AN ANALYSIS OF THE SPACE POLICIES OF THE MAJOR SPACE FARING NATIONS AND SELECTED EMERGING SPACE FARING NATIONS

By

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ABSTRACT

This Article provides information (as at April 2012) on national space policies even in the absence of a specific single comprehensive national space policy document. The national space policies analyzed are those of the United States, the European Union (EU) and European Space Agency (ESA, including selected ESA Member States (e.g., France, Germany, Italy and the United Kingdom); India, Japan, Russia, and, to the extent possible, China. The policies of emerging space faring nations such as Australia, Republic of Korea (South Korea) and South Africa are included in the analysis. These particular space-faring and emerging space-faring nations have been selected because their policies and programs are deemed to represent a comprehensive cross-section of the world's government space sector. In addition, and to the extent relevant, the policy directions (usually characterized as non-binding principles or guidelines) of multinational organizations, such as the United Nations Committee on the Peaceful Uses of Outer Space (UNCOPOUS) and the Group on Earth Observations (GEO) are included in the analysis.

RÉSUMÉ

Cet article datant d'avril 2012 décrit les politiques spatiales nationales des nombreux pays, alors que certains d'entre eux n'aient pas exprimé leur politique dans un seul document exhaustif. Les principales politiques spatiales étudiées sont celles des États Unis, de l'Union Européenne (l'UE) et de l'Agence Spatiale Européenne (y compris certains pays membres dont la France, le Royaume Uni, l'Allemagne et l'Italie), de l'Inde, du Japon, de la Fédération Russe et, dans une certaine mesure, celle de la Chine. Les politiques des puissances spatiales émergentes telles que l'Australie, la Corée du Sud et l'Afrique du Sud sont également considérées. Ces pays ont été élus parce qu'ils sont représentatifs du secteur spatial gouvernemental mondial. Les orientations politiques des organisations internationales, dont celles du Comité des Nations Unies pour l'utilisation pacifique de l'espace extra-atmosphérique (UNCOPUOS) et du Groupe sur l'Observation de la Terre sont aussi décrites.

I. INTRODUCTION

A country's national space policy usually provides policy directions for the conduct of the government's civil, military and national security space programs. It may also cover relations with the commercial and research space sectors, as well as international partners. In many cases a national space policy clarifies:

- The roles and responsibilities of the government departments with a stake in the nation's space sector including their inter-relationships;
- The government's position on the conduct of its space program e.g., peaceful use of outer space;
- The government's position on space activities as they relate to national security, sovereignty, foreign policy, international cooperation and similar matters;
- The government's civil, military and intelligence space priorities; and,
- Policy directions for government departments, support of and relationships with, the commercial, research and education sectors.

In some cases, e.g., the United States, a national space policy includes a classified section.

While a national space policy addresses a government's space priorities, it does not necessarily include all possible topics, as some space policy matters are handled through lower tier policy directives or simply left unaddressed. A national space policy is not a space strategy, nor a long term space plan. However, in analyzing national space policies, it is necessary in some cases to review national or space agency strategies and long term plans since they often reflect national space policies even in the absence of a single national space policy document. The United States is one of the few countries that consistently produces comprehensive national space policies to reflect a particular administration's position. Recently the European Union (EU) has, through its executive arm, the European Commission (EC) and in cooperation with the European Space Agency (ESA), developed a European space policy.

Space policies may be produced for a particular space sector (e.g., a national space transportation policy), or may be embedded in broader policy documents and then reflected in a national space agency strategy

as is the case for the recent German Federal Space Strategy. Though the United Kingdom (UK) does not explicitly have a national space policy, its policies with respect to space are reflected in the legislation creating the UK Space Agency and other supporting documents.

In sum, this Article provides information (as at April 2012) on national space policies even in the absence of a specific single comprehensive national space policy document. The national space policies analyzed are those of the United States, the European Union (EU) and European Space Agency (ESA, including selected ESA Member States (e.g., France, Germany, Italy and the United Kingdom); India, Japan, Russia, and, to the extent possible, China. The policies of emerging space faring nations such as Australia, Republic of Korea (South Korea) and South Africa are included in the analysis. These particular space-faring and emerging space-faring nations have been selected because their policies and programs are deemed to represent a comprehensive cross-section of the world's government space sector. In addition, and to the extent relevant, the policy directions (usually characterized as non-binding principles or guidelines) of multinational organizations, such as the United Nations Committee on the Peaceful Uses of Outer Space (UNCOPOUS) and the Group on Earth Observations (GEO) are included in the analysis.

With a few exceptions, this analysis does not cover a nation's space activities, and in certain instances, it only does so to put the policies in perspective and is only a gross summary. Further, the analysis focuses primarily on civil space policies. Before turning to the space policies of the aforementioned space-faring nations and relevant organizations involved in space activities, attention will be turned to some common policy themes.

II. COMMON POLICY THEMES

A. MOTIVATIONS FOR A NATIONAL SPACE PROGRAM

When we look at the motivations or space policy drivers of the world's major space faring nations, namely US, Europe, Japan, China, India and Russia, we find that the most common drivers are (not in any order of priority):

- Knowledge and understanding
- Discovery
- Economic growth – job creation and new markets

- National prestige
- Security and defence
- International relations
- Education and workforce development
- Leadership
- Applications (e.g., Earth Observations for sustainable development).

Despite a list of drivers commonly found in most national space policies, an in-depth analysis highlights three major trends:

- Space activities to meet the needs of citizens,
- The industrial space sector as an engine for technical innovation and competitiveness,
- Dual use (military and civil) applications.

1. SPACE AN ESSENTIAL PART OF A NATION'S INFRASTRUCTURE

Space-faring nations worldwide are increasingly acknowledging the essential role, and benefits, of space-based services to their citizens, national economy, security and commercial competitiveness.

2. SPACE AS AN ENGINE FOR INNOVATION AND ECONOMIC PROSPERITY

The work of the Organization for Economic Co-operation and Development (OECD) will be discussed later in this analysis, but in several OECD publications, the contributions of the space sector to economic activity is underlined. In its report titled 'Space Policies, Issues and Trends in 2010/2011, the European Space Policy Institute stated, "The EU places innovation at the core of its economic policy, as the main factor of European companies competitiveness …. We are going to see concrete relations between space and innovation as a motor for economic development for the whole society and not only dedicated to an obscure governmental project".[1] As the statements of policy from various countries quoted below demonstrate, the sentiment that the space sector is a beneficial engine for innovation to a nation's competitiveness is shared by the governments of most space faring nations.

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[1] Spyros Pagkratis, *Space Policies, Issues and Trends in 2010/2011*, European Space Policy Institute Report 35, June 2011, online: ESPI <www.espi.or.at/images/stories/dokumente/studies/ESPI_Report_35.pdf>.

2.1 EUROPE (SPACE POLICY, APRIL 2011)

"… space generates knowledge, new products and new forms of industrial cooperation, it is therefore a driving force for innovation and contributes to competitiveness, growth and job creation."[2]

2.2 GERMANY (FEDERAL SPACE STRATEGY, NOVEMBER 2010)

"A paradigm shift has occurred within space: once a symbol of the technology race and a contest between opposing systems, it is now, in every sense, a part of our everyday lives and an essential instrument for the achievement of economic, scientific, political and social goals. Today space makes a vital contribution when it comes to promoting research and development, education and innovation, economic growth, providing highly qualified jobs, improving our quality of life, protecting the Earth, ensuring our security and defence and furthering international cooperation."[3]

2.3 UK (ANNOUNCEMENT OF UK SPACE AGENCY, DECEMBER 2009)

"Space has been one of the nation's unsung economic success stories in recent years – and a thriving sector will be vital in building Britain's future." [4]

2.4 USA (NATIONAL SPACE POLICY, JUNE 2010):

"A robust and competitive commercial space sector is vital to continued progress in space. The United States is committed to encouraging and facilitating the growth of a U.S. commercial space sector that supports U.S. needs, is globally competitive, and advances U.S. leadership in the generation of new markets and innovation-driven

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[2] EU, European Commission, Towards a Space Strategy for the European Union that benefits its Citizens, COM(2011) 152 final, 4 April 2011, online: EC <ec.europa.eu/enterprise/policies/space/files/policy/comm_pdf_com_2011_0152_f_communication_en.pdf>.

[3] Germany, Federal Ministry of Economics and Technology, *Making Germany's Space sector fit for the Future: The Space Strategy of the German Federal Government,* online: Federal Ministry of Economics and Technology <www.bmwi.de/English/Redaktion/Pdf/space-strategy,property=pdf,bereich=bmwi,sprache=en,rwb=true.pdf>.

[4] "Science Minister Announces New Executive Agency for UK Space and Satellite Industry", online: CollectSpace <www.collectspace.com/ubb/Forum32/HTML/000171.html>.

entrepreneurship."[5]

2.5 JAPAN (BASIC PLAN FOR SPACE POLICY, JUNE 2009):

"The Government will place the space industry among strategic industries in the 21st Century and enhance competitiveness by promoting space machinery smaller, serialized, communized and standardized".[6] Furthermore, "it is important to strengthen the international competitiveness by developing Japan's space industry into a strategic industry for the 21st Century after the electric and electronic industries and automobile industry."

2.6 CHINA:

"Chinese officials believe that it (space) is a technology driver that can propel China's economy and facilitate innovation in pharmaceuticals and metallurgy. It can also provide other economic benefits, like increases in quality control testing and improving standards for selecting and training management personnel"[7].

In addition governments are putting in place initiatives to nurture Small and Medium Sized Enterprises (SMEs). SMEs are increasingly seen, especially in Europe, as a sector for innovation and job creation, even within the space sector.

B. COMMON POLICY CHALLENGES

1. NATIONAL SPACE AGENCIES GOVERNANCE STRUCTURES

Most nations' space programmes report to a high level in government, at least to a Minister or a cabinet committee for space, and sometimes directly to the Prime Minister or Deputy Prime Minister (as is the case in Russia). US military space is responsible to the Secretary of Defense and the NASA Administrator reports to the President's Science Advisor. The creation of a UK Space Agency on 1 April 2010, which reports to the Minister of State for Universities, Science and Innovation,

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[5] US, White House, *National Space Policy of the United States of America*, 28 June 2010, online: White House <http://www.whitehouse.gov/sites/default/files/national_space_policy_6-28-10.pdf>.

[6] Japan, *Basic Plan for Space Policy*, Strategic Headquarters for Space Policy, online: Kantei <http://www.kantei.go.jp/jp/singi/utyuu/basic_plan.pdf>.

[7] Dwayne A. Day, "The new path to space: India and China enter the game", The Space Review Monday, October 13, 2008, online: The Space Review http://www.thespacereview.com/article/1231/1

is one recent example of how a national space programme is managed. The German Aerospace Research Center and Space Agency (DLR) reports to the Federal Ministry of Economics and Technology (BMWi). The DLR is managed by an Executive Board, with the Head of DLR functioning as the Chairman of the Executive Board.

A major change in recent years is the increasing role of the EU, through its administrative arm the EC working in conjunction with the European Space Agency (ESA), in developing and directing European space policy and the funding of certain European multi-satellite programs (e.g., Galileo (Position, Navigation and Timing - 7.9 billion Euros to 2020), Global Monitoring for Environment and Security (GMES) (5.8 billion Euros to 2020) and more recently a Space Situational Awareness (SSA) system initiative). This policy and implementation role was hitherto under the ESA and its Council of Member States at the Ministerial level.

2. INTERDEPARTMENTAL/AGENCY COOPERATION

Two aspects of Interdepartmental/Agency cooperation are highlighted in the present discussion. The first is the national space agency executing space missions to serve other government departments and the second is the joint development of space missions among two or more government departments.

Almost every national space policy or lower tier policy makes reference to serving the needs of citizens. Thus, by way of example, the UK Space Strategy calls upon its Space Agency to serve other government departments (see below). While highlighting the benefits of interagency collaboration, a 2010 US National Research Council (NRC) Report[8] however warned that joint development activities can be complex and incur unforeseen costs and risks (see below). The principal recommendation of the NRC Report is that agencies should conduct Earth and space science projects independently unless:

- It is judged that cooperation will result in significant added scientific value to the project over what could be achieved by a single agency alone; or
- Unique capabilities reside within one agency that are

[8] U.S. National Research Council (NRC) Report (2010): Assessment of Impediments to Interagency Collaboration on Space and Earth Science Missions

necessary for the mission success of a project managed by another agency; or
- The project is intended to transfer from research to operations necessitating a change in responsibility from one agency to another during the project; or
- There are other compelling reasons to pursue collaboration, for example, a desire to build capacity at one of the cooperating agencies.

3. SPACE SITUATIONAL AWARENESS

As the use of Earth orbit grows, the need to track and monitor space objects to provide timely information about space operations becomes increasingly critical for a number of reasons, mainly to prevent operational satellites from colliding or damage to satellites by space debris. This information is known as Space Situational Awareness (SSA).

SSA or Space Security has become a major discussion topic among the policy and space operations communities.

Currently, the US military has the most advanced SSA capability in the world and maintains the most extensive and public catalog, though it is not fully complete. Although the US has been sharing SSA information since the 1950s, it recently formalized this sharing process beyond the US government.

In 2004, the US created the Commercial and Foreign Entities (CFE) Pilot Program to encourage data-sharing in the realm of SSA with the overarching goal of ensuring safe operations in space. Originally, the US Air Force Space Command oversaw the CFE Pilot Program and administered its website, Space-Track.org. In 2009, as part of an overall effort to consolidate SSA efforts in the US government, US Strategic Command (STRATCOM) assumed responsibility for the program, renaming it the SSA Sharing Program.

In this regard, the US Department of Defense (DoD) along with NASA and Europe (EU, EC and ESA) are sharing data on SSA, while several bilateral SSA statements of principles have also been signed with Canada, France, and Australia.

Despite the benefits and improvements brought about by the SSA sharing Program, there are still several concerns. Non-US government users and partners question the programme's links to the US military, as well as the reliability, accuracy, and credibility of the information that is

shared. Some within the US worry about the cost and liability burden of providing SSA services unilaterally, as well as potential national security issues like revealing orbital positions of satellites used for intelligence-gathering.

4. RESPONSIBLE BEHAVIOUR IN SPACE: CODE OF CONDUCT

Proposals by Canada, Europe and others to develop Transparency and Confidence-Building Measures (TCBMs), to encourage responsible actions in, and the peaceful use of space, through the UN gained traction with an EU proposal initially tabled in 2008 (and updated in December 2010) for a code of conduct.[9] The Obama Administration National Space Policy of June 2010 and subsequent comments by the US administration led many to believe that the US was ready to support the European initiative. Recently, however, the US has indicated it will offer an alternate proposal, whereas China, India and others have indicated concerns with the European proposal. Despite these apparent setbacks, there does appear to be a will to reach agreement on a multi-national space code of conduct.

The proposed European Code of Conduct for Outer Space Activities (CoC) provides for a non-binding consensus ranging from security of space assets to the mitigation of space debris. Reaction throughout the world has been mixed though, since Europe first tabled its proposal, but Europe has continued to promote the adoption of a CoC.

Japan appears to back the proposal. However, other nations such as Russia, China, India and Brazil, have distanced themselves from the CoC. Some of the objections are based on the non-binding nature of the instrument, replication of the existing domestic policies of nations and the underlying ambiguity related to certain issues. Specifically, China's objections to the CoC are primarily based on its focus on arms control rather than regulating and defining conduct. It views the CoC as a pre-emptive attempt towards its co-sponsorship of a treaty to ban the placement of weapons in outer space. Also, China is not keen on sharing information on its civil and military space policies as is called for in the proposed CoC.

Given the positive signals from the US administration during 2011,

[9] EU, Council Conclusions concerning the revised draft Code of Conduct for Outer Space Activities, 14455/10 (11 October 2010).

it came as a surprise when the Under Secretary of State for Arms Control and International Security informed reporters on 16 January 2012 that the US was not going to support the proposed European CoC because it is too restrictive. According to an unidentified US government official, the US is not rejecting the European CoC outright and suggested that it could serve as a starting point for future discussions on an international code of conduct. This has led to speculation that the US may soon table its own draft code of conduct.

5. CIVIL AND MILITARY DUAL USE OF SPACE ASSETS AND CLOSER COOPERATION

There is increasing acknowledgement of the dual use (civil and military) nature of space technologies, the efficiencies of their joint operations, and for some efficiency in joint interdepartmental development. The US is one of the few countries where the civil public space agency (NASA) is scarcely involved in joint development and operations with its defense counterpart (Department of Defense/US Air Force). The close cooperation between the civil and military space sectors is particularly evident in China, Russia, France, and more recently, Germany and Japan. Now, other countries in Asia as well as Europe are intensifying cooperation between their civil and military space sectors. As will be discussed below, a landmark example of enhancing closer cooperation between the national civil space agency and the military was the Japan Basic Space Law that came into effect in August 2008. The Japanese law re-defined its position on the peaceful use of outer space and the use by its defense forces of space assets. The 2010 German Federal Government Space Strategy also made it clear they would make greater use of synergies between civil and military space research when developing security-related technologies.

However, the genuine joint development of space missions between otherwise separate civil and military organizations continues to be a challenge, owing to differences in the culture, procedures and requirements of the two sectors. This was highlighted with the cancellation of the US' National Polar Orbiting Environmental Satellite System (NPOESS), which was a joint initiative between the National Oceanic and Atmospheric Administration (NOAA) (together with the National Aeronautics and Space Administration, NASA) and the US Department of Defense (DoD). NPOESS was cancelled due to rising costs and delays in favour of separate NOAA and DoD satellites. A 2010 US National Research Council Report titled 'Assessment of Impediments to Interagency Collaboration on Space and Earth Science Missions' stated in

part that "the development and implementation of Earth-observing or space science missions are often intrinsically complex and, therefore costly, and that a multiagency approach to developing these missions typically results in additional complexity and cost".[10] It concluded that such joint ventures should not be undertaken unless there were very compelling reasons, and listed the reasons.

6. INTERNATIONAL SPACE COOPERATION

For decades, space science was the 'poster-child' for international cooperation. Beginning in the 1990s, international cooperation in space activities intensified in all space disciplines. The foundation of ESA is, of course, built on international cooperation. However, cooperation between the US and its 'friends and allies' yields a different picture.

Historically, other than in space science missions, the US has resisted relying on its partners but has welcomed contributions that enhance its core programs or missions. NASA experienced a change in this trend when Russia was invited to join the International Space Station (ISS) partnership in the early 1990s. Today the ISS is an example of a successful partnership with each partner reliant on the other. Though US President Bush's ambitious Vision for Space Exploration (VSE) has been cancelled, at the outset it was quickly clear that the US alone could not afford the programme and that the US needed to engage the international community. The Global Exploration Strategy developed by fourteen space agencies was born out of these discussions and was premised on the acknowledgement that no single country can afford an ambitious space exploration program, and much more can be achieved at a lower cost through cooperation. While US national space policies have always mentioned international cooperation, it was not until the Obama Administration's National Space Policy 2010 that international cooperation gained prominence.

The Group on Earth Observations (GEO), which will be discussed in greater detail below, is a classic example of the increased willingness of nations to cooperate.

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[10] Assessment of Impediments to Interagency Cooperation on Space and Earth Science Missions, National Research Council, (Washington D.C.: National Academies Press, 2011.

Almost every space policy refers to international cooperation if for no other reason than it is the means to undertake space activities that otherwise could not be afforded. There is no doubt that the 21st Century will see an even greater increase in international cooperation in space activities. However, there are certain impediments that pose policy challenges. An onerous US exports control regime (International Traffic in Arms Regulations) is one such policy challenge. The changing geo-economic and political situations during space projects that often need over a decade of commitment, the lack of transparency or trust, in particular the intentions of some countries in relation to the peaceful use of outer space, are policy challenges worth noting. Furthermore, there are conflicting national policies in relation to data, intellectual property rights and protecting the competitiveness of the national space industrial base which may impede international cooperation.

At the multinational level, there are several entities which nurture international cooperation in space activities.

The oldest and most widely participated body is the United Nations Committee on the Peaceful Uses of Outer Space (UNCOPOUS) which provides a platform for addressing broad policy and legal problems arising from the use and exploration of outer space. The Group on Earth Observations (GEO) and the International Space Exploration Coordination Group are also classical examples of the increasing willingness of nations to cooperate at a multinational level. Later in the article, these three intergovernmental organizations, which have significant influence on discussions in policy circles, will be discussed in greater detail.

7. DATA POLICIES

Data policies have become a major focus in several domains of the space sector in recent years. The trend has been toward a fuller, more open and less restrictive data sharing. Perhaps the two most important from a policy perspective are occurring in Space Situational Awareness (SSA) and Earth observation.

The increasing reliance on government and commercial space-based services is causing governments and commercial satellite operators to pay closer attention to the issue of sharing information related to SSA – positional data about the satellites and space debris to avoid collisions (or 'conjunctions' in SSA parlance). Despite these developments in international cooperation and data sharing, there

continue to be policy challenges as discussed above in the segment relating to SSA.

In Earth observation, one of the most important accomplishments of the GEO was the acceptance of a set of high level data sharing principles as a foundation for its Global Earth Observing System of Systems (GEOSS). Ensuring that these principles are implemented in an effective yet flexible manner remains a major policy challenge. Details of GEO will be discussed below.

8. HOSTED PAYLOADS

The concept of hosted payloads - secondary payloads accommodated when there is spare launch or commercial satellite capacity - is not new. However, as governments seek access to space at lower costs and as commercial launch firms strive for greatest profitability, this concept is attracting more attention. Though the concept has considerable merit, there are several policy issues to be resolved relating to national security, intellectual property protection, liability, export controls and so forth.

On the margins of the Space Foundation's National Space Symposium in Colorado Springs in April 2011, a core industry group held a full-day workshop and launched the Hosted Payload Alliance (HPA). The Community website states HPA "has been formed by leading satellite companies, designed to advance the use of hosted payloads on commercial satellites and to create an open dialogue between government and industry on the issues affecting hosted payloads, at both the policy and program level."[11]

A practical example of a hosted payload in a commercial satellite is the January 2012 announcement that the Intelsat-22 satellite will carry a Ultra High Frequency UHF Hosted Payload on-board for use by the Australian Defence Force (ADF). The UHF payload will provide the ADF with tactical communications for their military at a cost savings of 150 million dollars over the cost of a dedicated satellite to provide the same capability.

[11] Hosted Payload Alliance, online: HPA <http://hostedpayloadalliance.org>.

III. SELECTED NATIONAL SPACE POLICIES

A. UNITED STATES OF AMERICA

"Federal policy must be inclusive of multiple interest groups and constituencies, not only to be effective but also to survive the test of time".[12]

The Obama Administration issued its National Space Policy in June 2010.[13] This supersedes the Bush Administration policy issued in October 2006.[14] The 2010 policy changed US space policy in many fundamental respects. The most important is the change of tone, for President Bush's 2006 policy was criticized in the US and abroad for its nationalistic tone and some even called it belligerent. Moreover, the Obama National Space Policy was issued just eighteen months into the new administration, as opposed to the general past tendency of issuing policies towards the end of a first term or even in the second term.

Overall, the goals of the 2010 US National Space Policy are to:

- Energize competitive domestic industries;
- Expand international cooperation;
- Strengthen stability in space;
- Increase assurance and resilience of mission-essential functions;
- Pursue human and robotic initiatives; and,
- Improve space-based Earth and solar observation.

The 2006 policy emphasized the need for the US to maintain the military high-ground in space whereas the 2010 policy is more inclusive as it aims to "[d]evelop capabilities ... to ... defeat efforts to interfere with or attack U.S. *or allied* space systems" (emphasis added). The 2006 policy declared that any purposeful interference with US space systems would be considered an infringement on its rights enabling it to take

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[12] Dick Darman, Director, US White House Office of Management and Budget 1989-1993. He had served five U.S. Presidents during the course of his career.

[13] US, White House, National Space Policy of the United States of America, 28 June 2010, online: White House <http://www.whitehouse.gov/sites/default/files/national_space_policy_6-28-10.pdf>.

[14] US, White House, National Space Policy of the United States of America, 31 August, 2006, online: White House <http://www.whitehouse.gov/sites/default/files/microsites/ostp/national-space-policy-2006.pdf>.

recourse to retaliatory action. In contrast, the 2010 policy changed the language from one that exclusively referred to US space assets to one that includes all nations having the right to freely use space without any harmful interference.

The 2010 policy places greater emphasis on international cooperation and building a global sense of responsibility for sustaining the space environment for use by all and for peaceful purposes through the enhancement of Transparency and Confidence Building Mechanisms (TCBMs). Further, the 2010 policy underlines the importance of building partnerships with the commercial space sector and also the need for greater space situational awareness in terms of the better monitoring of space debris and taking measures to avoid in-space collisions.

With regard to the human space exploration programme, the Obama Administration has radically changed the direction of the US from what was set out by President Bush in January 2004. The Obama Administration went ahead with the planned retirement of the Space Shuttle but committed the US to the international Space Station (ISS) project to *at least* 2020. In contrast, the Bush Administration envisaged the end of the ISS occurring in 2015. However, the Obama Administration cancelled the Bush vision for a return to the Moon and consequently also cancelled the Constellation lunar transportation systems programme that was being developed. The Obama policy has, instead, declared that an asteroid should be America's next destination for human exploration.

The Obama Administration is also putting emphasis on nurturing the commercial sector to develop crew and cargo transportation systems to serve the ISS. The cancellation of the Constellation programme and the increased reliance on the commercial sector have been very controversial especially in Congress. A compromise was reached and, as an insurance policy in case the commercial sector fails to produce the required space transportation vehicles, NASA is now developing a heavy lift launch vehicle and crew module that will be able to serve both the ISS and missions beyond Low Earth Orbit.

As is usual in a US national space policy, the 2010 Policy includes commercial, civil, and national security sector guidelines. It also provides some clarity on the respective roles and responsibilities of the heads of the prime government space-related agencies and departments i.e. the NASA Administrator, the NOAA Administrator, the Director of the US Geological Survey, the Secretary of Defense and the Director of

National Intelligence.

In summary, the sector guidelines are as follow:

- Commercial – the US government is to purchase and use commercial space capabilities and services to the maximum extent possible and practical;
- Civil – NASA Administrator shall set far-reaching exploration missions, continue operation of the ISS to at least 2020, seek partnerships with the private sector for ISS crew and cargo transportation services, implement a new technology development program including for next generation launchers, maintain a sustained robotic presence in the solar system, continue a strong space science program,
- Environmental Earth Observation and Weather – continue and improve a broad array of programs of space-based observation, research, and analysis for the Earth's land, oceans, and atmosphere. The policy provides guidelines for the responsibilities of the NASA Administrator, NOAA Administrator and Secretary of Defense working independently and together in this domain. The sector guidelines also state that mature research and development of Earth observation satellites should be transitioned to long-term operations (the transition from research to operations has been an issue especially for the NOAA Administrator and NOAA's international partners for many years),
- Land Remote Sensing – the Director of USGS shall conduct research on natural and human-induced changes to the Earth's land, land cover, inland surface waters, and manage a global land surface data national archive and its distribution. In addition, the Director of USGS is charged to coordinate with the Secretary of Defense, the Secretary of Homeland Security and the Director of National Intelligence to provide remote sensing information related to the environment and disasters *that is acquired from national security space systems* to other civil government agencies. (This is another example of dual use applications though one would assume it represents a policy whose implementation poses a considerable challenge).
- National Security – the Secretary of Defense and the Director of National Intelligence, in consultation with other appropriate heads of departments and agencies shall develop, acquire, and operate space systems and supporting

information systems and networks to support US national security and enable defense and intelligence operations during times of peace, crisis, and conflict. They are also charged with, reinvigorating US leadership by promoting technology development, maintaining a SSA system, and to develop capabilities to deter, defend against and if necessary, defeat efforts to interfere with or attack US or allied space systems.

B. EUROPEAN UNION AND THE EUROPEAN SPACE AGENCY

The legal framework for a European space policy was provided in Article 189 of the EU Lisbon Treaty which was signed in December 2007 and came into force in December 2009.[15] Article 189 provides in part as follows: "To promote scientific and technical progress, industrial competitiveness and the implementation of its policies, the Union shall draw up a European space policy. To this end, it may promote joint initiatives, support research and technological development and coordinate the efforts needed for the exploration and exploitation of space."

In 2003, the European Commission issued a White Paper titled 'Space: A new European frontier for an expanding Union – An Action Plan for Implementing the European Space Policy'.[16] This followed several years of debate in Europe about whether the EU (as against the European Space Agency (ESA) and EU Member States) should take a lead role in the development of European space policy. In a communication issued on 4 April 2011, the European Commission presented the first step for an integrated European space policy.[17] Antonio Tajani, EC Vice-President responsible for Industry and Entrepreneurship, commented on the occasion as follows:

Space is strategic for Europe's independence, job creation and

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[15] *Consolidated versions of the Treaty on European Union and the Treaty on the Functioning of the European Union*, [2010] OJ C 83.

[16] EU, European Commission, Space: a new European frontier for an expanding Union. An action plan for implementing the European Space policy, COM(2003) 673 final, online: European Commission: <http://eur-lex.europa.eu/LexUriServ/site/en/com/2003/com2003_0673en01.pdf>.

[17] EU, European Commission, Towards a space strategy for the European Union that benefits its citizens, COM(2011) 152 final, (4 April 2011), online: EC <http://ec.europa.eu/enterprise/policies/space/files/policy/comm_pdf_com_2011_0152_f_communication_en.pdf>.

> competitiveness. Space activities create high-skilled jobs, innovation, new commercial opportunities, and improve citizens' well-being and security. This is why we need to reinforce European space policy to best exploit its social and economic opportunities for industry and SMEs. In order to achieve our goals, Europe needs to keep an independent access to space.[18]

The consolidated EU space policy laid down certain priorities for the future. The consolidated policy requires the EU to:

- Realize the European navigation satellite programmes Galileo and European Geostationary Navigation Overlay Service (EGNOS). (A service that was recently introduced enables precision aircraft approaches and renders air navigation safer);
- Implement the European Earth monitoring programme called Global Monitoring for the Environment and Security which is designed for land, ocean, atmosphere, air quality and climate change monitoring, as well as emergency response and security, to become fully operational by 2014;
- Protect space infrastructures against space debris, solar radiation and asteroids by setting-up a European Space Situation Awareness (SSA) system;
- Identify and support actions at the EU level in the field of space exploration, notably exploring options to work with the ISS ensuring that all Member States participate in it;
- Pursue a space industrial policy developed in close collaboration with the European Space Agency and Member States;
- Support research and development to increase European technological non-dependence and ensure that innovation in this field will be of benefit to non-space sectors and citizens. (Communication satellites play a key role in this context);
- Strengthen partnerships with EU Member States and the European Space Agency (ESA) and implement improved management schemes.

The space policies for the three major contributors to the ESA, namely Germany, France and Italy are summarized below. The UK has also been included since the UK space sector is gaining political visibility

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[18] EU, *A new space policy for Europe: Independence, competitiveness and citizen's quality of life,* Press Release, IP/11/398

and support. For the most part, the space programs of ESA Member States are increasingly being influenced by the overall European space policies.

C. GERMANY

The most recent German space policy is contained in the country's Federal Space Strategy issued in November 2010.[19] The Strategy outlining the policy focuses on the specific benefits that space activities can achieve for society – it is thus a return to a more utilitarian program. Further, the Strategy specifically states that "a clear orientation towards benefits and needs, the principle of sustainability, and intensive international cooperation – particularly within Europe – are the guiding principles of our policy".

The ten key policy objectives contained in the Federal Space Strategy include:

1. Expanding strategic space expertise:
- Maintaining and expanding Germany's scientific and industrial base related to space technologies and ensuring the continued growth and excellence of the country's space sector;
- Emphasis will be on Earth observation, satellite communications, satellite navigation applications, robotics, artificial intelligence and autonomous systems.

2. Sustainably reinforcing Germany's strong position in space research:
- Expand Germany's role in European and international Solar System and cosmos exploration.

3. Tapping new markets and establishing a unified legal framework:
- Draft a German Space Act to complement the existing Satellite Data Security Act;
- Encourage the EU and its Member States to enact analogous regulations to ensure a level (commercial) competitive playing field.

4. Using space for purposes of whole-of-government security preparedness:

[19] Germany, Federal Ministry of Economics and Technology, Making Germany's space sector fit for the future: The space strategy of the German Federal Government, 30 November 2010.

- Make greater use of synergies between civil and military space research when developing security-related technologies.

5. Shaping the distribution of roles in the European space sector:

- Call for a clear demarcation of tasks between the EU (which through the Lisbon Treaty now has whole-of-EU space policy role) and EU Member States in accordance with the principles of complementarity and avoidance of duplication;
- Strengthen ESA as an independent intergovernmental organization.

6. Defining German and European roles in space exploration:

- Support the ISS and its utilization to at least 2020;
- Development of an autonomous robotic technology capability is a priority including robotic exploration of the Solar System and satellite on-orbit servicing and disposal.

7. Securing technological independence:

- Unhindered access to space as an essential element of Europe's political sovereignty.
- Continued involvement in the European launcher program with a focus on the Ariane launcher upper stage.

8. Human spaceflight:

- Support human spaceflight for as long as robotic systems are incapable of fully replacing human presence for conducting space activities.

9. The Moon as a target for exploration:

- Examine options for a robotic lunar mission within the ESA framework.

10. Ensuring the sustainability of space activities:

- Advocate for a common legal framework to cover the responsible use of space and a space-related arms control policy.

D. FRANCE

Despite being a major space faring nation, France does not have a national space policy. In fact, space policy documents in general also appear sparse, and it was only in June 2008 that France adopted specific legislation applicable to activities in space. The legislation sets out the legal framework for French space activities, and at the same time, it clearly indicates the perspectives of France in terms of business, national sovereignty and independence.

Founded in 1961, the Centre National d'Etudes Spatiales (CNES) is the French government space agency responsible for shaping and implementing France's civil and military space activities and also implementing France's space policy in Europe. The mandate of CNES includes fostering new technologies that will benefit society as a whole with a focus on:

- access to space;
- civil applications of space;
- sustainable development;
- science and technology research; and,
- security and defence.

A CNES publication titled 'Space, Defense and Security' released in January 2010 states as follows:

> CNES's mission is to implement France's space policy. It intervenes in defence space programmes on behalf of the DGA (Defence Procurement Agency) and capitalises on its expertise in the field for satellite applications for defence.[20]

A major focus, and also policy, of the French space program is to ensure independent access to space for Europe through the Ariane launcher program. This was confirmed in December 2010 by then French President Nicolas Sarkozy in a speech where he emphasized that autonomous access to space was a cornerstone of French as well as European space policy. France is thus a major player in the development of European space policy. Thus while pursuing its national interests such as economic development France's major space programmes are inextricably linked to those of Europe. For example, in addition to European programs such as Galileo and GMES, France has been a strong advocate for a European SSA initiative. In February 2009, US and French defense leaders signed an agreement on SSA.

E. ITALY

Despite the lack of a national space policy, it is possible to gain some insight into Italy's civil space policies through a document titled

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[20] CNES, *Space, Defense and Security*, General Public Department/Directorate of External Communication, Education and Public Relations, 2009, online: CNES <http://www.cnes.fr/automne_modules_files/pPublications/public/r3238_37_intercnesan.pdf>.

'Strategic Vision 2010-2020'.[21] The document was released by the Ministry for Education, University and Research (MIUR), and outlines the activities to be performed by the Italian space agency, Agenzia Spaziale Italiana (ASI) from a national, European and international perspective. Further, a paper presented by ASI at the International Astronautical Congress held in Cape Town in October 2011 elaborates on ASI activities to nurture small and medium enterprises (SMEs) in both national and ESA initiatives.[22]

The two major objectives of the ASI Strategic Vision 2010-2020 are:

a. Raising the awareness of the space sector within Italian society;
b. Improving the level of responsiveness to the goals and needs expressed by the citizens.

The principal activities of the Italian space sector are deep space observation and robotic exploration, microgravity and human exploration, Earth observation, telecommunications, navigation (Galileo), access to space, enabling technologies, education and training. ASI is engaged in a three-year cooperation agreement with national space industry associations, with the aim of promoting an effective industrial policy for the development and growth of Italian SMEs.

The Strategic Vision provides sector goal-setting guidelines to:

- Maintain and strengthen scientific knowledge through the development and the launch of key scientific instruments and analysis of the data they provide;
- Achieve a global leadership position in Earth observation;
- Support national security objectives;
- Foster independence and profitability in Italy's national telecommunications infrastructure; and,
- Pursue activities which will inspire the dreams and fuel the aspirations of future generations.

The Strategic Vision then provides the methods used to achieve these goals which include:

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[21] Italy, Agenzia Spaziale Italiana, Strategic Vision 2010-2020, online: ASI <http://www.asi.it/files/ASI_DVS_2010_2020_ENG_0.pdf>.

[22] O. Piperno et al, "Space Policies Towards SMEs Implemented by the Italian Space Agency, International Astronautical Congress October 2011, Paper reference IAC-11-E6.1.3.

- Driving exploration through participation in the ISS for human exploration and the ExoMars missions for robotic exploration;
- Establishing international partnerships enabled by the coordination of national centers of excellence and the ideas they generate;
- Giving priority to dual use programs;
- Exploitation of public-private partnerships as a means to enhance economic resource availability; and,
- Promoting a national culture of awareness and involvement in space.

The anticipated benefits from the application of these strategies include:

- Management of national territories;
- Research applied to improving human health;
- Study the universe as a laboratory for observing materials and processes in extreme physical environments;
- Study of human life near its physical limits in the near earth space environment;
- Space as a proactive means for international diplomacy;
- Promotion of innovative small and medium sized business companies via new technologies and services;
- Technical and scientific support to governmental administrations and to Technology Poles; and,
- Development of innovative initiatives by means of centers of excellence to support research, production and provision of high-tech services for the environmental sector.

F. UNITED KINGDOM

The UK Space Agency came into being on 1 April 2011 and it reports to the Minister of State for Universities and Science. The UK Space Agency is an executive agency of the Department for Business, Innovation and Skills, and the Space Leadership Council was formed to provide advice to the agency. The Council is co-chaired by the Minister and an industry executive, and its members include senior representatives from across the industry, research community and government.[23]

[23] See UK, UK Space Agency, online: UK Space Agency <http://www.bis.gov.uk/ukspaceagency/who-we-are/how-we-work/space-leadership-

The UK Space Agency brings together six government departments, two research councils, the Technology Strategy Board and the Met Office. Prior to its creation, the space activities of these organizations were overseen by the British National Space Centre, what was essentially a secretariat.

Coincident with the creation of the UK Space Agency, the 'UK Space Agency Strategy 2011-2015' was released for consultation.[24] The strategy provides the overall policy direction of the UK civil space agenda by setting out the following six areas of focus and describing how each area is important to the UK's "growth agenda":

1. Growth through new opportunities:
- Space-based services for an increasing range of customers, from the general public to multi-national organizations such as information systems to support carbon trading, systems for space surveillance, innovative launch systems, services to support space exploration and space tourism.
2. Growth from exports:
- The UK's objective is to grow its share of the global market to 10% by 2030. The UK Space Agency will assist the space sector to capture more business in all areas but particularly the global commercial and security markets which are forecast to grow most strongly.
3. Innovation supporting growth:
- The UK considers that the industrial and academic space sectors lie at the cutting edge of technology, data processing and analysis. In the technology area, the strategy highlights advanced structures and electric propulsion. New applications will be developed to assist in the resolution of many critical global issues such as the management of natural resources, understanding and managing our responses to climate change, planning and monitoring infrastructure, security and defence.
4. Science to enable growth:
- A sustained investment in basic science aimed at seeking new knowledge is seen as delivering tangible benefits. The

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council>.

[24] UK, UK Space Agency, *UK Space Agency Strategy 2011-2015*, online: UK Space Agency s, <http://www.bis.gov.uk/assets/ukspaceagency/docs/strategy/11-834-uk-space-agency-strategy-2011-2015-consultation.pdf>.

strategy highlights the benefits derived from Earth observation, space science and space exploration. It also notes that scientific missions inspire the next generation to use the tools of science, mathematics and engineering that underpin the modern economy. It also observes that a strong research community provides a technical and scientific knowledge base that feeds future developments both in the upstream industries and the downstream business.

5. Education for growth:

- The strategy highlights the fact that the future wealth of the nation is dependent on developing a highly skilled technical workforce. It states that studies have demonstrated the value of space activities in attracting children into science, technology, engineering and mathematics (STEM). The UK Space Agency is tasked with encouraging the study of STEM subjects for the benefit of the economy and to ensure that universities and colleges provide appropriate skills to meet the needs of the space sector.

6. Growth through smarter government:

- The UK Space Strategy highlights space in service of government departments. The verbatim text from the UK Space Strategy is reproduced below:

  Government will increasingly rely on satellite-derived services and data. In many areas, information gathered from space enables government to make better informed public policy decisions. For example, space can provide data on the environment, climate, weather, security, agriculture, coastal management and disaster mitigation. The UK Space Agency will support the development of 'smarter', more efficient government through the use of space data by providing the strategic leadership and acting as the centre of expertise for Government departments.[25]

G. RUSSIA

The last Russian strategy paper released was titled "Major provisions of the Russian Federal Space Program for 2006-2015", and it was approved by the Government of the Russian Federation on 22 October 2005 under Resolution No. 635.[26] The stated goals of the

[25] *UK Space Agency Strategy 2011-2015,* at 16.

[26] Russia, Major provisions of the Russian Federal Space Program for 2006-2015, online:

programme were to satisfy increasing needs of the state governmental institutes, regions, and the citizens of the country, by providing space technologies and services on the basis of the following:

- Enhanced and improved effectiveness of space utilization to achieve the objectives of the Russian Federation covering economic, social, scientific, cultural and other areas as well as for the benefits of Russian security;
- Enhancement of international cooperation in space and accomplishment of the international commitments of the Russian Federation;
- Consolidation and evolution of the space potential of the Russian Federation consistent with the world development level of space technologies as well as guaranteed access and essential presence in space.[27]

The 2005 Strategy provides some insight into the stakeholders in the Russian Federal Space Program that comes under the Russian federal space agency – Roscosmos – which is referred to as "The State Customer". The "Primary Developers" are listed as the Russian Federal Space Agency (ROSCOSMOS), the Russian Ministry of Civil Defense Affairs, Emergency Situations and Natural Disaster Accident Management, the Russian Ministry of Industry and Power Engineering, the Russian Ministry of Defense, Russian Ministry of Transport, the Russian Ministry of Informational Technology and Communication, the Federal Office of Hydro-Meteorology and Environment Monitoring, the Federal Fishery Agency, the Federal Agency of Geodesy and Mapping, the Russian Academy of Sciences, Central R&D Machine-Building Institute, Federal State Unitary Entity, the Organization Agat Federal State Unitary Entity, the Keldyish R&D Center Federal State Unitary Entity and the Technomash R&D Union Federal State Unitary Entity.

The stated principal objectives of the space program in 2005 were as follows:

- Development, accomplishment, augmentation and maintenance of satellite constellation(s) to provide socio-economic benefits, science and security (communication, TV-

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Inforespacial.com <http://www.infoespacial.com/wp-content/uploads/Major-provisions-of-the-Russian-Federal-Space-Program-for-2006-2015.pdf>.

[27] See Major provisions of the Russian Federal Space Program for 2006-2015.

broadcasting, relay, Earth remote sensing, ecological monitoring, emergency management, fundamental space research, space microgravity research);
- Development, deployment and maintenance of the ISS Russian Segment (RS) elements for fundamental and applied research;
- Support of the Russian Segment of the KOSPAS-SARSAT International Search and Rescue System;
- Development of advanced launch vehicles;
- Maintenance and enhancement of the Baikonur space port;
- Sustaining development of competitive rocket and space technologies.

For the period spanning 2006 – 2015, the milestones of the program were set out in two stages as follows:

By 2010, the first stage will be devoted to the development of:

- A fixed communication and TV broadcasting space system comprising thirteen spacecraft;
- A mobile satellite communication system comprising six spacecraft;
- A weather monitoring space system comprising five spacecraft;
- An environmental monitoring space system comprising four spacecraft;
- Space facilities for fundamental space research comprising two astrophysical research observatories;
- One spacecraft for Sun and solar-earth link studies;
- One spacecraft for Mars research and delivery of Martian soil to the Earth, single small spacecraft and life-science research spacecraft;
- The Russian Segment of the KOSPAS-SARSAT International Search and Rescue System comprising two spacecraft;
- The Russian Segment of the ISS comprising five modules; and,
- A multifunctional ground facility for space data acquisition, registration and processing and an integrated Earth remote sensing satellite system based on this facility.

The second stage of Russia's space program, up to 2015, will be devoted to augmenting and maintaining the following orbital constellations:

- Fixed communication and TV broadcasting space system comprising twenty-six spacecraft;
- Multifunctional relay system comprising two spacecraft
- Mobile satellite communication system comprising twelve spacecraft;
- Weather monitoring space system comprising three 4th generation spacecraft and two 3rd spacecraft;
- Environmental monitoring space system comprising five spacecraft;
- Space facilities for fundamental space research comprising three astrophysical research observatories;
- Three spacecraft for Sun and solar-earth link studies, one spacecraft for Moon exploration, single small spacecraft and life-science research spacecraft;
- Russian Segment of the KOSPAS-SARSAT International Search and Rescue System comprising two spacecraft;
- The Russian Segment of the ISS comprising eight modules;
- Space facilities for technological purposes comprising one spacecraft and single spacecraft with reduced operational lifetime.

So far, only a very few of the objectives and milestones have been achieved and a string of failures in six consecutive launches forced a change of leadership for Roscosmos in the spring of 2011. Thus, on 26 December 2011, the Russian Prime Minister Vladimir Putin put Deputy Prime Minister Dmitry Rogozin and the Russian defence industry in charge of the Russian space program. Given that previously, Roscosmos always had direct access to the Kremlin, the announcement that Roscosmos director Vladimir Popovkin will now report directly to the Deputy Prime Minister is a reflection of the current state of the venerable but now troubled Russian space program.

Popovkin was asked to present a report on these failures to the Deputy Prime Minister by 25 January 2012. According to the ITAR-TASS News Agency, Rogozin also granted Roscosmos 50 days to prepare a "strategy of space sector development to 2030 and later". Popovkin is quoted as saying the document will include objectives for fundamental research, for use of space in the interests of the social and economic development of the country and tasks for the sphere of piloting.[28]

[28] "Roscosmos to prepare strategy to 2030 by late February", *ITAR-TASS News Agency* (29 December 2011) online: ITAR-TASS News Agency, <http://www.itar-

Although the strategy is complete, it has not been made public as of the time of this writing.

H. CHINA

The process of setting and implementing national policy objectives in China is established mainly through White Papers released by the State Council. These may then be further elaborated through major announcements and speeches by high level officials, often at international forums. The analysis in this article draws on three White Papers (2003, 2006 and 2011), information from several informed policy analysts and from seminars of the Washington-based Marshall Institute and George Washington University Space Policy Institute.

China has an indigenous launch and space-asset capability. It launched its first satellite in 1970. It has launched over 100 orbital missions since then. Most of the launches were of Chinese communications, weather, remote sensing, navigation, or scientific satellites. Some of those satellites may be for military applications or for dual use purposes. In October 2003, China became the third nation, after Russia and the US, to successfully launch humans into orbit. This is seen as paving the way for an eventual Chinese space station in low Earth orbit by 2020, a modular design similar to the earlier Russian Mir space station. China successfully placed spacecraft in the lunar orbit on 1 October 2010, and also successfully launched its second lunar probe Chang'e-2, which will lead to a lunar sample return mission possibly in 2017.

Contrary to some opinions, China has not had a firm plan for a human landing on the Moon even though studies are reportedly underway. A White Paper, published in late December 2011, mentioned a human mission to the Moon for the first time but only in the context of studies.[29] It states "China will conduct studies on the preliminary plan for a human lunar landing".

In sum, China has an impressive indigenous space capability which began, as most do, with the development of space services for remote sensing, telecommunications and broadcasting, weather

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tass.com/en/c154/308791.html>.

[29] "China's Space Activities in 2011", China Daily (30 December 2011), online: China Daily <http://www.chinadaily.com.cn/cndy/2011-12/30/content_14354558.htm>.

forecasting, natural resource management and navigation and positioning. In addition, China is developing satellites for ocean sensing and has partnered with Brazil on a constellation of small satellites for environment and disaster monitoring. China also has developed space science spacecraft and instruments. A Chinese instrument was on the Russian Phobos-Grunt spacecraft destined for Mars that failed to reach orbit in November 2011. These are supported by a family of Long March launch vehicles and state-of-the-art ground facilities.

A Chinese anti-satellite test in January 2007 that destroyed one of its own decommissioned weather satellites generated a huge amount of space debris and continues to be condemned by the international community as an irresponsible act with respect to long-term space sustainability.

China's space program was initially institutionalized under the People's Liberation Army (PLA). Through a series of government reforms in the 1990s, the China National Space Administration (CNSA) was created under the civilian Commission of Science, Technology and Industry for National Defense. The PLA continues to play a role in China's overall space activities, managing both human civilian and military space efforts, while CNSA handles robotic science projects and international cooperation. As China's space activities and intentions are not transparent particularly in view of the dual-use nature of most space technology, any effort to interpret Chinese space policy and decision-making will be fraught with uncertainty.

There is an ongoing debate and some angst among the international community on the role played by the PLA in running the Chinese space programme. Informed sources provide the following explanation: When the Standing Committee of the Politburo gave the go-ahead for the human spaceflight programme, the Party Central Committee created a new office under the Special Committee called the Human Spaceflight Project Office responsible for coordinating and implementing the programme. At the policy level, space programme decisions are made by the civilian leadership. However, the Chinese military is probably the most capable institution and thus, is best placed to provide the day-to-day management of the human spaceflight programme. Those who suggest or imply that the military (PLA) "runs" the Chinese human spaceflight program are over simplifying the respective responsibilities of the (civilian) State and the military.

Chinese efforts in outer space have been shaped by political,

bureaucratic, and technical realities. In particular, the political turmoil of the Mao era and subsequent efforts to restore stability to the Chinese economy deferred many of their objectives. The Chinese government White Paper published in December 2003[30] stated the first guiding principle for its space program as:

> Adhering to the principle of long-term, stable and sustainable development and making the development of space activities cater to and serve the state's comprehensive development strategy. The Chinese government attaches great importance to the significant role of space activities in implementing the strategy of revitalizing the country with science and education and that of sustainable development, as well as in economic construction, national security, science and technology development and social progress. The development of space activities is encouraged and supported by the government as an integral part of the state's comprehensive development strategy.

Later, in December 2006, the Chinese government White Paper on China's Space Activities stated the first guiding principle as:

> Maintaining and serving the country's overall development strategy, and meeting the needs of the state and reflecting its will. China considers the development of its space industry as a strategic way to enhance its economic, scientific, technological and national defense strength, as well as a cohesive force for the unity of the Chinese people, in order to rejuvenate China. Since the space industry is an important part of the national overall development strategy, China will maintain long-term, stable development in this field.

The Chinese government White Paper on China's Space Activities in 2011 published in December 2011 states that:

> The purposes of China's space industry are to:
> - Explore outer space and to enhance understanding of the Earth and the cosmos;
> - Utilize outer space for peaceful purposes, promote human civilization and social progress, and to benefit the whole of mankind;

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[30] China, China National Space Administration, *China's Space Activities*, online: CNSA <http://www.cnsa.gov.cn/n615709/n620681/n771967/69198.html>.

- Meet the demands of economic development, scientific and technological development, national security and social progress; and
- Improve the scientific and cultural knowledge of the Chinese people, protect China's national rights and interests, and build up its national comprehensive strength.

These guiding principles have not changed much in eight years except, perhaps the idea of the space sector contributing to China's growth which appears as part of the 2011 statement that China's space industry capacity will "protect China's national rights and interests". This might appear subtle but an analysis of the 2011 policy paper reveals a potentially troubling trend towards a space program with a more serious national security element.

The 2011 White Paper states that three new Long March launchers will be built with one being specifically a "new type of high-speed response vehicle". Such launchers are generally only required for reactive military and intelligence tasks, perhaps even anti-satellite interception. The 2011 White Paper also states that China will develop "new-generation GEO meteorological satellites, stereo mapping satellites, radar satellites … electromagnetic monitoring test satellites" and, will "make breakthroughs in key technologies for interferometric synthetic-aperture radar and gravitational field measurement satellites". With the exception of electromagnetic monitoring satellites, the remaining are perhaps necessary for environmental and disaster monitoring. However, the report also states that these satellites will also be dual-use assets. The 2011 policy document also states that "China will continue building its Beidou satellite navigation system, implementing a regional Beidou satellite navigation system before 2012 …, and aims at completing the global Beidou satellite navigation system by 2020 …".

Lewis Page has summed up his assessment of the 2011 White Paper as follows:

> Reading the world's press, you'd imagine that these latter vague aspirations [reference to China's manned and science space missions] were the main thrust of the announcements. But the truth is that – just as with the USA and Russia, and to a significant extent with Europe – China's space programme is all about increasing its security and influence here on Earth, and with very

little to do with expanding humanity's frontiers out into space.[31]

In sum it seems that China's space policy is to implement a program that:

- Serves the needs of its peoples e.g., space services;
- Nurtures a space industry to strengthen China's economy, science, technology and national defense;
- Unifies the Chinese people and inspires them, perhaps externally showcase the success of the socialist system;
- Promotes its national aspiration of being a superpower;
- Secures "a place for its mat"[32] ("a seat at the table") with international recognition as a global partner; and,
- Enhances its security and global influence.

I. JAPAN

Japan's civil space programme has undergone several structural changes during the past five decades. The most recent amendment occurred in 2003 with the merger of the former Institute of Space and Astronautical Science, the National Aerospace Laboratory and the National Space Development Agency (the former civil space agency) into the Japan Aerospace Exploration Agency (JAXA). The Ministry of Land, Infrastructure, Transport and Tourism is responsible for policy and planning implementation while the Ministry of Education, Culture, Sports, Science and Education (MEXT) is in charge of the Japanese space budget. Japan's Maritime Self-Defense Force (SDF) and the Japanese Defense Agency (now Ministry of Defense) have maintained cooperation with JAXA, with two of JAXA's first astronauts serving as SDF officials. However, the utilization of space for national security purposes has been severely restricted to quasi-commercial space assets through the 1969 Diet Resolution Concerning the Peaceful Utilization of Space.

The management structure of the Japanese space programme, along with policy formulation and Japan's definition of what constitutes peaceful use of space underwent a significant change with the enactment of the Japan Basic Space Law in August 2008 and the Basic Plan for Space Policy released in June 2009.

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[31] Lewis Page, "New Chinese space plans are all about security and strategy on Earth", The Register (30th December 2011), online: The Register <http://www.theregister.co.uk/2011/12/30/chinese_space_white_paper/print.html>.

[32] G. Kulacki and J. Lewis, "A Place for One's Mat: China's Space Program, 1956-2003, American Academy of Arts & Sciences 2009.

The Basic Space Law[33] established a Strategic Headquarters for Space Policy. This is Japanese terminology for a new and higher level space governance structure. The administration of the Democratic Party of Japan elevated the importance of the Strategic Headquarters for Space Policy by announcing that its' Chair would be the Prime Minister with Acting Chairs being the Chief Cabinet Secretary and the Minister of Space Development. The Basic Space Law also provides that space will be used for the purpose of "improving and reinforcement of information gathering functions and enhancement of warning and surveillance activities in light of the international situation, especially the circumstances in North East Asia". This is indicative of a major shift in Japanese policy by eradicating the long-standing restrictions on the involvement of the Ministry of Defence in space activities.

The Basic Plan for Space Policy that was released by the Strategic Headquarters for Space Policy in June 2009 is a five-year plan with a ten-year horizon. The Plan articulates the following "Six Basic Pillars for Japan's use and R&D of space":

1. Ensure a rich, secure and safe life:
- Improve the national space-based infrastructure for more effective weather forecasting, telecommunications, food and energy management, positioning and navigation services etc.
2. Contribute to enhancement of security:
- Strengthen the national information gathering capability.
3. Promote the utilization of space for diplomacy;
- Provide access to satellite imagery to Asian neighbors for disaster prediction and management, climate change research and other global environmental concerns.
4. Create an energetic future by promoting R&D of the forefront areas:
- Build on Japan's space science successes and world-class expertise such as Moon and asteroid science missions, human space activity (ISS) and a space solar power program.
5. Foster strategic industries for the 21st century:
- "The Government will place the space industry among strategic industries in the 21st century and enhance

[33] Japan, *Basic Plan for Space Policy*, Strategic Headquarters for Space Policy, online: Kantei <http://www.kantei.go.jp/jp/singi/utyuu/basic_plan.pdf>.

competitiveness by promoting space machinery smaller, serialized, communized and standardized"; and

6. Consider the environment:

- "The Government will take measures considering the global and space environment, such as [the] space debris issue".

The Plan commits Japan to developing the following four systems for utilization:

- Land and ocean observing satellites
- Global environmental change and weather observing satellite system
- Advanced telecommunications satellite system
- Satellite system for national security

And to four R&D programs:

- Space science
- Human space activity
- Space solar power
- Small demonstration satellite

J. INDIA

For almost five decades, the Indian space program has been driven by the vision of Dr. Vikram Sarabhai, considered the father of the Indian space programme, who stated in part: "If we are to play a meaningful role nationally, and in the community of nations, we must be second to none in the application of advanced technologies to the real problems of man and society".[34] In this, and other respects, India has been particularly successful. As India looks toward celebrating fifty years as a space faring nation, its programme has expanded beyond its historic focus on space applications towards ever more sophisticated science missions and even the possibility of entering the human spaceflight arena.

India does not have a consolidated national space policy and, according to the Government of India website, its most recent science and technology policy was issued in 2003. Indian academicians and other experts have called for the formulation of a national space policy.

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[34] India, Indian Space Research Organization, *About ISRO,* online: ISRO, <http://www.isro.org/scripts/Aboutus.aspx>.

Today, India's primarily civil space programme is administered by the Department of Space (DoS), which was established in June 1972. The Indian Space Research Organization (ISRO), the Indian national space agency, is the primary research and development arm of the DoS, and other agencies of the DoS include the Physical Research Laboratory (PRL), the National Atmospheric Research Laboratory (NARL), the North Eastern Space Applications Centre (NE-SAC) and the Semi-Conductor Laboratory (SCL). The Indian Space programme under the DoS aims to promote the development and application of space science and technology for the socio-economic benefit of the country. Between 2003 and 2010, India's space budget increased from 473 million dollars to 1.25 billion dollars annually, and is expected to increase by an average of 14.8% annually by 2014. Currently, India is ranked sixth among space faring nations after the US, Europe, Russia, China and Japan.

India leads the world in "bringing space to the people". It has established programs that bring Earth observation data to the rural villages of India to aid in crop production. ISRO has also set up an enviable network for tele-education and tele-medicine services throughout India. ISRO has successfully created capability for national communication, television broadcasting and meteorological services and an Indian Remote Sensing Satellites (IRS) system for resources monitoring and management. The Antrix Corporation, the commercial arm of ISRO, sells remote sensing imagery as well as satellites and launch services.

From the beginning, India was keen on developing its own launch capability so that its space programme could operate autonomously. The launch programme began with sounding rockets, and the second launch of India's Space Launch Vehicle (SLV-3), a four-stage vehicle, in 1980 led to the development of a five-stage Augmented Satellite Launch Vehicle capable of placing a 150kg satellite into Low Earth Orbit. This was later followed by the highly successful Polar Satellite Launch Vehicle (PSLV). Although the PSLV is designed to place Indian Remote Sensing Satellites into sun-synchronous orbit, it has also placed payloads into geostationary orbit. To date, the PSLV has placed 25 Indian and 27 foreign satellites into orbit on a commercial basis. However, the Geo Synchronous Satellite Launch Vehicle (GSLV-2) has been less successful, and India is now placing its hope on a GSLV-3 which is expected to have its maiden launch in early 2013. Success with the GSLV-3 will enable India to launch its own communications satellites that are currently launched commercially by an Ariane-5. The GSLV-3 will also enable India to pursue its lunar science mission programme.

With the help of Indian government backing, ISRO announced in August 2007 that it intended to develop a human spaceflight program. However, after a change of leadership at ISRO, the programme has languished or in the words of its previous chief, "the new management is not doing enough to push it with the government and get its approval". The programme was started with the development and launch of the Space Capsule Recovery Experiment in January 2007.

Due to a strong interest within the Indian scientific community, ISRO has begun implementing dedicated science missions. In October 2008, India joined the ranks of China and Japan by launching Chandrayaan-1, the first in a series of lunar orbiters. Chandrayaan-1 is a complex spacecraft with 11 instruments including instruments from Europe (ESA), US (NASA) and Bulgaria. The mission, designed to measure the chemical and mineralogical properties of the Moon, particularly the southern pole, enjoyed a huge success, and was instrumental in the discovery of water on the Moon. ISRO has plans for a dedicated astronomy mission (Astrosat), a solar mission (Aditya-1) and a second Chandrayaan mission to the Moon in 2013. However, the timing for Chandrayaan-2 is somewhat dependant on the successful development of GSLV-3 or a decision to procure the launch. In the future, ISRO plans to undertake a dedicated space science mission every three to five years.

During a Space Science and Security Conference held in New Delhi in January 2011, it was highlighted that although India had only a civilian space program, the inherent dual use nature of satellite technology could be adapted for military purposes as well. Indeed, the dependence of the Indian armed forces on space technology is an undisputed fact. However, no specific information in this regard is available to quantify it precisely. Indian analysts are of the opinion that presently, this use is limited to areas like communication and navigation, but in the future, the dependence is likely to increase for surveillance and even for counter-space capabilities. For now, India has already established a "Space Cell" under the command of the Integrated Defence Services Headquarters. This is a single tri-service window for interaction in space by all agencies, including external ones. It also acts as a single organization for integration among the armed forces, the DoS and ISRO.

IV. SELECTED EMERGING SPACE FARING NATIONS

A. AUSTRALIA

Australia is perhaps best known for its telescopes and tracking stations and its attempts at establishing a commercial space port. Despite efforts, mostly from universities and industry, it has however not yet developed an indigenous space capability. In July 2009, the Australian Government established a Space Policy Unit within the Department of Innovation, Industry, Science and Research. The unit reports to the Minister and has the mandate to coordinate Australia's national and international civil space activities; a task which was previously undertaken by the Commonwealth Scientific and Industrial Research Organization (CSIRO).

The Space Policy Unit was tasked with developing a National Space Industry Policy for Australia to cover both civil and defence matters. The Space Policy Unit chairs the Australian Government Space Forum that facilitates the sharing of space matters between agencies and departments. It has also established a Space Industry Innovation Council, which examines Australia's current space activities, risks and strategic priorities with a focus on Earth observation, satellite communications and navigation. Additionally, the Unit has been administering a modest, 40 million dollars for the period 2009-2012 towards competitive Australian Space Research Grants Program open to industry, universities, secondary schools, researchers and international organizations.

In September 2011, the Minister for Innovation, Industry, Science and Research released the Principles for a National Space Industry Policy.[35] Though the timeline for completion is unclear, it is noteworthy that the foreword to the document acknowledges that Australia will continue "to rely to a substantial degree on international support for critical national security and civilian functions enabled by space systems" and that "Australia will continue to accept a substantial degree of dependence on global supply chains for space system capability". However, the policy will also "identify priorities to develop Australia's

[35] Australia, Principles for a National Space Industry Policy, online: Australian Government Space Portal <http://www.space.gov.au/SpacePolicyUnit/Documents/Principles%20for%20a%20National%20Space%20Industry%20Policy.pdf>.

nascent and growing capabilities" in space services, research, innovations and skills development.

The following seven principles will govern the Australian National Space Industry Policy:

1. Focus on space applications of national significance
- Earth Observation, Satellite Communications, Position Navigation and Timing
2. Assured access to space capability
- Leverage Australian ground stations, spectrum allocation, etc. for access to international systems
3. Strengthen and increase international cooperation
- Prioritize partnerships with the US, UK, Canada, New Zealand, Japan and the EU
4. Contribute to a stable space environment
- Support SSA initiatives, EU's proposal for an international Code of Conduct and regulatory frameworks
5. Improve domestic coordination
- Develop a "whole-of-government" approach to space systems, capabilities and issues
6. Support innovation, science and skills development
- Promote collaboration between Australian public and private research and development organizations with industry in space-related activity, including space science, research and innovation in niche areas of excellence or national significance
7. National security and economic well-being
- Protect national security through domestic and international means, improve the space capabilities of the Australian Defence Organisation, develop government-business partnerships to advance space research and indigenous space capabilities and explore the development of new space-borne capabilities, especially for natural disasters, energy and resource security and improving response to traditional security challenges.

B. REPUBLIC OF KOREA (SOUTH KOREA)

South Korea is developing an impressive space capability and has instituted a reliable space governance structure with a comprehensive set of laws to govern the program.

The Korean Aerospace Research Institute (KARI) was created in 1989 entrusted with responsibility for Korea's government space and aeronautical development activities. KARI is placed under the Ministry for Science and Technology (MOST). The Minister of MOST Chairs a National Space Committee that reports to the Office of the President of Korea.

The Korean space law framework comprises the following three statutes:

- Aerospace Industry Development Promotion Act of 1987:
- Space Development Promotion Act of 2005: and,
- Space Damage Compensation Act of 2007.

The Space Development Promotion Act[36] requires the National Space Committee through KARI to develop both long term plans (twenty year horizon) and medium term plans (five years). The Korean space vision is "to promote the peaceful use and scientific exploration of outer space, and to boost the national economy",[37] and its goals are to:

- Contribute to a prosperous world,
- Raise the national standard of living through space applications, and
- Promote international cooperation.

Korea has developed an indigenous space launch capability and satellites for remote sensing, weather, ocean monitoring and communications. It has deployed thirteen satellites so far. In April 2008, Yi Soyean became Korea's first astronaut on an eight-day mission to the ISS, which was commercially procured by the Korean government from Russia. She performed eighteen experiments during her mission, five of which were for elementary and high school students. She is referred to as 'Korea's Space Ambassador', and she confided with the author, during the 2008 International Astronautical Congress, that the primary political motivation for her mission was to encourage the Korean youth in science.

KARI is very active in international fora such as the Asia-Pacific Regional Space Agency Forum (APRSAF), UNCOPUOS, International

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[36] UNOOSA, *National Space Law: Korea,* online: UNOOSA <http://www.oosa.unvienna.org/oosa/en/SpaceLaw/national/republic_of_korea/space_development_promotions_actE.html>.

[37] *Space Development Promotion Act*, art. 1.

Space Exploration Coordination Group (ISECG) and the International Astronautical Federation (it hosted the International Astronautical Congress in 2009).

C. SOUTH AFRICA

Although South Africa has a long history in space, beginning with the establishment of the first southern hemisphere astronomical observatory in 1820, the South African National Space Agency (SANSA) was only recently formed in 2010. Along with Australia, it was one of the bidders to host the massive Square Kilometer Array radio telescope. South Africa remains a major partner in the Group on Earth Observations (GEO).

SANSA is mandated by the SANSA Act,[36] of 2008, to "promote the peaceful use of space, foster international cooperation in space-related activities and create an environment conducive to industrial development in space technology through research, human capital development, outreach programmes and infrastructure development".[38] SANSA's stated "value proposition" is to create:

- Societal capital - world-class and efficient services and societal benefits,
- Intellectual capital - cutting-edge research, development, innovation, technology and its applications,
- Human capital - effective human capital development and citizenry engagement
- Economic capital - globally competitive space industry and space applications
- Global capital - South Africa as a recognized global space citizen.

SANSA is merging the existing national capacity into six thematic focus areas (paraphrased):

1. Earth Observation - collecting, processing and distributing Earth observation data to support South Africa's policy-making, decision-making, planning, disaster management, resource and environmental management, economic growth and sustainable development initiatives.

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[38] South Africa, South African National Space Agency, *About Us- Mandate and Objectives,* online: SANSA <http://www.sansa.org.za/mandate-and-objectives.aspx>.

2. Space Operations - ground station facilities and services, including satellite tracking, telemetry and command.
3. Space Science - developing human capital and advancing science
4. Space Engineering - technical development of space systems and sub-systems
5. Space Advancement and Public Engagement – fostering appreciation of science among South African youth and engagement of the general public
6. Human Capital Development - training South Africans and contributing to transforming the country into a knowledge-based economy.

At the International Astronautical Congress held in Cape Town in October 2011, the head of SANSA identified the challenges encountered by the agency and listed them as:

- Capacity building,
- Indigenous design, manufacturing and operations,
- Explaining the benefits of space activities to politicians,
- Balancing near-term priorities with longer-term returns.[39]

He also pointed out that international Earth observation data policies were too restrictive for countries such as South Africa, which are barred from sharing Earth observation data products with their less capable neighbours due to the current licensing agreements that do not allow such cross-border support.

Recent cooperation agreements on space activities have allowed emerging spacefaring nations from Africa to reap social and economic benefits from space applications. In 2009, after years of discussion, Nigeria, Algeria, South Africa, and Kenya signed a regional cooperation agreement for an African Resources Management Satellite (ARMS) Constellation. Following the creation of SANSA in 2010, an interagency agreement with the Algerian Space Agency to cooperate in space science and technology was signed. In the same year, African nations requested that the African Union commission a study to examine the feasibility for the establishment of an African Space Agency and the development of a unified African space policy, in cooperation with the regional economic

[39] Comments by Sandile Malinga, Chief Executive Officer, South African National Space Agency during Plenary Event 9: South African and African Space Activities, International Astronautical Congress, Cape Town, South Africa, October 2011

communities, the UN Economic Commission for Africa, and the International Telecommunication Union.

V. MULTINATIONAL ORGANIZATIONS AND INITIATIVES

After reviewing the space policies of both major and emerging space faring nations, it is useful to turn our attention to the organizational framework of multinational organizations and initiatives involved in space activities. The policy and legal documents that originate from these organizations greatly influence the space policies and laws of spacefaring nations.

A. UN COMMITTEE ON THE PEACEFUL USES OF OUTER SPACE

The Committee on the Peaceful Uses of Outer Space (COPUOS) was set up by the General Assembly in 1959 to review the scope of international cooperation in peaceful uses of outer space, to devise programmes in this field to be undertaken under the auspices of the United Nations, to encourage continued research and the dissemination of information on outer space matters, and to study legal problems arising from the exploration of outer space. Currently, there are seventy Member States in the Committee.

The Committee has two standing Subcommittees – the Scientific and Technical Subcommittee and the Legal Subcommittee, and is supported by the full-time staff of the UN Office for Outer Space Affairs (OOSA). In addition to being the Secretariat for COPOUS, the Office has a Space Applications Section, which organizes and carries out the United Nations Programme on Space Applications responsible for capacity building in developing countries.

The UNCOPOUS is the main international forum for the development of international space law. Since its inception, the Committee has concluded five international legal instruments and five sets of legal principles governing space-related activities. The five treaties and agreements are:

- The Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (the "Outer Space Treaty"),

which entered into force on 10 October 1967;

- The Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space (the "Rescue Agreement"), which entered into force on 3 December 1968;
- The Convention on International Liability for Damage Caused by Space Objects (the "Liability Convention"), which entered into force on 1 September 1972;
- The Convention on Registration of Objects Launched into Outer Space (the "Registration Convention"), which entered into force on 15 September 1976;
- The Agreement Governing the Activities of States on the Moon and Other Celestial Bodies (the "Moon Agreement"), which entered into force on 11 July 1984.

The international legal principles in these five treaties provide for the non-appropriation of outer space, arms control, freedom of exploration, liability for damage caused by space objects, safety and rescue of spacecraft and astronauts, prevention of harmful interference with space activities and the environment, the notification and registration of space activities, scientific investigation and the exploitation of natural resources in outer space and the settlement of disputes.

The five sets of legal principles adopted by the United Nations General Assembly provide for the application of international law and promotion of international cooperation and understanding in space activities, the dissemination and exchange of information through transnational direct television broadcasting via satellites and remote satellite observations of Earth and general standards regulating the safe use of nuclear power sources necessary for the exploration and use of outer space.

The five declarations and legal principles are:

- The Declaration of Legal Principles Governing the Activities of States in the Exploration and Uses of Outer Space, 13 December 1963;
- The Principles Governing the Use by States of Artificial Earth Satellites for International Direct Television Broadcasting ,10 December 1982;
- The Principles Relating to Remote Sensing of the Earth from Outer Space, 3 December 1986;

- The Principles Relevant to the Use of Nuclear Power Sources in Outer Space, 14 December 1992;
- The Declaration on International Cooperation in the Exploration and Use of Outer Space for the Benefit and in the Interest of All States, Taking into Particular Account the Needs of Developing Countries, 13 December 1996.

B. ORGANIZATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT (OECD)

The Organization for Economic Co-operation and Development (OECD) is included in this article since at least one of its initiatives will have an influence on space policy discussions worldwide.

The OECD launched the 'Space Forum' in 2006 in cooperation with the space community. The Forum, hosted by the International Futures Programme (IFP), has as part of its mission to explore emerging sectors, to assist governments, space-related agencies and the private sector to better identify the statistical contours of the growing space sector worldwide, while investigating the economic importance and potential impacts of space infrastructure for the larger economy. The Forum includes organizations from Canada, France, Italy, Norway, UK, US, as well as the ESA. The Forum builds on the recommendations presented in the following OECD publications:

- Space Technologies and Food Security (2011): Second OECD publication on the value chains and socio-economic contributions derived from the use of innovative space applications such as, monitoring crops from space;
- The Space Economy at a Glance (2011): An updated, more comprehensive version of the 2007 publication. It provides a statistical overview of the global space sector and its contributions to economic activity.
- Space Technologies and Climate Change: Prospects and Implications for Water Management, Marine Resources and Maritime Transport (2008): OECD publication which provides findings on the socio-economic contributions that may be derived from the use of space applications, with an extensive review of existing assessing methodologies.
- Space 2030: Tackling Society's Challenges (2005): It documents results from consultation with more than a hundred public and private actors in the international space community.

C. GROUP ON EARTH OBSERVATIONS

The Group on Earth Observations is coordinating efforts to build a Global Earth Observation System of Systems.

The Group on Earth Observations (GEO) was launched in response to calls for action by the 2002 World Summit on Sustainable Development and by the Group of Eight leading industrialized countries. These high-level meetings recognized that international collaboration is essential for exploiting the growing potential of Earth observation to support decision making in an increasingly complex and environmentally stressed world. GEO is governed by a Plenary consisting of all members and participating organizations, though the latter do not have voting rights. It meets in plenary at least once a year at the level of senior officials and periodically at the ministerial level.

GEO is thus a voluntary partnership of governments and international organizations. It provides a framework within which these partners can develop new projects and coordinate their strategies and investments. As of September 2011, GEO's members included eighty-seven governments and the European Commission. In addition, sixty-four intergovernmental, international, and regional organizations with a mandate in Earth observation or related issues have been recognized as Participating Organizations.

The First Earth Observation Summit, at the Ministerial Level, convened in Washington, DC, in July 2003 adopted a Declaration establishing the ad hoc intergovernmental Group on Earth Observations and charged it to draft a GEOSS 10-Year Implementation Plan. The Third Earth Observation Summit, held in Brussels in February 2005, endorsed the GEOSS 10-Year Implementation Plan and established the permanent intergovernmental Group on Earth Observations (GEO) to carry it out.

The GEOSS 10 Year Implementation Plan defines a vision statement for GEOSS, its purpose and scope, expected benefits, and nine "Societal Benefit Areas" of disasters, health, energy, climate, water, weather, ecosystems, agriculture and biodiversity. The broad range of societal benefits GEOSS will yield are notably:

- Reducing loss of life and property from natural and human-induced disasters;
- Understanding environmental factors affecting human

health and well-being,
- Improving the management of energy resources;
- Understanding, assessing, predicting, mitigating, and adapting to climate variability and change;
- Improving water resource management through better understanding of the water cycle;
- Improving weather information, forecasting and warning;
- Improving the management and protection of terrestrial, coastal and marine ecosystems;
- Supporting sustainable agriculture and combating desertification, and;
- Understanding, monitoring and conserving biodiversity.

The 10-Year Implementation Plan states that "*The societal benefits of Earth observations cannot be achieved without data sharing*" and sets out the following GEOSS Data Sharing Principles:

- There will be full and open exchange of data, metadata and products shared within GEOSS, recognizing relevant international instruments and national policies and legislation;
- All shared data, metadata and products will be made available with minimum time delay and at minimum cost;
- All shared data, metadata and products being free of charge or no more than cost of reproduction will be encouraged for research and education.

The GEO VI Plenary held in Washington DC in December 2009 accepted Implementation Guidelines for the GEOSS Data Sharing Principles. A GEO Data Sharing Task Force has been established to reach a consensus among GEO members of the formal adoption and implementation of the Data Sharing principles.

The high-level guidelines are as follows:[40]

1. For GEOSS to realize its vision and potential, it is essential to promote the full and open exchange of data, metadata and products in accordance with the data sharing principles.

[40] Group on Earth Observations, Implementation Guidelines for the GEOSS Data Sharing Principles Document 7(Rev2), GEO-VI, 17-18 November 2009 online: GEO <http://www.earthobservations.org/documents/geo_vi/07_Implementation%20Guidelines%20for%20the%20GEOSS%20Data%20Sharing%20Principles%20Rev2.pdf>.

2. The full and open exchange of data called for in the data sharing principles should apply to GEOSS data, metadata and products even after such shared information is disseminated to users. Users need to be able to integrate, reuse, and re-disseminate the shared information with minimal restrictions in order to achieve maximum results in the GEOSS societal benefit areas
3. Many GEO members and participating organizations have various specific restrictions on the dissemination and use of certain data, metadata and products based on international instruments and national policies and legislation. Such restrictions pertain mainly to concerns regarding protection of: national security, financial viability, proprietary interests, privacy, confidentiality, indigenous rights, and conservation of sensitive ecological, natural, archaeological, or cultural resources.
4. The pricing of GEOSS data, metadata, and products should be based on the premise that the data and information within GEOSS is a public good for public-interest use in the nine societal benefit areas. GEO, together with its GEOSS data providers, should work to set standards for the full and open exchange of data based on this premise, with the only allowable cost being either that of reproduction and distribution, or the marginal cost of fulfilling the user request.
5. GEO should promote "minimal time delay" to data within GEOSS, depending on the type of data and application and the need for appropriate quality control, and data should be transmitted on a real-time basis whenever necessary or practicable.
6. GEO should clarify the definitions of "research" and "education".

From a policy perspective the adoption by GEO of the Implementation Guidelines for the GEOSS Data Sharing Principles is a major achievement. However, their full implementation presents a challenge.

D. INTERNATIONAL SPACE EXPLORATION COORDINATION GROUP

In 2006, fourteen space agencies came together to begin a series of discussions on global interests in space exploration. They took the

unprecedented step of elaborating a vision for peaceful robotic and human space exploration, focusing on destinations with the potential to sustain human habitation within the Solar System, and developed a common set of key space exploration themes. This vision was articulated in 'The Global Exploration Strategy: The Framework for Coordination,' released in May 2007.[41]

A key finding of this framework document was the need to establish a voluntary, non-binding international coordination mechanism, namely the International Space Exploration Coordination Group (ISECG), through which individual agencies may exchange information regarding interests, objectives, and plans in space exploration with the goal of strengthening both individual exploration programs as well as the collective effort.

The ISECG is important from a policy perspective because it is product-oriented. Its products such as exploration architectures and supporting documents reflect a consensus among the world's space agencies. For example, ISECG spent almost a year developing and reaching consensus on a Reference Architecture for Human Lunar Exploration, which was released in July 2010.[42] This ISECG architecture was developed in response to plans announced by NASA following the announcement by President Bush of a US Vision for Space Exploration for permanent human presence on the Moon in January 2004. The initial NASA architecture focused on a single lunar base but as a result of the growing ISECG consensus, NASA revised its plans to reflect a more distributed lunar surface architecture.

When President Obama cancelled the US program to return to the Moon, ISECG began the development of a Global Exploration Roadmap containing a more accurately reflected global viewpoint for human space exploration. The first version of the Global Exploration Roadmap was issued in September 2011[43]. It is now being used by space agencies to better formulate their plans and to identify areas for cooperation.

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[41] The Global Exploration Strategy: The Framework for Coordination, online: ISECG, http://www.globalspaceexploration.org/documents

[42] , The ISECG Reference Architecture for Human Lunar Exploration, ISECG , July 2010, online: ISECG http://www.globalspaceexploration.org/documents .

[43] The ISECG Global Exploration Roadmap, ISECG, September 2011, online ISECG http://www.globalspaceexploration.org/documents

E. SPACE SECURITY INDEX

The Space Security Index (SSI) is included in this Article since it contributes to the international space policy debate.

The SSI is an annual report on trends and developments related to security and outer space covering the previous calendar year. The goal of the SSI is to improve transparency with respect to space activities and provide a common, comprehensive knowledge base to support the development of national and international policies that contribute to space security. The trends and developments are assessed according to nine indicators that are organized under three themes:

1. The condition of the operating environment
- The space environment
- Space situational awareness
- Space laws, policies, and doctrines
2. The type of actors in space and how space is used
- Civil space programs and global utilities
- Commercial space
- Space support for terrestrial military operations
3. The status of space-related technology as it pertains to protecting or interfering with space systems, or harming Earth from space
- Space systems protection
- Space systems negation
- Space-based strike capabilities.

Each of the nine indicators is examined in a separate chapter that provides a description of the indicator and its overall impact on space security. A discussion of the prevailing trends associated with that indicator is followed by an overview of key developments throughout the year, and an assessment of their short-term effects on established trends and the broader security of outer space.

The report is managed and published by the Canadian Foundation Project Ploughshares Inc., with support and funding from US-based Secure World Foundation, The Simons Foundation, the International Security Research and Outreach Programme at Foreign Affairs and International Trade Canada, and the Institute of Air and Space Law at McGill University.

Space Security 2011[44] is the eighth annual report on trends and developments related to security in outer space, for calendar year 2010. The trends under each indicator (eight for SSI 2011) from the Executive Summary are reproduced below.

1. THE SPACE ENVIRONMENT
- Amount of orbital debris continues to increase, particularly in Low Earth Orbit (LEO),
- Increasing awareness of space debris threats and continued efforts to develop and implement international measures to tackle the problem,
- Growing demand for radio frequency (RF) spectrum and communications bandwidth,
- Increased recognition of the threat from Near-Earth Object (NEO) collisions and progress toward possible solutions.

2. SPACE SITUATIONAL AWARENESS
- U.S. space situational awareness (SSA) capabilities slowly Improving,
- Global SSA capabilities slowly improving,
- International SSA data sharing and cooperation efforts between space actors continue to increase.

3. LAWS, POLICIES, AND DOCTRINES
- Gradual development of normative framework for outer space activities,
- UN Committee on the Peaceful Uses of Outer Space (COPUOS) remains active as a forum for space governance, while CD deadlock persists,
- Formalized African cooperation in space increases,
- National space policies continue to focus on the security uses of outer space, with increased concentration on developing national space industries.

4. CIVIL SPACE PROGRAMS
- Growth in the number of actors accessing space,
- Civil space programs continue to prioritize scientific missions and exploration,
- Steady growth in international cooperation in civil space programs,
- Continued growth in global utilities as states seek to expand

[44] Space Security Index, online: SSI <http://www.spacesecurity.org>.

applications and accessibility.

5. COMMERCIAL SPACE

- The global commercial space industry continues to experience overall growth, but seeks creative solutions to offset probable future downturn,
- Commercial sector supporting increased access to space products and services,
- Continued government dependency on the commercial space sector develops interactions between public and private sectors,
- Commercial space operators gradually embrace cyberspace capabilities.

6. SPACE SUPPORT FOR TERRESTRIAL MILITARY OPERATIONS

- The U.S. and Russia continue to lead in deploying military space systems,
- China and India afford increasing roles to space-based military support,
- More states are developing military and multiuse space capabilities.

7. SPACE SYSTEMS RESILIENCY

- Efforts to protect satellite communications links increase, but ground stations remain vulnerable,
- Protection of satellites against direct attacks limited but improving,
- Efforts under way to develop capacity to rapidly rebuild space systems following direct attacks, but operational capabilities remain limited.

8. SPACE SYSTEMS NEGATION

- Increasing capabilities to attack space communications links,
- Ongoing proliferation of ground-based capabilities to attack satellites,
- Increased access to space-based negation-enabling capabilities.