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(ECOSOC)

Topic area A: "Science, Technology and Innovation (STI) for Sustainable Development; New and Emerging Technologies for the implementation of Sustainable Development Goals"

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Topic Area A: Science, Technology and Innovation (STI) for Sustainable Development; New and Emerging Technologies for the implementation of Sustainable Development Goals

TABLE OF CONTENTS

WELCOMING LETTER BY THE CHAIRS OF THE ECOSOC ..ΣΦΑΛΜΑ! ΔΕΝ ΕΧΕΙ ΟΡΙΣΤΕΙ ΣΕΛΙΔΟΔΕΙΚΤΗΣ.

MANDATE OF THE UN ECOSOC **5**

INTRODUCTION **6**

DEFINING THE KEY TERMS OF THE TOPIC **7**

HISTORICAL BACKGROUND **8**

INTERNATIONAL FRAMEWORK **10**

DISCUSSION OF THE TOPIC **14**

Contribution of STI to Sustainable Development Goals 14

Science and research- The role of higher education, scientific data and Indigenous and Local Knowledge 20

Innovation- Building efficient National Systems of Innovation 23

New and Emerging Technologies- Typology- Applications 24

Concerns and potential threats 26

RECENT DEVELOPMENTS **28**

CONCLUSION **29**

POINTS TO BE ADDRESSED **30**

BIBLIOGRAPHY **31**

Welcoming letter by the Chairs of the ECOSOC

Distinguished delegates,

We are more than delighted to welcome you to Thessaloniki International Student Model United Nations - ThessISMUN 2019, and especially, to the United Nations Economic and Social Council. It is an honor and privilege for us to be part of this year's UN ECOSOC and we are looking forward to our communication, interaction and cooperation, both prior and during the proceedings of our Committee.

During this year's conference, the Council will deal with two topics that are highly debated currently in the meetings of it, which are "Science, Technology and Innovation (STI) for Sustainable Development; New and Emerging Technologies for the implementation of Sustainable Development Goals" and "The economic and social repercussions in post-conflict areas." Both topics are considered crucial for achieving prosperity for all and sustainable economic and social development on a global scale.

Our first agenda item focuses on the contribution of Science, Technology and Innovation-STI, as well as the New and Emerging Technologies, to the achievement of Sustainable Development Agenda. Ensuring the equal spread of beneficial effects of the applications of STI and eliminating their possible disadvantages are some of the most prevalent and contemporary issues that the international community faces nowadays. Thus, addressing the current and the possible challenges in the field of STI can lead to a bit brighter future for the humankind.

The study guide at hand is a product of thorough research from our part and has been written in order to provide you a deeper insight into Topic Area A. In order for you to prepare as thoroughly as possible, your personal research shall not be limited to the study guide. Thus, you have to find out your country's policy on the topic in national, regional and international level. Therefore, you are supposed to propose the adequate solutions to address the matter, bearing in mind your policy, both in your position papers and during the debate. The procedure and its outcome is defined by your effort

during the sessions of the conference. We, as the board members, are always in your disposal should any wish or inquiry occurs.

Finest regards,

Ioannis Maniatakos, Chair

Anastasios- Aias Oikonomidis, Co-Chair

Mandate of the UN ECOSOC

The Economic and Social Council (hereinafter ECOSOC) of the United Nations was established in 1945 and since then has been one of the six main bodies of the Organization.

Its mandate (functions and powers) is described in Chapter X of the UN Charter. Amongst others, it may make or initiate studies and reports, recommendations, resolutions and prepare draft conventions always in accordance with the matters falling within its competence, which are the international economic, social, cultural, educational and health ones.[1] ECOSOC is inextricably linked with the purposes of Article 1 par. 3 of the UN Charter and, thus, is considered as the principle body towards the achievement of them.

In order for these to be achieved, ECOSOC is in continuous interaction with the civil society. It is a global forum for productive dialogues among policymakers, parliamentarians, academics, foundations, businesses, youth and 3,200+ registered non-governmental organizations. ECOSOC currently aims at advancing the three dimensions of sustainable development – economic, social and environmental.[2]

The Members of ECOSOC shall be fifty-four (54), with the possibility of reelection and with only one representative per member state. Each member state has the right to one vote and the decisions in the Economic and Social Council are made based on the majority of the members present and voting (Article 67).

[1] UN Charter, Chapter X
[2] Un.org. (2018). *About Us | UNITED NATIONS ECONOMIC and SOCIAL COUNCIL*. [online] [Accessed 14 December 2018]. Available from: https://www.un.org/ecosoc/en/about-us

Introduction

Each and every human on the planet Earth makes use of products and services derived from science and technology progress. At the same time, a variety of innovative products of the past decades and centuries are accessible to almost everyone. Food, clean water, accommodation, transportation, electricity, communications are outcomes of scientific and technological applications to our everyday needs.

Although science, technology and innovation seem far away from our everyday interests, they are present in almost every aspect of our economic, social and professional lives. Our cities and societies are built thanks to scientific and technological progress, and the diffusion of innovations. Besides, the sovereign states can launch STI strategies for brining prosperity and, thus, claim a privileged place in the international community. Sometimes, cooperation between sovereign states, in regional and international level, result in further development of scientific knowledge and, thus, in technological and innovative products and services.

However, there are many challenges at an international level that demand closer cooperation. All of them are illustrated in the 2030 Agenda for Sustainable Development. Moreover, the rapid progress of STI can bring upon negative and, sometimes, irreversible consequences which require a comprehensive approach. The actors of a universal approach shall be the international and regional organizations, the sovereign states, the local communities and, mainly, each and every citizen of the world.

Empowering Science, Technology and Innovation and dealing with their possible threats is a prerequisite for achieving the Sustainable Development Goals, otherwise as Global Goals, is the key to ensure than no one will be left behind.

Definitions of key terms

Science: In general, science refers to "*the pursuit and application of knowledge and understanding of the natural and social world following a systematic methodology based on evidence."*[3] According to a definition derived from an official document of the United Nations, namely the Summary of the theme study "Harnessing Science, Technology and Innovation for Inclusive and Sustainable Development in Asia and the Pacific". *Science can be defined as the systematic study of the physical or material world (natural science) and of society (social science) that generates, or creates, knowledge from which data and information is drawn*.[4]

Technology: From a business perspective, technology is "the purposeful application of information in the design, production, and utilization of goods and services, and in the organization of human activities"[5]. The United Nations define technology as "*the application of scientific knowledge to develop techniques to produce a product and /or deliver a service or as the application of scientific knowledge for practical ends."*[6]

New and emerging technologies: A new technology includes *"any set of productive techniques which offers a significant improvement (whether measured in terms of increased output or savings in costs) over the established technology for a given process in a specific historical context."*[7] On the contrary, an emerging technology may refer to new or existing technologies *"that are currently developing, or that are expected to be available within the next five to ten years, and is usually reserved for*

[3] The Science Council. (2018). *Our definition of science - The Science Council*. [online] [Accessed 8 Dec. 2018]. Available from: https://sciencecouncil.org/about-science/our-definition-of-science/
[4] Unescap.org. (2018). [online] [Accessed 8 Dec. 2018]. Available from: https://www.unescap.org/sites/default/files/E72_32E.pdf
[5] BusinessDictionary.com. (2018). *Read the full definition.*. [online] [Accessed 8 Dec. 2018]. Available from: http://www.businessdictionary.com/definition/technology.html
[6] See ref. 4
[7] Encyclopedia.com. (2018). *New Technology | Encyclopedia.com*. [online] [Accessed 9 Dec. 2018]. Available from: https://www.encyclopedia.com/social-sciences-and-law/sociology-and-social-reform/sociology-general-terms-and-concepts/new-0

technologies that are creating, or are expected to create, significant social or economic effects."[8]

Innovation: The term refers to the process *of "deriving the benefits from a new or significantly improved product (good or service), or process (such as a new marketing method) or a new organizational method (such as in business practices, workplace organization or external relations).* In contrast with the term "improvement", *innovation derives significantly (as opposed to incrementally) more impact (economic, social and environmental) from existing products, processes and services or from a combination of proven and new science and technology to develop new products, processes or services.*[9] Besides, social innovation *can similarly be defined with the addition that it simultaneously meets social needs while creating new social relationships or collaborations.* From an economic point of view, an innovation *shall be replicable at an economical cost and must satisfy a specific need* of a customer.[10]

Historical Background

As already mentioned, the concept of STI emerged the recent years, with a view to maximize the profits of Science, Technology and Innovation to the humankind. In that sense, each element has its distinct history. However, from the creation of human artefacts during prehistoric time, until the development of quantum computers nowadays, it can be easily comprehended that science and technology have been in an interactive progress throughout history.

The intersection between science and technology was firstly supported in the 17th century by Francis Bacon, who considered technology as the application of scientific knowledge to achieve a specific human purpose and, thus, called for the development of experimental science as a way to enlarge man's dominion over nature. His efforts

[8] Winston & Strawn. (2018). *What is the Definition of Emerging Technology? | Winston & Strawn Legal Glossary*. [online] [Accessed 9 Dec. 2018]. Available from: https://www.winston.com/en/legal-glossary/emerging-technology.html
[9] See ref 2
[10] BusinessDictionary.com. (2018). *What comes after those ellipses?*. [online] [Accessed 9 Dec. 2018]. Available from: http://www.businessdictionary.com/definition/innovation.html

to direct scientific research toward useful results did not managed to prevail for the next two centuries.

One of "America's greatest inventors", Thomas Edison, has determinately contributed to the close interaction between science and technology, through following the "trial-and-error process" for the invention of the electric lightbulb, as well as with the establishment of the first industrial research laboratory, in Menlo Park, New Jersey. Moreover, the application of scientific principles to technology, the development of mass production forms affected the common progress of science and technology. [11]

Moving on to the 20th century, the two World Wars were themselves the most important proofs of technological progress, since a rapid transformation from "little science", carried by small-scale efforts of a few isolated scientists, to "big science", with the large research teams sponsored by governments and corporations, working collectively on the development and application of new techniques, took place during 1900-1945. The appearance of the airplane and the tank during the World War I and the denotation of the atomic bomb during World War II proved, apart from the need to avoid another major war, the need to utilize science and technology for other purposes. [12]

During the Cold War, the techno-scientific practices were placed on the frontline for national security purposes in the United States and the Soviet Union, while France and China focused on their scientific independence and self-reliance. The development of (nuclear) weapons, agriculture, biomedicine, computer science, ecology, meteorology, transport, communications and the exploration of the deep oceans, the deep interior of the earth and the space were the targets of large state-funded investments. After the 1991 collapse of the USSR and the end of Cold War, the international com-

[11] Encyclopedia Britannica. (2018). *History of technology - Perceptions of technology*. [online] [Accessed 10 Dec. 2018]. Available from: https://www.britannica.com/technology/history-of-technology/Perceptions-of-technology

[12] Encyclopedia Britannica. (2018). *History of technology - The 20th century*. [online] [Accessed 10 Dec. 2018]. Available from: https://www.britannica.com/technology/history-of-technology/The-20th-century

munity focused on the development of science and technology under the principle of sustainability which recently emerged.[13]

International Framework

The United Nations Sustainable Development Goals- Goal 17- Technology Facilitation Mechanism, United Nations Interagency Task Team on Science, Technology and Innovation for the SDGs :

The Sustainable Development Goals (SDGs), otherwise known as the Global Goals, are a universal call to action to end poverty, protect the planet and ensure that all people enjoy peace and prosperity.

These 17 Goals build on the momentum and success of the Millennium Development Goals, while including new areas such as climate change, economic inequality, innovation, decent work, sustainable consumption, peace and justice, amongst other priorities. The goals are interconnected – often the key to success on one will involve tackling issues more commonly associated with another.[14] Although unanimously agreed by the United Nations General Assembly with the A/RES/70/1, the Goals are not legally binding.

The Goal 17- "Strengthen the means of implementation and revitalize the global partnership for sustainable development" underlines the contribution of Science and Technology to achieve the goals and sets the STI as a target. In particular:

Target 17.6- KNOWLEDGE SHARING AND COOPERATION FOR ACCESS TO SCIENCE, TECHNOLOGY AND INNOVA-

[13] Oreskes, N. and John Kringe, J eds. *Science and Technology in the Global Cold War* Massachusetts, The MIT Press, 2014

[14] The Global Goals. (2018). *The Global Goals.* [online] [Accessed 10 Dec. 2018]. Available from: https://www.globalgoals.org/

TION: Enhance North-South, South-South and triangular regional and international cooperation on and access to science, technology and innovation and enhance knowledge sharing on mutually agreed terms, including through improved coordination among existing mechanisms, in particular at the United Nations level, and through a global technology facilitation mechanism.

Target 17.7: PROMOTE SUSTAINABLE TECHNOLOGIES TO DEVELOPING COUNTRIES: Promote the development, transfer, dissemination and diffusion of environmentally sound technologies to developing countries on favourable terms, including on concessional and preferential terms, as mutually agreed.

Target 17.8- STRENGTHEN THE SCIENCE, TECHNOLOGY AND INNOVATION CAPACITY FOR LEAST DEVELOPED COUNTRIES: Fully operationalize the technology bank and science, technology and innovation capacity-building mechanism for least developed countries by 2017 and enhance the use of enabling technology, in particular information and communications technology.

In addition, the paragraph 70 of the 2030 Agenda for Sustainable Development launches a "Technology Facilitation Mechanism" (TFM) so as to support the implementation of the Sustainable Development Goals (SDGs) through multi-stakeholder collaboration between Member States, civil society, private sector, scientific community, United Nations entities and other stakeholders. TFM will be composed of[15]:

a) A United Nations Interagency Task Team on Science, Technology and Innovation for the SDGs, composed of a 10-Member Group of representatives from civil society, the private sector and the scientific community. A variety of international actors participate in its sessions, such as e United Nations Environment Programme, UNIDO, the United Nations Educational, Scientific and Cultural Organization- UNESCO, and other UN agencies, funds and programmes.[16]

[15] Sustainabledevelopment.un.org. (2018). *Facilitation mechanism .:. Sustainable Development Knowledge Platform*. [online] [Accessed 10 Dec. 2018]. Available from: https://sustainabledevelopment.un.org/tfm

[16] Ibid

b) A collaborative Multistakeholder Forum on Science, Technology and Innovation for the SDGs- STI Forum. The STI Forum convenes once a year[17] and aims to promote interaction, matchmaking and the establishment of networks between relevant stakeholders and multi-stakeholder partnerships so as to reduce technological inequalities. [18]

c) An on-line platform so as to facilitate the access to the relevant information.[19] This ambitious initiative can be considered as "the map of existing information on technology applications" worldwide, as it is going to contribute to the dissemination of all the necessary knowledge and experience, best practices and relevant scientific publications on the STI initiatives and policies. Currently, a demo version of the Online Platform is accessible to everyone.[20]

Agenda 21: The "agenda for the 21st century" is a political commitment action plan derived from the UN Earth Summit held in Rio in 1992, with the aim to minimize the human impacts on the environment. The notion of sustainable development was introduced and the Commission on Sustainable Development (CSD) was created in December 1992.[21] More specifically, the role of Science for sustainable development is emphasized on Chapter 35 of Agenda 21. It calls for*: strengthening the scientific basis for sustainable management; enhancing scientific understanding; improving long-term scientific assessment; and building up scientific capacity and capability*.[22] Moreover, the Chapter 31 calls the members of the scientific and technological community and the policy-makers *"to make a more open and effective contribution to the*

[17] Sustainabledevelopment.un.org. (2018). *Third annual Multi-stakeholder Forum on Science, Technology and Innovation for the Sustainable Development Goals (STI Forum 2018) .:. Sustainable Development Knowledge Platform*. [online] [Accessed 10 Dec. 2018]. Available from: https://sustainabledevelopment.un.org/TFM/STIForum2018
[18] See ref. 15
[19] See ref. 15
[20] Ec2-18-208-31-215.compute-1.amazonaws.com. (2018). United Nations - Science, Technology and Innovation. [online] [Accessed 15 Dec. 2018]. Available from: http://ec2-18-208-31-215.compute-1.amazonaws.com/
[21] Sustainabledevelopment.un.org. (2018). Agenda 21. [online] [Accessed 10 Dec. 2018] Available from: https://sustainabledevelopment.un.org/milestones/unced/agenda21
[22] Sustainabledevelopment.un.org. (2018*). Science .:. Sustainable Development Knowledge Platform.* [online] [Accessed 10 Dec. 2018]. Available from: https://sustainabledevelopment.un.org/topics/science

decision-making processes concerning environment and development", whilst the key role of technology is highlighted in many sections of the Agenda.[23]

GA 19th Special Session - Implementation Agenda 21: A special session of the General Assembly reviewed the implementation of Agenda 21 and concluded to a "Programme for the Further Implementation of Agenda 21" with the A/RES/S-19/2[24].

World Summit on Sustainable Development (WSSD), Johannesburg Summit 2002: Heads of States and Governments, national delegates and leaders from non-governmental organizations (NGOs), businesses and stakeholders focused on the conservation of the natural resources.[25] The chapters 3 and 4 asked for a science-based decision-making, inter alia, by: *integrating scientists' advice into decision-making bodies; partnerships between scientific, public and private institutions; improved collaboration between natural and social scientists, and establishing regular channels for requesting and receiving advice between scientists and policy makers; making greater use of integrated scientific assessments, risk assessments and interdisciplinary and intersectoral approaches; increasing the beneficial use of local and indigenous knowledge.*[26] With regards to technology, its role" *to reduce the gap between developed and developing countries", "to increase food availability and affordability to develop waste management systems, "to promote concrete international support and partnership for the conservation and sustainable use of biodiversity*", as well was the education and health sector is highlighted.[27]

[23] Sustainabledevelopment.un.org. (2018). *Technology .:. Sustainable Development Knowledge Platform*. [online] [Accessed 10 Dec. 2018]. Available from: https://sustainabledevelopment.un.org/topics/technology

[24] United Nations General Assembly Resolution A/RES/S-19/2 *Programme for the Further Implementation of Agenda 21 Nineteenth special session (23-28 June 1997)* [online] 1997 A/RES/S-19/2[Accessed 10 Dec 2018]. Available from: http://www.un.org/documents/ga/res/spec/aress19-2.htm

[25] Sustainabledevelopment.un.org. (2018). WSSD .:. Sustainable Development Knowledge Platform. [online] [Accessed 10 Dec. 2018]. Available from: https://sustainabledevelopment.un.org/milesstones/wssd

[26] See ref. 16

[27] See ref 17

Copenhagen Accord: Call for technology, finance and capacity building support: A new Technology Mechanism was established in this political agreement, so as to accelerate technology development and transfer for adaptation and mitigation.[28]

United Nations Conference on Sustainable Development, RIO +20: the Future We Want: The Conference took place in Rio de Janeiro, Brazil on 20-22 June 2012 and the political outcome document derived stressed the need to form a post-2015 development agenda, the Sustainable Development Goals. The promotion of Science, Technology and Innovation was reaffirmed, not only as a means to achieve sustainable development but both as a target as well.[29]

Discussion of the Topic

Contribution of STI to Sustainable Development Goals

The STI Forum has already engaged with the contribution of STI to sustainable development goals, and released their proposals and best practices for the achievement of each goal. Apart from them, the members of the UN Economic and Social Council are also invited to deliver their proposals during the sessions of the Council.

Science, Technology and Innovation for ending poverty in all its forms everywhere- Goal 1

Economic growth is the goal of every government, but environmentally sustainable and socially inclusive growth remains a *desideratum*. The promotion of Science, Technology and Innovation can bridge the gaps among population group so as to "leave no one behind". Taking into account the needs, the differences and the capabilities of vulnerable groups can lead to a long-term economic growth, as well.[30]

In this regard, the STI shall focus on job creation for these groups and, also, the youth. Science and research have to be considered as a cornerstone in any national

[28] See ref. 17
[29] Sustainabledevelopment.un.org. (2018). *Future We Want - Outcome document .:. Sustainable Development Knowledge Platform*. [online] [Accessed 10 Dec. 2018]. Available from: https://sustainabledevelopment.un.org/futurewewant.html
[30] Un.org. (2018). United Nations Official Document. [online] [Accessed 17 Dec. 2018]. Available from: http://www.un.org/ga/search/view_doc.asp?symbol=E/HLPF/2017/4&Lang=E

development agenda. Facilitating access to knowledge will educate and inspire the young generations and the future leaders. Nevertheless, partnerships on the development and adaptation of low-cost technologies which will have beneficial impact on societies and individuals should also be enhanced. For instance, affordable Internet access for all is the key for knowledge and technology diffusion.

Science, Technology and Innovation for ending hunger, achieving food security and improved nutrition and promoting sustainable agriculture - Goal 2

Science Technology and Innovation can be crucial for addressing the needs of 800 million people around the world who remain malnourished. Collaboration among the actors in the agricultural system is fundamental to eradicating hunger and increasing food security, since the potential contribution of local practices is considerable.

The new technologies offer a considerable potential as well for the development of hybrid crops, bio-fortification, genome editing, big data, satellite imagery and predictive analytics. In that sense, new markets have to be discovered. Finally, collaboration is the key and, in this regard, the Forum invites international collaboration in sharing data and knowledge.[31]

Science, Technology and Innovation for ensuring healthy lives and promoting well-being for all at all ages-Goal 3

It can be easily comprehended that STI is inextricably linked with ensuring health and well-being for all. Outbreaks of infectious diseases spread by animals can be prevented with training for medical staff, veterinarians and epidemiologists. The application of microelectronics, nanotechnology, fine chemicals, biotechnology and information technology by qualified personnel should also be supported in national and international level. Moreover, the forum encourages that diffusion of appropriate and innovative technologies must be combined with effective intellectual property rights protections.[32]

[31] Ibid
[32] Ibid

Science, Technology and Innovation for achieving gender equality and empowering all women and girls-Goal 5

It is well known that progress in science, technology and innovation most often supports gender equality and *vice versa*. Although women are the majority of new university graduates in most countries, they still account for less than one third of all researchers. The governments have to create an environment that can encourage and prepare girls to participate and succeed in Science Technology Engineering Mathematics (STEM) sector. Equal access to resources for women and men in science, technology and innovation at the workplace has to be promoted through preventing gender bias in the hiring process, combatting gender-based violence and changing cultural perceptions regarding women's role in the workforce and in research. [33]

Science, technology and innovation for sustainable management of water and sanitation for all- Goal 6

Water is vital for all known forms of life on earth, as well as the economic, social and environmental sustainability. However, it is estimated that over 2 billion people drink unsafe water and have to walk long distances to access water resources, and more than 4.5 billion people do not have adequately and safely managed sanitation services. What is more, the water demands are going to grow the upcoming decades and, bearing in mind the climate change, the possible shortages can put the economic and social development, as well as the international security, at risk.

The STI Forum has underlined the application of new materials, digital technologies, biotechnologies, nanotechnologies and artificial intelligence towards addressing water needs, especially for developing countries. Concerning the efficient management of water resources, the Forum recognized the contribution of investments in satellite data and the Internet of things (IoT) to such projects. On a concluding remark, the participants stressed the need to enhance Public-Private-Partnerships for the accomplishment of both challenges. [34]

[33] Ibid
[34] Un.org. (2018). United Nations Official Document. [online] [Accessed 17 Dec. 2018]. Available from: http://www.un.org/ga/search/view_doc.asp?symbol=E/HLPF/2018/6&Lang=E

Science, technology and innovation for Affordable and clean energy- Goal 7

It is well know that energy production requires a kind of intervention to the environment. The last decades, the international community is looking for ways and plans to minimize the dependence from non-renewable energy, but the lack of know-how, infrastructure and, sometimes, the necessary political will impede the development of renewable energy worldwide. Besides, the cost of renewable energy has dramatically fallen. Another question lies in the accessibility and reliability of energy. To be precise, the United Nations have highlighted the affordable and reliable energy, which are also included in the Goal 7.

The role of STI is critical for the development of energy and electricity grids in marginalized areas. What's more, the Forum emphasized on the role of private investments in national level, which depends on the policy frameworks and, consequently, on the political will. In order to achieve a holistic and sustainable approach, investing in research and development, promoting the relevant education, supporting the young practitioners and the new business models are also required.

Science, Technology and Innovation for building resilient infrastructure, promoting inclusive and sustainable industrialization and fostering innovation-Goal 9

To achieve inclusive and sustainable industrialization, competitive economic forces need to be unleashed to generate employment and income, facilitate international trade and foster innovation. Knowledge-sharing is the key for these goals. Thus, the exploration of new forms of learning, student exchanges on a global scale and artificial intelligence shall be set on the forefront. The diffusion on technology to all people can inspire them so as to form their innovative products and services. Innovators from the least developed countries have to confront the absence of funds, knowledge and experience. When it comes to infrastructure, there is a great imbalance between urban and rural infrastructure investments, even if they are necessary everywhere. For

this reason, the Forum has underlined the contribution of communications and the internet.[35]

Science, technology and innovation for sustainable cities and communities- Goal 11

It is estimated that 54% of the world population lives in cities. The extensive urbanization started the last decades of the 20th century has decisively affected the living conditions of citizens. Air and noise pollution, diseases, slums, inadequate infrastructure and health services are only some of the by-products of rapid urbanization that makes our cities fragile.

Shaping inclusive, safe, resilient and sustainable urban spaces is inconceivable without the use of STI on a wide range of activities, such as the development of sensory design and of public health infrastructure. However, focus should be given to a sustainable approach by the policy makers and public administration. Thus, the role of data is remarkable towards monitoring and responding to these challenges and making our cities "smart". [36]

Science, technology and innovation for responsible production and consumption- Goal 12

As mentioned before, the environmental protection and the depletion of natural resources were not taken into account during the development and the implementation of the economic agendas of the past decades. Introducing sustainable production and consumption patterns is more necessary than ever, since one third of the food produced is lost in production and transportation in developing countries, while in developed countries 40% of food is lost in retailing. Bearing also in mind the worrying hunger rates, the need of a global pitched plan for a circular economy approach is crucial.

Consumption and production patterns can be made more sustainable by creating new efficiencies in existing models, which will based on science and technology, by gov-

[35] See ref. 30
[36] See ref 34

ernments with a view to reduce food waste and to promote sustainable and nutritious dies, by imposing taxes on emission-intensive food products. The role of innovation is also considerable, bearing in mind the Small and Medium-sized Enterprises operating in food sector.

Science, Technology and Innovation for conserving and sustainably using the oceans, seas and marine resources for sustainable development -Goal 14

The blue economy, as known as the use of seas and coasts for economic activities, offers great opportunities for the development of STI, and *vice versa*. On the one hand, technological applications can be useful to connect such States to the outside world and data for harnessing offshore wind, ocean wave and tidal energy. On the other hand, the further exploration of the "blue world", namely the oceans and the seas, can be facilitated through collaboration on ocean observation based on new technologies to gather data for ocean assessments.[37]

Science, technology and innovation for the sustainable use of terrestrial ecosystems- Goal 15

The deterioration of ecosystems and their destabilization through the desertification, land degradation, deforestation, can put biological diversity in danger. STI can be crucial towards preventing and confronting such phenomena directly and indirectly.

Improving existing technologies, such as remote sensing for land use, planning and monitoring, locally applicable soil conservation methods, citizen science, and community-based monitoring for the restructure and transformation of agricultural and mining sectors. In addition, deep concerns have been expressed for the genetic technologies, such as changes in DNA that impact biodiversity, ecosystems and species. Consequently, a comprehensive regulation that will take account of environmental and ethical challenges is needed.[38].

[37] See ref. 33
[38] See ref. 34

Science and research- The role of higher education, scientific data and Indigenous and Local Knowledge

UNESCO, the competent UN Agency for the promotion of science related issues has published the Science Report, which presents the role of science in international decision-making, the necessity to reinforce science education and research in developed and developing states, the current situation and the perspectives for enhancing STI in the future.

a. Higher education challenges

To begin with, higher education is more accessible than ever. The number of international students is growing rapidly and, currently, they are estimated to 4.1 million. This rate is much higher than 40 years ago, when there were only 0.8 million tertiary-level international students worldwide. Today, people are convinced that knowledge and skills obtained at universities are crucial to personal well-being, as well as to the social and economic growth of cities, nations and regions. It is true that universities play a decisive role in world affairs, since the answers to some of most important global challenges, such as energy, water and food security, urbanization, and climate change, lie in technological innovation and the scientific data. The findings contributed by research institutes and universities determine the activities of the private sector (investments, industrialization), as well as the economic agendas of governments. In other words, universities are not just an integral part of our societies, but an equal actors in national, regional and international level.

In this context, universities are competing with one another to attract funds, prominent professors and talented students from all over the world, as a response to global university rankings, a trend appeared the last decade. The dominant ones, the "world-class universities", prevail due to their qualified professors and students, their self-governance and administrative autonomy, the promotion of academic freedom for faculty and research, the empowering of young researchers to head their own laboratories, and sufficient economic resources to provide a comprehensive environment for research and development.

Nevertheless, the relation among universities is not just competitive, but also cooperative. Long-distance scientific collaboration and brain circulation can lead to holistic approaches towards global challenges and, of course, the enhancement productivity and innovation on a global scale. Attention should be drawn to possible innovation gaps between the developed and developing states. Universities of the 21st century can spread the knowledge to a global audience, so that no region or nation can remain a simple 'user' of new knowledge but must also become a 'creator' of it. The development of massive open online courses (MOOCs), primarily by "world class universities" can ensure than the existing gaps will be bridged. [39]

b. The diffusion of scientific data

Another question lies in the diffusion and use of scientific data for sustainable development. A modern approach towards science encompasses interconnectedness, information-sharing and data-reuse between collaborators. The "collaborative science" can utilize local data to develop global policies and *vice versa*. Thus, scientific discovery has shifted from basic research to 'relevant' or big science. Big science has already contributed to the examination of the world's major challenges and the formation of the Sustainable Development Goals as well. Today, the scientific community does not just look for a new element to add to the periodic table, but how to prevent and confront challenges that could ultimately threaten human existence, such as pandemics, water, food and energy insecurity and climate change. In other words, the scientific research has focused on commercially viable and sustainable product or technology which a positive socio-economic impact.

This modern approach towards science is inextricably linked with the problems, concerns and needs of our societies. Whereas the scientific community engages with the amelioration of human lives, there is no better way to identify their needs and challenges than to involve them in this process. Thus, the data shall be open and accessible, not only because citizens are not able to participate if science is not open and

[39] Unesdoc.unesco.org. (2018). *UNESCO SCIENCE REPORT*. [online] [Accessed 18 Dec. 2018]. Available from: https://unesdoc.unesco.org/ark:/48223/pf0000235406/PDF/235406eng.pdf.multi

transparent, but also as way to recognize the local needs. In fact, a greater interaction between science, policy and society brings a more open, transdisciplinary and democratic research.[40]

c. The role of Local and Indigenous Knowledge- LIK

A further step towards the science-policy interface is bringing the Local and Indigenous Knowledge - LIK to the fore. In spite of the separation, and even opposition, of science and local and indigenous knowledge throughout history, when scientists supported the superiority of "nature" to "culture", today the international scientific community has recognized the interconnections between them. Science emerged as a distinct body of understanding with different methods than culture, but this long period of separation between science and local and indigenous knowledge systems is coming to an end.

The term Local and Indigenous Knowledge refers to*" knowledge and know-how that have been accumulated across generations, which guide human societies in their innumerable interactions with their environment; they contribute to the well-being of people around the globe by ensuring food security from hunting, fishing, gathering, pastoralism or small-scale agriculture, as well as by providing health care, clothing, shelter and strategies for coping with environmental fluctuations and change."*. The LIK has been recognized as a tool for addressing climate change, for wildlife management and environmental impact assessment, for mid-term and long-term weather forecasts and for the prevention and response to natural disasters. For instance, in December 2004, when the Indian Ocean tsunami tragically took over 200 000 lives, the Moken peoples of the Surin Islands in Thailand survived, although the tsunami destroyed their village. The villagers explained that all the residents, adults and children, had known that the unusual withdrawal of the ocean from the island shore was a sign that they should abandon the village and move immediately to a higher ground.

However, attention should be drawn to the future of LIK, as maintaining the vitality and dynamism of local and indigenous knowledge and practices in the local commu-

[40] Ibid

nities is in danger, due to the mainstream education systems that ignore the vital importance of a childhood education anchored in indigenous languages and the global lingual and cultural conformism, in general.[41]

Innovation- Building efficient National Systems of Innovation

As already mentioned, the concept of STI emerged recently. Until then, innovation was not even on the periphery of many countries' development strategies, since the countries tended to emphasize investment only in formal research and development (R&D) and, rarely, to put some efforts in transferring the outcomes of R&D to the commercial sector. In other words, these traditional strategies failed to fully monetize the knowledge generated from national R&D strategies.

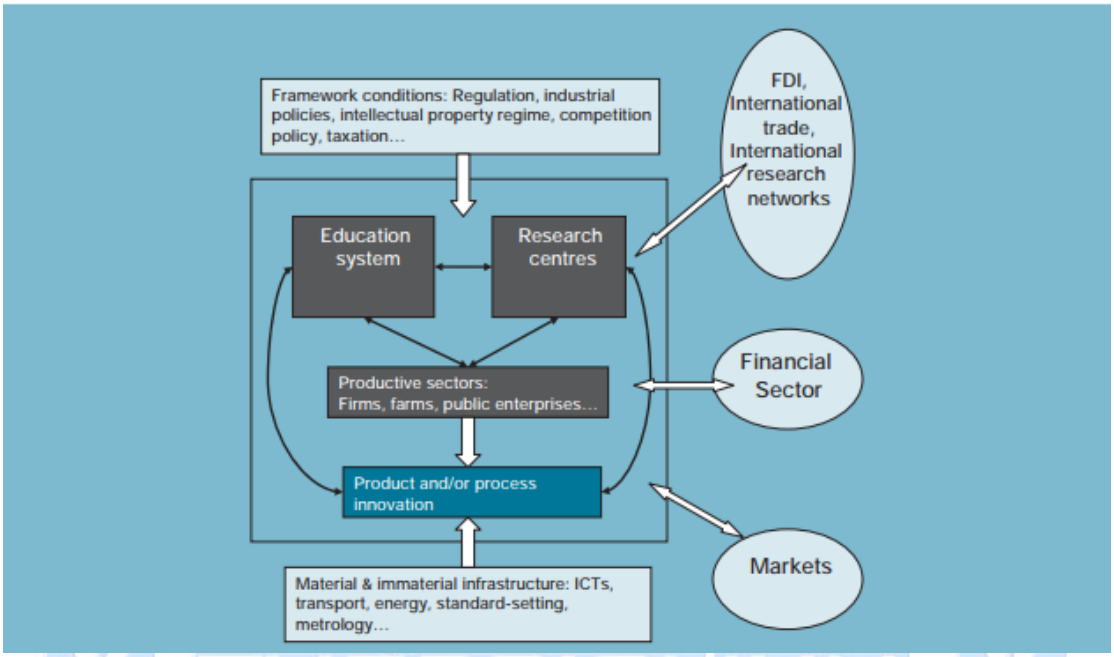
Currently, innovation is not just an aftereffect of scientific and technological development, but an explicit part of any development agenda. A National System of Innovation (NSI) aims at incentivizing and supporting interactions among market and non-market actors, such as firms, universities, research centers, public agencies involved in the production, diffusion and use of science and technology. To wit, the interaction between the "supply side" of knowledge and technology (universities, research centers) and the "demand side"(firms, farms and public sector which utilize knowledge and technology for the production of goods and services).

A comprehensive national approach to innovation encompasses a variety of actors, elements and interactions between them. A typical national system of innovation has to coordinate the actions of policy instruments, as well as to establish the appropriate legal framework (competition policy, intellectual property law, taxation), to revise education policies so as to match job market needs, to develop STI infrastructure, to boost foreign direct investments, trade and other market-based mechanisms. Above all, the fundamental objective of a national system of innovation is the creation of "absorptive capacity" for the actors of national innovation system, which refers to as

[41] Ibid

the availability of a wide range of skills and experience and of material and immaterial infrastructure.[42]

Figure 1 A schematic diagram of a national system of innovation



New and Emerging Technologies- Typology- Applications

It is an undeniable fact that socio-economic development goes hand in hand with technology change, as technology, society and institutions co-evolve. Thanks to global technological development, the inclusion of all social groups is achieved and international cooperation is facilitated. In that sense, the 2030 Agenda has recognized the importance of technology for the achievement of the SDGs as a "means for implementation" of various goals and targets.

More specifically, in the context of the 2030 Agenda, the new and emerging technologies and their applications can offer great opportunities for achieving economic prosperity, inclusion, and environmental sustainability. New technologies are developing at exponential pace, faster than ever before, and the 2030 Agenda may play an

[42] Unctad.org. (2018). *A Framework For Science, Technology and Innovation Policy Reviews*. [online] [Accessed 18 Dec. 2018] Available from: http://unctad.org/en/Docs/dtlstict2011d7_en.pdf

important role in their transformation, as well. Currently, the new and emerging technologies include:[43]

a. Biotechnology

Biotechnology is one of the driving forces in the biological sciences and is increasingly being applied in the study of environmental issues, medicine and pharmaceuticals, infectious diseases, and modifications of food crops. It can be a part of the solution in addressing food insecurity in developing countries, as well as in the fields of bio-engineered medicines, manufacturing and effective recycling.

b. Digital Technology

Digital information and communications technologies (ICTs) are in a continuous and rapid advance. Some digital gaps, such as mobile phones ownership, have closed, but some others continually open with the introduction and the development of new technologies. In the context of sustainable development, these gaps have to be bridged, as well.

Some of the applications of digital technology include the new fifth generation (5G) mobile phones, which are connected even faster than traditional phones, the "Internet of Things" and "Big Data", the 3D printing, digital monitoring technologies, digital security technology and Massive Open Online Courses, which can provide equitable access to world-class education content. In that sense, the digital technology applications can be useful in fostering employment and decent work for all, manufacturing, sustainable agriculture, health services, sustainable cities etc.

c. Nanotechnology

Nanotechnology has great potential for increasing innovation for sustainable development in the fields of solar energy, wastewater treatment, chemical industry, medicine and pharmaceuticals. Some of the most promising future, inorganic and organic

[43] Sustainabledevelopment.un.org. (2018). [online] [Accessed 18 Dec. 2018] Available from: https://sustainabledevelopment.un.org/content/documents/2328Global%20Sustainable%20development%20report%202016%20(final).pdf

nanomaterials are perovskites, gold nanoparticles, graphene, carbon nanotubes, carbon nanodots and conducting polymers.

d. Neuro-technology

Neuro-technology can help societies to monitor, detect various environmental challenges and to respond or adapt to them. The advancement of emerging technologies in the area of artificial intelligence, as computer systems carry out tasks normally done by humans, such as speech recognition and decision making, of robotics, in which machines or mechanical systems automatically handle tasks, of virtual reality and of digital automation, such as the autonomous vehicles or self-driving cars, offer great opportunities to ameliorate life and working conditions and reduce inequalities.

e. Green Technology

Green technology includes an environmental-friendly technology. Existing technologies as well as new nanotechnology, biotechnology, and digital technology may all be deployed in a sustainable way in in a variety of sectors. Firstly, the circular economy can be enhanced thanks to green technology applications, such as technologies for remanufacturing, product life-cycle extension and recycling and multifunctional infrastructures. In the energy sector, the green technology can be applied by smart grids, highly energy efficient buildings, electric vehicles, vastly improved and cheap batteries, nuclear power, hydrogen fueled vehicles and supply infrastructures, and natural gas technologies in developed countries, whilst in developing countries, by new ways of electrification and small and medium sized nuclear reactors. Concerning the agricultural sector, technological applications, such as bio-based products, low-input processing and storage technologies and irrigation technologies, can promote sustainable agriculture. Finally, with regards to transport sector, electric vehicles, hydrogen-fuelled vehicles are only some of the technological opportunities provided by green technology.

Concerns and potential threats

It is undeniable that inequalities between the developed and developing nations still exist. Moreover, there are many vulnerable groups whose fundamental needs are not

sufficiently addressed, as well as possible challenges which may put the future of the humankind in danger. Even if the Sustainable Development Agenda makes us feel more optimistic about the future of humanity, are we sure that the benefits of STI are going to be distributed equally? Are there any possible risks?

To begin with, it is already mentioned that the success of any development agenda depends on the participation of the local communities. Such initiatives are intrinsically linked with the needs and the interests of the populations. Thus, the active participation of the civil society in the development and promotion of the STI agenda is of paramount importance.

Moving on to the objectives of such strategies, these have to be realistic and inclusive. Emphasis shall be drawn to the access of vulnerable groups of our societies, such as women and girls, persons with disabilities, the elderly, indigenous people, people in marginalized areas, to the benefits of STI. The rapid progress of STI can exaggerate the gaps, instead of bridging them. For instance 85% of households lack Internet access in least developed countries.[44]

Moreover, the rapid growth of new and emerging technologies might bring upon ethical, socioeconomic, environmental and human rights challenges. It is well known that technology is a double edged tool, since it has been utilized for "immoral" purposes, especially during the 20th century.

From an environmental perspective, all technologies consume natural resources and cause air, water and soil pollution, among others. Moreover, in the field of human rights, deep concerns about privacy, freedom and data fraud have been expressed. The human rights in the digital era are questionable. In addition, technological progress may bring upon ethical dilemmas, such as whether genetically modifying plants or animals could create problems, even though they are currently used for food security purposes. Ethical concerns may derive also from the development of artificial intelligence and robotics, as well. Lastly, the socioeconomic challenges lie in the future of

[44] Developmentfinance.un.org. (2018). [online] [Accessed 18 Dec. 2018] Available from: https://developmentfinance.un.org/sites/developmentfinance.un.org/files/IATF%202018_Chapter%20III.G.%20STI%20chapter.pdf

labor markets and jobs. The question is if computers and robots are going to create more job opportunities and reinforce workers' capabilities or they are going to replace them at all. Such dilemmas have to be answered before the consequences of rapid technological progress become irreversible. [45]

Recent Developments

Information Repository for STI Roadmaps for SDGs: An online information repository platform is created under the auspices of the STI Forum, combining information from organizations and agencies both within the UN system and beyond. This platform aims at exchanging information on recent developments and providing it to member states, in order for them to set the necessary agendas and policies. A variety of UN agencies and funds, as well as other governmental organizations have shared their agendas and guidelines.[46]

Secretary-General's Strategy on New Technologies: In September 2018, the Secretary-General published an agenda focusing on accelerating the achievement of the 2030 Agenda through STI in compliance with the principles of the UN Charter, the Universal Declaration of Human Rights and the norms and standards of International Law. More precisely, the strategy stresses the need to protect and promote global values, to foster inclusion and transparency, to enhance partnerships, to build on existing capabilities and mandates and to promote equal dialogue among the UN and the civil society. [47]

UNCTAD Technology and Innovation Report 2018: Harnessing Frontier Technologies for Sustainable Development: The Report presents the current challenges in the fields of technology and innovation and supports the continuous innovative combina-

[45] Ibid
[46] Sustainabledevelopment.un.org. (2018). *Facilitation mechanism .:. Sustainable Development Knowledge Platform*. [online] [Accessed 18 Dec. 2018] Available from: https://sustainabledevelopment.un.org/tfm#roadmaps
[47] Un.org. (2018). [online] [Accessed 18 Dec. 2018] Available from: http://www.un.org/en/newtechnologies/images/pdf/SGs-Strategy-on-New-Technologies.pdf

tion of different technologies, the democratization of new technologies and underlines the appropriate strategies and actions.[48]

Conclusion

The actors of international community have already expressed their dedication to the promotion of 2030 Agenda and have recognized the valuable contribution of Science, Technology and Innovation to this process. A variety of actions, strategies and plans for achieving sustainable development through STI have been launched by national, regional and international actors. Preventing the possible negative effects of rapid, unconscious development of STI is an imperative need. Including all the relevant stakeholders, the private sector, the scientific community and the vulnerable groups of our societies is a key factor for the successful implementation of relevant agendas. However, the coordination of these ambitious plans constitutes the greatest challenge that the UN ECOSOC has to deal with.

[48] Unctad.org. (2018). *Technology and Innovation Report 2018: Harnessing Frontier Technologies for Sustainable Development*. [online] [Accessed 18 Dec. 2018] Available from: https://unctad.org/en/PublicationsLibrary/tir2018_en.pdf

Points to be addressed

- Apart from the best practices proposed by the STI Forum, are there any specific actions that should be done for the achievement of Sustainable Development Goals through STI?
- Is the current international framework adequate for ensuring the compliance of all member states to the principles of STI for Sustainable Development?
- How can the role of universities be reinforced? Are there any other ways to promote long-distance scientific collaboration? How can we bridge the gaps between universities?
- How can we assure that research is conducted in a transparent and democratic way?
- Shall the role Local and Indigenous Knowledge be further promoted? How can we ensure its existence in a globalized environment?
- How can we monetize the scientific knowledge derived from research in a practical way? Are there any ways to improve the National Systems of Innovation (NSI)? How can "absorptive capacity" be enhanced in national and international level?
- In what specific means can each type of New and Emerging Technologies be developed?
- Which is the role of vulnerable groups in STI strategies? Are their needs and interests ensured? How can we minimize the possible negative impact to them?
- Bearing in mind the potential risks of rapid technological development, how can we deal with the ethical, socioeconomic, environmental and human rights challenges?

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