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INNOVATION FOR SUSTAINABLE DEVELOPMENT

Learning Module

Integrating Talent Development into Innovation Ecosystems in Higher Education

586227-EPP-1-2017-1-BG-EPP

INNOTAL

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This module presents the social and environmental dimensions of innovation, in addition to its traditional economic dimension. It underscores the urgent challenges that societies face and the role of innovation in facilitating the transition to inclusive, low-carbon and knowledge-based economies and societies.
The module is intended to develop knowledge and skills for co-creation in innovation.

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Grand societal challenges

ANNOTATION

The subject of the lecture is Grand societal challenges (GSCs). The concept of GSCs is well established in the science-policy discourse and in recent years has gained wide popularity among various stakeholders - policy makers, intergovernmental actors, business practitioners and researchers. Yet, there is no common understanding of the term and it is open to interpretation in various contexts. The lecture starts with a discussion of the GSCs concept, its emergence and global diffusion. We try to define GSCs, also known as "grand challenges", "societal challenges", "urgent challenges" or "global challenges" by looking at their characteristics. Clearly, these are certain complex and massive social and environmental issues that are urgent, transcend national borders, have a disruptive societal impact, affect large numbers of people, communities and the planet as a whole, and require special efforts of shared responsibility to seize opportunities and find solutions. Students are introduced to the most frequently identified GSCs, such as climate change and global warming; depletion of resources; the Fourth Industrial Revolution and the digitalization of the economy; increasing inequality and decline in societal integration; ageing population and healthcare.

Next, we study how diverse organisations around the world (national governments, international forums, private foundations, scientific societies and universities and research institutes) respond to these challenges. Dealing with GSCs has become a major goal and an important determinant of policy in general and of Science, Technology and Innovation (STI) policy in particular. While before most research programmes were structured by research themes or disciplines, in recent years the trend is to design research programmes through boundary spanning collaborations in such a way as to contribute to meeting major societal challenges. The state is increasingly seen not just as enabler but as an actor that can shape the directionality of innovation. Notwithstanding the crucial role of governments, the private sector also has a critical contribution in developing solutions to the GSCs, as exemplified by the concept of "responsible innovation".

GRAND SOCIETAL CHALLENGES – CONCEPT, DIFFUSION, CHARACTERISATION

Accelerating globalisation and fast technological change bring about unprecedented social, economic and environmental challenges to today's complex world. Those challenges are hard to be precisely defined, they are complex, interdependent, not clearly delineated and resemble '*wicked problems*'. Wicked problems are multidimensional issues that cannot be solved once and for all because of incomplete, contradictory and changing requirements that are difficult (if not impossible) to recognize up front. Wicked problems need to be continuously addressed and their solution is outside the realm of one single knowledge area or academic discipline, implying that they require competences and knowledge from multiple scientific domains.

The concept of GSCs is well established in the science-policy discourse and in recent years has gained popularity among various stakeholders - policy makers, intergovernmental actors, business practitioners and

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researchers. Yet there is no explicit definition and common understanding of the term. It is open to interpretation, especially in various contexts. Often, lists of examples in very different thematic ranges are used to illustrate the related terms "grand challenges", "societal challenges", "urgent challenges" or "global challenges".

The Grand Challenges concept has gained wide popularity since 2003 when the 'Grand Challenges in Global Health' programme of the Bill and Melinda Gates foundation in partnership with the US National Institutes of Health was announced at the World Economic Forum in Davos. This program funds research on diseases affecting people in the developing world. The 200 million US dollar initiative was based on a century-old model formulated by the German mathematician Dr. David Hilbert at the International Congress of Mathematicians in Paris in 1900. He listed a set of 23 problems, collectively termed as "grand challenges", representing specific mathematical problems that were formulated to spur interest and dialogue among mathematicians, which in turn generated breakthroughs in mathematics, physics, and other scientific fields. The idea of articulating important research issues in an intriguing and inspiring way in order to engender collaborative responses to solving common problems has been extended beyond the scientific community to refer to societal problems and to involve a broader set of actors. At first promoted by scientific leaders in technical disciplines, the concept of grand challenges nowadays is taken up by national governments, research organisations, scientific societies and international organisations.

There are several definitions of GSCs that tend to focus on specific domains (e.g. health or engineering). For example, the US Networking and Information Technology Research and Development Program (2003) defines a grand challenge as a long-term science, engineering, or societal advance, whose realization requires innovative breakthroughs in information technology research and development and which will help address the country's priorities.

A broader definition is given by the Joint Institute for Innovation Research (2012) stressing that GSCs involve a combination of major public and private interests, are seen as key for realising future economic growth, and are concerned with important social and/or environmental problems. Grand Challenges Canada (2011) defines grand challenges as specific critical barrier(s) that, if removed, would help solve an important societal problem with a high likelihood of global impact through widespread implementation.

It is clear that GSCs are certain complex and multifaceted social and/or environmental issues that are urgent, have a disruptive societal impact, affect various stakeholders on a global scale and will require special efforts. GSCs involve a large number of strongly interdependent variables that must be taken into account when identifying and tackling them. These include a range of phenomena and relate to various societal subsystems such as science, politics and industry, as well as to the

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interactions between these sub-systems. They cannot be confined regionally, nationally or geographically, and are often relevant at the transnational or global levels.

A major characteristic of GSCs is that they are real-life problems of a grand scale and scope that must be addressed urgently. If neglected, they can have catastrophic consequences over the next few decades. Usually the risks associated with GSCs often receive more attention than the opportunities they offer. At the same time, the expectations are that the emergence, course and consequences of GSCs are not unalterable and via appropriate behaviour they can be affected and confined by human activity and steered onto a more manageable course. By their very nature, GSCs require coordinated and sustained effort from multiple and diverse stakeholders and innovative and integrated approaches from both policy and science that harness input from multiple perspectives (social sciences, policy studies, engineering, entrepreneurship, environmental studies, etc.) Solutions to GSCs typically involve changes in individual and societal behaviors, changes to how actions are organized and implemented, and progress in technologies and tools to solve these problems.

IDENTIFICATION OF GRAND SOCIETAL CHALLENGES

Given the finite resources and differences in perceived urgencies, the decision as to which GSCs should be tackled is a matter of setting priorities. The scientific system and the current state of scientific knowledge can help identify global trends and interdependencies and can contribute to the recognition and understanding of GSCs. However, the identification of urgent societal challenges is ultimately a political decision that should be taken with the broadest possible participation of stakeholders representing the fields of science, politics, industry, media and the public.

Various organisations around the world have launched multiple initiatives that list GSCs, and these initiatives are characterized by considerable diversity of ideas and priorities. However, there are also many common elements in these lists. The most frequently cited examples of GSCs could be grouped in the following way:

- Climate change and environment
- Depletion of resources – securing the world's water and energy supply
- Digitalization of the economy, fourth industrial revolution and the future of work
- Increasing inequality and decline in societal integration
- Ageing population and health.

The National Academy of Engineering has summoned an international group of leading technological thinkers to identify the Grand Challenges for Engineering in the 21st century. Their 14 game-changing goals for improving life on the planet, announced in 2008, fall into four

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cross-cutting themes: *Sustainability, Health, Security*, and *Joy of Living*. The 14 Grand Challenges for Engineering are:

1) Make solar energy economical; 2) Provide energy from fusion; 3) Develop carbon sequestration methods; 4) Manage the nitrogen cycle; 5) Provide access to clean water; 6) Restore and improve urban infrastructure; 7) Advance health informatics; 8) Engineer better medicines; 9) Reverse-engineer the brain; 10) Prevent nuclear terror; 11) Secure cyberspace; 12) Enhance virtual reality; 13) Advance personalized learning; 14) Engineer the tools of scientific discovery.

The European Union has identified 6 GSCs in its research and innovation agenda:

- Health, demographic change and wellbeing
- Food security, sustainable agriculture, marine and maritime research and the bio-economy
- Secure, clean and efficient energy
- Smart, green and integrated transport
- Climate action, resource efficiency and raw materials
- Inclusive, innovative and secure societies.

Probably the most influential current framework that relates to the grand challenges is the United Nations Sustainable Development Goals (SDGs). At a historic UN summit in September 2015, 193 member states of the UN adopted a set of 17 goals to end poverty, protect the planet, and ensure prosperity for all as part of a sustainable development agenda. These 17 SDGs set 169 targets between them to be achieved by 2030. The merits of the SDGs, presented in table 1, are in the articulation that human progress stems from achieving these clear targets through collective, collaborative, and coordinated effort.

Table 1. UN Sustainable Development Goals

Goal	*Title*	*Description*
1	No poverty	End poverty in all its forms everywhere
2	No hunger	End hunger, achieve food security and improved nutrition, and promote sustainable agriculture
3	Good Health and well-being	Ensure healthy lives and promote well-being for all at all ages
4	Quality education	Ensure inclusive and equitable quality education and promote lifelong learning for all
5	Gender equality	Achieve gender equality and empower all women and girls

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6	Clean water and sanitation	Ensure availability and sustainable management of water and sanitation for all
7	Affordable and clean energy	Ensure access to affordable, reliable, sustainable, and clean energy for all
8	Decent work and economic growth	Promote sustained, inclusive, and sustainable economic growth, full and productive employment, and decent work for all
9	Industry, innovation and infrastructure	Build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation
10	Reduced inequalities	Reduce inequality within and among countries
11	Sustainable cities and communities	Make cities and human settlements inclusive, safe, resilient and sustainable
12	Responsible consumption and production	Ensure sustainable consumption and production patterns
13	Climate action	Take urgent action to combat climate change and its impacts
14	Life below water	Conserve and sustainably use the oceans, seas and marine resources for sustainable development
15	Life on land	Protect, restore, and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and stop and reverse land degradation and halt biodiversity loss
16	Peace and justice	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all, and build effective, accountable, and inclusive institutions at all levels
17	Partnerships for the Goals	Strengthen the means of implementation and revitalize the global partnership for sustainable development

Source: United Nations (2015)

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When proposing the UN's SDGs, the Secretary General H. E. Ban Ki-Moon reiterated in his speech his often-quoted remark that very well illustrates the importance and urgency of dealing with GSCs:

"*There is no Plan B for action, as there is no Planet B.*"

ADDRESSING GRAND SOCIETAL CHALLENGES

The rapid advance of science and technology associated with the rise of digitalization have deeply disrupted innovation pathways with increased complexity, faster pace of change, the rise of network effects and enhanced uncertainty about their net impacts on society. Unless steered with a purpose, the accelerated technological change may widen inequities, exacerbate social disintegration and accelerate resource depletion. At the same time, there is a growing expectation on the part of science and innovation to tackle the major societal problems of our time. Researchers and policy makers alike are intensively exploring how to use research and innovation to solve today's pressing global challenges.

There is a redefinition of the rationale and role of governments in supporting and managing innovation and a shift towards challenge-oriented policies that try to define areas of societal concern and tackle defined societal challenges. Traditional innovation policies aimed at building an enabling environment for innovation by:

- investing in fundamental science and skills (to address 'market failure'), as these traditionally suffer from private underinvestment, and
- fostering knowledge flows through the strengthening of regional and national innovation systems (to address 'system failure')

These policies continue to be very relevant. However, they are aimed at boosting the "quantity of innovation" and are insufficient on their own. In the new context, innovation policy also needs

- to ensure the orientation or 'quality of innovation', so that it is contributing more directly towards broad societal goals such as inclusiveness or sustainability ('orientation failure').

In this new paradigm, rather than supporting traditional research and innovation programs that deliver incremental results, the state is increasingly seen as an actor that can shape the directionality of innovation, i.e., create the conditions for systemic transformation. Governments are not mere enablers of innovation, but fundamental shapers of innovation that, together with citizens, set the direction.

Table 2. Examples of GSCs research initiatives

Type of Institution	Initiative
Suprantional economic blocs	The EU Horizon 2020 programme
National governments	American innovation strategy

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	(2009) Grand Challenges Canada (2010) The Netherlands: 'Global Challenges, Dutch solutions' (2014)
International forums	ICSU Earth System Science for Global Sustainability: the Grand Challenges OECD Meeting Global Challenges Through Better Governance
Private foundations	Gates Foundation Grand Challenges in Global Health
Scientific societies	National Academy of Engineering: 14 Grand Challenges for Engineering Royal Society: knowledge, networks and nations reports
Universities	University College, London; University of Exeter; Princeton University; Georgia Tech.

Source: Ulnicane, I. (2016)

While various organisations around the world have launched multiple research initiatives to deal with the GSCs (see Table 2), scientific contributions to the solution of global challenges will primarily be developed in scientific systems that are structured and financed mainly by national governments. An important role to address GSCs transnationally is played by the European Union Research Policy where the concept of societal challenges is a core one. Horizon 2020 - the European Research, Technology and Innovation Programme - puts explicit focus on resolving global and societal problems. There are three funding areas: academic, industrial, and societal and the area of GSCs received the greatest share of the €80 billion of funding made available for the period 2014 to 2020. The idea was that a challenge-based approach would bring together resources and knowledge across different fields, technologies and disciplines, including social sciences and the humanities. Research activities in Horizon 2020 now bridge research to market with a new focus on innovation-related activities, such as piloting, demonstration, test-beds, and support for public procurement and market uptake.

There is no high-level international research funding that is comparable in terms of scope to Horizon 2020 funding. So tackling GSCs lies mostly within the tasks of national governments that have to take into account their global character.

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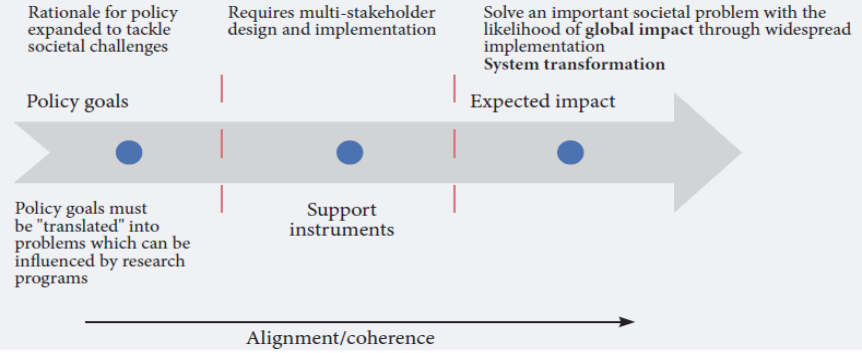
Figure 1 illustrates a framework that could be used to conduct a coherence analysis of nested relationships between policies that address societal challenges, support instruments deployed, and the impact they have. The framework is designed to highlight a new type of policy coherence that is compatible with a more sophisticated, multi-actor, and dynamic understanding of the processes of formulating policy that aims at system transformation, its implementation, and the impact it can be expected to have. High coherence indicates that the political objective of addressing societal challenges can be implemented. Low coherence indicates that the selected instrument cannot fully implement the changes needed to address societal challenges.

Fig. 1. Framework for Analyzing Policy Coherence in Programs that Address GSCs



Source: Ek, I. (2018)

Despite the crucial role of governments, the private sector is increasingly seen to have a critical role in contributing to finding solutions to GSCs, as evidenced by the growing number of partnerships between the business community, civil society organizations, and governmental as well as intergovernmental agencies; the emergence of dedicated corporate social responsibility (CSR) departments in many companies; and corporate engagement in initiatives like the UN Global Compact or the World Business Council for Sustainable Development.

A new concept that includes business as part of the solution of GSCs and focuses on the global agenda for sustainable development is "*responsible innovation*". It consists of three types of responsibility which are relevant for exploring the role of private businesses: (1) the responsibility to do no harm, (2) the responsibility to do good and (3) responsible governance, which involves establishing institutions, structures, and procedures on multiple levels in order to facilitate innovations that fulfil (1) and (2).

FURTHER READING

EU Horizon 2020, https://ec.europa.eu/programmes/horizon2020/h2020-sections

Provides information about the biggest EU research and innovation programme that deals with societal challenges on a transnational level

McKinsey Digital, https://www.mckinsey.com/business-

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functions/digital-mckinsey/our-insights/disruptive-technologies

A report by McKinsey Global Institute identifying 12 disruptive technologies that could drive truly massive economic transformations in life, business and the global economy in the coming years.

National Academy of Engineering (NAE), www.engineeringchallenges.org

Presents the 14 Grand Challenges for Engineering for the 21st century.

OECD, http://www.tipconsortium.net/poster/oecd-project-on-the-design-and-implementation-of-mission-oriented-policies-to-address-societal-challenges/

Project on the design and implementation of mission-oriented policies to address societal challenges.

UN SDGs, https://sustainabledevelopment.un.org/sdgs

Presents the most influential current framework related to grand societal challenges – the UN Sustainable development goals.

UN Global Compact, https://www.unglobalcompact.org/

A voluntary initiative based on CEO commitments to encourage businesses worldwide to implement sustainable and socially responsible policies and to take steps to support UN goals.

World Economic Forum, Global Risks, https://www.weforum.org/global-risks/

The Global Risks Initiative is an ongoing workstream built around milestone products, including but not limited to the annual flagship Global Risks Report, that identify and analyse critical global risks, and communicate such risks to both stakeholders and the wider public through digital and other media assets.

SUMMARY OF KEY POINTS

- At first promoted by scientific leaders in technical disciplines, the concept of grand societal challenges (GSCs) nowadays is taken up by national governments, research organisations, scientific societies and international organisations.
- GSCs are complex, interdependent, not clearly delineated and resemble 'wicked problems'. They are multidimensional issues that need to be continuously addressed in a systemic way. Their solution is outside the realm of one single knowledge or scientific discipline.
- The identification of urgent societal challenges is ultimately a political decision that should be taken with the broadest possible participation of stakeholders. The most frequently identified examples of GSCs could be grouped in the following way: climate change and environment; depletion of resources – securing the world's water and energy supply; digitalization of economy, fourth industrial revolution and the future of work;

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increasing inequality and decline in societal integration; ageing population and health.

- There is a growing expectation on the part of science and innovation to tackle the major societal problems of our time by harnessing input from multiple perspectives (social sciences, policy studies, engineering, entrepreneurship, environmental studies, etc.).
- Research programs that address GSCs have to exhibit high coherence between policy goals, instruments and expected impact.
- Rather than mere enablers, governments are nowadays increasingly seen as fundamental shapers of innovation that set the direction and create conditions for systemic transformation. While governments have the leading role, the private sector is expected to play a critical role in developing solutions to the GSCs by engaging in "responsible innovation".

CASE STUDIES / REAL-WORLD EXAMPLES

Digitalization to transform industry and society

In modern society and industrial environments, organizational operating systems are becoming increasingly complex and automated. These systems comprise people, machines, workstations, devices, robots, and other assets, as well as appropriate monitoring, sensors and control systems. New technology insertion is a constant challenge in relation to these systems. It includes digitalization, frequent changes in operating processes, random disruptions, and dramatically fluctuating market demands. The business world is full of disruption. New business models and innovative technologies are continually being invented, and these inventions demand a sharp focus on effective innovation and organization to stay relevant, engaged, and ahead of the future curve. Digitalization does not just mean going paperless; it means being able to integrate solutions to manage, organize, control, and generate value from digital data for value creation, sustainability, and new opportunity creation for business and society.

According to Gartner, digitalization is the use of digital technologies to change a business model and provide new revenue and value-creation opportunities. It is the process of moving into a digital business. Digitalization clearly holds implications outside the industrial sphere. Governments are faced with the issues of potential inequality and wage deflation or even social unrest due to the uncertainty that the workforce faces in the digital future. This radical technological transformation is based on networks of sensors, actuators, and other devices from the Internet of Things (IoT). The number of devices that make up the IoT is estimated to have grown to 50 billion by 2020, forming a solid foundation for digitalization. The aforementioned networks integrate the physical system into the digitalized cyber physical system for applications in smart homes, cities, factories, services, transportation,

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and so forth. The three elements of digitalization are 1) sensors, 2) devices that make the smart system, and 3) connectivity integration from the devices to the computer and digitalized platform. These three elements combine to enable predictive and prescriptive analytics for business solutions and value generation.

Industrial transformation through digitalization is particularly evident in the manufacturing industry, where the related term *Industry 4.0* has been coined. Industry 4.0 suggests that digital enterprises are built using industrial Internet or digital factories. Industry 4.0 focuses on end-to-end digitalization of all physical assets and integration with value chain partners into digital ecosystems. PWC's 2016 Global Industry 4.0 Survey (2016) indicated that digitalization in manufacturing industry would drive a 2.9% increase in annual revenues and reduce costs by 3.6% per annum over the next five years. Additionally, products, systems, and services would be increasingly customized to empower customers and to meet their needs. The biggest challenge was found to be the lack of digital culture and skills in organizations, so the focus should be on people and culture to drive this transformation. There is a general agreement that digitalization causes large-scale, sweeping transformations across multiple areas of industry and society. These areas include customers, employees' skills, and lack of digital culture. In addition, technology adoption by industries provides unparalleled opportunities for value creation, yet it also represents a major source of risk. In the digital age, certain companies, such as Google, Amazon, and Facebook, have become digital platform owners. This ownership gives them a monopolistic position and allows them to apply winner-takes-all logic, which leads to greater inequality in terms of exploitation of business opportunities. The economic and social implications of digitalization are controversial and contested, and raise concerns over the wider societal impact of digital transformation.

Source: Parida, V., (2018) Digitalization, in: Frishammar, J., Å. Ericson (ed.) Addressing Societal Challenges, Lulea University of Technology.

PROPOSED ASSIGNMENTS AND EXERCISES

1. Read the text of the real-world examples above. Answer the following questions:

   1.1 There is a general agreement that digitalization causes large-scale, sweeping transformations across multiple areas of industry and society. What kind of societal challenges can you identify as arising from digital transformation?

   1.2 How can firms capitalize on digitalization?

   1.3 Digitalization has become a key issue on the political agenda. Provide examples of government strategies for digitalization of industry. Does your country have an Industry 4.0 strategy? What types of measures does it envisage?

2. Within your lifetime you will witness sweeping changes and burgeoning needs related to climate change and environment,

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energy resources, mobility/transportation, housing, food and water, resource recovery/recycling, and health care. Choose one of those topics, form teams of 3-4 people and:

2.1 study the societal issue from both technical and political perspective

2.2 discuss with your teammates the genesis, magnitude, implications and possible solutions to the problem

2.3 write a short essay on a selected aspect of the societal challenge

2.4 prepare a final team report on the issue:

2.4.1 make a 5-minute video clip presenting your team's value proposition

2.4.2 design a poster telling your "story".

ASSESSMENT

Multiple choice test	
Question 1: Grand societal challenges can be characterized as:	
Answer 1	multidimensional issues that need to be continuously addressed in a systemic way
Answer 2	real-life problems of a grand scale and scope
Answer 3	urgent issues that cannot be confined regionally, nationally or geographically, and are often relevant on a transnational or global level
Answer 4	problems that require coordinated and sustained effort from multiple and diverse stakeholders and innovative and integrated approaches from STI policy
Answer 5	all of the above
Correct answer(s)	Answer 5
Question 2: Which of the following statements regarding the concept of GSCs is not true?	
Answer 1	The concept of GSCs is well established in the science-policy discourse but there is no common definition of it
Answer 2	The term is often used to describe the rationale for public funding of science and to formulate the expectations associated with

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	this funding for recipients
Answer 3	The most influential current framework that relates to grand challenges is the United Nations Sustainable Development Goals
Answer 4	GSCs are urgent issues of a grand scale that can be clearly delineated and their solution is in the realm of a particular knowledge area
Answer 5	The identification of the urgent GSCs is ultimately a political decision.
Correct answer(s)	Answer 4
Question 3: Which of the following are not among the GSCs identified by the EU?	
Answer 1	Health, demographic change and wellbeing
Answer 2	Climate action, resource efficiency and raw materials
Answer 3	Culture, youth and sports
Answer 4	Secure, clean and efficient energy
Answer 5	Smart, green and integrated transport
Correct answer(s)	Answer 3
Question 4: Which of the following statements about the Sustainable Development Goals (SDGs) are true?	
Answer 1	The SDGs were adopted at a historic UN summit in September 2015 with the participation of 193 member states
Answer 2	The 17 SDGs set 169 targets between them intended to be achieved by 2030
Answer 3	The first and the second SDGs aim at ending poverty and hunger
Answer 4	In each country, governments must translate the SDGs into national legislation, develop a plan of action and establish budgets
Answer 5	All of the above
Correct answer(s)	Answer 5
Question 5: Which of the following statements related to	

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addressing the GSCs is not true?	
Answer 1	Solutions to GSCs typically involve changes in individual and societal behaviors and changes to how actions are organized and implemented.
Answer 2	In the new context, the role of governments is limited mostly to building an enabling environment for innovation.
Answer 3	Together with governments the private sector has an important role to play in addressing GSCs.
Answer 4	Tackling GSCs requires innovative and integrated approaches from science, technology and innovation policy that harness input from multiple perspectives (social sciences, policy studies, engineering, entrepreneurship, environmental studies, etc.)
Answer 5	In order to be effective research programs that address GSCs have to exhibit high coherence between policy goals, instruments and expected impact.
Correct answer(s)	Answer 2

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GLOSSARY

"wicked problems"	Multidimensional problems that cannot be solved once and for all because of incomplete, contradictory and changing requirements that are difficult to recognize up front.
Grand societal challenges (GSCs)	Complex issues that are urgent, have a disruptive societal impact, affect various stakeholders and require special efforts of shared responsibility.
Sustainable Development Goals (SDGs)	The 17 SDGs are the blueprint to achieve a better and more sustainable future for all. They address the global challenges we face, including those related to poverty, inequality, climate change, environmental degradation, peace and justice. They have to be achieved by 2030.
Climate change	A defining issue of our time that refers to significant changes in global temperature, precipitation, wind patterns and other measures of climate that occur over several decades or longer. Its impacts are global in scope and unprecedented in scale.
Digitalization of economy	Fundamental disruptive force triggered by the Fourth Industrial Revolution and Internet of Things, which has placed advanced technology at the heart of all processes, products, and services, and created new business models.

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Food security	It exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life.
Energy security	The continuous availability of energy in varied forms, in sufficient quantities, and at affordable prices.
Resource depletion	Occurs when the renewable and non-renewable natural resources become scarce because they are consumed faster than they can recover. It is commonly associated with water usage, fossil fuel consumption, cutting of trees and fishing and may cause environmental change.
Mission-oriented innovation policies	Public intervention aiming at addressing societal challenges via a coordinated package of research and innovation policy measures.
"responsible innovation"	A transparent, interactive process by which societal actors and innovators become mutually responsive to each other with a view on the (ethical) acceptability, sustainability and societal desirability of the innovation process and its marketable products.

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Creative destruction and economic growth; technology push and market pull

ANNOTATION

The lecture examines the relations between creative destruction and economic growth and reveals the peculiarities of technology push and market pull innovation models. Its first part represents an analysis of creative destruction and the relevant connections with entrepreneurship and market power. The next part gives a short description of economic growth and outlines the main conclusions of different growth models. In the third part, the Aghion-Howitt creative destruction model of economic growth is presented and some additional important implications for growth are discussed. The fourth part analyses the influences of creative destruction on business cycle, job flows and „missing growth". The fifth and sixth parts of the lecture refer to the technology push and market pull models of innovation respectively. The lecture ends with some inferences about evolution and the applicability of the innovation models to contemporary economic reality.

CREATIVE DESTRUCTION

The concept of creative destruction was proposed by J. Schumpeter in the 1940s. It refers to the dynamic effects of innovation and represents a process of economic restructuring. This is „the process of industrial mutation … that incessantly revolutionizes the economic structure from within, incessantly destroying the old one, incessantly creating a new one" (1, p.83). In concrete terms it means that new products, new processes, new methods of production, new means of distribution, and new ways of doing things replace existing and obsolete ones. The respective innovation mechanism includes the reconfiguring of outdated economic structures through failure of old production entities and creation of new units. As a result of the inability of old industries and firms to run profit, resources are reallocated towards new business.

Based on his idea about the major role of entrepreneurship in economic development, Schumpeter came to the conclusion that the entrepreneur is the engine of creative destruction due to his/her willingness to innovate in the attempt to seek more profit. At the same time, the author has described accelerated innovation as associated with the presence of large firms with high market power. On one hand, only firms with enough market power, and especially monopolists, can pay the costs of innovations. This initial finding contradicts the understanding of the classical school that economic performance is encouraged by competition. On the other hand, if firms have monopolistic positions, they aim to retain their market power by additional innovations. From a Schumpeterian point of view, innovations are also considered to be competitive. In such a situation, the monopolist firms will be able to innovate more as a result of their potential to protect intellectual property rights. This practice of protecting innovations is inconsistent with antitrust policy and the conflict between the two is unavoidable.

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ECONOMIC GROWTH

As a long-term phenomenon, economic growth is defined as an increase in the production capacity of the economy. It must be distinguished from the business cycle, which represents the fluctuations of real GDP around its long-term trend. The modern theory of economic growth originated from the neoclassical growth model of Robert Solow. This model analyses growth as being driven by technological change, increased labor supply and capital accumulation. Technological change is determined exogenously as the Solow residual, measuring the part of GDP growth that cannot be explained by increases in the factors of production.

The new generation of growth theories - the endogenous growth models, try to explain how technological progress may be generated endogenously. In accordance with the main sources of technological advances and economic growth, these models are divided into two major groups. The first group includes the so called *human capital models*, where economic growth is presented through a production function with presence or absence of human capital. In the first case human capital leads to the production of the final goods as well as to accumulation of new human capital. As a result, it has both direct and indirect effects on economic growth, related to the increase of resources and to the encouragement of technological progress. In cases when human capital is absent in the production function, the human capital influences economic growth only through its impact on total factor productivity. The second group of models – *R&D models*, assumes that capital includes knowledge about production processes and accumulation of new knowledge. This new form of capital is characterized by increasing marginal productivity, which is sufficient to compensate for the decreasing marginal productivity of the physical capital. In some R&D models the economy is split into two sectors, respectively a sector that produces traditional goods and a sector that creates knowledge. Knowledge is used throughout the economy, which means that its accumulation is a positive externality for traditional firms. With increasing returns to scale, these models conclude that economic growth is highly dependent on the relative share of employees in the knowledge creating sector.

FROM CREATIVE DESTRUCTION TO ECONOMIC GROWTH

Ph. Aghion and P. Howitt developed a prototype endogenous model of growth through creative destruction (2). The model represents economic growth as a function of quality-improving innovations. These quality-improving innovations, which are usually called „vertical innovations“, are seen as resulting from competition among research firms. They are driven by the desires to run monopoly rents and are protected through patents and other intellectual property rights. The monopolist rent will disappear with the emergence of a new innovator, who will be able to introduce a new line of intermediate goods and to produce the final goods more effectively. This is exactly the process of creative destruction in which outdated products, processes and technologies are replaced by new ones. The Aghion - Howitt creative destruction model

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of economic growth differs from the standard endogenous growth models in the following two respects. First, it discusses the growth effect of market power and concludes that there is a positive relationship between market power and growth. Second, it examines the dependence of economic growth on the development of firms and infers that the innovations of both incumbents and entrants have positive impact on productivity growth.

Creative destruction has two other very important implications for economic growth.

> "In positive terms, the prospect of a high level of research in the future can deter research today by threatening the fruits of that research with rapid obsolescence. In normative terms, obsolescence creates a negative externality from innovations, and hence a tendency for laissez-faire to generate too much growth." (2, p.1)

Economic growth depends also on the accumulation of knowledge through „learning by doing". It is not a deliberate activity, but an external effect from traditional production process and from usage of higher amount of capital.

OTHER INFLUENCES OF CREATIVE DESTRUCTION

Creative destruction influences not only long-term economic growth, but also the cyclical fluctuations of the economy and the factor reallocation on the labor market. In Schumpeter's theory, business cycles depend on the innovation activity of pioneering entrepreneurs. This activity usually requires bank loans and banks are not only traders, but also creators of purchasing power. Once an entrepreneur receives credit, he makes an innovation and runs an increasing profit. Then the innovator is followed by the imitators and the process will lead to expansion of economic activity. On the contrary, economic crisis occurs when

> "more and more of the consequences of the innovation actually reach the market, extra profits diminish, and entrepreneurs start paying back their loans". (6, p. 12)

In the context of Ph. Aghion and P. Howitt growth model, recessions might be good for economic growth since they weaken the positions of old firms, enhance research by outside firms and stimulate new creative destructions. Booms, on the other hand, eliminate desire for R&D, discourage leaders and creative destruction and thus have a negative impact of economic growth.

Reallocations of labor and jobs flows are among the most important consequences of creative destruction. The jobs turnover is driven by new entrants that destroy existing firms and jobs, and convert them into obsolete ones. As a result of the failure of old incumbents and technologies, the workers in old firms lose their jobs and start seeking for new jobs. At the same time, new entrants, applying new ways of production, post new vacancies. Thus, the ultimate impact on unemployment is determined by two contradictory effects and depends

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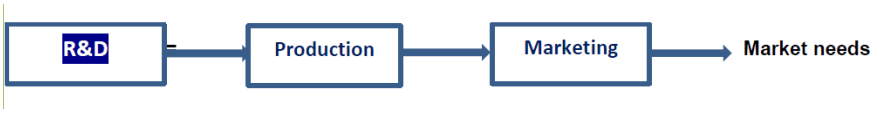
on their relative importance. The higher is the "capitalization" effect related to the increase of new vacancies, the lower is the equilibrium level of unemployment. If the economy experiences a prevailing "creative destruction" effect, this implies a higher rate of job destruction which tends to increase unemployment.

A possible problem is the so called „missing growth from creative destruction". It relates to the difference between actual and measured productivity growth in the economy due to the use of statistical imputations (the process of replacing missing data with substituted values). Imputation means that goods subjects to creative destruction are not included in measuring inflation rate and thus the inflation rate is overrated. The use of that procedure is explained by the inability of statistics to measure both the quality improvements of upgraded products and the benefits of new varieties.

Technology push

The technology push is a model of innovation adoption and transfer, which is characterized by the leading role of R&D in new technology. As a result of the high importance of research and ideas, it is also called "idea push" innovation model. The technology push can be depicted in the following way:



The figure shows that the initial impulse for innovation comes from research and development, without concern for market needs. This impulse can arise from internal or external sources. Internal sources include the company's own creativity and competences, whereas external sources as a rule represent external alerts for disruptive technologies. As a result, the different sources of R&D induce various changes in technologies.

> "The internal development can lead to new technology or major improvement of existing one, the technology push originated from external source leads to creative destroying of old technologies" (11, p. 135).

The technology push gives rise big advancements in production technologies, and that is among the most important advantages of this technology oriented practice. At the same time, this model of innovation requires large investments in research and development, and this is one of its great disadvantages.

After ending the R&D stage, an innovation process proceeds by pushing the new invention through production, marketing, and finally market entry. The market by itself has not expressed explicitly its demands and is seen simply as a recipient of the output of research and invention. It is assumed also that the producer understands customers' needs and recognizes them even before the market does. In other words, the technology push strategy requires teaching the customers the benefits of the inventions, which creates greater uncertainty about their ultimate

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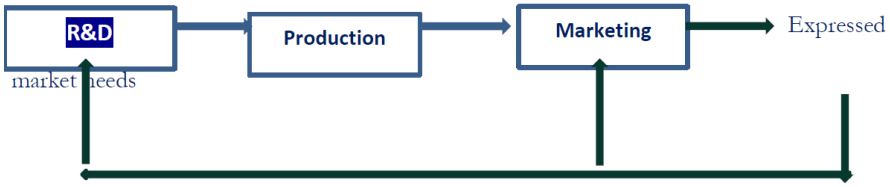
success on the market. Another possible problem occurs when the performance of the new technology is not competitive in comparison with the existing ones.

Market pull

In the market pull model, the innovation arises as a response to expressed market demand. That is way this model is also called "demand pull" or "market oriented" innovation. It can be presented as in the next figure:



In it, the primary incentive for innovation comes from customers' needs for a new product or a solution to an existing problem. The basic market pull needs are related to consumption and production targets, public procurement, tax incentives, increasing public awareness, etc. These needs are identified and assessed mainly through market research and potential customers, seeking for improvements of the current products. As a second step in successful innovations, a clear description of how far the needs are met by existing products must be made. Finally, innovators must answer the question how the identified needs might be satisfied effectively by a new and improved product or service (the innovation). Thus, the market pull approach to innovation relies on the abilities to both identify customers and accumulate information about them, and focuses mainly on customer value. It

> "enables companies to deliver market focused innovation and sustainable competitive advantage by their commitment to continuous market learning, discovering latent needs and hidden markets". (11, p. 136)

One of the most important characteristics of this approach is putting necessity above invention in the innovation process. Necessity can be appraised by the use of two models - the consultancy model and the codevelopment model. In the first one, the R&D team is consulting customers about their expressed needs, but they are not included in the processes of research and development. In the case of the codevelopment model, the development process is based on combining the efforts of inventors and potential users.

The market pull approach is also open for criticism and has its deficiencies and disadvantages. They refer mostly to the inability of inventors to satisfy customers' requirements. Another important problem stems from the fact that customers often do not know what they really want. They usually prefer to use the same products as in the past, while biasness is interested in future developments. The market pull strategy also carries the risk that the producers will look only at

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needs that are easily identified but have minor potential to induce innovations.

In reality, successful innovations are based on the combination of technology push and market pull models and "they have to be permanently adjusted to each other" (7, p. 356). An example of such a combination is the coupling model of innovations, which describes the interactions between technological capabilities and market needs. The next generation model – the chain-linked model – considers innovation as a parallel process, in which corporate functions are connected through numerous feedbacks (8, p. 6).

The most recent innovation models – the networking model and the open innovation model – are not closely related to the technology push and market pull practices. They pay attention to external sources of innovation including the acquisition and incorporation of knowledge and technology from outside the organization (7, p.14). The evolution of the innovation models shows that they are gradually moving away from the initial technology push – market pull debate. Despite of this fact, the two initial models have a serious impact on future ones, and still retain their significance in explaining contemporary innovation activities.

FURTHER READING

1. Capitalism, Socialism & Democracy

https://eet.pixelonline.org/files/etranslation/original/Schumpeter,%20Capitalism,%20Socialism%20and%20Democracy.pdf

One of the most influential works in social science that displays the way the capitalist economy works and elaborates the idea of creative destruction.

2. A Model of Growth Through Creative Destruction

https://www.nber.org/papers/w3223

The paper presents endogenous growth model based on creative destruction and concludes that technological progress creates losses as well as gains for the economy.

3. The Schumpeterian Growth Paradigm

https://www.brown.edu/Departments/Economics/Faculty/Peter_Howitt/publication/Schumpeterian_Paradigm.pdf

The paper analyses the main ideas of the Schumpeterian growth model, in which growth depends on innovations and new innovations drive out old technologies.

4. Creative Destruction and Development: Institutions, Crises, and Restructuring

http://www.rrojasdatabank.info/wbdevecon00-13.pdf

The article argues that creative destruction is a core mechanism of economic growth and defines the major obstacles to the process of creative destruction in developing countries.

5. **Has creative destruction become more destructive?**

https://freakonomics.com/media/Has%20Creative%20Destruction

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%20Become%20More%20Destructive.pdf

The paper studies some destructive components of innovations, including negative externalities on economic growth, employment and welfare.

6. Cycles „Versus" Growth in Schumpeter: A Graphical Interpretation of Some Core Theoretical Remarks

https://www.cairn.info/revue-cahiers-d-economie-politique-2014-2-page-35.htm

A theoretical paper, summarizing core theoretical remarks by Schumpeter and his theory of business cycles.

7. **Integration of Market Pull and Thechnology Push in the Corporate Front End and Innovation Management – Insights from the German Software Industry,** https://www.researchgate.net/publication/239358064_Integration_of_Market_Pull_and_Technology_Push_in_the_Corporate_Front_End_and_Innovation_Management_-_Insights_from_the_German_Software_Industry

The paper presents an extensive theoretical overview of technology and innovation management, discusses some aspects of technology push and market pull, and explains the way they can be integrated within corporate technology and innovation management.

8. **Conceptualizing the Innovation Process Towards the „Active Innovation Paradigm" - Trends and Outlook**

https://www.researchgate.net/publication/299413400_Conceptualizing_the_innovation_process_towards_the_'active_innovatioun_paradigm'-trends_and_outlook

A paper introducing the conceptualization of innovation process models and describing their evolution and peculiarities

9. **A Case study of Technology Push and Market Pull Strategies: Magnomics Start-up and Livedrive Spin-off**

https://www.academia.edu/17224618/A_Case_study_of_Technology_Push_and_Market_Pull_Strategies_Magnomics_Start-up_and_Livedrive_Spin-off

The paper analyzes the different technology transfer strategies - technology push and market pull, and based on two cases, compares the final results from their application.

10. **Market-pull and Technology-push in Manufacturing Start-ups in Emerging Industries,** https://www.researchgate.net/publication/259867744_Market-pull_and_Technology-push_in_Manufacturing_Start-ups_in_Emerging_Industries

The paper is focused on market-pull and technology-push orientations in manufacturing ventures, and specifically on the shift in their orientations during the

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firm's formative years.

11. **Analysis of Strategy Focus vs. Market Share in the Mobile Phone Case Business,**

https://www.researchgate.net/profile/Pekka_Kess/publication/228526548_Analysis_of_Strategy_Focus_vs_Market_Share_in_the_Mobile_Phone_Case_Business/links/0fcfd50fdcc80165cb000000/Analysis-of-Strategy-Focus-vs-Market-Share-in-the-Mobile-Phone-Case-Business.pdf?origin=publication_detail

The study analyses the main characteristics of technology push, market pull, customer focus and product focus in the case of mobile phone business.

SUMMARY OF KEY POINTS

- Contemporary economies experience creative destruction - the process of new innovations replacing existing ones that are rendered obsolete over time.
- In the Aghion-Howitt growth model, through creative destruction economic growth is defined as dependent on endogenous technological progress, which is connected with quality-improving innovations.
- Creative destruction influences not only long-term economic growth, but also business cycles, job flows and the accuracy of growth calculations.
- Innovation can be adopted through the use of two main models - technology push and markets pull.
- Technology push and market pull are usually considered to be competitive, but in some cases they can be applied simultaneously.

CASE STUDIES / REAL-WORLD EXAMPLES

Thomas Cook collapse

The world's oldest travel agency Thomas Cook, which specializes in package holidays, collapsed in September 2019 under the burden of a $2.1 billion debt, leaving 600,000 customers stranded. The collapse left 21,000 staff members jobless. The ripple effect worldwide damaged tourism business in Germany, Turkey, Spain, Greece, Cyprus, Egypt, etc. Established in 1841, Thomas Cook survived two centuries as one of the most successful companies in the tourism business. This unprecedented crisis in global travel industry demonstrated that everything changes and nothing is permanent. Having a successful future or disappearing depends on how effectively a company adapts to change.

A long operating history does not guarantee success in a rapidly modernising world. Rightly, some commentators have pointed out that in recent years Thomas Cook has failed to adapt to changes in consumption habits such as the widespread use of internet. The

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importance of this transformation was illustrated by a recent YouGov poll in the UK (March 2019) which found that just 6% of people surveyed booked holidays in-store via a travel agent, while 63% used PCs, laptops, smart phones or tablet devices…

The package holidays offered by Thomas Cook faced serious competition. Consumers looking for traditional lodgings such as the hotels and apartments increasingly turned toward popular travel comparison websites such as Expedia and Booking.com, which offered a bigger variety of options at a range of price points or Airbnb, the start-up offering a more authentic and often more affordable experience. At the backdrop of such competition, Thomas Cook, with its bricks and mortar business operation, began to look increasingly outdated. While the company was looking to profit from the revival of tourism in destinations they are renowned for: Egypt, Turkey and Tunisia, recent years have seen a general shift towards an increasing demand for city breaks.

So when we ask whether the company's collapse is a reflection of weakening consumers or whether there are greater forces at work, we can safely point to the latter. Technological innovation has and will continue to impact every part of our lives.

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Task:

Discuss in groups how do you interpret the collapse of Thomas Cook in terms of the concept of creative destruction? What are the major disruptive and positive impacts on the economy?

PROPOSED ASSIGNMENTS AND EXERCISES

1. Give some examples of creative destructions in modern economies. Discuss the impact of these destructions on real GDP and reallocation of labor. Comment the possible role of national innovation policies in the considered countries.

2. Analyse the connection between entrepreneurship, market power, innovations and creative destruction. What do you think about its

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dependency on antitrust policies, on one hand, and the defences of intellectual property rights, and especially patents, on the other?

3. Describe the major characteristics of the Aghion-Howitt model of growth through creative destruction. Explain how it differs from traditional endogenous models of growth and particularly from R&D growth models.

4. Comment on the impact of creative destruction on business cycle, and especially on the phase of recession. Find additional theoretical and empirical information about this impact and analyse its influences on economic growth in the long run.

5. Read the paper "Has Creative Destruction Become More Destructive?" by John Komlos (See №5 in Further reading). Summarize the main negative externalities of the described cases of creative destruction and trace their evolution over time. Outline the specific features of contemporary creative destruction in comparison with the First and Second Industrial Revolutions.

6. Define the technology push model of innovation and explain its characteristics. Give some real-world examples.

7. What are the main specificities of market pull innovations? Provide some examples from the real life.

8. Read the paper "A Case study of Technology Push and Market Pull Strategies: Magnomics Start-up and Livedrive Spin-off" (See №9 in Further reading). Based on the given analysis, summarize the major advantages and disadvantages of technology push and market pull innovations.

ASSESSMENT

Multiple choice test	
Question 1: Creative destruction does not refer to:	
Answer 1	destruction of products, processes and businesses to make way for new ones
Answer 2	sweeping out old products, old technologies and old organizations and replacing them with modern ones
Answer 3	constantly destroying the old forms of production and changing the structure of the economy
Answer 4	improvement of the existing products, technologies and structures aiming to enhance factor productivity
Answer 5	all of the above
Correct answer(s)	Answer 4

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Question 2: Creative destruction:	
Answer 1	produces job turnover on the labor market, which is driven by new entrants in the goods market
Answer 2	leads to an increase of unemployment if the "capitalization" effect is greater than the "creative destruction" effect
Answer 3	leads to a decrease of unemployment if the "creative destruction" effect is greater than the "capitalization" effect
Answer 4	has only positive effects on the economy and its segments in both the short run and the long run
Answer 5	none of the above
Correct answer(s)	Answer 1
Question 3: The creative destruction model of economic growth of Ph. Aghion and P. Howitt:	
Answer 1	is a prototype of endogenous growth models
Answer 2	presents economic growth as a function of vertical innovations
Answer 3	explains the growth effect of the market power and assumes that there is a positive relation between them
Answer 4	examines the dependence of economic growth on firms' development and concludes that innovations of both incumbents and entrants have a positive impact on productivity growth
Answer 5	all of the above
Correct answer(s)	Answer 5
Question 4: The technology push model of innovation:	
Answer 1	shows that innovation is driven mainly by market needs
Answer 2	is sometimes called „idea push" model
Answer 3	assumes that the innovation process starts

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	with marketing
Answer 4	assumes that the innovation process starts with production
Answer 5	none of the above
Correct answer(s)	Answer 2
Question 5: The market pull model of innovation:	
Answer 1	does not consider whether or not a new invention meets user needs
Answer 2	starts by a basic science-driven invention
Answer 3	comes from changes in the customer needs
Answer 4	occurs when large technology-driven companies push a given technology offering onto the marketplace
Answer 5	none of the above
Correct answer(s)	Answer 3

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GLOSSARY

Creative destruction:	Introduction of new products by innovating firms and the replacement of incumbent market leaders.
Economic growth:	An increase in the production capacity of the economy in the long run, measured by changes in real GDP.
Aghion-Howitt growth model through creative destruction:	An endogenous growth model, explaining a positive relationship between long-run economic growth and vertical innovations, induced by competition among research firms.
Creative destruction effect on job flows:	A creative destruction influence on the labor market, which implies a higher rate of job destruction and tends to increase unemployment.
Innovation models	Ways to adopt innovations, which are divided into two primary groups – technology push and market pull.
Technology push	A model of innovation according to which the company undertakes R&D activity and applies it to a product, without considering the market needs.
Market pull	A model of innovation according to which R&D activity and introduction of a new product occur as a result of expressed market needs.

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The concept of sustainability and sustainable development; models, principles and indicators of sustainable development

ANNOTATION

Sustainability issues are all around us nowadays. At the beginning, when the sustainability concept was only a good wish and was not accepted as something important, it was based on four main principles - consideration of public priorities, not only taking into account the needs of today but also the needs of the future generations; reasonable use of natural resources and restoration of ecological balance; linking economic effectiveness to environmental effectiveness; equal environmental responsibility and cooperation between countries in solving the global problems facing humanity. These principles are even more valid today. Since the 1970s, they have been significantly improved and developed. Furthermore, different sustainability models have emerged due to the different understandings and the different approaches to the subject on international level.

Many efforts have been made to popularize these ideas and to educate the population around the world about the need to live and act in a sustainable manner. This lecture aims at briefly presenting the concept of sustainability and its historical development. Analysis of the results of the actions in the sustainability field taken at national and international levels shows that most sustainability ideas are viewed more as desired behavior, not as an obligation. Therefore, especially nowadays, when the negative effects of human footprint are everywhere, there is the need for strict but achievable indicators to measure the actual results of the efforts on all levels.

THE CONCEPT OF SUSTAINABLE DEVELOPMENT

A lot has already been written and discussed about sustainable development, its nature and main characteristics. Some authors see it as a package of development programs that will help solve the problem of scarcity and lack of natural resources as well as issues of social equality (Bartelmus, 1994). Other authors accept it as a system of activities and mechanisms whose main purpose is to ensure optimal growth of the economy through the use of natural resources in the most efficient way that will preserve them for future generations (Pearce, Barbier, Markandya, 1990). Still others present it as achieving a balance between social and environmental principles in a socially justified and environmentally sound economic development (Gechev, 2005). The most popular definition of the concept comes from a report written in 1987 by an international commission, led by Gro Brundtland, known as the Brundtland report. It states that

> "*Sustainable development is development that meets the needs of the present without compromising the needs of future generations to meet their own needs*".

Since the Brundtland Report, the sustainable development idea has evolved further beyond the primary framework for "socially inclusive and environmentally sustainable economic growth". In 1992, the UN Conference on Environment and Development published the Earth Charter with the main purpose to outline the building of a fair and sustainable "global society" in the 21st century. The UN Agenda 21 action plan defined the three pillars of sustainable development -

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environment, social inclusion, and economics - as interdependent. It pointed out the need to change the business practices from the old resource-oriented to new approaches that involve interdisciplinary coordination and integration of environmental and social issues. Furthermore, Agenda 21 stressed that all activities related to sustainable development would be in vain without broad public participation in the decision making process.

In December 1997, the Kyoto Protocol was adopted. It was based on the principle of "common but differentiated responsibilities". It is the first legally binding global instrument that engaged the developed countries with specific quantitative reductions on their greenhouse gas emissions. The Protocol entered into force in 2005 and its first commitment period was until the end of 2012. The Protocol was then extended for a second commitment period until end 2020. It has been ratified by 190 states and the European Union.

The Protocol's scope includes six main greenhouse gases and its purpose was to reduce their emissions by 5% for the period 2008-2012 based on the emissions registered in 1990. The countries that have signed the Protocol are divided into Annex 1 countries (industrialized countries) and non-Annex 1 countries (mostly developing countries). For each state that has ratified it, the Protocol sets mandatory targets for reducing the amounts of emitted harmful gases, but it also develops three mechanisms to encourage the participation of private companies. These mechanisms are as follows:

- Joint Implementation (JI) - a mechanism that provides opportunity to developed countries that cannot reduce their own greenhouse gas emissions to invest and develop projects in transition economy countries. In return they receive a share of the reduced emissions by which to achieve their own obligations.

- Clean Development Mechanism (CDM) - enables developing countries to get investments for construction of new, low-carbon installations. On the other hand, the investors get the so called "credits from projects" by which they can cover part of their own obligations under the Protocol.

- Emissions trading – this mechanism allows countries to sell part of the reduced greenhouse gas emissions that exceed the commitments under the Protocol (the so-called "Surplus of Assigned Emission Units"). Using this mechanism, countries that have failed to reduce their emissions can buy part of the "surplus" emission units from countries that managed to reduce their greenhouse gas emissions below the required levels.

In 2000, the United Nations Millennium Declaration was adopted. The Declaration committed nations to a new global partnership to reduce extreme poverty. It identified eight time-bound targets (with a deadline for achieving them set for 2015) that became known as the Millennium Development Goals (MDGs). Many actions taken after that on worldwide level were targeted at achieving these goals. The MDGs are as follows:

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- Eradicate extreme poverty and hunger
- Achieve universal primary education
- Promote gender equality and empower women
- Reduce child mortality
- Improve maternal health
- Combat HIV/AIDS, malaria and other diseases
- Ensure environmental sustainability
- Develop a global partnership for development.

The United Nations Conference on Sustainable Development (known as Rio 2012) is the third international conference on sustainable development. Its aim is to reconcile the economic and environmental goals of the global community. The result of this conference was the development of the Sustainable Development Goals that aim to eliminate inequalities in the world and to promote sustainability.

After the Kiyoto protocol, the next important action in the field of climate change and sustainable development was the Paris Agreement. The Agreement builds on the UN Framework Convention on Climate Change, posing a common global target to rapidly reduce greenhouse gas emissions and to strengthen the ability of countries to build resilience and adapt to the impacts of climate change.

PRINCIPLES AND MODELS OF SUSTAINABLE DEVELOPMENT

At the beginning, when the sustainability concept was only a good wish and was not seen as something important, it was based on several main principles. They are even more valid today but since the 1970s, they have been significantly improved and developed. Furthermore, different sustainability models have emerged due to the different understandings and the different approaches to the subject at international level.

The concept of sustainable development is built upon the three most important aspects in the life of every society - economic development, social equity and environmental protection. In the context of sustainable development, they are known as the "pillars" of sustainable development.

The Brundtland report formulates the following basic principles of sustainable development:

- consideration of public priorities, taking into account not only with the needs of today but also the needs of future generations
- reasonable use of natural resources and restoration of the ecological balance
- linking economic effectiveness to environmental effectiveness

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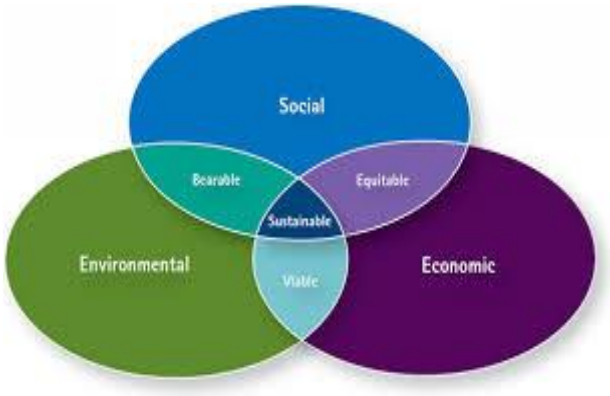
- equal environmental responsibility and cooperation between countries in solving the global problems facing humanity.

The relationships among these pillars is graphically presented in Fig.1.

Fig. 1 Sustainability



Source: https://www.sustainable-environment.org.uk/Principles/principles.php

The sustainability concept has developed throughout the years. There are several models that present the evolution of the concept and its improvement in time. Some of these are:

- 3-Legged Stool model
- Prism Models or 3 Overlapping Circles model
- The egg or 3 Nested Dependencies model

3 Legged Sool model

At the beginning and even sometimes nowadays, sustainable development has been depicted as a three-legged stool, where the environment, the economy, and the society are the legs. This model treats each of the three pillars as separate and equal entities.

The main idea of the stool is that if any of the legs is shorter, meaning is with smaller importance, or is missing, the stool will be unstable. However, if all three legs are with identical length (each pillar being given equal weight), the result is a balanced stool that will support sustainable development. This model sometimes is described as the "Three E's balance rule": Environment, Equity, Economy (SOGESID, n.d.).

The model has seen its share of criticism. Some authors (Dawe, Ryan, 2003) argue that it should not be a matter of balance as the world could not be forced to select among economics, environment and society. Each nation should have the right to achieve prosperity and this, according to the critics of the model, is not possible without jeopardizing the nature. Therefore, the environment should not be a leg of this stool but the ground on which the model should be build. It is the foundation of any economy and social well-being that humanity is fortunate enough to achieve (Herath, Rathnayake, 2019).

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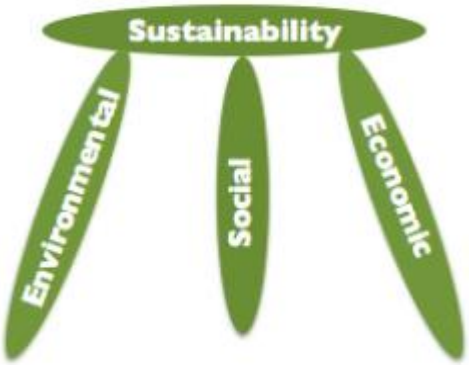
Fig. 2. – 3-Legged stool model



Source: https://bridgebrighton.wordpress.com/2012/11/20/defining-sustainable/

Prism Models or 3 Overlapping Circles model

Other authors (Lehtonen, 2004) think that the three pillars of sustainability are not equal, but have different positions in a hierarchy. In line with this, some authors propose a more complex and profound model, such as the "egg" or Prism model.

Fig. 3. - 3 Overlapping Circles model

Source: IUCN (2006)

The Prism model develops four dimensions of sustainable development:

• Economic

• Environmental

• Social

• Institutional

In each circle there are imperatives (as norms for action). Indicators are used to measure how far one has actually come in comparison to the overall vision of sustainable development (Keiner, 2005).

The critics of the 3-Legged Stool model are valid for this model as well. Both take it as granted that the different sustainable development elements are independent and in reality are quite intertwined and cannot exist separately.

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The Egg or 3 Nested Dependencies model

An alternative model is offered by the International Development Research Center. In 1997 it was proposes to replace the three pillars and the circles of society, economy, and the environment with the "egg of sustainability", originally designed in 1994 by the International Union for the Conservation of Nature, IUCN (Herath, Rathnayake, 2019).

Source: Herath, Rathnayake, 2019

This new approach describes all previous elements as an entire ecosystem where each element depends on the other. This model seems to be most comprehensive as it takes into consideration that nature provides all necessary resources and each of the elements cannot function without the others. However, this model faces criticism from those who place greater emphasis on human wellbeing (Herath, Rathnayake, 2019).

INDICATORS OF SUSTAINABLE DEVELOPMENT

Analyses of the results of actions taken in the area of sustainability on national and international level show that most of the ideas are viewed as a wish, not as an obligation. Therefore, especially nowadays when the negative effects of human footprint are evident, there is a need for strict but achievable indicators to measure the actual results of the efforts on all levels.

Sustainable Development Indicators (SDI) are various statistical values that collectively measure the capacity to meet present and future needs. They provide information crucial to decisions of national policy and to the general public. Some of the organisations that are dealing with sustainable development indicators issues are:

- Commission for Sustainable Development
- Dow Jones Sustainability Indices
- International Institute for Environment and Development
- International Institute for Sustainable Development
- Organisation for Economic Co-operation and Development

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- World Bank

The main function of these indicators is to provide information on the different aspects of the interdependence among sustainability elements. There are different sets of indicators that are developed by different international organisations to measure sustainability achievements. Among the ones most often used are (Dong, Hauschild,2017):

1. Environmental indicators (global warming potential, waste treatment, energy efficiency, energy recourse use, etc.)

2. Economic indicators (GDP, investment potential, government income, etc.)

3. Social indicators (equity rights, education, demographics, etc.)

An excellent source of indicators is the "Guidelines and Methodologies" book, published by the UN Commission on Sustainable Development which contains 140 indicators covering all sustainability aspects. The UN has also elaborated a System of Integrated Environmental and Economic Accounting, which is a useful tool.

FURTHER READING

The Concept of Sustainable Development: Definition and Defining Principles

https://sustainabledevelopment.un.org/content/documents/5839GSDR%202015_SD_concept_definiton_rev.pdf

The material presents in short the main ideas about sustainable development. It provides definitions and describes the main sustainability principles

Sustainable development: Meaning, history, principles, pillars, and implications for human action: Literature review

https://www.tandfonline.com/doi/pdf/10.1080/23311886.2019.1653531?needAccess=true

The article presents the main steps in the development of the sustainable development concept, and explains some of the main impacts on the human life

Millennium Development Goals

https://www.undp.org/content/undp/en/home/sdgoverview/mdg_goals.html

Presents the millennium goals and describes the ideas behind each goal

Indicators of Sustainable Development: Guidelines and Methodologies

https://www.un.org/esa/sustdev/natlinfo/indicators/guidelines.pdf

UN guidelines that present in detail the 140 indicators developed by the organisation for measuring the sustainability progress

SDG indicators: goal by goal

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https://ec.europa.eu/eurostat/web/sdi/indicators

Presents the sustainability indicators developed and monitored by the EU in line with the achievements for each of the millennium goals.

SUMMARY OF KEY POINTS

- Sustainable development ideals are not new. Their date back to the 1970s but have nowadays become a crucial element of global policy
- The contemporary world has finally admitted that sustainable development is something that should be taken into account and all countries should dedicate their efforts to follow the main sustainability principles in their strive for well-being
- The development of the concept led to elaboration of different models and approaches that try to explain the main sustainability ideas
- In 2000, the adoption of the Millennium Goals was a great achievement as it was the world's attempt to preserve the resources for future generations
- The development of different sets of sustainability indicators by different international organizations shows the great concern about sustainability issues worldwide.

CASE STUDIES / REAL-WORLD EXAMPLES

Example 1: Solid Waste Management, case in Ireland

Reproduced (with cuts) from:

http://personal.colby.edu/personal/t/thtieten/litter.htm

> "The litter problem in Ireland has been at the forefront of Irish environmental concerns in recent years. Rapid economic growth in the 1990's was marked by a significant increase in the amount of solid waste per capita. The lack of adequate landfill sites resulted in escalating costs of waste disposal, which in turn led to more frequent incidents of illegal dumping and littering.
>
> The litter problem was a prominent issue for the government because of the severe damage it was inflicting on the Irish 'green image'. It was feared that tourism, one of Ireland's largest industries, would be negatively affected as a consequence of the degradation of the environment. The food industry, which based a significant amount of their marketing strategies on a healthy, wholesome reputation, also suffered as a result of the increased litter and pollution.
>
> The most visible element of litter was plastic bags, so the government set about reducing this particular component of waste. Each year, 19,000 supermarkets and other retail outlets around the country provided to Irish consumers 1.26 billion plastic bags, free of charge. This translates to roughly 14,000 tons of plastic and 325 bags per consumer, per annum. A staggering 99.5% of this plastic was eventually sent to landfill sites or became litter on roadsides, in parks and along the coastline.

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On March 4th, 2002, the government introduced the Plastic Bag Environmental Levy on all plastic shopping bags, with a few exceptions on bags used for dairy products, fruits and vegetables, confectionary items, meat and fish. These exemptions were sanctioned for health and safety reasons. Retailers were charged a fee of 15c per plastic bag, which they were obliged, by the government, to pass on to the consumer. This levy was designed to alter consumer behavior and create financial incentives for consumers to choose more environmentally friendly alternatives to plastic, such as 'bags-for-life' or paper bags.

The Revenue Commissioners, working in conjunction with the Department of the Environment and Local Government, are responsible for collecting the levy from the various supermarkets and retailers. Retailers, for their part, are required to keep comprehensive records on the number of plastic bags they purchase and subsequently sell to customers. Since retailers are obliged to bear the compliance and administration costs, the government wished to minimize these costs in order to maximize compliance with the levy. It is estimated that these costs are offset by the savings made by retailers from no longer providing disposable bags to customers free of charge, as well as the profit margin earned on the sale of 'bags-for-life' whose sales have increased by 600%-700% since the introduction of the levy.

It was first hoped that this levy would bring about a 50% reduction in the number of plastic bags used, but this figure is currently estimated at 95%! In a single year, Irish consumers reduced their consumption of plastic bags from 1.26 billion p.a. to 120,000 p.a., while concurrently raising approximately €10 million for the Irish Revenue Commissioners. This collected revenue was placed in the Environmental Fund, which will be used in the future to finance environmental initiatives such as recycling, waste management and anti-litter campaigns.

This levy has been viewed as a major success by the government and environmental groups alike. It has also been enthusiastically embraced by Irish consumers, thanks to an intensive environmental awareness campaign that was launched in conjunction with the levy. Irish retailers, although skeptical in the beginning, have also recognized the huge benefits of this levy. The amount of plastic being sent to Irish landfills has been dramatically reduced, bringing about a clear, visual improvement in cities, on coastlines and in the countryside due to the decrease of litter. The Department of the Environment has received a number of calls from a multitude of countries expressing interest in the levy, including Australia, New Zealand, and Britain. It is hoped that many other countries will adopt similar policies in the future, which will further reduce the unnecessary use of plastic bags around the world."

Example 2: Waste management (case from Germany)

Reproduced from: http://personal.colby.edu/personal/t/thtieten/swm-germ.html

"The issue of waste management is of concern in Germany as it is in many places. In an attempt to minimize the quantity of solid waste, Germany placed an ordinance on packaging in 1991. This ordinance

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placed the responsibility to minimize waste on the manufacturers. By requiring manufacturers to take back the packaging of their goods and reuse or recycle it, the ordinance would work towards reductions in solid waste. The green dot system is a way to facilitate the industries' compliance with German regulations concerning waste management. Two goals were set: one for gathering waste and the other for separating. Together these goals imply a recycling rate. The aim is to recycle 72 percent of glass, tinplate and aluminum packaging waste, and 64 percent of paper, plastic and composite packaging. For comparison, the U.S. reported about 22 percent of glass and tinplate packaging was recycled in 1990. The regulations to achieve this ambitious goal would create incentives for the industries to minimize waste in the production processes and packaging.

Germany's green dot system in theory would cause manufactures to design packaging for waste avoidance. The system concentrates on three types of packaging. The first type is transport packaging such as pallets and crates used specifically for the transport of materials and goods. Secondary packaging consists of containers that are not essential for the use of the good such as the boxes around toothpaste and aspirin. This type of packaging primarily protects and displays the goods in a store, but is often discarded immediately after purchase. The third type is primary packaging which is the actual casing of a good. For example, toothpaste tubes and soda bottles are forms of primary packaging.

Companies found that it was challenging to meet the recycling quotas on their own. As a result, the "Dual System" (Duales System Deutschland) was created. It is a non-profit organization in which industries pay a fee to become a member. Members of the Dual System (DSD) will then put the green dot trademark on their packaging. They are now guaranteed from a recycling company that their packaging will be recycled if collected. Drop off and curb-side collection for all packaging with the green dot trademark is also available. The availability of recycling receptacles makes it more convenient and more likely for households to recycle which leads to a greater chance of companies meeting the required recycling quotas. As of September 1993, 12,000 companies had signed on for the green dot program including 1900 firms based outside of Germany.

In addition to the membership fee, which covers administrative costs, companies had to pay according to a schedule based on each package's volume. The highest fee was $0.12 for package volume greater than 30 liters (1,014 oz.). Most of the German packages fell into an intermediate category in which the fee consisted of $0.012 per 200mL-3liters (6.8-101oz.) volume packaging.

In October of 1993, a new fee schedule was announced and went into effect. The industries would now have to pay fees based on the package materials and weight. For example, glass is pre-sorted by households, so the fees on glass ($0.04/lb.) are the lowest fees. These fees are considerably lower than those on plastics ($0.82/lb.) which still need to be sorted at the recycling plant. Therefore the new fee schedule reflects the true costs of recycling particular materials. This new fee schedule would hopefully alleviate any of DSD's financial problems as compliance and payment of fees increase. The burden is

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clearly placed on the manufacturers initially. However, the consumers will share the burden as prices of consumer goods increase due to the increase in costs to the producer. The green dot system has proven to reduce waste. In 1992-1993, the consumption of packaging decreased by about 4 percent. Containers have been reused more and the quantity of secondary packaging has dropped by 80 percent. (Chilton, 1995) The green dot system was responsible for the collection of 4.6 million tons of recyclables in 1993. (BioCycle, 1994) There are some concerns with the green dot system such as the oversupply of recyclable waste. As the program proves to be successful, more markets for products made of recyclable waste will need to be created. In order for this program to be completely successful, the collected waste will need to be reused or recycled fully".

PROPOSED ASSIGNMENTS AND EXERCISES

1. Read the examples above. Describe how the ideas of sustainable development are applied in them.
2. Which of the sustainable development models is most applicable to these real-world examples in your opinion? Explain why.
3. Read the text below and answer the following questions:
   - 3.1 Are there any sustainable development ideas presented in the cases?
   - 3.2 Which of the Millennium Goals are addressed in the cases?
   - 3.3 Give your own opinion on what more can be done in the described cases for ensuring further sustainability.

ASSESMENT

Multiple choice test	
Question 1: The most commonly used definition of sustainable development states that:	
Answer 1	It is the development that meets the needs of the present without compromising the ability of future generations to meet their own needs
Answer 2	It is the development that looks for balance between the economic and the social life of society
Answer 3	It is the development that meets the needs of the present generations and tries to create a higher standard of life for the future one
Answer 4	It is the development that aims to preserve natural resources and to reduce waste and hazardous emissions
Answer 5	It is development that tries to promote economic development worldwide and to protect women's rights

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Correct answer(s)	Answer 1
Question 2: The Kiyoto protocol is one of the most important documents related to sustainable development because:	
Answer 1	it gives instruments for imposing penalties and taxes to the companies that do not comply with it
Answer 2	it addresses poverty and human rights issues
Answer 3	it is the first legally binding global instrument that commits developed countries to specific quantitative reduction of their greenhouse gas emissions
Answer 4	it is signed by all countries around the world including the big industrially developed countries
Answer 5	it imposes specific targets to companies in different countries for decreasing the quantities of waste they generate
Correct answer(s)	Answer 3
Question 3: The importance of the Paris agreement is related to:	
Answer 1	the fact that it addresses not only greenhouse gas emissions but also water and forest protection
Answer 2	the fact that it sets a common world target to rapidly reduce greenhouse gas emissions and to strengthen the ability of countries to build resilience and adapt to the impacts of climate change
Answer 3	the fact that it poses common target for all industrially-developed countries to reduce their greenhouse gas emissions
Answer 4	the fact that it imposes strict requirements on developed countries to further reduce their environmental footprint
Answer 5	the fact that it imposes specific targets for poverty reduction in low-income countries
Correct answer(s)	Answer 2
Question 4: According to the 3-Legged Stool model of sustainable development	

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Answer 1	the main principles of sustainable development are the economic, the social and the environmental and they are separate and equal to each other
Answer 2	The main principles of sustainable development are the economic and the social, with the environmental one at the base
Answer 3	The main principles of sustainable development are the social and the environmental and they are independent from each other
Answer 4	The main principles of sustainable development are the economic, the social and the environmental and the environmental one is the most important principle in this model
Correct answer(s)	Answer 1
Question 5: Sustainable Development Indicators (SDI) are:	
Answer 1	various statistical values that separately measure the capacity to reduce poverty worldwide
Answer 2	various statistical values that collectively measure the capacity to reduce greenhouse gas emissions
Answer 3	various statistical values that separately measure the achievements of each country in waste recycling
Answer 4	various statistical values that collectively measure the capacity to meet present and future needs
Answer 5	various statistical values that measure the capacity of the countries to deal with climate change
Correct answer(s)	Answer 4

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GLOSSARY

Sustainable development	A concept related to achieving prosperity with care for the environment and society
Environment	The natural surrounding that provides the resources needed for economic development
Models for sustainable development	Different approaches that describe the main sustainability ideas
Kiyoto protocol	The first legally binding documents related to sustainable development
Paris agreement	An important document related to mitigating the effects of climate change
Millennium development goals	Goals set on global level for achieving prosperity based on the sustainability principles
Sustainable development indicators	Indicators that measure the capacity to meet present and future needs

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The economics of sustainability (environmental economics)

ANNOTATION

The lecture examines the general conceptual framework used in economics to approach environmental problems. It starts with a brief overview of the range of terms employed to designate the sub-discipline of economics that deals with the relationship between the environment and the economic system. Then, the lecture sifts through the prevailing methods for economic valuation of changes in environmental assets. As far as the environment is a composite asset (that provides a variety of services), environmental changes are virtually impossible to comprehend in their entirety. Nonetheless, a number of environmental professionals now support economic valuation as a way to demonstrate the enormous value of the environment to modern society. The last part of the lecture presents the accepted economic instruments of environmental policy.

SURVIVAL IN THE TERMINOLOGY MAELSTROM

The economy and the environment are inextricably linked. The economy is a subset of our environment, which is finite.

The market shows inability to account for the full environmental costs of economic production of goods and services. In this sense, environmental problems can be seen as a form of market failure. Respectively, the theory of external effects concludes that when present, externalities produce suboptimal levels of human wellbeing. In an attempt to redress the balance, environmental economics has emerged as a sub-discipline of economics.

Modern economics employs various economic terms and concepts to environmental issues like environmental degradation, resource depletion, and global environmental change. Titles such as environmental economics, natural resource economics, ecological economics, and economics of sustainability are used to describe this domain. Although some sources consider the distinction between environmental economics and natural resource economics as insignificant, others still distinguish between them. Natural resource economics deals with rates of exhaustible resource depletion and the determination of optimal harvest rates for renewable resources. Environmental economics is focused on pollution. Another strand in the field is ecological economics, wherein there is greater emphasis on the biogeophysical limits of the Earth – the limits set by the carrying capacity of the Earth and its environment.

Last but not least, sustainability economics emphasizes the idea of justice in the domain of human-nature relationships. Its concern is for economic efficiency, understood as non-wastefulness, in the allocation of natural assets for achieving justice, including inter- and intra-generational justice and justice towards nature, in the setting of human-nature relationships over the long term and inherently uncertain future. While intergenerational and intra-generational justice reflect an anthropocentric idea of justice, according to which nature matters to humans exclusively for its instrumental value in satisfying human needs, justice towards nature reflects a physiocentric idea of justice, according to which nature matters because of its intrinsic value. The latter interpretation of justice implies nature conservation for its own sake.

As far as the lecture deals with the economics of environmental assets, the label 'environmental economics' is used throughout it. Environmental

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economics is about *the allocation of scarce environmental resources for maximizing value (instrumental and intrinsic value) in human-nature relationships*. Thus, the problem of valuation emerges.

ECONOMIC VALUATION OF CHANGES IN ENVIRONMENTAL ASSETS

Two of the major contributions of environmental economics have been to emphasize the incompleteness of project and policy appraisals that omit environmental change and to develop the means of incorporating environmental values into appraisals. Hence, the issue of money valuation of environmental change (or preservation) arises. The impossibility of avoiding monetary valuation brings in the theory of economic valuation to the analytical armoury of environmental economics.

Money valuation is the economic rent, i.e., price minus marginal costs. While data on rents are difficult to come by, the valuation issue for marketed products – fisheries, timber, energy, for example – is not complex in principle. But where the asset being valued is not marketed, individuals' willingness to pay to prevent environmental changes is reduced. Thus, probably the largest, and most controversial, research effort in environmental economics has been devoted to the issue of valuing non-marketed asset change. The focus has been on nature assets. (Only recently, attention has started to be paid to the changes in social assets.)

Several methods are available to estimate environmental asset values. A brief overview to convey some sense of the range of possibilities is provided in Table 1.

Table 1

Economic methods for measuring environmental (incl. resource) values

Methods	Revealed Preference	Stated Preference
Direct	Market Price	Contingent Valuation
	Simulated Markets	
Indirect	Travel Cost	Attribute-Based Methods
	Hedonic Property Values	Conjoint Analysis
	Hedonic Wage Values	Choice Experiments
	Avoidance Expenditures	Contingent Ranking

Source: Tietenberg and Lewis, 8th ed.

Direct revealed preference methods are based on direct estimation of actual resource values. For example, in calculating how many local fishermen lost from oil spill, the direct revealed preference method might calculate how much the catch declined and the resulting value of the catch. In this case, prices are publicly available, so the value lost can be directly calculated.

The second group of methods is **indirect revealed preference methods**, which are "revealed" because they involve **actual behaviour** and "indirect"

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because they **infer** a value and do not estimate it directly.

Another way is to use **travel-cost method**. Travel-cost methods may infer the value of a recreational resource, e.g. a wildlife preserve, by using information on how much the visitors spent to travel to that place. Based on such inferences, a demand curve for willingness to pay for a visit can be built. In such a way, individual preferences for a non-marketed good are revealed through data coming from other markets.

The travel-cost method was proposed by Hotelling in 1947 when asked by the U.S. National Parks Service how to measure the worth of national parks. As the parks offered free entrance, the problem was similar to that tackled by Dupuit in the 1840s – although there was no market for roads and bridges, people were willing to pay for them. In regard to the use of the park, people incurred costs in order to enjoy its amenities - these are mainly the costs of travelling to the park. As people started from different places, the costs they incurred were also different. Taking the differential costs as prices allowed the demand curve for recreational visits to be constructed. The resulting area under the demand curve provided an estimate of the total consumer surplus accruing to visitors to the park. The value of the flow of services from the recreational site is the area under the estimated demand curve for those services or for access to the site, aggregated over all who visit the site.

Travel-cost methodologies and techniques have been further developed to estimate benefits in the case of multiple recreational sites. The impact of site characteristics on choice is analysed, so the value of these characteristics is inferred. Being aware of the variation in the value of each site in view of its characteristics, the analyst can infer how degradation of those characteristics, e.g. from pollution, would diminish the value of the site. This second variant uses random utility models to value quality changes: a person choosing a particular site considers site characteristics and its price (what are the costs of getting to that place). Determinants influencing visitor decisions include ease of access and environmental quality. Each site results in a specific level of utility and a visitor is assumed to go for the place which provides the highest level of utility. Welfare damages from an oil spill, for example can then be measured by the change in utility if the visitor has to select another site.

An issue in travel cost studies is that they use surveys of users to determine their mode and starting point of travel. The way surveys are designed and the truthfulness of the responses bear on the quality of results, just as they do in the "stated preference" methods tat will be discussed later.

Two more indirect observable methods are the hedonic property value and the hedonic wage approaches. They use a multiple regression analysis to isolate the environmental component of value in a related market. For example, all other things being equal, property values are lower in areas with polluted air than in areas with clean air. Hedonic property value models use market data (house prices) and then deconstruct the price into its components, including the house characteristics (number of rooms, etc.), the neighbourhood characteristics (crime rates, etc.), and environmental characteristics (air quality, etc.). Hedonic models allow for the measurement of the marginal willingness to pay for marginal changes in the attribute. For

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example, Ridker (1967) established statistical links between levels of air pollution and property values in St. Louise, Missouri. The value obtained is the coefficient on air pollution in a regression of property prices on determining factors.

Another group of indirect revealed preference methods are hedonic wage methods. They disentangle the component of wages paid to workers in risky occupations to compensate the risk. In that case the dependent variable is the labour wage, and the independent variables are factors such as skill level, union membership, risk, etc. When the risk is environmental (such as working in toxic conditions), the results of the multiple regression analysis can be used to derive a willingness to pay to avoid this risk.

The second major type of methods - stated preference methods - are applied in case the value sought is not directly available. Stated preference methods use surveys (questionnaires) to derive the value the respondents ascribe to conservation. A major advantage is that these methods can produce various kinds of economic value for making policy or project decisions. Importantly, they can elicit values placed on an environmental asset by nonusers of the asset, i.e., those who want the asset to stay intact or be taken care of, but who do not use that asset in a direct manner. Categories such as "nonuse" or "passive use" value have become relevant to the application of stated preference techniques but are also controversial. Contingent valuation methods aim to retrieve the respondents' willingness to pay (i.e. their stated preference) by asking questions such as "what are you willing to pay?" and/or "are you willing to pay $X to prevent the change", with change here referring to issues such as the loss of wetlands or increased exposure to pollution. In view of the risks that the respondents' cognitive constraints may influence the results, modified stated preference methods can be applied instead, such as conjoint analysis and contingent ranking. The former uses a survey but it asks the respondents to choose from alternative scenarios, each of them described by a number of characteristics and a price. The latter also uses a survey but in this case respondents are asked to rank alternative scenarios that describe various levels of environmental amenity. Based on the rankings, a trade-off analysis is made – between the level of the environmental amenity and the level of the other characteristics. If some of these characteristics can be measured in monetary terms, estimates of the value of the environmental amenity can be derived.

A major problem with stated preference methods is the misrepresentation of preferences as stated by the respondents. The challenge is to design questionnaires that eliminate or considerably minimize the risk for biased answers on the part of respondents. The conclusion is that it is impossible to guarantee truth telling. However, the analysis is stringer and, to the extent possible, bias-proof if the directions of bias can be identified.

ENVIRONMENTAL POLICY ECONOMIC INSTRUMENTS

Environmental economists strive to incorporate rational economic concepts into policy making. They encourage the application of economic instruments for the sake of achieving environmental cost minimization and benefit maximization. Instruments such as pollution taxes, deposit-refund schemes,

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tradeable pollution or resource permits, send a price signal to polluters and resource users. Their rationale is related to the expectation that they will (1) minimize the costs of complying with regulations; (2) stimulate technological upgrade.

The notion of an environmental tax dates from Pigou (1920). Pigou argued that, where "marginal net private product" deviated from "marginal net social product" (i.e. when there is an externality) intervention through a tax would be justified as a means of maximizing the "national dividend" (economic welfare). Apart from the point of determining tax rates to offset the marginal externality, tax rates also fulfil the function of minimizing compliance costs. The rationale is that the polluter will be willing to limit pollution while the marginal cost incurred for reducing pollution is lower than the tax costs.

The origins of marketable permits lie with the work of Dales (1968). The underlying rationale is as follows. If the number of polluters is X and they are responsible for generating pollution amounting to Y quantity, permits equal to that quantity can be issued and distributed among the polluters so that they can buy and sell them. It can be expected that polluters will constrain pollution to the point at which the costs incurred for pollution abatement are less than the costs of acquiring permits. Strong polluters will buy permits while low-abatement cost polluters will sell permits. Thus the market will come up with an equilibrium price for the permits.

Both instruments – taxation and tradable permits, place the burden of costs on the polluter. However, according to Coase (1960), besides the polluter pays principle, one more solution is possible: when the sufferer pays the polluter not to pollute. According to Coase both solutions are equally efficient. While the second solution might be perceived as unfair, it has real world applications, for example in the case of a low-income polluter and a high-income sufferer. Higher-income states suffering transboundary pollution may provide funds and equipment for pollution abatement to lower-income states.

The practice of both instruments – environmental taxes and tradable permits, is now extensive. Environmental taxes are widely applied in OECD countries and are being introduced in middle-income and even low-income countries. Tradable permits cover traditional air pollutants, fisheries, and water, and they are also used in the solid waste sector through tradable recycling obligations and tradable landfill quotas. On the one hand, environmental economists have been successful in getting their ideas adopted. On the other hand, it remains unclear just how successful the instruments have actually been. There is a need for more ex-post studies of the feasibility of economic instruments.

FURTHER READING

Environmental Economics: the essentials

http://www.rgvi.gtk.szie.hu/system/files/upload/course_material/enviroecon-vol1.pdf

The guide provides easy-to-understand explanations of common economic terms; recommended websites and articles are included.

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The Economics of the coming spaceship Earth

http://arachnid.biosci.utexas.edu/courses/THOC/Readings/Boulding_SpaceshipEarth.pdf

Boulding's 1966 "spaceship Earth" essay - a celebrated paper that provoked many questions that were subsequently analyzed in environmental economics. Boulding likened planet Earth to a spaceship.

Resources for the Future

www.rff.org

Resources for the Future is an independent, nonprofit research institution working to improve environmental, energy, and natural resource decisions through impartial economic research and policy engagement.

The International Institute for Sustainable Development

www.iisd.org

The International Institute for Sustainable Development is a research organization that contributes to sustainable development by advancing policy recommendations on international trade and investment, economic policy, climate change, and natural resources management.

UNESCO: Education for Sustainable Development

http://www.unesco.org/new/en/venice/special-themes/education-for-sustainable-development/

This site features information on a variety of themes related to sustainable development and provides a clearing house for information briefs, news, and demonstration projects.

Ecosystemvaluation.org

http://www.ecosystemvaluation.org

Professors Dennis King and Marisa Mazzotta provide this website for non-economists with clear, non-technical explanations of ecosystem valuation concepts, methods, and applications.

SUMMARY OF KEY POINTS

- The economy is a subset of our environment, which is finite.
- Modern economics employs various terms - environmental economics, natural resource economics, ecological economics, and economics of sustainability – to designate the sub-discipline of economics that is concerned with the development and application of economic concepts to environmental issues.
- Two of the major contributions of environmental economics have been to emphasize the incompleteness of project and policy appraisals that omit environmental change and to develop the economic methods for valuing environmental values.
- Environmental economics attempts to advance the use of economic instruments such as pollution taxes, deposit-refund schemes, and

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tradeable pollution or resource permits, to bear on environmental policy making.

- Economic instruments of environmental policy are now being extensively used in practice. In this sense, environmental economists have been successful in getting their ideas adopted. Nevertheless, it remains unclear just how successful the instruments have been in achieving their intended impact.

CASE STUDIES AND REAL-WORLD EXAMPLES

Do affluent people care more for their local environment than less affluent people?

"The Buriganga River, which passes through Dhaka City, the capital of Bangladesh, was selected as the case study for this research. Although considered to be the lifeline of the capital, the city part of the Buriganga River has become biologically and hydrologically dead because of the indiscriminate dumping of domestic and industrial wastes, encroachment of riverbanks by unscrupulous people, and negligence on the part of the authority to enforce rules and regulations pertaining to the ecological health of the river. A hypothetical cleanup programme was designed for the Buriganga River to frame the application of the economic valuation technique where respondents were asked for their preferences for the improvement of its water quality and development of new facilities in and around the river.

The contingent valuation (CV) scenario framed for the study captured non-market benefits of the Buriganga River Cleanup Program (BRCP) which was hypothetically proposed over a 10-year period. The survey design used a payment card elicitation format, and an increase in water bill as a payment vehicle. The study area was restricted to Dhaka City. Using a stratified random sampling technique[1], 400 households (from a total of 643,016) in Dhaka City were interviewed. The survey questionnaire was refined using inputs from focus group discussions, and pre-tested before fielded for implementation.

After describing the valuation scenario, respondents were asked to determine how much they would value the environmental improvements of the Buriganga River if confronted with the opportunity to obtain the potential range of goods and services under some specified terms and conditions. Irrespective of a respondent's decision whether to agree to pay or not for the BRCP, a question was asked whether the respondent would agree to contribute time to the cleanup programme. If they agreed, they were asked the duration of time per month and the manner in which they wanted to contribute. Responses to direct questions about the willingness to contribute (WTC), both in the form of money and time, can be interpreted as estimates of each individual's preference for the good in question.

Estimates of the Willingness to Contribute Money (WTCM)

Table1: Willingness to contribute money

[1] The study area was stratified into two constituents: 'Buriganga River area' (BRA), i.e. adjacent to the river, and 'outside Buriganga area' (OBA). Distance of locality from the river was used as the basis of this demarcation.

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WTCM	Counts
YES	102
NO	298
TOTAL	400

Table 2: Distribution of willingness to contribute money

Monthly amount (X)	Midpoints (x)	Frequency (f)	Cumulative frequency (cf)
>Tk[2] 2000	3000	3	3
Tk 1001 - 2000	1500.5	0	3
Tk 501 – Tk 1000	750.5	2	5
Tk 201 - 500	250.5	10	15
Tk 101 - 200	150.5	8	23
Tk 51 - 100	75.5	27	50
Tk 1 - 50	26	49	99
		n=99	

For measuring the WTCM amount in this study, the median is chosen rather than the mean. The median of Tk 51.91 is a relatively small sum and is just above the lowest bracket of the payment card.

Estimates of the willingness to contribute time (WTCT)

In the field survey, it was observed that many respondents were found to be very supportive of the BRCP, but when the question of WTCM arose, a substantial portion of respondents (about 73 percent of those who supported the BRCP) were found to be unwilling to commit a monetary contribution. More than a quarter of the unwillingness was due to financial inability. This was not completely unexpected in an extremely poor economy, because respondents might have other more pressing priorities (e.g. basic food and shelter) to spend their money on. To complement such a situation, a question was included in the interview schedule – irrespective of respondents' decision for WTCM, whether they were willing to contribute their own time for the BRCP and whether there was any other contribution they were willing to make, other than monetary involvement.

Table 3: Willingness to contribute time for the cleanup programme

WTCT	Observed counts	Percent
Yes to WTCT	131	32.75
No to WTCT	269	67.25
Total	400	100.0

Respondents were also asked how many hours per month they were prepared to dedicate to the BRCP.

[2] Taka (Tk) is the Bangladesh currency.

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Table 4: Respondents' willingness to contribute time in a month

WTCT in a month	Frequency	Percent
Unable to give time	265	66.25
Willing to contribute time	131	32.75
- **Less than one hour**	82	62.60
- **One to four hours**	39	29.77
- **Five to twelve hours**	10	7.63
Don't know/unwilling to answer	4	1
Interviewed sample (n)	400	100.00

An attempt is made in Table 5 to monetize the contribution of time for the residents of Dhaka City. The mid-points for the class intervals of (i) less than one hour; (ii) one hour to four hours; and (iii) five to twelve hours are estimated as 30, 150 and 510 minutes respectively. As per the expressed willingness of 131 respondents, a total of 223.50 hours time per month is committed by the participants for the six categories of work. This information together with data on current market rates of wage and salary is used to estimate the WTCT in monetary terms in Table 5.

Table 5: Monetization of contribution in terms of time in a month (in Tk)

Type of work	Total hours*	Money value of WTCT (in Tk)
Physical labour	29.42	294.17
Campaign and public awareness building	90.67	1813.33
Organizing meeting and rally	48.50	970.00
Non-technical office work	42.50	1700.00
Technical office work	8.17	1225.00
Consultancy	4.25	2125.00
Total	223.50	8127.50

Notes: Multiple answers were allowed.

* Total hours of work are equally divided among categories of work when respondents show their intention to volunteer time for more than one category.

The values of per hour physical labour, work for campaign and public awareness building, organizing meeting and rally, non-technical office work, technical office work and consultancy are estimated at Tk 10, Tk 20, Tk 20, Tk 40, Tk 150 and Tk 500 respectively. These rates, fixed at focus group discussions, are considered to be the market rate for these types of work in Dhaka City. The respondents' average value of willingness to contribute in terms of time is estimated as (Tk 8127.50/131=) Tk 62.04 per month.

Economic value of non-market benefits

The total annual value of non-market benefits is shown in Table 6.

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Table 6: Estimate of yearly non-market benefits

Category	Amount in Tk
Households' average WTC_M per month (Proportion of household WTC_M: 25.50%)	51.91
Total number of households in Dhaka City	1,107,474
Annual value of monetary contribution (WTC_M)	175.91 million
Households average WTC_T per month (Proportion of household WTC_T: 32.75%)	62.04
Annual value of time contribution (WTC_T)	270.02 million
Total estimated annual non-market benefits	445.93 million

Source: Field survey and BBS (2001) for number of households in Dhaka City

Such information about residents' willingness to contribute could be extremely valuable for the decision-making body. The application of the contingent valuation method allows the residents of Dhaka City to voice the importance of saving the river and to accommodate its non-market value into a monetary economic framework."

Source: Alam, K., Valuing the environment in developing countries: Problems and potentials, Paper presented at the 49th Australian Agricultural and Resource Economics Society (AARES) Annual Conference, February 9-11, 2005, Coffs Harbour, NSW, Australia

Task:

What is your reaction to the information presented above? What are your questions and comments?

PROPOSED ASSIGNMENTS AND EXERCISES

1. Read the essay "The Economics of the Coming Spaceship Earth" by Kenneth E. Boulding (See Further reading No2). What questions related to the domain of environmental economics/ecological economics/sustainability economics does the essay provoke you to ask and comment on?
2. How would you evaluate a project that has irreversible effects, e.g. the flooding of an environmentally important valley in order to produce hydroelectricity? In particular, share your questions and comments on one of the following issues (if necessary, carry out research to better understand the terms and economic concepts):
   - The inclusion of nonuse values and option values of the environmental amenity as part of the opportunity cost of the development
   - The rate of technological change as a decay factor in the benefits

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of development – its repercussions for the discount rate applied to development benefits and the present value of the project

- If environmental assets are fixed in supply but demand for them grows through time, there will be a relative price effect that will inflate the conservation benefits. What does this mean for the discount rate applied to forgone benefits, and respectively, for the present value of the project?
- What is the value of delaying irreversible action? What does the notion of quasi-option value suggest in a world of irreversibility and uncertainty?
- What are the contributions of environmental economics to cost-benefit analysis?

3. In economics, the system of measurement is anthropocentric (human-centric). That does not imply that ecosystem effects are ignored. Nonetheless, the notion that humans are doing the valuing is a controversial point. What are your questions and comments?
4. Carry out research to find examples of applications of the methods of economic valuation of environmental assets. What are the lessons learned?
5. What economic instruments / measures of environmental policy making are adopted in your country? Try to find out information on the effectiveness of their application.
6. Find out real-life examples of the "victim pays" solution in an externality context.

ASSESSMENT

Multiple choice test	
Question 1: In a broad sense, environmental economics deals with:	
Answer 1	rates of exhaustible resource depletion and the determination of optimal harvest rates for renewable resources
Answer 2	pollution
Answer 3	the relationship between the economic system and the biogeophysical limits of the Earth - the limits set by the carrying capacity of the Earth and its environment
Answer 4	the economic efficiency in the allocation of environmental assets for achieving justice in the domain

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	of human-nature relationships
Answer 5	All of the above
Correct answer(s)	Answer 5
Question 2: Two of the major contributions of environmental economics have been to:	
Answer 1	emphasize the incompleteness of project and policy appraisals that omit environmental change, and to develop the means of incorporating environmental values into appraisals
Answer 2	develop the travel cost method and hedonic methods for measuring environmental values
Answer 3	develop conjoint analysis and contingent ranking methods for measuring environmental values
Answer 4	develop hedonic property values method and hedonic wage values method for measuring environmental values
Answer 5	develop contingent valuation method and attribute-based methods for measuring environmental values
Correct answer(s)	Answer 1
Question 3: Direct revealed preference methods are based on:	
Answer 1	actual observable prices, from which actual environmental values can be directly estimated
Answer 2	actual observable prices, from which environmental values can be inferred rather than directly estimated
Answer 3	the use a survey (questionnaires) to derive the value the respondents place on preserving natural assets
Answer 4	the use a statistical technique known as multiple regression

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	analysis to disentangle the environmental component of value in a related market
Answer 5	the use of a set of hypothetical situations that differ in terms of environmental amenity available, whereupon respondents are asked to rank order them
Correct answer(s)	Answer 1
Question 4: Contingent valuation method is a kind of:	
Answer 1	direct revealed preference method
Answer 2	indirect revealed preference method
Answer 3	direct stated preference method
Answer 4	indirect stated preference method
Answer 5	hedonic valuation method
Correct answer(s)	Answer 3
Question 5: Environmental taxes and tradable pollution permits are examples of:	
Answer 1	economic methods for measuring environmental values
Answer 2	'the sufferer paying the polluter not to pollute' principle
Answer 3	Environmental externalities
Answer 4	direct stated preference method for measuring environmental values
Answer 5	economic instruments for environmental policy making
Correct answer(s)	Answer 5

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Environmental Literary Council, Environmental Economics: the essentials

http://www.rgvi.gtk.szie.hu/system/files/upload/course_material/enviroecon-vol1.pdf

GLOSSARY

Externality	An externality is a detrimental (or beneficial) effect to a third party for which no price is exacted. Pollution damage fits neatly into this definition. Polluters cause damage to third parties but may not be required to pay for that damage.
Environmental economics	Environmental economics is about the allocation of scarce environmental resources for maximizing value (instrumental and intrinsic value) in human-nature relationships.
Direct revealed preference methods (for measuring environmental values)	Methods for measuring environmental values that are based on actual observable choices, from which actual resource values can be directly estimated.
Indirect revealed preference methods (for measuring environmental values)	Methods for measuring environmental values that are based on actual observable behaviour but are "indirect" because they infer a value rather than estimate it directly.
Stated preference methods (for measuring environmental values)	Methods for measuring environmental values that use surveys (questionnaires) to derive the value the respondents place on preserving environmental assets.
Environmental tax	In case 'marginal net private product' deviates from 'marginal net social product' (i.e. when there is an externality), intervention through a tax would be justified as a means of maximizing economic welfare as a whole. The idea of setting taxes equal to the marginal externality is the cornerstone of the

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	environmental tax approach. In addition, environmental taxes have the feature of minimizing compliance costs.
Marketable (pollution) permits	Given the need to meet some target, say X tonnes of pollution, and the source of the pollution is Y emitters, this solution is based on distributing permits equal to X tonnes to the emitters, and then allowing them to buy and sell the permits.

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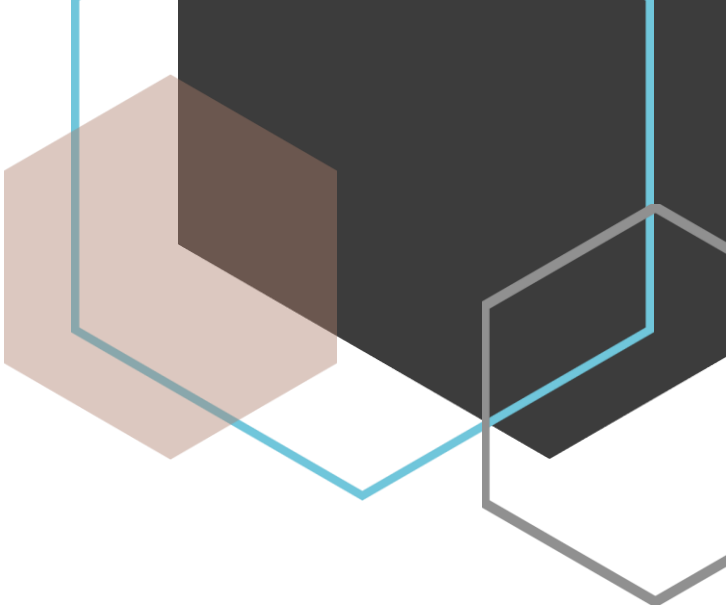
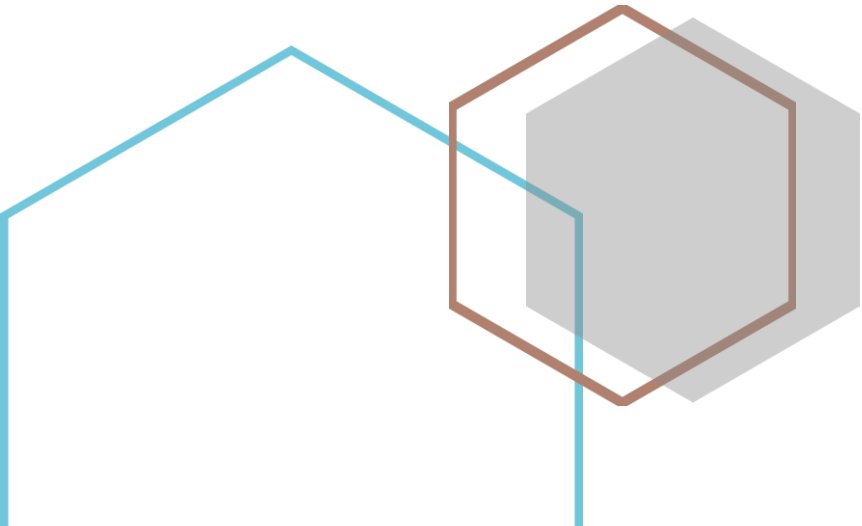


Evolutionary perspectives on innovation

Non-market barriers and constraints to the supply of innovation

System innovation

'Society pull' approaches to innovation



ANNOTATION

Environmental and societal pressures have gradually incited the need to reconsider innovations in the context of sustainable development. New theoretical approaches such as evolutionary economics have appeared. Evolutionary economics recognizes the challenges of adjusting market based instruments (prices, taxes) and the role of demand-pull. However, it takes into consideration also many non-market constraints (institutional, societal and political barriers) to the supply of innovation and asks why market based instruments do not lead to a promotion of green innovations. Grand societal challenges need to be addressed with the help of non-neutral policies that support more radical transformations and modernizations. At company level, the study of innovation in business has been explored within the theoretical framework of different disciplines.

The approaches of "strategic niche management" and "transition management" emphasize the experimental introduction of sustainable technologies using societal experiments. The concept of "time strategies" is described as political planning and exploitation of "time windows" of opportunities during the insecure phases of technological development. They allow for developing technology competitiveness in particular.

The "Society pull approach" describes the endeavour for sustainable development. Society has to decide which economical, ecological and social goals, or a balance among them, is to be met. Social innovation can be examined as one of the aspects of the society pull approach. Social innovation can take place both in social enterprises and in for-profit companies that orient part of their business to innovations with a strong social impact. It can originate either in a new or in an existing company that combines its innovation culture and tradition with the identification of unsatisfied social needs.

INNOVATION

Innovation is a major driver of change in modern society. In the second half of the twentieth century, research was focused on public R&D spending and its impact on economic growth. It was found that there was no direct link between the two variables. However, increased research and the creation of a business environment conducive to innovation stimulate the ideation and commercialization of new products and services at the company level. The innovation approach to growth has looked at the positive spill-over effects of more R&D in companies. The implications of this model are that investment in human capital and R&D generate increasing returns to growth. The main discussion on innovation in the neo-classical approach is whether technological innovation has been driven by technological development (technology push) or by demand factors (market or demand pull). Empirical evidence has shown that both are relevant and important for the innovation success. With regard to eco-innovation, new technologies can be incorporated under technology push factors, while preferences for environmentally friendly products or image can be considered under market pull factors. The government policy has

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to correct market failures.

Environmental and societal pressures have gradually incited the need to reconsider innovations in the context of sustainable development. Growing competition, uneven access to scarce natural resources, an aging workforce and environmental degradation have motivated the discussion to go beyond a traditional understanding of innovation which focused mostly on technological solutions and market needs. An integrated perspective encompassing the social, economic and environmental dimensions of innovation became necessary. Innovation has to be socially, environmentally and economically sustainable. New theoretical approaches, such as evolutionary economics, appeared.

EVOLUTIONARY ECONOMICS

Evolutionary economics is concerned with the transition processes, such as how to transform the economy into a more resource efficient and green one, and to explain the limitations of certain technologies and innovations. Evolutionary policy approaches focus on the dynamics of change and their drivers and allow for a substantive perspective on technologies beyond mere input–output (Nill & Kemp, 2009). It recognizes the challenges of adjusting market based instruments (prices, taxes) and the role of demand pull. However, it takes in consideration also many non-market constraints (institutional, societal and political barriers) to the supply side of innovation and studies why market based-instruments do not lead to a promotion of green innovations (Nill & Kemp, 2009). Policymakers have to adopt a holistic approach or a systemic view in order for the "system of interconnected institutions to create, store and transfer the knowledge, skills and artefacts that define new technologies" (Metcalfe, 1995, p. 38).

Political actions should lead to changes in the supply and demand side of the national innovation system and the intermediaries that ease the interaction among them (Fig.1). Policy supports collaboration between industry and universities/research organisations, training, regional innovation systems development, etc. Efforts are needed for better integration of evolutionary approaches into sustainable innovation policies. New transformational and transition management policy strategies have to change the roles of different stakeholders and to restructure the institutional setup of societies. It may lead to new organisation of R&D institutions, priority settings, public-private partnerships at national and regional level, regulatory frameworks, etc. The grand societal challenges need to be addressed with the help of non-neutral policies that support more radical transformations and modernizations. In addition to climate change, challenges that will continue to be issues for the society and policymakers in the future are migration, regional inequalities, and populism (Brenner & Broekel, 2019). Innovation policy should focus on them.

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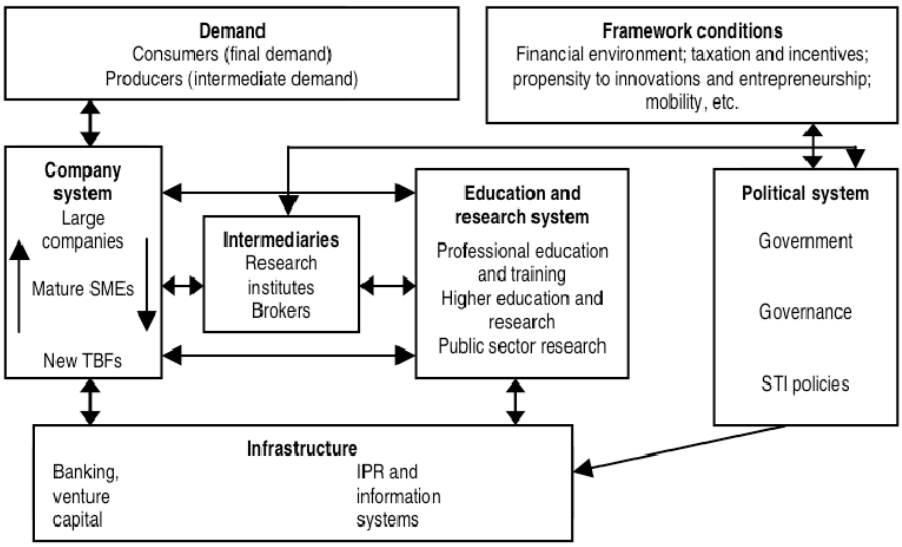
Fig.1 National Innovation System



Source: Speirs, et al., 2008

The approach of "strategic niche management" emphasises the experimental introduction of sustainable technologies using societal experiments. It can help to encourage a broader socio-technical transition towards more sustainable development by improving interactions among the elements of a sociotechnical system and its efficiency in achieving its objectives. The idea is to enable the introduction and diffusion of new sustainable technologies through protected societal experiments like pilot plants in fields such as wind energy, biogas, public transport systems, electric vehicle transport and eco-friendly food production. A major challenge in strategic niche management is the process by which such experiments can progress into viable market niches and in the end contribute to a broader shift towards sustainable development (Caniels & Romijin, 2008; Gasmeldseid, 2011).

Transition management is a method of change. It focuses on system innovation and brings together numerous viewpoints and a variety of approaches to the 'transition area'. Participants have to structure their shared problems with the existing system and develop shared visions and goals whose viability and pragmatism are then tested through experimentation, learning and reflexivity. The concept of "time strategies" is described as political planning and exploitation of "time windows" of opportunities during the insecure phases of technological development. They allow for developing technology competitiveness.

At company level the study of innovation in business has been explored within the theoretical frameworks of different disciplines such as strategic management, organizational behaviour, marketing, operations management perspective, etc. Gradually, a general consensus was reached that innovation management includes all company activities from innovation strategy development and ideation to commercialization of the idea and post-sales services. Success factors of innovation were researched as well as the internal and external barriers to innovation

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adoption. There was also a debate on whether innovation should be managed or companies should rely more on serendipity. Scholars have also been trying to identify the importance of marketing and technological push for new product success on the markets. They have identified a clear need for internal coordination within companies not only between marketing and sales but also between the R&D and marketing activities, as well as between the IT departments and marketing (Trott, 2017).

At company level, the theory focused also on finding different types of innovation and their role in business growth. For example, combining newness of the product and the market, in the 1970s Booz, Allen and Hamilton Co. suggested one of the most popular and often widely cited classifications of innovation that clarifies both advantages and risks. Researchers in consumer behaviour on their part explored innovation from the point of view of its impact on changing buyer behaviour. Following the Harvard Business School concept of product life cycle, consumers were grouped based on their readiness to buy. Product characteristics that encourage faster diffusion of innovation were formulated (Rogers, 2010).

A major paradigm in innovation management was the idea of bringing the final and industrial consumers closer to the manufacturer or service provider. The belief was that thus products and services that do not meet customer expectations will be eliminated in the initial phases of the innovation process and the business will decrease the risk of failure (Tidd and Bessant, 2013). This concept is followed today by the concept of lean management in both young and well established companies (Ries, 2011; Blank, 2013).

Eric von Hippel (1978) was one of the first researchers who challenged the assumption that the dominant mode of innovation is the "producers' model" and that producers develop economically important innovations. He focused the attention on the role of market for the innovation not only of consumer goods but also for industrial products and services. Other researchers followed this stream of research (Poetz, *et al.,* 2014, Harkoff and Lakhani, 2016).

Cooperation with partners (universities, Technology Transfer Offices, clusters and networks) at national, regional and international levels has also been an important stream of research. It explores how large, medium- and small-sized business overcomes the constraints of limited research potential. The body of knowledge in this area is the basis for the concept of open innovation stimulated by technology advances in many regions of the world and by rapid globalisation.

In the 1990s and the beginning of the 21st century, the reasons for new products' success have continued to be debated. There is a general consensus that companies possessing knowledge and the ability to commercialize this knowledge are able to expand their business and increase profit. New models of innovation have appeared in the knowledge-based economy, exploiting the development of information and communication technologies. Web 2 technologies allow global reach

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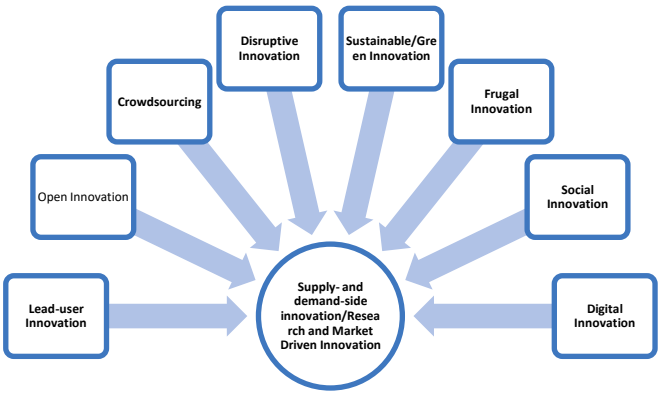
to the customers of many large and small companies. The way individuals and groups of customers interact has also changed. Rapid development of digital technologies and social media, as well as the increasing knowledge and technology of all value chain participants, influence innovation in manufacturing companies and service providers. The international flow of innovative ideas is intensified due to the growth of substantial high-quality cheap and accessible research potential in China and India and the fast expansion of multinational enterprises in emerging economies. The landscape of R&D is constantly changing. Today more R&D is conducted in Asia than in North America or Europe (Jaruzelski *et al.*, 2015).

In more recent studies, innovation management has centered on how the use of internal and external resources should be combined for successful innovation (Jaruzelski et al., 2018). The practice of the company's relationships with customers and the linkages with partners in the value chain allow capturing more opportunities for new product development. Networking is an invaluable tool for innovation management. Research on innovation management proves also that innovation has become less of an individual and more of "a team game" (Trott, 2017).

Technological advances, better access to customers and the increasingly connected partners in the global value chains have brought about a variety of theoretical concepts on the types of innovation and innovation management processes that the companies should follow. They are overlapping and to some extent contradict one another (Fig. 2). Supply-side innovation is still dominating. However, industrial and final customers are integrated to a greater extent in the innovation process due to digital technologies.

Fig.2. Contemporary models/approaches to innovation



Source: Slavova, 2019

SUSTAINABLE AND GREEN INNOVATION

Over the last three decades, consumers have shown growing concerns about sustainability-related issues (Ottman, 2011). Environment- and health-related fears have raised the demand for different types of products defined as sustainable or green. Janssens and Jaager (2002) describe these as the products and services that minimize the environmental impact of their consumption. The rising income of the population in the developed

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economies has made green products also affordable. Changes in consumers' lifestyle have influenced business decisions with regard to the development of different types of new products. Sustainable consumerism requires that innovation should "decouple growth from natural capital depletion" (OECD, 2011).

Large companies develop sustainable innovation strategies and even redefine their business models on the basis of access. Product innovation is accompanied by service innovation to respond to the demand for shared value, presumably attributable to the new consumer culture of using goods. For example, PUMA challenges the business community and consumers with the idea of "leasing the shoes" in the future by changing the design, the loyalty programme and the participation of customers in the New Product Development process. IKEA sustainability and profitability plans aim to utilise renewable sources for 100 percent of its energy needs and to increase significantly the sales of sustainable products by 2020. These plans will be implemented while maintaining the strategy of low-cost quality home furnishings. Coca-Cola increases the utilization of PlantBottle packaging that uses up to 30% plants-based materials. PlantBottle is an example of the company approach to regard packaging not as waste but as a valuable resource for future use. Currently, PlantBottle is used for mineral water, Coca-Cola, Coca-Cola Light and Coca-Cola Zero in the USA, Japan, Brazil, Sweden, Denmark and many other countries from different continents. The new bottle was introduced in Bulgaria in 2013 for packaging Bankia mineral water, which is one of the most popular brands in Bulgaria. In the long run, the company will use PlantBottle instead of plastic packaging for all its products. Green products are offered also extensively by the financial services sector. Green banking products as well as sustainability in business operations are on the rise, very much in congruence with consumer demands.

Consumer demand is a major driver of investment in sustainable innovation. One in three developed market consumers surveyed are considering the environmental impacts of purchases more often now than three years ago. The number of consumers buying locally sourced or made products is growing. However, the demand for green or sustainable products is fluctuating even in the most developed economies. The penetration rate of green products is growing but still limited because customers have to pay more for less and many of them are concerned by the prices. For many consumers, the identification of a product as 'green' is insufficient to justify purchase (Villano, 2011). The European Union's *Behavioural Study on Consumers' Engagement in the Circular Economy* (2018) confirms that consumers are generally willing to engage in circular economy practices. Yet actual engagement is still rather low. One of the reasons is that consumers lack information regarding product durability and reparability. There are no sufficiently developed markets for second-hand products, renting, leasing or sharing services, etc. The conclusion is that countries need political activities and regulations that encourage consumer behaviour favouring sustainable products and services.

Lowering the cost of sustainable innovations is important for increasing

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the consumption of sustainable products and services. Process innovation that will improve the efficiency of core operations for the production of sustainable products is crucial, too. Balancing consumer needs for quality, performance, affordability and convenience with the imperatives of environment protection and social engagement is likely to increase sales and to satisfy the expectations of customers and company shareholders.

In emerging economies, the growing middle class and the increase in disposable incomes have elicited an unparalleled wave of consumerism. The creation of affluent consumer markets eager to improve and expand their lifestyles attracts investors and inspires the development of new products and services for those markets. For example, the rapid expansion of mobile phone technologies has encouraged the launch of a new business model like mobile banking. In Kenya, six million people are using it. Though growth in the emerging economies has been slowing down in recent years, their demand for high-tech, luxurious and healthy new products and services is an important driver of consumerism in the world. The needs of social inclusion require also new approaches to innovation.

SOCIAL INNOVATION

"Society pull approach" is a term developed by Frans Vollenbroek (2002) to describe the quest for sustainable development. Society has to decide which economical, ecological and social goals, or a balance among them are to be met. Society pull can be organised by developing shared perspectives for the future, which are inspiring for public and private policy-makers and investors.

One of the aspects of society pull approach is social innovation. The social welfare and the growing variety of unmet social needs provide the grounds for social innovation (Carvalho, 2015; Phills *et al.*, 2008). Such innovation can involve a product, service, idea or a new model (Mulgan *et al.*, 2007; BEPA, 2011; EC, 2014; Howaldt *et al.*, 2016; Noya, 2009; OECD, 2010). The major differences between business and social innovation are sought mainly in their triggers. The triggers for the business innovation are competition and profit distributed among shareholders, whereas the triggers for social innovation pertain to the creation of community value.

Social innovation can take place both in social enterprises and in for-profit companies that orient part of their business to innovations with a strong social impact. It can originate both in a new or in an existing company that combines its innovation culture and tradition with the identification of unsatisfied social needs. The social issues are "technological challenges as well as market opportunities" (Pfitzer *et al.*, 2013). Social innovation can be also user-driven. The active participation of users in new product development is growing both in high-tech and traditional sectors (Juchniewicz and Grzybowska, 2015).

Social innovation is closely connected with the terms "social entrepreneurship" and "social enterprise". An extensive comparative research on social entrepreneurship has been done by researchers and a

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number of national and international institutions and projects (Short *et al.*, 2009: Scoll Foundation, 2015; EC, 2014; Buchko, 2018). Research results confirm that in its development the social enterprise may acquire commercial, public and hybrid features (Kickul and Lyons, 2012). Social entrepreneurs have to implement business knowledge and skills in order to attain operational efficiency and meet financial goals while satisfying social needs.

European research and innovation projects have supported social innovation since 1998 (EC, 2017). European institutions' publications are looking for similarity between corporate social responsibility and social entrepreneurship (EC, 2015). In recent years, the European Commission has initiated a number of activities that promote social innovation as a source of growth and jobs at the national and community level. The European Union has also launched new programmes for funding social innovation such as Horizon Prize (EC, 2017). Similarly to technology enhancement, social innovation, defined as "new products, services and models creating social value and new social relationships or collaboration" (BEPA, 2011), is expected to be an equally important source of future growth and well-being of modern society. Design thinking appears as a new social technology whose tools help to innovate through customers' empathy and stronger employee involvement (Liedtka, 2018).

FURTHER READING

Jan Nill, René Kempb, Evolutionary approaches for sustainable innovation policies: From niche to paradigm?

https://econpapers.repec.org/article/eeerespol/v_3a38_3ay_3a2009_3ai_3a4_3ap_3a668-680.htm

The authors "assess the theoretical rationale, instrumental aspects and the coping with policy constraints of three evolutionary policy approaches which have also been used in empirical studies: strategic niche management, transition management and time strategies".

Frans A Vollenbroek, Sustainable development and the challenge of innovation

https://www.sciencedirect.com/science/article/pii/S0959652601000488 or https://www.researchgate.net/publication/245167749_Sustainable_development_and_the_challenge_of_innovation

Society pull can be organised by developing shared perspectives for the future that are inspiring for public and private policymakers and investors. In this paper, this is worked out as transition management: a process approach directing innovation towards sustainable development.

Department for Business Innovation and Skills, The Case for Public Support of Innovation. At the sector, technology and challenge area levels, July 2014

https://www.gov.uk/government/publications/the-case-for-public-support-of-innovation-at-the-sector-technology-and-challenge-area-

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levels

The study discusses the barriers to innovation in 24 areas of economic interest, and in doing so outlines the rationale for public support for innovation at the sectoral level.

Thomas Brenner & Tom Broekel, Evolutionary economics and policy: Introduction to the special issue

https://link.springer.com/article/10.1007/s00191-019-00625-y

The perspective of evolutionary economics on policy, its underlying theoretical implications and conception, are different than that of neo-classical economics. Evolutionary Economics has a lot to offer. However, to do so it has to take a more active role in policy evaluation.

Pfitzer, M., Bockstette, V., Stamp, M., (2013) Innovating for Shared Value, HBR September 2013

https://hbr.org/2013/09/innovating-for-shared-value

At its best, business is about innovating to meet societal needs and to build a profitable enterprise. But many corporate leaders are struggling to achieve those twin goals. In a study of more than 30 companies that have succeeded in creating so-called shared value, the authors identify five mutually reinforcing elements.

SUMMARY OF KEY POINTS

- Environmental and societal pressures have incited gradually the need to reconsider innovations in the context of sustainable development. Innovation has to be socially, environmentally and economically sustainable.
- Evolutionary economics is concerned with how to transform the economy into a more resource efficient and green one, and how to explain the limitations of certain technologies and innovations.
- The approach of "strategic niche management" emphasises the experimental introduction of sustainable technologies using societal experiments.
- The concept of "time strategies" is described as political planning and exploitation of "time windows" of opportunities during the insecure phases of technological development.
- "Society pull approach" describes the quest for sustainable development. Society pull can be organised by developing shared perspectives for the future, which are stimulating cooperation among public and private policymakers and investors.

CASE STUDIES AND REAL WORLD EXAMPLES

Experimental Finland

Experimentation is considered as a major way to achieve transition to sustainability. It allows creating niches or areas for innovative solutions. Niche creation, market creation, societal problem, solving and spatial planning are often defined as categories or purposes of the experiments

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(Kivimaa, *et al.*, 2017). Experiments are promoted as a positive evidence of government interventions in the area of innovation. Urban living labs and the open "governance lab" of the UK government are often cited as examples.

In 2015, the Finnish government introduced "Experimental Finland" as part of the government's strategic 10-year vision of introducing a culture of experimentation in the country. The Finnish experimental model is a combination of both top-down and bottom-up approaches: it incorporates rapid grassroots experiments and groups of pilot programmes on a common theme, as well as larger policy trials based on the government's agenda. The aim is to find innovative ways to develop society and services, and to promote individual initiative and entrepreneurship. The work includes producing and spreading knowledge, building networks and supporting the planning and implementation of experiments.

Organisation of the experiment: Implementation of this new culture was explicitly included in the government's policy agenda, and that has proven to be a strong license to experiment. Organising Experimental Finland as a small taskforce of three to five people, and placing that team in the Prime Minister's office, was the ideal approach to help quickly spread the idea, especially among governmental organisations. The team works in collaboration with ministries, municipalities, local authorities, educational and research organisations, the business community and the 3rd and 4th sectors. The value of the experiment often lies in co-design. The new phenomenon is approached by getting as broad participation as possible, then focusing on what can be tested and harvesting the outcome: what works and what doesn't.

The public budget for supporting experimentation was specifically targeted at two areas of intervention. The first was the creation of a digital platform for funding and co-creating small scale experiments, and gathering the lessons learned from them. The second was directly funding of experiments falling under three themes: the circular economy, artificial intelligence and digital workforce skills. Projects and trials that pass are funded by the government or co-financed by the public and private sector.

The government has opened a digital platform called *kokeilunpaikka*. It means 'Place of Experiment'. Here, people can read up on results and analyses of past experiments, find out what sorts of projects the government is looking for, and go through a step-by-step process of submitting their own experiment. In healthcare innovation, for example, a group of nurses is testing robotic vests that may help them lift up patients more easily. In another project, a game is being piloted that helps prepare medical patients for diagnostic testing (OECD Observer, 2019).

One of the major projects concerns the social security system. The project started at the beginning of 2017 and its results are still under research. The major idea is to change the outdated current system of tying people's social protection to their jobs by introducing universal basic income. The

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preparation included the organisation of a two-day Basic Income Hack. For 32 hours straight, 10 teams composed of coders, researchers, politicians, communications specialists, graphic designers, activists and information designers brainstormed about basic income. Some of their ideas, including a basic income game that simulates how certain life choices affect public finance, shaped the design of the UBI trial (OECD Observer, 2019). The results from the first year did not identify changes in employment but recognised a perception of improved wellbeing (https://kokeilevasuomi.fi/en/frontpage).

Major barriers: The first barrier is the civil servants behaviour. The team realised that the thing stopping civil servants from experimenting and inspiring others to do so was lack of courage and fear of failure. Collaboration between different networks, shared learning initiatives and even accelerators have proven a good remedy to that problem. Trust is being built in a space with a unifying message: **we are licensed to experiment**. That means exploring unexplored challenges to which, by definition, no one knows the right answer. Co-design – working in a group to make sense of what we learn on the way to a shared goal – is essential.

Another barrier is the legislation. Sometimes it has prevented certain experiments. The team aims to minimise that obstacle, through a new set of guidelines for how to draft new legislation when it is needed to enable experimentation.

However, experimenting is not just a matter of having the right tools and laws, but of changing people's mindsets. Agile action taken in small steps makes experimenting effective and efficient. The process can also be seen as more democratic than traditional policy development procedures, because experimentation often incorporates multiple viewpoints.

The team comes to the conclusion that in the future experiment-based knowledge should be used more efficiently in all levels of society. That means more focus on how to scale up learnings and how to incorporate experimentation more thoroughly into government strategies, policy design and other long-term development processes.

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PROPOSED ASSIGNMENTS AND EXERCISES

1. Analyze the findings of the project Universal Basic Income in Finland and discuss the impact of the experiment. Find other countries that implemented or intend to try a similar experiment.
2. Discuss the experiment culture in policy making in your country. Find examples supporting your opinion. Suggest areas for strategic niche management and transition management in your region or country.
3. Research the controlled experiments in UK public policy. Discuss the results and their implementation at national and regional level.
4. The Netherlands is a country famous for its liberal drug laws. From 2021, cafes in 10 cities will get a legal supply of "quality" cannabis as part of a four-year experiment. The "weed trials" are aimed at providing a controlled and legalized supply of cannabis, making the industry more transparent and testing whether that will free up police officers to focus on other crimes. Research the progress of the experiment. Discuss its advantages and drawbacks. Debate its applicability in your country.
5. Research "Australia's Big Energy Experiment". What are the lessons learned?
6. Discuss the results of the experiment in energy self-sufficiency in Seoul, Republic of Korea, through a particular energy policy called the One Less Nuclear Power Plant (OLNPP) policy. Can the experiment facilitate urban energy governance and enhance innovation?

ASSESSMENT

Multiple choice test	
Question 1: Evolutionary economics is concerned with	
Answer 1	market pull and technology push
Answer 2	the transition to a more resource efficient and green economy
Answer 3	the positive spill-over effects of more R&D in companies

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Answer 4	increasing returns to growth
Answer 5	creative destruction of existing technologies
Correct answer(s)	Answer 2
Question 2: The approach of "strategic niche management" emphasises	
Answer 1	R&D investment in the social experiment
Answer 2	social innovation and experiment
Answer 3	the experimental introduction of sustainable technologies using societal experiments
Answer 4	development of niche for a company in the local market
Answer 5	development of niche for a company in the global market
Correct answer(s)	Answer 3
Question 3: The quest for sustainable development is known as:	
Answer 1	society-push approach
Answer 2	society-pull approach
Answer 3	sustainable society approach
Answer 4	green society approach
Answer 5	innovative society approach
Correct answer(s)	Answer 2
Question 4: Participants have to develop shared visions and goals whose pragmatism is then tested for experimentation, learning and reflexivity in:	
Answer 1	Transition management
Answer 2	Strategic niche management
Answer 3	Time strategies
Answer 4	Public-private partnership
Answer 5	Governmental social policy

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Correct answer(s)	Answer 1
Question 5: What are the barriers to the adoption of experimental culture by the civil servants?	
Answer 1	Fear of failure
Answer 2	Lack of experience in experimental policy
Answer 3	Collaborative work with networks
Answer 4	Co-design and sharing of knowledge and responsibility
Answer 5	All of the above
Correct answer(s)	Answer 5

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GLOSSARY

Innovation in the neo-classical approach	Technological innovation has been driven by technological development (technology push) or by demand factors (market or demand pull). Both approaches are relevant and important for innovation success.
Evolutionary economics	It is concerned with the transition processes, such as how to transform the economy into a more resource efficient and green economy and the explanation of the limitations of certain technologies and innovations.
Strategic niche management	The experimental introduction of sustainable technologies using societal experiments
Transition management	A method of change that focuses on system innovation and brings together numerous viewpoints and a variety of approaches to the 'transition area'
Time strategies	Political planning and exploitation of "time windows" of opportunities during the insecure phases of technological development
Society pull approach	Society has to decide which economical, ecological and social goals, or what combination among them, is to be found. Society pull can be organised by developing shared perspectives for the future, which are inspiring for public and private policy-makers and investors.
Social innovation	New products, services and models creating social value and new social relationships or collaboration
The difference between business and social Innovation	The triggers for business innovation are competition and profit distributed among shareholders, whereas the triggers for social innovation pertain to the creation of community value.

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Social dimensions of sustainable development

ANNOTATION

The concept of sustainability has its origins in the environmental movement of the 1960's, particularly in response to concerns about the impact of society consuming natural resources faster that they could be replaced. Sustainable development most prominently entered the global political arena in 1987 in a report from the United Nations Commission on Environment and Development, also known as the Brundtland report. In response to the concept of sustainable development, a vast array of ideas, concepts, methods and tools to aid organisations and governments in addressing the socio-ecological problems has been developed.

If sustainable development is understood as a process of transformation of the economy, it is, in consequence, also a transformation of society. Thereby, the social dimension of sustainable development seems essential for discussions on sustainability. But compared with the economic and environmental dimension of sustainability, social sustainability seems to be quite less addressed in sustainability research.

According to the assumption that the three dimensions of sustainability are interdependent, such a deficit may potentially hamper sustainable development in total. In recent years, the social dimension (or 'social sustainability') has gained increased recognition as a fundamental component of sustainable development. Environmental and economic issues dominated the sustainable development debate at its beginning whilst it is only in the late 1990s that social issues were taken into account within the sustainability agenda.

In this context, Lecture 6 puts a focus on the definition of the social dimension of sustainable development as one of the three pillars of sustainability. The key components and goals of social sustainability are discussed in the light of the key international strategic and programming documents in the field. The lecture also contains further reading titles and offers case studies and exercises to support the learning process. Finally, a sample test is provided, together with a glossary of key social sustainability terms.

MAIN CONCEPTS

The concept of sustainability has its origins in the environmental movement of the 1960's, particularly in response to concerns about the impact of society consuming natural resources faster that they could be replaced. Sustainable development was first described by the Brundtland Commission (1987) as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs". However, numerous definitions have been developed over the years with the only harmony being that it is consistently described in term of three overarching and interacting fundamentals – social, environmental and economic (Mak and Peacock, 2011).

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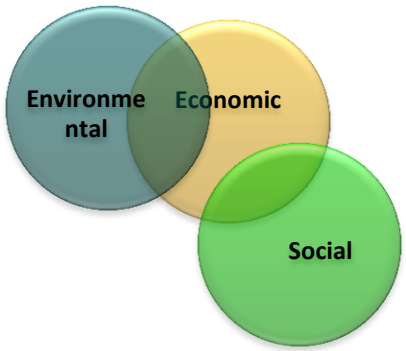
A number of models for conceptualising sustainability and the association between the three fundamentals have been developed. The first model of sustainability is represented as three interlocking circles (see Figure 1 below). This model of sustainability is understood in terms of an appreciation of the associations between the three elements and also through achieving equilibrium between them. In particular, this model enables an assessment of the dynamics that transpire within each sphere and at the boundaries between the spheres.

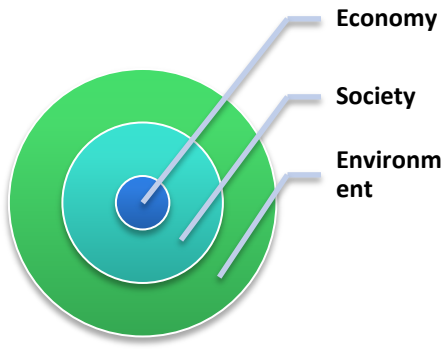
In the second model (Figure 2), sustainability is represented as three concentric circles, i.e. the environment, society and economy as systems within systems. This model demonstrates that the economy exists wholly within society on the foundation that all parts of the economy require human interface. However, society is much more than the economy and includes a range of relations other than those that simply relate to the exchange of goods and services. In turn, society is seen to sit wholly within the environment on which we rely for basic necessities.

Figure 1: Interlocking circles model of sustainability



Source: Mak and Peacock, 2011

Figure 2: Concentric circles model of sustainability



Source: Mak and Peacock, 2011

The two models above serve different purposes. The concentric model provides a representation of how we should understand the relationship between the environment and the social and economic spheres, portraying the mutual independence and our ultimate reliance, as social and economic beings, on the physical environment. In contrast, the interlocking spheres model is a way of representing, in visual form, how

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we might go about understanding the nature of each sphere. The focus on the interlocking spheres model also reflects the fact that while there has been considerable work done on the environmental and economic aspects, the social has tended to fall off the sustainability agenda and remains relatively unexplored.

Sustainable development and its three pillars

Sustainable development offers a positive long-term vision of a society that is more prosperous and more just, and which promises a cleaner, safer, healthier environment – a society that delivers a better quality of life for us, for our children, and for our grandchildren. This relates to the general goals for the three pillars described in the literature:

- ensuring economic development
- improving the rational use of natural resources
- enhancing social well-being.

The concept of sustainable development comprises environmental, economic and social interests. It advocates a well-balanced equilibrium between the environmental, economic and social dimension. Achieving this in practice requires that economic growth supports social progress and respects the environment, that social policy underpins economic performance, and that environmental policy is cost-effective. The concept of sustainable development is also widely applied as a basis for empirical models to conceptualise the causality of the relationship between the environmental, economic and social dimension. The roots of the basic model lie in the 1960s in Firey's theory of resource use that acknowledges a close relationship between environmental, economic and social development. Economists, environmental scientists and sociologists later developed more sophisticated models. Variants add three elements to this model. In the first place, the three dimensions of sustainable development are revealed. For example, a distinction is made between the societal reality and government policies or policy targets for each of the three dimensions. Secondly, intersections between the three dimensions are denominated. Thirdly, the dimensions of sustainable development are used, in normative sense, as criteria for decision making and assessment of interests. This can lead to the claim that public decision-making should take into account the effects of decisions on all three dimensions (Coenen, 2005).

The concept of sustainability will continue to influence future discussions on development science. This implies that the best choices are likely to remain those that meet the needs of society and are environmentally and economically viable, economically and socially equitable as well as socially and environmentally bearable. This leads to three interconnected spheres or domains of sustainability that describe the relationships among the environmental, economic, and social aspects of sustainable development, as depicted in Figure 3 below.

Figure 3. Relationships among social, environmental and economic sustainability.

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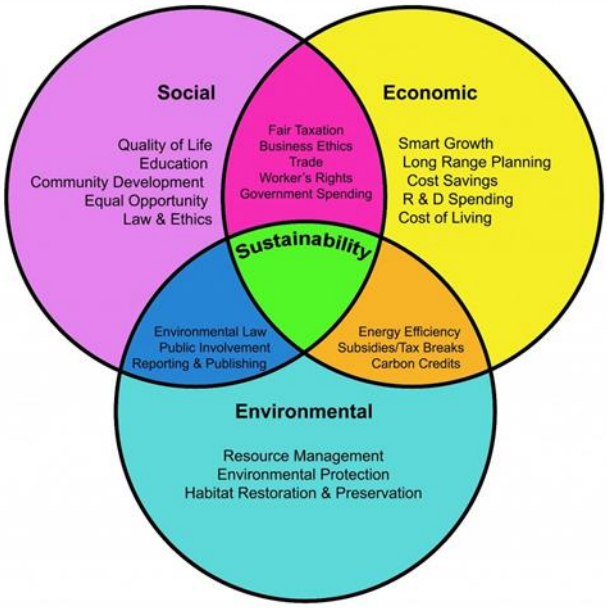

Source: Wanamaker (2018). The Environmental, Economic, and Social Components of Sustainability: The Three Spheres of Sustainability.

Basically, it can be concluded from the figure that human activities have implications for the environment, economy and society. The spheres constitute a set of interrelated concepts which should inform policy decisions and actions. Proper decisions on sustainable resource management are crucial for sustainable growth and for sustainable society. Examples of these include decisions on land use, surface water management, agricultural practices, building design and construction, energy management, education, equal opportunities, law-making and enforcement. The argument is that, when the concepts contained in the three spheres of sustainability are applied well to real world situations, superior outcomes are achieved for the whole society (Mensah, 2019).

SOCIAL SUSTAINABILITY

Sustainability means striving to define and to realise our quality of life in ways that do not diminish the opportunities of future generations to define and to realise their quality of life. Such an understanding of sustainability acknowledges that further development is necessary to meet the needs of the present. But this process has to be realised in a way that respects the limitations imposed by existing technology and social organisation on the environment's ability to meet present and future needs. Social sustainability should be understood as part of this general concept. But the concept of sustainability is complex and the concept of social sustainability inherits its complexity while introducing additional problems that are often neglected by a narrower environmental and economic understanding of sustainability (Pieper *et. al.*, 2016).

Social sustainability can be broadly defined as the maintenance and improvement of well-being of current and future generations. To

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achieve social sustainability, it is necessary to have in place equity of access to key services (including health, education, transport housing and recreation), as well as equity between generations, meaning that future generations will not be disadvantaged by the activities of the current generation. Social sustainability is also a system of cultural relations in which the positive aspects of different cultures are valued and promoted. It also entails the need for widespread political participation of citizens not only in electoral procedures but also in other areas of political activity, particularly at the local level. Social sustainability is thus regularly interpreted from three perspectives: development-oriented, environment-oriented, and people-oriented (Mak and Peacock, 2011).

Social sustainability relates to equity, accessibility, participation, human rights, gender equality, rule of law and institutional stability. Above all, it connotes a system of social organisation that alleviates poverty. In a more fundamental sense, it also addresses the interrelatedness between poverty and environmental degradation. In this regard, the theory of social sustainability posits that the alleviation of poverty should lead neither to unwarranted environmental destruction nor to economic instability. It should aim to alleviate poverty without compromising the existing environmental and economic resource base of the society.

At the social level sustainability entails fostering the development of people, communities and cultures through proper healthcare, education, gender equality, peace and stability. It is argued that social sustainability is not easy to achieve because the social dimension is complicated and overwhelming. Unlike the environmental and economic systems where flows and cycles are easily observable, the dynamics within the social system are intangible and cannot be easily modelled. Generally speaking, social sustainability is not about ensuring that everyone's needs are met. Rather, its aims at providing enabling conditions for everyone to have the capacity to realise their needs, if they so desire. Anything that impedes this capacity is considered a barrier, and needs to be addressed in order for individuals, organisations or communities to make progress towards social sustainability (Mensah, 2019).

The social dimension of sustainable development has a normative basis. It may be specified in two ways: sustainable social development and social sustainable development. The first may be understood as the objective that social development has to be based on norms which are in line with the idea of sustainability. The second may be understood as the condition of sustainable development being socially acceptable. These terms seem to be different perspectives, but they might share the same normative basis: the idea of social justice.

Social sustainability can be seen as the condition of a society where social tensions do not escalate but are solved in a peaceful way. This should result in social peace, just chances for individual self-development and maximal freedom of action. Furthermore, it entails finding solutions to distribution problems between social classes,

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regions, genders and generations. As far as the development of social sustainability is operationalised by particular objectives, it can be understood as conditions in society that are achieved by these objectives. Therefore, the effect of these objectives has to bear permanently on social life and social structure. Those objectives may be social stability, individual freedom, social justice, equal opportunities and ensuring and improving ecological, economic and social performance (Ketschau, 2017).

There is general agreement that the different dimensions of sustainable development (e.g. social, economic, environmental and institutional) have not been equally prioritised by policy makers within the sustainability discourse. This is mainly because sustainable development was born out of the synergy between the emerging environmental movement of the 1960s and the 'basic need' advocates of the 1970s, but also because assessing the intangible nature of social aspects of development presents various challenges regarding measurement. As a result, approaches to the social sustainability concept have not been grounded on theory but rather on a practical understanding of plausibility and current political agendas. In addition, social sustainability is currently dealt with in connection with the social implications of environmental politics rather than as an equally constitutive component of sustainable development.

Social sciences and social policy research have developed a plethora of social objective strategies and measurement instruments, but with little regard for the sustainability perspective. Thus, while there are many social research studies and policy documents, they have rarely been integrated into the sustainability framework. Even when cross-discipline approaches have been attempted, covering for example the environmental and the social dimensions of sustainable development within the 'ecological footprint' concept, it can be argued that such endeavours have only been partially framed within an integrated approach to sustainability (Colantonio, 2009).

Overall, the concept of social sustainability has been under-theorised or often oversimplified in existing theoretical constructs. Furthermore, no consensus seems to exist on what criteria and perspectives should be adopted in defining social sustainability. Each author or policy maker derives their own definition according to discipline-specific criteria or study perspective, making a generalised definition difficult to achieve (Missimer, 2013). Thus, there seem to be a number of challenges:

- The social sustainability concepts are built on other concepts, such as community, society, and inclusiveness, that themselves have no clear definition.
- Social sustainability is an analytical and a normative concept, but these aspects are not always clearly separated, leading to confusion in the prioritisation process.
- Objectives and indicators are frequently selected based on

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practical understanding rather than theory and, therefore, often reflect current political agendas as well as theoretically unfounded assumptions.

- Social sustainability is approached differently in different countries based on the internal political debates (e.g. emphasis on labour in Germany, consumption in the Netherlands, etc.). Sometimes, the term social sustainability is simply used to describe the current system of social welfare and policy.
- The social sciences have concerned themselves with a wide variety of social objectives, strategies and measurement instruments, but often with little consideration of the sustainability perspective.
- There are no optimum values for indicators and it is problematic to establish benchmarks.

COMPONENTS AND GOALS OF SOCIAL SUSTAINABILITY

Despite the lack of consensus on the scope of social sustainability, there seem to be some broadly accepted common ingredients:

- meeting basic needs
- overcoming disadvantages attributable to personal disability
- fostering personal responsibility, including social responsibility and regard for the needs of future generations
- maintaining and developing the stock of social capital, in order to foster trusting, harmonious and cooperative behaviour needed to underpin civil society
- attention to the equitable distribution of opportunities in development, in the present and in the future
- acknowledging cultural and community diversity, and fostering tolerance
- empowering people to participate on mutually agreeable terms in influencing choices for development and in decision-making.

All these elements are inter-linked and, to some extent, they overlap. Meeting basic needs contributes to wellbeing and depends on personal responsibility, opportunity and social capital. Meeting the basic needs of all groups in the community is one of the most fundamental aspects of equity. The ability to participate in debates influencing the priorities for social wellbeing and the decisions on how basic needs are met is another important equity consideration. The range of social resources that foster cooperative behaviour in society and the economy should also reflect considerations of equity, including equitable distribution of opportunities, as well as tolerance of cultural and community diversity. There are also some tensions and conflicts between these elements. For example, re-distributing resources to meet equity objectives can undermine social capital and tolerance if it involves targeting

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beneficiaries on the basis of criteria that are not widely accepted (Baines and Morgan, 2004).

Although it is difficult to make a distinction between social, economic and environmental goals of sustainable development y, some goals are more consistent with the concept of social sustainable development than others, such as:

- poverty reduction
- ensuring inclusive education
- promoting full employment and decent work
- ensuring access to healthcare
- decent housing
- reducing inequality
- promoting social inclusion
- safety and security.

Social dimensions of sustainable development can be found in a number of strategic and programming documents at international level, the most important of which are:

- Transforming Our World: the 2030 Agenda for Sustainable Development (UN, 2015):
  - sets out a wide range of economic, social and environmental objectives
  - insists on interconnections between the new goals and targets
  - defines the goals as global, closely interrelated and depend on each country's circumstances.
- Europe 2020: A Strategy for Smart, Sustainable and Inclusive Growth (EC, 2010):
  - adopted in the period of globalization and economic crisis
  - takes into account the concept of sustainable development
  - offers a framework for a more sustainable future based upon: sustainable development → inclusive growth → high employment → high productivity → social cohesion.

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SUMMARY OF KEY POINTS

- The concept of sustainability has its origins in the environmental movement of the 1960's, particularly in response to concerns about the impact of society consuming natural resources faster that they could be replaced. Sustainable development was first described as "development that meets the needs of the present

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without compromising the ability of future generations to meet their own needs".

- Sustainable development offers a positive long-term vision of a society that is more prosperous and more just, and which promises a cleaner, safer, healthier environment – a society that delivers a better quality of life for us, for our children, and for our grandchildren. This relates to the general goals for the three pillars described in the literature: ensuring economic development; improving the rational use of natural resources; enhancing social wellbeing.
- Social sustainability can be broadly defined as the maintenance and improvement of the wellbeing of the current and future generations. To achieve social sustainability, it is necessary to have in place equity of access to key services (including health, education, transport housing and recreation), as well as equity between generations, meaning that future generations will not be disadvantaged by the activities of the current generation. Generally speaking, social sustainability is not about ensuring that everyone's needs are met. Rather, it aims at providing enabling conditions.
- Although it is difficult to make a distinction between social, economic and environmental goals of sustainable development, some goals are more consistent with the concept of social sustainable development than others, such as: poverty reduction; ensuring inclusive education; promoting full employment and decent work; ensuring access to healthcare; decent housing; reducing inequality; promoting social inclusion; safety and security.
- Social dimensions of sustainable development can be found in a number of strategic and programming documents at international level, the most important of which are: Transforming Our World: the 2030 Agenda for Sustainable Development (UN, 2015) and Europe 2020: A strategy for Smart, Sustainable and Inclusive Growth (EC, 2010).

CASE STUDIES AND REAL WORLD EXAMPLES

Sonoma Mountain Village

The Sonoma Mountain Village in the USA is considered one of the most sustainable communities in the world. Its award-winning, deeply sustainable community combines the idea of people-centred design with cutting-edge sustainability to create a community that cares for the lifestyle, as well as the Earth's natural resources. Sonoma Mountain Village is located 40 miles north of San Francisco and is planned as a mixed-use community. The model for this development is to create a community designed to care for its residents, the community and the planet without compromising quality of life. The project is proposed to include a maximum of 1,694 residential units and an additional 198

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secondary dwelling units.

The project site is located in a former industrial business technology park and this development includes adaptive reuse of the existing industrial business park buildings to contain a mix of residential, office and retail/commercial uses. Construction work of new buildings began in 2011, with the first homes completed in mid-2011, and construction planned until 2025. Before that, renovation of the existing buildings was implemented to serve the daily needs of the neighbourhoods and surrounding community.

The major project objectives identified by the developers of Sonoma Mountain village include, "Choosing building-materials responsibly reduces waste, while responsible choices in energy offer an alternative to fossil fuels. Opportunities for residents and tenants to support each other with social and business networks contribute to living well with less impact on the Earth". Implications of the project on society are that it will offer choices for a healthier, happier way of life. The planned development lives well and within the Earth's natural resources.

Source: Mak, M.Y., C. J. Peacock (2011). Social Sustainability: A Comparison of Case Studies in UK, USA and Australia. 17th Pacific Rim Real Estate Society Conference, Gold Coast, 16-19 Jan 2011

The New Rouse Hill

The New Rouse Hill development is located in the Baulkham Hills Local Government Area in north-west Sydney, Australia. The development demonstrates combining the traditional streetscape of a contemporary town with community spaces. In particular the socially sustainable elements include several community focused assets including library, community business hub, town square, market square, community employment website and community engagement program.

The developer claimed that this project balances a pedestrian friendly and environmentally sustainable town centre that respects the heritage, cultural and landscape features of the local community. The New Rouse Hill has a strong connection to its residential neighbourhoods, primary and secondary schools and natural environment. The mix of great architecture and active spaces creates an authentic and contemporary Australian town. In addition, the Rouse Hill town centre is able to reduce its ecological footprint by 32% compared to a standard regional shopping centre. Based on these design concepts, the new Rouse Hill development has also received a number of prestigious awards both nationally and internationally for sustainability and design excellence. It is considered one of Australia's best new developments which pays particular attention to sustainability and community interaction.

The Rouse Hill town centre development was completed in March 2008. The New Rouse Hill became home to approximately 4500 residents, upon completion comprising of up to 1800 residential properties, with approximately one quarter of the total development area being devoted to open space, including parks, playgrounds, waterways and walking and

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cycling trails.

Source: Mak, M.Y., C. J. Peacock (2011). Social Sustainability: A Comparison of Case Studies in UK, USA and Australia. 17th Pacific Rim Real Estate Society Conference, Gold Coast, 16-19 Jan 2011

PROPOSED ASSIGNMENTS AND EXERCISES

EXERCISE No.1

Read carefully the two case studies above and provide short written responses (between 100 and 200 words) to each of the questions below:

- What are the main advantages of the two communities, described in the case studies?
- Do you think there are any chances for similar communities to be developed in your regions? What prerequisites have to be fulfilled in order for this to happen? Do people in your community / settlement / region have the right mindset for that?
- If you had sufficient resources, would you undertake the establishment of such a community? Why? Think about the people/organisations/institutions you will have to cooperate with and the effects such an undertaking would generate.

After answering the questions above, share your thoughts with your peers. Do your ideas need revision? Do they still seem feasible?

Instructions for the trainer:

Training participants can work individually or in groups, depending on the size of the class. The time allocation for answering the questions above shall be 20-30 minutes, while another 20-30 minutes shall be devoted to discussions and presentations of ideas by individual learners or teams.

EXERCISE No.2

Please, go back to the goals of social sustainability and read them carefully again. Now select the one which seems most important for your community. If you had the opportunity to initiate a project to achieve this goal, would you take it?

Now, please form a team with two of your peers and reach an understanding which of your individual goals you will elaborate. Allocate amongst yourselves the roles of representatives of government institutions, a business organisation and a civil society organization. Now decide who will be the initiator of the social sustainability undertaking and put down in writing information on the following aspects of the initiative:

- Title of the initiative
- Social sustainability goal addressed with it

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- Leading organisation
- Foreseen activities
- Target group(s) and territory(ies)
- Stakeholders to cooperate with
- Necessary resources – financial, human, etc.
- Time needed for implementation of the initiative
- Expected outputs, outcomes and impacts in the short and long term.

After your team is finished with the above tasks, please select one representative to present the results of your assignment before the rest of the class.

Instructions for the trainer:

After forming the teams, training participants shall be given 30 minutes to shape their projects and cover the above aspects. The time for team presentations shall not exceed 5 minutes for each team.

ASSESSMENT

Multiple choice test	
Question 1: Which of the following is not among the overarching pillars of sustainable development?	
Answer 1	Economy
Answer 2	Society
Answer 3	Institutions
Answer 4	Environment
Answer 5	None of the above
Correct answer(s)	Answer No.3
Question 2: When did the concept of sustainable development first take shape?	
Answer 1	In 2010, with Europe 2020: A Strategy for Smart, Sustainable and Inclusive Growth
Answer 2	In 2015, with the UN 2030 Agenda for Sustainable Development
Answer 3	In 2000, with the Lisbon Strategy
Answer 4	In 1987, with the UN Brundtland report
Answer 5	In the 1960s, with the environmental movement

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Correct answer(s)	Answer No.4
Question 3: Regarding the relationships among social, environmental and economic sustainability, 'worker's rights' lies in the intersection of:	
Answer 1	social and environmental sustainability
Answer 2	social and economic sustainability
Answer 3	environmental and economic sustainability
Answer 4	social, economic and environmental sustainability
Answer 5	None of the above
Correct answer(s)	Answer No.2
Question 4: Which of the following statements is false?	
Answer 1	Social sustainability is about ensuring that everyone's needs are met.
Answer 2	Social sustainability encompasses notions of equity, empowerment, accessibility, participation, cultural identity and institutional stability.
Answer 3	Social sustainability can be broadly defined as the maintenance and improvement of the wellbeing of current and future generations.
Answer 4	Social sustainability is a system of cultural relations in which the positive aspects of disparate cultures are valued and promoted.
Answer 5	Social sustainability can be seen as the condition of a society where social tensions do not escalate but are solved in a peaceful way.
Correct answer(s)	Answer No.1
Question 5: Which of the goals below are consistent with the concept of social sustainable development?	
Answer 1	Smart growth
Answer 2	Energy efficiency

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Answer 3	Resource management
Answer 4	R&D spending
Answer 5	Inclusive education
Correct answer(s)	Answer No.5

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

This project has been funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

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GLOSSARY

Social capital	The networks of relationships among people – links, shared values and understandings in society that enable individuals and groups to trust each other and work together, so that the society functions effectively.
Social cohesion	A social process which aims to consolidate plurality of citizenship by reducing inequality, socioeconomic disparities and fractures in the society, referring to the extent of connectedness and solidarity among groups in society.
Social inclusion	The process of improving the terms for individuals and groups to take part in society, or, more precisely, the process of improving the ability, opportunity, and dignity of those disadvantaged on the basis of their identity to take part in society.
Social responsibility	The practice of producing goods and services in a way that is not harmful to society or the environment, by adopting key principles, such as accountability and transparency.
Social sustainability	The condition of a society where social tensions do not escalate but are solved in a peaceful way, which should result in social peace, just chances for individual self-development and maximal freedom of action.
Sustainability	The process of continuing into the future, coping with and recovering from stresses and shocks, while not undermining the resources (environmental, economic and social), from which mankind draws its existence.
Sustainable development	Development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It combines economic development with protection of the environment and social justice.
Sustainable development pillars	Sustainability is understood as a three-pillar concept that integrates social, economic and environment concerns and contributes to ensuring economic development; improving the rational use of natural resources and enhancing

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	social wellbeing.

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