IAC-09.3.4.1

REPORT ON THE STATUS OF PROGRESS TOWARD THE LONG-TERM SUSTAINABILITY OF SPACE ACTIVITIES

Dr. Ray A. Williamson
Secure World Foundation, United States
rwilliamson@swfound.org

Dr. Kazuto Suzuki
Hokkaido University, Japan
kazutos@juris.hokudai.ac.jp

Mr. Nicolas Peter
European Space Policy Institute (ESPI), Austria
nicolas.peter@espi.or.at

Mr. Brian Weeden
Secure World Foundation, Canada
bweeden@swfound.org

Mr. Ben Baseley-Walker
Secure World Foundation, United States
bbw@swfound.org

Ms. Agnieszka Lukaszczyk
Secure World Foundation, Austria
alukaszczyk@swfound.org

ABSTRACT

As space activities continue to play an ever growing role in international interactions, States have begun to recognize the need to ensure their long-term sustainability. For this to happen, the essentials of space sustainability issues for established and emerging space players must be well understood. Raising the profile of space sustainability issues in the international community and at the national level is crucial to achieving the long-term sustainability of space activities and ensuring the continued maintenance of the Earthly benefits these activities provide.

Space sustainability of the global commons of outer space is a fundamentally international question with profound national implications. Consequently, a few members of the International Astronautical Federation Space Security Committee have begun an exercise to assess the current state of efforts to maintain space sustainability. They have also identified several key technical, organizational, and political challenges to achieving the long-term sustainability of outer space activities.

This paper summarizes those efforts and lays the groundwork for future assessments of progress along these lines. It is not meant to supplement the much more comprehensive treatment of space security by the Space Security Index (SSI). [1] On the contrary, it is intended to provide material for leading into the next SSI yearly assessment.

I. INTRODUCTION

Since the beginning of the Space Age, outer space has belonged to no State, and is therefore open to exploitation by any State. It is a global commons with relatively little governance beyond the four UN treaties and the regulations of the International Telecommunication Union. States and their citizens have been free to launch payloads into orbit with only relatively little coordination and minimal regulation. Yet recently, both the public and private sectors have come to realize that space activities must be subject to greater caution and care than seemed necessary just a few years ago. This realization has led to several initiatives to improve the governance of Earth orbital space, which are discussed below. These initiatives, if successful, will in time contribute to the responsible and fair use of outer space by all spacefaring States.

Over the past decade, the world has seen a sharp increase of spacefaring States—those who own and operate their own satellite—from 27 to 37. This number is expected to increase steadily in the future. Further, the number of States capable of launching their own spacecraft into orbit has increased to a total of eight. In February 2009, for example, Iran became the latest entrant to the launch-capable club of States by launching a small experimental satellite on an indigenous launcher.[2] South Korea tried and failed to place its STSAT 2 into orbit in August 2009 during its first launch attempt[3]; however, this effort did demonstrate that South Korea would not be far behind in successfully reaching orbit. Increasing numbers of spacecraft in Earth orbit means that some orbits, specifically the geosynchronous orbits (GSO) that are ideal for communications, and the sun synchronous orbits (SSO) favored for Earth observing satellites, are becoming increasingly crowded, which heightens the probability of accidental spacecraft-spacecraft collisions.

Yet the most likely collision possibilities are between working satellites and space debris. The U.S. Space Track Catalog contains some 15,000 orbital objects greater than 10 cm in size, of which about 960 are working satellites [4]. The remainder is space junk. The U.S. Air Force tracks an additional 6,000 or so orbital objects that do not appear in the catalog because their launching State cannot be identified or their orbits cannot be maintained over the long term. Above about 600 km, the near vacuum surrounding Earth doesn't clean itself very quickly. Junk left in orbit, whether from launch or on-orbit operations, may take years to 'wash out' and burn up in the atmosphere. Objects in very high altitudes remain in orbit for centuries, continuing to threaten working satellites. Worse yet, these objects move around over time, perturbed by pressure from the sun and gravitational forces, thus requiring constant vigilance. The world received a "wake-up call" about the threat of orbital debris on Feb. 10, 2009, when a low Earth orbit (LEO) commercially-operated Iridium communications satellite unexpectedly collided with a non-functional Russian Cosmos communications satellite, leaving two substantial debris clouds to threaten other satellites.[5] Extensive media coverage of this incident has led to heightened awareness among the general public, and the professional space community, of the need for greater governance of outer space.

This paper examines several ongoing efforts to tackle the important task of achieving the long-term sustainability of outer space and will provide a progress report on those efforts.

II. CURRENT INITIATIVES

A. SPACE SITUATIONAL AWARENESS

The foundation for long-term space sustainability is knowledge about the problem: what is in Earth orbit and how it affects our activities. Space situational awareness (SSA) provides this knowledge and has been an important part of military space activities for many years, particularly in the United States and Russia. Yet like many other space applications, such as global positioning data and satellite communications, there is also a growing need for SSA for civil, commercial and safety applications that is currently not being met by military SSA efforts.

The fundamental differences between civil SSA and military SSA are in the types of information that it provides. Civil SSA only needs to focus on the location of an object in Earth orbit and to maintain a point of contact for that object, along with environmental information about space weather. The additional military requirements of determining function, intent, and capabilities and limitations are unnecessary for civil safety applications.

Today, many of the satellites in Earth orbit operate in an environment of highly limited information. The owner or operator of a particular satellite usually has excellent knowledge about the position of that satellite in space, but little to no information about the locations of other objects around them. This

situation was the root cause behind the collision of the Iridium and Cosmos satellites in February: the owner of the Iridium satellite, which could have potentially maneuvered it out of the way, did not know about the impending close approach. This collision produced over one thousand pieces of trackable debris, much of it in the region where the remaining 64 Iridium satellites operate.

SSA is also crucial for the safety of human space flight. On March 12, 2009, the crew of the International Space Station (ISS) was forced to prepare for emergency shelter inside the Soyuz spacecraft in response to an unexpectedly close approach by a piece of debris from the 1993 US launch of a Global Positioning System (GPS) satellite. This was followed a few days later by another close approach by a piece of debris from an expired Russian satellite on March 16. On March 22, the docked Space Shuttle Orbiter and ISS were forced to change orbit to avoid an extremely close piece from a Chinese rocket booster launched in 1999. These close approaches have been occurring with greater frequency over the last few years.

The continual increase in the number of actors in space heightens this problem. Unfortunately, most space actors do not have the resources or capacity to provide the SSA information necessary to make safe and secure decisions regarding activities in space. The few States that do have the resources to provide this information are often limited by national security or military restrictions from sharing it with other space actors.

Accurate tracking of all objects in Earth orbit from the ground requires a geographically distributed network of both radar and optical telescopes. Such a network is very expensive to create and maintain. The United States military currently has the world's best SSA network, but it still has significant limitations as a result of the lack of coverage in areas where the United States does not have a presence. Additionally, from an organizational perspective, this network does not currently have the financial resources, capacity or requirement to provide the necessary SSA data and resources for civil and commercial purposes globally. Upgrades to this network are planned and underway by the US military but are subject to fiscal constraints that may cause delays or reductions in desired capabilities.

The United States is not alone in its capacity to provide SSA data. Many other States possess a limited SSA capability, usually not more than a few radars or optical telescopes. Taken separately, these sensors only provide spot coverage and very limited capacity. However, if the data from these existing sensors were combined, they would provide a large fraction of the capabilities necessary for global coverage. Thus, some level of international data sharing would increase SSA capacity without the expense of building additional sensors.

In addition to global sensor coverage, SSA must include data from satellite owner-operators, especially commercial companies, as they have positional data on their satellites that is more accurate than any ground-based sensor could obtain. These commercial operators have very precise information about the locations of their own satellites, but little to no information about other satellites, dead satellites and other pieces of debris that float through their slots. Their positional data complements the ground-based tracking of debris and also reduces the workload requirements for the tracking networks, freeing up capacity to focus on inactive satellites and debris.

In an attempt to provide some level of SSA data to the world for civil use, the US military initiated the Commercial and Foreign Entities (CFE) Program in 2004 which places portions of the satellite catalog on a public website. Over the last five years, the US government has made some progress on two-way communication and data transfer with outside entities, including collision warning, but these efforts have struggled with policy and legal concerns over security and liability.

Over the last few years, certain commercial satellite operators have voluntarily formed an initiative to share data on the location of their satellites with each other and a third party who provides collision warning and maneuver planning assistance. Recently, this initiative, called SOCRATES, has expanded beyond GEO to include satellite operators in LEO and is experimenting with including tracking data from surveillance networks to supplement the owner-operator data and public satellite catalog.

Research and discussions are also underway on potential methods of sharing SSA data among States, commercial operators, and tracking systems in a more thorough way. Key to this analysis is development of a data sharing model that provides for both security and collaboration.

B. BEST PRACTICES GUIDELINES

In February 2009, during the 46th meeting of the United Nations Committee on Peaceful Uses of Outer Space (COPUOS)'s Subcommittee on Science and Technology, the French delegation proposed a new agenda item for consideration by the full committee, entitled "The Long Term Sustainability of Space Activities." This proposal grew out of an informal meeting of interested States and a few industry representatives immediately prior to the 2008 meeting of the Subcommittee that focused on the task of developing and codifying a set of "best practices" for States and commercial entities to follow when conducting space activities in Earth orbit. This "bottom-up" approach to achieving greater space safety and security was inspired by COPUOS' 2007 adoption of voluntary orbital debris guidelines.[6] The UN guidelines were modeled closely on the guidelines adopted earlier by the Interagency Debris Coordination Committee (IADC).

Internationally agreed best practices are needed because space agencies have generally not shared their operational practices with each other except in limited cases when it was needed in order to cooperate on specific projects. Hence, these agencies have adopted different practices, some of which are more effective than others in ensuring the long-term sustainability of space activities. Further, the emergence of many more States into the club of spacefaring States and the proliferation of commercial activities generates a need for greater cross-fertilization of knowledge to ensure that space operations are safe and secure.

Such practices include limiting the operational generation of orbital debris, but extend further to include sufficiently separating spacecraft and transmission frequencies to avoid interference with other operators, safety of space operations, and monitoring of space weather, as well as others.

During the June 2009 meeting of COPUOS, the Committee agreed to add a new agenda item for consideration by the Scientific and Technical Subcommittee in its February 2010 meeting: the long-term sustainability of outer space activities. The plan of work calls for the establishment of a working group of States in 2010, "preparation of a report on the long-term sustainability of outer space activities and examination of measures that could enhance their long-term sustainability; preparation of a draft set of best practices guidelines" in 2011, and "continuation of consideration and finalization of the report and of the set of best practices guidelines for presentation to and review by the Committee" in 2012/2013.[7]

C. EU DRAFT CODE OF CONDUCT

Illustrating the fact that space security in Europe has become an issue of growing interest, a series of high-level conferences and reports have been taking place or released in recent months. In particular, EU Member States pursued an initiative on the elaboration of a Space Code of Conduct on Outer Space Activities to strengthen existing agreements and codify new best practices for the safe and secure use of space. The aim of this initiative is to lower the risks of misinterpretation of incidents occurring in space, to avoid collisions and deliberate explosions, and to provide reassurance to other space operators through improved information exchanges, transparency and notification measures. The Space Code of Conduct would strengthen existing United Nations treaties, principles and other arrangements, since those adhering would commit to comply, adhere, implement, and then promote them.

Second, the Space Code of Conduct aims to complement the aforementioned UN texts by codifying new best practices in space operations, including measures of notification and of consultation that would strengthen the confidence and transparency among space actors and help lead to a spirit of cooperation in space.

The discussions on a Space Code of Conduct were initiated by Italy and further developed during the German Presidency of the Council of the European Union (first half of 2007) in order to build consensus on developing an instrument other than a treaty-level agreement. The idea was first promoted as an instrument of arms control. However, the concrete issues identified in the E-Task Force under the Portuguese Presidency beginning in 2007, had a number of overlaps with the civil use of outer space. The Portuguese Presidency drafted a first version of an EU Code of Conduct. An updated version entitled "Best Practices guidelines for / Code of Conduct on Outer Space Activities," was circulated in the first quarter of 2008. The document was eventually agreed upon in the EU working group on UN Disarmament (CODUN) by the end of the Slovenian Presidency in June 2008. Additionally, the Netherlands proposed a document that indicated the next steps regarding

discussions with key partners and identifying modalities for promoting the document in the relevant international forums. The EU's Code of Conduct proposal became a French Presidency priority and the draft text of the CoC was supported by the Council of the European Union during its Dec. 8-9, 2008 meeting.

The EU's Space Code of Conduct consists of a Preamble and 12 Articles subdivided into four sections: I. Core Principles and Objectives, II. General Measures, III. Co-operation Mechanisms, and IV. Organizational Aspects.[8] The EU's Space Code of Conduct is based on the principles of: (1) freedom of access to space for all for peaceful purposes; (2) preservation of the security and integrity of space objects in orbit; (3) due consideration to the legitimate defense interest of States. Additionally, its Article 2 provides for the following general principles: "the freedom of access to, exploration and use of outer space and exploitation of space objects for peaceful purposes without interference, fully respecting the security, safety and integrity of space objects in orbit." The main objectives of the Space Code of Conduct are thus to strengthen the safety, security and predictability of all space activities, *inter alia* by limiting or minimizing harmful interference in space activities. It covers all current civil and military activities, as well as future ones.

From the very beginning, the European Union intended to elaborate an instrument open for adherence to all space-faring countries in order to reach a consensus to ensure the long-term sustainability of space activities. Briefings on the Space Code of Conduct were conducted with the United States, Russia, China, and others. As the Space Code of Conduct is voluntary and open to all States, it aims to lay down the basic rules to be observed by States. The hope is to have a conference in late 2009 or early 2010 at which a number of States could indicate adherence to the Code.

D. Conference on Disarmament

In terms of space sustainability, the United Nations' Conference on Disarmament (CD) has been a key forum for discussions of international interaction in space. This organization is the predominant arena for dialog about the military aspects of international space relations. This is most commonly defined as the prevention of an arms race in outer space, or PAROS. The CD first established an *ad hoc* committee on PAROS in 1985, but this achieved little. After the CD became deadlocked on agreeing to a program of work in the late 1990s, little movement was made on moving forward to formal negotiations.

Yet the situation recently changed rather dramatically. In 2008, Russia introduced a joint Russian-Chinese draft treaty entitled "Treaty on the Prevention of the Placement of Weapons in Outer Space, the Threat or Use of Force against Outer Space Objects."[9] In the wake of this introduction, the debate on PAROS and the weaponization of space has been revitalized. The main tenets of the draft Treaty are a ban on weapons placed in outer space, a ban on threats or use of force in Space, and the establishment of an international monitoring and enforcement agency.

The draft treaty received a mixed reception in the CD and in the international community at large. A number of States submitted comments to the Russian and Chinese governments, including Austria, Belarus, Canada, France, Germany, the Netherlands, New Zealand, South Africa, Sweden, Switzerland, Ukraine, the United Kingdom and the United States. Many of the concerns raised are focused on a perception that the treaty is too broad and does not limit the use of debris-causing anti-satellite weapons. In some quarters, the Russian-Chinese draft has been perceived as a political maneuver to highlight the United States' refusal to engage on any multilateral negotiations on disarmament and space. Others have felt that the draft treaty is a good start in an important international discussion. Whatever one's reaction to the draft, it should be credited with energizing the debate.

In September 2009, the Russian government planned to release responses to the comments of States on the draft treaty. The unofficial translation of these comments is, in many ways, a step towards a position in which substantive negotiations might be able to be undertaken.

In February 2009, Canada introduced proposals on PAROS into the CD in a document entitled "Draft transparency and confidence building measures and treaty proposals for space security." [10] The

Canadian proposal has some merits and again has potential to move forward to PAROS debate in the context of disarmament and the CD.

Space security issues have, however, been affected by the bigger picture of global interaction in the CD. On May 29, 2009, the CD agreed on a program of work – the first in twelve years.[11]. The program of work laid out mandates for four working groups; working group three is charged with discussing "substantively, without limitations, all issues related to the prevention of an arms race in outer space." Unfortunately, though the CD was unable to come to agreement on the implementation mechanisms for the program of work, primarily because of the objections of Pakistan as a result over its concerns about the Fissile Materials Control Treaty. As a result, this issue has come to a grinding halt in the disarmament community for reasons that have nothing to do with space issues.

The key question that must be posed now is where does the international community go from here? It is imperative that space security issues continue to be discussed at both the diplomatic level and in the disarmament context. Bringing in emerging space players is essential. Developing States are becoming increasingly invested in the use of space technologies and therefore have a growing stake in safeguarding the space environment and ensuring sustainability. Whether such multilateral discussion take place in the CD, a consensus body, remains to be seen. However, efforts to utilize the expertise and skills of the diplomatic disarmament community to find new methods, means and venues for negotiation is a valuable and ongoing undertaking. It is hoped that continued education on space security issues and through the evolution of current proposals such as those of Russia, China, and Canada, effective foundations can be laid for discussion and negotiation on future measures, working towards a more comprehensive space security regime.

E. Findings and Recommendations of the Ifri Workshop

In June 2009, the *Institut français des relations internationals (Ifri)* and the Secure World Foundation (SWF) held a workshop entitled "Assessing the Current Dynamics of Space Security" in Paris. The workshop was convened to complement various space security discussions that have recently been taking place.

The workshop was a closed meeting of experts from government, civil society and industry. This allowed the discussion to begin from informed standpoints. The workshop was conducted under Chatham House rules (confidentiality of sources), which fostered a more open discussion. The goal of the workshop was not to hear presentations or statements of various positions, but to brainstorm about the topics at hand, exchange ideas, and generate solid recommendations..

Many of the participants of the workshop were familiar with the issues discussed through involvement with COPUOS or the CD. In the United Nations, civil space is discussed at COPUOS, with space weapons or the military use of space never being an agenda item for the UN committee, instead being discussed in the CD. Unfortunately, there is very little interaction between the two bodies even though their responsibilities often overlap, for example, in possible transparency and confidence building measures (TCBMs). Therefore, workshops such as the one co-organized by Ifri and SWF offered a rare opportunity for representatives of both bodies to meet at one venue and discuss issues relevant to both.

Several key recommendations emerged from this workshop, which are summarized as follows:

- **Better Cooperation between COPUOS and the CD**: both bodies need to exchange information and cooperate on a more regular basis to foster better communication and understanding of how each works with respect to space security issues in particular.
- **Better Informed Actors**: Create am make available a "Space for Diplomats" manual to assist delegates of both the CD and COPUOS in understanding the basics of space technologies and activities crucial to their deliberations. It is essential that policymakers have a good understanding of the basic technical issues arising from outer space activities.
- **Developing a Strategy:** the international community needs to devise a strategy for crafting appropriate international agreements for reaching long-term sustainability of outer space. The strategy would be considering TCBMs as well as treaty proposals.
- **Agreeing on Legal Definitions:** often there is great difficulty in reaching

consensus on legal definitions of certain key space and disarmament terms. This impedes progress on draft treaty discussions. Thus, a study group of experts could be convened to discuss legal definitions and provide necessary clarifications.

- **Orbital Debris:** the voluntary guidelines in the UN resolution of December 2007 demonstrated a growing political consensus that debris must be limited. This is a good first step. However, it is not enough to avoid space debris from becoming a century-long curse. There are both political and technical issues to solve with regard to the increasing threat of space debris. They are not exclusively linked to disarmament issues. Working groups within COPUOS should pursue additional means to limit creation of space debris in parallel with regular communication between the CD and COPUOS.
- **Space Situational Awareness:** the debris caused by the February 2009 collision between a commercial Iridium communications satellite and a retired Russian Kosmos satellite illustrates the pressing need to reduce the chances of future collisions. One way to proceed is to increase the effort to locate and track satellites and debris in their orbits. There should be a concerted effort to establish an international Space Situational Awareness (SSA) architecture in order to reduce the risk of accidental collisions in space.
- **Debris Removal:** research should be increased on methods of deorbiting critical pieces of debris safely and effectively. In addition, research should start on the legal and political issues of removing debris from orbit in order to provide the legal and policy bases for such activities.
- **The Role of the Commercial Satellite Operators:** commercial space operators should be involved in discussions that relate to space sustainability. The model adopted in the creation of a draft Set of Best Practices that will be considered by UN COPUOS is a good example on how this could be achieved.

III. CONCLUSIONS AND RECOMMENDATIONS

The sustainable use of space is not an unachievable goal. Rather, it is a necessity for every spacefaring State. A safe and secure space environment is an absolute requirement for all activities in space, be they civil, commercial or military. Without a safe and secure environment, it would be difficult for any space actors to provide the continuous services that are vital for activities on the ground. Many States, if not all, are significantly dependent on space assets for providing commercial, social, political and military services, and the security of those assets is a number one priority for mankind.

The space environment is already contaminated to a certain degree, particularly with the 2007 Chinese satellite destruction and the 2009 collision of the Iridium and Cosmos satellites. The increasing risk of space debris is threatening the future sustainable use of space. Currently, the only possible solution is to avoid collision by strengthening the debris monitoring system through SSA, but maneuvering satellites would be too costly and risky if there are too many debris and non-operational spacecraft. Thus, it is imperative for all space actors to agree upon international rules for sustainable use of space. As was discussed above, there are several proposals for improving the orbital environment by regulating space activities and minimizing the potential for increasing debris.

It is not yet certain which proposals of legal or institutional frameworks would be taken as a standard practice for minimizing the creation of debris. One of the most important questions to be answered in converging these proposals is whether responsible States would be willing to comply with these legal or institutional frameworks.

Among the responsible States, the role of United States is by far the most important, and there are some signs that the United States may move away from the unilateralist stance of the previous administration. The National Space Policy of 2006 stated that the United States "rejects any limitations on the fundamental right of the United States to operate in and acquire data from space."[12] This statement made it very difficult to assume that the United States would comply with any international agreement for regulating the activities in space, including debris mitigation. However, the current administration thus far has redirected its foreign and space policy towards greater openness and increased

international coordination and cooperation. If this administration would promote further coordination of debris mitigation arrangements, the possibility of convergence of legal and institutional instruments would increase.

On the other hand, more attention must be paid to the new participants in space activities. As discussed in the Ifri workshop, the “space for diplomats” manual would widen acceptance of the necessity for instituting debris mitigation measures by emerging space countries. This sort of general exercise for enhancing the common understanding of the risks and danger of space debris would increase the sense of responsibility for these newly emerging countries.

For ensuring the compliance of spacefaring States, the form of a "code of conduct" seems to be the most appropriate approach. Since there is no solid agreement on how to strike a balance between debris mitigation and safeguarding freedom of action in space, it would be unlikely that a legally-binding document will achieve enough signatory States. On the other hand, the Space Code of Conduct that is proposed by European Union does not bind the actions of States, but instead creates guidelines for what should and should not be done in space. This voluntary framework would help develop a common understanding of and normative bases for debris mitigation, and possibly could be extended to a further binding document. A Space Code of Conduct itself is not a goal, but a possible interim step.

In addition to the legal and institutional issues, it is urgent for all spacefaring States to combine their technical and financial capabilities to develop technology for debris removal. The United States’ Defense Advanced Research Projects Agency (DARPA) released a Request for Information on orbital debris removal in September 2009 [13]. This is just the beginning of the process for developing debris removal technology, but finding cost-effective ways to do so would greatly assist space sustainability.

There are three main reasons why sustainable space environment has not yet been achieved:

(a) the lack of information and understanding about the issues among the public and States
(b) the different intentions and objectives of States,
(c) the lack so far of cost-effective debris removal technology

Although the debris removal technology development will not be feasible soon, awareness and understanding can be improved and, with effort, the objectives of States in space can be brought together. In light of recent policy changes by the United States, it is hoped that spacefaring States would be able to converge their interests and understanding of the importance of this issue, and agree upon the steps for establishing an appropriate legal and institutional framework for space operations.

After all, while rules crafted by States can be broken by malicious behavior, the ultimate laws of outer space are the laws of physics, which, for example, do not ask which State a satellite belongs to, but rather blindly distribute the risks and consequences. No matter whether the operators are civil, commercial or military, the results of irresponsible uses of space would be distributed to everyone. Whatever spacefaring States try to achieve, they cannot escape from the consequences of their actions. In other words, there is no choice but to use space responsibly.

IV. REFERENCES

[1] Space Security Index: http://www.spacesecurity.org

[2] http://www.guardian.co.uk/world/2009/feb/03/iran-satellite-launch-omid ; Jonathan's Space Report, No. 606, 16 February 2009.

[3] Choe Sang-Hun, South Korea Launches Satellite, *New York Times*, 26 Aug. 2009, http://www.nytimes.com/2009/08/26/world/asia/26rocket.html, accessed September 2009.

[4] http://www.orbitaldebris.jsc.nasa.gov/newsletter/pdfs/ODQNv13i4.pdf, accessed September 2009.

[5] Brian Weeden, "Billiards in Space," http://www.thespacereview.com/article/1314/1.

[6] *Report on the Committee on the Peaceful Uses of Outer Space (2007)*. General Assembly 62nd Session supplement #20 (A/62/20), pp. 17

[7] *Report of the Committee on the Peaceful Uses of Outer Space, Sixty-fourth Session*, Supplement No. 20, June 2009, accessed September 2009 at http://www.oosa.unvienna.org/pdf/gadocs/A_64_20E.pdf, para 161.

[8] The full text of the CoC for outer space activities is available at the address: http://register.consilium.europa.eu/pdf/en/08/st17/st17175.en08.pdf

[9] UN Document number, CD/1839

[10] UN Document number, CD/1865

[11] UN Document number, CD/1864

[12] U.S. 2006 Space Policy: http://fas.org/irp/offdocs/nspd/space.pdf, accessed, September 2009.

[13] Federal Business Opportunity Webpage, DARPA Orbital Debris Removal (ODR), 17 September, 2009. (https://www.fbo.gov/index?s=opportunity&mode=form&id=a55fd6e5721284ee7df2068d2b300b5f&tab=core&_cview=0)