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SPACE FOR DEVELOPMENT: A POLICY PERSPECTIVE

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Developed countries are increasingly relying on their technology advancement and financial means to pursue their socio-economic development and ensure their security using space applications (e.g. in defence, human and environment security). In developing countries, space-based services could provide the same benefits and support global development policies such as the United Nations Millennium Development Goals. They could have a tangible impact for improving the living conditions of the poorest, giving for instance access to better health care, education and ensuring food security. The availability of space-based data and/or technology could also enable economic growth through the development of efficient communication and transport networks, of a service industry and a better use of natural resources. Moreover, space has proved to be a crucial tool for disaster and crisis management and for delivering humanitarian aid.

The full potential of space for the benefit of developing countries, however, is still hindered by different factors. These include the fragmentation and an insufficient level of cooperation efforts at international and regional levels, difficult access to funding, lack of infrastructure, expertise and education. The paper analyses these issues from a policy perspective at various levels (international, regional and national). The role, efficiency and gaps of existing international and national initiatives will be analysed. The paper eventually formulates policy recommendations and proposes elements for a way forward at policy level for national, regional and international authorities and organizations.

NOTE: The views expressed are purely those of the writers and cannot in any circumstances be regarded as stating an official position of the European Commission.

I. WHICH SPACE APPLICATIONS, FOR WHICH DEVELOPMENT?

The Right to Development

In its Declaration on the Right to Development of December 1986[*], the United Nations (UN) General Assembly (GA) laid down the core principles of development for individuals. The GA insisted in the preamble on the multifaceted aspect of development which is *"a comprehensive economic, social, cultural and political process, which aims at the constant improvement of the well-being of the entire population and of all individuals on the basis of their active, free and meaningful participation in development and in the fair distribution of benefits resulting therefrom"*.

[*] United Nations General Assembly, "*Declaration on the Right to Development*", 97th plenary meeting, 4 December 1986, A/RES/41/128.

This Declaration has made the right to development an undeniable human right for every human person who is the central subject of development. It has also emphasized the fundamental role of states, which have the primary responsibility for the creation of national and international conditions favourable to the realization of the right to development. It says: *"States should undertake, at the national level, all necessary measures for the realization of the right to development and shall ensure, inter alia, equality of opportunity for all in their access to basic resources, education, health services, food, housing, employment and the fair distribution of income"*. The Declaration finally insists on the importance of international cooperation: *"states have the duty to co-operate with each other in ensuring development and eliminating obstacles to development."*

Space and the Right to Development

The UN has regularly highlighted the relevance of space applications in support of development. Space has been considered as one of the tools and means to foster development. The Vienna Declaration on Space and

Human Development[*] in 1999 marked an important milestone. It has recognized the major contribution that space science and technology can make towards the well-being of humanity and specifically to economic, social and cultural development. To that end, the Declaration has proposed the nucleus of a strategy to be followed by states and international organizations, so that space can play its role as a major contributor to people's well-being. The interests of developing countries and countries with economies in transition constituted a particular focus of the declaration. In particular, it has encouraged cooperation programmes and activities between "space-faring" and "non-spacefaring" countries, as well as among developing countries, involving civil society, and including industry.

Most recently, in the UN Resolution[†] 66/71 of January 2012, the UN General Assembly has recognized that *"space science and technology and their applications make important contributions to economic, social and cultural development and welfare"*. The resolution also highlighted the importance of international cooperation in the field of space activities which is *"essential to strengthen the peaceful uses of outer space, assist States in the development of their space capabilities and contribute to the achievement of the goals of the United Nations Millennium Declaration"*.

Space Applications for Development

Today satellite services can be categorised among the following three categories:

- Telecommunication
- Remote sensing and Earth observation
- Navigation and positioning

The various applications of the satellite services that are relevant to the use of space technology for socio-economic development and poverty reduction are described hereafter.

Telecommunication

Communication satellites is the category with the largest number of users worldwide today, as it includes the *broadcast of television* channels on a large area, without the need of local terrestrial stations, which is particular advantageous to rural and remote areas.

[*] "*The Space Millennium: Vienna Declaration on Space and Human Development"*, adopted by the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III) at its 10th plenary meeting, 30 July 1999.

[†] A/RES/66/71 UN General Assembly, 12 January 2012, Sixty-sixth session, Agenda item 51.

Besides television services, telecom satellites can also form the backbone of an infrastructure for the provision of *telephony*, broadband *Internet connectivity* and private networks for corporate and commercial enterprises. Today only 10% of those living in emerging economies have access to the Internet, compared to a global average of 23%[‡]. Recent studies have shown that a 10% increase of penetration of Internet would result in a 1.2% increase of the per-capita GDP growth[§]. The coverage of a country - and of its most distant regions - with satellite telecommunication services would be therefore a fundamental enabler and a catalyst for economic growth.

Bridging the digital divide of less developed countries would not only stimulate the economy, but also ameliorate the conditions of the poorest. Several projects have demonstrated the role of satellite technology in supporting education and health. Systems of *tele-medicine*, for example, have been implemented and tested (e.g. by ESA and UN), showing the possibility to provide health care minimising the physical presence of diagnostic equipment and specialised doctors (cardiologists, radiologists, etc.), and avoiding the patient to travel distant areas to urban centres[**]. Tele-medicine systems are useful both in emergency situations as well as on a permanent basis.

Experiences for the use of satellite technology for *tele-education*, which have been implemented in some developing countries, are also promising. They have shown the potential especially for rural education, connecting schools and promoting distance learning.

Satellite systems are also an important tool for providing mobile phones services in areas not covered by cellular terrestrial network, which is particularly useful in cases of humanitarian intervention and *disaster relief*.

Earth Observation and Remote Sensing

A second category of satellites are those designed and developed for the collection of data from instruments that observe and record the characteristics of the Earth, either passing over from a low altitude or from a fixed relative position in a geostationary orbit. Those satellites are a pivotal instrument for climate

[‡] World Economic Forum (2009), *"Enabling Transformation: Information and Communications Technologies and the Networked Society",*. Annual Meeting Report, p. 2.

[§] World Economic Forum (2009), *"Scaling Opportunity: Information and Communications Technology for Social Inclusion"*, Annual Meeting Report, p. 3.

[**] European Space Agency (2011), "*Sustainable Development 2009–10 report",* ESA SP-1319 (January 2011), p. 26.

study, environmental monitoring, and mapping purposes.

One important application of Earth observation is the *study of the weather*, which - collecting information on the atmospheric characteristics of a certain region - gives valuable information for aviation and maritime safety, and in farming and fishery activities. Weather observation contributes to the longer-term *evaluation of climate changes*, and satellites are also used to monitor the dangers of *floods and storms*.

Climate change can have a devastating impact on developing countries for food security for instance. In 2010, forest fires in Russia, draughts in Brazil and floods in Australia plumped global food supplies. Developing countries are expected to be the most affected by of climate change. According to the Intergovernmental Panel on Climate Change (IPCC), yields from agriculture could be reduced by up to 50% in some developing countries because of climate change[*].

Another field of application of Earth observation satellites is *land management* and *mapping*. High-resolution images observed from the satellites can serve to build accurate maps that are used for *urban development*, *infrastructure planning*, *territory zoning* and *titles management*, and *cadastre* services, in regions where this kind of information is outdated or non-existent. The presence of a good cadastre system is known to be a catalyst for growth (as an example, in rural areas, a farmer who has assurance of access to land is more likely to install an irrigation system), and small countries with a good land titling tend to have greater wealth than larger countries where these systems are lacking. A recent study[†] estimated that cadastral inefficiency restricts growth of the country's GDP by an estimated 1.3% each year.

In the area of industrial activities, remote sensing is also used for *geological and topographic mapping*, for *mining* exploration and *quarries impact assessment*, *oil and gas* concessions and *pipelines monitoring*.

In addition, Earth observation data are a fundamental tool for the analysis and the optimisation of agriculture production. They provide information on the current *vegetation level*, *desertification* and *soil erosion*, *hydro-geological information*, and can support *forest management* and forest *fire prevention*.

In support to agriculture production, remote sensing is used for *crop identification* and forecast for food security programmes. Studies have also shown the possibility to detect *locusts reproduction* areas, and mapping for focused chemical treatment[‡]. Furthermore, Earth observation is used in some countries (including in the EU) for *surveillance* of fishing fleets and to combat illegal fishing.

In the context of UN-based programmes[§], environmental monitoring has also been used to support *health studies* and *epidemiology*. Combining data from satellite-based remote sensing and global positioning, scientists have improved the risk mapping for communicable diseases such as malaria, blue tongue, water-borne cholera, which afflict millions of people each year and are a cause of mortality and poor economic development.

Supporting human security, welfare, and health, as well as the study of environment, earth observation applications contribute to the achievement of the UN Millennium Development Goals[**].

Positioning and Navigation

The utilisation of GPS devices has spread in most of the developed countries in the last decade, mainly for car navigation and more recently integrated in mobile phones for personal localisation. Satellite navigation has also started to be used in aviation and marine transport.

In developing countries, the use of satellite positioning and navigation still has not reached its full potential, although there are many possible utilisations.

In conjunction with Earth observation services, for examples, precise satellite positioning (when accuracy is enhanced by additional space-based systems) can support the establishment of accurate cartography at a very low cost. This could be useful for rural *parcels measurements*, in support to land reform programmes and to help solving land disputes.

Used with mechanised farming machinery, satellite navigation can also support more efficient *irrigation* and water management, soil sampling, as well as better use of pesticides and fertilizers with *precise spraying*, thereby reducing environmental impact, increasing agriculture productivity, and bringing cost savings to the farmers.

[*] Intergovernmental Panel on Climate Change (2007), *"Climate Change 2007: Synthesis Report"*.

[†] Fosburgh, B. A (2011), *"Cadastre: A catalyst for economic growth"* published in Geospatial World, 18 November 2011, p. 2.

[‡] VEGA Space (2011), *"Creation of an African Space Agency - Feasibility Study"*. Draft Final Report for the African Union Commission Ref: 48/IED/10, p. 9-37.

[§] UNOOSA (2008), *"OOSA Activities in tele-health and tele-epidemiology"*, presentation by United Nations Office for Outer Space Affairs - Programme on Space Applications.

[**] United Nations Millennium Declaration, A/RES/55/2, 18 September 2000.

The utilisation of precise satellite navigation in *aviation* would yield important socio-economic advantages in countries where the existing terrestrial navigation infrastructure is not well developed or properly maintained. Using reliable satellite navigation services when landing an aircraft, for example, would greatly reduce the rate of the fatal accidents, which in some African regions is today the world's highest. Also when expanding *new railway networks* (which are at present very poorly developed in many countries), the adoption of the satellite technology would enhance safety, and at the same time reduce the cost for the expensive deployment and maintenance of the ground infrastructure for train signalling.

The safety of navigation in *inland waterways* (including in river segments where today navigation is increasingly limited due to climate change, like part of the Congo River), as well as navigation along the coasts and the entrance into ports could be enhanced, with tangible socio-economic benefits. In road transportation and logistics, satellite navigation is also useful for the *tracking* of valuable or dangerous goods, or the continuous *tracing of containers* along their way.

Signals from navigation satellites can also be used for earthquake and monitoring of volcano activities, as well as early warning of tsunamis.

Disaster Management

The three types of services can be combined to support efficiently disaster warning, prevention and management (e.g. with rapid mapping, communication and assessment of local emergency situations and post-disaster reconstruction activities). Of course, in order to benefit from these services, there should be an equitable access in place to outer space and to the resources associated with it (orbital slots and radio frequencies). Also the long sustainability of the outer space itself needs to be assured. Best practices or guidelines are currently being developed through various international initiatives, aiming to propose measures to ensure the safe and sustainable use of outer space for peaceful purposes and the benefit of all countries. Some are legally binding such as the Russian-Chinese Proposal Treaty on the Prevention of the Placement of Weapons in Outer Space, the Threat or Use of Force Against Outer Space Objects (PPWT); others are voluntary such as the EU proposed International Code of Conduct for Outer Space Activities.

II. DEVELOPING COUNTRIES AND POLICIES FOR ACCESS TO SPACE SERVICES

Developed countries are increasingly relying on their technology advancement and financial means to pursue their socio-economic development and ensure their security using space applications (e.g.in defence, human and environment security). In developing countries, space-based services could provide the same benefits and could support global development policies such as the UN MDGs*. It has been observed that they could have a tangible impact for improving the living conditions of the poorest.

However, there are different types of developing countries and they do not constitute a monolithic group. Some have very limited technological and financial means while others can have the means to benefit from space services. In fact, the definition and classification of developing countries is a complex task and setting criteria can be cumbersome. This is reflected in the variety of classifications of countries provided by the United Nations, the International Monetary Fund or the World Bank. Those institutions use different indicators and metrics. The UN has developed the Human Development Index (HDI) which allows measuring development by combining indicators of life expectancy, educational attainment and income. The HDI is therefore a single statistic which serves as a frame of reference for both social and economic development. The IMF and the WB rather use economic indicators like the gross national product of the level of incomes. It is worth noting that all these organizations treat the BRICS (Brazil, Russian Federation, India, Democratic Republic of China and South Africa) countries differently than the other developing countries (but they are not yet classified as developed countries or advanced economies). This distinction of treatment on the basis of economic and social indicators is prolonged in the space domain since all these countries are 'space-faring' countries unlike most other developing countries.

It is therefore relevant in the analysis of the path for accessing space services to group countries according to the different levels of autonomy in the acquisition and development of space technology. Four groups can be identified, namely:

i. Countries with sufficient technological knowledge to develop their own space systems and/or launch them (e.g. China, India and Brazil).

* United Nations Millennium Declaration, A/RES/55/2, 18 September 2000.

ii. Countries that can afford to procure abroad their own space systems, satellite or payload (including launch and operations).
iii. Countries that can afford to buy and to utilize/process, as often as needed, space products such as satellite imagery or communication bandwidth
iv. Countries that cannot afford to acquire space products or do not have internal capacity to utilize/process space data, even if provided for free

The country's policies to access to the space products depend therefore on its level of technological development, and different paths can be pursued to reach the same goal. There can be:

- Policies implemented nationally, aimed to develop indigenous/independent solutions;
- Policies of bilateral cooperation on space, often including important trade aspects;
- Regional policies, notably to share the cost of a regional satellite system amongst various participants and enjoy common benefits (some examples are described here later);
- International policies supported by inter-governmental organisation such as UN or the World Bank, mostly in the context of international development aid for the provision of space products and capacity building.

Different Paths for Developing Space Technology

The theoretical analysis of the evolution steps that a society needs to undertake in the technological development path has been the subject of academic research for many decades. In the specific case of space technology, however, it is only in the last few years that researchers have started building a more precise framework and comparing the path that different countries have followed, trying to extract a common pattern.

Wood[*] has defined a sequence of achievements that correspond to the different degrees of technological maturity required for the implementation of a space system, which includes the steps of owning, operating, manufacturing satellites and eventually being capable to launch it autonomously in a geostationary orbit. The first step that is considered is the initial *establishment of a national space office*, which would later evolve in a fully-fledged national space agency. Of course, the mere establishment of a governmental entity does not imply the ownership of technical capabilities, but it is considered an essential step towards the acquisition of the know-how to manage space projects.

A second milestone that indicates a progression in a country's competence in space is the *capability to procure a satellite* to fly in LEO orbit (orbits at low altitude, normally used in remote sensing applications). The procurement could of course be done with different degrees of assistance from international partners (just training, or a full or partial satellite manufacturing), which are different approaches to the 'make-or-buy' strategy.

Further steps of the ladder include the *capability to build a satellite* in geostationary orbit (those more complex satellites used for telecommunications), which can also be accomplished with various degrees of external assistance. The last level of complexity is the *capability to launch* in both low-Earth and geostationary orbits.

The 'ladder analysis' shows the diversity of the approach that many countries have followed in their path for growing capability in space. However, it does not consider how - for a vast number of cases - the rationale behind the first steps in space is related to the country's military ambitions and the intention to develop ballistic missiles (conventional and/or nuclear) to strengthen the national power. Whereas this objective has little to do with the construction of a satellite or the utilisation of space technology for poverty reduction and socio-economic growth, it has been the driver of a space policy in many countries.

Once again, the importance of bi-lateral, regional or international cooperation should be emphasised, as the complexity of any space endeavour does not allow a single nation to reach alone any significant results with the resources that can be reasonably put at disposal by the government.

The 'Make-or-Buy' Option

There are different strategies - for a country without the needed competences - to exploit the potential of space applications. On one hand, governments could stimulate the acquisition of technology already established, and procure space systems or space-related data through contracts, commercial agreements, or international cooperation. On the other hand, a longer-term policy of research and technological development could be put in place, aiming to establishing indigenous competences and ultimately reaching an autonomous production capability.

The evaluation of the opportunities and challenges of establishing a space industry in developing countries

[*] Wood, D., Weigel, A. (2012), "*Charting the evolution of satellite programs in developing countries - The Space Technology Ladder*", Space Policy Volume 28, Issue 1, February 2012, p. 17.

should be a strategic starting point for any national and international policy making. Nonetheless, the motivation of some developing countries to embark into space projects goes often alongside the recognition of the tangible advantages, and is rather dictated by nationalistic concerns and military ambitions, with dispersion of precious resources. In this context, the role of the international community is paramount, and the establishment of appropriate international coordination and cooperation policies (e.g. for the sharing of satellite data) could be beneficial and should be pursued.

The Development of a 'Downstream' Space Industry

Because satellite services are not a commodity, and products must be tailored to the final users, the mere acquisition of a replicated system is not sufficient. In fact, specific expertise is needed for the definition of the requirements, specific expertise is needed for the procurement of the system or services, and specific expertise is needed for the utilisation of satellite products. Users, however, do not need to be involved in the construction of the system.

The research and development efforts should be much more focused on the *utilisation* of space data (development of software or user equipment), rather than for its *production* (development of satellites): which, in the terminology of the space industry, is called the 'downstream' technology.

Reaching a competitive level of expertise in this area could in turn open important commercial opportunities also for SMEs, possibly also outside of the country, and contribute to an economic growth. In this case, a 'reverse innovation' can occur, and ideas and products are exported in most advanced countries.

For the last point, it should be recalled that, in the case of cooperation initiatives, the sustainability of a space project in a developing country requires a total involvement of the user since the inception phase of the project, through the process of definition of the requirements, specification of procurement characteristics, and validation of the system. A large number of pilot projects in the area of space for health and education have unfortunately failed, especially in rural areas, for the lack of technological sustainability, maintenance of contents and skills of the teachers and health-care professionals in using new services and technology[*].

Experiences of Regional Cooperation

Several countries pursue their developments through the establishment of bilateral agreements or commercial endeavours with foreign enterprises. Beside ad-hoc cooperation, however, structuring wider regional cooperation among emerging space countries would be a powerful way to foster technology transfer and advancement.

Already at the end of the '80s, Argentina and other Latin American countries had an intention to form a Latin American space agency. At the first space conference of the Americas, held in 1991 in Costa Rica, even the idea of a pan-American space agency (thus including US and Canada) was brought forward[†]. Interestingly, in 1993 six countries (Argentina, Brazil, Chile, Costa Rica, Mexico and Uruguay) joined their efforts in the study of the parasite that causes Chagas disease (an endemic disease affecting between 16 and 18 million people and killing about 20,000 annually) in an experimental project that flew on-board the Space Shuttle. Today the Space Conference of the Americas is the only existing regional framework, and has the aim to enhance space education and economic development[‡].

In Asia, two organisations exist today: the Asia Pacific Regional Space Agency Forum[§] (APRSAF), and the Asia Pacific Space Cooperation Organization[**] (APSCO). The former, established in 1993 with initial Japanese leadership, includes space agencies, governmental bodies, international organisations, companies, universities and research institutes, and organises working groups on earth observation, communication satellite applications, space education and space environment utilisation. The latter is headquartered in China and includes agencies from Bangladesh, China, Iran, Mongolia, Pakistan, Peru, and Thailand, and is more focused on cooperation and promotion of collaborative programmes amongst member States.

In Africa, the African Leadership Conference on Space Science and Technology for Sustainable Development (ALC) is the regional conference to promote intra-African cooperation in the uses of space science and technology, and it was firstly held in 2005 in Abuja, Nigeria. In 2010, the African Union conference of Ministers in charge of Communications and Information Technologies mandated the African

[*] UNCOPUOS (2012), *"Report on the United Nations/International Astronautical Federation Workshop on Space for Human and Environmental Security"*, United Nations Committee on the Peaceful Uses of Outer Space, p. 8.

[†] Freeman, M. (2002), *"Reaping the Benefits of Latin American Space Cooperation"*, interview with astronaut *Franklin* Chang-Diaz.

[‡] Arévalo, C. (2005), *"The Space Conference of the Americas: A regional framework to enhance space education and economic development",* Presentation at the 15th IAF Workshop.

[§] http://www.aprsaf.org

[**] http://www.apsco.int

Union Commission to evaluate the feasibility of establishing an African Space Agency.

Another regional coordination initiative is also the Islamic Network on Space Sciences and Technology[*] (ISNET), which includes 14 Islamic countries (Bangladesh, Iraq, Indonesia, Morocco, Niger, Pakistan, Saudi Arabia, Tunisia, Turkey, Syria, Iran, Sudan, Azerbaijan and Senegal). Furthermore, in 2007 the UAE announced the intention to establish a Pan-Arab Space Agency in the frame of the Arab League.

III. LIMITS TO THE EFFECTIVENESS OF POLICIES FOR ACCESS TO SPACE SERVICES

The efficiency of the policies introduced above can be limited by several factors. Some depend on the state itself while others are independent of it. The main identified limits are listed below.

Lack of Awareness

Low level of public awareness and public pressure has been recognised as the barriers that in general hinder an efficient process of technology transfer[†]. Without proper knowledge of the advantages for the society and the economy, governments and businesses are reluctant to act, and good ideas might not receive sufficient attention and funding. In reference to current space programmes in Europe, the European Parliament quotes the importance of raising awareness - among decision-makers and the wider public - on the cost and benefits brought by satellite navigation to the EU economy, as a way to secure additional funding[‡].

This is precisely the direction in which various workshops are recently being organised, with the involvement of many the stakeholders and the contribution of the UNCOPUOS[§]. The role of NGOs in the space sector is also crucial, with their activities in outreach and education[**]. Particularly important is the fact that, besides advocacy to institutions and decision-makers, NGOs like SGAC target people and end-users, educating about the impact of space technologies in their day to day lives and how they could greatly benefit from space applications[††].

Also at a political level within developing countries there is a growing perception about the importance of international advocacy for the use of space at the service of growth and development. One of the objectives of the African Leadership Conference, for example, was raising awareness among African leaders[‡‡]. Likewise, the implementation guidelines for the establishment of the African Space Agency indicate the promotion of awareness as one key pillar of space policy, both for politicians and the decision-makers, as well as young people to stimulate education and a career development in space technology or science and engineering in general[§§].

Depth of International Cooperation

The depth of international cooperation depends on several factors; space is just one item on the agenda of states. Therefore cooperation on space can be impacted by the level of economic and political ties between two countries. Generally speaking, it is advisable to maintain good diplomatic relations with space-faring countries so that they will be more inclined to cooperate and enhance capacity-building.

Cost and Access Policy of Space Data and Products

The data produced from space systems (especially from earth observation satellites) can be subject to different access policies, and is often constrained by the commercial nature of the source, preventing poor countries from using it. In some cases – on the contrary – a "free-access" policy is implemented.

Depending on the data access policies put in place by space-faring nations and their industries, the use of data by other countries could sometimes be impossible (e.g. for security reasons) or out of reach because of their high prices.

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[*] http://www.isnet.org.pk

[†] Rathgeber et al. (2010), "*The Fair and Responsible Use of Space: An International Perspective",* Studies in Space Policy, Vol. 4, 1st Edition. ISBN 978-3-211-99652-2. p. 98.

[‡] European Parliament (2011), *"Report on a space strategy for the European Union that benefits its citizens"*, Committee on Industry, Research and Energy (2011/2148(INI)), p.8/24.

[§] UNCOPUOS (2012), *"Report on the United Nations/International Astronautical Federation Workshop on Space for Human and Environmental Security"*, United Nations Committee on the Peaceful Uses of Outer Space, p. 3.

[**] Lukaszczyk, A. (2011"*Space Policy: What is it and why do emerging space states need it?"* Secure World Foundation, IAC-11-B5.2.9, Presented at IAC 2011 in Cape Town, South Africa, 3-7 October 2011, p. 4.

[††] Lukaszczyk, A., Williamson, R. (2008), "*The Role of space Related Non-Governmental Organisations (NGOs) in Capacity Building",* IAC-08-E3.2.6.p. 4

[‡‡] Martinez, P. (2012), "*The African Leadership Conference on Space Science and Technology for Sustainable Development",* Space Policy Volume 28, Issue 1, February 2012, pp. 33–37.

[§§] VEGA Space (2011), *"Creation of an African Space Agency - Feasibility Study".* Draft Final Report for the African Union Commission Ref: 48/IED/10, p. 14.8.

Already relevant international frameworks are in place. For example, the International Charter[*] for space data acquisition and delivery to those affected by natural or technological disasters is an interesting example in this respect. At time of a crisis the Charter can be activated by its members, the European Union or the UN, and relevant data will supplied at no cost to those affected by the crisis to allow a quick and coordinated response. This mechanism showed its effectiveness in the responses to the earthquake in Haiti and the tsunami and nuclear crisis in Japan[†].

In other cases, countries establish bilateral or multilateral agreements with other states, which have satellite data available for the same region, as it is the case for example of Tunisia, Algeria, Morocco, Libya and Egypt[‡]. Indeed, one of the inherent goals of the African Space Agency (which is currently under study by the African Union Commission) is the centralisation of the purchase of space data (like maps and satellite images), avoiding duplications and centralising disaster management and emergency response.

For the study of science and astronomy, researchers already put at the international community's disposal the space data coming from complex systems, and this could stimulate further basic research in developing nations, freeing from the need to develop costly infrastructure.

Unlike in the science domain; however, the access to space data for other uses from the poorest countries is still limited and far from being free. In a recent Workshop on Space for Human and Environmental Security[§], organised by the United Nations and the International Astronautical Federation and attended by delegates from 39 countries plus international organisations, the issue came forward loudly. The workshop focused on the use of space technology, data and services in four areas: "climate change studies", "food security and water management", "medical and public health services", "environmental monitoring and natural resource management"[**]. In the area of space for health and education, as well as in the areas of space for food, water and the environment the delegates affirmed that *"Data-sharing policies at the national level should be created and harmonized"*. Also the African Leadership Conference, convened in Mombasa (Kenya) in 2011 highlighted similar issues, and a specific session on data availability, accessibility and dissemination led to several recommendations for facilitating data access and exchange, which were reflected in the Mombasa Declaration[††].

The data access policy seems therefore to constitute today one of the hurdles that developing countries and space newcomers need to overcome. The questions of transfer regimes shall however be tackled: should data be shared with those who cannot afford its production, or merely exchanged in cooperation initiatives? What is the incentive for space actors to contribute to the generation of the data? In Europe, discussions on the data access policies are being held for the on-going space programmes (GMES and Galileo) with member States, civil society and end-users, and decisions are included in the relevant regulations. Certainly, divergent and complex interests exist. Security-related entities, for example, need to be involved in the definition of data transfer regimes, and the widest number of stakeholders should also be consulted. The issue of space data access needs to be continued to be tackled in order to make space technology a common good and deploy its intrinsic potential for development.

Financial Sustainability

Obviously, the state of the national finances will have a great impact on the development of national and international policies. For instance, because of the global economic recession, which has started in 2008, developed countries have reduced their development aid. The OECD[‡‡] warns that the official development assistance has dropped by nearly 3% in 2011, breaking a long trend of annual increases. OECD attributes explicitly this fall to the economic crisis that affects the most industrialized countries. In addition to less benefiting from international aid, the developing countries are obviously also affected themselves by the crisis slowing down as a consequence the implementation of their national policies.

Technological Development

[*] www.disasterscharter.org/web/charter/charter

[†] Fondation pour la recherche stratégique (2011), *"Understanding the European Space Policy. The Reference Book"*. Prepared in the frame of the C-SPACE project funded by the European Commission (FP7), p.15.

[‡] Giannopapa, C. (2010), "*African Partnership in Satellite Applications for Sustainable Development. A Comprehensive Mapping of European-African Actors and Activities"*, Vienna: European Space Policy Institute (ESPI) Report 26. ISSN: 2076-6688, p. 64.

[§] Held in Cape Town, South Africa, from 30 September to 2 October 2011

[**] UNCOPUOS (2012), *"Report on the United Nations/International Astronautical Federation Workshop on Space for Human and Environmental Security"*, United Nations Committee on the Peaceful Uses of Outer Space, p. 7 and foll.

[††] Martinez, P. (2012/2), "*The African Leadership Conference on Space Science and Technology for Sustainable Development"*, Space Policy Volume 28, Issue 1, February 2012, p. 35

[‡‡] www.oecd.org/document/3/0,3746,en_21571361_44315115_50058883_1_1_1_1,00&&en-USS_01DBC.html

For some countries, the technological gap to develop space systems or process space data is simply too hard to accomplish it alone or it would take too much time while the current needs remain unsatisfied. In this case, purely policy focusing on national initiatives won't be successful and a policy for international cooperation will be a must in order for a country to have proper guidelines and regulations in place for buying products (data) or to benefit from development aid.

Education and Research

An efficient education and research system, in particular in higher education, is necessary to develop local human resources that will benefit the local space industry and government. Moreover, thanks to international cooperation, the training of teachers, the exchange of teaching methods, materials and experience and the development of infrastructure and policy regulations will enhance capacity-building.

Sustainability of Political Commitment

In order for any governmental policy to be successful, it needs strong and continuous political support and will. Otherwise, this policy could be dropped before it brings results because of financial pressure or the reorientation of political priorities after an election, for instance.

Efficiency of the Development Aid

During the last ten years considerable efforts have been made to improve the quality of development aid. New methods have been developed that better fit the needs of the developing countries themselves. Most notably, improvements were initiated by the Paris Declaration in March 2005 and the Accra Agenda for Action signed in September 2008[*]. They both insist on several principles, mainly:

- *Ownership*: the benefiting countries develop their own policy for development. The donor countries accept that the partner country takes the lead in implementing the policy.
- *Alignment of aid*: donors agree to align their development aid with the national strategies, institutions and procedures.
- *Harmonisation*: donor countries have to rationalize their own interventions to make the joint development efforts more effective. Transparency and complementarity are essential principles to optimally do the job.
- *Results Oriented Management*: aid must be geared to achieving the targeted results and the available information must be used to improve the decision-making process.
- *Mutual responsibility*: the donor countries and partner countries jointly analyse the results of the efforts.

These principles must obviously also apply to the development aid related to the space sector.

IV. CONCLUSIONS AND POLICY RECOMMENDATIONS

Space technology is one of the greatest achievements of the second half of the 20th century, and has opened up opportunities for improving citizens' life that are now gradually starting to reach the entire world. The countries that initiated the space race have since then become established space powers, with their technological progress pushed by international competition and hegemony aspirations. Many countries followed the path of those early starters, driven by the willingness to capture the same socio-economic advantages and often to address their specific national security issues.

However, this endeavour has required huge financial resources, which few countries have been able to afford. Reaching the necessary technological capability and knowledge is not easy, even with international aid and cooperation. The transfer of technology and the access to space-based data and applications, from more developed to developing countries presents intrinsic difficulties and encounters barriers in the current economic, political and regulatory frameworks. Countries ought to make choices on their national (eg education, research) and international (eg development aid) policies in order to benefit from space in support of their development.

The main conclusions and recommendations derived from the analysis of the emerging space programmes and of the issues surrounding the transfer of the space technology for developing countries are following:

1. International cooperation in the development of space technology has proven to be essential for the success of a country's technological development. In this context, the role of the initiatives for training put in place by the United Nations, the NGOs, and the international research community is crucial and should be reinforced. The capacity building should be extended beyond purely technical matters, and include organisational, legal, and regulatory aspects to allow the end-users to be fully involved in all the process of definition of the requirements and procurement of technology.

[*] www.oecd.org/dataoecd/11/41/34428351.pdf

2. Space programmes of the emerging space nations often suffer from lack of sustainability (financial, political, etc.) and long-term commitment. A coordinated space policy with a greater involvement of the international community would better support emerging space programmes and give a major impulse towards the improvement of developing countries' capabilities.

3. The effort of building technological capabilities shall be extended to the utilisation of space technology (software or user equipment), and not only limited to the construction of satellites. This could allow the development of a “downstream” space industry in developing countries thereby generating further economic growth.

4. Property rights and data access policy are also an issue. International regulatory frameworks are already in place today (mainly for use in case of natural disasters and crisis such as the Disaster Charter*), but many stakeholders have expressed the need to allow a more open access to space data for health, education, food, water and environment management. It should address not only the sharing of data, but also the process of date, especially during crisis but also on a more regular basis in order to support development in poor states. The corresponding organisational, technical and legal aspects need to be addressed.

5. Lack of awareness for the politicians and policy-makers on the advantages of space technology is a limiting factor and might have a deleterious effect of diverting resources towards less effective initiatives. Although space is increasingly brought to the attention of the general public and to politicians, there is still scepticism in accepting that investments should be made in high-technology services when other basic needs are still not fulfilled. The role of the international community should continue to raise awareness.

* *"Charter On Cooperation To Achieve The Coordinated Use Of Space Facilities In The Event Of Natural Or Technological Disasters",* Rev.3 (25/4/2000)