of that, thus everyone takes part in the learning process. The organization creates conditions for development at individual level, while it is crucial to initiate the learning process at the level of teams.
- Thirdly, organization must provide appropriate motivation for a broadly defined innovation by activating both mental and emotional sphere and maintaining them in conformity with actions to be taken. This results in deep personal commitment of organization members, but is also subject to various methods of learnings adopted by individuals.
- Fourthly, the learning process should be continuous and conscious. The awareness of implementation of organizational learning processes should be expressed at three different levels: individual, group and organizational.

On the other hand, Peter M. Senge (1990: 3) believes that learning organizations are "organizations where people continually expand their capacity to create the results they truly desire, where new and expansive patterns of thinking are nurtured, where collective aspiration is set free, and where people are continually learning to see the whole together".

Innovation leadership

Innovation leadership has two components: 1) An innovative approach to leadership and 2) Leadership for innovation.

Innovative leadership	Leadership for innovation
Bringing up new thinking and different actions to how you lead, manage, and go about your work.	Creating an organizational climate where employees apply innovative thinking to solve problems and develop new products and services. It is about growing a culture of innovation, not just hiring a few creative outliers

Table 3.2 *Innovative leadership vs Leadership for innovation*

Creating a climate conducive to innovation helps to encourage employees to engage in the innovation process. Leaders in such organizations continuously provide intellectual stimulation to their employees, inspire them to critically appraise existing assumptions and working methods, motivate them to think in a creative way, and build a climate for excellence. This climate should cover as many of the staff members as possible, if not all employees.

Considering the need for broad involvement of stakeholders in the process of innovation, overcoming obstacles can be facilitated by an organization based on a new form of participation.

In this case, everything comes down to cooperation and relationships between members of the organization. In his book titled "Winning", Jack Welch writes that building relationships with other members of organization based on mutual respect is a good advice to be followed (Welch, 2005: 319). Human attitudes and readiness to cooperate form the core of a learning organization. This constitutes a departure from the old model of participation and behaviour based on extrinsic motivation. A learning organization is a place of a broadly defined "becoming". The leader should know the needs, aspirations and life goals of the employees to be able to provide the means necessary to achieve them (Szejniuk, 2016: 194). Functional management is being replaced by situational management popularized by Blanchard (2008: 45-58). Situational approach is based on the assumption that there is no method of action that would be universal and optimal at the same time. On the contrary, numerous solutions exist and an organization should provide "enough room for everyone". This new approach to solving organizational problems and taking decisions, based on getting the employees involved in the process, considering their opinions and interpretations, and increasing the number of perspectives and variants is widely spreading.

In universal understanding, leaders and managers should display the following competences:

- Ability to formulate and effectively execute the mission, vision and organization strategy, and the ability to achieve goals;
- Knowledge and cognitive skills allowing to professionally perform all management functions;
- Ability to reconcile the interests of the entire organization with the interests of its part they manage, and the interests of organization with the interests of its external environment;
- Effective and rational management of the entrusted material and financial resources, as well as the ability to manage both one's own and others' time and information;
- Ability to perform the function of an ambassador of the organization to its environment in terms of public relations (Szczepańska-Woszczyna, 2016: 98-99).

Vroom-Yetton-Jago Decision-making Model of Leadership

The Vroom-Yetton-Jago Decision-Making Model of Leadership can be described as a decision tree. It allows the leader to examine the situation and determine what management style should be applied. This model identifies five styles along the continuum, from autocratic through consultative to group styles. By asking yourself a series of questions about the nature of the problem, decisions and consequences, a leader can decide how large his participation should be in making decisions. (Table 3.3).

This model is a great example of knowledge extraction and modelling. At the same time, it shows the advantages of situational nature of management, which favours unconventional thinking and creative action.

Decision-making style	Definition
Highly autocratic	The manager solves the problem by himself or makes a decision using the information he/she has.
Autocratic	The manager obtains the necessary information from his subordinates, then he decides him-/herself how to solve the problem. While collecting data from subordinates, the manager may, but does not have to, inform them of the essence of the problem. The role of subordinates in solving the problem is to provide the necessary information, not to generate or evaluate alternative solutions.
Consultative (at individual level)	The manager discusses the problem individually with some of their subordinates and collects their opinions and suggestions. Then the manager makes a decision, which may, but does not necessarily have to, reflect the influence of subordinates.
Consultative (at group level)	The manager discusses the problem with subordinates as a group with a view to collecting their opinions and suggestions. Then the manager makes a decision, which may, but does not necessarily have to, reflect the influence of subordinates.
Democratic	The manager discusses the problem with subordinates. Together with them, he/she is looking for alternative solutions to the problem, and then tries to reach an agreement about which alternatives to choose. The manager does not impose his own solutions on the group, but he/she is willing to accept and implement a solution that has been endorsed by the whole group.

Table 3.3 *Innovative leadership vs Leadership for innovation*

Further reading and learning material

1. *InnoWork project*. Module 2 "Organizational Structure (Business Model), Creative Process and Governance for Innovation"
   - Text version URL: http://www.innowork-project.eu/documents/Module_2_Organizational_Structure_890.pdf
   - Interactive version URL: http://www.innowork-project.eu/index.php?t=10

2. *InnoWork project*. Module 7 "Innovation leadership".
   - Text version URL: http://www.innowork-project.eu/documents/Module_7_Innovation_Leadership_895.pdf
   - Interactive version URL: http://www.innowork-project.eu/index.php?t=10

3. Baumgartner, J. (2011). *What is Innovative Leadership?* URL: https://innovationmanagement.se/imtool-articles/what-is-innovative-leadership/

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Summary of key points

- Leadership is a complicated process that consists in motivating a people to work towards achieving a common goal.
- The main approaches to leadership include qualification, behavioural and situational approaches.
- Qualification approach to leadership argues that personal traits determine effective leaders. Behavioural approach argues that effective leadership is a combination of a task-oriented and relationship-oriented behaviour. And situational approach stands for the argument that different situations demand different types of leadership.
- Knowledge management is one of the functions that effective leaders should be able to perform.
- Transactional leaders (result-oriented) stand in opposition to Transformational leader (visionary and future-oriented).
- An inclusive organisation creates a climate of innovation.

Self-assessment test

Please mark the answers that you think are correct. There may be more than one correct answer for each question.

Q1: Highly autocratic style of leadership in Vroom-Yetton-Jago model means that:

1. The manager solves the problem by himself and makes a decision alone.
2. The manager discusses the problem and together with people is looking for alternative solutions.
3. The manager obtains the necessary information from his subordinates.
4. The manager does not impose his own solutions on the group.
5. The manager tries to reach an agreement with employees.

Q2: In universal understanding, leaders and managers should display the following competences:

1. The ability to reconcile the interests of the organization with the interests of its external environment.
2. Knowledge and cognitive skills allowing to professionally perform management functions.
3. The ability to formulate promotional texts for the media.
4. The ability to perform the function of an ambassador of the organization to its environment in terms of public relations.
5. All answers are correct

Q3: In Nonaka's model of knowledge creation, socialization is a process in which:

1. Tacit knowledge is written down and expressed in documents and manuals.
2. Knowledge is passes on through sharing of experience, observation and imitation.
3. Written knowledge is combined to create new knowledge.
4. Explicit knowledge is used and learned.
5. All answers are correct

Q4: In Nonaka's model of knowledge creation, externalization is a process in which:

1. Knowledge is passes on through sharing of experience, observation and imitation.
2. Tacit knowledge is written down and expressed in documents and manuals.
3. Written knowledge is combined to create new knowledge.
4. Explicit knowledge is used.
5. Explicit knowledge is learned.

Q5: In Nonaka's model of knowledge creation, middle management plays:

1. Passive role
2. Active role
3. Progressive role
4. Indifferent role
5. Laissez-faire

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Glossary

Leadership	An impact process to achieve the organization's goals and motivating behaviours.
Transformational leadership	Based on a vision that takes into account the interests of the organization's participants, stimulates and inspires. Transformational leaders exert a profound influence on their subordinates.
Transactional leadership	Refers to routine duties performed by the leader, consisting in directing the efforts of others through tasks, rewards, and structures.
Participation	Taking part in the organization management, co-decision making, consulting processes, taking responsibility.

Lecture 4.

Types of innovation

Annotation

Innovation is the process of creating value by applying novel solutions to meaningful problems. Several types of innovation are distinguished: product innovation, process innovation, marketing innovation, organizational innovation; radical innovations versus incremental innovations; sustaining innovations versus disruptive innovations; open innovation versus closed innovation. Innovation is distinguished from invention: invention can be defined as the creation of a product or introduction of a process for the first time. Innovation, on the other hand, occurs if someone improves on or makes a significant contribution to an existing product, process or service.

Key words

Types of innovation, Sources of innovation, Product innovation, Radical innovation, Disruptive innovation.

Learning outcomes

- Ability to define innovation and describe major types of innovation
- Ability to explain the specifics of innovation in low- and middle-income countries

Structure of the learning content

- Definition of innovation
- Types of innovation
- Innovation in low-and middle-income countries

Learning content

Definition and types of innovation

Innovation is one of the topics that is increasingly being discussed in all areas. There is talk of innovation as a way to initiate and manage change, to do things differently, to determine the impact on the quality of our work and life. In the past, innovation was defined in different ways by specialists; no generally accepted definition existed. From the economic perspective, the notion of innovation was first analysed in the 20th century by the Austrian scholar J. Schumpeter. In his work "The Theory of Economic Development" he defined innovation as creative destruction, as "the process of industrial mutation that incessantly revolutionizes the economic structure from within, incessantly destroying the old one, incessantly creating a new one" (Schumpeter, 1934).

In the course of time, the understanding of innovation has changed. Nowadays, innovation is defined as "a new or improved product or process (or combination thereof) that differs significantly from the unit's previous products or processes and that has been made available to potential users (product) or brought into use by the unit (process)" (Oslo Manual, 2018). Innovation is considered either as an outcome, or as activities through implementation of which innovations are developed (ibid).

The International Association of Innovation Professionals (IAOIP), the professional membership organization and the world's only innovation certification body, defines innovation as the exploitation of new ideas that lead to the creation of new products, processes or services. It describes the goal of innovation as bringing the idea to a productive position – either development and launch of a new or significantly improved product, or implementation of a new or better way of doing things (improvement of a service, a process, management or marketing practices, or a business model). The definition of "new" here includes a novelty to the world, or to the country, or to the company. Innovation aims to bring value to the company (e.g. competitive advantage and financial benefits), to customers (e.g. better or cheaper products and services), and/or to society (e.g. tackling societal and environmental challenges).

Four types of innovation are distinguished: product innovation, process innovation, marketing innovation and organizational innovation (The Oslo Manual, 2018).

- ***Product innovation***: A good or service that is new or significantly improved. This includes improvements in technical specifications, components and materials, software in the product, user friendliness or other functional characteristics.
- ***Process innovation***: A new or significantly improved production or delivery method. This includes significant changes in techniques, equipment and/or software.

Product- and process-oriented innovation stems from the concept of technological development. Driven by advancing technologies, product innovation normally incorporates significantly improved characteristics in goods and services. Product innovation has been used as a main driver to improve the competitive advantage of firms, generating profits by either introducing wholly new products and services or improving the features and functionality of existing products and services. In adopting a new or significantly improved production or delivery method, process innovation also intends to increase the competitive capability of a firm by decreasing unit costs of production or increasing the quality of the existing products.

- ***Marketing innovation***: A new marketing method involving significant changes in product design or packaging, product placement, product promotion or pricing.

Marketing-oriented innovations indicate the introduction of a new marketing strategy, which intends to address customer needs or open up new markets, which would eventually lead to increasing firms' sales.

- ***Organisational innovation***: A new organisational method in business practices, workplace organisation or external relations.

Organisational innovations imply the development and adoption of new managerial approaches in the company's business practices, workplace or external relationships. Such innovations aim to increase firm's performance by reducing administrative and transaction costs, improving organisational efficiency, providing access to non-tradable assets such as non-codified (tacit) external knowledge.

According to "Innovation in low income countries: A survey" (2014), a report that was published within the framework of the DFID-ESRC Growth Research Programme (DEGRP) and The Diffusion of Innovation in Low Income Countries project (2014), the major benefits obtained from being involved in product innovation is:

- Increased range of goods or services
- Entered new markets
- Increased market share
- Improved quality of goods or services
- Started to export
- Expanded export volumes or export to new market
- Improved flexibility of production or service provision
- Increased capacity of production or service provision
- Reduced production costs per unit of labour, materials and energy
- Reduced organisational costs
- Increased management efficiency
- Improved supervision and accountability
- Targeted new customers
- Entered new geographical markets
- Reduced environmental impacts
- Improved working conditions on health and safety
- Met governmental regulatory requirements
- Used less energy or generated less pollution

Organisational innovations, which are strongly related to administrative efforts to renew managerial routines, procedures, mechanisms and systems, aim to promote information sharing, coordination and collaboration among actors within the organisation.

Linkages between innovation and social challenges cover many other impacts of innovation such as reducing environmental impacts, improving working conditions on health and safety, meeting governmental regulatory requirements, and using less energy or generating less pollution.

Innovations are frequently classified according to the degree of novelty or the extent of change introduced by the innovation. There are two classifications of this kind. The first one distinguishes between incremental and radical innovations, and the other one – between sustaining and disruptive innovations.

- ***Radical innovation***: new products, services or processes and involve significant change.
- ***Incremental innovation***: further development and improvement of existing products, services or processes. The objective and benefits of incremental innovations include improvement of customer experience, reduction of costs, better positioning, adaptation for entering a new markets or adaptation to new conditions (e.g. new laws and standards).

Hence, radical innovations are revolutions (pure innovations), while incremental innovations are evolutions (improvements, adaptations or follow-up innovations).

- ***Sustaining innovation***: preserving or continuous innovation that refers to the improvement of existing products or services. It is similar to incremental innovations. Sustaining innovation is focused on the needs of current customers.
- ***Disruptive innovation***: replacement of an existing product, service or process by a completely new one. Disruptive innovation shapes a new market.

Another classification of innovation distinguishes between closed and open innovation, and "technology push" and "market pull" innovations.

- ***Closed innovation***: involves only internal resources for generating ideas, developing and implementing innovations.
- ***Open innovation***: integrates external partners such as customers, research institutes or suppliers into the innovation process.
- ***Technology push innovation***: is the result of new technologies for which suitable application possibilities are sought and implemented.
- ***Market pull innovation***: originates from the market and is initiated by a specific customer request.

You can find more information on technology pull, market push and open innovation models in Lecture 2.

Here are a few examples of innovation:

- One of the most famous and ground-breaking examples of process innovation is Henry Ford's invention of the world's first moving assembly line that not only simplified vehicle assembly, but reduced the time needed to produce a single vehicle from 12 hours to 90 minutes;
- One of the recent product innovations is touch screen smart phones can substituted classic call phones;
- IBM has managed changes in customer offers from mainframes to personal computers to technology services;
- Amazon found a new channel to the customer through technology by eliminating the traditional retail distribution channel and developing direct relationships.

Innovation in low-and middle-income countries (LMICs)

Innovation in LMICs can have an impact on multiple dimensions, from income growth and job creation to poverty reduction and, more generally, improving human well-being. The impact can be achieved at different levels through three main channels:

- Firstly, innovation can contribute to household's poverty reduction by improving medical care, supporting education, updating agricultural techniques, and providing sustainable energy.
- Secondly, innovation can have a direct impact on the people and production at the bottom of the pyramid. If innovations were affordable and easy enough to be used, poorer people would be provided with more goods and opportunities. In such context scenario, innovation aims to reduce both the complexity of the technologies and the skills needed to use them, making them affordable to poorer people.
- Thirdly, at the macro-economic and structural levels innovation is a driver for improving productivity and increasing the production capacity of an economy. The impact of innovation reflects in enhanced competitiveness, increased sales and profits, and job creation. Improving more people's living conditions can also help others to leave poverty.

Although the transfer, adoption and adaptation of knowledge and technologies to LMICs are acknowledged to constitute an important issue for economic growth and global development, so far, our understanding of innovation in developing countries has been limited. For example, how does innovation emerge, which kinds of innovation are found and how are innovations transmitted to and spread within LMICs?

How innovations emerge

Innovation can be developed from an original idea, but it can also emerge from diffusion, absorption, or imitation of the new methods that are observed. To be relevant many innovations need to be economically and socially appropriate and accessible for the people.

How innovations are materialized

- The product or process was mainly developed within the enterprise
- The firm developed the innovation in a research & development department
- Technicians in the firm created the innovation as a solution to a problem that constrained the production or competitiveness of the company
- Skilled workers in the firm found out a better way for the production process after some experiments
- The firm modified the product in response to customers' requirement
- The firm adapted or modified goods or services originally developed by other enterprises or institutions
- The firm created the innovation together with supplier
- The firm created the innovation together with customer
- The firm created the innovation together with other firm in the industry
- The firm created the innovation together with universities and research institutions
- The firm created the innovation together with other firm in the same company group
- The firm acquired technology originally developed by others by licensing and adapted or modified it

- The firm acquired technology originally developed by others by licensing without any adaptation and modification
- The firm observed or heard of the innovation by other companies and imitated it directly
- The firm observed or heard of the innovation by other companies and imitated it with some modification

How innovations are born and materialise in LMICs

Understanding how an innovation gets born and materialises provides relevant insights into the innovation behaviour of firms. In the environment, in which research and development departments are hardly developed, firms need to find ways to improve the production and increase sales. Most of the innovations get born in response to customers' requirements. This, on the one hand, shows how the market inspires innovation, and, on the other hand, how a strong connection between firms and customers can be mutually beneficial. Customers not only serve as a source of information. They are often actively involved in the process of innovation. Nevertheless, most of the innovations turn to be developed mainly within the company.

Many companies innovate by imitating what is done by other firms. This is a normal behaviour when research and development departments are rare. Many companies but adapt and modify innovations observed at other firms. Again, the process of adapting materials, production, management structures, or marketing tools to the nature and the resources of the adopting firms is a critical feature of innovation in Low-and Middle-Income Countries.

How firms gather information for the innovation activities

Information is an essential component for innovation creation and transmission. The sources of information used for innovation are grouped into five categories: sources internal to the firm, membership in networks, market resources, institutional resources, and other sources which include ICTs, conferences and publications (Table 4.1).

Category	Items
Internal sources	Sources within the firm (colleagues)
	Sources within the group (if you have subsidiary)
Network	Member of cluster
	Member of associations
Market resources	Suppliers of equipment, material, components, software
	Clients or customers
	Competitors or other enterprises in your sector
	Consultants, commercial labs or private R&D institutions
Institutional sources	National universities or other higher education institutions
	Government or public research institutes
Other sources	Radio
	Internet

	Conferences, trade fairs, exhibitions
	Scientific journals and trade/technical publications
	Professional and industry associations

Table 4.1 *Sources of information for innovation activities*

Customers and clients are a crucial source of information. This finding reinforces the evidence that innovations often arise in response to customer requirements or are developed together with customers. In addition to clients and customers, competitors or other enterprises in the same sector are an important source of information.

Companies also gather information on innovations from members of clusters and associations. The relevance of clusters and associations is also based on the fact that those institutions by nature provide information that is context- and sector-specific to the members. This finding supports the role of clusters in fostering innovation and technological transfers, through knowledge spill-overs and labour market pooling.

Internal sources of information (e.g. colleagues) are also important. Labour mobility and hiring experienced employees can boost the innovation activities of firms.

Finally, the Internet is considered a significant source of information, considering the potential, which the global network holds to overcome the lack of information in Low- and Middle-Income Countries and allow users to find specific information.

Regarding the cooperation with universities, in advanced economies universities play a key role in the innovation process and are an integral part of a national innovation system together with the state and industry. Universities are essential partners in collaborative research and development activities, and play an active role in national and regional innovation systems. In the context of Low- and Middle-Income Countries, universities could have equal importance, being seen as tools for knowledge-based economic development and change through spin-off companies, licences for new technologies, and transferring knowledge to existing businesses.

Foreign sources of knowledge and innovation

The costly, risky, and path-dependent nature of innovation pushes firms in LMICs to seek external sources in order to compensate for weak indigenous technological capability. Innovation activities in LMIC's firms are characterised by adoption of existing knowledge and technological advances. Hence, foreign sources of knowledge represent a substantial driver of economic growth in LMICs. Knowledge obtained from foreign sources not only helps the economy of these countries to fill gaps in their technological capability, but also helps to align the existing technologies with internationally recognized standards. Types of foreign sources of knowledge are listed in Table 4.2.

Category	Items
Technology transaction	Foreign technology acquired through licensing

Trade and value chain	Imported goods in the same industry
	Imported goods that input as intermediate goods into production
	Imported machinery and equipment
	Observing and imitating competitors in export market
	New product or quality requirement raised by customers in export market
	Knowledge transferred from foreign suppliers
	Knowledge transferred from foreign customers in export market
Foreign invested firms	Foreign firms in the same industry
	Foreign firms in upstream industry
	Foreign firms in downstream industry
Innovation collaboration	Foreign research institutions & universities
	Foreign competitors
	Foreign suppliers
	Foreign customers
Labour mobility	Returnees employed in your firm
	Foreign workers/managers employed in your firm
	Local workers who have worked in multinational enterprises before
Social networks	Relatives or friends working/living abroad
Standards and Internet	Information found via Internet
	International standards that your firm has to meet
Short term foreign visit & trade fairs	Visits to foreign production sites
	Attending international trade fairs

Table 4.2 *Types of foreign sources of knowledge used for innovation in LMICs*

Trade brings technological spill-overs not only by allowing firms to learn from importing and exporting activities, but also by granting firms access to foreign knowledge-embedded machinery and equipment. All goods and services imported from developed countries contain some technological information. Employing machinery and equipment, which has been purchased from abroad, is expected to improve productivity through using it in production.

The presence of foreign direct investments (FDI) provides domestic firms in LMICs with more efficient foreign technologies and results in technological diffusion in many ways.

Collaboration with foreign partners allows local firms to gain access to a broader knowledge pool at lower cost and to share the risks. Collaborative activities can take a variety of forms: with foreign research institutions and universities, with foreign competitors, with foreign suppliers, and with foreign customers.

Knowledge flows from multinationals to domestic firms occur not only through machinery, equipment, licensing, but also through expatriate managers and technicians.

Internet is a crucial channel to obtain information about foreign technology. Learning and imitation can also occur through networks, foreign visits, or trade fairs.

Constraints to innovation

An obstacle to innovation is perceived as a factor that potentially prevents an innovation decision or increases the difficulties, timeframe and cost of the process. Operating in resource- and experience-poor environment, firms in LMICs are likely to encounter substantial obstacles in the process of innovation and knowledge adoption compared to companies in advanced economies. Better understanding of the types of innovation obstacles and the patterns of their appearance is essential for the government to design efficient innovation strategies and policies.

Barriers can be examined at different stages starting from the innovation idea and moving up to the innovation investment decision, the invention and adaptation process, and the commercialization. Any missteps would lead to abandonment, delay, or failure. Table 4.3 summarizes possible obstacles in innovation.

Category	Items
Cost factors	Lack of funds within your enterprise or group
	Lack of finance from sources outside your enterprise
	Innovation costs too high
	Excessive perceived economic risks
Knowledge factors	Lack of qualified personnel
	Lack of information on technology
	Lack of information on markets
	Difficulty in finding co-operation partners for innovation
Market factors	Market dominated by established enterprises
	Uncertain demand for innovative goods or services
	Innovation is easy to imitate
	Poor competition in the market and absence of necessity to innovate
	Too much competition in the market and too low perceived return of innovation investment
Other factors	Organisational rigidities within the enterprise

	Workers do not have the incentive to innovate
	Insufficient flexibility of regulations or standards
	Limitations of science and technology public policies
	Weak intellectual property rights protection
	Practices used by informal firms
No need to innovate	No need due to prior innovations
	No need because of no demand for innovations
	Social or cultural factors

Table 4.3 *Obstacles in innovation*

The success of innovation cannot be achieved without having a compatible internal technological capability to absorb and integrate various knowledge sources during production.

The statistics indicate that the major hampering effects in this category were in relation to the lack of technology and market information, the collection of which is time-consuming, expensive and difficult to use. Furthermore, university graduates often lack the required skills to foster technological innovation for economic growth. This is recognized as one of the major obstacles for strengthening the technological performance in LMICs.

The nature and intensity of competition within markets affect the risks and profitability of innovation investment. Insufficient flexibility of regulations or standards, limitations of science and technology public policies, weak intellectual property rights (IPR) protection can also impede innovation.
To encourage innovation and facilitate economic growth, governments in LMICs should collaborate with the private sector and collectively establish an effective innovation system to overcome the potential innovation barriers.

Is innovation relevant for the LMICs?

For some people the answer is a clear 'yes', but other people may argue that there are other more important issues in LMICs, such as food safety, water, health and conflict. However, only innovation and technological progress can provide fundamental solutions to the major challenges facing LMICs, such as poverty reduction, environment and resource constraints, and sustainable development. Hence, innovation should be considered not as an outcome of development, but a means to achieve it.

Further reading and learning material

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2. Resources available on the website of *International Association of Innovation Professionals* (IAOIP) - the world's only innovation certification body, providing members with the knowledge, skills, and opportunities to deliver real change in their industry or field. URL: https://www.iaoip.org/page/AboutUs
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Summary of key points

- Innovation is understood as an outcome (a new product, service, marketing solution, or organisational/management approach) and as a process (innovation activities).
- There are several classifications of innovation: 1) product, process, marketing and organisational innovation; 2) incremental vs radical innovation; 3) sustaining vs disruptive innovation; 4) closed vs open innovation; 5) technology push vs market pull innovations.
- Innovation in LMICs have impact on multiple dimensions, from income growth and job creation to poverty reduction and improving human well-being.
- Innovations in LMICs are driven by customer needs and are often created together with customers. Nonetheless, most of the innovations appear to be developed primarily within the firm.
- Since R&D departments are rare in LMICs, many firms innovate by imitating from other companies, or by adapting and modifying innovations observed or heard from other firms.
- Foreign sources of knowledge have become a substantial driver of economic growth in developing countries. Knowledge acquired from foreign channels helps the host economy to fill gaps in indigenous technological capability and to upgrade the existing technologies to international standards.

- The major constraints to innovation in LMICs are associated with cost factors, knowledge factors and market factors, as well as other factors such as rigid institutional or organisational frameworks, weak IPR protection, lack of motivation for innovation on behalf of workforce, or lack of incentives.
- Innovation and technological progress can provide fundamental solutions to the major challenges facing LMICs. Therefore, innovation should be viewed not as an outcome of development but as a means to achieve it.

Self-assessment test

Please mark the answers that you think are correct. There may be more than one correct answer for each question.

Q1: What types of innovation exist?

1. Product innovation
2. Marketing innovation
3. Organizational innovation
4. Market innovation
5. Process innovation

Q2: Which are the sources of innovation?

1. Internal sources
2. Media/ newspapers
3. Network
4. Market resources
5. Institutional sources

Q3: What is product innovation?

1. An old product
2. A good that has the same characteristics
3. A good or service that is new or significantly improved
4. An unchanged product
5. A good or service that is new or significantly improved

Q4: Which are the foreign sources of innovation?

1. Trade fairs
2. Labour mobility
3. Internet
4. Internal sources/ Internal Institutional sources
5. Foreign firms

Q5: What factor constraints innovation?

1. Cost factors
2. Foreign firms
3. Knowledge factors
4. Trade fairs
5. Market factors

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Glossary

Product innovation	A good or service that is new or significantly improved. This includes significant improvements in technical specifications, components and materials, software in the product, user friendliness or other functional characteristics.
Process innovation	A new or significantly improved production or delivery method. This includes significant changes in techniques, equipment and/or software.
Marketing innovation	A new marketing method involving significant changes in product design or packaging, product placement, product promotion or pricing.
Organisational innovation	A new organisational method in business practices, workplace organisation or external relations.
Radical innovation	A new product, service or process involving significant change.
Incremental innovation	Optimization and further development of existing products, services or processes.
Sustaining innovation	Preserving or continuous innovation that refers to the improvement of existing products and services (similar to incremental innovations). This type of innovation focuses on current customers and their needs.
Disruptive innovation	Innovation that shape a new market. Disruptive innovations mostly originate in the low-end segment, in less attractive segments. However, as the maturity of technology and products increases, they are gradually attacking the mass market and thus replacing existing services.
Closed innovation	Innovation that involves only internal resources for generating ideas, developing and implementing innovations.
Open innovation	Innovation that integrates external partners such as customers, research institutes or suppliers into the innovation process.
Low- and middle-income countries (LMCIs)	For 2019 fiscal year, low-income economies are defined as those with a GNI per capita, calculated using the World Bank Atlas method, of $3,895 or less; middle-income economies are those with a GNI per capita between $3,896 and $12,055; high-income economies are those with a GNI per capita of $12,056 or more. https://iamcr.org/income https://datahelpdesk.worldbank.org/knowledgebase/articles/906519

Lecture 5.

Open innovation

Annotation

Open innovation means a situation where an organisation does not just rely on their own internal knowledge, sources and resources (such as their own staff or R&D, for example) for innovation of products, services, business models, processes etc., but also uses multiple external sources (such as customer feedback, published patents, competitors, external agencies, the public etc.) to drive innovation. Unlike open innovation that integrates external partners such as customers, research institutes or suppliers into the innovation process, closed innovation involves only internal resources for generating ideas, and developing and implementing innovations.

Key words

Open innovation, Closed innovation, Low- and Middle-Income countries

Learning outcomes

- Ability to define open innovation and compare it with a closed approach to innovation
- Ability to identify and justify benefits of open innovation for an enterprise

Structure of the learning content

- Definition of open/closed innovation
- Universities and open innovation
- Benefits of open innovation
- Open innovation requirements

Learning content

Definition of closed and open innovation

Open innovation is a widespread practice in organizations. It developed into a prominent research topic in the current innovation management literature (Chesbrough, 2012). Today, companies are rapidly embracing innovation processes and are using a wide range of technologies and knowledge developed within or outside companies to create business value. Such approach is considered the most widespread method for managing innovation.

According to one of the pioneers of open innovation (Fabrizio 2006), this approach means "the purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the market for external use of innovation, respectively". According to the Oxford Review (2014), the term "open innovation" means a situation where an organisation does not just rely on their own internal knowledge, sources and resources (such as their own staff or R&D) for innovation, but also uses multiple external sources to drive innovation. These external sources usually include published patents, external agencies, feedback from customers etc.

In the traditional understanding, the in-house research and development (R&D) department is the most important source of innovation. An opening to the outside world changes this understanding. In the closed innovation model, innovation is created in a self-contained company environment; Open innovation model, on the contrary, integrates external knowledge into the innovation process.

The characteristic of closed innovation is that it is developed by companies themselves. This approach can be functionally compared to a perpetuum mobile:

- Companies develop their own research centers with the support of consistent financial investments;
- These research centers produce significant technological inventions that lead to the development of advanced products and processes;
- Consequently, the innovation system becomes a closed system, in which the innovation processes are controlled by the internal research activities developed within the company.

Closed innovation relies only on internal knowledge, know-how and resources for generating ideas and developing innovations. A key aspect of closed innovation is that successful innovation needs protection, control and ownership of intellectual property (Bogers, 2012).

Open innovation integrates external partners such as customers, research institutes or suppliers into the innovation process. The characteristic of open innovation is that in today's world characterized by wide access to knowledge, companies have the opportunity and should partner with other people to achieve their goals. This is particularly valid in low- and middle-income countries, as it may constitute a factor of success. This strategy refers to the fact that companies can not only rely on their own resources and innovation methods developed by their own specialists, but can buy or license free market processes or inventions from other companies.

Recently, attention to the concept of "open innovation" has been growing, both in the university environment and in practice. Chesbrough (2003), who coined this term, describes the factors

that led to the erosion of the closed innovation model and motivated companies to shift towards a more open way of innovating:

- Increased availability and mobility of highly educated people that results in existence of large amounts of knowledge outside the research laboratories of the companies, as well as in knowledge flows between firms;
- Increased availability of venture capital, which makes it possible for promising ideas and technologies to be further developed outside the firm in the form spin-offs or through licensing agreements;
- Increased importance of the role of other players, for instance suppliers and competitors, in the innovation process, as the cooperation with the stakeholders along the value chain can help to create customer value.

Open innovation can thus be described as "combining internal and external ideas as well as internal and external paths to market to advance the development of new technologies" (Ahn, Minshall & Mortara, 2015).

Companies in low- and middle-income countries have to become aware of the increasing importance of open innovation. For business, open innovation is a more profitable way to innovate even within the context of LMIC, because it can reduce costs, accelerate time to market, increase differentiation in the market, and create new revenue streams for the company.

Open innovation is viewed as the opposite of traditional approach to innovation, in which internal research and development activities lead to new products that are then distributed by the company. As H. W. Chesbrough's (2006) definition suggests, there are two facets of open innovation. One is the "outside in" aspect. It implies that external ideas and technologies are introduced into the company's own innovation process. This is the most common feature of open innovation. The other, less known aspect is the "inside out". In this case un-utilized and under-utilized ideas and technologies in the company are allowed to go outside to be incorporated into the innovation process of other firms.

Integrating universities and business in open innovation

In the traditional sense, universities were seen as systems that produce theoretical knowledge without a large-scale involvement in the economic environment. Recent research on the relationship between universities and the economic environment favours the new "open role" of universities that complies with their function of knowledge providers. This new approach to the economic environment of universities is introduced by Chesbrough (2008) in the term "open innovation". Companies are the main providers of jobs operating in a global competitive market. Survival in this economic environment is increasingly conditioned by circulation and knowledge. Consequently, this demanding environment requires companies to pay increasing attention to identifying relevant sources of knowledge, which can ensure their economic success. A resource available to companies is public science and academia, which are stakeholders in the national innovation system. According to Fabrizio (2006), "public science supports the productivity of private science in many ways." Therefore, the efficiency and effectiveness of innovation processes in companies can significantly support innovation processes (Cockburn & Henderson, 2000). In low-and middle-income countries, the inclusion

of universities in the network of the innovation system may ensure a continuous source of ideas, human resources and partnership opportunities, which create the conditions for overall success.

Sustainable and successful cooperation of researchers (public science) and entrepreneurs (private science) is preconditioned by the existence of overlapping interests and motives (Lee, 2000). For example, researchers are interested in cooperation with industry as it offers a possibility for testing their theoretical models and results under practical conditions and thus for validating their scientific knowledge in economic environment. Another motive for cooperation with the private companies is a possibility for researchers (particularly, academic staff at universities) to support the transfer of students and graduates to industry in order to support internships and job opportunities. Furthermore, researchers may look for cooperation with industry to equip their teaching and research laboratories and to promote partnership in scientific research. In this cooperation, companies have their own objectives of partnering with the scientific community, namely to develop economically profitable innovations and inventions and to continuously improve manufactured products.

Benefits of Open Innovation

- ***Creating new products and services***

Start-ups with limited budgets may be reluctant to invest time and resources in creating new products, because it can unbalance them financially. Yet, by investing in the creation of something new, you can bring added value to your own company and to the community. Innovation can help you increase profits and get your brand more recognizable on the market. The creation of new products and services is therefore a valuable motivating tool for entrepreneurs in low- and middle-income countries, where the need for new products and services is still relatively high.

- ***Innovating old products and services***

In some situations, you may feel no need to create new products, for instance because your marketing service manages to attract customers to your existing products. If so, a new creative team could be gathered to improve your product idea.

- ***Building a strong community***

Open innovation can be promoted through allocating resources to connect with customers, fans, and especially new talent. You have to know what your customers want and how to satisfy their desires. In this regard, the most enthusiastic members will want to dedicate some of their time to you and contribute to creating something new and better. These relationships need to be cultivated because it can help the company build a strong community that is involved in solving projects.

- ***Keeping your employees engaged***

Lack of ownership of the ideas and projects may be a source of employees' dissatisfaction. In some situations, your team may have outstanding ideas, but may lack motivation to take them further. If an open innovation initiative at workplace is used, the team can be more motivated

and deeply involved in solving the problem. One remark is that the staff members involved in the major decisions and objectives of the organization, become more enthusiastic, more motivated and more participatory.

- ***Staying ahead of the competition***

Open innovation can offer support through which your organization can put itself in a valuable position within the community. This can be achieved by involving your team and community members in the search for new ideas that are useful and relevant to the community.

- ***Costs reduction***

Partnering with other companies can help reduce costs. Strong partnership relationships can allow you and your partners to specialize in what you and they are good at, thus increasing efficiency of all involved parties.

- ***Time-to-market acceleration***

In order to accelerate the process of bringing the product on the market, it is preferable to work with a company that has required equipment and trained personnel instead of starting with the initial training of human resources and infrastructure acquisitions, etc.

- ***New revenue streams***

There are situations when some companies make higher revenue from selling secondary products compared to primary products. Partnering with other companies can allow you to enter new markets with concepts and products you have.

- ***Innovation risk reduction***

Innovation can present risks, but if you work with experts, it can be reduced, especially through permanent consultations and collection of feedback from your targeted clients.

Methods to perform open innovation

Let's look at how a company producing traditional consumer goods can become an engine of innovation.

We must start from understanding that there are no immediate and easy-to-apply solutions for this transformation process, which requires leadership, vision, allocation of resources. But the companies that are embarking on this path are the ones that are rewarded for their effort. In low- and middle-income countries, innovation is favoured by the features of emerging markets which are open to changes and incorporate them quickly and fluently into their dynamics.

With the economic stagnation of the markets, the competition among brands intensifies. In this context, it is necessary for companies to develop competitive strategies, take more offensive and ambitious actions, increase the degree of product and process innovation and expand its scope. Through open innovation, the industrial system can be strategically fed with high quality ideas and concepts. Open innovation is a complex system that has multiple inputs from its own

employees, suppliers, strategic partners but also from customers and consumers who initiate, develop and market innovation, as can be seen in Figure 5.1.

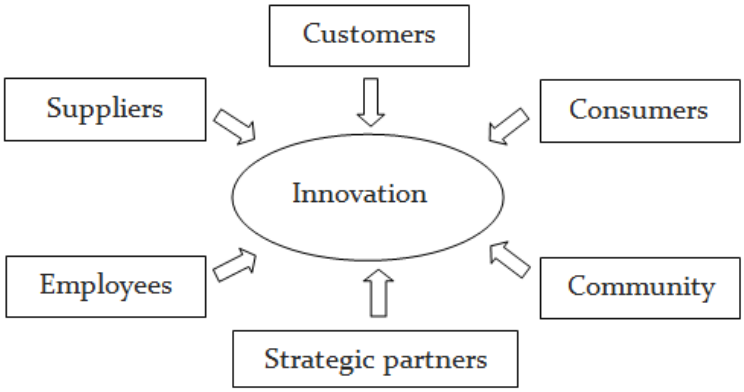

Figure 5.1 *External sources of open innovation*

The concept of open innovation emerged in the technology industry, due to manufacturing of products with short life cycles that require massive rates of continuous innovation, as well as because of the absence of a "core business" to support the existence of companies.

Successful innovators use multiple sources for their innovative ideas, have multiple partnerships, identify and manage potential targets for their ideas. In this way, open innovation can lead to significantly higher success rates, shorter time to market, and increased adaptability in responding to pressures from production costs. All this makes open innovation lead to amazing results.

When applying the open innovation concept in the context of low- and middle-income countries, there are different methods which can lead to significant short-term gains, create a constructive background, and engage employees through a new climate that destructs and breaks down old relationships and traditional work constraints. The characteristic of the method is that a unified program of integration of all open innovation efforts is elaborated, in which all the directions of innovation are gathered on a background of efficient communication and change management.

The organization approaches open innovation through successive waves of sequences and tactics that allow it to move faster. And the tactics can be different, locally or even globally. These can range from a wide variety of actions, from online forums, various dialogues and / or internal or external innovation competitions to innovation peaks.

With this support, a series of elements can be designed and executed which ensure the efficiency of innovation processes, generate new innovation capacities and, most importantly, create a collective mentality and a culture for innovation:

1. Establishing an innovation strategy and open innovation needs

At the beginning, a coherent innovation-oriented strategy should be established, which defines the role that open innovation plays in the strategy. Then specific quantifiable objectives related to open innovation should be set.

After developing the strategy, open innovation challenges are defined, which can range from a variety of details such as solving problems and creating new home appliances products to structural ones such as resolving production capacity or technology constraints.

On the one hand, the challenges posed by innovation must be focused so that they could be successfully addressed by innovation partners, and on the other hand, these challenges must be broad enough to allow the generation of new ideas. In this way, pivoting and expanding the challenges posed by innovation is a path on which open innovation can generate new and unexpected solutions for high-priority innovation needs.

2. Matching challenges to tactics

Once the challenges are identified, they must be solved through appropriate open innovation tactics, such as crowd sourcing, employee involvement, key supplier involvement, or even through benchmarking with other industries or similar challenges that may have found feasible solutions. The strategy is to involve partners on a large scale, to collect and refine the best ideas making sure they are not lost, as shown in Figure 5.2.

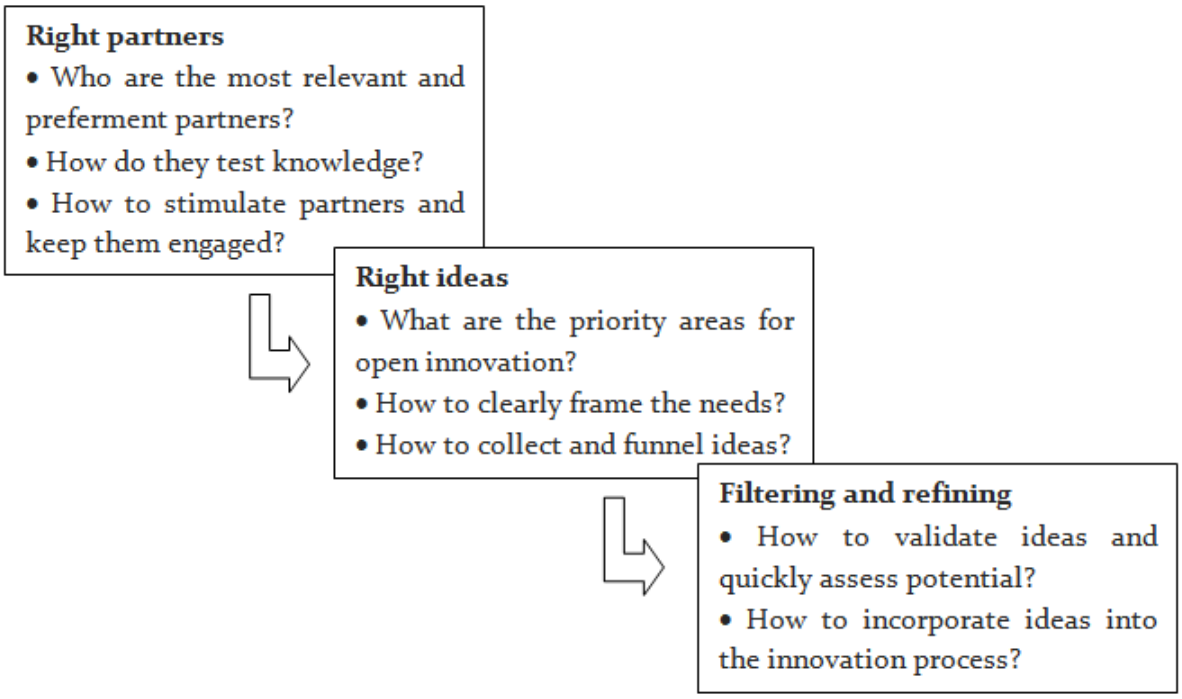

Figure 5.2 *Open innovation requirements*

3. Refining good ideas and using them in the system

Statistics show that less than 10 percent of the ideas generated by the open innovation model are strong enough to be marketed in terms of their rapid development and direct applicability. In order to facilitate this process, business model acceleration techniques can be used to quickly reach ideas that have high potential.

For example, one enterprise had distanced itself from crowdsourcing because the ideas they usually received were underdeveloped. Later on, this enterprise returned to the crowdsourcing approach, but limited it to collecting ideas only from two groups: inventors and graduate students. By applying simple filters, the submitted ideas with the highest potential were selected, and the best rated teams were invited to the company's headquarters to refine the concepts. The teams of students and inventors were strengthened with specialists in research, marketing, finance who contributed by analysing the operational feasibility of ideas and funding possibilities.

4. Improving the way you work

Continuous improvement of activities not only can support the growth of the company's core activities; it can also create the environment that truly supports open innovation. For these reasons, in the next step it is necessary to integrate innovation in the organizational culture. It should start with top management who should prioritize open innovation activities, require employees' involvement, encourage risk taking and commend staff members for their achievements in generating open innovation ideas.

This approach to the development of open innovation brings benefits for the company culture. It allows for getting access to more and better innovative ideas and quickly changes the way innovation is pursued. It also allows for building, testing and refining a series of tactics that can to constitute a continuous cycle of open innovation.

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Summary of key points

- Open innovation describes a situation, which an organisation does not rely exclusively on their internal knowledge and resources for innovation, but also uses various external sources to drive innovation. These usually include published patents, external agencies, feedback from customers etc.
- Open innovation is opposed to closed innovation that relies only on internal knowledge, know-how and resources for generating ideas and developing innovations.

- The major benefits of open innovation include: reducing costs and innovation risks, decreasing time-to-market for a new product, staying ahead of the competition, keeping employees engaged and building a strong community.
- Most popular tactics of open innovation include crowdsourcing, involvement of key suppliers and customers, and even cooperation with other companies facing similar challenges.
- Employing the open innovation model requires: laying out an innovation strategy, needs and objectives; matching challenges and open innovation tactics; selecting and refining good ideas; improving the way of work.

Self-assessment test

Q1: What is open innovation?

1. The type of innovation that involves external partners such as customers, research institutes or suppliers into the innovation process.
2. Innovation developed by companies themselves.
3. The type of innovation that incorporates internally and externally developed and extended technologies and knowledge to create business value.
4. The type of innovation that involves only internal resources for generating ideas, developing and implementing innovations
5. The type of innovation, in which R&D department is the most important source of innovation.

Q2: What is closed innovation?

1. Innovations developed by companies themselves.
2. Innovations that involve external knowledge into innovation management.
3. Innovations that incorporate internally and externally developed and extended technologies and knowledge to create business value.
4. Innovations developed in a self-contained company environment.
5. The purposive inflows and outflows of knowledge to accelerate internal innovation.

Q3: What are the sources of open innovation?

1. Customers
2. Own R&D department
3. Research institutes, universities
4. The company itself
5. Suppliers, partners

Q4: What are the benefits of open innovation?

1. Creating new products and services
2. Improving old products and services

3. Reducing production costs
4. All above
5. None of the above

Q5: What are the open innovation requirements?

1. Match challenges to tactics
2. Filter and develop good ideas
3. Change the way you work
4. Define an innovation strategy and open innovation needs
5. All above

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Glossary

Open innovation	The type of innovation that integrates external partners such as customers, research institutes or suppliers into the innovation process.
Closed innovation	The type of innovation that involves only internal resources for generating ideas, developing and implementing innovations.
Low-and middle-income countries	For the current 2019 fiscal year, low-income economies are defined as those with a GNI per capita, calculated using the World Bank Atlas method, of $3,895 or less; middle-income economies are those with a GNI per capita between $3,896 and $12,055; high-income economies are those with a GNI per capita of $12,056 or more. https://iamcr.org/income https://datahelpdesk.worldbank.org/knowledgebase/articles/906519
Crowdsourcing	Uses the intelligence, creativity and know-how of many people outside the company to solve problems.
R&D - Research and development	Is the process by which a company works to obtain new knowledge that it might use to create new technology, products, services, or systems that it will either use or sell.
Intellectual property	Is a category of property that includes intangible creations of the human intellect.
Know how	Is knowledge of the methods or techniques of doing something, especially something technical or practical

Lecture 6.

Knowledge transfer

Annotation

Knowledge transfer refers to a very broad range of activities to support mutually beneficial collaborations between universities, businesses and the public sector; it presents the systematic process of sharing knowledge and learning from the experience of others. Knowledge transfer is the transmission of practical or theoretical knowledge, apprehended in the academic environment, to the entrepreneurial context with the objectives of improving production techniques and augmenting monetary returns.

This lecture provides a foundational knowledge on the subject of knowledge transfer and reflects on the specificities of this process in Low-and Middle-Income Countries.

Key words

Knowledge transfer, Open innovation, Science transfer, Knowledge utilization.

Learning outcomes

- Ability to define knowledge transfer and describe common approaches and techniques used for knowledge transfer
- Ability to justify reasons for technology transfer between public and private domains
- Ability to analyse the specifics of knowledge transfer in low- and middle-income countries

Structure of the learning content

- Definition of knowledge transfer
- Knowledge transfer between public and private domains
- Types of knowledge
- Common approaches to knowledge transfer
- Knowledge transfer in Low- and Middle-Income Counties
- Contextualizing strategies for technology transfer in low-and middle-income countries

Learning content

Even though the immediate interest of developing countries is to achieve successful transfers of advanced technologies, the policies of these countries have as their main objective the support of innovation processes and the successful application of technologies in productive activities and social developments. The goal is to create value, especially economic value, but also social value.

Developing countries' policies on technology transfer are complex and closely linked to other major goals in their development agenda. The results of national policies must aim at increased access to technology, i.e. improving the capacity of companies and technology users to identify, acquire, adapt and use advanced knowledge and modern technology. National policies must support the improvement of domestic absorption capacities, stimulate local innovation and support international efforts to develop an environment conducive to technology transfer.

The concepts and definitions are diversified; they lack clear consensus on the nature of this process. The definitions of knowledge transfer as well as of the concept of technology itself are strongly influenced by the context in which the process takes place, by the degree of development of the country. In developed countries, the concept of technology transfer means the process by which universities and/or research centres provide access to the technologies they have created, through mechanisms of interaction with economic operators.

Knowledge transfer is a term that encompasses a very wide range of activities that support mutually beneficial collaborations between universities, businesses and the public sector. Knowledge transfer involves the transfer of corporate and intellectual property, expertise, learning and skills between the academic environment and the non-academic community. For academics, knowledge transfer is often a validation of theories in practice, but also a way to explore new perspectives and research directions. In this way a two-way knowledge transfer link is established which can support successful and sustainable collaboration.

According to the definition provided by Argote & Ingram (2000), knowledge transfer is "the process by which one unit (e.g. department) is affected by the experience of another". The definition highlights the process of transferring organizational knowledge: good practices, routine, etc., which can be found and which lead to changes in the knowledge and performance of the units that received it. But sometimes the transfer of best practices and organizational knowledge can be quite difficult to achieve.

The transfer of knowledge within a company is negatively influenced by the absence of incentives, but also by other factors. The extent to which knowledge and application of best practices are accessible within a firm depends primarily on the nature of the knowledge transferred, and then on the organizational context in which any transfer occurs: where (or from whom) it is transmitted and who receives it. A comparison can be made with the concept of stickiness which describes the difficulty of circulating the liquid around an oil refinery, through the effects of the native viscosity of the fluid. Such an analysis can be applied to scientific theories, but through different descriptors and evolutions (Szulanski, Gabriel, 1996).

In principle, three related concepts are used: "knowledge use", "research use" and "implementation". These concepts describe the process of adopting new ideas, practices or

technologies in a technological environment, in which they are consistently and adequately applied to the company's interests (Greenhalgh et all, 2004).

Ethical considerations underlie the transfer of knowledge between organizations, especially if there is an imbalance in power relations such as those between employer and employee. Ethical considerations also underlie the transfer of knowledge between nations, especially where there are imbalances between the levels of knowledge resource needs such as those between developed and developing countries.

Knowledge transfer between the public and private domains (entrepreneurship)

Universities are increasingly interested in partnership with private environment, because it offers opportunities for practical application of the research carried out and allows for access to various programs and funding schemes that stimulate public-private partnerships through grants.

As a result of the shift in advanced economies from a resource-based production to a knowledge-based production, there has been a change in attitude in many countries. National governments have increasingly recognized "knowledge" and "innovation" as important drivers of economic growth, social development and job creation.

It is highlighted that technology transfer processes are supported by entrepreneurship in technology-based companies. New technology companies have a key role to play in building connections between science and business environment. Against this background, governments need to launch programs to encourage the development of public research and stimulate innovation.

The US Competitiveness Council (1998) was of the opinion that nations which stimulate and create infrastructures that connect companies, universities and governments gain competitive advantage due to the rapid dissemination of information and the development of innovative products.

For these reasons, the promotion of "knowledge transfer" has become a central topic of public and economic policies.

The contemporary literature (e.g. Holland G., 1999) more and more highlights the potential for increased collaboration between industry and universities. In the Open Innovation approach, the development of business value is explicitly based on the assumption that universities are a vital source for accessing external ideas. Universities are a great resource that is not sufficiently exploited, but that can contribute to the creation of wealth and economic competitiveness.

The transfer of publicly produced knowledge for its private exploitation has, over time, led universities and other public sector research organizations to gain a great deal of experience and develop practices that facilitate this process. Thus, public sector research organizations have developed policies and processes for the discovery, protection and exploitation of intellectual property rights. This ensures that intellectual property is successfully transferred to private companies or is invested in new companies set up for the purpose of its exploitation. Intellectual property produced by public sector research organizations is marketed through licensing, joint venture, royalty-based assignments and the formation of new companies.

The capacities and motivation of entrepreneurs support entrepreneurial research, but there are contextual factors that can generate and support entrepreneurial activity. The stimulation of entrepreneurial activity is achieved by four factors:

- the availability of financial support,
- the regional production of knowledge,
- the influence of the local universities, and
- the presence of industrial groups pursuing similar objectives.

There are also a number of factors that influence the environment of small businesses, especially family businesses: opportunities to rapidly adopt and change technology platforms and systems that encourage entrepreneurial thinking and initiative, and the potential for human and social capital development.

In today's business, knowledge transfer programs are accelerating for several reasons. The first reason is the need for organizations to capture the knowledge of long-time employees and transfer it to younger employees. Another reason is the emergence and widespread use of digital technologies that are used to collect, store and provide important information.

The task of developing and managing the knowledge transfer activities within the organizations is the responsibility of the training departments. They need to formalize knowledge management processes, which create repositories of knowledge that can store useful information and allow easy retrieval.

A wide variety of tools and methods are used through which an efficient transfer of knowledge is achieved. These include peer-to-peer training, team training activities such as mentoring networks, work shadowing and coaching. Other very popular activities based on technology and supported by mobile devices are collaborative social networks: video presentations, chat, forum, intranet blog posts.

Types of knowledge

The contemporary post-industrial society is characterized and dominated by knowledge, and knowledge workers are indispensable in organizations. The entire activity carried out daily in companies is based on knowledge. For this reason, identifying and knowing the types of knowledge needed within an organization can allow us to encourage internal compartmental structures that facilitate and support learning in all organizational areas.

Types of knowledge can be categorized as: embrained, embodied, encultured, embedded and encoded (Blackler, 1995). An important aspect to mention is that these types of knowledge do not only refer to knowledge-based organizations, they can be indicative for any type of organization.

Conceptual skills and cognitive skills are what determine ***embrained knowledge***. This type of knowledge is practical, at a high level, in which the objectives are met through recognition and perpetual renewal. This category also includes tacit knowledge, even if it is mainly subconscious.

Contextual practices and action orientation generate ***embodied knowledge***. Being more of a social acquisition, this type of unexplained knowledge is created by the way individuals interact and interpret their environment.

The process of achieving shared understandings through socialization and acculturation generates ***encultured knowledge***. The relationships between roles, technologies, formal procedures and emerging routines within a complex system generate ***embedded knowledge***. It is explicit and is found in systematic routines.

The information that is transmitted with signs and symbols (databases, manuals, books, etc.) forms ***encoded knowledge***. It is decontextualized in codes of practice, it deals more with the transmission, storage and interrogation of knowledge and does not constitute a specific type of knowledge.

Common approaches to knowledge transfer

Knowledge transfer consists in the dissemination of knowledge from one individual to another, from one work formation to another or between organizations. The information that exists in an individual's mind forms knowledge. Knowledge transfer is imperfect because translating knowledge into words or visualization can be difficult.

The common approaches to knowledge transfer are as follows:

- ***Mentoring*** – involves guidance and transfer of knowledge, skills and cultural capital in a given field, through a relationship established over a period of time between an experienced person and a less experienced person.

- ***Training*** – is a form of education that aims to transfer the applicable knowledge and skills between an instructor and a group of professionally trained people. For example, an expert in management systems who develops and provides training in quality assurance for all employees of a company.

- ***Coaching*** – is a partnership with clients in a creative process of challenging awareness that inspires them to value their personal and professional potential at the highest level. Coaching is a modern approach to the development of personal and business performance, the effectiveness of which has become evident in recent decades. Its growth rate worldwide has recently been surpassed only by that of the IT sector. For example, coaching provided by a customer service coach specializing in the hotel industry who evaluates the performance and results of employees who work with customers and gives them recommendations that orient and improve their work.

- ***Mastery training*** – is an approach to education and training in which a participant is given all the skills required at a certain level of instruction, before moving on to training with more advanced skills. For example, a production team consists of 6 members, and each position they work on needs different skills. Each member of the team is trained for each of the roles, in turn, and the rotation is done when the current roles are mastered.

- ***On the job training*** – it is a process of learning skills, a role or a trade, by practicing them in a workplace under the supervision and guidance of a trainer. For example, a person who is going on a 6-month leave can train another employee at work before leaving for assistance for one month.

- ***Presentations*** – are information exchange sessions, scheduled during the day, which include learning sequences and breaks, and which allow teams to exchange information with each other on topics of interest. Presentations may contain readable information and attractive visual information that is easy to remember.

- ***Documentation*** – it consists of transmitting knowledge in the form of text, media and visualizations. It is an essential element of knowledge transfer because the documentation is stored over time and can be used by several sets of employees. However, it is difficult to assimilate more types of knowledge by going through documentation that is the main source of knowledge for employees. Documentation may also not be clear enough or not used because employees do not use it when needed. For example, using a complete documentation an employee can reconstruct a process from scratch that was previously optimized at considerable costs and fully documented, without having been used for a long time.

- ***Redistribution*** – knowledge is in the minds of employees, and an effective way to transfer knowledge between jobs, teams or organizations is to transfer employees who possess the necessary knowledge. For example, a marketing team is prospecting for new modern technologies to explore markets. To help solve this problem, an expert in consumer psychology agrees to be transferred to the marketing team as a prospect. This individual helps to transfer technical skills to the marketing team by acquiring skills related to product sales such as collecting customer requirements.

The efficiency of the technology transfer process is manifested through a virtuous circle in which the successful technology transfer and the resulting innovation lead to the improvement of technology absorption capacities. An important component in the dynamization of this circle is the regional or national innovation systems. Through perseverance, policy coordination and integration, national innovation systems can be built that have both domestic innovative capacities and absorbing capacities for efficient technology acquisition abroad. This is a complex, long-term effort that requires an appropriate business environment, international investment, financial support and strong links with knowledge and technology providers.

Knowledge transfer in low- and middle-income countries

Knowledge transfer provides mechanisms that can reduce inequalities in public and private outcomes of public sector research organizations. Research on knowledge transfer processes examines how knowledge transfer can better contribute to reducing global economic inequities.

In the context of public-private cooperation promoted by public-sector research organizations, there are substantial complexities that affect the knowledge transfer process. Some of these relate to the existence and functioning of organizations in low-resource environments, such as low levels of infrastructure and lack of qualified human resources, financial and technical resources. There are also complexities that build on existing structural inequities. These refer to the historical influence of high-income countries in the field of economy and global development but also to the formulation of sectoral policies in the research agenda and on how research results are used.

Contextualizing strategies for technology transfer in low-and middle-income countries

The use of research results to influence the development of economic development policies is complex, and this process is influenced by many factors. In low- and middle-income countries there are particular factors that contribute to this complexity, including issues related to power structures and capacity discussed above. It is important that the technology transfer strategies applied by low-and middle-income countries are adapted to the cultural, political and economic decision-making context in which this transfer takes place (Siron, 2015).

There are many models of technology transfer that are described in the literature (Moat, 2014). However, most models have been developed in high-income countries and are therefore likely to have limited applicability in the context of low-and middle-income countries. The aspects that reduce applicability of technology transfer models in low-and middle-income countries are generally associated with a lack of awareness, knowledge and clarity of knowledge transfer techniques. Despite these shortcomings, there have been attempts to adopt and use specific knowledge transfer techniques in low- and middle-income countries, often through partnerships.

The literature describes some techniques, such as: knowledge transfer platforms, formal knowledge networks, integrated knowledge transfer, systematic reviews, rapid response mechanisms, evidence briefs and deliberative dialogues, social knowledge management and employment of knowledge brokers (Hamel & Schrecker, 2011). The success of these techniques is conditioned by a number of common features that require strong training, capacity building, taking into account the political, cultural and economic context but also encouraging an atmosphere of collaboration between sectors and between researchers and decision makers.

The factors that facilitate knowledge transfer in low-and middle-income countries are the partnerships between researchers and decision-makers, the characteristics of the research itself, as well as the institutional strengthening for knowledge transfer.

Increasing knowledge transfer capacity in low- and middle-income countries requires institutional strengthening and development of both policymaking and research systems, in order to promote evidence-based policies.

In many cases, existing capacity building in these areas is not a systemized, but rather an ad hoc process targeted at individuals rather than organisations. Institutional strengthening of policy-making systems requires legitimacy and regulatory support, as well as the provision of resources for infrastructure. It also requires a good level of critical research skills, knowledge management skills and skills in leading knowledge transfer processes, based on a good understanding of the organisation's capacity for research use.

A major advantage for knowledge transfer is the partnerships between researchers and decision makers, including formal and informal knowledge networks, as well as personal relationships. Institutional platforms that allow researchers, policy makers and other stakeholders to communicate with each other lead to enhanced understanding of each other's processes and challenges. These platforms can be represented as formal networks, virtual networks, events, websites or separate entities with its own office. Maintaining long-term links between organizations facilitates the continuous exchange of information, which allows the capacity building of both providers and users of evidence.

There are a number of strategies that allow the processes optimization for adoption of research results by entrepreneurs. The main features of the research that lead to the increase of their adoption by decision makers refer to high quality, timely, contextualized evidence that provides economically viable solutions for economy needs, and if possible, provided by local researchers with high credibility. The production of research results with these characteristics is facilitated by collaborations between researchers and decision makers. Research that is in line with the economic agenda can have significant effects.

Contextualizing knowledge transfer in low-and middle-income countries can be facilitated by monitoring and evaluating knowledge transfer processes. But there is a lack of structures to carry out these activities, as discussed in the works of many researchers (e.g. Siron S., Orem J.N., Welcj V.).

There is a need to develop sound evaluation frameworks, systems and tools for knowledge transfer in low-and middle-income countries that allow for the evaluation of the results and impact of knowledge transfer activities on behavioural changes of decision makers and the structural impact on innovation systems.

Knowledge transfer is influenced by both the nature of knowledge and the context in which these processes occur and, therefore, these factors must be identified and evaluated.

By influencing and acting on these contextual factors, it is possible to reach conceptual and strategic ways that allow changes in knowledge and understanding as well as changes in perception, attitudes and beliefs.

Further reading and learning material

1. Organizational Learning: Creating, Retaining and Transferring Knowledge by Linda Argote. URL: https://books.google.ro/books?hl=en&lr=&id=lr01J_ISmesC&oi=fnd&pg=PR5&ots=vpr_gHdpDn&sig=_Mh6fohlPXAa31S78my-8Uoxwks&redir_esc=y#v=onepage&q&f=false
2. 8 Types of Knowledge Transfer posted by John Spacey. URL: https://simplicable.com/new/knowledge-transfer
3. Transfer of Technology and knowledge sharing for development: Science, Technology and Innovation issues for developing countries, United Nations Conference on Trade and Development. URL: https://unctad.org/en
4. What is knowledge transfer? University of Cambridge. URL: https://www.cam.ac.uk/research/news/what-is-knowledge-transfer

Summary of key points

- Knowledge transfer refers to a very broad range of activities to support mutually beneficial collaborations between universities, businesses and the public sector;
- It presents the systematic process of sharing knowledge and learning from the experience of others;

- Knowledge transfer is the transmission of practical or theoretical knowledge, apprehended in the academic environment, to the entrepreneurial context with the objectives of improving production techniques and augmenting monetary returns.

Self-assessment test

Q1: What is knowledge transfer?

1. A very broad range of activities to support mutually beneficial collaborations between universities, businesses and the public sector
2. A very broad range of activities to prevent mutually beneficial collaborations between universities, businesses and the public sector
3. The transfer of tangible and intellectual property, expertise, learning and skills between academia and the non-academic community
4. A way of gaining new perspectives on possible directions and approaches for research.
5. The dissemination of knowledge from one organization, team or individual to another

Q2: How Knowledge transfer takes place between public and private domains?

1. By peer-to-peer and team training activities such as mentor networks, coaching, and work shadowing
2. By media
3. By meetings
4. By technology-based activities such as video captured presentations, social and collaborative tools such as chat, forum, intranet blog postings and mobile devices
5. By licensing, joint venture, new company formation

Q3: What are the types of Knowledge transfer?

1. Embrained knowledge
2. Technological knowledge
3. Embedded knowledge
4. Encoded knowledge
5. Science knowledge

Q4: What is the role of Knowledge transfer in Low- and Medium-Income Countries?

1. It is a mechanism by which the inequities in public and private outcomes for LMICs can be increased
2. It is a mechanism by which the inequities in public and private outcomes for LMICs can be reduced
3. Allows an institutional weakening of both research and policymaking systems in order to promote a greater use of evidence in policymaking
4. Allows an institutional strengthening of both research and policymaking systems in order to promote a greater use of evidence in policymaking

5. Allows the development of LMICs countries

Q5: What are the ways to disseminate knowledge from one organization, team or individual to another?

1. Mentoring
2. Discussions
3. Coaching
4. Training
5. Presentations

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Glossary

Knowledge transfer	A very broad range of activities to support mutually beneficial collaborations between universities, businesses and the public sector.
Embrained knowledge	is that which is dependent on conceptual skills and cognitive abilities. We could consider this to be practical, high-level knowledge, where objectives are met through perpetual recognition and revamping. Tacit knowledge may also be embrained, even though it is mainly subconscious.
Embodied knowledge	is action oriented and consists of contextual practices. It is more of a social acquisition, as how individuals interact in and interpret their environment creates this non-explicit type of knowledge.
Encultured knowledge	is the process of achieving shared understandings through socialization and acculturation. Language and negotiation become the discourse of this type of knowledge in an enterprise.
Embedded knowledge	is explicit and resides within systematic routines. It relates to the relationships between roles, technologies, formal procedures and emergent routines within a complex system.
Encoded knowledge	is information that is conveyed in signs and symbols (books, manuals, data bases, etc.) and decontextualized into codes of practice. Rather than being a specific type of knowledge, it deals more with the transmission, storage and interrogation of knowledge.

Mentoring	A relationship between an experienced person and a less experienced person in a particular domain over a sustained period of time that involves guidance and the transfer of knowledge, skills and cultural capital.
Coaching	is a type of leadership that is accountable for the performance of a team or individual. This is a common way to transfer tacit knowledge such as leadership skills, interpersonal skills or physical abilities. For example, a customer service coach who is involved in the day-to-day operations of a hotel to provide direction, knowledge of performance and knowledge of results to customer-facing employees.
Training	Education aimed at transferring applicable knowledge and skills. For example, an information security expert who develops and provides defensive computing training for all employees of a firm.
Open Educational Resources (OER)	Are teaching, learning and research materials in any medium – digital or otherwise – that reside in the public domain or have been released under an open license that permits no-cost access, use, adaptation and redistribution by others with no or limited restrictions.
Low-and middle-income countries (LMCI)	For the current 2019 fiscal year, low-income economies are defined as those with a GNI per capita, calculated using the World Bank Atlas method, of $3,895 or less; middle-income economies are those with a GNI per capita between $3,896 and $12,055; high-income economies are those with a GNI per capita of $12,056 or more. https://iamcr.org/income https://datahelpdesk.worldbank.org/knowledgebase/articles/906519

Lecture 7.

Technological learning, technological catch-up, technological leapfrogging

Annotation

Innovation plays a pivotal role to address urgent developmental challenges necessary to increase wellbeing, as fully demonstrated by the experience of successful developing and emerging countries. In fact, while they help to drive economic growth, growth-enhancing innovations can also address socio-economic challenges such as poverty (OECD, 2012). In that, technology represents a key tool to boost economic growth and plays a central role in meeting social welfare related goals that are not fully captured by standard economic measures (such as GDP), including health, education, gender equality, environmental and climate change challenges, that will be increasingly relevant in the near future (World Bank, 2008). In the framework of speedy spread of technologies between and within countries, developing countries are narrowing the technological gap that separates them from high-income countries. Nevertheless, the technology divide remains large and for some countries, including several low-income countries, it is widening rather than closing (World Bank, 2008). This lecture discusses the processes of technological learning, technological catch-up and technological leapfrogging and their effects on bridging technological gap between developed and developing countries.

Key words

Technological learning, technological catch-up, technological leapfrogging

Learning outcomes

- Ability to describe the process of technological learning and relate the models of national learning dynamics to the context of low- and middle-income countries
- Ability to define the processes of technological catch-up and leapfrogging, and explain key factors supporting their realization

Structure of the learning content

- Technological learning
- Technological catch-up
- Technological leapfrogging

Learning content

Technological learning

The extent to which radical global change is both creating and foreclosing opportunities for poorer developing countries to facilitate the accumulation of technological capabilities represents a major issue facing the world economic system (Juma & Clark, 2002). Skills and technology interact, and this relationship represents a key reason for the large observed differences in productivity and income level. Technology represents a key tool to boost economic growth and plays a central role in meeting social welfare. Technological gap among countries in the world is decreasing. Nevertheless, the technology divide remains large and for some countries, including several low-income countries, it is widening rather than closing.

Efficient policies aimed at increasing the level of national human capital and pushing the private sector to the technological frontier represent a foundation for technology-driven increase in living standards. While some countries, as for example the United States, the European and the East Asian countries, rapidly engage in the process, many low- and middle-income countries proceed much more slowly (De Ferranti et al., 2003). The technological progress and its rate of spread throughout the economy is mainly determined by the capability to effectively adopt, adapt, and successfully apply existing technologies.

Firms' and countries' inventive activity strongly depends on innovation opportunity and appropriability of technology (i.e. the quality of being imitable and reproducible) that act as principal industry-level determinants of inventive activity (Cohen & Levin, 1989).

Innovation is crucial at all stages of development. However, at different stages of development different types of innovation play critical roles. In earlier stages, incremental innovation and social innovation are important. Incremental innovation is associated with the adoption of foreign technology, and social innovation – with improving the effectiveness of public services. In later stages, innovation based on high-technology and R&D is the factor of competitiveness (OECD, 2012).

The importance of sectoral, national and international networks for innovation arises not exclusively from the existing links between education and technology, but also from the effectiveness of institutions and organizations as well as from the existing level of informational asymmetries that characterize the process of knowledge creation, diffusion and absorption (De Ferranti et al., 2003).

In this framework, the capacity to recognize, assimilate, and exploit information is substantial in determining the capacity of assimilation of external knowledge. The capability to learn the socioeconomic success of countries depends on the extent to which the country is exposed to foreign technologies and the ability of the domestic economy to absorb and adapt the technologies to which it is exposed (World Bank, 2008).

Nevertheless, the process of technology absorption is also affected by virtuous circles determined by the existence of scale economies in particular in technologically sophisticated sectors and in learning by doing. Consequently, gaps in technological achievement can lead to divergence if the conditions for technology adoption in developing countries are insufficient (World Bank, 2008).

In that, the learning process should happen at all levels of national economies, involving all main actors and allow countries as a whole to absorb and disseminate existing knowledge as well as generate and process new knowledge. Furthermore, the learning process should involve multidisciplinary aspects, including not only scientific and engineering knowledge, but also economic, managerial, and institutional knowledge that is required for successful use of more technical knowledge (Soubbotina, 2006).

In developed countries, scientific or applied research represents the main basis of technological improvement efforts. In developing countries, technological improvements are mainly determined by imitation and improvement of imported technology. In fact, many developing countries lack the necessary skills and competences to effectively participate in the kind of scientific innovation and invention that occurs at the frontier. As a result, the bulk of technological progress in developing countries develops trough dynamics of absorption and adaptation of pre-existing and new-to-the-market or new-to-the-firm technologies (World Bank, 2008).

In this framework, the notion of indigenous technological innovation capabilities (ITICs), based on "initiation-imitation-improvement-innovation", figures out as fully necessary as in the case of Japan, South Korea, Taiwan (China), Singapore, involving developed as well as developing countries (Park et al., 2011).

In the case of developing low-income countries, incremental innovation based on foreign innovations and technologies needs to be adapted to specific local conditions. In that, the promotion of inclusive innovation enhances the capability to access business opportunities and increase welfare levels (OECD, 2012). The process necessarily involves agents strongly exposed to foreign markets and businesses, as universities and research centres, but also leading private businesses and public and private associations engaged in disseminating knowledge networks (OECD, 2002).

Starting from the differences in countries' access to external sources of technological knowledge, largely rooted in their unequal learning capabilities, on the one hand, and in various international environments faced by concrete countries, on the other, Soubbotina (2006) proposes a useful criterion to define six major models of relatively fast national learning dynamics:

- Traditionalist Slow Science & Technology (S&T) Learning
- Passive FDI-dependent
- Active FDI-dependent

- Autonomous
- Creative-isolated, and
- Creative-cooperative learning.

Traditionalist Slow S&T Learners are countries relying mostly on traditional technologies and characterized by a low level of S&T learning capacity and opportunities. In this case, low international competitiveness can further increase the risk of economic marginalization.

Passive FDI-dependent Learners are represented by countries with low or medium technological learning capabilities. In this case, the exposure to foreign direct investment represents a crucial variable to facilitate learning processes. In general, Passive FDI-dependent learners are not significantly active in promoting efforts to foster local absorption and dissemination of foreign knowledge. Soubbotina (2006) stresses that in case of countries endowed with a very low endogenous capabilities and/or low attractiveness for foreign investors, this learning model may not be.

Active FDI-dependent Learners are represented by countries that actively facilitate and promote national S&T learning from various opportunities provided by FDI, despite of the existence of a government expressed interest or approved strategy in the innovation policy. In this case, the existence of favourable negotiating positions that, for example, allow countries to be sufficiently attractive for foreign investors, may be relevant.

Autonomous Learners are countries that succeed in active learning from foreign sources but take advantage of learning strategies that allow a not-heavy dependence from FDI, e.g. active learning from open-source S&T publications, hiring foreign consultants and managers, etc. In this case, it is necessary to be endowed with advanced endogenous S&T capacity.

Creative-isolated Learners represent countries characterized by relatively high S&T capabilities, domestically producing most of the needed S&T knowledge. The category may characterize politically isolated countries, even in their transitional phase.

Creative-cooperative Learners are countries acting as technological leaders endowed with the highest levels of accumulated human capital. In this case, the learning process takes advantage of both new knowledge generation by domestic R&D and international S&T cooperation.

At firm level, acquired knowledge is determined by endogenous, mainly internal R&D activity and external factors.

Internally generated knowledge is usually formal knowledge, i.e. it is based on documents, methodologies, tools and on scientific communication strategies that are coded and can be transferred, via scientific conferences, for example. In that, licenses represent a coded knowledge sources able to identify innovation capability and turn into a commercial application of knowledge.

In this framework, knowledge creation process from R&D activity is complemented by the so-called informal R&D activities represented by the activity belonging to different sectors of the value chain, e.g. logistics and marketing sectors.

Firms characterized by insufficient level of internal R&D, mainly small and medium-sized enterprises, should necessarily take advantage of external sources of knowledge as represented by their contractors and suppliers, in particular if the last are represented by larger organizations. In this case, the knowledge can be either embodied in capital and intermediate goods that are used in the productive process, or disembodied in licenses.

A different channel of knowledge transfer is the reverse engineering determined by import processes of high-level knowledge intensity goods and the technological transfer promoted by cooperation agreement with other firms or research centres and universities (see Figure 7.1).

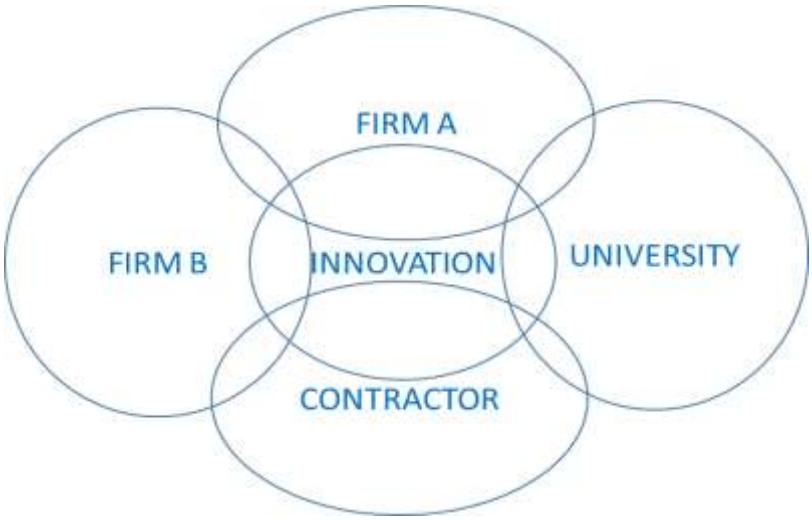

Figure 7.1 *Integrated model of innovation creation*
(source: Fariselli, 2014)

At firm level, it is also possible to distinguish between internal and external learning processes that can be defined as sources of knowledge. ***Internal learning mechanisms*** are represented by internalization processes of the knowledge generated by the internal formal and informal R&D activity, mentioned before. Differently, ***external learning mechanisms*** usually refer to knowledge generating processes belonging to other firms, research centres, etc. (Table 7.1).

Type of learning mechanisms	
External learning mechanisms	Hiring of expertise
	Local education and training programmes
	International education and training programmes

	Organizational arrangements for external knowledge acquisition
	Learning from technical assistance and specialized consulting firms
	Acquisition of codified knowledge as a basis for different innovative activities
	Training with local and foreign suppliers
	Knowledge-based interaction with leading users
	R&D-based interaction with competitors
	R&D-based interaction with local universities and research institutes
	R&D-based interaction with international universities and research institutes
Internal learning mechanism	Various kinds of training to acquire and disseminate innovation related-skills
	Knowledge articulation and various kind of intra-firm communication
	Knowledge sharing and various forms of knowledge acquisition within the firm
	Knowledge codification and related organizational arrangements

Table 7.1 *External learning mechanisms*
(Source: Figuereido et al., 2013)

Technological catch-up

As in De Ferranti, et al. (2003) and also mentioned before, the linkages between universities and private sector firms represent a fundamental tool to promote innovation and technological improvement even at early stages of technological catch-up. In fact, at this stage, universities and research institutions (mostly public institutions) generally represent the main actors of scientific research and dissemination of technological knowledge. As a consequence, their role is significant to support firms and the country system as a whole to successfully engage in the adoption and adaptations of (foreign) technologies, together with supportive policy measures to effectively develop innovation capacity in national industries (OECD, 2012).

The notion of catching-up commonly indicates the ability of a country/economy to reduce income and productivity gaps with leading countries/economies. In that, intuitively, the lager the existing gap, the higher the potential for backward countries/economies to make a large leap, engaging in a faster growth pattern than leaders, benefiting from international technological spill overs.

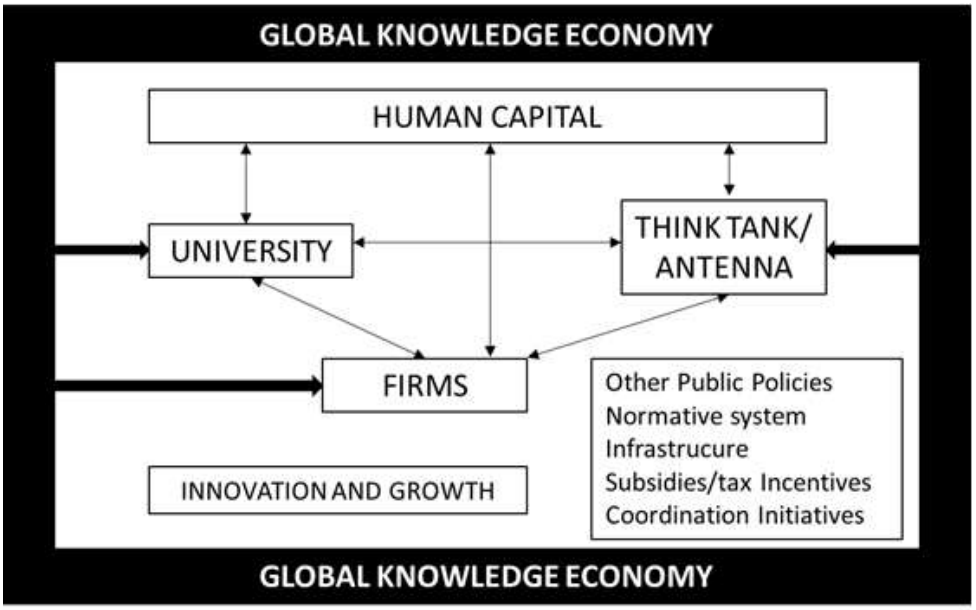

Figure 7.2 *Global Innovation System: The innovation cluster*
(Source: De Ferranti, et al., 2003)

Coherently with highlighted elements of technological learning, nevertheless, the catching-up process cannot be viewed exclusively in terms of a linear process, merely consisting in passive copying and adoption of new technologies. In fact, the catch-up process strongly depends on the ability of countries to promote the development of technological congruent systems with leaders, including successful social capabilities, i.e. market dynamics, availability of inputs as well as adequate educational structures and institutions supporting technological capabilities.

Empirical evidence shows that while some newly industrialized countries, as Korea and Taiwan, have achieved high levels of rapid economic growth, an equally effective catch-up process is not recorded in many other parts of the world, despite of huge flows of development aid and promotion of policy changes (Lee, 2005). Lee and Lim (2001) identify three patterns of catching-up that can also mix among them and create further paths:

- The first pattern is the so-called ***path-following catching-up***. It foresees latecomer industries following the same path as taken by the forerunners, but in a shorter period than the latter.
- The second pattern is called ***stage-skipping catching-up***, which means that while following the path experienced by the forerunners, latecomers' industries skip some stages and, as a result, save time.
- The third catching-up model is called ***path-creating catching-up***. It predicts latecomer industries exploring their own path of technological development (the new different paths of development are labelled as C* and D* in the Fig. 7.3 below). The authors argue that usually this last type of process can happen when latecomers, after having followed the path of the forerunners, turn into and create a new path (Lee and Lim, 2001).

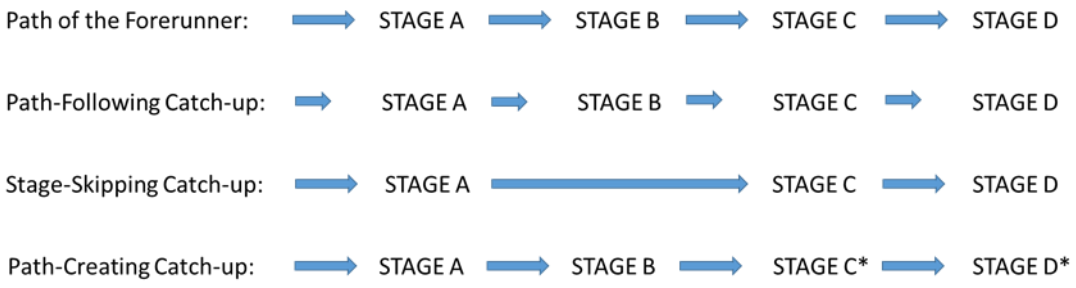

Figure 7.3 *Patterns of Catching-up*
(Source: Lee and Lim, 2001).

It is possible to identify several key aspects as main ***sources of technological catch-up***.

- ***The overall national policy towards technology*** plays a pivotal role in promoting catching up processes together with the institutional setting and the adopted policies' implementation strategies, as experienced in South Asia (Juma and Clark, 2002). The South Asian countries, in particular, showed the possibility to push economic development in conditions of shared growth characterized by capital formation oriented policies. In this framework, the creation of institutions and institutional arrangements that facilitate the economic development trend and the catching-up process result to be essential. The effectiveness of such created institutions is found out to be strongly affected by the existence of adequate policies that facilitate their interaction and cooperation. As Juma and Clark argue at a technical level, institutional cooperation represents a fundamental condition for creation of a successful national system of innovation.

- ***Human resources development*** constitutes a critical aspect of economic transformation with evidence in developing countries of strong relationships between investments in education and transformation of the economic system as a whole. Characteristics of the investments in education and their positive effects on economic dynamics dramatically depend on the initial development conditions. In developed countries the most successful educational policies target training in technical subjects, while poor countries mostly focus on primary education. Nevertheless, the overall prospects for catch-up for developing countries will finally depend on their capability to balance between primary education for all and higher education, pushing the enhancement of knowledge in strategic technical subjects, e.g. technical tertiary education (Juma and Clark, 2002).

- ***The robustness and diversity of a national innovation system*** is important to facilitate accumulation of technological capability enhancing the creation of a context in which knowledge is created, transmitted and turned into innovative products and processes (Juma and Clark, 2002). National innovation systems are defined as the set of organizations (firms, universities, public laboratories, etc.) and their linkages through which innovation processes develop. In developing countries, the public sector is

strongly involved in the industrial development, sometimes at the expense of the private sector. Policies that fail to recognize the central role of industries and firms in the industrial learning process cannot be effective in the promotion of technology rapid accumulation (Juma and Clark, 2002). Furthermore, innovation systems in developing countries are generally poorly constructed and fragmented: a large number of micro-enterprises operate in the informal economy, and foreign-based firms tend to be disconnected from the rest of the economy.

- ***International trade policies and direct foreign aids*** affect technological development. Outward policies can positively affect catching-up processes, pushing the importation of foreign technology, even though the role of state interventions will continue to be essential to promote technological innovation in the poorest countries.

Technological leapfrogging

Following the leapfrogging notion, countries and industries lying in the state of relative underdevelopment have the preconditions and the opportunity to move to an advanced industrial and technological state, in a relatively short span of time. In this case, development dynamics allow countries to skip inferior, less efficient and more expensive technologies and industries to move directly to more advanced ones.

Even though leapfrogging may appear as an attractive option for latecomers' economies and industries, it may not provide the intended results in all circumstances. In fact, as in the case of ICT, the successful use of new technology needs to overcome the passive adoption of advanced standard products (developed by industrialised countries) for immediate application. But it needs to go towards the application of implied knowledge regarding the organisation and management of the technology and its application to the contextual environment, in which it is to be used (Davison et al., 2000).

The case of the IT knowledge is straightforward. The above-mentioned implied knowledge is represented by the knowledge accumulated throughout the deployment of previous technology: the lack of these earlier experiences may inhibit the accumulation of the necessary knowledge required to successfully exploit new technologies (ibid).

It is possible to extend the model defined by Fong (2009) to the ICT framework to identify factors relevant to conditions for technological leapfrogging in a more general fashion (Table 7.2).

Factors	Examples of issues
Market conditions (Market demand + Market competition)	Adequate market competition for rational pricing of new products/services Adaptation of new products/services to relevant local conditions

	Foreign participation through investment to avoid monopoly structure
Institutional capacity	Promotion of human capital development Development of a stable learning and attractive investment environment Improvement of environment security and stability Establishment of an enabling regulatory and legislative framework Promotion of socioeconomic and political stability
Social	Promotion of equal access to new products/services Reduction of inequality levels in access to new products/services
Human capabilities	Increase of literacy levels Increase of technological skills and knowledge Increase of the level of investment in human capital
Government	Development of a strategic political agenda Coordination of stakeholders' cooperation and interaction
Stakeholders	Development of cooperation at regional, national and international level Improvement of stakeholders' cooperation and interaction
Utility infrastructures	Improvement of necessary infrastructures

Table 7.2 *Factors relevant to conditions for technological leapfrogging*
(Source: Fong, 2009)

Further reading

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Summary of key points

- Skills and technology interact and this relationship represents a key reason for the large observed differences in productivity and income level.
- The technological progress and its rate of spread throughout the economy is mainly determined by the capability to effectively adopt, adapt, and successfully apply existing technologies.
- The importance of sectoral, national and international networks for innovation arises not exclusively from the existing links between education and technology, but also from the effectiveness of institutions and organizations as well as from the existing level of informational asymmetries that characterize the process of knowledge creation, diffusion and absorption.
- The capability to learn affects the socioeconomic success of countries; it depends on the extent to which the country is exposed to foreign technologies and the ability of the domestic economy to absorb and adapt the technologies to which it is exposed.
- The learning process should happen at all levels of national economies, involving all main actors and allow countries as a whole to absorb and disseminate existing knowledge as well as generate and process new knowledge. Furthermore, the learning process should involve multidisciplinary aspects, including not only scientific and engineering knowledge, but also economic, managerial, and institutional knowledge that is required for successful use of more technical knowledge.
- External learning mechanisms usually refer to knowledge generating processes belonging to other firms, research centers, etc.

- The notion of catching-up commonly indicates the ability of a country/economy to reduce income and productivity gaps with leading countries/economies.
- The catching-up process cannot be viewed exclusively in terms of a linear process, merely consisting in passive copying and adoption of new technologies.
- Lee and Lim (2001) identify three patterns of catching-up that can also mix among them and create further paths. It is possible to identify several key aspects as main sources of technological catch-up.
- It is possible to extent the model defined by Fong (2009) to the ITC framework, to identify factors relevant to conditions for technological leapfrogging in a more general fashion (Table 7.2).

Self-assessment test

Please, answer the questions below choosing the most suitable / the most precise answer.

Q1: What does the technological progress and the rate of its spread throughout the economy in LMIC depend on?

1. Exposure of the economy to foreign technology.
2. Capability of the economy to adopt existing technologies.
3. Capability of the economy to adapt existing technologies.
4. Capability of the economy to successfully apply existing technologies.
5. All mentioned above.

Q2: What characterizes the national learning dynamics called "Autonomous Learning" (Soubbotina, 2006)?

1. Exclusive reliance on traditional technologies.
2. Passive local absorption and dissemination of foreign knowledge.
3. Active promotion of national science and technology learning from various opportunities provided by FDI.
4. Active learning from foreign knowledge that is not highly dependent upon FDI (e.g. learning from open-source S&T publications).
5. Domestic production of most of the needed science and technology knowledge.

Q3: What does the notion of catching-up commonly indicate?

1. The notion of catching-up commonly indicates the ability of a country/economy to increase income and productivity gaps with leading countries/economies.
2. The notion of catching-up commonly indicates the ability of a country/economy to modify income and productivity gaps with leading countries/economies.
3. The notion of catching-up commonly indicates the ability of a country/economy to reduce income and productivity gaps with leading countries/economies.
4. The notion of catching-up is related to the e-learning for countries/economies.

5. The notion of catching-up is related to the innovation technologies

Q4: What are the main sources of technological catch-up?

1. The overall national research towards technology
   Human resources development
   The robustness and diversity of a national innovation system
   National trade policies and direct foreign aids
2. The overall national policy towards technology
   Human resources development
   The lack of a national innovation system
   International trade policies and direct foreign aids
3. The overall national policy towards car technology
   Technologies development
   The robustness and diversity of a national innovation system
   Municipality trade policies and direct foreign aids
4. The overall national policy towards health care
   Technologies resources development
   The robustness and diversity of a national innovation system
   International trade policies and direct foreign aids
5. The overall national policy towards technology
   Human resources development
   The robustness and diversity of a national innovation system
   International trade policies and direct foreign aids

Q5: IT knowledge

1. IT knowledge is represented by the knowledge accumulated throughout the deployment of previous technology: the lack of these earlier experiences may inhibit the accumulation of the necessary knowledge required to successfully exploit new technologies
2. IT knowledge is represented by the accumulation of the necessary knowledge required to successfully exploit new technologies
3. IT knowledge is represented by the knowledge accumulated throughout the deployment of previous technology
4. IT knowledge is not important for country development
5. IT knowledge is linked only to the universities

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Glossary

Traditionalist Slow S&T Learning	countries relying mostly on traditional technologies and characterized by a low level of S&T learning capacity and opportunities
Passive FDI-dependent,	are represented by countries with low or medium technological learning capabilities.
Autonomous	are countries succeeding in active learning from foreign sources but that take advantage of learning strategies that allow a not-heady dependence from FDI
Creative-isolated learners	represent countries characterized by relatively high S&T capabilities, domestically producing most of the needed S&T knowledge
Creative-cooperative learners	countries acting as technological leaders endowed with the highest levels of accumulated human capital.
Informal R&D activities	represented by the activity belonging to different sectors of the value chain, e.g. logistics and marketing sectors.
Catching-up	commonly indicates the ability of a country/economy to reduce income and productivity gaps with leading countries/economies.
Catch-up process	strongly depends on the ability of countries to promote the development of technological congruent systems with leaders, including successful social capabilities,
Technological catch-up	• The overall national policy towards technology • Human resources development • The robustness and diversity of a national innovation system • International trade policies and direct foreign aids
IT knowledge	Information technologies knowledge

Lecture 8.

Innovations exploitation and management

Annotation

Innovation is usually referred to as the process of creation of better and more effective products, services, technologies, ideas, etc. In order to turn the innovative ideas into valuable economic and/or social results, three distinctive steps can be defined: conception, exploration, and exploitation. The conception stage is the first and starting line for new ideas. Successful idea generation should be fuelled by both the freedom to explore and the pressure to compete. Once a new idea has been generated, it travels to a different logical or physical location, a process known as mobilization. Since most innovators are not necessarily marketers, a new idea would certainly need someone other than the originator to move it along. This is a critical process in the progression of new ideas.

The second stage is the exploration one. It is the stage of advocacy and screening, and experimentation where pros and cons of any new idea is critically considered. Advocacy and screening have therefore to take place more or less at the same time to eliminate ideas that lack potential. Experimentation on the other hand allows the new idea to be tested for suitability for a particular entity, in a particular context at a given time. It is at this stage that we determine the would-be customer and the relevance of the innovation to him or her. This process gives the innovator the opportunity to realize that, even though an idea might be great, it could be ahead of its time or just not right for a particular market.

The last step is that of exploitation. This step allows the materialization of the original idea into a successful business step, utilizing the findings of the conception and exploration steps. This stage is also referred to as commercialization stage, where an organization looks to its customers to verify if the innovation really solves their problem(s). At this stage it would also be important to look at how the new idea would gain final acceptance within the organization, and put in place structures, systems and resources needed to produce the final product/service/technology so as to ensure its competitiveness.

This process is not a straightforward and linear one. In order for the exploitation step to be successful, the industry/country system has to be endowed with adequate political, social and economic settings. Despite some cases of innovation-targeted policies, low- and middle-income countries still face important limitations that hinder full development of innovation processes, thus reducing not only the exploitation of innovations but the development of innovation itself.

This lecture proposes a description of the innovation exploitation and exploration processes together with an overview of STI priorities in the East Africa Community Countries, particularly Tanzania, Kenya and Uganda. In addition, the final section provides general information on the management innovation that plays a crucial role in the framework of the development processes and has attracted extensive attention, even though little research has been made into the nature of its implementation, which actually realizes the value of innovation.

Key words

Innovation, Technology exploration, Technology exploitation, Management innovation

Learning outcomes

- Ability to define and characterize the concept of "innovation exploitation", as well as to differentiate it from the concept of "innovation exploration"
- Ability to relate the priorities of the EASTECO Strategic Plan 2017/18 – 2021/22 to the developmental challenges faced by East African countries (Kenya, Tanzania and Uganda)
- Ability to argue for the importance of management innovation for exploration and exploitation of S&T innovations

Structure of the learning content

- Innovation exploration and innovation exploitation
- General dimensions of innovation exploitation
- The East African Science and Technology Commission (EASTECO) Strategic Plan 2017/18 – 2021/22
- Management innovation

Learning content

Innovation can be viewed in a number of forms (Ahn et al. 2016; Lee et al. 2010; Hauser et al. 2017; Lin et al. 2017). One type focuses on creative ideas to ***improve products or services***. Severely limiting assumptions characterize this form of innovation as the one that generally belongs to the "building a better mousetrap" way of thinking. In fact, it defines the goal in terms of the solution of a problem (the "how") rather than in terms of what the consumer needs (the "what"), assuming that the only answer to a defined problem has to be found within the technology field of a product/service. While it leads to better things for consumers, it does not alter business models.

A second type is to ***improve processes in the value chain***. This form of innovation leads to better efficiency through increased productivity. While it also provides value to consumers, such as lower price and better product quality, it also does not lead to altered business models. A third type is ***redefining the customer base***, bypassing middle-men organizations by exploring e-customers, global customers, customer communities and even non customers. The last form of innovation is ***strategic, involving new business models***, and has been fostered by companies in different industries.

The convergence revolution is opening new opportunities to create value in different ways than the traditional business thinking. The traditional management strategies emphasize reinforcing or optimizing the existing core competence of the firm as a stand-alone organization. Examples of these strategies include benchmarking, continuous improvement, differentiation, focus, cost leadership, global strategy, and customer-centric management. In this framework, innovation exploitation represents a crucial step while management innovation despite the slow development of research on the issue is critical to the realization of the value of innovation.

Innovation exploration and innovation exploitation

The economic literature distinguishes between exploration and exploitation. March introduced the two terms in 1991 by considering the existing relation between the exploration of new possibilities and the exploitation of old certainties in organizational learning (March, 1991). The author defines ***exploration*** as a concept including "things captured by terms such as search, variation, risk taking, experimentation, flexibility, discovery, and innovation" (March, 1991, p. 71), i.e. identifying exploration as the search for new knowledge, technology, competences, markets or relations. He defines ***exploitation*** as a concept including "such things as refinement, choice, production, efficiency, selection, implementation, and execution" (ibid, p. 71), i.e. identifying exploitation as further development of existing technological innovations. Indeed, Argyres (1996) refers to exploration as technological capability broadening, and exploitation as technological capability. In this framework, while exploration is variation-seeking, risk-taking and experimentation oriented, exploitation is variety-reducing and efficiency oriented (March, 1991).

The two different concepts require different structures, processes, strategies, capabilities and cultures, and may have different impacts on the economic performance of an organization, or in more general terms on an industry/country system. In fact, as in Li et al. (2008), adaptive systems that exclusively engage in exploration, fully excluding exploitation, are not able to effectively benefit from the gain deriving by innovation as they exhibit many undeveloped ideas, while are negatively affected by exploration costs. On the contrary, systems engaging in exploitation while excluding exploration are likely to be trapped in suboptimal stable equilibria. Consequently, in the context of an apparent trade-off, an appropriate balance between exploration, where new invention is developed, and exploitation, where already existing technologies are refined, results to be necessary in order to properly benefit from innovation processes (Li et al., 2008).

In the original definition by March (1991), exploitation was not strictly intended as a knowledge-search process. But, as in many following studies (Ahuja and Lampert, 2001, Benner and Tushman, 2002, Katila and Ahuja, 2002, and Rosenkopf and Nerkar, 2001), exploitation was defined as a process of "local" knowledge search. In that, familiar, mature and current or proximate knowledge facilitates incremental innovation, thus differentiating it from exploration intended as a "distant" knowledge search (i.e., unfamiliar, distant and remote knowledge that allows achieving radical innovations) (Li et al., 2008).

The European Strategy for effective dissemination and exploitation of Horizon 2020 (H2020) - the European Framework Programme for Research an Innovation that aims at increasing the impact of science, technology and innovation effort – clearly outlines the fundamental role of innovation exploitation (and dissemination) (Ala-Mutka, 2017). H2020, with its nearly € 80 billion of funding available over 7 years (2014 to 2020) is the financial instrument implementing the Innovation Union, a Europe 2020 flagship initiative aimed at securing Europe's global competitiveness, promising more breakthroughs, discoveries and world-firsts by taking great ideas from the lab to the market.

The dissemination and the exploitation of research results should foster development processes by increasing the economic and social use of R&I project results and by promoting the availability of scientific evidence in support of policy making to address effectively pressing global challenges.

The two issues are strictly interlinked. In fact, the dissemination, i.e. the public disclosure of the research results by any appropriate means, allows the transfer of knowledge to the ones that can best make use of it and maximizes the impact of research, enabling the value of results to be potentially wider than the original focus. The exploitation processes then ensure the utilization of such results in further research activities, or in developing, creating and marketing a product or process, or in creating and providing a service, or in standardization activities, increasing innovation and development capability.

Figure 8.1 *Innovation exploitation (Source: Ala-Mutka, 2017)*

Despite of the increasing relevance of exploitation and dissemination of research results, there still exist barriers that limit effective spread of knowledge (Ala-Mutka, 2017):

- Dissemination and exploitation are still perceived as not so relevant in terms of research activities,
- Confusion persists among communication, dissemination and exploitation actions,
- Efforts commonly focus on implementing and validating technical objectives instead of aligning work with the needs of users and stakeholders,
- Limited considerations of valuable key results and lack of skills to effectively consider the importance of key results outside the typical community,
- Lack of cooperation and joint discussion.

General dimensions of innovation exploitation

Li et al. (2008) identify ***three different dimensions relevant for knowledge and innovation exploitation***.

- The first dimension is the ***cognitive dimension***. It measures the degree of familiarity between the newly searched knowledge and the existing knowledge. This dimension refers to the content of knowledge and basically depends on the cognitive distance recorded with reference to the adopting firm/industry. The cognitive distance can be recognized by considering either the characteristics of the firm/industry itself (e.g. the innovation belongs to a firm/industry different from the one adopting the innovation), or the level of novelty of the innovation per se (e.g. the innovation does not represent a completely new knowledge/idea but is new for the adopting firm/industry – on the contrary exploration process is recorded) (Li et al., 2008).

- The second dimension is the ***temporal dimension*** and represents the role of time while defining the exploitation process. Temporal exploitation is the creation of new knowledge through searching for recent knowledge and not focusing on knowledge

remote in time (as typical of exploration processes). The main consequence may be a temporal myopia as older knowledge can be valuable in terms of both capabilities to focus on valuable older innovation/knowledge and capability to adopt successfully older technology endowed with the necessary recent complementary knowledge (Li et al., 2008).

- The third dimension consists in the ***geographically defined spatial dimension***. In that, the search for proximate technology (geographically defined) is typical of exploitation defined processes. This is straightforward as it is considered that the existence of a small area of reference increases probability and capacity of transmission, for example facilitating interactions and the development of joint practices (Li et al., 2008).

If technology exploitation is considered, the capability of a country/industry system to provide adequate pro-innovation policies plays a pivotal role (Gill, 2002; De Ferranti et al., 2003). Gill (2002) analyses policy regimes adopted by 10 countries and their characteristics in terms of education and technology innovation related policies. These countries include: 5 Latin American (Brazil, Costa Rica, Chile, Peru and Mexico) and 5 non-Latin American countries (China, Korea, Finland, Spain and Singapore). These countries share, during their development patterns, both similarities and dissimilarities in educational and technological policies.

Empirical results seem to identify ***4 different systems on the basis of capability of policy regimes to boost economic growth*** starting from their capacity to exploit technological knowledge innovation (Gill, 2002; De Ferranti et al., 2003):

- Countries - that neither increase education levels nor institute policies facilitating technology transfer and innovation - experience low productivity growth;
- Countries - that increase average education levels but do not institute policies facilitating technology transfer and innovation - experience low productivity growth, even though, in this case, increase in productivity can be determined by outward policies related to foreign trade, investment and knowledge flows;
- Countries - that, through direct public sector provision, increase average education levels and institute policies facilitating technology transfer and innovation - experience low productivity growth as they can fail in boosting private sector participation in the processes of developing new technologies and delivering education and training;
- Countries - that increase average education levels (strengthening primary and secondary schooling) and institute policies facilitating technology transfer and innovation by boosting active participation of the private sector - can experience higher productivity growth if successful in enhancing R&D and knowledge network at national and international level.

Thus, policy regimes and firms must cooperate and be active in supporting the diffusion of economically relevant technologies and innovations. It means that while firms should be able to profit from the exploitation of new technologies, policies should be supportive, pushing

technology research and dissemination as well as strongly focusing on strategies and actions that are able to assist firms in technology and innovation exploitation.

As argued while discussing learning processes, also in terms of incremental innovation dynamic and valuable foreign sources of technology, the selection, adaptation and improvements of the latter are not mechanical, straightforward processes. They require specific activities and investments to allow full exploitation. Thus, government policy appears to be largely responsible for creating industry environment facilitating competitiveness and supporting the profits determined by the exploitation of new technologies.

The East African Science and Technology Commission (EASTECO) Strategic Plan 2017/18 – 2021/22

The importance of Science, Technology and Innovation (STI) has been widely recognized for the Countries of the East African Community (EAC). The EAC is active to promote a prosperous, competitive, secure and politically united East Africa, aiming at fostering economic, political, social and cultural integration to improve the quality of life of the people of East Africa through increased competitiveness, value added production and enhanced trade and investment (EAC, 2016).

The development strategy promoted by the EAC focuses on the improvement of the global competitiveness of the Community for faster and sustainable economic growth aiming at transforming the area into an industrialized region. As a result, the countries of the EAC implemented actions to integrate Science, Technology and Innovation considerations into a range of policy frameworks, as for example the establishment of the East African Science and Technology Commission (EASTECO) with the objective of promoting regional integration in the development, management and application of STI in the East African Community (EAC, 2016).

EASTECO sets four strategic priorities that will enable partner countries to cooperate on a set of regional activities and interventions in STI:

- Strategic priority 1: ***Support for evidence-based policies***
    1. Development of regional STI policies and framework
    2. Strengthening of the regional STI knowledge management

- Strategic priority 2: ***Promotion of STI knowledge and innovation***
    1. Enhancement of Science, Technology, Engineering and Mathematics (STEM) education
    2. Leveraging of scientific research
    3. Support for innovation and commercialization of technology

- Strategic priority 3: ***Application of STI for socioeconomic development***
    1. Increasing value addition on agriculture
    2. Promotion of technological solutions in energy and environment

3. Enhancement of bio-technological initiatives
4. Support for export-oriented industrial development and trade
5. Information and communication technology as a cross-cutting area

- Strategic priority 4: ***EASTECO foundational commitments***
  1. Strengthening of EASTECO's institutional framework
  2. Improvement of collaboration and partnership in STI

The effort to regionally cooperate in Science, Technology and Innovation is, as a result, emphasized by key official documents of the Community, as for example the Treaty for the Establishment of the EAC and the Protocol on the Establishment of the East African Community Common Market.

A snapshot of the research effort in the African continent as a whole, proposed by EAC (2016), highlights the concentration of research efforts on specific fields different from the Physical Sciences and Science, Technology, Engineering and Mathematics (STEM) that make up only 29% of all research in Sub-Saharan Africa, excluding South Africa as a result of low quality of basic education in science and math and a skewed higher education system to other disciplines other than STEM (EAC, 2016):

- Health sciences
- Natural sciences
- Applied sciences
- Economic and social sciences
- Arts and humanities

Such a situation dramatically differs from the countries characterized by high rate of innovation record, as for example Vietnam and Malaysia where STEM constitutes the largest share of scientific outputs. Furthermore, constraints are also evident if the performance of the National Innovation Systems of Kenya, Tanzania and Uganda is taken into account with the latest available data on the distribution of GDP on R&D expenditures. The domestic expenditure on R&D as a percentage of GDP for Kenya, Tanzania and Uganda represents, in fact, respectively 0.786%, 0.5% and 0.48% (Emong et al. 2018; Abdulrahim et al., 2018; Aminga et al., 2018). Increases in STI would be critical to address the immense challenges to development faced by the countries of the East African community.

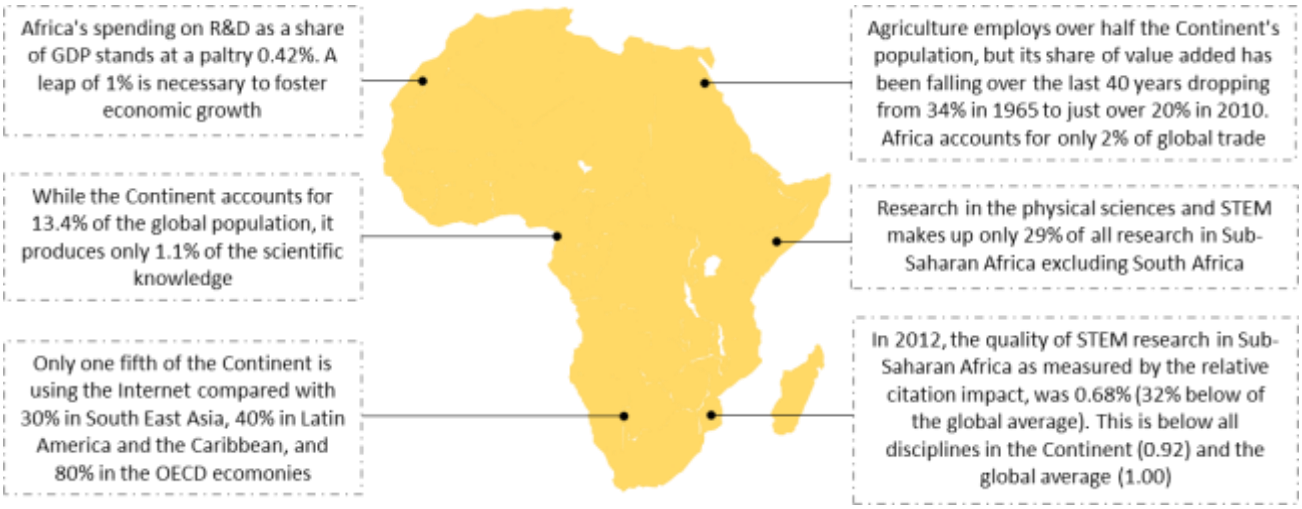

Figure 8.2 *Key development in STI in Africa*
(Source: EAC, 2016; World Bank, 2014)

In fact, while the community has witnessed impressive economic growth over the past decade, inclusiveness of growth processes must improve. Poverty still affects a large proportion of the Community's people and food insecurity continues to bedevil the region because of declining production and increasing food prices. In this situation, water scarcity and losses in biodiversity have been worsened by climate change and related extreme weather conditions, while the prevalence of diseases especially HIV/AIDS has resulted in the deaths of many who would have constituted the most productive segment of the region's population and further engendered poverty.

In this framework, science and innovation capacities represent fundamental tools to deal with poverty, hunger, income and gender inequalities, as they will be the foundations for new approaches and technologies to identify, clarify and tackle global challenges. At national level, the achievement of sustainable development for all people will require the adoption of a multi-dimensional view that integrates economic, social and environmental factors in a balanced manner.

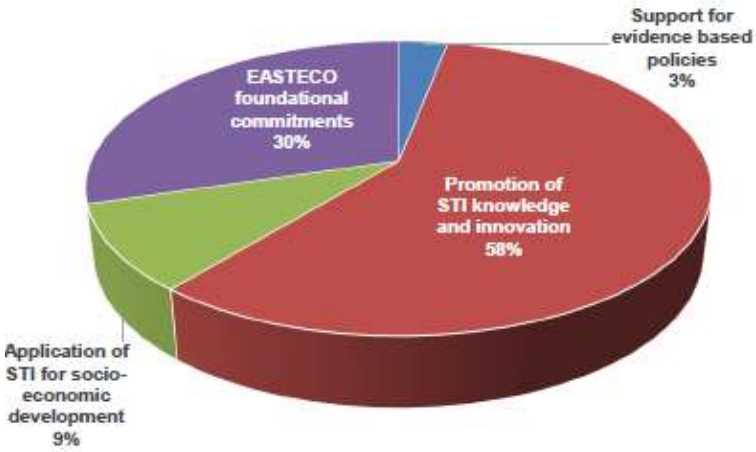

Figure 8.3 *Proportion of budget for EASTECO's Strategic Priorities* (Source: EAC, 2016)

Coherently with the regional strategic plan, the national policies enacted by all the EAC nations outline the increasing relevance of the STI in the definition of the priorities each country has adopted (see Table 8.1 for a snapshot of the Kenya, Tanzania and Uganda cases).

Country	National priorities and objectives outlined in policy	Areas/sectors
Kenya	- Increase strategic investments of science and technology for higher socioeconomic returns - Enhance science education and training - Develop effective intellectual property rights strategies, providing incentives to increase national and international research effort - Foster STI research effort - Increase cooperation and networking capabilities, involving academia - Promote a wide variety of funding and support mechanisms for national R&D	Transport, communication, health, agriculture, energy, environment, shelter, trade and commerce, education
Tanzania	- Promote science and technology as a tool for economic development - Promote STI - Foster science and technology culture increasing awareness - Promote research in STI, increasing capability to identify and develop special talents - Promote rational usage of natural resources for sustainable development - Reduce gender gap - Promote commercialization of research results - Improving the legal framework to increase the STI research effort	Food and agriculture, industry, energy, natural resources, environment, health, transport, communication, education in science and technology
Uganda	- Promote and foster STI - Improve environment for industry development - Facilitate S&T innovation - Promote adequate use of traditional and emerging technologies for sustainable development - Financially support STI activities - Improve the education and training system - Promote STI research establishing mechanisms to ensure development and application of STI - Develop an STI information management system	Economic growth, employment, export, human capital development, environment, tourism, rural development

Table 8.1 *National priorities: some examples of national priorities and objectives from Kenya, Tanzania, Uganda*

All shortly described national policies translate into mandates and strategic issues of national bodies such as councils and commissions that, despite of severe challenges (Figure 8.4), aim at contributing to socioeconomic development via effective promotion of STI efforts, e.g.:

- the National Commission for Science, Technology and Innovation (NACOSTI) in Kenya
- the Commission for Science and Technology (COSTECH) in Tanzania
- the National Council for Science and Technology (UNCST) in Uganda

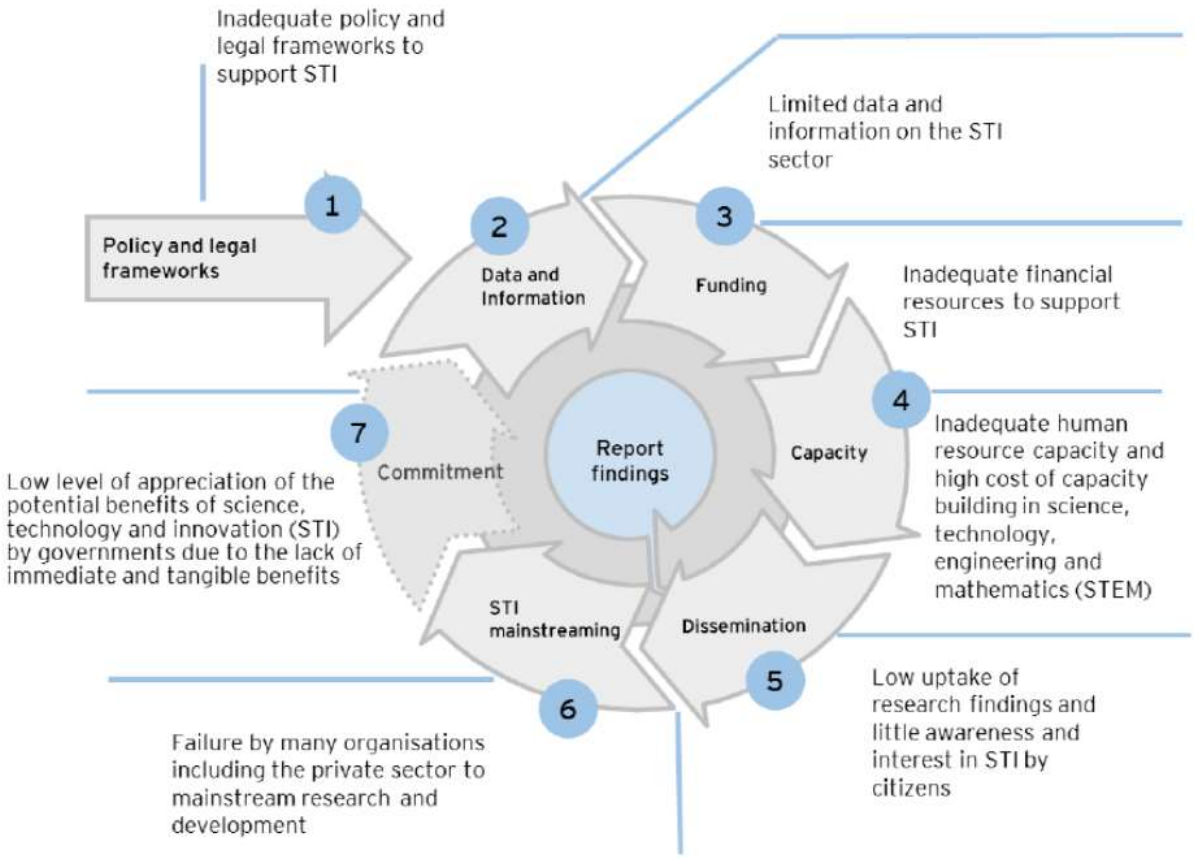

Figure 8.4 *Challenges in STI in the EAC Partner States*
(Source: EAC, 2016)

In this framework, research institutions and universities, together represent some of the more important stakeholders. They are promoter stakeholders and act as stakeholders who attach a high priority to the Strategic plan and whose actions have an impact on the implementation of the strategic plan.

As defined in the EASTECO Strategic Plan, research institutions and universities provide evidence-based research to inform policy, provide solutions to problems through scientific research, can act as education promoters delivering appropriate training in STI, can increase public awareness and help the identification of research priorities to promote inclusive and sustainable development.

The final exploitation of STI findings will strategically depends on the capability of all involved actors to bring effectively innovations to the market. In fact, as recalled in the Strategic priority 2, the support for innovation and commercialization of technology represents one of the main tasks of the EASTECO in the framework of its strategic plan through (EAC, 2016):

- the establishment of regional centers of innovation that are devoted to the development and diffusion of simple, affordable and efficient technologies that address the basic needs of communities,
- the establishment of a regional technology and innovation fund to provide merit-based and competitive funding for promising innovations initiated by the innovation centers and other institutions,
- the promotion of initiatives to enhance the Community's innovation capacity including:
    1. actions for award recognition (as annual ceremony to recognize regional scientific excellence specifically for innovations and research that contribute to the uplifting of the socio-economic status of the people of the East African Community), and
    2. commercialization strategies to facilitate the use of promising innovation by the private sector and the government system.

In this context, the role of universities and research centers is straightforward as the commercialization of innovation will mainly go through the active involvement of academia:

- promotion of spin-offs and incubators within the research institutes, Universities, etc;
- promotion of cluster-based cooperation between industry and academia;
- identification of venture capital that will enable transformation of research into new products and services;
- creation of links between SME and informal sector and the academia for their mutual benefit;
- promotion of training and forums to foster effective approaches for patenting and intellectual property rights issues.

Management innovation

Even though research results are still limited, management innovation plays a crucial role in a strategic pathway toward development and maximization of innovation's impact. Hamel (2006) identifies management innovation as "a marked departure from traditional management principles, processes, and practices or a departure from customary organizational forms that significantly alters the way the work of management is performed". Similarly, Birkinshaw et al. (2008) define management innovation as the "generation and implementation of a management practice, process, structure or technique that is new to the state of the art and is intended to further organizational goals". Focusing on innovations adopted from somewhere else, Lin and Su (2014) regard adoptive management innovation as "the introduction and implementation of an existing or mature management practice, process, structure, or technique that has been not only implemented somewhere else successfully but also intended to improve operation

efficiency and organizational performance and further organizational goals". All these studies focus on observable innovation at an operational level and advocate a positive effect of management innovation on organizational performance. Hamel (2006: 73) forcefully argues that "management innovation is able to deliver a potent advantage to the innovating company and produce a seismic shift in industry leadership".

Management innovation has received considerable attention over recent years (Ahn et al. 2016; Firpo, 2018; Padovani, 2018; Lee et al. 2010; Hauser et al. 2017; Lin et al. 2017). Most studies focus on what antecedents may affect innovations and how innovations occur. As for antecedents of innovations, earlier studies examined effects of a single element, such as institutional factors (Guillén, 1994), organizational culture (McCabe, 2002), core managers (Howell and Higgins,1990), and human resources (Osterman, 1994; Chi et al., 2007); while more recent studies tend to examine multiple elements, such as environmental, organizational and senior managers' characteristics (Damanpour and Schneider, 2006), context, search and their interaction (Mol and Birkinshaw, 2009), and relational capability, sensing capability, absorptive capacity, and integrative capability (Lin et al., 2016). Specifically, research on institutional factors emphasizes the socio-economic conditions in which new management concept and practices emerge, which stresses the importance of the preconditions in which innovations emerge or the factors for innovation adoption (Ahn et al. 2016; Firpo, 2018; Padovani, 2018; Lee et al. 2010; Hauser et al. 2017; Lin et al. 2017).

Studies on core managers argue that it is managers that address critical problems by creating or adopting new practices and offering support for implementation (Howell & Higgins, 1990). Studies on human resources focus on how internal employees affect management innovations, and draw the conclusions that: employee training is the main driver for adoption and diffusion of management innovations in organizations, especially human resources innovations (Osterman, 1994; Chi et al., 2007).

Building on the organizational reference group literature, Mol and Birkinshaw (2009) regard management innovation, as a result of a firm's internal context and the external search for new knowledge. Lin, Su and Higgins (2016) confirm dynamic capabilities as an important driver of management innovation, from initiation through to implementation.

In addition, Xu and his colleagues (2003, 2006) propose comprehensive innovation theory, which emphasizes the important role of organic integration among technologies, organizing, marketing, strategies, culture and institutions, in realizing the goal of overall innovation. Lin, Su and Higgins (2016) propose a four-phase process consisting of initiation, outside search, proposal establishment, and innovation implementation. All these studies regard implementation as an indispensable phase of management innovation. In conclusion, management innovation, a complex project, has attracted extensive attention; while little research has gone to the nature of its implementation, which actually realizes the value of innovation.

Further reading

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Summary of key points

- The economic literature uses to distinguish between exploration and exploitation, where the first can be identified as the search for new knowledge, technology, competences, markets or relations, and the second as the further development of existing technological innovations;
- Different relevant dimensions can be identified in terms of knowledge and innovation exploitation: the cognitive dimension, the temporal dimension and the spatial dimension;
- If technology exploitation is considered, the capability of a country/industry system to provide adequate pro-innovation policies plays a pivotal role;
- There are 4 different systems than can be defined on the basis of their capability to boost economic growth starting from their capacity to exploit technological knowledge innovation;
- The processes of dissemination and exploitation of research results are strictly linked and foster development dynamics by increasing the economic and social use of R&I project results and by promoting the availability of scientific evidence to address effectively pressing global challenges;
- Policy regime and firms must be cooperative and active in supporting the diffusion of economically relevant technologies and innovations;
- Government policy appears to be largely responsible for creating industry environment facilitating competitiveness and supporting the profits determined by the exploitation of new technologies;

- The importance of Science, Technology and Innovation (STI) has been widely recognized for the Countries of the East African Community (EAC) in the framework of a promoted development strategies focusing on the improvement of the global competitiveness of the Community for faster and sustainable economic growth and promoting the integrations of Science, Technology and Innovation considerations into a range of policy frameworks;
- The East African Science and Technology Commission (EASTECO), with the objective of promoting regional integration in the development, management and application of STI in the East African Community, sets 4 different strategic priorities that will enable partner countries to cooperate on regional activities and interventions in STI;
- Management innovation plays a crucial role in a strategic pathway toward development and maximization of innovation's impact with a recordable positive effect on organizational performances.

Self-assessment test

Choose one – most appropriate – answer to each of the questions.

Q1: The economic literature distinguishes exploration of innovation from exploitation of innovation. How can exploitation be defined?

1. It is the search for new knowledge, technology, competences, markets or relations.
2. It implies search, variation, risk taking, experimentation, flexibility, discovery, and innovation.
3. It can be identified as further development of existing technological innovations.
4. It cannot be identified as further development of existing technological innovations.
5. It is variation-seeking and experimentation oriented.

Q2: What are the consequences of engaging exclusively in exploration or exploitation of innovation?

1. Systems engaging exclusively in exploration benefit from the gain deriving by innovation and exhibit many undeveloped ideas.
2. Systems engaging exclusively in exploitation exhibit many undeveloped ideas.
3. Systems engaging exclusively in exploration or exploitation are either not able to effectively benefit from the gain deriving by innovation or are trapped in suboptimal stable equilibria.
4. Systems engaging in both exploration or exploitation are not able to effectively benefit from the gain deriving by innovation and are trapped in suboptimal stable equilibria.
5. Systems engaging exclusively in exploitation are not able to refine existing knowledge.

Q3: What are the most relevant dimensions in terms of knowledge and innovation exploitation?

1. Cognitive and temporal dimensions.
2. Temporal and spatial dimensions.
3. Cognitive, temporal and spatial dimensions.
4. All relevant dimensions of knowledge and innovation exploitation are geographically defined.
5. All relevant dimensions of knowledge and innovation exploitation are related to the role of time in the exploitation process.

Q4: What characterizes systems/countries that increase average educational levels, but do not institute policies facilitating technology transfer and innovation?

1. They surely experience low productivity growth.
2. They can avoid low productivity growth by promoting outward policies related to foreign trade, investment and knowledge flows.
3. They boost private sector participation in the processes of developing new technologies and delivering education and training.
4. They facilitate technology transfer and innovation by boosting the active participation of the private sector.
5. They cannot avoid low productivity growth by promoting outward policies related to foreign trade, investment and knowledge flows.

Q5: What are the main constraints to research results dissemination and exploitation?

1. Dissemination and exploitation efforts commonly focus on implementing and validating technical objectives instead of aligning work with the needs of users and stakeholders.
2. Dissemination and exploitation are often not perceived as relevant for research activities.
3. Confusion persists among communication, dissemination and exploitation actions.
4. Dissemination and exploitation activities pay little attention to the importance of the key results for the community.
5. All mentioned above.

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Glossary

Exploration	A concept including “things captured by terms such as search, variation, risk taking, experimentation, flexibility, discovery, and innovation”
Exploitation	A concept including “such things as refinement, choice, production, efficiency, selection, implementation, and execution”
Cognitive dimension	One of the dimensions of knowledge and innovation exploitation that measures the degree of familiarity between the newly searched knowledge and the existing knowledge
Temporal dimension	One of the dimensions of knowledge and innovation exploitation that represent the role of time while defining the exploitation process.
Spatial dimension	Geographical dimension of knowledge and innovation exploitation
Policy	A deliberate system of principles to guide decisions and achieve rational outcomes
Dissemination	Public disclosure of the research results by any appropriate means that will allow the transfer of knowledge and results to the ones that can best make use of them and will maximize the impact of research, enabling the value of results to be potentially wider than the original focus
STI	Science and Technology Innovation
STEM	Science, Technology, Engineering and Mathematics

Answers to Self-Assessment Questions

Lecture.1
Q1: 1, 4
Q2: 5
Q3: 1, 3, 5
Q4: 2, 3, 4
Q5: 5

Lecture.2
Q1: 1, 3, 5
Q2: 2
Q3: 3
Q4: 1, 2, 3
Q5: 1, 2, 3

Lecture.3
Q1: 1, 3, 5
Q2: 2
Q3: 3
Q4: 1, 2, 3
Q5: 1, 2, 3

Lecture.4
Q1: 1, 2, 3, 5
Q2: 1, 3, 4, 5
Q3: 3, 5
Q4: 1, 2, 3, 5
Q5: 1, 3, 5

Lecture.5
Q1: 1, 3
Q2: 1, 4
Q3: 1, 3, 5
Q4: 1, 2, 3
Q5: 1, 3, 4

Lecture.6
Q1: 1, 3, 4, 5
Q2: 1, 4, 5
Q3: 1, 3, 4
Q4: 2, 4, 5
Q5: 1, 3, 4, 5

Lecture.7
Q1: 5
Q2: 4
Q3: 3
Q4: 5
Q5: 1

Lecture.8
Q1: 3
Q2: 3
Q3: 3
Q4: 2
Q5: 5

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