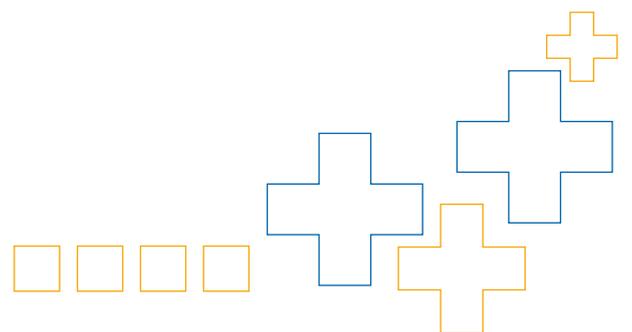
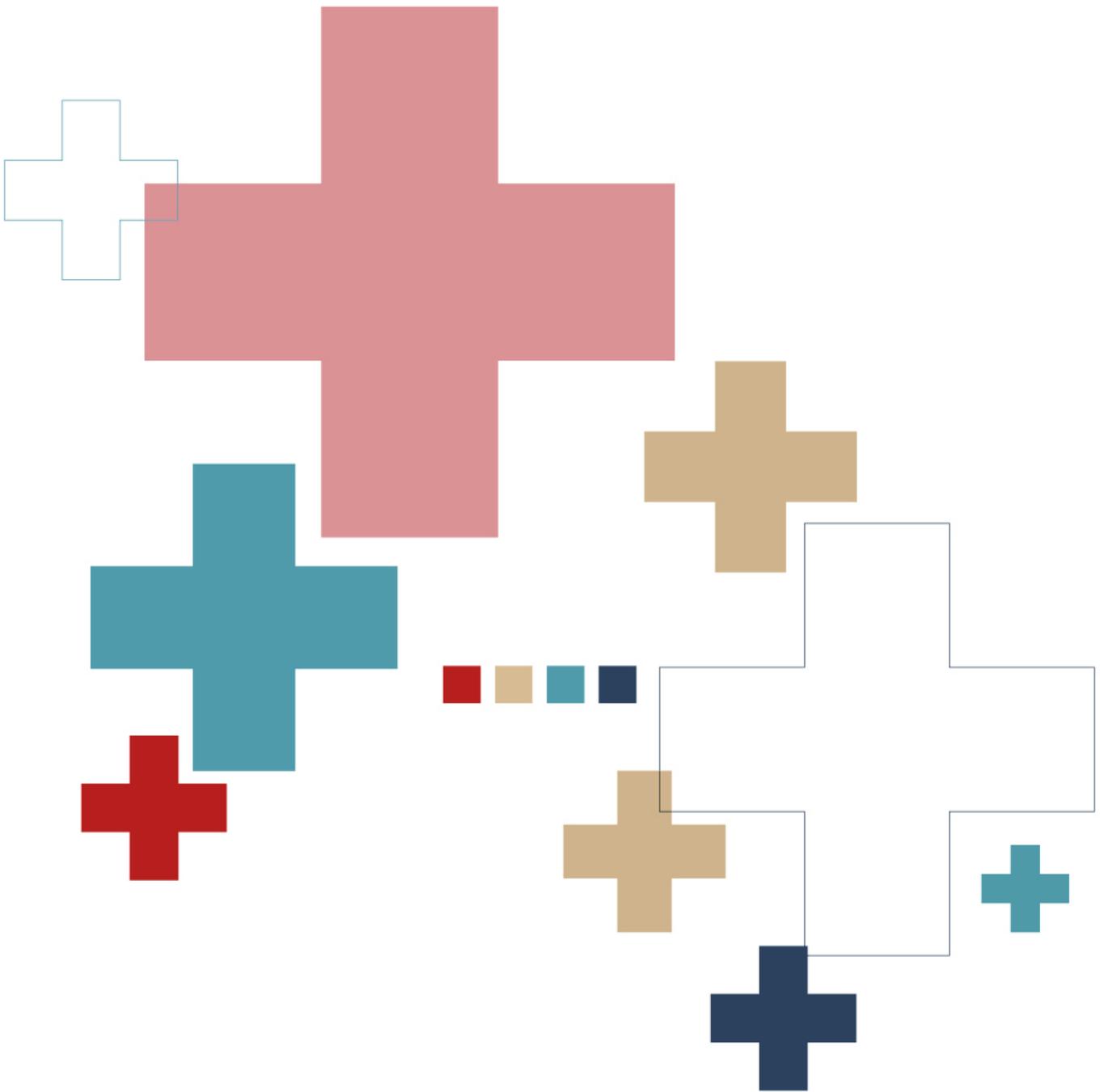




# REFLECTIONS FOR THE FUTURE: INNOVATION, TECHNOLOGY AND SUSTAINABILITY





The world is living its fourth industrial revolution. You may be aware of it or not. You may like it or not. But we are living the fourth industrial revolution. Smarter computers at lower prices and the intensive use of software are causing business models and traditional methods of production to be seriously threatened, and many of them may disappear in the next 20 years. Consider, for instance, how Uber is changing transport or Airbnb is transforming the hotel industry. Artificial intelligence, autonomous vehicles, 3D printers, bio and nanotechnology, to name but a few, will make businesses, cities, health and education systems, food production, goods and services, change dramatically or become obsolete. The question is, then, whether governments are preparing adequately and pushing for the necessary changes in legal frameworks, as well as whether they are planning incentives adjusted to the new realities. It is worth asking if governments, companies and universities are adapting with the required speed; if business is moving in the right direction; if universities are preparing students for these new challenges.

With a perspective from Brazil, the Global Forum on Innovation, Technology and Sustainability was held to find answers to these questions and present possible solutions. This publication builds upon the discussions initiated at the Forum, co-organized by the RIO+ Centre, in conjunction with the CITS and the Museum of Tomorrow, held in Rio de Janeiro, Brazil, in November 2018. It was designed to be a space for debate on the promotion of innovation and technology focused on inclusive and productive processes that stimulate economic and social progress in harmony with the environment.

The event sought to understand the advances in the areas of research and to understand the innovations and technological development fundamental both to have a competitive and productive economic sector and to encourage new social and environmental solutions that help societies and countries to be more sustainable and inclusive.

To make this Global Forum possible, the Rio+ Centre received support in many ways, which I would like to acknowledge in the following, and specially thank the Museum of Tomorrow, CITS (especially Alice Abreu), the Brazilian-German cooperation for sustainable development, through GIZ; as well as the Irish Embassy, APEX, Terna; and Furnas.

I would like to express our sincere gratitude to the Brazilian government and especially to Ambassador José Antônio Marcondes de Carvalho (Ministry of External Relations, Brazil) for working closely with me in providing guidance for the Centre's work in 2018.

We would like to express our deep appreciation to the key note speakers at the Forum, Mr. Luis Felipe Lopez-Calva (UN Assistant Secretary General and Regional Director for Latin America and the Caribbean of the United Nations Development Programme, UNDP) and Professor Johan Schot (Director of the Science Policy Research Unit, University of Sussex), who gave an excellent introduction to the event. We are also grateful to all the panelists who contributed with precious insights on issues related to public policies, education and the future of work, infrastructure and sustainability, agro-economy and food security, innovation and competitiveness, and innovative financing. For more information on the Forum, see the Centre's website: <https://riopluscentre.org/news/global-forum-on-innovation-and-technology-for-sustainability-fits-2018>

We would like to thank again the Museum of Tomorrow, especially Mr. Ricardo Piquet (President Director of Museum) and Mr. Alfredo Tolmasquim (Director of Scientific Development at the Museum) for their trust and commitment. The event was co-organized with the Museum, with a view of repositioning the wonderful and symbolic City of Rio de Janeiro in the front of the international discussions about "the future we want" and about "the meaning of technological innovation for the world" from a sustainability perspective.

Our appreciation extends also to the Ministry of Science, Technology, Innovation and Communications (MCTIC) of Brazil, as well as to ECLAC, FAO, UNDP and UNESCO and, through them, to all UN agencies, funds and programmes working in Brazil, for their support to the event.

Finally, we also would like to thank all the authors of this publication for their generous and insightful contributions, as well as to Ms. Claudia Bresanovich (UNDP/RBLAC) and Mr. Gustavo Chianca (FAO/Brazil) without whom this issue would not have been possible.

I wish you a fruitful reading of this publication, which I hope will allow us to better understand what opportunities we have in Brazil and in the world; bring new perspectives on how to face challenges, with an innovative spirit, as well as to inspire us to plan actions that could crystallize in a better future for our companies, our communities, our countries and our planet.

Niky Fabiancic

Director a.i. of the Centre RIO+



The World Center for Sustainable Development, RIO+ Center, is a partnership between the United Nations Development Programme (UNDP) and the Government of Brazil. It was created in 2013 in Rio de Janeiro as a legacy of the Rio +20 Conference of 2012, by a wide range of founding institutions, such as the Ministry of Environment and the Ministry of Foreign Affairs. The mission of the Rio+ Center is to inform and inspire public policies and practices that lead to a more just and sustainable world, using evidence, promoting a broad-based dialogue and developing actions in alliance with other partners. One of the main objectives of the Center is to internationally promote the appropriation of a sustainable development paradigm that encompasses the economic, social and environmental dimensions in an integrated way.



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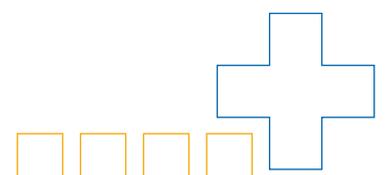
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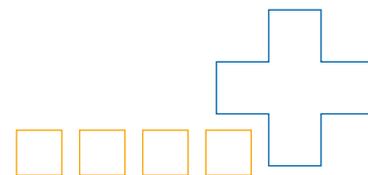
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# FOREWORD:

## CREATING INNOVATION ECOSYSTEMS TO IMPROVE PEOPLE'S LIVES

*Luis Felipe Lopez Calva, UNDP Regional Director for Latin America and the Caribbean*

**T**he German physicist Niels Bohr once said that “Predicting is very difficult, especially about the future.” If we had the capacity to foresee the future, perhaps we could have prevented many problems that we face today. For instance, 15 years ago, Latin America and the Caribbean embarked in a process of economic growth – driven, not only but significantly by very high prices of commodities–, and we witnessed significant social and economic changes in the region: poverty was reduced, the middle class was growing, and we believed that we were entering a new phase of economic development. Yet, only years later we realized how vulnerable that process was.

Latin America and the Caribbean is a middle-income region, but it is far from being a strong middle-class society. In fact, if we look at the data and define the middle class as those that have a low probability of falling back into poverty or have a measure of economic security, we see that a large part of Latin America is vulnerable. What does this mean? Although these individuals are not entirely poor, they are not outside the socio-economic threshold and can fall back into poverty when facing any adverse event.

We must imagine responses to the challenges that this vulnerability imposes upon us. We must come up with new policies and make use of science and technology as much as possible in order to innovate in the public arena and try to face these challenges.

The 2030 Agenda for Sustainable Development is a set of politically legitimized objectives, composing our aspirational vision for ourselves as a global community. We are trying to transition from a global equilibrium based on ideologies to a global equilibrium based on ideas. The 2030 Agenda is a document signed by all countries, through which we try and move into an ideal world where all countries, independently of their ideology or their politics, pursue the same goals for every member of society. The Sustainable Development Goals contained in the Agenda set out the path that we, as a global society, want to achieve for all citizens.

This is our legitimizing space, but we must define how to achieve these goals. In the case of Latin America and the Caribbean, the road to achieve the SDGs is a three-lane highway. The three lanes include: Productivity, Inclusion, and Resilience. This three-lane highway can only be built and paved with effective governance.

And how do we move forward with these three-lanes? One important instrument to improve productivity, resilience, inclusion and effective governance is the use of innovation and technology. Innovation, in its most basic definition, is the process of transforming an idea into a good or service that creates value. In a sense, it is the ability to create value from where there was none. Without innovation processes, ideas are a valuable resource that go to waste.

However, innovation does not happen just by decree. Innovation needs to be promoted and fostered and requires the interaction of many actors. Creating adequate conditions for innovation, what some call the ‘innovation ecosystem’, requires deliberate policies that support innovative thinking. The conditions need to be created for innovation to flourish, and that is not a simple task.

It not only requires incentives for research and development (R&D), but also complementary factors such as adequate conditions for investors, spaces where problems and innovative solutions can be matched, entrepreneurs that have the skills to take an idea to the market, and firms that have the managerial capacity to adopt new technologies. In this sense, governments need to be facilitators of innovation.

From the focus that I bring coming from the public space, through working with governments, I understand that it is particularly difficult for the public sector, because creating a space for innovation requires many complementary policies.

It requires very important rethinking of how we produce our human capital, how we educate new generations, not only pointing out what students

should know but how they can gain the skills needed to be more able to adapt to our rapidly changing environment. Moreover, we must rethink social protection so that it is flexible and adaptable to the needs of entrepreneurs.

Secondly, from a regulatory focus, we need to simplify processes, lift the barriers for innovations, make creativity something that pays off for individuals and eliminate all regulatory burdens that prevents innovation from taking place.

From a fiscal perspective, we need to create a fiscal system and the incentives for innovation to flourish, for instance through establishing tax incentives for newly established companies in innovative sectors, or through creating grants for research and development.

In terms of infrastructure, public policies can improve access to internet and telecommunication services. Public sector, in many cases in partnership with the private sector, must create all the infrastructure and connectivity that allows people to collectively think creatively.

All these policies must complement each other in order to create this “innovation ecosystem”, which also has implication for inclusion.

Jan Tinbergen, who was awarded the first Nobel Prize in Economic Sciences, suggested thinking about inequality in the labor market as a race between technology and skills. Fundamentally, technological change favors certain workers over others because they are more able to adapt to that technical change, which increases inequality. But after a while, skills catch up with technology, and inequality falls. These cycles of increasing and decreasing inequality are determined by the technological cycle. However, more recently, these technological cycles and the speed of innovation have become much faster. Thus, there is little time for these skills to adapt in terms of knowledge, but rather we need to create skills that are able to adapt very rapidly to these technological changes.

The challenges that these changes present for public policy cannot be thought about in an isolated way. Academia, civil society, public sector and private sector need to come together and connect. Different stakeholders usually speak very different languages, have different time frames and have few shared spaces where they interact. Building a bridge that connects government problems with innovative solutions and allows partnerships to flourish is a critical role that UNDP and other partners can play.

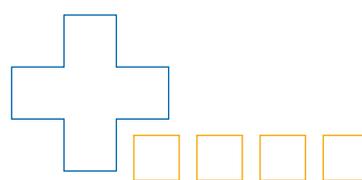
At the center of what we are calling the next generation UNDP is precisely the opportunity to create that space for creativity, experi-

mentation and innovation. However, from our perspective, what matters is trying to improve the capabilities of every member of society. Technology and innovation are not ends in themselves, but instruments to be used in the public sphere to improve policies and outcomes within the realm of the 2030 Agenda.

I am privileged to introduce this publication, with the expectation that it will be an input to contribute to this important debate.

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*(text based on the Opening Speech Luis Felipe Lopez Calva at the Global Forum on Innovation and Technology for Sustainability - FITS 28-29 November 2018)*



# SCIENCE AND POLITICS:



## FROM GALILEO GALILEI TO CLIMATE CHANGE SCIENCE

*Alfredo Tolmasquim, Director of Scientific Development of the Museum of Tomorrow*

**H**istory is full of examples of where scientific concepts have been challenged for religious and ideological reasons or simply because of a resistance to accepting new ideas. This does not mean that scientific knowledge cannot be questioned, or that it represents some immutable truth. One of the main acknowledgments of science is knowing that it is fleeting and that its theories can be complemented or replaced at any time. Furthermore, science reflects a specific worldview that is characteristic of the period in which it is produced. It is not uncommon that our understanding of nature, our observations and experiments, reflect the social order of our time. Even the notion of scientific revolution, as common as it is today, comes from the appreciation of the concept of revolution in modern societies. The genius of some scientists is expressly founded in their ability to think differently, ask questions, or raise hypotheses when nobody else has done so. Naturally, these new ideas spark resistance from existing power structures, whether religious, ideological, political or even academic.

Galileo Galilei is a paradigmatic example of this movement. He broke away from the well-established truths and ideals of his time. The belief during his time was that if God is perfect and in heaven, heaven must also be perfect and distinct from Earth, where worldly life takes place full of errors and imperfections. However, when pointing his perspicillum towards the sky to investigate the secrets of other celestial bodies inhabiting the heavens, Galileo discovered that the moon also has imperfections, like craters and valleys, similar to Earth. There was no longer a reason to believe that the Earth was unique and consequently, the centre of the Universe. By making the sky no longer sacred, it enabled the possibility that the Sun and no longer the Earth were the centre of the Universe. This theory had already been calculated by Nicolaus Copernicus many years earlier. Aware of the tragic fate of his predecessor Giordano Bruno, who was burned at the stake, Galileo did not think twice about going back on his ideas before the inquisitorial court of the Church and denying his discoveries.

Similarly, Charles Darwin was and continues to be highly criticised for proposing, based on his observations, that man and monkeys have the same biological origin and that the human species is permanently changing and adapting to its environment. How could this be possible if humans, in the image of their Creator, are born perfect?

In order to not dwell on religion, we can cite Albert Einstein. When trying to understand the results obtained in experiments being conducted by other scientists, Einstein broke away from the model proposed by Isaac Newton, relating gravity to the distortion of space-time caused by large masses. His ideas and theories emerged during the First World War, and his Jewish ancestry, alongside his political advocacy for pacifism against the involvement of scientists in war, were fundamental elements for the movement in opposition to his new ideas. He referred to this as the anti-relativity campaign. In addition to this opposition were other scientists that clung on to traditional concepts in physics. In the same vein, we can recall the Russian botanist Nikolai Vanilov, who in 1943, was condemned by the Soviet Union for defending the ideas of Gregor Mendel about the existence of genetic heritage passed from parents to their children. For Bolshevik leaders, the idea of hereditary inheritance, even genetic, had its roots in the bourgeoisie and large international capital. This view was contrary to the principles of the Revolution.

Sometime later and with the natural development of science, many of these oppositions, which might seem anecdotal in some cases, eventually disappeared. To make these assessments normally requires the benefit of hindsight. However, we can affirm that today we are already experiencing similar situations of challenge. Scientific concepts are being questioned for religious or ideological reasons. The most alarming example of this involves global warming caused by anthropogenic factors. The President of the United States has already stated that 'he does not believe in global warming', as if the studies and observations made by scientists are the result of their beliefs and are not founded

in evidence. There are people – including politicians, economists and opinion leaders – who maintain that global warming is a theory created by NGOs and scientists that oppose industrial progression and development, or that they are conspiring with China to halt the economic and technological leadership of the West.

There are, however, two fundamental differences between old cases of opposition to scientific concepts and the current resistance to acceptance of the fact that we are experiencing a process of global climate change caused by humans. The first of these concerns the scale of research. Historically the opposition was against research conducted by small groups of scientists. Today, the scale of global warming research involves tens of thousands of scientists from around the world collaborating and working together with the goal of better understanding this phenomenon. There are paleoclimatologists searching for indications of the planet's temperature during the Pleistocene and other moments in the Earth's history. They are conducting temperature dating studies of the oceans, Himalayan mountains, and the Tibetan Plateau. Glaciologists track the reduction of the ice layers in the poles of the European Alps, in the Andes of South America, and in the mountains of Asia. Meanwhile, astronomers and astrophysicists study the climates of other planets. Their findings led to the conclusion that there is a correlation between high temperatures on the surface of Venus and the greenhouse effect on the planet. Meteorologists study the climate in many stations spread across the globe. Oceanographers monitor the water temperature and the changes that take place in the ocean's currents in various locations. Botanists, ecologists and marine biologists study changes in the temperature, acidity and quantity of oxygen in oceans that may affect marine life. Concurrently, physicists and chemists study the composition of each gas in the atmosphere that contributes to the greenhouse effect. They develop mathematical models in an effort to understand the movement of these gases in the atmosphere. We could list many more specialists and researchers from different fields that are working together to understand this phenomenon of global proportions. In human history, there has never been an effort of this magnitude, by so many scientists from so many countries and regions, to try and understand the numerous aspects and consequences of a single phenomenon. By the mid-twentieth century it was thought that the increase in greenhouse gases was caused by natural planetary cycles. However, today there is no doubt that the cause of this increase is because of anthropogenic factors.

The second aspect that differentiates climate change from other cases of opposition to

scientific knowledge, for religious or ideological reasons, is its urgency and the unpredictable consequences for the planet, its ecosystems, and for humanity itself. Regardless of Galileo's retraction of his own ideas, studies of the stars continued to take place in other places outside (and even inside) of Italy. Although a symbolic gesture, Pope John Paul II's acknowledgement of the errors of the Church, with regards to the trial of Galileo in 2000 almost 500 years later, meant very little to science. Similarly, genetic studies continued to take place in other countries outside of the Soviet Union, and the Theory of Relativity gradually became accepted by physicists around the world. We can also think similarly about global climate change. Why worry about politicians or critics? Studies will continue to be conducted and over time these ideas will be accepted by society. Who knows, 200 or 300 years from now, a politician might say "it was a mistake to have disagreed with the theories and information given by scientists and now we recognise the error of our ways".

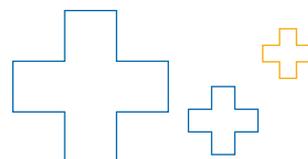
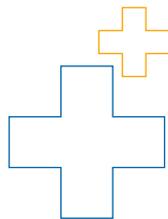
In the case of the Theory of Relativity, the worst that could have happened, if the calculations predicted by Einstein were slow to be accepted, would have been a few unlucky astronauts floating around in space because their rockets didn't travel in the exact direction of the moon. Similarly, distracted drivers might crash their vehicles into a wall because their GPS did not indicate their exact location. We can all agree that the consequences for the future of humanity, with regards to resisting the acceptance of the Theory of Relativity, would not have been catastrophic.

The situation of climate change, however, is drastically different. The most immediate consequence is the rise in seas levels. This increase is due to either the large-scale melting of ice sheets or the expansion of the volume of water because of increasing ocean temperatures. This will affect inhabitants of ecosystems such as islands, coastal areas, and river basins. Sea life is also threatened by changes in the physical and chemical conditions of ocean water, which will result in the reduction of biodiversity. Tornadoes, hurricanes, floods and droughts are increasing in frequency and intensity. They are directly impacting ecosystems, the supply of potable water, food production and the intensification of diseases, in addition to the economies of affected countries.

Just as Galileo's observation of the moon's craters framed social debate at the time, modern scientists' studies of carbon dioxide affect fundamental concepts of current society, such as the idea of production and unlimited development as a way of promoting happiness and wellbeing. We live in a utopia envisioned by Francis Bacon, whose theory, foreseeing the

industrial revolution, predicted that with technological advancements and growing productivity, it would be possible to build a world in which all human needs were obsolete. Examining chemical molecules and geologic formations plays the same role: the insight this provides can promote the reexamination of well-established theories that maintain existing power dynamics and social and economic structures.

Science is not immutable, but scientific studies influence where we find ourselves today and the different paths that will be laid out before us tomorrow. It is not necessary to try and promote an unwavering faith in science that is capable of dictating hard and fast truths about the world. Just as the world changes, the ways of understanding it and scientific concepts also change. Scientists share their knowledge, although ephemeral, with one another and with society. Every generation has to face its own fleeting but fundamental truths. It is then up to present society to make its own choices and decide the path that it will forge in the future.





## FOR SUSTAINABLE DEVELOPMENT

*Haroldo Machado Filho, RIO+ Centre Coordinator and Senior Advisor of UNDP/Brazil*

Infrastructure has been a building block of modern societies. Infrastructure (or the lack of it) impacts, in a significant manner, how we live, eat, move and communicate. As Professor Paul N. Edwards, University of Michigan, says: “To be modern is to live within and by means of infrastructures”.

Infrastructure, as human-made systems and processes that function to produce and distribute a continuous flow of goods and services, is the basis of modern economy: energy production and storage; information and communications; piped water supply; sanitation and sewerage; solid waste collection and disposal; major dam and canal works for irrigation and drainage; roads and transport sectors, urban and interurban railways, bus rapid transit and other urban transport, ports, water ways and air transport in addition to facilities for health care, education, banking and government services, for example.

A paper published in Nature Sustainability, authored by staff from the UN Office for Project Services (UNOPS), University of Oxford, World Bank, UK Department for International Development (DFID), German Agency for International Cooperation (GIZ) and Inter-American Development Bank (IDB), based on the premise that ‘infrastructure systems form the backbone of every society’, states that infrastructure influences nearly three-quarters (72 percent) of the 169 Sustainable Development Goals (SDG) targets. According to the report, five of the seventeen SDGs (SDG 3, 6, 7, 9 and 11) have all of their targets influenced by infrastructure, whereas for fifteen of the SDGs more than half of their targets are influenced by infrastructure.

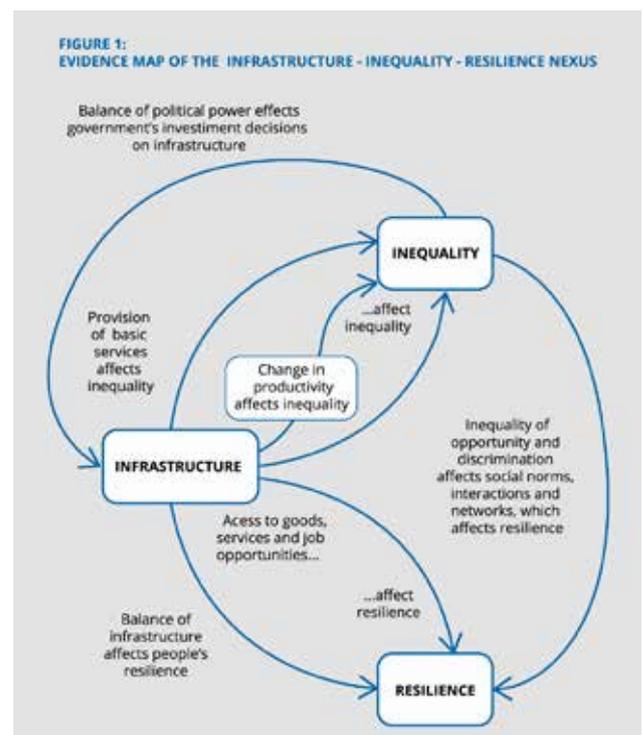
Although this paper does not intend to verify the accuracy of the percentage of relationships proposed, it will examine the synergies and trade-offs among infrastructure and other SDGs in the light of the ‘three-lanes’ mentioned by Luis-Lopez Calva in the foreword of this publication: prosperity, inclusion and resilience.

It is uncontroversial that the availability of infrastructure drives the conditions of production

and the competitiveness of producers, as well as facilitates access to goods and services for consumers. It also generates opportunities and open space for the development of innovations. On the other hand, the deficit in infrastructure penalizes producers and consumers and limits their opportunities.

Although infrastructure is indivisible from productivity, ensuring rights to economic resources and access to services, its linkages with inclusion is less evident. Nowadays, there is a strong global agreement that it is crucial to tackle inequality to achieve more inclusive and balanced growth. The disparity in opportunities or outcomes between people or groups of people is the main barrier to more inclusive societies.

The UN Department of Economic and Social Affairs (UN-DESA), in its Global Sustainable Development Report 2016, investigated the infrastructure – inequality – resilience nexus (see image below).



Source: UN-DESA, Global Sustainable Development Report, 2016.

This report states that infrastructure affects inequality in three main ways. Firstly, the provision of basic services' infrastructure (eg. water, sanitation and electricity) may affect inequality depending on the quality, design, coverage, accessibility and distribution of that infrastructure. This nexus is evident in many urban areas of developing countries, where basic infrastructure is prioritised in central and rich areas and is neglected in the peri-urban areas, with harmful impacts, including on people's health.

Secondly, infrastructure that facilitates production systems (eg. energy, water, irrigation and roads) reduces trade costs and affects the structural dynamics of the economy, including levels of income and the distribution of jobs. There are several examples in which this kind of infrastructure influenced the reduction of inequality. The construction of rural roads can lead to increased agricultural production, given that small farmers' families have easier access to markets and broader coverage of electrification giving opportunities to people in the countryside to study at night, among other things.

Thirdly, connectivity infrastructure (eg. roads and information and communications technology – ICT) affects people's access to goods, services and job opportunities. It is increasingly recognised that access to the internet and mobile telephony has a significant impact on access to goods, services and job opportunities. Better roads, facilitating access to hospital and other health facilities for instance, can have an impact on maternal and child mortality.

The report mentions that the inequality of outcomes affects infrastructure through its effect on the balance of political power. As previously mentioned, the three-lane highway (productivity, inclusion and resilience) can only be built and paved with effective governance. Government decisions and the involvement of private companies on the provision of basic services have a profound impact on the distribution of infrastructure. Unfortunately, the reality in many countries is that investments and the quality of services favour the rich and the design of urban and rural infrastructure and operation of public services tend to follow the wider balance of power.

By adopting the 2030 Agenda, Member States have committed to leave no one behind in their implementation of the SDGs. This means that the specific needs of vulnerable people (people living in poverty and other vulnerable situations, including children, young people, people with disabilities, people living with HIV/AIDS, older people, indigenous peoples, refugees and internally displaced people and migrants) must

be addressed, so that everyone can enjoy sustained, inclusive and sustainable economic growth and social progress. 'Leaving no one behind' also requires the transformation of how governance structures and business models address infrastructure at all levels, from local to global.

Regarding the connection between infrastructure and resilience, the DESA Report states that infrastructure affects resilience through its effect on people's access to goods, services and job opportunities, which influence the ability of people to adapt to shocks. For instance, the availability and location of basic infrastructures for water management (eg. pipe water system, drainage system and irrigation) is related to the vulnerability and resilience of areas to natural disasters such as flooding and droughts.

Moreover, the quality, design, distribution, interrelation and operation of infrastructure also affect the resilience of the infrastructure itself, which has an effect on people's resilience to economic, social and environmental shocks. Floods in urban areas are good examples of how infrastructure can influence social and economic vulnerability. Furthermore, the increasing awareness of climate change impacts have highlighted that urban planning and management strategies can increase the resilience of cities to such impacts.

Policies aimed at improving inclusion increase the likelihood of infrastructure investments that benefit vulnerable groups and, therefore, can have a positive effect on infrastructure provision and increasing resilience.

Certainly, provision of infrastructure does not only have positive impacts. Infrastructure systems can have harmful social and environmental impacts not only during their construction (eg. displacing people, overexploitation of natural resources, hazardous working conditions) but also within (eg. poor air quality due to energy production and transportation), and beyond the lifetime of assets (eg. water and soil contamination, the greenhouse effect). Infrastructure can also increase vulnerability to natural and man-made hazards (eg. enabling development in hazardous locations, such as floodplains and mountain sides). Moreover, the design and allocation of infrastructure can exacerbate gender inequality and inequality more broadly, including among and within countries. For instance, ICT infrastructure has tremendous potential for enabling the achievement of the SDGs, but in many cases innovation and technology have exacerbated inequalities, especially between the rich and poor.

As presented in the previous paragraphs, inequality in access to infrastructure has reinforced

ced inequalities in opportunities and outcomes among people, compromising inclusion and resilience. With a view to achieving the SDGs, infrastructure needs to be secure, inclusive, reliable, and resilient. Therefore, the next generation of infrastructure must enable a broad range of solutions, from smart cities and climate monitoring, to public and financial services.

If the objective is to raise the quality of life by combining technological and social innovation, it is fundamental to develop infrastructure that has the potential to improve the performance of sectors like transport, health, education, energy, urban safety and waste disposal, with benefits for all people, including the most vulnerable.

Structural change towards secure, inclusive, reliable, and resilient infrastructure will require significant investment from both the private and public sectors, including a combination of both, by means of public-private partnerships (PPPs). Investment decisions that are being made now will determine patterns of development for future generations. Although for the most part these investments are motivated by the desire to increase economic productivity and generate profit, in order to ensure that the right infrastructure is built, policymakers need to establish long-term visions for sustainable infrastructure systems and create enabling conditions so that the ambitious vision that 'no one is left behind' can be demonstrably delivered.

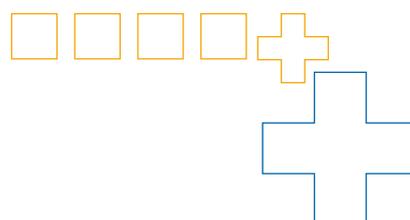
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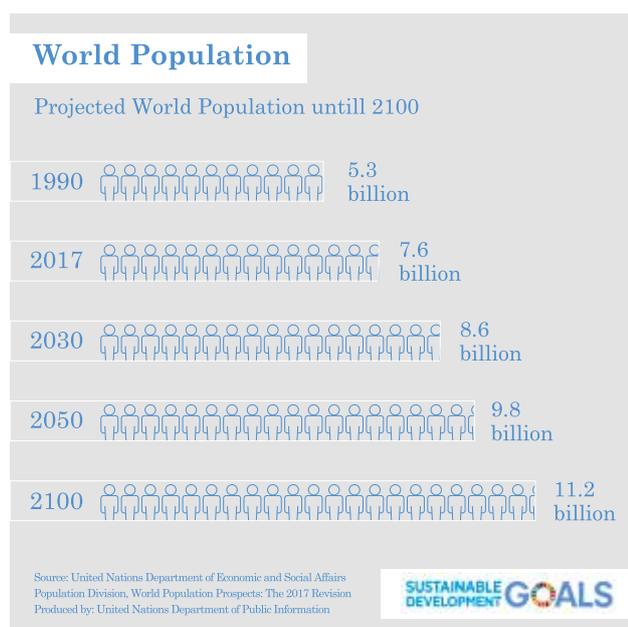


# AGROECONOMY AND FOOD SECURITY:

## THE ROLE OF DIGITAL TECHNOLOGIES AND DISRUPTIVE INNOVATIONS

*Alan Bojanic, FAO Representative in Colombia*

It is impossible to talk about the food and agricultural sector without talking about world population growth. Some time ago, forecasts indicated that the world population would stabilise at 10 billion by 2050. New statistics, however, show that the population will continue to grow beyond this number, forcing us to talk about the 2100 challenge, the time when the human population on earth will most likely be more than 11 billion.



This forecast represents an enormous challenge that not only consists of feeding everyone and developing a culture of sustainability, as well as a sustainable food system that impacts less on the environment and emits fewer greenhouse gases.

Technologies will play a key role in addressing these challenges but how to feed the world's future population is not only a question for technology. Though technology can help to increase productivity, for example through intensified agriculture, policy makers will also have to think about specific policies for vulnerable populations. Social programmes that reach everyone are going to be needed. A combination of a range of activities will be needed to

feed the world and technology will play a central role within this.

The 2030 Agenda requires us to think across three major spheres of sustainability with regards to food security: social aspects, economic aspects and environmental aspects such as environmentally friendly production. Many of the activities that are needed to achieve the Sustainable Development Goals (SDGs) by the year 2030 – our results framework for humanity that guides our actions – are to do with agriculture.

The first industrial revolution which started in the UK in the late 18th century brought about the mechanisation of industry. For instance, textiles were no longer produced only manually but with the help of machines in factories. The second industrial revolution in the early 20th century made mass production possible using moving assembly lines. The third one happened soon after, in the mid-20th century, digitalising manufacturing. The fourth industrial revolution – as with all the others before – is building on the previous revolutions. It is characterised by a fusion of technologies that are blurring the lines between the physical, digital, and biological spheres.

There are three main reasons, however, that make this revolution a distinct one: velocity, scope and systemic impact. When compared with previous ones, changes within the fourth revolution are occurring at an exponential rather than linear pace and are disrupting almost every industry in every country. These changes will be responsible for transforming entire systems of production, management and governance. This is also true for agriculture, where each day new technologies are surging. For the Food and Agricultural Organisation (FAO) it is key to remain up to date with these big, exponential changes.

The possibilities that could arise from billions of people connected by mobile devices, with unprecedented processing power, storage capacity and access to knowledge, are unlimited. These possibilities will be multiplied by emerging

technology breakthroughs in fields such as: artificial intelligence, robotics, the Internet of Things, autonomous vehicles, 3-D printing, nanotechnology, biotechnology, material science, energy storage, and quantum computing.

Technological breakthroughs from previous decades have opened the path to new economics, a focus on fewer carbon emissions and on resilience-oriented solutions. For example, the circular economy – an industrial system that is restorative or regenerative by intention and design – follows three main principles: designing out waste from processes, differentiating between consumable and durable components of a product and using renewable energy to fuel the circle. In this way, it replaces the end-of-life concept with restoration, shifting towards the use of renewable energy eliminates the use of toxic chemicals, which impair reuse and return to the biosphere, and aims for the elimination of waste through the superior design of materials, products, systems and business models. This approach is creating entirely new demands for agriculture and is triggering innovation in fields such as farm management and the reduction of food waste.

As the FAO has calculated<sup>1</sup>, one third of the world's food production is wasted or lost every year. This problem is addressed within the SDG 12 for responsible consumption and production. SDG target 12.3 states that the per capita global food waste should be reduced by 50 percent by the year 2030. This reduction means having to be much more efficient, which implies having systems working along the production chain from the harvest to the consumer's plate with much more convincing approaches to waste reduction.

Following the path stipulated by the circular economy means that consumer practices need to be reformed and environmentally friendly behaviours, such as recycling, need to be incorporated more widely. All social agents must be included in the production chain.

Another important new economic approach to food security is the bioeconomy. The bioeconomy can be defined as the knowledge-based production and utilisation of biological resources, biological processes and principles to sustainably provide goods and services across all economic sectors<sup>2</sup>. It involves three elements: the use of renewable biomass and efficient bioprocesses to achieve sustainable production; the use of enabling and conver-

ging technologies, including biotechnology; and finally, the integration across disciplines and use in areas such as agriculture, health and industry.

These new economic systems have created demands for new solutions and connections that themselves have an unprecedented velocity, scope and systematic impact. Synthetic biology, artificial intelligence, remote sensing technology, transgenics, robotics, nanotechnology, mobile phone applications, big data, drones and digital laboratories are some of the many complex technological innovations that are taking place. These innovations offer solutions to future challenges that the agricultural sector will face. To use them in the best way, existing technologies and processes must be understood so that new technologies can be integrated in a beneficial way for everyone, both producers and consumers.

The benefits of three new technologies for agriculture will be now discussed. These technologies are big data, artificial intelligence and nanotechnology.

Big data and the collection and processing of complex data sets is a very useful tool for monitoring land. With satellite images, one can monitor land occupation, compare soil quality globally, estimate crop yields and link this information to climate forecasts. Global weather information as well as information on land use and practices, all have an impact on the food market and price estimates. Big data is also closely linked to innovation processes. It measures the needs, habits and preferences of consumers. It allows businesses worldwide to make informed and accurate product plans. It can also help to track production and give more detailed consumer information.

The collection, storage and correlation of data allows for more logical and effective decisions to be made in all areas. In agricultural and rural areas, the use of big data technologies is of strategic importance given the fact that farms already generate large amounts of data in real time. If this data was collected properly and interpreted, decisions around crop planning, intelligent irrigation systems, pests and weather alerts, among other things, could be implemented effectively.

This, together with the enormous potential of real-time generated images and high definition level maps captured by drones, could allow a precipitous advance towards new precision agriculture. In an optimal scenario, the combination of locally and globally collected information would make food safety monitoring systems more robust. Therefore, big data considers not only economic, social and sectoral data, but also

1 <http://www.fao.org/save-food/resources/keyfindings/en/>

2 <http://www.fao.org/energy/bioeconomy/en/>

news generated by a variety of networks and social media. In all of these data channels that can be subjected to semantic analysis, knowledge can be obtained on related topics, for example, the prediction of situations of hunger, food scarcity, disease and risk in general.

Artificial intelligence (AI) in agriculture is another key tool that can increase productivity and efficiency, as well as our central theme, sustainability. Farm data is becoming increasingly richer and more robust in its content. The availability of this data is paving the way to develop and deploy AI for improved agricultural productivity. Intelligent systems are supporting producers to manage money, energy, labour and resources that are needed for planting, maintaining, and harvesting crops. What if one could use technology to replace some human activities and guarantee efficiency? That is where AI comes in and it is emerging in four major sectors: (i) agricultural robotics, (ii) soil and crop monitoring, (iii) predictive analytics and (iv) application in agriculture. Farmers are increasingly using sensors and soil sampling to gather data and this data is stored on farm management systems that allow for better processing and analysis. The availability of this data and other related data is paving a way to deploy AI in agriculture that will benefit both producers and consumers.

Nanotechnology, recently described as the manipulation of matter on a very small scale, promises higher quality monitoring and a reduction in environmental damage. Several areas related to the agricultural sector, such as precision agriculture, product traceability, certification, biofuel production, veterinary drug industry and the food industry, among others, will benefit from advances in nanotechnology.

Its goal in the agricultural sector is to improve human intervention using sensor devices, increasing control over events and facilitating decision-making to achieve better traceability, productivity and quality. One example of its use is precision farming that focusses on the optimisation of returns on inputs.

Nanotechnology also works on the development of biosensors and transducers of high sensitivity that allow the identification and quantification of chemical and organic compounds and other impurities, in addition to, changes in composition in plants, fruits and soils. It is also used for the development of irrigation control devices and high-performance sensors. It is used to improve the functional efficiency of products such as nutrients, synthetic or biological pesticides, as well as the safe handling of these products, reducing the risks of toxicity to humans, tillage and environmental contamination.

Finally, nanotechnology can also contribute significantly to improving the performance of agricultural products and the development of new applications, adding value and opening new markets. It has the potential to help the whole sector of a country to move from a simple commodity producer to a series of other products made from renewable sources obtained in a sustainable way, as is the most recent case in agroenergy.

As discussed in the previous examples, the importance of nanotechnology lies in the improvement of performance, efficiency and economy of inputs. This is by the development of nanoparticles and nanoencapsulation for the controlled release of fertilisers and pesticides in soils, and drug administration for veterinary use.

What do all of these technologies have to do with sustainability? They are usually more efficient and could be used to help save resources, improve the use of soil and to make better use of the technologies that are related to the reduction of greenhouse gases. The biggest challenge will be to achieve the balance between productivity and land use intensification alongside the social impact of technology and environmental conservation to make the world sustainable for the future.

Taking the example of cassava, or mandioca as it is called in Brazil, you can observe a great production asymmetry. On one hand, this is the result of very modern agriculture making use of the latest technological innovations, on the other hand, 80% of cassava from the state of Pará, the country's largest producer, is not mechanised. Some producers are still working with pre-first industrial revolution systems; so how can we incorporate and massify the use of new technologies?

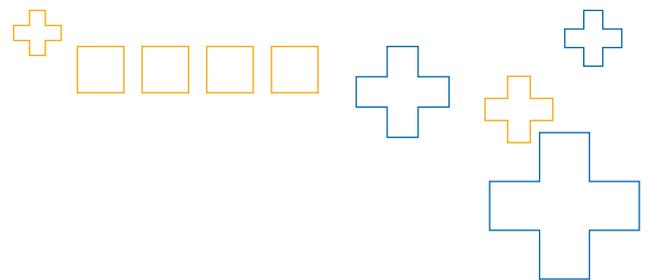
This asymmetry and dichotomy in terms of productive systems is a challenge when considering how to supply the world in the future without causing significant social and environmental impact. All around the world, Brazil is referred to as the "granary of the world" and this will be even more the case by the year 2025 when it could surpass the United States in terms of grain production. For this to happen, however, the range and number of producers who adopt these new technologies must be increased in a thoughtful way and for their benefit.

There are many considerations that will have to be made in the future about the benefits of technologies and innovations for the sustainability of the agricultural sector. The 2030 Agenda and the Sustainable Development Goals give us very useful and globally accepted guidance. A

major concern that is indirectly raised through them, is how the gradual incorporation of these technologies might cause the “creative destruction” of jobs and will affect the employer – employee relationship. It might make it necessary to redirect farmers to other areas of work. Furthermore, big data, AI and nanotechnology are likely to improve the use of natural resources by reducing waste and, consequently, increasing the producer’s income. How can access to these technologies by the producers be organised in a fair way that benefits everyone? The economic benefits generated by the use of new technologies in agricultural activities are clear. Now we have to work to realise their potential and increase access to food making nutrition safer for consumers and ensuring it is possible to feed everyone in the future.

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*FAO is concerned about how big data and other technologies can generate intelligent information systems to help stakeholders address their problems and it serves as a facilitator and reference centre to support the producer, the marketer and the consumer through the access of information to make informed decisions.*



# INNOVATION POLICY TO ACHIEVE THE SUSTAINABLE DEVELOPMENT GOALS



*Jose Luiz Gordon, Planning and Management Director of the Brazilian Association for Research and Industrial Innovation – EMBRAPPI*

The growth dynamic of modern economies is increasingly driven by the process of innovation and its impact on the National Innovative System (NIS). Aiming to measure up to the Sustainable Development Goals (SDGs), the innovation agenda is a fundamental component to attain greener economic development and social inclusion. Globally, successful economic and social development have been underpinned by a strong national State, capable of articulating policies which benefit the country's development, with significant contribution from the business sector. In this way, they have established a sturdy model of partnership amongst both the productive and private sectors (MAZZUCATO; MCPHERSON, 2018). In this context, it would be the responsibility of the State to generate policies that foment and direct innovative activity to contribute to the strengthening of knowledge generation and its dissemination in the national productive sector, with a focus on the SDGs.

Within its role of developing innovation policies, the State can determine and strengthen interactions using a wide range of tools that enable the achievement of increasing innovative capacity and investment in innovation within the productive sector. The use of risk-reduction and uncertainty tools, for instance, public procurement and grant, demonstrates that the State prioritises certain investments in innovation (GORDON, 2017). The many sources of public policy tools (offer and demand) have varied impacts on different activities, and on the type of innovation, in view of the uncertainty level and inherent risk to the innovation process (GORDON, 2017).

The debate over a more environmentally sustainable society is shown through the impact of green technologies in many fields such as: renewable energy, energy storage, smart cities, urban motility, and more efficient machines and equipment that save energy and materials. In the social sector for example, technologies in health are fundamental in better attending to patients who are based in localities that are difficult for doctors to access,

or for patients' preventive treatment using real time data. Within this new era of digital and sustainable economy, exists windows of opportunity capable of contributing to more sustainable and inclusive development. It is the State's duty, in partnership with the productive sector, to build policies to develop this agenda.

In this context, two underlying actions are highlighted that contribute to the innovation agenda and could be the basis for innovative SDGs oriented development. Firstly, implementing public policies to organise interaction amongst businesses, and scientific and technological institutions (STI), organised by intermediaries' agents for the process of innovation, which should be less bureaucratized and more flexible, favouring innovation activity. These intermediaries' agents may initiate this collaborative innovation process. The STI networks, constituted in this environment, would perform applied research, attending the needs of the business sector for innovation. The STI networks organised by these intermediaries' agents should get non-refundable public resources (grant) to perform such research and development (R&D) activity with businesses. Therefore, one of the intermediaries' agents assignments should be contributing to and fomenting social and green technology development in the productive sector, in partnership with STIs. Such intermediaries' institutions are already globally renowned as innovation policy cornerstones (GORDON, 2017), and tend to be fundamental in contributing to the development of technologies connected to the SDGs. There are several examples: Fraunhofer and AIF in Germany; Institut Carnot, in France; Catapult, in England; GTS, in Denmark; Manufacturing Extension Partnership, and Manufacturing USA, in the USA; RISE, in Sweden; amongst others. Such institutions run, in the majority, as hubs that connect the STI research capacity with business demands for R&D activities. The new-found innovation policies could focus on prioritising the allocation of specific non-refundable public

resources to comply with the demands for projects that focus on the SDGs. Therefore, it is the State's duty to indicate the priorities that foment businesses to innovate, and to contribute further for more sustainable and inclusive development. This model makes the assumption that businesses direct their strategies to answer the demand for innovation without increased State direction.

In Brazil, the Brazilian Association for Research and Industrial Innovation – Embrapii – started its operation in late 2014. To contribute to the intensification of the innovative effort of the industry in Brazil, Embrapii has implemented a differentiated model of action, based on the formation of STI networks with high standards of excellence – so called Embrapii Units (EUs) – to cooperate with the industrial sector. Nowadays, there are 42 operating EUs. The EUs should present their proven technical capability, high tech infrastructure, history of attending to businesses, and technological focus. The Embrapii model acts on the premise that (1) cooperation between STIs and enterprises is fundamental, and (2) projects can only be developed if there is at least one business involved, in other words, there should be a demand of the industrial sector to guarantee that the technological development is applied in the productive sector. Government's contribution is capped at one third of the total projects' portfolio amount between businesses and EUs, which is granted in the form of non-refundable resources. The remaining two thirds come from EUs resources (often non-financial resources) and businesses (necessary financial resources). This model enables cooperation between STIs and businesses, and shares the R&D projects' risks and costs. Between the end of 2014 and the end of 2018, more than 650 projects were supported by this model. In practice, the private sector has invested almost 50 percent of the total amount for innovation projects, the government has contributed 33 percent, and the remaining has been from the EUs' economical counterpart. This data demonstrates that Embrapii has been capable of leveraging significant resources from the private sector for investments in innovation, and cooperation between businesses and STIs. Moreover, Embrapii's supported investments are already contributing to a more sustainable development trajectory in Brazil. Within Embrapii's supported projects' portfolio, around 12 percent focus on the health sector, which is one of the main areas of social demand, and about 13 percent of the projects concentrate on the development of energy efficiency technologies, for the reduction of gases contributing to the greenhouse effect, and to green technologies. The impact would

be even greater if new specific resources were directed to the development of green and social technologies.

A second action to foment targeted innovation developments for the SDGs, is to build national challenge models, following the guidelines suggested by the economist Mariana Mazzucato (MAZZUCATO; MCPHERSON, 2018). A possibility would be to create national challenges that consider the SDGs' priorities. Within this model, it is crucial to have interaction between the different NIS players: government, businesses, STIs, and, in many cases, civil society. Such national challenges may rule the innovation agenda and create synergies alongside NIS to strengthen innovation activity in the economy. Taking into consideration these policies, government should use a variety of available instruments, e.g. public procurement, technological orders, non-refundable resources, variable income, and regulatory tools. Nonetheless, national challenges yet to be released should be factual, with goals and measures that are narrowly elaborated on by civil society actors. In other words, it would take a planning process, which would lead to the definition of factual goals in the short, mid, and long term, to engage those interested in being part of the agenda. This could be a partnership model between the public and the private sectors, to strike national challenges which would impact on the country's sustainable development. Such challenges tend to encompass different players, such as research/university centres, businesses of different sizes (of distinct sectors, such as industrial, and service), start-ups, different government departments (within the different federative levels), and the financial sector. This process requires a high level of coordination, which imposes a greater responsibility on the federal government to deliver this. This model demands the development of challenges to enable innovation in areas such as: electric car engines, new batteries, new solar energy sources and new aeolian energy sources, among others. These challenges cannot be too generic, for they may end up missing out on focus and impact. They should also not be too specific, in ways that restrict the technological likelihood of solving these challenges. Therefore, different players will present distinct possible solutions to certain challenges, and they will be supported. It would follow a funnel model, starting by supporting some potential solutions and ending up obtaining fewer final solutions. Following this process, many technologies will be uncovered, and many solutions will be set aside. Nonetheless, a favourable environment for the innovative effort will be created. This model greatly relies on the State being capable

of picking challenges and accompanying them with possible solutions.

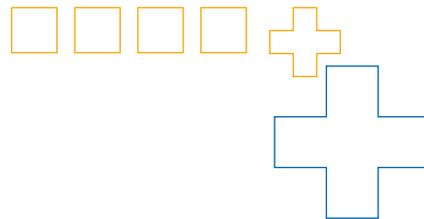
Therefore, two actions may be considered fundamental, from the public policies' point of view, to achieve the SDGs. Firstly, to stimulate an STI research network with demonstrated competence of working with the demands of the business sector to generate sustainable solutions, with the support of non-refundable public resources. Secondly, the generation of national challenges, which in great measure are connected to the country's strategic agenda, and, in a few cases, public demands, in which priorities and choices are enfolded starting with the SDGs goals. Actions will be further arranged, creating new markets for the nation's private sector. Encompassing these two central innovation policies, the State will generate a favourable environment to stimulate and initiate the productive sector to invest in activities with greater risk and uncertainty levels, leading to the development of new solutions and more inclusive and sustainable development.

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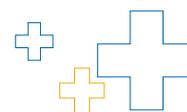
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# FINANCING FOR SUSTAINABLE DEVELOPMENT:



## SELF-DETERMINATION DRIVES INNOVATIONS IN DEVELOPMENT FINANCE



*Valerie Hickey, Biodiversity Specialist of The World Bank*

Innovation, science and technology hold out great promise for accelerating inclusive growth and giving everyone a genuine opportunity to live their best and most dignified lives. The right finance, the right amount provided at the right-time, is equally important to make inclusive growth a reality and insure against science, technology and innovation being used to exacerbate existing inequities and further cement pockets of poverty.

The ability to adequately finance the 2030 Agenda development framework requires at least three things. The first is a common and shared understanding of what success looks like. The second is a recognition that traditional aid architecture is outdated. And the third is that as new actors and ideas drive innovation in finance, strong institutions and regulatory cohesion still matter.

The term 'sustainable development' came into common practice following the Rio Summit in 1992; it morphed into the concept of green growth at the Rio+20 Summit many years later. Today, we have added more colour, talking about the importance of blue growth. Too often these terms are used to posit a distinction even though there is little difference. In a world where people worry about being left behind, we need growth that enables everyone to be better off and ensures that people can escape from poverty today to join the middle classes of tomorrow, where they stay generation after generation. In addition, we want a world that is able to feed the additional 2 billion people who will exist by 2030. It is a world where the term sustainability is not just about the environment and saving the planet, but about people leading better lives today and always. The Sustainable Development Goals (SDGs) are the highest expression of human ambition to deliver results that will grow economies and protect the environment, on which those economies depend, in addition to empowering the people, without whom the economy and the environment stand empty. Development finance must deliver in all three of these areas.

The good news is that inclusive, sustainable growth is taking shape in the real world. The finance that is driving this is not philanthropic in nature, but profit-centered. Innovative financing, especially from the private sector, both at home and abroad, is driving this shift towards a new, cleaner and greener normal. Financing sustainable development is no longer just about international public financing with a healthy dose of philanthropic capital. Domestic resource mobilisation and private financing are key. Sustainable, inclusive development is opening up new markets, bringing new consumers to the marketplace and is very good for business.

International public and philanthropic capital remain the cornerstones of development finance, but this in itself is changing shape. New actors, such as the Gates Foundation, are driving innovation in financing, with a focus on impact over ideology. New ways of providing finance are similarly driving innovation. For example, vertical funds are multi-stakeholder global programs that provide earmarked funding for specific purposes. They have proved very effective in channeling assistance to chronically underfunded development sectors, such as the environment (e.g. the Global Environment Facility, a partnership between 182 countries, international agencies, civil society, and the private sector, has provided US\$11.5 billion in grants since its creation in 1991 and leveraged US\$57 billion in co-financing for over 3,215 projects in over 165 countries). However, the proliferation of vertical funds has not always been conducive to aid effectiveness, often leading to the fragmentation of priorities, new cost-centres and supply-driven initiatives, particularly in low-capacity environments with weak planning and budgeting systems. Many of these funds were created in the hope of attracting substantial private contributions but all remain overwhelmingly dependent on traditional Official Development Assistance (ODA) providers. Some have reached a critical size. The Global Fund to Fight AIDS, Tuberculosis, and Malaria has secured pledges totaling

approximately US\$30 billion since its creation in 2002, 95 percent of which comes from the public sector.

Development financing solutions now exist in many forms beyond that of traditional loans. They go beyond providing money to purchase expertise or finance infrastructure. For example, risk management instruments to derisk and transfer risk for investors (through establishing traceability schemes and through insurance mechanisms) or consumers (e.g. weather insurance for farmers, local currency matching for micro, small and medium-sized enterprises) is nudging behavior change that in turn is mobilising domestic resources and marshalling private finance to deliver sustainable solutions. Results-based financing, where payments are made specifically for desired results, is also rewarding success and not simply paying for inputs.

ODA is also coming from partners outside of traditional donors, including newer members of the OECD and EU, upper middle-income countries (in Latin America, the Middle East, and East Asia), and other developing countries. Many are ramping up their development engagements through a broad range of channels and activities. This includes the BRICS group of countries (Brazil, Russia, India, China, and South Africa), which account for 25 percent of global GDP and 40 percent of the world's population, as well as Saudi Arabia, South Korea and Turkey.

Taking all of this into account, the scale remains small: official development assistance amounted to less than \$150 billion in 2017. In the same year, private capital flowing into emerging and developing economies dwarfed this sum, attracted by opportunities and significant upsides, amounting to \$646 billion for developing countries alone (2). This private capital is increasingly interested in triple-bottom line outcomes, not for some sense of higher purpose, but because it is good for business. Take competitiveness for example, markets for commodities are increasingly demanding higher standards because in turn consumers are more demanding. Consumers want clean, green commodities that salve their conscience and their appetites. This is why from 2020, McDonald's will only source beef from deforestation-free supply chains; the largest growth in the beef market is due to the demand for cleaner beef. The market for people is equally competitive. Global talent can travel anywhere in the world but it does not travel to areas that are dirty and unsafe, nor will tourists. As much as competitiveness is cleaning supply chains, cities and landscapes, domestic demands for quality of life

are also accelerating this shift. As more and more people climb out of poverty into middle class, they expect development dividends that include safer neighborhoods, more trees and cleaner skies.

The scale of international private finance is matched and beaten only by domestic resource mobilisation, which has too often been left out of discussions about inclusive growth. Developing countries themselves are leading the mobilisation of financing that is necessary for their own development. Domestic revenues in emerging and developing economies amounted to USD7.7 trillion in 2012, having grown by 14 percent annually since 2000, leading to over USD6 trillion more each year for developing country's Treasuries compared with this amount in 2000. These buoyant domestic revenues have also lowered aid dependency and raised country creditworthiness for official and private non-concessional loans. This is having a multiplier effect on the volume of resources available for development. In 2010, for example, Sub-Saharan African countries collected nearly USD10 in own-source revenue for every dollar of foreign assistance received (1).

In addition to recognising how much the traditional aid architecture is no longer relevant today, we must also admit that investing in inclusive development today is not like it was a generation ago. New financial engineering is growing exponentially, for example green bond issue volume amounted to over USD160 billion in 2017. In another example, in March 2017, the World Bank raised its first SDG bonds, which directly link returns to the performance of companies advancing the global development priorities set out in the SDGs, including gender equality, health and sustainable infrastructure. These bonds were arranged by BNP Paribas and raised EUR163 million from institutional investors in France and Italy. Diaspora resources, beyond the current flow of remittances, also have the potential to bring new investors into the market. The annual savings of the diasporas from developing countries, USD400 billion by some estimates which is kept under mattresses or in low interest savings accounts (3), represent a hitherto untapped potential source of financing for development efforts.

Whatever the source of capital, innovative finance is generating additional funds to grow emerging and developing economies by tapping into new funding sources and engaging new partners. This is enhancing the efficiency of financial flows by reducing delivery time and/or costs and is making financial flows more results-oriented by

explicitly linking funding flows to measurable performance on the ground. For all of this to work in the pursuit of inclusive growth, one thing has not changed: countries still require regulatory regimes that attract investors and track success. Having rules of the game that are consistent, enshrined in law and implemented by credible institutions, remains a key concern for many investors and a key focus for domestic and international public and private finance flows. So too is finding ways to measure success beyond traditional measures of GDP. Adjusted net savings is one such attempt that measures the true rate of saving in an economy after taking into account investments in human capital, depletion of natural resources and damage caused by pollution. It provides two related sets of information: comprehensive wealth accounts (a stock measure in total and per capita values of human, natural and manufactured capital), and adjusted net savings (a flow measure).

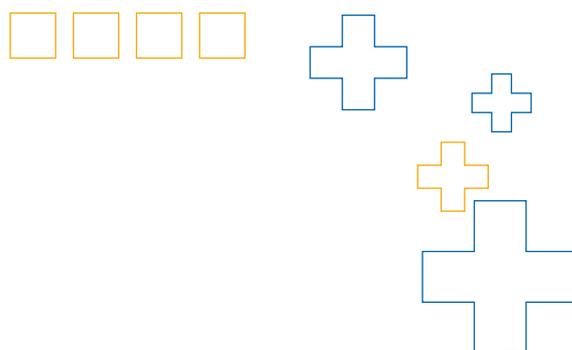
The SDGs have introduced a post-2015 development framework that measures success and not simply effort. Emerging and developing countries and companies are at the forefront of development finance engineered to achieve this success. They are no longer seen as passive recipients or active obstacles, and they increasingly look to international public finance and philanthropic capital to help them innovate. Self-determination has replaced supply-driven in all concepts of development finance.

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*(1) See "Public Resource Mobilization and Aid," in Africa Eco-nomic Outlook, 2010.*

*(2) OECD figures and UNCTAD World Investment Report 2017*

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# PUBLIC POLICY IN THE AGE OF GOVTECH ECOSYSTEMS



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An extraordinary technological revolution is transforming the economy and inevitably impacting all kinds of sectors. Even though the rigidity of public institutions and their legacies prevent innovation from flourishing as fast as it does in other types of industries, governments are also experiencing a major transformation, driven by a more sophisticated demand from citizens, and permanent fiscal constraints.

The widespread use of information technology and devices, as well as widely available connectivity, are changing traditional ideas about what “the public” means and what public spaces for citizen interaction are <sup>3</sup>.

Also, governments are facing unprecedented challenges that are growing in volume and complexity, such as an ageing population, climate change, the lack of affordable housing, immigration flows and uncertainty about the future of work. The sustainability of the welfare state is being challenged by a fast-changing reality that could break some of the consensuses that define our current liberal democracies.

At the same time, it is not clear how governments will be able to find more resources to confront these significant challenges and invest in better and modern services. The stagnation of wages and the low productivity of many economies will limit governments’ fiscal capacity. Governments will need to do more with the same resources and permanent budgetary constraints.

In this context, governments cannot afford to continue with business as usual. Public leaders and civil servants must leverage technological advancements, the use of data and new business models to reshape the way governments deploy their services. A new approach is to collaborate with technology-focused startups, where entrepreneurs can help public agents understand the potential of exponential technology, design services based on people’s needs, and use data to inform and evaluate decision-making processes.

## The emergence of the GovTech space

The space where government operations meet innovation and collaborate with entrepreneurs is starting to be known as GovTech. GovTech can be defined as a dynamic segment at the intersection of public service delivery and innovation, where technology-focused startups work to make governments more open, accessible and efficient.

Some of the main characteristics of this new space are the following:

■ **Startups, scale-ups and non-traditional innovators are the key players in the GovTech space.** However, interesting commercial partnerships between established companies and startups are gaining traction, fostering new schemes of public-private partnerships in the digital market. Big companies are good for large infrastructure and the standardisation of processes, while small companies develop effective front-end user-centered solutions. The combination of the two is improving the market offerings made to the public. Additionally, going hand in hand with big companies gives startups access to bigger public contracts and grants big companies a significant differentiation from other competitors.

■ **GovTech leverages technology (AI, blockchain, IoT, etc.), new business models and the power of data to solve the most entrenched public challenges.** Many of these solutions use public data and data generated by their platforms to provide valuable insights key to informing better decision-making and more targeted public action.

■ **Many of these new services do not require large upfront investments from the public clients** because they are easy to integrate, use the cloud and are sold as a service. This flexibility also allows for experimentation and non-costly piloting, enabling public officials to learn and unders-

<sup>3</sup> <https://www.svb.com/healthcare-investments-exits-report/>

tand the value of what they are buying and, in addition, avoid lock-in contracts.

■ **The GovTech market redefines the public regulations and processes that are in place.**

Many of these solutions create new digital processes that are still limited by regulations designed for analogical processes. The same phenomenon also happens with public procurement regulations, which are the biggest barriers for SMEs selling innovation as a service. Currently, many governments are already creating regulations that enable them to attract new solutions in a market that is constantly evolving.

GovTech ecosystems are already a reality in some countries. The United States, the UK, Denmark, Estonia, India and Israel are some of the countries where sophisticated governments are nurturing an innovative and diversified technology vendor marketplace. Some of the startups in these countries have the public sector as their main client (B2G). Many others are traditional B2B companies that are gaining some traction and a diversity of clients before trying to break into the public market. Although public procurement is not an easy business, even for incumbent corporations, the private sector sees the public sector as a potentially large market to scale. This is especially the case in certain industries, such as education and transportation, where the government has traditionally been the main provider.

GovTech is gaining some momentum particularly in the urban space, where entrepreneurs are working to reimagine city life. Uber, Airbnb and WeWork are redefining the dynamics of our cities, but there are also other kinds of entrepreneurs who are tackling the most significant urban challenges, such as inequality, affordable housing and education, and finding entrepreneurial solutions to these public problems. Businesses incubated in cities can provide new jobs and economic growth as well as solve the challenges that city governments face to help them run well<sup>4</sup>.

Why is GovTech gaining more traction in cities? There are at least four reasons to explain this phenomenon:

■ **Local governments have a better idea of citizens' needs** and have limited resources to respond to their constituencies. Innovation and efficiency are necessary for city leaders.

<sup>4</sup> City Initiatives for Technology, Innovation and Entrepreneurship. June 2015. John Gibson, Matthew Robinson and Scott Cain.

■ **Leading cities are attracting new digital talent** and creating leadership positions such as CTOs (chief technology officers) or CDOs (chief data officers). These new positions bring private sector approaches to create, experiment with, prototype and scale solutions.

■ **Cities are major pools of data**, and with the use of sensors and other devices, the number of data generated has multiplied. To make use of this data, local governments are asking for support from entrepreneurs and businesses outside of their constituency.

■ **New, innovation-friendly programmes** are allowing small businesses with no procurement experience to access public contracts, which opens the city up to new approaches and ideas as well as creates commercial opportunities for local entrepreneurs.

Besides startups and entrepreneurs, there are also other investors, accelerators, universities and public institutions that have already seen the opportunity to foster public-sector innovation in cities by matching entrepreneurial solutions to public problems and social challenges. In the United States, incubators such as 1776 and UrbanX, and VCs such as GovTech Fund and Urban Innovation Fund, are already investing in this new space. Philanthropies such as Bloomberg Philanthropies are deploying innovation teams and studying best practices to replicate these innovations in other cities. Local governments such as New York, Chicago and Boston are putting in place programmes to attract startups to work with them. In Europe, Govtech is also having a great momentum. The Governments of the UK, Portugal and Denmark have launched new Govtech programmes, prestigious academic institutions such as the University of Cambridge and the Publictech Lab at IE University are studying and promoting these new local ecosystems, and accelerator programs such as Public are already working with startups from the UK, Denmark, France and Germany at the national and urban levels.

Local governments have a large variety of competencies, and the tech products offered to governments can be broadly categorised into these four sub-groups:

**Digital infrastructure:** Startups offering hardware, sensors or other systems mainly to improve connectivity and gather data in real time. Connektings, a French IoT (Internet of Things) company, helps cities to provide relevant information to their citizens via a platform that helps to understand the user context and necessities.

**Administration:** Startups developing solutions to make internal processes more agile, efficient and secure. One such company is Oneconcern, a US startup with a platform that provides unprecedented situational awareness and insight for decision-makers when natural disasters occur.

**Public service:** Startups focused on improving citizens' experience with the basic services provided by local governments. Some entrepreneurs innovate in areas such as education, public safety, mobility and urban planning. Many others develop solutions to new public challenges, such as climate change, the ageing population and the future of work. Cubigo is a Belgian company that connects community staff, residents and family members to improve the experience of senior-living communities.

**Participation, representation and transparency:** Startups are helping local governments to communicate better with their constituencies to allow citizens to play a stronger role in the political decision-making process. Scytl is a Spanish company developing secure electronic voting and electoral modernisation solutions for the public and private sectors.

### Barriers to the advancement of innovation in cities

Although collaboration between cities and startups is growing, there are still important barriers that prevent this market from flourishing to its full potential. The most common barrier for startups when working with local governments is the length of the sale cycle. Startups do not have time to spend a year or longer trying to get a contract. Entrepreneurs are up against the clock, with financial rounds occurring every 12 or 18 months. Since their competitive advantage is innovative technology, time is precious for the value of their product and for differentiation from competitors.

Besides the long cycle, there are other obstacles in the public bidding processes such as: rigid RFPs (request for proposals) looking for specific outputs instead of outcomes, a lack of budget or flexibility to pilot programmes, the lack of technical skills on behalf of the public client to understand the value of the technological innovation, and a lack of clear channels of communication between small vendors and public institutions.

These barriers force startups to focus their innovative business solutions and efforts towards the private sector. This fosters greater inequality in access to innovative solutions with

high social value and makes the gap between the services provided by the city and those provided by a private entity even more apparent.

### Policy recommendations to foster Govtech Ecosystems

Through a constant and intense relationship between entrepreneurs outside the city government and innovative public officials within, urban ecosystems offer rich potential for innovation in the GovTech space. However, to realise this potential, city leaders need to invest resources and political capital in policies aimed at lowering the barriers mentioned in the previous section. Concretely, there are some policies that could allow a city to identify the best innovations for their urban challenges, pilot and evaluate those innovations in real-world contexts, and, if interested, buy those innovations on a diverse and competitive market. Some examples are as follows:

### Matching public-sector demand with innovative market solutions: Acceleration units

Urban GovTech is a nascent market where the demand (governments) is not able to articulate its "pain points" and where the supply (startups and entrepreneurs) struggles to find communication channels with its potential clients. To help to connect the two sides of the market, many cities have created their own acceleration units or programmes to i) promote public innovation demand, ii) articulate public challenges from different departments, iii) create a simple channel of communication for the public innovation ecosystem, and iv) match the demand with innovative market solutions. There are phenomenal examples of such initiatives. In 2014, San Francisco created the Startup in Residence programme (STIR), which aims to connect government agencies with startups to develop technology products that address civic challenges. Over 16 weeks, the programme helps coordinate selected startups with government departments to "co-create" solutions that have real-world impact. The programme has spread to other cities in the United States and Europe.

The Mayor's Office of New Urban Mechanics (MONUM) in Boston is another example. MONUM was created with the goal of running innovation projects in collaboration with external entrepreneurs and internal government policy experts. They use a rapid prototyping method and work with innovators to develop pilots quickly and cheaply. MONUM is located in the mayor's office, which ensures that they are aligned with the office's priorities and well connected to the city's departments.

## Experimentation, iterative engagement and solution development: Financing pilot programmes

By promoting open calls and pilots—and reserving some funds for these trials—governments have the chance to understand the value of innovative projects, evaluate them and then decide whether they want to buy the innovation. By creating pre-procurement engagements or spaces, tech startups have room to experiment, pilot new ideas and demonstrate new, innovative approaches.

In 2017, the UK government presented the GovTech Catalyst Programme to launch public competitions based on issues identified by government departments. The programme has a fund of £20 million to finance the research and prototype development of all the vendors that win the challenges. Once a prototype has been created, the department has the option to buy the product of the competition. Another similar example is the Israeli government's Digital Innovation Fund for Public Sector Challenges.

## New approaches to procurement processes: Procurement for SMEs and innovation

Procurement processes follow rules that aim to ensure and foster competition in public purchases. However, the high requirements for putting in government bids and the long sale cycles have created the opposite effect: only established companies who have the experience to fulfil the requirements, with enough financial muscle to survive long cycles and with the knowledge and staff to invest in customised and tedious processes, are able to bid. But in this new, digital era, cities have realised that they need to address the fast-moving market and open their institutions to all companies leading innovation, including the small and medium-sized tech companies that are challenging incumbents in all sectors.

There are some initiatives facilitating the entrance of new small and medium-sized tech vendors into the market. For instance, the UK government created the Digital Marketplace, which addresses the needs of government civil servants to find people and technology for their digital projects in a short time frame and makes the public purchase cycle affordable for SMEs.

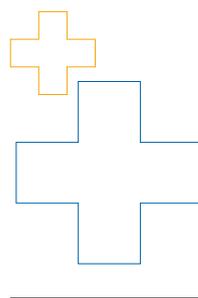
Other initiatives aim to attract innovative solutions to the government, no matter the size of the company. The European Union is pushing hard for the public procurement of innovation. These regulations target the innovation market in all development phases, from research to commercialisation, encouraging cities, regions and national governments to influence the market towards innovative solutions<sup>5</sup>.

## Conclusion

Citizens deserve a modern, efficient, innovative and creative public sector able to leverage all available technology and resources with the sole purpose of improving their lives. This statement is particularly true in cities, where problems - from pothole fixes to rises in the sea level - need to be solved quickly. GovTech has the potential to open up a new world of opportunities for governments, businesses and citizens, deeply transforming the way they interact.

In many cities, from New York to Seoul and Barcelona to Amsterdam, entrepreneurs are working with government officials and already reshaping their cities, solving the challenges of local governments and helping them run efficiently. An ecosystem of incubators, accelerators, investors and companies is also emerging in urban settings - an ecosystem that tries to solve market friction and barriers to the modernisation of the public.

Despite this potential, there are important barriers that are slowing down GovTech's take-off: long sale cycles, rigid and complex processes and the lack of space for experimentation are some of the most salient ones. We hope that this article will start to shed some light on some of the policies that could help develop GovTech ecosystems around city challenges and promote more open, efficient and innovative local governments to improve citizens' lives.



<sup>5</sup> <https://www.innovation-procurement.org/about-ppi/>

# USING DATA TO MEASURE THE SUSTAINABLE DEVELOPMENT GOALS (SDGS) IN MUNICIPALITIES



*Samantha Dotto Salve, Human Development Unit Coordinator, UNDP/Brazil*

In a world where it seems that everything we do — or even want— has become data, how is it possible that those who work in the public sector feel they do not have enough data to work with?

The 2030 Agenda and the Sustainable Development Goals (SDGs) give us the opportunity to achieve common goals for a better future. But how do we know whether we are achieving them? Data allows us to understand if our choices are having the impact that we want. That is why the 2030 Agenda needs a data revolution. A bold plan of action is needed, where the SDGs rely on relevant targets and specific indicators to measure their progress. A lot of information about economics is available, but there is a long way to go in terms of social and environmental data.

In a country of continental dimensions with more than 5,500 municipalities, like Brazil, thinking about the SDGs at a national level is important, but territorialising the SDGs at the municipal level is also essential.

Reliable, quality and accessible data will be needed to support the adoption and monitoring of these measures by countries, states and municipalities. This process represents an exercise in systematising available knowledge about the local reality in an integrated and comprehensive manner, allowing for a deeper analysis of the national context.

Presenting local indicators equips society with essential tools to design and implement more effective public policies. The democratisation of information at the municipal and metropolitan levels contributes to the strengthening of local capacities, the improvement of public management and the empowerment of citizens through the expansion of knowledge about their reality.

UNDP Brazil has been working with municipal data since 1998, when it launched, together with the Institute for Applied Economic Research (Ipea) and João Pinheiro Founda-

tion, the Atlas of Human Development (the Atlas), which includes the subnational Human Development Index (HDI) and more than 200 indicators of human development.

The objective of the Atlas for Brazil is to provide tools to Brazilian society by disseminating knowledge and increasing awareness about the realities that citizens live in. Making municipal and metropolitan information more democratically-accessible strengthens local capacities, improves public management and empowers Brazilian citizens.

The Atlas aims to consolidate a well-grounded development dialogue using an international reference - the Human Development Index (HDI). It is a tool that encourages people to use socioeconomic data to analyse our society.

Besides the fact that the Atlas brings transparency to development processes, it also helps to track the paths taken by a country in recent decades and, therefore, gives us an essential foundation for outlining the future.

The Atlas Brazil is targeted at several stakeholders:

- *State and federal managers - for managers of federal and state policies, the Atlas is a concise way to identify areas that need the intervention of programmes, sectoral and territorial policies and specific actions;*

- *Municipal players - the Atlas provides both the public administration and local civil society with support to diagnose major municipal challenges, providing tools to officers and expanding the space for participation by society at large;*

- *Researchers - the comparative analysis of the municipal and metropolitan contexts and their evolution throughout the years - through selected indicators - contribute to public policy studies to identify successful programmes and replicable experiences, as well as to map out territorial challenges and opportunities;*

- *Civil society and the private sector - the Atlas guides civil society and the private sector in their activities towards Brazilian development, including allocating resources, defining the target audience and initiatives;*

- *Citizens - access to clear and concise information encourages social participation which, in turn, makes Brazilian citizens increasingly greater protagonists in their realities and futures.*

Since its launch, the subnational HDI has been used as a parameter in some of the most important public policies in Brazil, such as the ‘Mais Médicos’ programme – a public policy that brings doctors to the most vulnerable communities. In addition, it has been used in 8 federal laws and state political platforms, such as “Mais IDH” in the state of Maranhão.

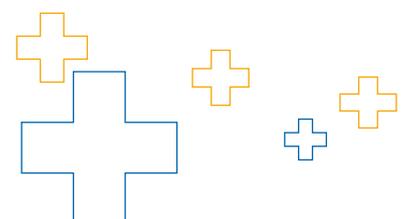
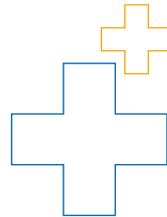
When world leaders adopted the 2030 Agenda, one of the challenges which arose was how to inform municipal public managers of their progress towards the SDGs. With the important support of Itaipu Binacional, UNDP/Brazil started a local pilot programme to check what kind of administrative data is available that can be related to the SDGs. This resulted in a new platform, the “Oeste do Paraná”. It has 67 indicators for 54 municipalities from the West of Paraná State, a region known for its important UNESCO-rated subtropical forests and the Itaipu hydroelectric dam, which is the second largest in the world. The indicators are shown as tables, maps and a municipal profile that combines the region’s most important information. The webpage also carries information regarding the SDGs and a tool to monitor plans for the 2030 Agenda.

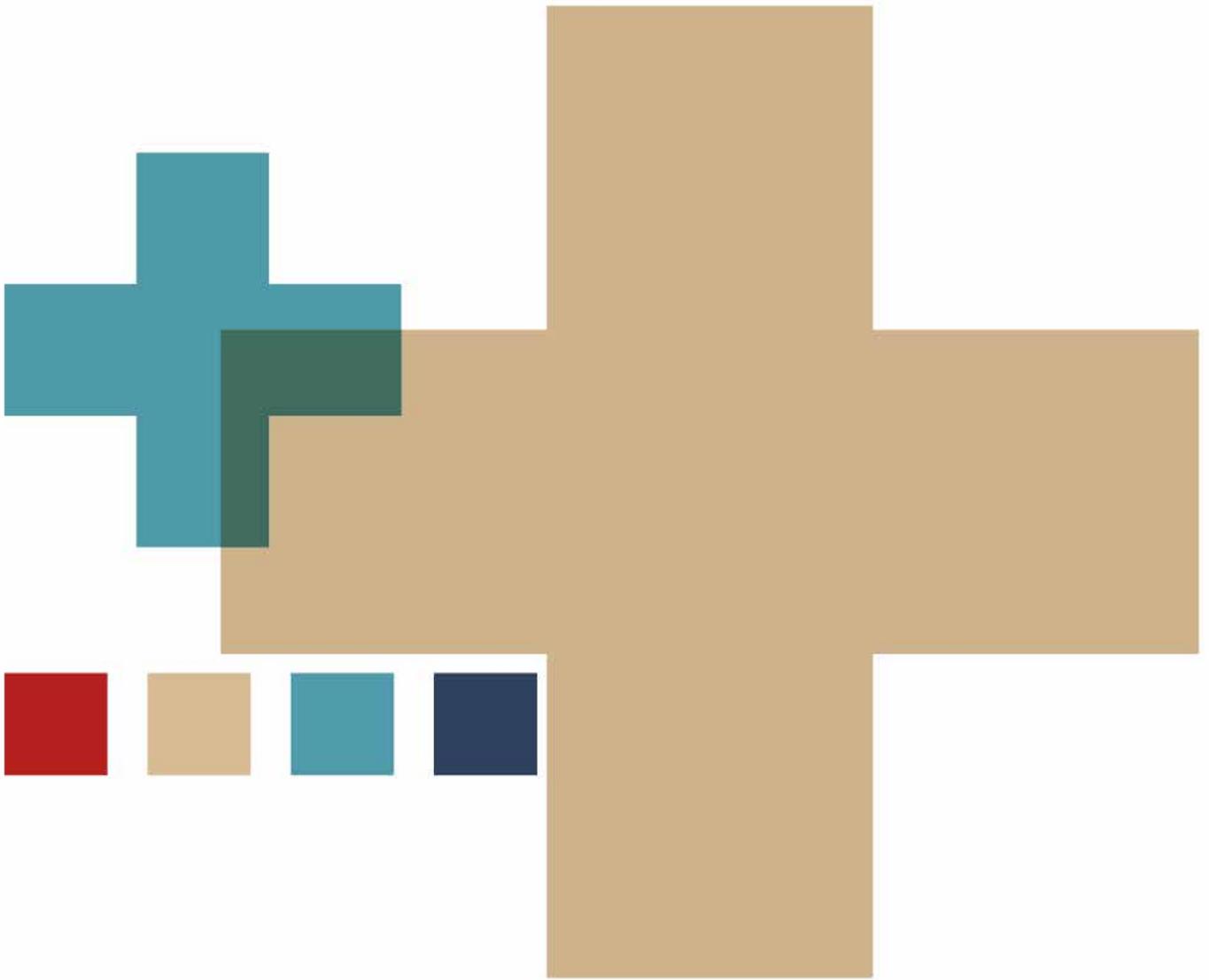
Based on both experiences, UNDP Brazil is also preparing a new version of the Atlas of Human Development. This project is part of an initiative from UNDP to boost innovative experiences in the field. Besides its traditional indicators, the Atlas will have administrative data connected to the SDGs, which will help to provide the most recent information to municipalities as they devise policies to align with the 2030 Agenda. The administrative data will be selected from the perspective of human development and sustainable development. In a world that is in constant transformation, we need the most up-to-date disaggregated data to create data-driven public policies.

it is crucial to go beyond census and household surveys and think about new forms of data. Furthermore, it is important to learn how to use all of the data that is being collected on our smartphones and systems of registration

and turn it into information and knowledge. We still have a long way to go. Big data, machine learning and artificial intelligence are relatively recent concepts in development— 90 percent of all data was collected in the last two years — but in Brazil we have made a good start.

The SDGs invite us to think creatively and take a step further in the use of data for public policies, developing ways to discover who is being left behind, and change the course of history by 2030.





REFLECTIONS FOR  
THE FUTURE:  
INNOVATION,  
TECHNOLOGY AND  
SUSTAINABILITY



*Empowered lives.  
Resilient nations.*



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