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The Commercialisation of the International Space Station.

by

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Abstract

The assembly of the International Space Station opened a new era of space exploration. It also created new challenges for the lawyers that had to deal with new issues related to this endeavour. This study will focus on the prospect of commercialisation of the ISS and on the legal problems that could appear with respect to this undertaking. By examining available markets and managing structure of the ISS, this study will reveal the potential and the drawbacks of the international enterprise. Furthermore, the detailed analysis of the Intergovernmental Agreement signed by the State Partners to the ISS will describe the particularities of ISS' legal regime, especially emphasising on the Intellectual Property provisions and other Issues not covered by the cross waiver of liability.

Résumé

La construction de la Station Spatiale a commence une autre époque de l'exploration spatiale. Elle a de même apporte de nouvelles épreuves pour les juristes qui devaient alors résoudre des problèmes liés a cette entreprise. Cette étude va se concentrer sur les perspectives de commercialisation de l'ISS et les problèmes juridiques qui en découlent. En examinant les marches potentiels et la structure de gestion, on pourra relever des points forts et faibles de cette initiative internationale. De plus l'analyse détaillée de l'Accord Intergouvernemental signé par les Etats Partenaires va décrire le régime juridique applicable à la Station. On s'attachera surtout aux dispositions relatives à la Propriété Intellectuelle et aux autres domaines exclues par le régime de la renonciation mutuelle de la responsabilité.

Introduction

The International Space Station (formerly the Freedom Space Station) is one of the world's most ambitious technologic initiatives ever undertaken. Its constructions and operations involve a co-operative venture of 16 countries.[1] According to a NASA statement: *"...the ISS is much more than just a world-class laboratory in a novel environment; it is an international human experiment—an exciting "city in space"—a place where we will learn how to live and work "off planet" alongside our international partners."*[2]

I. Historical background of the project.

The idea of creating a station permanently inhabited was not new, as the Soviet Union had launched its orbital stations Salute and Mir in the 1980's. Thus, on January 25, 1984, President Reagan in his State of the Union called for the commitment of the United States to the construction of a space station. On September 29, 1988, the Space Station Agreement was signed between United States, Canada, Japan and nine member States of European Space Agency(ESA)[3]. The agreement contemplates the creation of Memoranda of Understanding(MOUs) and Implementing Arrangements.[4] Three interagency memoranda of understanding pursuant to Phase b (detailed definition and preliminary design) of the U.S / International Space Station project have been agreed upon by the U.S. National Aeronautics and Space Administration (NASA) and the Canadian Ministry of State

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[1] *The International Space Station as an Earth Observation Platform: Hyperspectral and Sar Technologies*, Report of the Canadian Space Agency, Saint-Hubert, Canada 1999

[2] "Putting Space To Work The World Over," NASA home Page <http://www.station.nasa.gov/station/science/>

[3] The member states of the ESA that have signed the Agreement are the Kingdom of Belgium, the Kingdom of Denmark, the French Republic, the Federal Republic of Germany, the Italian Republic, the Kingdom of Netherlands, the Kingdom of Norway, the Kingdom of Spain and the United Kingdom of Great Britain and Northern Ireland.

[4] Footnote in ", M.B. McCord, "Responding to the Space Station Agreement: The Extension of U.S. Law into Space", Georgetown L. J.,(1989), 1933

for Science Technology, the Science and technology Agency of Japan, and the European Space Agency respectively.[5]

In 1993, after NASA experienced considerable delays in getting its own Freedom Space Station project off the ground. President Clinton called for the station to be redesigned to reduce costs and identified a need for more international involvement. As a result NASA proposed three new designs of the station and Russia was officially added to the list of participants ISS nations. [6] The ISS project began to materialise in 1992, when the United States and Russia engaged in the co-operative Shuttle-Mir program.

The first element of the ISS, the Zarya control module, was launched from the Baikonur Cosmodrome, Kazakhstan, on November 20, 1998. This was followed by the Unity connecting module which was launched aboard the Space Shuttle Endeavour from the Kennedy Space Centre in December, 1998. There were plans for five launches during 1999 to support the assembly of the International Space Station. There were intended to provide:

a. Equipment for the interior of the Zarya and Unity modules, as well as for the Service Module.
b. The Service Module, which would provide living quarters, life support, navigation , propulsion, communications and other systems;
c. equipment for the interior of the Service module
d. first exterior framework, including a docking adapter and gyroscopic systems; and
e. first set of solar panels

Unfortunately, only one flight was performed so far by the Partners; on May 27 1999, Discovery mission was launched in order to supply Unity and Zarya with

[5] "The U.S./ International Space Station: Aspects of Technology and Law", remarks by Stephen Gorove, American Society of International Law Proceedings, (1987), April 8-11,

tools and cranes. On July 12 2000 Russia successfully operated the launch of Zvezda module from Baikonur.[7] As assembly of the ISS progresses, other Partners modules will be added, and for this purpose 37 flights are planned overall in order to complete the ISS.[8]

II. Technical characteristics

Technological aspect of the International spaces station is very ambitious, it is designed to create the platform fort the current requirements of consumers as well as for the future of human kind.

Professor Terrance T. Finn points out the goals of ISS as follows:

> *"The space station will be primarily a research centre, but it may at some later date become a point of departure for missions beyond low earth orbits, if future political leaders, engineers and scientists deem it worthwhile.<...>*
> *The architecture of the station would utilize a "dual keel configuration". The pressurized modules would be located in a figure –eight pattern at the mid-point of the transverse boom, which is bisected by two 105 –meter keels for the location of scientific instruments. Some 85.5 kilowatts of power by photovolatic generation is envisaged. In addition, several unmanned free-flying platforms, both co-orbiting in the 28.5 inclination of the station and in polar orbit, are components of the space station's initial operating capability."*[9]

The general technical characteristics of the ISS may be summarised as follows:

The ISS would be in a low –altitude orbit around the earth relative to other Earth Observation satellites. The orbit has an inclination of 51.6 degrees and it slowly decays in altitude at a rate of 3.3 km per month. This decay in the orbit will require the ISS to be boosted back into its original orbit every 3 to 4 months. The intended

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[6] Quotation in J.H. Shoemaker, "The Patents in Space Act: Jedi Mind Trick or Real Protection for American Inventors on the International Space Station, "(spring 1999), J. Intel Prop L.
[7] See Reuters Report on <http://dailynews.yahoo.com/h/nm/20000712/ts/space_russia_dc_7.html>
[8] See Annexe I, NASA's schedule for flights.
[9] "The U.S./ International Space Station: Aspects of Technology and Law," remarks by Terrance T. Finn, American Society of International law Proceedings, April 8-11, 1987.

equatorial altitude is between 352 km to 426 km. The orbit of the ISS takes it over 75% of the earth's surface and 95 % of the planet's population.

The ISS will be the largest space structure ever assembled. Thanks to its size it will be able to provide support for very sizeable payloads which may be physically complex and may have unique support requirements.
It will consist of different modules and parts provided by the different partners.[10]
The major ones are specified with the given names and assigned specific tasks as listed below:

1. Zarya Control Module also known as Functional Cargo Block-designed to provide the station initial propulsion and power to which is attached Node I.
2. Unity Node is a connecting passageway to living and work areas. ISS, delivered by the space shuttle with Pressurized Mating Adapter.
3. The Laboratory Module is the centrepiece of the International Space Station, where unprecedented science experiments will be performed in the near zero gravity This pressurised module is designed to accommodate pressurised payloads. It has a capacity of 24 rack locations. Payload racks will occupy 13 locations especially designed to support experiments.
4. The TransHab, is designed to provide a large volume habitation module for the International Space Station while demonstrating its use for future transit spacecraft
5. Spacehab has the purpose of providing flight logistics for the early assembly missions.
6. Service Module will provide the early station living quarters; life support system; electrical power distribution; data processing system; flight control system, and propulsion system. It also will provide a communications system that includes remote command capabilities from ground flight controllers.

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[10] See Annex: Space Station Elements Provided by the Partners; for the detailed provisions on the elements provided by each participant see *Memoranda of Understanding between Partners*, [hereinafter MOU], Space Law, Basic Legal documents, edited K-H. Bockstiegel and Marietta Benko (Martinus Nijhoff Publishers, 1993).

7. Mobile servicing system is Canada's contribution to the ISS. It is an essential component of the International Space Station. This robotic system will play a key role in space station assembly and maintenance, moving equipment and supplies around the station, releasing and capturing satellites, supporting astronauts working in space and servicing instruments and other payloads attached to the space station. Astronauts will receive robotics training to enable them to perform these functions with the arm.
8. The Leonardo Multipurpose Logistics Module, which was built by the Italian Space Agency (ASI), is one of three such pressurised modules that will serve as the International Space Station's "moving vans," carrying laboratory racks filled with equipment, experiments and supplies to and from the station aboard the space shuttle.
9. The EXPRESS program consists of two separate systems: the EXPRESS rack for pressurized payloads and the EXPRESS pallet for attached payloads.The EXPRESS pallet for attached payloads is provided by Brazil as a participant through a bilateral arrangement with the United States and the Brazilian Space Agency (AEB).
10. X-38 – Crew Return Vehicle. During the first years of the International Space Station's life on orbit, a Russian Soyuz capsule will always be present to provide crewmembers with the means to evacuate the station quickly. But work is well under way on development of the new emergency crew return lifeboat for the International Space Station.[11]

The ISS will be large enough to support multiple antennae or optical sensors, opening up the potential for advanced observation missions. The ISS' standard interfaces have been designed to simplify the task of integrating payloads with the ISS bus. Most payloads (at least within the NASA portion) will be palletized, both to simplify the task of transporting payloads to space and to simplify the integration of the payloads in space.

There is a variety of sensor payloads that could be considered for deployment on the International Space Station. The two most popular families of Earth Observation payloads may be grouped into passive and active sensors. The passive sensors measure reflective or emitted energy from the earth while the active sensors generate their own energy and measure the returned signatures from the illuminated target areas. Two of most promising types of sensors in use today : Synthetic Aperture Radar or SAR systems (active) and Hyperspectral or HIS systems (passive). HIS is used to detect energy or imaging water or even wetlands. SAR payloads operate with five frequency bands each provided for different use. Thus L-Band was used for terrain signature measurements especially those elements whose dimensions are close to the 20 cm wavelength of the radar. S-Band was used for research and expected that this frequency will be valuable for space based remote-sensing systems, C-Band is useful for most measurement applications, especially sensitive to target structures whose dimensions are a few cm, X-Band is used for a variety of application but in the past the acquired data was not available due to its military nature, Ku –Band shows strong-potential for oceanographic observations as well as for ice classification.[12]

Both payloads can be configured to conform to the current pallet standards. All the Earth Observation missions will require substantial on-board data storage, given the large amounts of data from an HIS and SAR. Several data storage options are offered. Solid–state recorders that buffer the data for downlink are already going on free flying satellites. Manual exchange of recording media using station crew offers other possibilities both for local archives, for on–site management and retransmissions. A large amount of received data will require more down-link bandwidth than can be allocated over the existing TT &C link. It is also likely that

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[11] See on ISS modules and elements: <http://www.station.nasa.gov/station/assembly/elements/> and See for the plan of the station Annex II

[12] On the commercialisation of these payloads see *infra* at 22.

the Earth Observation missions for the ISS will require their own down-link systems.[13]

Earth observation payloads will require a clear view in the nadir direction. They must also communicate with ground stations, and so must be provided with an antenna systems that can transmit data to the earth and receive commands from it. These communications are relayed through a second satellite.

For a successful commercialisation of the ISS it was necessary to design Communication and Data Transfer. The ISS Communications and Tracking System is designed to support two important functions ISS operations and payload operations. It is very important for the commercial user to be able to download data according to his needs.[14]

The Video Distribution Systems, which constitute part of the Communications and Tracking System and distribute video on board the ISS and to external interfaces, together with the Ku-Band subsystems provide for end-to-end distribution of video from the ISS to the ground Tracking and Data Relay Satellite System.

III. The International Space Station Environment

Another domain which is considered to be of major interest to the commercialisation of the International Space Station is related to the ISS environment. Since the ISS will be subject to an environment of micro-gravity, it may be used for a variety of research projects. The micro-gravity environment will be maintained during a pre-established schedule in order to avoid the perturbations caused by the acceleration, which cause structural fatigue and contribute to gradual

[13] *The International Space Station as an Earth Observation Platform: Hyperspectral and SAR Technologies*, see *supra* at note 1

deterioration of space structures. Those accelerations are caused by atmospheric drag, solar pressure or the operations of thrusters and magnetic torquers, docking operations, movement of mechanical parts and crew motion. The ISS is planned to have at least 180 days each year in "micro-gravity quiescent" mode.[15]

Another aspect that should be taken into account is the characteristics of the internal and external atmosphere. It is anticipated that temperature in the vicinity of the modules can vary from –126 to 149C during one orbit.

IV. Technological Constraints for the commercialisation of the ISS

Several issues related to the originality of the undertaking may impede regular commercial use of the ISS. They arise from the particular environment of the ISS as well as from its position in space.

Contamination is an important factor which may influence activities aboard the ISS and therefore it is foreseen to have 30-day "contamination-quiescent periods". Collision of objects with the ISS presents another danger of module depressurisation, with sever consequences for crew safety and damage to ISS systems and payloads.[16] The modules of the ISS were conceived in the form of dual aluminium walls, containing several intermediate thermal insulation layers. The most sensitive elements are placed at low risk locations while the external areas of ISS can withstand collisions with objects up to 1 gram in mass.[17]

The collision avoidance strategy is developed by the Strategic Defence Initiative and the US Space Command. Yet, the risk of emergency collision

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[14] *Open for Business: A New Approach to Commercialisation of the ISS*, Master of Space Studies 1998-1999, International Space University
[15] *Open for Business*, see *supra* note 14
[16] *Open for Business*, see *supra* note 14

avoidance manoeuvres remains. This implies a possible deterioration of the micro–gravity environment. The same problem may result from the human operator fault and, therefore, very strict safety requirements were imposed on all activities aboard the ISS.

Access to and from International Space Station limits the opportunity of the successful commercialisation. Maintaining the station and transportating equipment, raw materials and the crew require consistant launcher availability. It creates problems of cost and technical readiness. The delays in transportation may cause significant loss to the potential users and discourage them from the utilisation of the ISS.

For the moment there are several transfer vehicles to the ISS such as Soyuz TM, STS, X-38/CRV, Progress M, ATV, HTV which are used for the operation and utilisation of the ISS. A number of expendable launch vehicles for the ISS is also available – among them Proton K, Soyuz U, Ariane 5, H-II A 212/5S, but their cost presents a considerable constraint for the users.

V. Partners' programs concerning the utilisation of the International Space Station.

Since the ISS appears as a condominium of several international partners, each participant had to elaborate its own program in order to define the most appropriate way of exploiting the International space station, namely the modules and the elements assigned to them respectively.

Each program disclose the information necessary for the successful marketing of the ISS as each partner determines potential fields where the experiments may be conducted.

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[17] Most of the particles have a mass between 10^{-7} and 10^{-9}kg , a diameter of about 0.01cm and a

a.) Russian Program:

According to the Annex of the IGA, Russia is supposed to provide the ISS with several elements, namely the Functional Cargo Module, Service Module, docking Compartment-1; Science/Power Platform, Universal Docking Compartment-2, Docking and Logistics Module, Laboratory Module and Laboratory Module n2.[18]

A significant portion of research on the ISS RS can be performed on Science/Power Platform, universal Docking Modules and laboratory Modules[19]. Given Russia's significant practical experience and research on space activities for the past 40 years, it is clear that the prospective of conducting the experiments on the International Space Station will expand and deepen the knowledge in various science and application research areas. For its ISS activity Russia intends to use the results obtained on the MIR station by extending its research program to the ISS.

Although Russia is constantly experiencing funding problems, the feasibility of several experiments on each element has been shown. Hence, the Service Module is usable for geophysical studies, space biotechnology, life science studies, technology studies and experiments, extra atmospheric astronomy, space power and propulsion problem.[20] The Science / Power Platform is a potential place of conducting studies in the following areas: Space processing and material science, geophysical research, study of planets and small bodies in the Sun system; space biotechnology, technology studies and experiments; extra-atmospheric astronomy,

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density about 0.5g/cm^3, source in *Open for business*, see *supra* note 14

[18] For the list of elements provided by Russia, see Art. 3.3 of the MOU between the NASA and the RSA Concerning Co-operation on the Civil International Space Station, Article 3.3 January 29,1998 in Space Law Basic Materials, see *supra* note 10

[19] V. F. Utkin, "The Russian Program for the International Space Station and Russian Utilisation Plan", Proceedings of the Second European Symposium on the Utilisation of the International Space Station, (ESA, ESTEC, Noordwijk, The Netherlands, 16-18 November1998.)

[20] Hereinafter, on the Russian segment's utilisation see V. F. Utkin, *supra* note 19

space power and propulsion system. Same fields of studies seem to be possible on the Universal Docking Module with the particularity of conducting study of natural resources and environmental monitoring.

Some studies are expected to be conducted in extensive co-operation with international parties. Joint experiments with the European partner seem to be planned for "Radiatsionny Monitoring" -dynamics of radiation dose accumulation in antropomorphic phantoms on the Russian unit called "Matrioshka". Matrioshka is a multi-user external phantom facility representing the upper part of the human body for studies of depth of the distribution of the different components of the orbital radiation field in different organs, occurring in humans being exposed during an Extra Vehicular Activity. It may lead to improvements in research on risks of radiation exposure of critical radio-sensitive organs of astronauts.[21]

Subject to constraints of funding, Russian partner is most likely to engage in wide international co-operation combined with the commercialisation of its potential on the ISS.

b.) Europe.

Europe's main contribution to the International Space Station is the Columbus Laboratory. Yet, the necessity of guaranteeing a multidisciplinary approach has led Europe to add to its program the construction of four External Attachment Points to the Columbus Laboratory[22].

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[21] K. Knott, *"The European Research Plan for ISS"*, Proceedings of the Second European Symposium on the Utilisation of the International Space Station, (ESA, ESTEC, Noordwijk, The Netherlands, 16-18 November1998).

[22] For the list of elements provided by Europe see Art.3.3 of the MOU between the NASA and ESA Concerning Co-operation on the Civil International Space Station, January 29, 1998 in Space Law, Basic Materials, see *supra* note 10.

Europe is planning to install four major facilities in the Columbus Laboratory. Biolab is designed to study the effect of micro-gravity and space radiation on cell culture, micro-organism, small plants and small vertebrates[23]. Fluid Science lab, operated in automatic or semi-automatic mode is designed to investigate fluid physics under micro-gravity effect. European Physiology Module is built for experiments in cardiovascular conditions, hormonal/body fluid shift, bone demineralisation and neuroscience.

The European Drawer Rack would provide main services, such as power supply, heat rejection, data management and gas supply /vacuum venting.

The utilisation of the External Attachment Points has not been determined yet. Europe is planning extensive international co-operation, namely by using the US and Russian laboratories. ESA intends to be actively involved in the PEMS [24] and MARES[25] related experiments in the Human Research Facilities of the US laboratory.

According to the barter agreements concluded with the US, ESA has acquired a right to occupy NASA express positions for a period of three years. ESA has selected a total of 5 Express pallet Adaptors: ETEF[26] SOLAR,[27] EXPORT,[28] ACES[29] and FOCUS[30].

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[23] Hereinafter for European projects see K. Knott, *supra* note 21, on the recent development see <http://www.estec.esa.nl/spaceflight/index.htm>

[24] PEMS–Percutaneous Electrical Muscle Stimulator creates electrical stimulation pulses that are applied to specific muscle groups in order to create involuntary contractions of those muscles.

[25] MARES–The Muscle Atrophy Research and Exercise system supports research in to the muscle atrophy that occurs during extended period of weightlessness.

[26] ETEF-Europe's Technology Exposure Facility adapted for the demonstration of High temperature superconductors for satellite, degradation of thermo-optical properties, effect of contamination /radiation on the ISS optical surfaces, effect of LEO environment on solar cells, testing of thermal energy storage receivers, robotics technology.

[27] SOLAR—Three Solar Experiments on a Coarse Pointing System, aiming the Sun observation, measurement of sun radiation.

[28] EXPORT – a combination of an Exobiology and an Astrophysics instruments which will allow to study the photo-processing of organic molecules and the survival of micro-organisms in space.

[29] ACES- an Atomic Clock Ensemble in Space providing the facilities for research in fundamental physics.

It is also working with the Russian partners to implement a project called Global Transmissions System which is designed to transmit signals from the Space Station to synchronise watches on ground and to the systems, potentially aiding car theft protection systems. This project has been selected in order to make a large public aware of the opportunities available on the International Space Station.

c.) Japanese Program.

Japanese activities on the ISS will be conducted over the major eleven elements: Development of Japanese Experiment Module, Development of H-2 Transfer Vehicle, Development of Centrifuge, Operation of Japanese Experimental Module, Research and Promotion of Space Utilisation[31], Development of Experimental Apparatus, Space Experiment, Astronaut Training, Crew Health Care, Safety and Product Assurance. Others imply the miscellaneous such as Space Station Integration and Promotion Centre maintenance and upgrade, Technical information management, Planning for the future and Public relations Japan through the National Space Development Agency of Japan (NASDA) has established strategic researches according to which four main domains will be privileged: Semiconductor Research, Diffusion Research, Gravitation Biology Research and Marangoni flow research.

JEM has seen several missions assigned as mission payloads were selected. It is foreseen to develop All –Sky X-Ray Monitoring, Laser Communication Demonstration Experiments, Space environment Monitor, Experimental Observation of Atmosphere Using Submillimeter –Wave Limb Emission Sounder.

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[30] FOCUS-an Intelligent infared remote sensor, the scientific purpose and the main objectives of FOCUS are related to Earth Observation.

[31] Tatuo Yamanaka & Yoshinori Fujimori, "Japanese Programme and Research Plans", Proceedings of the Second European Symposium on the Utilisation of the International Space Station, (ESA, ESTEC, Noordwijk, The Netherlands, 16-18 November1998).

d.)Canada [32]

Canada has focused its interests on the providing hardware for the Station.[33]. Canadian Space Agency is making considerable efforts to re-adapt several facilities designed for the Space Shuttle and MIR to those for the ISS. Among the selected pieces there are Micro-gravity Vibration Isolation Mount[34], QUELD,[35] Osteoporosis Experiments in Orbit,[36] Visuo-motor Coordination Facility[37], Aquatic Research Facility[38], Radiation Assessment Instruments for Space Application[39], Insect Habitat.[40]

Canada intends to participate and to conduct active research in the fields –Micro-gravity Sciences concerning biotechnology, semiconductor and materials, metals and alloys, glasses and ceramics, combustion, and space life sciences in order to deepen its knowledge in cardiovascular physiology, bone and muscle loss, gravitational biology/ early development, neurovestibular physiology, adaptation to Radiation.

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[32] On Canada hereinafter see Barry L. Wetter, "Canadian Programme and research plans for International Space Station Utilisation", Proceedings of the Second European Symposium on the Utilisation of the International Space Station, (ESA, ESTEC, Noordwijk, The Netherlands, 16-18 November1998).

[33] For the list of elements provided by Canada, see Art. 3.3a of the MOU between the NASA and the CSA Concerning Co-operation on the Civil International Space Station, January 29, 1998, Space Law Basic Materials, *supra* note 10.

[34] MIM is designed to insolate experiments from high-frequency vibrations on orbiting space platforms.

[35] Queld–Queen's University Experiments in liquid diffusion: a metal and glass refining apparatus designed for use in micro-gravity environment which involves the heating and mixing of different combinations of metal or semi-conductor materials.

[36] This program plans to send 192 bone cell samples into orbit that were grown on an artificial and uniform bone substitute in order to investigate the impact of the space environment on the osteoblasts and osteoclasts.

[37] VSM is designed to measure the subtle loss of eye-hand co-ordination that occurs when astronauts work in the weightless environment.

[38] ARF is a space laboratory allowing scientists to study small aquatic animals in a micro-gravity environment.

[39] RAISA has a purpose of developing a tool capable of measuring radioactivity in space.

[40] IH- would be a part of Gravitational Biology Facility, consisting of twelve insect containers.

e.) USA

The American Partner is the initiator of the International Space Station program. Therefore, its contribution to the Station is fundamental. It costs two billions dollars[41] per year to NASA and, hence, NASA is planning to be a part of all opportunities that may become available with the exploitation of the International Space Station.

The American partner is providing the International Space Station with the essential elements such as US Laboratory Module, Habitation Module, Crew Return Vehicle attached to Node 3, Node1 and numerous payloads.

It expects to conduct research in many areas concerning biomedicine, gravitation biology, combustion science, fluid physics, materials science, fundamental physics, biotechnology research, earth system science, space science, advanced human support technology, engineering research, commercial product development.

Chapter I The International Space Station in business

I. Markets available

a.)Biotechnology

Biotechnology is a set of enabling technologies which allow the use of organisms or their cellular, sub-cellular or molecular components, to make products; or to modify plants, animals and micro-organisms to carry desired traits.

[41] Statistics from "The letter to NASA Administrator Daniel S. Goldin on behalf of Dr. M. J. Osborn, Dr C.R Canizares, Dr. M. E. Glicksman", *in* NASA, "Commerce and The International Space Station"

The ISS R&D facilities will provide an environment that could accelerate breakthroughs in biotechnology through research and production in micro-gravity.

Hence, micro-gravity appears as a favourable environment for several studies. In the area of tissue engineering, which shows promises in the treatment of diseases such as ageing, degenerative diseases, burns, blood and lymphoid disorders, the research in micro-gravity would allow experiments that would indicate a change in cell function related to gravity level.[42]

Other major studies will be conducted in the field of protein crystallisation. Three protein crystallisation facilities are scheduled for installation on board the ISS. Each facility should be located in a different module: the Protein Crystallisation Diagnostic Facility located on the Columbus module, the Solution Protein Crystal Growth Facility located on the JEM, the Advanced Protein Crystallisation Facility located in the US Laboratory module.[43]

The importance of these studies is due to the role that protein plays in all living organisms. This biological molecule is fundamental to cellular maintenance, growth and development.

Protein crystallisation is the process of growing protein crystals in a solution. These crystals are analysed under the x-rays in order to construct a three–dimensional structure of the protein which will elucidate the molecular basis of the function of protein in the body.

The process of protein crystallisation on the ground is continually exposed to unidirectional gravity and, therefore, the accuracy of the final three dimensional atomic model of protein is very altered.

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[42] R. A. Binot, *"Tissue Engineering in Micro--gravity: Potentials for Biotechnology within the Applications Promotion Programme of the European Space Agency"*, in NASA, Commerce and the International Space Station.

The micro-gravity environment of the ISS will enable the growth of high quality protein crystallisation, over long periods, with the near absence of a unidirectional gravitational field.

New protein structures facilitate the design and modelling of specific drugs to combat a multitude of human conditions. As Shuttle astronaut Dan Bursh explained:

"The whole goal is to eventually synthesise the protein. There was a protein I flew on one of my past flights called alpha interferon that's used in the treatment of cancer. The treatment has some bad effects. If we understand the structure of the protein then we can alter the protein just so slightly and synthesise it. We can make a whole new family of pharmaceuticals that can be used in the treatment of cancer but without the bad side effects."[44]

The target market is the one of pharmaceutical companies with the annual research and development expenditures of $200M[45]. There is a high potential for research and development in this area as only 1% of the protein molecules' detailed tertiary structure is known. The ISS offers an unprecedented long term opportunity for continuous research in micro-gravity which would complement the ground-based research.

Companies such as Bristol Myers Squib, Dupont Merck, SmithKline Beecham, Sterling Winthrop and Upjohn are already involved in this type of research[46].

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[43] Open for Business, *supra* note 14

[44] Dan Bursh *in* NASA,' Commerce and the International Space Station.

[45] Open for Business, *supra* note 14

[46] About the entities involved in the protein crystallisation research and about the research in general see a detailed report presented by Dr. Lawrence J. De Lucas, Centre for Macromolecular Crystallography, University of Alabama at Birmingham, for the NASA Commercial Centre on <http://www.house.gov/science/delucas_4-9.html>

Glaxo Welcome has recently formed a collaboration with the Imperial College of London to develop a new protein crystallisation apparatus which can accommodate 1000 protein crystal samples.

b.) Market of Space Technology

The Space technology test bed sector describes using the ISS to test technologies that can be utilised for use in traditional applications , as well as in the emerging space markets. [47]

The ISS may be used as a platform for the study of materials and technologies that could be used in space for the purpose of satellite management. The data obtained in the research conducted on the ISS could be profitable to the traditional satellite industry.
The development may be made in tether technologies, namely in construction of Terminator Tether.

The Terminator Tether is made of tether technology using cables made of high-strength fibres such as Spectra, Zylon, or Kevlar. The Terminator is conceived to be able to conduct various functions such as propulsion, space debris removal and power generation. It is a small, lightweight system that will use passive electro-dynamic tether drag to rapidly de-orbit spacecraft from low Earth orbit. It can also provide a low –cost and reliable method of mitigating the growth of debris in valuable constellation orbits and to remove a typical constellation satellite within a few months.

Space Solar Power could be developed thanks to the space station. Conceived by Peter Glaser this design proposes using a large number of satellites as a means of collecting the sun's energy to be beamed as microwaves to a ground

[47] NASA, *supra* note 42 "NASA: Commerce and the International Space Station."

station and then distributed through the existing electrical system. The facilities that are provided by the Space Station would allow the further development of the project.

Satellite servicing could be one of the most daring projects planned on the ISS. It would consist of providing the maintenance and repair services for in-orbit satellites.[48] Potential services provided could consist of fixing problems that arise during various stages of the satellites life, the "International Space Satellite Servicing Station" [49]will also permit the re-fuelling, replenishment of degrading parts (e.g. batteries and solar arrays), replacement of failed equipment and the potential satellite upgrades.

An essential element of the necessary hardware for establishing I4S is space tug called Aetos. It is capable of navigating to the target satellite, grappling it, interfacing with its fuel system, returning it to the ISS, interfacing with the ISS and returning the satellite to its original orbit.[50]

The development of such a facility will greatly affect the satellite market, and, indirectly, the whole space business. A longer life expectation for satellites will change marketing strategies, financial analysis and business plans. Yet, it may result in reluctance of the traditional satellite industry, as they could perceive the new maintenance of the satellite as a threat to their manufacturing business.

Although this project may have great success before the private satellite operators, namely before the operators of the LEO satellite constellation, this project will have to take into account the considerations of the present satellite manufacturers. The absence of standardisation can also be a great impediment to the accomplishment of this project.

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[48] NASA, *supra* note 42
[49] [Hereinafter] called H4S
[50] *Open to business, supra* note 14.

c.) Materials and processes

Materials science investigates the relationships among the structure, properties and processing of materials

Materials research is an activity conducted on behalf of numerous industries and serves many purposes. Materials research focuses on improving upon existing materials, creation of new processes for their manufacture or use. Micro-gravity materials scientists seek to use micro-gravity to study the process by which materials are produced and the relationships between the formation of a material and its properties. One such method uses containerless processing which eliminates impurities and stresses that are realised when the material comes in contact with container walls.[51]

As industries are reaching their limits of what they can do with ordinary silicon –based materials the studies in micro-gravity would bring significant improvement in the field of the new semiconductor materials. They may be used in the largest information technology industry.

The Aircraft and automotive engine components, gas turbine components, fibre optics telecommunications, thermal, electrical, environmental and ballistic insulation manufacturers will be interested in research in ceramics materials.

Space also enables the collection of data needed to understand and to resolve practical combustion problems. These measurements are most made on large, steady, slow –moving, and symmetric flames that provide good time and space resolution. These simplified flames are not present on Earth because convection causes flames to take on their characteristically elongated shape.[52]

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[51] NASA *supra* note 42.

[52] For more details on science combustion see on <http://microgravity.nasa.gov/Combustion.html>

Research conducted in this area is important as well for heating and transportation technologies and because of the impact of air pollution caused by combustion-generated pollutants.

d.) Fluid physics

Fluid physics is a fundamental science of understanding of practically all industrial and natural processes. The low-gravity environment allows the scientists to probe into the flow phenomena almost in ideal conditions and to study the flows that are usually masked on the Earth.

The knowledge obtained in these conditions will be of a great interest for the numerous industries such as spacecraft manufacturers, and information technology companies.[53]

e.) Entertainment

The three most probable domestic entertainment industries in a position to involve the ISS in their content are television, motion pictures and internet. They would contribute to the large awareness of the general public about the operation of the ISS. Most likely the promotion of four different areas will be privileged: sound stage which includes external shots of deep space, the celestial bodies, the planets in the solar system, space athletic events, showing the regular sporting events in an on-orbit facility, space tourism, and space theme parks which would be built on orbit in order to provide entertainment to visiting tourist. [54]

Media can also benefit from Earth Observation activities that are provided by the Hyperspectral and SAR payloads system. The target users would be technical

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[53] For more detailed information on fluid physics see on <http://microgravity.nasa.gov/FPTP.html>
[54] *International Space Station as an Earth Observation Platform*, *supra* note 1.

journals such as National Geographic. The latter often uses Earth observation imagery to illustrate various applications.

f.) Education

Private sector education initiatives surrounding ISS research represent potential commercial markets where NASA expenditures could (what?...). Boeing was the first one to begin exploring the possibility of developing an international space education program. It was said that Boeing believed that "few organisations would walk away from the opportunity to bring education to the children of the Earth"[55]

According to NASA's research, educational programming generated on the ISS is likely to find numerous terrestrial markets. It was suggested to create a program on board of the International Space Station during which the astronauts in residence on board the ISS would conduct short 10 to 15minute live presentations and/ or interactive discussions carried by a teacher in the classroom. Successful marketing and advertising on this matter would create an independent market involving the distribution and sales of the education related materials from the ISS.

g.) Earth Observation available markets.

Hyperspectral and SAR technologies described in the technological part provide the ISS with an opportunity to commercialise its products in several markets. The orbit of the ISS is unlike that of any existing remote sensing satellite. It is more limited for he look angles and image location. Yet, it has a high potential for use in several application domains such as agriculture, boreal forests, major construction projects.

1. Agriculture

According to the research done by the Canadian Space Agency[56], Hyperspectral data will be used to identify and quantify areas where there are problems in the crops to facilitate precision agriculture and improve productivity. Another potential market is assumed to be irrigated land. Major users interested in this data will be large corporate farmers, chemical dealers, seed dealers, equipment dealers and customs operators. Most likely the same users will be interested in the SAR products which will allow the crops monitoring and, therefore, predict the necessity for the supply of the vital crop.

2. Forestry

The increased deforestation of the recent years had preoccupied governments of the industrialised countries. The ISS Earth Observation capacities will provide the public with information enabling the improvement of the current situation. While the SAR data would cover the map updating and forest inventory, Hyperspectral data would allow the forestry community to evaluate the vegetation health, regeneration success. Potential users are mainly governmental organisations and logging companies.

3. Mineral and Petroleum Exploration.

Mineral exploration is by its nature additive in how it uses data sets to decide on where to look to develop a new mine. The most critical element to all exploration is the exposure of bedrock. In unglaciated regions the Hyperspectral data would allow to locate this bedrock and provide the mineral explorers with more information on where to look for samples.

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[55] Cathleen E. Shields, *"The International Space Station: An Opportunity for Industry–Sponsored Global Education"*, (The Boeing Company, 1999), in NASA *supra* note 42.

Another potential market of Hyperspectral imagery is in petroleum exploration related to ground seeps. It would target such industries as Offshore Oil and Gas Exploration Companies and Government Geological Surveys.

4. Wetlands

There is no obvious commercial market for the wetlands, however the wetlands are very important for the environmental purposes as they protect shorelines from the erosion and storm damage. They are also a major wildlife habitat.

Government Agencies such as Canadian Wildlife Service and Parks Canada, Chesapeake Bay in USSA, Nakuru National Park in Kenya are some of the potential users.

The information required by these users concerns health, extent and changes within a wetland. In many jurisdictions those causing any negative impact are legally obligated to correct any negative changes. For this reason highly accurate aerial photography is used in accordance with the laws of evidence.

Many projects involving monitoring of the Coastal water will interest governmental Agencies as it would provide data with respect to the problems of pollution and sewage management

5. Disaster management and Insurance.

Canadian Space Agency' research has shown a great potential of using the Earth Observation systems of the International Space Station for the disaster management. The Hyperspectral imagery could embrace a very large number of fields such as large technological accidents and spills; areas affected by tsunami, coastal and land areas, refugee migrations, desertification, and the effect of global warming.

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[56] *International Space Station As an Earth Observation Platform, supra* note 1.

The data provided by the ISS systems of Earth Observation will provide the disaster management agencies with important new opportunities. The major clients are foreseen to include the Non –Government Agencies, aid agencies, and the insurance industry. It will allow these organisations to intervene before the disasters by using Hyperspectral data in mitigation and preparedness and after the disasters to evaluate damage assessment, recovery and remedy.

6. Development and Construction

The clients like major engineering companies, pipeline companies, utilities, environmental, consulting firms, land developers would be able to take advantage of the imagery provided by the ISS systems that will cover vegetation, ecological mapping, geological mapping and the general evaluation of the location. The received information could help them speed up the environmental agencies' approval.

II. Management of the International Space Station

Although the International Space Station seems to be an ambitious project with a strong potential for commercialisation because of the markets it can cover, this potential is not always obvious.

These difficulties are due to the fact that the space station's international marketing structure favours political co-operation rather than commercial efficiency. In addition, due to its legal framework with its numerous lacunas potential users are not encouraged to get involved to the maximum extent possible which would encourage efficiency

a.)Drawbacks of the "genuine partnership"

The division of management among the partners is laid down in the IGA which states in its Article 7 that:

> *Management of the Space Station will be established on a multilateral basis and the Partners, acting through their Co-operating Agencies will participate and discharge responsibilities in management bodies established in accordance with the MOUs and implementing arrangements as provided below.*[57]

The United States assumes the main role in this undertaking since NASA is responsible not only for management of its own program(including utilisation activities) but also for the *"overall program management and co-ordination of the Space Station."*[58]

Other partners are responsible for the management of their own programs as well as for the development and implementation of detailed safety requirements and the plans for the provided elements . As far as the overall responsibilities are concerned the other partners only support the United States's leading role .[59]

The managing structure of the ISS lacks commercial efficiency due to the fact that the initial intention of the partners saw the ISS as a platform for the promotion of governmental interests as opposed to a commercial venture. Another major obstacle to co-operation on Alpha Station besides political confrontation and the absence of a unified marketing policy is the incompatibility of the various nations' spacecraft systems. The ISS management will be constantly faced with the problem of the compatibility of hardware/ software of different countries because each country establishes its own operational requirements for its respective space systems.. Therefore, the Arrangement stresses the need to reach agreements on a case-by-case basis to ensure efficient and effective operations on the ISS.[60].

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[57] Ibid. Art. 7of the IGA
[58] Ibid Art. 7of the IGA
[59] Ibid Art. 7.3 of the IGA
[60] Ibid Art. 8 of the IGA, also see Art 6.2.21on the Respective Responsibilities, of the MOUs

Since each of five partners represents a different commercial market, each has its own program for the development of the station.

According to the Memoranda of Understanding each Partner has a certain share of the International Space Station that they can use. As Article 9.1 of the IGA states:[61]

> *Utilisation rights are derived from the partner provisions of user elements, infrastructure elements, or both. Any Partner that provides Space Station user elements shall retain use of those elements, except as otherwise provided in this paragraph. Partners which provide resources to operate and use the Space Station which are derived from their Space Station infrastructure elements, shall receive in exchange a fixed share of the use of certain user elements.*

The ISS utilisation rights comprises three different types of allocations available to the Partners for the commercial use of the station. The ISS elements available for utilisation and potential commercialisation include "user accommodations", "the utilisation resources", and utilisation crew time. Once resources for ISS operations such as power and communications are covered the remaining "utilisation resources" can be used for commercial purposes.

From the point of view of global allocation, Russia should be excluded from this scheme because it represents a special case. Due to its crucial role in constructing the station, it has reserved the right to keep user accommodation utilisation rights and utilisation resources of the Russian module for its own use.[62]

Others,[63] have concluded numerous agreements according to which they exchanged their respective utilisation rights as seen in the example of the European

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[61] Ibid. Art. 9 of the IGA.
[62] See the MOU between NASA and RSA.
[63] *Supra* at 10 –11.

program.. According to the initial agreement the rights which were assigned are as follow[64]:

ISS Partner	User accommodation	Utilisation Resources	Crew Time allocation
USA	97.7%of the US module 97.7 %of the US accommodation sites for external payloads 46.7 %of the Columbus module 45.7% of the JEM	76.6 of ISS utilisation resources	76.6%of on–orbit crew time of the equivalent of four astronauts .
Russia	100% of the Russian Research modules 100% of the Russain accommodation sites for external payloads	100% of ISS utilisation resources that Russia provides	On-orbit crew time of the equivalent of three astronauts
Japan	51% of the JEM	12.8% of the ISS utilisation resource	12.8 ofon –orbit crew tine of the equivalent of four astronauts

[64] On the time, resource and accommodation sharing, see Art. 8.3a of the MOUs between Partners,

Europe	51% of the Columbus module	8.3% of the ISS utilisation resources	8.3 of on-orbit crewtime of the equivalent of four astronauts
Canada	2.3 % of the ISS user accommodation provided by NASA, ESA and Japan	2.3% of ISS utilisation resources	2.3 % of on –orbit crew time of the equivalent of four astronauts.

Article 9 of IGA and respective MOUs[65] authorise Partners to barter their respective allocations. However, this apparent flexibility endangers a successful commercialisation. Complicated utilisation of time-sharing combined with the necessity to adopt to the different micro-gravity quiescient periods[66] may confuse potential users and form a schedule that maybe unsuitable for many of them.

In addition the process of allocations barter has to be preceded by governmental bodies.

Any transaction will have to be approved by all the Partners, on a case by case basis which introduces the possibility of political confrontation and thus endangers the commercial endeavour.

In order to make the ISS a truly international successful undertaking, it is important for the Partners to attract as many non-partner participants as possible.

The process of governmental participation by a state non-signatory to any ISS agreement is already taking place through the participation of Brazil. An

[65] Art. 8.3.1 of the MOUs between ESA and NASA, CSA and NASA, RSA and NASA.
[66] See *supra* at 7

agreement was reached by the Brazilian Government and NASA, in order for Brazil to fly scientific experiments using NASA resources.[67]

The secondary phase of participation will be to reach the industries of countries that are not partners within the context of the ISS Agreement. This will be difficult to achieve due to the fact that the managing structure of the ISS is not adapted for an easy integration of the non signatories of the IGA . Since the Agreement was conceived as a consensus, it suffers the defects of the absence of an efficient decision –making mechanism.

Article 9 stipulates that[68] :

> *"Each Partner may use and select users for its allocation s for any purpose consistent with the object of this Agreement and provisions set forth in the MOUs and implementing arrangements:*
> *any proposed use of a user element by a non–Partner or private entity under the jurisdiction of a non -Partner shall require the prior notification to and timely consensus among all Partners through their Co-operating Agencies.*

This article opens, on the one hand, with the possibility for a wider international marketing but, on the other hand, it mounts considerable obstacles by requiring the necessity of consensus every time a non partner or private user is involved. These proceedings may become discouraging for various industries as well as time consuming because of the complexity of negotiation process between the governmental agencies.

Private users will also have to overcome a mountain of administrative barriers in order to reach the market of the Space Station while dealing with the peculiarities of their respective agencies.

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[67] *Open for Business, supra note 14.*
[68] Ibid. Art 9 of the IGA.

b.) The problems related to the access of the Space Station

In order to access the Space Station and to use it for commercial purposes, a private entity has to apply through a space agency to obtain a license to participate in future space activities. The private partner has also to submit a proposal to one or more of the ISS Partner Space agencies. [69]

Each agency has its own procedure to follow for potential users. Thus, the current procedure to access space via NASA requires an interested entity to form a partnership with a specific commercial space centre, which represents government, universities and industry. This private entity has to meet technological readiness requirements, business plans, market assessment and evidence of significant commercial resources at risk, space flight requirements, and funding availability for product.

The Japanese agency has a similar procedure but it is open only for Japanese companies.

To reach the ESA a company would need to contact an information centre for users at the European Science and Technology Centre and submit their proposal to the European Utilisation Board. A company from a country that is not an ESA member state participating in the ISS program will be allowed to access to the ISS through ESA but will have to pay the full cost of the experiments as well as the flight costs.[70]

The Canadian Space Agency[71] is planning to establish a special managing company incorporated under the Canadian law which would deal with the commercialisation of the International Space Station expressly. It will also consider

[69] *Open for Business*, see supra note 14
[70] For the procedure to follow in ESA see online <http://www.estec.esa.nl/spaceflight/index.htm>

the applications from the potential users and commercial viability of the projects submitted to it. It has already signed an option for a contract with an education company who purchased CSA's allocation in order to use the Station for some education purposes. The biggest constraint for the commercialisation is the limited allocation provided to the Canadian Partner.

Russian procedures to access the Space Station remain unclear. Most likely the Rocket Space Corporation Energia will provide services on semi-commercial basis since the financial situation in Russia does not allow to use the ISS for purely scientific research with no commercial implications.

After the applications are accepted by the respective partners agency they are supposed to be approved by other Partners as provided in the Article 9. The Partners intend to manage the ISS through the Multilateral Co-ordination Board[72]. The MCB has the task ensuring co-ordination of the Partners related to the operation and utilisation of the ISS, either periodically over the life time of the program or promptly at the request of any Partner.[73]

It is a representative body composed of the RSA Director General, the Science and Technology Agency's Director General of the Research and Development Bureau (Japan), the ESA Columbus Programme Deputy Head, the CSA Vice-President for Space Flight (Canada) and presided by the NASA Space Station Program Director[74]. All the decisions of the MCB are made by the consensus and if the consensus cannot be achieved, NASA's representative will take

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[71] Interview with Stephane Corbin, Head of the Department for the Commercialisation of the ISS in the Canadian Space Agency, (April, 2000).

[72] Art. 8.1.b of respective MOUs. This Article reaffirms the principle of consensus adopted by the partners, it states that: "*The parties agree that, in order to protect the interests of all Partners in the program, the operation and utilisation of the Space Station will be most successful when consensus is reached and when the affected partners 'interests are taken into account. MCB decisions will not modify rights of the partners specifically provided in this MOU*".

[73] *Open for Business, supra* note 14

[74] J.B. Ashe III, "Space Station Alpha: International Shining Star or Legal black Hole?", (1995), 9 Temple Intern. Comp. L. J..

decisions[75] subject to the dispute matter resolutions. MCB is supposed to meet periodically or at the request of the Parties or a Co-operating Agency.

Three panels were established in order to insure co-ordination between the Partners.[76] The System Operation Panel exists for the co-ordination of the operations activities and operations planning activities and it is composed of the representatives of each country and take decisions on consensus basis with an option to address the MCB in case the consensus fails. Utilisation Operations Panel on the other hand is responsible for the development, approval and maintenance of the Utilisation Management Plan (UMP) establishing strategic, tactical and execution aspects of utilisation management. The UMP will also establish processes for utilisation of ISS elements, including the user support centres and other ISS unique ground elements provided by all the Partners.[77]

Multilateral Crew Operation panel is the third subdivision of the MCB and it is responsible for all operations concerning the personnel on the board of the ISS. The Partners tries to organise the managing structure of the ISS as a net of compromises, but by that effort they defeated potential economic efficiency that the ISSmay have acquiredhad it had more autonomous management body that was able to take decions that were not influenced by political considerations . The effort should have been more oriented to reach compromise between economic commercialisation concerns and scientific priorities as opposed to the governmental preoccupation with political efficiency.

Besides the management problems that ISS may encounter, the legal framework organised by the Intergovernmental Agreement and respective MOUs

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[75] NASA's role in decisions making process is due to the financial participation of the latter in the project, however it does not affect the rights under the Agreement, see MOUs, also see statistics in Annexe III.

[76] See respective MOUs, provisions on Management Aspects of the Space Station Program Primarily Related to Operations and Utilisation.

[77] *Open for Business, supra* note 10

does not encourage the private users. It raises numerous problems related to the confusion and uncertainty of the set of rules established by the Agreement.

Chapter II Legal framework for the commercialisation of the ISS.

The Agreement which constitutes the legal framework and bedrock for the commercialisation of the International Space Station was signed in Washington, DC on 29th January 1998.

This Agreement is an international treaty that once ratified becomes binding on the Contracting States.[78] More detailed provisions are included in the bilateral agreements known as Memoranda of Understanding which supplement the agreement. It is conceived as international space venture entirely based on "genuine partnership"[79].

The Intergovernmental Agreement was drafted in accordance with the existing international law developed within last 50 years along with the space exploration, but it is not a new co-operative effort. NASA has concluded many agreements with other countries and it has achieved similar results in co-operation with Soviet Union in projects such as Apollo-Soyuz and Shuttle-Mir.[80]

The innovation brought by the Agreement is due to the size and ambition of the ISS project. Numerous technologies and political concerns gave birth to many new legal issues ..S. Malpass thinks that with this Agreement

> *"...the space law has been broken in to two components. One involves principles of international treaties, essentially Earth-oriented law in*

[78] R. Jakhu, Note from a Seminar on Legal Environment of International Space Activities, Moscow, Russia, (26-27 February 1998), [unpublished]
[79] Art 1 of the IGA.
[80] On the history of these projects see online <http://spaceflight.nasa.gov/history/index.html>

the areas of launch liability and contracts. The other component deals with more futuristic legal concepts to be applied to the social order of long-duration manned missions, such as will exist aboard the space station. This second component has been referred as "astrolaw", the law of living and working in outer space. The legal regime of the space station is primarily concerned with astrolaw. This area of space law will expand as space law becomes predominantly private law to deal with the day-to-day problems of people living and working in space."[81]

These logically leads us to see provisions of the IGA under the two angles: traditional space law and its implications on the International Space Station legal regime and the alleged astrolaw.

I Traditional space law features.

The Intergovernmental Agreement has incorporated in its structure several main principles developed by the decades of the International Space law. It states in the Article I that the

"Object of this Agreement is to establish a long-term international co-operative framework among Partners on the basis of genuine partnership, for the detailed design, development, operation, and utilisation of a permanently inhabited civil international Space Station for peaceful purposes in accordance with international law."[82]

By this statement the Agreement has consecrated a well established principle of peaceful exploration[83] of the outer space which is *"the common heritage of the mankind"*. This provision indicates that the Agreement will not change any rights and obligations, deriving from the previously elaborated norms.[84]

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[81] S. R. Malpass, "Legal Aspects of the United States/ International Space Station,"(1991) Hous J.I Intern. L. Fall.

[82] Art. 1 of the IGA

[83] On peaceful exploration see letters after the MOU's

[84] This assertion is confirmed by the express provisions of the Article 2 which reminds that:
"Nothing in this Agreement shall be interpreted as:
(a) modifying the rights and obligations of the partner States found in the treaties listed in paragraph 1 above, either toward each other or toward other state, except as otherwise provided in Article 16

Under the doctrine of "*the common heritage of mankind*" outer space can not be owned or claimed by any sovereign. This principle was adopted by analogy with the Antarctica's and high seas' legal regime as both of them used the principle of the common heritage of mankind.[85]

This principle being a bedrock of the legal regime governing the outer space, the Agreement recall in its preamble all other international instruments that regulated the outer-space.

a.) The Outer Space treaty

The recalled treaties of the Preamble are four treaties governing the activities of the States in the exploration of the space.

The Treaty on Principles Governing the Activities of States in the Exploration and use of Outer Space, including Moon and other Celestial Bodies, entered into force on 10 October 1967 and is considered as laying down the basic principles of the outer -space legal regime. [86]It adopted the common heritage of

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(b)affecting the rights and obligations of the partner States when exploring or using outer space obligations of the Partner States when exploring or using outer space, whether individually or in co-operation with other States, in activities unrelated to the Space Station
(c) constituting a basis for asserting a claim to national appropriation over outer Space or over any portion of outer space."

[85] Article IV Section I of the Antarctic Treaty provides that:
"*Nothing in the treaty shall be interpreted as a renunciation by any signatory of previously asserted claims to territorial sovereignty in Antarctica as affecting a signatory's recognition or non - recognition of any other state's claim to such sovereignty", Antarctic Treaty*, December 1, 1959. Helen Shin suggested to compare Antarctica's legal regime to the outer space with respect to the problems arising from the lack of laws regulating inter-personal relations. She underlines the absence of a comprehensive jurisdictional regime due to the fact that Antarctic treaty regulate only the activity of the scientific personnel, members of their staff, and observers who are nationals of that state. On the contrary the regime of the high seas is more concerned a detailed on the principles governing private relations. Thus, the State under whose flag a ship sails, continues to have his exclusive jurisdiction over its own personal. See H. Shin, "Oh, I have slipped the surly bonds of earth: Multinational Space Station s and Choice of Law", (1990), California Law Review, 1375.

[86] Outer Space Treaty currently binds 102 nations.

mankind philosophy for outer space and it provides in its Article VI that parties shall bear the inherent responsibility to the international community when conducting space activities whether the actor is a government agency or private enterprise.[87] These responsibilities include the maintenance of international peace and security, and promoting international co-operation and understanding. This is further confirmed by the IGA. Furthermore, the Outer Space Treaty provides that the State "on whose registry an object launched into outer space shall retain jurisdiction and control over such object and over any personnel thereof, while in outer space or on celestial body."

This essential principle is perpetrated by the IGA. According to the Article 5 each Partner shall retain jurisdiction and control over the elements it registers in accordance with paragraph I above and over personnel in or on the Space Station who are its nationals. This is a fundamental principle as it guarantees the launching countries the ownership of their elements once they are in the outer space which belongs to nobody. It excludes all potential misinterpretations that can be caused by the specific legal regime adopted for the outer space and possible appropriation by another country because the ownership allegedly disappeared once put into space[88].

b.) The Liability Convention

Another major space treaty which is recalled in the preamble is the Liability Convention of 1972.[89]

It establishes two main principles regulating the damages resulting from the space activities: the strict liability applicable to the damages caused on the earth, on the seas and in the air, and liability based on negligence for damages caused in space.

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[87] Art. VI of the Outer Space Treaty.
[88] See S. R. Malpass, *supra* note 81 .
[89] The Liability Convention was adopted and entered into force on March 22, 1972.

Hence, Article II of the Liability Convention[90] provides that:

A launching State shall be absolutely liable to pay compensation for damage caused by its space object on the surface of the earth.[91]

The Intergovernmental Agreement expressly refers to the Liability Convention in the Article 17 that:

Except as otherwise provided in Article 16, the Partner States, as well as ESA, shall remain liable in accordance with Liability Convention.

It may be assumed therefore, that the claims not specifically covered by the cross -waiver of liability, should fall under the umbrella of Liability Convention and be treated through the diplomatic channels.[92]

The alleged clarity of the provisions is somewhat precarious and it may give birth to several issues that will be discussed below.[93]

c.) The Registration Convention

The third Space treaty applicable to the space station is the Registration Convention of 1975. The Registration Convention formalised the process for the countries or private entities to register their space objects in order to maintain jurisdiction and ownership of such objects.[94] To gain the benefits of the United

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[90] Ibid Art II of the Liability Convention

[91] This provision imposes on Partners the risk of paying the exorbitant costs of the potential damages related to the assembly and operation of the International Space Station. It will be important for the Partners concluding the contracts with non-Partners participants to determine whether the sub-contractor becomes jointly liable under the Liability Convention on joint and several liability for damages caused by the object. Article 17 (3) suggests as follow:
"*Regarding the provisions of launch and return services provided for in Article 12(2), the Partners concerned (and ESA if appropriate) may conclude separate agreements the apportionment of any potential joint and several liability arising out of Liability Convention*" *ibid* see IGA.

[92] The Liability Convention foresees a special procedure when the diplomatic solutions fail. The claims Commission may be required to be established.

[93] *Infra* at 72

[94] Convention of Registration of Objects launched into Space, January 14, 1975

Nations space treaties, any space object must be registered under this Treaty. The Secretary General of the United Nations maintains the register.[95]

Accordingly to this Convention Article 5 of the IGA provides that:

> *In accordance with Article I of the Registration Convention, each Partner shall register as space objects the flight elements listed in the Annex which it provides, the European partner having delegated this responsibility to ESA acting in its name and on its behalf.*

Under the Registration Convention if two States join in launching a space object, they must jointly determine who will register the object.[96] However, the States can agree among themselves as to which State will maintain jurisdiction and control over the object.[97]

When space objects cause damage and are unidentifiable through the registry, the Partners will co-operate to identify the objects using all space monitoring and tracking technology available. These provisions attempt to ensure that when space objects cause damage, the proper party will be held liable.[98]

d.) The Agreement on Astronauts

The Agreement on the Rescue of Astronauts, the return of Astronauts, and the Return of Objects launched into Outer Space[99] is the last treaty referred by the IGA. This agreement requires each participating country to take all possible steps to rescue and render assistance to personnel of space who land in its territory through accident, distress, emergency, or unintended landing.[100]

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[95] S. Malpass, *supra* note 81.
[96] Art. 2 of the Registration Convention
[97] Id. Art 2
[98] S. Malpass, *supra* note 81
[99] The Rescue Agreement entered in to force on 3 December 1968.
[100] Articles 1-2

Since International Space Station is conceived as an inhibited station, the risk for the astronauts working on it to land in unintended territory on their return is foreseeable and in this case the Rescue Treaty would be applicable. The provisions of the Treaty may also be applicable in the event of accident occurring to a space shuttle travelling to or from the station, or involving an element of the station that has fallen on earth. A State which may discover such en element is under the obligation to notify the launching state about the discovery and if required to recover the latter.[101]

II The Law specific to the Space Station

The originality of the Space Station Agreement is primarily due to the fact that it refers not only to the Partner States[102] but also to the Partners who are distinguished from the States. This novelty is due to the particular status of European Space Agency[103]. The latter possesses status of an International Organisation and therefore can act on behalf of the European Governments members to ESA. It is stated in the Article 5:that each Partner shall register the elements it provide, *the European Partner having delegated this responsibility to ESA.*

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[101] Art. 5 of the Rescue Agreement

[102] According to the Article 3

(b) the Partners(or where appropriate, "each Partner"): the Government of Canada; the European Governments listed in the Preamble which become parties to this Agreement, as well as any other European Government that may accede to this Agreement in accordance with Article 25(3), acting collectively as one Partner; the Government of Japan, the Government of Russian Federation and the Government of the United States.

(c) Partner State; each Contracting Party for which this Agreement has entered into force in accordance with Article 25.

[103] The 1975 Convention for the Establishment of a European Space Agency provides in Article XV and Annex1° that: *"The Agency shall have legal personality. It shall particular have the capacity to contract , acquire and dispose movable and immovable property and to be a party to legal proceedings."*

Thus ESA was delegated a power sufficient to enable it to conduct relevant to the international Space Station operation.

This distinction was necessary to be made in order to establish the retribution of jurisdictions over the activities. Although the ESA possesses a legal personality, it can not exercise all the powers attributed to States such as enforcement of laws and exercise of jurisdictions; enforce judgements and laws therefore it was necessary to introduce States in the Agreement.

The IGA being the international treaty, its entry into force requires ratification by each State who signed the Treaty. Hence, the IGA is subject to national proceedings of ratification proper to each participating State. This principle is crucial for the development of the International Space Station. Since the Agreement introduces numerous novel in their substance provisions, one may expect the necessity to modify national legislation of the participating countries. Therefore the national legal instruments brought to the ratifying authorities should comprise necessary modification in several parts of the national laws.[104]

As it was revealed before the Intergovernmental Agreement focuses on the political commitments of the Partners and the legal regime within which the program will operate.[105] It favours the "genuine partnership" among the signatories, who consequently assuming all the disadvantages that may result from the inter-governmental co-operation based on the consensus approach.

The ISS is not the enterprise with no possible exit. Under the IGA any partner may withdraw... *at any time by giving... at least one year's prior written*

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[104] See Bill C-4 of the House of Commons of Canada ratifying the ISS (first reading, October 15, 1999) This bill introduces modifications in the Canadian Criminal Code in order to bring it in accordance with the IGA. Similarly Germany has passed the bill which has modified provision of the national Intellectual Property Law (Bill, July 13, 1991). However many other provisions require modifications in the national laws and they have not been attentively examined by the Partner States. Thus, the financing part should be included in the provisions related to national budget (see Article 15 of the IGA).

[105] S. Malpass, *supra* note 81

notice and under the obligation to endeavour to reach agreement concerning the terms and conditions of that partner's withdrawal.[106]

The Space Station is neither a club open to signatories only, it contemplates future use of the Space Station by non –Partners. However, no new initiative can be taken without the original signatories assessment. Thus, any proposed use of a component of the space station by a non-Partner or private party requires prior notice to all other partners.[107] Likewise, a Partner may not transfer ownership to any non Partner without first obtaining the concurrence of all the other Partners[108]

As for the general structure of IGA, it deals with several domains and it is seen as a model for future international co-operative space ventures. The IGA presents many legal issues some of which are not addressed as adequately as others. Legal issues involved in the space station include: jurisdiction and control, liability and registration, criminal jurisdiction, dispute resolution and taxes which constitute the core of the another component proper to the venture. However, after a brief description of the issues dealt with, this study will be focused on the conflicts which may occurs in the fields not covered by the cross–waiver of liability.

a.) Jurisdiction and control

As it was mentioned on several occasions, the operation of the International Space Station is based on the principle of *genuine partnership*. It implies that each Partner provides the elements listed in the Annex to the Agreement and retain the ownership over the elements.[109] Also each Partner acting through its Co-operating Agency would inform the other Partners about the ownership of any equipment in or

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[106] Ibid Art. 28
[107] Ibid Art. 9
[108] S. Malpass, *supra* note 81 .
[109] Art 6 of the IGA .

on the Space Station.[110] Consequently Partners are obliged to bear the costs of fulfilling their respective responsibilities under the Agreement, including "*sharing on an equitable basis of the agreed common system operations costs or activities attributed to the operation of the Space Station*"[111]

Moreover, the Partners are responsible for sustaining the functional performance of the elements they provide[112], of developing and managing the programs on the elements they provide, including the utilisation activities, implement detailed safety requirements and plans on their respective elements.[113]Consequently, to the retained ownership principle and the provisions of international law: each Partner is required, in accordance with the provisions of the Registration Convention, to register as space objects the flight elements it provides.[114]

The Outer Space Treaty[115] and the Registration Convention [116] assigns to the State of registration the jurisdiction and control over its space object and over the personnel. The ISS Agreement followed this logic and in similar terms assigned to the respective Partners to retain jurisdiction and control over the elements it registers and over the personnel in or on the Space Station who are its nationals.[117]

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[110] ESA has been entrusted with the ownership of the "*elements*" and "*equipment*" belonging to the European Partner, see Art. 5.2 of the IGA

[111] Ibid d Art 15 of the IGA. It is interesting to notice the provisions of Article (2): "*Financial obligations of each Partner pursuant to this Agreement are subject to its funding procedures and the availability of appropriated funds. Recognising the importance of Space Station co-operation, each Partner undertakes to make its best effort to obtain approval for funds to meet those obligations, consistent with respective funding procedures.*"
It seems that the Agreement is willing to avoid the obstacles of financing justifications by indicating to the States to make their best effort to obtain the financing. It also seeks to minimise the exchange of funds in the implementation of Space Station co-operation, which indicates the will of lift the financial proceedings burden.

[112] Art 10 of the IGA

[113] Art 7.3 of the IGA

[114] Art 5 of the IGA

[115] See *supra* at 34...

[116] See *supra* at .36

[117] Art 5.2 of the IGA

However, in the ISS the ownership does not always seem to coincide with the principle of retained jurisdiction.

Thus, Article 6 states that the transfer of ownership of any elements or equipment shall not affect the rights and obligations of the Partners under this Agreement. This leads one to believe that the jurisdiction shall not be changed even though the owner of an element is different from the original one. Logically, it may be assumed that in case of the transfer of ownership, the rights and obligation for the initial Partner owner who is State of registry, could be changed only if the registration is accordingly changed.

Similarly, to avoid potential confusion and deliberate modification of the registration, Partners agreed that they can not transfer the ownership of their elements to non–Partner or private entities without the concurrence of other Partners.[118]

This preoccupation was fully justified by an important consequence of the retained principles. The net of jurisdictions creates the coexistence of several legal systems on the Station. Already as the IGA drafted now, the stipulated rules lead to numerous problems concerning conflicts of jurisdictions. The hazardous transfer of ownership and change of registration in without clear modifications accepted by all participants could have tremendous consequence.

The IGA made an effort to eliminate the problems related to the discrepancies of the legal systems of the partners involved in the venture. It created a status quo regime of cross-waiver of liability which constitutes a particularity of the treaty. However, the drafters left several field untouched: the civil jurisdiction was not regulated to the full extent, the provisions on criminal jurisdiction need precision, the Intellectual Property demand further clarifications.

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[118] Art. 6.4 of the IGA.

b.) Cross–waiver of Liability

Due to the unique experience of the Space Station in the particular environment of the Outer Space and to the will to create a true international enterprise, only one legal system of a Partner -country could not be applicable to the whole undertaking. But the space activities involve a lot of risk that may provoke accidents and therefore, numerous liability issues can arise. In the condominium where several legal systems coexist the situation of legal chaos is highly probable. Such an anarchy could be dissuasive for the potential commercial users anxious about the lack of protection. The Partners may also be induced in confusion and unnecessary disputes . Thus, the whole undertaking could have been jeopardised.

The compromise was necessary to reach. The partners preferred the state of non-law, by installing the cross –waiver of liability.

Since certain terms of space operations are not clearly defined in current space agreements, article 5.2 provides working definitions for key words to include the following[119]: damage[120], launch vehicle, [121]payload,[122] protected space operations[123] and related entity.

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[119] J.B. Ashe, *supra* note 74

[120] Article 16.2 provides:

(c) *the term damage means:*

(1) the bodily injury to, or other impairment of health of, or death of, any person

(2) damage to, loss of, or loss of use of any property

(3) loss of revenue or profits; or

(4) *other direct, indirect or consequential damage.*

[121] Article 16.2 (d) provides:

the term launch vehicle means an object (or nay part of thereof) intended for launch, launched from Earth, or returning to Earth which carries payloads or persons, or both.

[122] Article 16.2 (e) provides :

the term "payload" means all property to be flown or used on or in a launch vehicle or the Space Station.

[123] Id. Article 16.2 (f) provides

the term "Protected Space operations' means all launch vehicle activities, Space Station activities, and payload activities on Earth, in outer space, or in transit between Earth and outer space in

The Article 16 aims to lift maximum of possible legal confusion by stipulating the cross–waiver of liability. According to this cross waiver each party waives all claims against any other Party, a related entity of another partner State, the employees of any of the partner State.

It bars the application of the Liability Convention as applicable to any damage suffered by one Partner as a result of the activities of another Partner. Thus, the Partners become "self-insurers for their own property damaged during protected space operations."[124]

The introduction of the cross-waiver of liability raises numerous issues related to negligence, defect of conceptions and thereby tremendous complexity of conflicts of jurisdictions and laws related to these subjects.

Since the objective of this Article is to encourage" participation in the exploration exploitation, and use of outer space through the Space Station, the protection in the form of cross-waiver of liability against any possible liability claim must be broadly construed to achieve this objective."[125] Hence, the Article 16 requires the parties to encompass into the cross-waiver of liability their contractors, subcontractors, users, and any customers of that Partner. The cross-waivers do not apply, however, to claims for intentional torts, intellectual property claims, or

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implementation of this Agreement, the MOU's and implementing arrangements. It includes, but not limited to:

(1) research, design, development, test, manufacture, assembly, integration, operation, or use of launch or transfer vehicles, the Space Station, or a payload, as well as related support equipment and facilities and services, and

(2) all activities related to ground support, test, training simulation or guidance and control equipment and related facilities or services.

"Protected Space Operations" also include all activities on Earth which are conducted on return from the Space Station to develop further a payload's product or process for use other than for Space Station related activities in implementation of this Agreement

[124] S. Malpass, *supra* note 81

[125] Art. 16.1 of the IGA

claims by a natural person for injury or death These exceptions will constitute the object of the analysis of the following chapters

c.) Exchange of Technical data and goods

Due to the enormous amount of data and hardware exchanged among the parties involved, the Agreement had to ensure that certain confidential proprietary rights are protected. The complexity of the Space venture requires each partner to be aware of the technical parameters and other aspects of each element. Therefore there should be an exchange of data and goods to a maximum possible extent.[126]
Article19 covering the exchange of data and goods stipulates that:

> *Except as otherwise provided in this paragraph, each Partner, acting through its Co-operating Agency shall transfer all technical data and goods considered to be necessary (by both parties to any transfer) to fulfil the responsibilities of that Partner's co-operating Agency...*

The necessity of such transfer being priority, the Article, however takes into consideration the sensitivity of the matter. The agreement requires the parties to implement national laws and regulations that shall apply to the requests for authorisation of transfers of technical data and goods by persons or entities other than the Partners or their co-operating agencies[127]. Article 19.3 expressly states that

> *Such technical data or goods shall not be used by persons or entities other than the receiving Co-operating Agency, its contractors or subcontractors, or for any other purposes without the prior written permission of the furnishing Partner state, acting through its Co-operating Agency.*

By this saying, the Agreement leaves to the Partners the possibility to prohibit the transfer of certain information due to security reasons. In addition, the Agreement ensures the confidentiality of data passing through means of communications used with "the connection to the Space Station"[128]

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[126] R. Jakhu, *supra* note 78.
[127] *Open to business*, *supra* note 14

With respect to the commercialisation aspect, the crucial questions concerning data is the confidentiality of data transfer. While exploiting the possibility of the International Space Station on the Earth Observation, the reception of the data requires a certain protection for the potential consumer. The confidentiality is theoretically ensured by the Article 19 of the Intergovernmental Agreement as follow:

> *Each Partner State shall take all necessary steps to ensure that technical data or goods received by it{...}shall be treated by the receiving Partner States, its Co-operating Agency, and other persons and entities (including contractors and subcontractors) to which the technical data or goods are subsequently re-transferred in accordance with the terms of the notice or identification. Each Partner State and Co-operating Agency shall take all reasonably necessary steps, including ensuring appropriate contractual conditions in their contracts and subcontracts, to prevent unauthorised use, disclosure, or retransfer of, or unauthorised access to, such technical data or goods.*[129]

Nevertheless this protection, a potential user may be preoccupied by the fact that the data is handled by the astronauts and hence may be accidently disclosed. Therefore, it seems necessary to elaborate a code of conduct to prevent eventual disclosure by the crew members.

Chapter III The issues non covered by the cross-waiver of liability

I. Criminal jurisdiction.

The ISS was conceived as a manned space station and, therefore, the presence of human beings is required for its function. The coexistence of several individuals, coming from different cultures and countries may be accompanied with difficulties which may incite criminal conduct. In addition, a particular environment of the Space station may provoke unexpected behaviour. Experiments have confirmed that living in space affects the plasma and vascular systems of astronauts. Also weightlessness causes fluid movement to the head which creates some dizziness and

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[128] Art. 13.4 of the IGA
[129] Art 19 of the IGA .

pronounced slowness in physical and intellectual reactions. Further weightlessness affects the normal flow of the endocrine system making body chemical composition and temperature unstable[130] All these factors taken into consideration may be favourable for the unusual conduct on the Space Station.

The provisions regulating criminal offences in space had to be foreseen. The drafting of such provisions is however problematic. What should be considered as criminal offence in space? Is it reasonable to apply the earthbound qualification to the space while aware of the physical factors which may affect the human behaviour??

The question that has troubled the space academic doctrine was to know if the solution to the "jurisdiction and control"[131] issue should dictate a solution to the criminal law issue by subjecting individuals to the criminal laws of the nation having jurisdiction and control over that portion of the space station where the crime is committed.[132]

Should the law of the individual who committed the crime follow the accused or should the law of the party on whose territory the violation occurred be applicable?

The Agreement on the International Space Station has retained almost all jurisdictional competence known in present International Law.[133]

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[130] S. Malpass, *supra* note 81.

[131] On the jurisdiction and control see *supra*.at 39

[132] Remarks by John O'Brien in The US/ International Space Station Aspects of Technology and Law, see supra.

[133] There are four accepted in international law jurisdictional principles:

1.The *Territorial Principle* which permits the courts of the place where a crime or a tort is committed to exercise jurisdiction. In the criminal context this is applied as the objective territorial principle whereby "jurisdiction is founded when any essential constituent of crime is consummated on state territory"

2. The *Nationality Principle* allows a State to regulate the activities of its nationals irrespective of their location.

3. The *Passive Personality Principle* under which, where a national of the State is the victim of an offence, jurisdictional nexus is claimed. Some States reject this principle.

4. The *Universality Principle* according to which the States can try persons committing crimes that are universally condemned by all nations.

The last but the most controversial principle is the *Protective* one is manly found in the extra-territorial application of US Anti-Trust Laws. The claim of jurisdiction is justified by the need to

The Agreement in its Article 22 retains as the general principle the exercise of jurisdiction by the State of nationality of the perpetrator of a criminal action.[134] This provision embodies the nationality principle in general.

However, the initial will of compromise has led parties to incorporate in the Agreement the possibility for other affected parties to exercise their jurisdictions.

Hence, Article 22.2 (a) affirms the passive personality principle by allowing the State whose national's life or safety is affected to claim the exercise of jurisdiction.[135]

The next paragraph generously accepts the possibility to apply the territorial principle. It authorises the Party on whose flight element an alleged misconduct is occurred to claim the exercise of the jurisdiction. However, the introduction of these principles has been attenuated. Thus, the affected party may request the consultation with the state of nationality and can exercise its criminal jurisdiction under the condition that the State of nationality either concurs in such exercise of criminal jurisdiction or fails to provide assurances that it will submit the case to its competent authorities.[136]

Nevertheless the conditions for exercise of "secondary" jurisdictions, the Space Station Agreement establishes several basis for the Partners to exercise jurisdiction, which increases the potential overlapping of competence .

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prevent adverse effects on the security of a State, see in general on jurisdiction principles in Criminal law C. Lombois, *Droit Penal International*, (Paris: Precis Dalloz, 1979), at .280.

[134] Ibid. Art 22.1 of the IGA

[135] Ibid Art. 22.2 of the IGA.

[136] Article 22.2 of the IGA opens the option of consultation to the parties, however, if by the expiry of 90 days delay one of the two conditions of the article 22. 2 are fulfilled, the affected party may exercise its jurisdiction.

In a hypothetical case where a British astronaut commits an offence on an American module and affects life and/or safety of a Japanese astronaut, several solutions may be presented. Assuming that the United Kingdom concurs to the exercise of jurisdiction by other affected states, the question remains, which affected State should exercise its jurisdiction?[137]The Japanese Partner may feel to be more affected since its national was a victim of an alleged misconduct. However, it means the exercise of the passive personality jurisdiction which is not accepted by the US doctrine. Taking into consideration the US interests in development of the Station, it may often have the greatest interest in exercising criminal jurisdiction over wrongdoers[138]. It may become a cause of political pressure on behalf of the United States during the required consultation to make other interested states to concur in the US exercise of criminal jurisdiction.

Certainly, the Article 22.4 encourages the Parties to the co-operation: Each Partner State shall, subject to its national laws and regulations, afford the other Partner assistance in connection with alleged misconduct on obit. Yet, potential conflicts over jurisdiction should not be ignored. Unfortunately, apart from diplomatic consultations the IGA does not provide any guidelines for their resolutions. How to determine the most reasonable jurisdiction?

Several proposals were made with respect to the determination of the most reasonable jurisdiction. Among them the doctrine of minimum contact test as recognised by the United States case law,[139] the third restatement and Nottebohm[140]

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[137] The question of complex offences remains also open: which State should be considered as the most interested to exercise the jurisdiction when the offence takes place in several different modules belonging to different States

[138] The US is the main builder of the International space Station; it is also its financial provider.

[139] The Minimum contact test had substantial precedents in the US since the *International Shoe* case, however, it is a civil case, see on the *International Shoe infra* at 83. A similar test was applied by *Lauritzen v Larsen*, 345 US, 571, 583-93 where the court refused to apply U.S. law when alleged tort occurred between Danish Parties on board a Danish ship not in its territorial waters and under an employment contract to apply Danish law, because these factors outweighed the fact that the defendant was served with process in the United States and had signed employment contract with plaintiff, a US citizen, while engaged in foreign commerce.

case in general International Law. According to this doctrine only the state which has sufficient contact with the criminal conduct can exercise the jurisdiction. In order to establish these minimum contacts a court dealing with the matter has to take into account several factors such as presence, domicile, residence, nationality or citizenship[141]...

However, the possible consideration of minimum contact tests as applied to the criminal jurisdiction is more relevant to the common law countries, while the civil law countries have weaker tendency to the flexible interpretations. Therefore, very often discrepancies of perception of various jurisdictions may lead to the conflicts.

In addition to the conflicts of overlapping jurisdictions, it is very unclear how the criminal laws enforced on the Earth will be applicable in Space; Due to the numerous factors that were mentioned in the beginning of this study, the human behaviour is highly modified in the conditions of weightlessness. As one author asserted: *Many criminal laws may be illogical when applied to space.*[142]

Human functions may be so greatly altered in the outer space, that it may become difficult to assess the mens rea element of a crime. The standards retained by the earthbound laws for determining the intent of committing a crime may be irrelevant in the outer space.

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[140] The International Court of Justice had to decide on the dispute bewteen Guatemala and Liechtenstein over a citizen of Germany, Nottebohm, who acquired the citizenship of Liechtenstein., that Guatemala refused to recognise. The Court decided in favour of Guatemala by applying minimum contact test in order to know whether the Nottebohm has enough connection citizenship of Liechtenstein, see Nottebohm (Guatemala v. Liechstenstein), [1955], I.C.J.

[141] The Restatement lists 11 basis for a State to assert personal jurisdiction: presence, domicile, residence, nationality, consent, appearance in an action, doing business in the state, an act done in the state, causing an effect in the state by an act done elsewhere, ownership, use or possession of a thing in the state and other relationships to the State which make the exercise of judicial jurisdiction reasonable.

[142] M. McCord, *supra* note 4 at 1954

Yet, the International Space Station Agreement does not provide us with guidelines on with respect to these matters and only assumptions could be made in this respect.

Hence, the drafting of a detailed code of the crew behaviour is required. It has already been foreseen by the IGA and the relevant MOU's, however all of the aforesaid should be taken in to consideration.

It would most useful and desirable that the applicable substantial laws took into account the specific case of offences committed in the outer space. The criminal behaviour in space should become a subject of attention with regard to the definition of crimes and their punishment.

It could be desirable to recognise the conditions of outer space attendant to the crime as mitigating factors in sentencing.[143]

II. The issues of the intellectual property provisions

The International Space Station was conceived to widen the human knowledge about the outer space environment. Micro-gravity environment provides an important arena for scientific research and exploration as we have seen in the chapter dedicated to the technology. Therefore, it was necessary to develop a set rules that could regulate scientific activity and protect the result obtained during the experiments. The IGA has set up a number of provisions on the intellectual property as applicable to the ISS. However, before examining provisions adopted by the IGA, it will be necessary to look at the development of the intellectual property law in space and the problems the drafters of the ISS Agreement had to face.

[143] M. McCord, *supra* note 4 at 1954.

a.) The problem of the Intellectual property in the outer space

The exploration of space has been carried by governmental entities due to the political sensitivity of the matter. The scientific mobilisation requested for the successful enterprise and the cost of undertaking could not be afforded by the private investors.
As the space activities enter their new era with the construction of the Space Station, private sector activities will increase.

The space shuttle has already demonstrated its commercial viability by proving the commercial advantages of space manufacturing. Use of data remotely sensed from Earth was another successful example of commercialisation and it caught the interest of the private industries. The space countries, especially the USA are now seeking for the commercialisation to the fullest extent of the space activities[144]. To achieve this task the participation of private investors is crucial. However, private entities investing in commercial space ventures will spend large amounts of money over a long period of time before a return on investment can be expected. They will also have to undergo the high risk related to the space business due to the novelty of technology, hostile environment of outer space and impossibility to access their own property once it is on the orbit. Those entities will require assurance that they can obtain profits form the space activities and especially that once the scientific exploration is commenced that they will be able to protect ideas and inventions resulting from their space activities. [145]

On this level , the intellectual property law development becomes vital for the private industries. Its importance has been succinctly stated by Lockheed Missiles and Space Company Counsel Roger Hover, in terms that

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[144] National Aeronautics and Space Act declared that "*the general welfare of the United States requires to the National Aeronautics and Space Administration...seek and encourage to the maximum extent possible, the fullest commercial use of space.*", 42 U.S.C. 2451, 1984.
[145] B.Luxenberg & G.J Mossinghoff, "Intellectual Property and Space Activities",(1985), 13, 1, J. Space L..

«The Intellectual property of private industry is vital to its existence. The information and technology which make up the proprietary data and trade secrets of a private industry are lifeblood of that industry. To the extent that the right to retain and protect such technology is diluted or lost, the industry will be weakened or destroyed. Thus, a vital issue of security to private industry in outer space activities is its ability to maintain its proprietary positions."[146]

It is even more true for the activities carried on board of the international Space Station. As we have analysed in the chapter concerning different available markets, the development of the Space Station is highly dependant on the success of the commercialisation of the potential facilities of research. Indeed, the microbiology, especially the protein Crystal Growth seem to be one of the most important programs foreseen[147]. Other experiments carried in the environment if the weightlessness constitute the major part of the ISS activities.

These program may result in a large amount of important inventions or discoveries whose benefits may be claimed by several participants. To assure the optimal application of the results obtained in the Space Station and to avoid possible conflicts the provisions regulating the Intellectual property protection were necessary, especially those concerning the patents. The Intergovernmental Agreement deals with the IP in its Article XXI. It starts by adopting a definition to the Intellectual Property.

1. The concept of IP and case of patents

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[146] R. K Hoover, "Law and Security in Outer Space Form the Viewpoint of Private Industry", (1983), 11, 198, J. Space L., as cited in A. J.Young " Law and Policy in the Space Stations Era", (Dodrecht/ Boston/ London: Martinius Nijhoff Publishers 1988)

[147] D.L. Burk considers the protein crystallisation process as "*the proper subject matter of a United States patent*" in his article, "Application of United States Patent Law to Commercial Activity in Outer Space", (January 1991), 6 Santa Clara Computer and High Technology Law Journal.. In the same article he emphasises the importance of the microbiology programs carried on the space objects for the United States and states in favour of the largest protection of American inventions so the superiority achieved in the biotechnology belongs to the US or remains under the control of the US firms that invested in the development of this domain.

This definition is crucial to the intellectual property law because of a « confusion which often exists in the mind of jurists, engineers or scientists when discussing « intellectual property » matters ». as Professor Oosterlink outlined [148]

In many countries the term of intellectual property covers copyright and related issues, while the term of industrial property deals with inventions and patents.

Without considering in depth this quarrel[149], it should, however, be mentioned that these discrepancies in interpretation preoccupied the drafters of the International Space Station Agreement. The outcome of the discussion was the adoption[150] of the definition given by the Stockholm Convention establishing the World Intellectual Property Organisation in its Article II. According to this definition :

« Intellectual Property shall include rights relating to

- literary, artistic, and scientific works ;
- performances of performing artists, phonogram, and broadcast ;
- inventions in all fields of human endeavour ;
- scientific discoveries ;
- industrial design
- trademarks, service marks, and commercial names and designations
- protection against unfair competition ;

and all other rights resulting from intellectual activity in industrial, scientific, literary *or artistic fields.*

Thus the definition of the WIPO regroups both terms of intellectual property as well of the industrial property. It aims to protect or encourage the inventor along

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[148] R. Oosterlinck, "Intellectual Property and Outer Space Activities", (1998) ZLW.

[149] The term of "industrial property" was firstly used in the international context by the Paris Conventions entered into force on 7 July 1884 according to which: *"The protection of industrial property has its object patents, utility models, industrial designs, trademarks, service marks, trade names, indications of source or appellations of origin, and the repression of unfair competition"*, see Article 1. This list is not exhausitve as the Convention authorises to the members of the Union to introduce in their national laws different kind of protection in addition to those given in the Article 1

[150] IGA Art 21

with taking into consideration the interest of the society. From this double preoccupation springs the double characteristics of the Intellectual Property protection:the creator is protected but generally for a limited period of time.

Our main concern with respect to the successful commercialisation of the International Space Station consists of examining the protection assured by patents, as the main market lays in the area of inventions and discoveries in microbiology.

Therefore, a brief description of the protection provided by patents law will be given which would allow to understand several issues proper to the Intellectual Property issues proper to the Station Agreement.

A patent is an agreement between a State and an inventor, in return for a full disclosure of the invention, the inventor is granted a certain number of exclusive rights for a fixed period of time.[151]

Although national laws of different countries give different protection under the patents, they however possess several common features. Generally in order to give monopoly to the inventor a State, granting patent, would require some conditions to be fulfilled.

The process or the thing for which the patent is required has to be an invention,[152] therefore, it has to possess several characteristics allowing this invention to be patented. Laws of different countries impose different requirements to declare an invention patentable. A typical example is found in the Patent Law of the United Kingdom :

« A patent may be granted only for an invention in respect of which the

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[151] R. Oosterlink, *supra* note 147.

[152] Black's dictionary describes the invention as "a concept, a thing evolved in the mind; it is not a revelation of something which exists and was unknown, but is creation of something which did not exist before, possessing elements of novelty and utility in-kind and measure different from and greater than what the art might expect from skilled workers."

following conditions are satisfied, that is to say :

- *the invention is new*
- *it involves an inventive step*
- *it is capable of industrial application*
- *the grant of a patent for it is not excluded by... »*

excluded are in particular; discoveries, scientific methods and mathematical formulas[153]

It is important to differentiate the notion of discovery from the notion of invention. While the discovery is the revelation of something which exists, but unknown before, an invention should involve an inventive step, a creative activity. In addition, the legislations across the world require from the invention to be a novel idea which presumes that it has not already been published or publicly used. The character of utility for an industrial application and beneficial use is also a frequent requirement.[154]

Non-obviousness is another feature that the invention should possess. It supposes the invention to be something which is not obvious or common knowledge in the field of the invention.

A patent does not give rights similar to the property rights to the inventor, but rather precludes others from practising the invention. The patent being granted to an inventor, the inventor possesses a number of exclusive rights whose violation constitutes an infringement of patent. Thus, in most countries the inventor will be able to prevent third parties from using his invention in commercial aims without his consent. The infringement of the patents may be direct, indirect, literal or by equivalency.[155]However, the monopoly granted to the patentee comprises certain limitations related to the specificity of the granted rights.

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[153] As cited in R. Oosterlinck, *supra* note 147.

[154] Some countries such as US do not consider sufficient for the patentability an invention which might offer potential advantages. Others are more relaxed in this respect.

[155] On the direct or indirect infringement see articles 25 and 26 of the Convention for the European Partnent for the Common Market, on the literal infringement and by equivalency, see R.Oosterlink, supra note 147

This protection is generally limited in time. Depending on the granting State the length of protection may vary from 17 years in the United States to 20 in most European countries. The starting date of protection also varies depending on the system. If the country operates with the system of the first to file, the protection starts running from the date of file, whereas in the countries with first to invent system, the term starts from the date of granting.[156]

Another limitation is brought by the scope of the application of the patent. A patent comprises in general rules : an abstract of invention, a full disclosure of the invention, and of the manner and process of making and using it and one or claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention. The drafting of the claims is extremely important since they limit the scope of patent rights[157]

The last limitation and probably the most important one is the *territorial* one. Once granted in a country, the patent is able to protect an invention only on the territory of the granting State. All other countries are free to use the invention, if the latter did not receive protection on their territory. The intellectual property law in its current state moves towards the international protection of inventions but it is still on the stage of co-ordination rather than on the state of effective protection.[158]

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[156] On the different systems *infra at 56*.

[157] R. Oosterlink, see *supra* note 147.

[158] See on the international protection see Paris Convention 1883 for the protection of Industrial property , the Stockholm Convention establishing the World Intellectual Property Organisation whose role consists merely of co-ordinating activities of States in this domain, by harmonising and speeding up the process of application of the patents. Two important instruments were adopted in Strasbourg in 1971, known as Strasbourg Agreement Concerning the International Patent Classification, in 1970 in Washington, Patent co-operation treaty. The World Trade Organisation has also worked on the subject by adopting the Agreement on Trade Related Aspects of Intellectual Property Protection whose significance is merely modest, since it repeats the rules of the Paris Convention. In addition, not possessing the character of self-executing treaty, it does not have direct implication the national legal regimes, see K-H. Bockstiegel, P.M. Kramer, I. Polley, "Patent for the Operation of Telecommunication Satellite Systems in Outer Space", (1998) ZLW 3 – 17.

The principle of the *territoriality* of the patent gave birth to the controversies in the application for the patent to the space activities.[159]

2. The international treaties and the legal status of the space versus territoriality of IP.

The aforesaid characteristics of the patents raised several problems in regard to the application of the intellectual property rights in the space activities..

For the present state of international space law, there is no international instrument which would directly deal with the patent protection in space. The IGA Agreement is the first international instrument which directly recognises the possibility of the Intellectual property protection on the Station which is situated in the Outer Space. However, the IGA's provisions are questionable with regard to the principles retained by the treaties recalled in the preamble.

Thus, the major difficulties have been and are related to the need to reconcile the opposite characters of the Outer Space Legal regime to the Intellectual Property rights. While the Intellectual Property laws seek to protect and grant monopoly, the activities in the Outer Space were thought to be conducted in the environment of freedom of exploration. The pre-occupation of the possibility of the patentability of inventions in general was expressed. The Outer Space Treaty proclaimed in its Article I :

> *« The exploration and use of outer space, including moon and other celestial bodies, shall be carried out for the benefit and in the interests of all countries, irrespective of their degree of economic or scientific development, and shall be the province of all mankind. »*[160]

Several authors have logically concluded that technical achievements made in outer space should be made available for the benefit and interest of all nations.

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[159] On the patents in space, see *infra* at 56 .
[160] Id Article I of the Outer Space Treaty

Consequently, the inventions made in the outer space can not be eligible[161] for the protection whose main objective is to assure the technological superiority of one Nation over another.[162] To confirm this vision the provisions of the Article XI of the Outer Space Treaty may be cited :

> *In order to promote international Co-operation and the peaceful exploration and use of outer space, State Parties to the Treaty conducting activities in outer space, including the moon and other celestial bodies, agree to inform the Secretary-General of the United Nations as well as the public and the international scientific community, to the greatest extent feasible and practicable, of the nature, conduct , locations and results of such activities. On receiving the said information, the Secretary- General of the United Nations should be prepared to disseminate it immediately and effectively.*[163]

Although tempting from the equity point of view, such reasoning could hardly be adopted in the context of the free market.

Another cornerstone of the application of the intellectual property rights to space activities is the territorial character of the protection. The territorial approach of the intellectual property law seems to encroach the principles of the international space law as it appears to prohibit territorial claims in the outer space.
Thus the Outer Space treaty states :
Outer Space, including the moon and other celestial bodies, is not subject to national appropriation by claims of sovereignty, by means of use or occupation, or by any other means.[164]

Combined with the previous theory according to which the inventions in Outer space belong to the mankind, the supporters of the introduction of the intellectual property in the outer space were faced to a real problem

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[161] See R. Oosterlink, *supra* note 147.
[162] See D.L. Burk, *supra* 146
[163] Ibid Art. XI of the Outer Space Treaty.
[164] Id Article II of the Outer Space Treaty.

3. In a search of solutions

As it was mentioned before none of the existing treaties regulating activities in outer space deals with the intellectual property laws. In order to counterpart the theory of absence of protection in the outer space, the global interpretation of the international space law had to be made.

Whereas the Outer Space treaty proclaims the impossibility of appropriation of the Outer space and freedom of exploration in general, it does, however, attribute to a State Party to the Treaty on whose registry an object is launched into outer space [...][165] *jurisdiction over such object and over any personnel thereof, while in outer space or on a celestial body.*[166]

The Registration Convention goes in the same direction by affirming the jurisdiction over the registered object and over the personnel on the craft[167]. According to the Liability Convention the States become liable for the damages caused by the objects which are under their jurisdiction and control.[168] These international legal instruments were interpreted as supporting the proposition that outer space is freely available for use by all, but that personal rights[169] may be protected.

The general principle of the possibility of protection by the patent being accepted, the question which remains open is on which basis the intellectual property law of any State should apply.

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[165] Quotation omitted
[166] Article VIII of the Outer Space Treaty
[167] See Registration Convention in general
[168] See Liability Convention in general.
[169] D. L. Burk, see *supra* 146

Three potential connecting factors were considered[170] nationality, territoriality and jurisdiction.

In the first case in order to assure protection to the inventor, the nationality of the invention or of the financing company[171] could be taken as a connecting factor. This interpretation was adopted by the Appeals Board in the *McKey* case which partially reversed the rejection of the grant of a patent for an process that could be used only on the moon. To reverse this rejection the Board had to rely upon the jurisdiction over persons as stated by Article VIII of the Outer Space treaty.[172]

Yet, this approach is not exempt of its critics as it poses several problems with respect to the individuals possessing several nationalities: which one should be preferred?

In addition many countries rely more on the connecting factor of domicile or residence while determining the applicable law, rather than on the nationality. It would be unnatural for these States to operate with nationality only for the space activities.[173]

Moreover, basing the patent law on the nationality principle would render the system absurd by depriving it of the main foundation –the territoriality of protection. Thus, in case of infringement, the only relevant issue will become the nationality of the infringerer. The latter, in order to use the invention will just have

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[170] The problem of connecting factor is very similar in this context to the problem of choice of laws we had examined in the chapter dedicated to the international private law issues.
[171] R. Oosterlinck, *supra* note 417
[172] D.L Burk, see *supra 146* .
[173] See the case of UK see J. Philips, *Introduction to intellectual property Law*, (London Butterworths, 1986):

to be of a different nationality from the patentee. [174] this approach may lead to several unwanted results.

The territoriality approach has also several drawbacks. Although tending to the direct transposition of the current patents system, the territoriality can not be adopted for the outer space activities per se.

The territoriality is closely related to the earth activity and to the notion of location. It is obvious that in the outer space the location and the precise territory is more difficult to be delimited. The Outer Space is not divided into parts with immovable frontiers as it does not and cannot belong to any State. Therefore, the territorial transposition for the national systems should rather be linked to the notion of jurisdiction over the objects launched by the States into the space.

We will not come back to the definition of jurisdiction. In theory, the States should assert their jurisdiction within the boundaries of their territories, but in practice they have largely extended their assertions and this through various theories seen in the previous chapters.[175] The dilemma which rises in the case of the jurisdiction approach is the jurisdiction is the choice of the relevant principle.
To find a solution, the jurisprudence had to look into the regime analogous to the outer space, namely to the high seas. Thus, both in outer space and on the high seas, craft and operate in areas where no nation may claim sovereignty, yet nations may exercise jurisdiction over the craft carried on their registry.[176]

As far as the law of sea is concerned, often the theory of the floating island was applicable. According to this theory, the high seas and airspace above do not

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[174] The case is particularly true for the companies which would be encouraged in this situation to create a company in a country where the invention is not secured and use the invention after with no prior authorisation of the patentee, see in general on this problem R. Oosterlink, *supra* note 47
[175] See on the Territoriality, Protective Personal, Universal and the Passive Personality Principle, *supra* note 132
[176] D.L Burk, see *supra note 146.*

possess any permanent jurisdiction, but would be subject to the jurisdiction of a craft or ship operating in this area. In other words, all activities taking place aboard such a ship or a craft will happen within the scope of the jurisdiction of the country of registry. In this context the registered ship or aircraft seem to be the prolongation of the national territory.

Thus, several commentators suggested the same principle to be applied to the objects launched into outer space and consider them as an extension of the national territory of the state of registry.

The courts seemed to judge in favour of attributing the jurisdiction by the extension of the national territory in case of the patents infringement problems.[177] Despite the extended jurisprudence,[178] it was still an uncertain basis for the private investing companies to know the law which may be applicable to their inventions.

Therefore, several countries. such as United States had to adopt special provisions on the patent law in space. Therefore the actors on the International Space Station may face the conflicts resulting from the evolution national laws of participating states and the regime created by the Intergovernmental Agreement.

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[177] The First case was *Gardiner v Howe* (9 F Cas. 1157(C.C.D.Mass.1865) (N5219). According to the to the holding

The patent laws of the United States afford no protection to inventions beyond or outside of the United States, but this jurisdiction extends to the deck of American vessels on the high sea, as much as it does to all territory of the country and for many purposes is even more exclusive

[178] The American Patent Board which is an important instance in the matter of patents, inclined towards the approach adopted by *Gardiner*. In *Rosen v NASA*, 152 USPQ, Appeals board was called upon to decide, inter alia, the date upon which a device for orienting a satellite was first reduced to practice. . Reduction to practice required that all the elements of the invention be operated in combination under conditions demonstrating that they worked as intended to work in their practical contemplated use, namely on orbit for a satellite. The question before the court was whether or not this use occurred outside the United States for purposes of reduction to practice. The Court relied on the territoriality approach of *Gardiner*.

In Decca v US, a similar logic was adopted. However the reliance upon *Gardiner* was rejected by the Courts of Claims, that preferred to base itself on the fiction of the extended instrumentality and thereby rely upon Rosen. However *Rosen* has derived from the *Gardiner*.

b.) A solution of the IGA.

The Intellectual property provisions in the Intergovernmental agreement constitute an interesting step in the area of patent protection.
It seems to be willing to combine the systems of the ISS Partners' domestic laws and regulations with regard to their respective ISS contribution and personnel. [179]The approach adopted by the Intergovernmental Agreement does not appear by the substantive rules of law, but rather a set of rules directing the application of different laws.

The fundamental principle laid down in the IGA is that the part of the Space station complex in which the invention was made is deemed an extensions of the territory of the State having registered that element.[180]

Thus according to the Article 21.2 :

> *Subject to the provisions of this Article, for purposes of intellectual property law, an activity occurring in or on a Space Station flight element shall be deemed to have occurred only in the territory of the Partner State of that elements registry, except that for ESA-registered elements any European Partner State may deem that activity to have occurred within its territory. For avoidance of doubt, participation by a Partner State, its Co-operating Agency, or its related entities in an activity occurring in or on any other Partner's Space Station flight element shall not in and of itself alter or affect the jurisdiction over such activity provided for in the previous sentence.*[181]

Thereby, the provisions stipulated in this Article re-affirms the territorial approach for the attribution of jurisdiction in the patents protection issues and eliminates the theory that had been taken in the Mckay concerning the possibility to consider the nationality as the connecting factor. The territorial approach accepted

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[179] *Open for business*, see *supra* note 14 .
[180] A. M. Balsano, The European Space Agency: Intellectual Property Rights and International Cooperation, *in* Sa'id Mosteshar, *Research and Invention in Outer Space: Liability and Intellectual Property Rights*, (Dordecht, Boston, London: Martinus Nijhoff Publishers and International Bar Association, 1995)
[181] Id Article 21

by an international treaty although dealing with a specific enterprise could have a major influence on the evolution of the intellectual property.

Due to these provisions, the national laws of the partner states governing intellectual property become relevant for activities on the ISS.

The IGA especially deals with the case of European Partner by creating a legal fiction of the unified legal regime over this territory.

This particular approach poses several question that should be examined with more attention. The Intellectual property rights provisions raise a number of important issues with regard to commercialisation of the ISS, as they set up a system which is somehow confusing.

1. Possible conflicts

As it was mentioned on several occasions, the enterprise of the International Space Station is the creation of multinational efforts.

The Contracting Parties tried to avoid all possible judicial conflicts by stipulating the cross-waiver of liability, yet they have expressly excluded the intellectual property issues. By stating the territorial jurisdictional approach for the inventions' protection, Parties have obliged themselves to deal with four conflicting systems : USA, Europe, Japan and Russia. As it was examined in the previous paragraphs, the nowadays legal network is not harmonised in the intellectual property field. Thereby, the four operating legal regimes will have to reconcile their difference in this multinational venture.

This situation is farther complicated by the fact that Russia does not possess a very strong and sharp legal regime with regard to the patents and other intellectual property rights. Different laws have been passed but they change very quickly. In

addition, the courts system does not function in a very effective way which brings another problem on stake : the judicial protection of rights and the enforceability of courts decisions.

As far as the three remaining systems are concerned they also possess several discrepancies whose consequences should not be neglected by the potential investors willing to conduct their activities on the Station.

Generally there are two major systems for the protection of IPRs world wide.
These are first to file and first-to-invent.[182] Practically the whole world operates with the first-to-file system, whereas the United States and Canada operate with first to invent one.[183]

In case of first to invent allows to whoever can prove that he was the first to develop the invention has priority in obtaining the patent, even if someone else files first. This place the burden of proof on the inventor to keep the details of their work development. During the patent review process others will have the opportunity to challenge a patent and prove that the inventor is not first person to develop the invention.[184]

The European Partner[185] and Japan will have a first-to-file system under which whoever elaborates a file which could qualify for a patent if presented at time. Therefore, the approach of research is different, it should be done very discretely so

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[182] On different systems of Intellectual Property Law in general see, J.M. Samuels, *Patent, Trademark and Copy right Laws*, (The Bureau of National Affairs Inc., Washington, D.C., 1997), J. Philips, *Introduction to Intellectual Property Law*, (London: Butterworths, 1986), H.Pearson& C.Miller, *Commercial Exploitation of Intellectual Property*, (Blackstone Press Limited, 1990)
[183] During the TRIP agreement there was a great pressure on US to change this approach in to the first to file.
[184] C. H. Walker, "Potential Patent Problems on the ISS", Georgetown University Law Center (1999)
[185] Europe operates with the legal regime based on the Convention of the Grant of European Patents of 5 October 1973, the patentability and its pre-requisites are generally the same in the national laws as national laws are harmonised with the European law.

others could not have access to the important information and file the application for a patent, since the presumption of priority can not be challenged under this system.

In addition to this essential difference, a problem of keeping the information secret could arise. On the ISS, in the environment of multinational co-operation, secrecy could become problematic. This difference may lead to abuses of the systems and to privilege the most protective system. This risk increases since the ISS agreement decides on waiving any prior permission requirements for nationals wishing to first file in a foreign country.[186] On this point the problem of the disclosure may arise. All participating countries require that a patent be filed before public disclosure of the invention.[187] In the first to –file system the principle of absolute novelty [188]is applicable, meaning that any public use or disclosure of the invention, oral or written, anywhere in the world is a bar to obtaining a patent.[189] The particular environment of the ISS may give birth to several problems with respect to disclosure of invention.

It is unclear from the Agreement what the disclosure is constituted of. Most likely, the scientists and astronauts conducting the experiments on the ISS will have to share the information from the experiments. In addition the Agreement is silent

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[186] Article 21.1 provides:
In respect of an invention made in or on any Space Station flight element by a person who is not its national or resident, a Partner State shall not apply its laws concerning secrecy of inventions so as to prevent the filing of a patent application (for example, by imposing a delay or requiring prior authorisation) in any other Partner State that provides for the protection of the secrecy of patent applications containing information that is classified or otherwise protected for national security purposes. This provision does not prejudice
(a)the right of any Partner State in which a patent application is first filed to control the secrecy of such patent application or restrict its further filing; or
(b) the right of any other Partner State in which an application is subsequently filed to restrict, pursuant to any international obligation, the dissemination of an application.
[187] C. H. Walker, see *supra* 183
[188] To determine the potential of any invention, it is necessary to compare it to the prior art which refers to the state of technology prior to the invention. The prior art may include public disclosures or use of technology. The technology becomes prior art once it is disclosed to the public. Thus it is important to know the date of the file of a patent for the first to file system and the date of invention for the first to invent.
[189] *Open to business*, see *supra* note 14

on the transmissions that may be held while astronauts need to consult the experts on earth. Do they have to be kept secret?

Since we are dealing with attempt to commercialise the ISS, it is likely that the data transmitted on earth will be communicated to a corporation financing the projects and its scientists would examine the results of the experiments in order to establish the progressing success of a project. Should these consultations to be considered as public disclosure ?

Heather Walker hypothised as well a possibility for the astronauts to use on their own initiative a particular useful adaptation obtained during an experiment for another research. On Earth, public disclosure occurs if the adaptation is used in public or if another inventor or company uses it.[190] In space the circumstances are different since the scientists who elaborate a particular process can not always have a direct access to the experiments conducted on the ISS. Everything is done by astronauts working in outer space. In case of their own initiative for the use of results of experiments, astronauts could apply for a joint claim to obtain a patent with the company conducting the main research. In Japan and Europe there is not joint claim system, therefore the attribution of the patent will depend on the interpretation of the question of disclosure: is astronauts' initiative arise to a public disclosure or not.

2. The problems of standards of patentability.

Another confusing domain could be the difference in the standards of patentability.

While Europe and US sought to protect the inventor by granting to him a patent, Japanese system was concerned by inciting the industries to increase the research activities. Thus, standards of patentability in Japan are less rigorous and

Japanese authorities tend to give patents for the slightest innovation made obtained out of the experiments.

The United States and Europe have stricter rules of patentability which are conform to the WIPO requirements.

Europe and the US require an invention to be technical and not abstract and it should have a concrete and technical character, while in Japan, section 29 of Japanese patent law demands that the invention be industrially applicable and not be publicly . known or worked in Japan. Thus, the ISS participants have very different legislation with respect to the evaluation of the criteria of inventive step and usefulness.

While the United States asks for an unobvious step in order to patent an invention, Europe tends to focus more on the creativity performed for the invention. The Japanese approach in ever more lax, in which requirements for an inventive step are even lower and patents are often granted to even the most minor of changes.

The usefulness is also perceived differently in different countries. The United States reject theoretical future of advantageous inventions and requires concrete benefits be proven. Japan with its lax policy of granting patents would consider the invention as patentable since it could be developed to have potential commercial utility.[191]

The difference in standards of patentability may lead to major difficulties : an invention could be patentable in one country and not patentable in another one. In the environment of ISS it may give birth to various conflicts.

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[190] C. H. Walker see *supra* 183

Different inventions used for specific devices may be patented in country A for some minor changes and not to be patented B. [192]If an astronaut uses a device from country A which is patented while being on the module of country B, it may constitute an infringement of another instrument which has not experienced these minor changes but still is very similar to the device patented in country A. The royalties that must be paid by a company could be enormous.

The condition of non obviousness is also left in the dark by the present Agreement. The process which is considered as not obvious on earth, can be seen as obvious by the astronauts conducting the experiments due to the specific environment of the ISS.

To determine whether the invention was obvious or not will entirely depend on the *countries' interpretation, on the policy adopted by them. Thus identical results obtained on the ISS will eventually be patentable in one country and not patentable in another.*

Another problem could be related to the different ethic approaches adopted by the participating countries. This is particularly true for the biotechnological experiments.[193] While Europe forbids certain types of research such as experiments involving human genomes, the US has liberal biotech patent policies.[194] It is unclear which approach will be retained and how it will be reconciled with the need of the commercial participants. In a hypothetical situation where an American company contracts with NASA to conduct the experiments which are patentable in US and

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[191] On Japan see H. Walker, *supra* note 183 ..

[192] Although the IGA foresees the problems of products in transit in the Article 21.6, it does not resolve the problem of use of similar devices patented only because of the legal difference between countries.

[193] The issue of biotechnology is very controversial. Thus the research on the human genome clons have been forbidden in Europe.

[194] C. H. Walker, *supra* note 183. Despite the liberalism of the US patent policy, the main challenge to patent a development still remains the utility requirement. Since US want a concrete application of the invention, it may happen that higher prove of benefitial use may be wanted. A development that

not patentable in Europe on the Columbus module, it is unclear what reactions different legal systems may have to deal with these questions..

In more general terms, the difference in the national legislations concerning the standard of patentability will lead the companies to make sure that the devices used by them in the ISS for different experiments are equally patented in all participating countries otherwise the threat of being sued for an infringement of another patent is very high. Knowing the high cost and the length of the patent procedures, the consideration of potential lawsuits may become an additional criterion for a company to take a decision whether it should or should not participate in the ISS activities.

3. The United States' particular concerns[195]

The United States being the major contributor to the ISS endeavour is particularly concerned by the benefits it may obtained through the activities conducted on the Station.

Until very recently, the intellectual property protection in the outer space was monopolised by the NASA.

Section 305 (a) of NASAct provides :

> *Whenever any invention is made in the performance of any work under any contract of the Administration (i.e. NASA)...such invention shall be the exclusive property of the United States and if such invention is patentable a patent therefore shall be issued to the United States upon application made by the [NASA] Administrator, unless the Administrator waives all or any part of the rights of the United States to such invention.*

Any such waiver is subject to the reservation of an:

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outcame of the experiments in the outer space which helps the treat of disease may not amount to an patentable invention.

Irrevocable non-exclusive, non transferable, royalty –free licence for the practice of such invention throughout the world by or on behalf of the United States or any foreign government pursuant to any treaty or agreement with the United States[196].

Yet, the strict monopoly firstly adopted by the NASA was considerably relaxed accordingly to the new policy of the Untied States which emphasises on the encouragement of the private investments into outer space activities.[197]

The United States in order to promote their commercial activities and to end the uncertainty of the jurisprudence over the intellectual property mentioned in the previous chapter, was willing to protect and to encourage their industries to invest into research in the Space activities.

For this purpose the Congress in 1990 enacted the Patents in Space Act .The PSA was to provide a «clear, undefinite and understandable set of rules for determining when and how United States patent law applies to outer space. »[198] The Act which was meant to encourage private investors, reaches its goal of ensuring the effective protection by extending United States jurisdiction to the space objects registered by US. The Article 105 of the Patents in Space Act provides that

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[195] See generally on US patent system: J.M. Samuels, *Patent, Trademark and Copyright Laws*, (The Bureau of National Affairs Inc., Washington, D.C, 1997)

[196] NASAct, 29 July, 1958, as cited in A. Young; see supra.

[197] United States have enacted the Commercial Space Launch Act of 1984, the stated purpose of which is *"to encourage the United States private sector to provide launch vehicles and associated services by simplifying and expenditing the issuance and transfer of commercial launch licenses; and facilitating and encouraging the use of Government-developed space technology."*
In addition several special programs were adopted by NASA focusing on the promotion of the commercial space exploration, it developed Joint Endeavour Agreement which permit a company which provides hardware and scientific expertise to have a flight aboard the shuttle with no exchange of funds. Another program was The Technical Exchange Agreement program (TEA)through which NASA allows privately –funded researchers to use its ground facilities.

[198] See *Patents in Space Acts* quoted in J.M. Samuels, *Patent, Trademark and Copyright Laws, supra* note 194

any invention made, used or sold in outer space on a space object or component thereof under the jurisdiction or control of the United States shall be considered to be made, used or sold within the United States for the purpose of this title, except with respect to any space object or component thereof that is specifically identified and otherwise provided for by an international agreement to which the United States is a party or with respect to any space object or component thereof that is carried on the registry of a foreign state in accordance with the Convention on Registration of Objects Launched into Outer Space.
Any invention made, used or sold in outer space on a space object or component thereof that is carried on the registry of a foreign state in accordance with the Convention on Registration of Objects Launched into Outer Space, shall be considered to be made, used, or sold within the United States for the purpose of this title if specifically so agreed in an international agreement between the United States and the States of registry.

The Patent in Space Act is, however, subject to international treaties to which the United States is a signatory.[199] Thus, the Intergovernmental Agreement pre-empts the Patents in Space Act and, therefore, the provisions of the Article 21 will take over the US legislation. Some authors expressed worries with regard to the efficiency of protection of the invention made by American firms on the ISS.

Indeed, it is unlikely that private participants would agree to leave their rights to NASA through the section 305 of NASAct. The scenario which is more foreseeable is the one when according to NASA will waive all rights concerning the appropriation of intellectual property rights[200] if it is willing to attract the participation for the private sector.

Consequently, the private users will be left under the protection provided by the Patents in Space Act. However, it is probable that the Patents in Space Act and the overall federal patent scheme are inadequate to meet their goal of protection of

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[199] See J.H. Shoemaker, *supra* note 6.
[200] With Space transportation systems development and in the stream of willing to promote the commercial utilisation federal regulations were adopted obliging NASA [...] not to acquire "*rights to inventions, patents or proprietary data privately funded by a user or arising out of activities from which a user has reimbursed NASA*", Title 14 CFR, Chapter V. s. 1214. 104 Patent and Data Rights.

American investment in research and development on ISS and this for following reasons.

Firstly, the Patents in Space Act faces the problem of incompatibility of approach of freedom and non–appropriation of Space examined in the previous paragraph. The ISS, as it was mentioned before incorporates the principles of the international space law. Potential conflicts any arise as Patents in Space Act is not going in the direction of co-operation and sharing in the outer space but rather is aiming to protect the interests of the US.

Secondly, if the spirit of the Patents in Space Act could eventually be reconciled with the ISS, its effectiveness is undermined by the structure of the ISS itself. None of the research modules on which the inventive activity may occur will be under the jurisdiction or control of the United States.[201]

Yet, it results from the Article 21 that for "*the intellectual property law, an activity occurring on a Space station flight element shall be deemed to have occurred only in the territory of the Partner State of that element.*"

Although, paragraph 3 authorises the patent application in another state while the invention is made by the non-national or resident of the State of registry of the flight element on which the invention occurs, it is not without limitations. In order to be registered by a state different from the state registry, the protected information must be classified or otherwise protected for national security purposes[202]

Thus US research will have to undergo the limitation of the IGA, and the uncertainty of what information should be considered as amounting to the national security.

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[201] J.H. Shoemaker *supra* note 6

Another problem is related to the fact that the participants of the ISS enterprise are not identical to the countries mentioned in the Patents in Space Act. Thus, if a US researcher works on the Russian module and makes an invention, he cannot apply for the protection provided by the Patent Act as Russia is not WTO member. The Patent in Space Act authorises to apply for US protection only for those foreign activities that have occurred on the WTO member territories.

It is unlikely that US companies will be satisfied with the protection insured by the Russian law. Hence, it is unclear for the moment how the system will operate in the absence of well harmonised set of rules. The United States is therefore rightly afraid of being left out in space.[203]

4. The Europe's concerns.

The European Space Agency similarly to NASA has also developed a uniform set of provisions in order to regulate intellectual property

According to the ESA Convention,[204] the Agency has adopted a regulation pursuant to which

> (a) *All information and technical data resulting from work funded by ESA shall be made available free of charge for its own requirements in the field of space research and technology, as specified in Article II of the Convention ;*
> *Similarly, all inventions and technical data resulting from space programmes and activities shall be made available to participating member States free of charge.*[205]

Thus, the rights over invention and data can be protected by a patent, but ESA in most of cases has a right to use inventions and proprietary technical data on the royalty free-basis. However, it is easily conceivable that the activity may occur

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[202] Art 21.3 of the IGA
[203] J.H. Shoemaker, *supra* note 6.
[204] Article III of the ESA Convention stipulates that: *In carrying out its activities the Agency shall ensure that any scientific results shall be published or otherwise made widely available after prior use by the scientists responsible for the experiments. The resulting reduced data shall be the property of the Agency.*
[205] Ibid ESA/C(89) 95

outside of the contract conclude with ESA. Hence, provisions of IGA acquire their major importance.

The activity occurring on the territory of the European partner was an object of the special draft. It was stipulated that for the purposes of intellectual property an such an activity is deem to occur within the territory of any European Partner State. Thereby, this Article establishes a legal fiction regarding the European Partner States according to which they are deemed to be a single territory subject to the same regulations.[206]

In reality it is not a single territory but a community of independent states with distinct legal regimes.

This may give rise to important question and obstacles. Being independent States, the European Partners in order to implement an International treaty such as IGA have to pursue their national procedures as in most countries the international treaties are not self executing. Thus in many countries a modification should be introduced in the national copyright law that the activity occurring on the ESA element is deem to occur within the territory of the state enacting the said legislation.[207]

If such a modification is not introduced, conflicts may arise given different interpretation from other countries' solutions.

Another important issue is the fact that despite a great effort made by the EEC and the establishment of the European Patent Office which delivers the European patents, national laws are still different which results in the coexistence of a multitude of national and international property regulations.

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[206] A-M.Balsano, see *supra* note 179 at 162

[207] See for Germany, ratification of IGA on 13 July 1991 see online <http://www.germanembassy-india.org/embassy/press/pr970729.htm>

Therefore, the procedure of patent application may be slightly different from one State to another. Since the Agreement provides that the activity is deem to occur within the territory of any European State, it may give rise to a sort of forum shopping for the easiest and least costly procedure[208]

This problem is even more true for the infringement procedure. Article 21.4 states that:

Where a person or entity owns intellectual property which is protected in more than one European State that person or entity may not recover in more than one such State for the same act of infringement of the same rights in such intellectual property which occurs in or on an ESA–registered element. Where the same act of infringement in or on an ESA-registered element gives rise to actions by different intellectual property owners by virtue of more than one European Partner State's deeming the activity to have occurred in its territory, a court may grant a temporary stay of proceeding in a later-filed action pending the outcome of an earlier –filed action. Where more than one action is brought, satisfaction of a judgement rendered for damages in any of the actions shall bar further recovery of damages in any pending or future action for infringement based upon the same act of infringement.

This provision will allow the holder of the infringed right to choose the most advantageous legal system as the expenses, the delay and the interpretation of patent claims are concerned. He also may try to file successively[209] claims in different

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[208] The European Patent Office issues a European patent which is a bundle of national patents. The procedure on the grant of European Patents is uniform and has some standard pre-requisite conditions such, reconginsed by all contracting States, the national State deal with the enforcement individually.
See *Convention on the Grant of European Patents*, signed at Munich 5 October 1973, entered into force 7 July 1977.

[209] Since the activity is deemed to happen in every European State, the patent can be filed in several different countries. If the claimant is willing to try in several courts he may, because *The Brussels Convention on Jurisdiction and Enforcement of Judgements in Civil and Commercial Matters of 1968* provides in its Article 16.4
In proceedings concerned with the registration or validity of patents, trade marks, designs, or other similar rights required to be deposited or registered, the courts of the Contracting State in which the

European courts until he gets a satisfactory decisions. The enforcement measures can also influence the choice of jurisdiction[210].

Hence provisions of IGA, relying on inexistant fiction, can induce potential users into a considerable confusion, and render them cautious vis-à-vis the whole undertaking.

III. Problems of Article 16

Despite the considerable effort of the creators of the ISS Agreement, many issues have not been elucidated. The drafters could not foresee all possible issues and regulate all potential conflicts, however a certain carelessness was committed with respect to the matters excluded by the cross –waiver of liability. Although the treaty tends to eliminate the problem of tort this waiver does not apply to many potential claims.[211]

To illustrate potential problems, a following hypothesis should be considered.

Imagine that a Colombian astronaut works in an American Laboratory according to the contract concluded between Columbia and Canada, and he has been attacked for some unknown reason by an Argentinean astronaut working under the contract between ESA and Argentina. The Colombian astronaut by some unfortunate accident enters into the European module and breaks the container of protein samples which are provided by an international company incorporated in Caiman

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deposit or registration has been applied for , has taken place or is under the terms of an international convention deemed to have taken place.
Since, the registration can occur in several states, several courts could recognise their jurisdictions, however, the courts should stay their proceedings according to the provisions on lis pendens:
Where proceedings involving the same cause of action and between the same parties are brought in the courts of different Contracting States, any court other than the court first seised shall of its own motion stay its proceedings until such time as the jurisdiction of the court first seised is established

[210] If United Kingdom operates with a complexe systems of three levels representations and three-levels forum, France operates with Tribunal de Grande Instance for the civil matters and Tribunal correctionnel for the criminal ones which alleviates possible patents proceedings

[211] M. McCord, see *supra* note 4 *Ibid* see Helen Shin, *supra* note 85, also *Open for Business*, see *supra* note 14

Islands but working on the Station under the contract with ESA. This situation is easily conceivable since the Agreement authorises Partners to use their allocations under the condition of the prior notification.[212]

Another situation could render the questions even more obvious: an Argentinean company contracts with the Canadian Space Agency to work on the ESA's module and an accident occurs to the experimental samples due to the fault of Canadian astronaut working on it. In this situation, the claim will be made to the Canadian authorities by its "related entity", but the accident occurs on the ESA module under the European Partner's jurisdiction.

Taking element by element, we may be faced with several problems of jurisdiction and laws as our protagonists cross "the borders in Space"

The reasoning should be the following: could we apply the cross waiver of liability?

In the case of an attack committed by an Argentinean astronaut if we refer to the Article 16 of the Intergovernmental Agreement, we are in presence of wilful misconduct which is excluded from the cross-waiver of liability. Damage[213] committed accidently to the protein samples container is the prolongation of the act committed in the first place.

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[212] Art9 (3) stipulates: *Each partner may use and select users for its allocations for any purpose consistent with the object of this Agreement and provisions set forth in the MOU's and implementing arrangements except that*
(a) any proposed use of a user element by a non Partner or private entity under the jurisdiction of a non Partner shall require the prior notification to and timely consensus among all Partners through their Co-operating Agencies

[213] According to the Article 16 (c): *The term "damage means":*
(1) bodily injury to, or other impairment of health of, or death of, any person;
(2) damage to, loss of, or loss of use of any property;
(3) loss of revenue or profits; or
(4) other direct, indirect or consequential damage.

Therefore, the umbrella of the cross –waiver of liability in order to escape the potential conflict cannot be used. The example of the claim of related entity is also excluded from the cross –waiver of liability and the accident occurs on the "foreign" territory for the interested actors. We are now faced not only with a trial if other solutions fail but also with transnational trial involving several international actors.

a.) The precariousness of the application of the Liability Convention

Should the application of the Liability Convention of 1972 be considered for the tort caused by an astronaut to another? As international space law provides in the outer space treaty

> *"States Parties to the Treaty shall bear international responsibility for national activities in outer space, including the Moon and other celestial bodies, whether such activities are carried on by governmental agencies or by non-governmental entities, and for assuring that national activities are carried out in conformity with the provisions set forth in the present Treaty. The activities of non-governmental entities in outer space, including the Moon and other celestial bodies, shall require authorisation and continuing supervision by the appropriate State Party to the Treaty".*[214]

The Liability Convention deepens and expands[215] this principle and establishes a set of rules in order to solve potential disputes. Article IIof the Liability Convention provides that:

> *In the event of damage being caused elsewhere that on the surface of the earth to a space object of one launching State or to a persons or property on board such a space object by a space object of another launching State, the latter shall be liable only if damage is due to its fault or the fault of the persons for whom it is responsible.*

The application of this article raises several problems. Indeed, provisions of the article 16(c) clarify that "the cross waiver of liability includes a cross-waiver of

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[214] Ibid Article IV of the Outer Space Treaty. This Article makes the contracting States internationally responsible for national activities in outer space. Different interpretations had been given to this term: should this responsibility cover personal conduct of a national. In this case, it is unclear against whom the action should be brought.

[215] See Office of Technology Assessment, US Congress, Space Stations and the Law: Selected legal issues – Background paper., August 1986, online<http://www.wws.princeton.edu/~ota/>

liability arising from the liability Convention where the person, entity, to property causing the damage is involved in Protected Space Operations and person entity, or property damaged is damaged by virtue of its involvement in Protected Space Operations.[216] Article 17 perpetrates the application of the Liability Convention except as otherwise provided by article 16. Yet, in our case we are confronted with a situation where a damage causes injury to one individual by another and to the property. Paragraph (d) of Article 16 excludes the application of the cross-waiver expressly to "*the natural persons, his estate survivor or subrogees for bodily injury to, or other impairment of health of, or death of such natural person.*"

An interpretation of the Liability Convention was given as not allowing the survivors of an astronaut to bring the claim under this Convention. Thus, this interpretation introduced, the application of Liability Convention to this issue is doubtful.[217]

In addition, this accident happens on the board of a space object but it is not caused by another space object.

On the other hand, the legal regime of the International Space Station is established by the Agreement and it foresees the reflect of the territorial jurisdiction over the respective registered elements, as it were a transposition of the ground map. Therefore, all activities deem to happen within the prototype of the territory of the States-Partners and consequently apply their interior legal regime.

From the practical standpoint of view, the application of the Liability Convention is questionable as concerning other possible disputes mentioned in the Article 16. If the claim arises between a Partner State and its related entity with regard to the tort which had taken place on the Space Station, it is absurd to envisage the application of the Liability Convention with the consequential

[216] I.d. Article 16

diplomatic consultations of the Parties. This procedure through diplomatic channels is not adapted to the commercial ventures which ISS is envisaged to be.[218]

The doctrine seems to be in favour of this argument [219] and anticipates the claims between individuals to be brought rather to the municipal courts than through diplomatic channels of the Liability Convention.[220] It leaves the application of the Liability Convention to the third states not involved in the International Space Station and undergoing some damages due to its activity. [221]

Finally the Liability Convention itself provides in article XI that: "*Nothing in this Convention shall prevent a State, or the natural or juridical persons it might represent, from pursuing a claim in the courts... of a launching state*"[222]

This article combined with the previous arguments favours the irrelevance of the Liability Convention with further development of the ISS, Hence several problems may arise. If the diplomatic consultations are rejected and the individuals will have to go through the common civil procedures, the trial will involve all issues that are proper the discipline commonly called as International Private Law.

b.) Possible conflicts of jurisdictions

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[217] In support of this argument see B A. Hurwitz, *State Liability for outer Space Activities in Accordance with the 1972 Convention on International Liability for Damage caused by Space Objects*, (Martinus Nijhoff Publishers, 1992)

[218] OTA's report has doubted the viability of the application of the Liability Convention on the activities on the space stations. Liability Convention seems to be too states' oriented and hardly adapted to the individual claims.

[219] M. McCord, *supra* note 4, S. Malpass *supra* note 81

[220] Article IX requires injured parties to present their claims for compensation for damage to the launching State through diplomatic channels, Liability Convention, 1972

[221] M. McCord, *supra* note 4 at 1947, an example of the damage caused on the ground of a third state by an element fallen from the ISS.

[222] In case of ISS, the launching State remains a mystery. It will probably not be considered for the accidents inside the Station.

Despite the fact that the Agreement provides that all States shall retain jurisdiction over the elements they have registered, in a particular given situation, the conflicts of competence of different courts may arise. Once the competent court is determined, it is unclear which core of rules it shall apply. The Agreement is silent on the guide-lines to adopt for the choice of law rules. But before dealing with these complex matters, it is worth to look into the problem of characterisation of the subject matter

1. Characterisation of the subject matter

Every time a court has to deal with the choice of laws and determining the the competence of the court, it has to qualify the legal problem it is dealing with.[223] It is necessary for the court to determine the nature of the question in order to be able to determine which law is applicable in the case. The object to qualify is the substantial question to answer in the matter, it is formed by the claimant and the facts that are relevant to the case.

The legal problems of the International Space Station are related to the novelty of the matter. Is there a need to develop a branch of special "space tort" as it was suggested by the OTA Report? Given the fact that the Space l

Law is merely an inter -governmental law, in which nations are responsible for activities in space whether conducted by governmental or non –governmental activities, courts will not have the usual support of reference to a foreign law in order to determine the object of qualification.[224]

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[223] See on the question of characterisation in Private International Law, P. Mayer, *Droit International Prive*, 5eme ed, (Paris, Montrchrestien, 1994), also H. Battifol & P. Lagarde, *Droit International Prive*, t.2, 7eme ed, (Paris: LGDJ, 1981).

[224] P. Mayer cites as an example of qualification a famous french case Stroganoff -Sherbatoff (12 janv. 1966, Rev Crit, 1967. 120) where the succession of determination of the law applicable to the succession of artistic works was dependent on the characterization of succession mobiliere(trust) in which case the law of the last domicile of the decedent would be applicable ou immobiliere(estate) when the law of the place of the estate is applicable.

Most likely a court seized in this matter will have to qualify it according to *lex fori* as it is the general tendency admitted in the field of International Private Law.

In our case the term of wilful misconduct is not in itself qualified as "a tort", it is merely an element which may allow to a particular wrong to be amounted to a tort. If we take the definition of the common law countries "a tort consists of some act done by the defendant whereby he has without just cause or excuse caused some form of harm to the plaintiff.[225] The fundamental principle of this branch is *alterum non laedere* –to hurt nobody by word or deed. To be liable under the torts law one must prove that the damage has occurred and that it did cause an injury, a loss. Only certain torts require an intentional element. In our example, the attack committed by an astronaut will constitute a battery according to the definition given by Common law decisions: Intentionally to bring any material object into contact with another 's person is sufficient application of force to constitute a battery.

In our case, the fact of breaking the sample container amounts to the tort of trespass to goods as this tort consists in committing without lawful justification any act of direct physical interference with goods in the possession of another person.

Civil law countries will have to qualify according to the definition confined in their respective torts laws. Thus, in France a civil tort consists of an intentional damage caused to a person or his property.[226] In order to declare a person liable under the torts law, three elements should be present: the harmful, the fault and link of causality between them.[227]

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[225] Salmond & Heuston *On the law of Torts*, (London: Sweet and Maxwell, 1996), a similar definition was approved by the famous case *Philip Morris LTD v Airley*, 1975, : *"a tort is a civil wrongfor which the remedy is a common law action for unliquidated damages and which is not exclusively the breach of a contract or the breach of a trust or other merely equitable obligation."*

[226] *"Un delit civil proprement dit consiste a causer intentionnellement un dommage a autrui. Le quasi-delit est le fait de causer un dommage dans des conditions entrainant la responsabilite, sans intention de nuire.,"* P.Voirin, *Droit Civil*, t.I, 26 ed, (Paris: L.G.D.J.).

The wrong committed by an astronaut will constitute a "delit" towards another astronaut and towards the property of the involved company.

Having qualified the problem, the seized Court will have to consider whether it has the appropriate competence on the matter and which substantial law it will have to apply.

2. The discrepancies in the choice of jurisdictions in torts law.[228]

The question of competent jurisdiction is relevant every time there is a claim: the seized tribunal will have to determine whether it has jurisdiction *ratione loci* and *ratione materae.* In private international law a court has in addition consider the question of its competence with respect to the external (or foreign) element present in the claim. It is important to answer the question whether the courts of a country have jurisdiction as a system. The attribution of the jurisdiction should not be confused with the territory of the interested State. A court may be declared as having jurisdiction that is irrelevant to its geographical situation.[229]

Another confusion frequently made is the distinction which should be operated between the conflicts of law and conflicts of jurisdiction. To declare a

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[227] Commonly used terminology in civil law countries: *le dommage, le fait generateur de responsabilite, le lien de causalite*, P. Voirin, *supra* note 227.

[228] We are not considering here the initiation of the criminal prosecution. In the countries where the civil action can be joint to the criminal prosecution, it will most likely see the criminal jurisdiction to be applied for the civil action. Yet the choice of law problem remains, as in most countries the civil action keeps its independent nature and therefore, its choice of law rules, see Battifol, Lagarde, *Droit International Prive, supra* note 223.

[229] Mayer explains the difficulty of the distinction by the confusion of linguistic terms ratione loci and territorial competence. In France the territorial competence is the one which is attributed to the jurisdiction depending on the geographical situation of the tribunal itself– for example when Tribunal de Grande Instance de Paris is declared as competent because of the absence of parties' domicile in France, yet it is not the ratione loci one because it is not attributed with resect of the situation of a person or of a wrong. On the contrary in international private law the jurisdiction will entirely depend on the geographical situation of a personal or a legal act, place of the tort, see P. Mayer *supra* note 223

court having jurisdiction is totally different from declaring the applicable law, according to the choice of laws rules of the seized forum.[230]

The applicable law does not obviously coincide with the law of the jurisdiction declared as having competence and that for several reasons.

The choice of law rules does not retain the same criteria as the choice of jurisdictions.

While the conflict of laws rules take into consideration only one criterion which appears as the most significant in the matter as it is impossible to apply to different laws in the same time, the choice of jurisdictions rules are more flexible. It is conceivable having several foreign jurisdictions which may exercise their competence. Several factors may be taken into account while determining a relevant jurisdiction–the cost for the defendant to move into the country of an alleged jurisdiction, the availability of evidence within the jurisdiction, the possibility of judicial execution of a rendered decision. The court will, therefore, determine firstly its competence and make a choice of applicable law in second place.

The adoption of multi-jurisdictional approach by the Intergovernmental agreement is certainly very respectful towards the sovereignty of the States participanting but hard in practice for the potential claimants and courts. An extremely limited space on which the crew is supposed to operate crossing several times a day the borders of the territories of different countries. For the moment these countries are not unified by a coherent system of rules on conflicts of jurisdictions.

By assigning jurisdictional competence to the States of registry, the IGA gave to the participating countries the power to regulate the activities occurring on

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[230] Principles of jurisdiction in International law (including space law) delimit the power of nations to prescribe, adjudicate, and enforce their laws. In our hypothetical cases there is overlap over these powers.

their elements similarly to their competencies on Earth. However, on Earth, the national courts do not or can not always recognise the exercise of their jurisdictional power if their connection with the activity is too weak.

If we go back to our example, we immediately reach the heart of the problem. Both astronauts are in practice foreign to all territories on which they operate. Provided the fact that their governments have concluded contracts that are covered by the cross waiver of liability, they are still not covered in the case of wilful misconduct. Therefore, in a potential claim against an Argentinean partner we are in presence of several foreign elements:

a. A tort has been committed on the American territory and on the European territory
b. By an Argentinean citizen
c. To a Colombian citizen
d. And to the international corporation property registered in Cayman Islands.

The supplementary difficulties may arise from the contracts concluded between the actors and the respective partners selling their time, space and resources to the third parties. It is unclear from the Agreement whether it prohibits the forum selection clauses[231] by saying that:

"*Each Partner shall retain jurisdiction and control over the elements it registers in accordance with paragraph 1 above and over the personnel in or on the Space Station who are its nationals*"[232]?

Assuming that this forum selection clause is not stipulated by the contractors, to which court the claim will be brought? Assuming that the Colombian

[231]The easily conceivable situation is the contract concluded by a Partner State and its related entities in which there is a forum selection clause according to which all claims that are not covered by the cross-waiver of liability are submitted to the tribunal designated by the concluded contract. All torts matters arising from wilful misconduct will immediately fall into this clause. It is unclear how the Agreement deals with this problem.
[232] Ibid Art 5of IGA .

Partner brings a claim against the Argentinean with respect to article 5 of the Agreement considering the fact that a battery was committed on the territory of the United States.

An American court [233]after having qualified the problem as a tort, will have to decide whether it retains its jurisdiction because in private international law this question is not answered automatically.

3. The pro jurisdiction justifications.

It is quite possible that an American court seized in the matter will accept its jurisdiction as the one of the "loci delicti", but this solution is given not without doubts as American tradition of choice of jurisdiction in the mater of torts is not unified on this question.

In the United States the basis of jurisdiction is derived mostly from case law. In order to establish its jurisdiction an American court must proceed through the examination of the minimum contacts doctrine.[234]

This doctrine derives from the interpretation of the Due Process Clause in the famous case of International Shoe Co. v Washington. According to this interpretation *"Due Process Clause forbids to exercise the jurisdiction under the circumstances that would offend traditional notions of fair play and substantial justice."*[235]

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[233] It is unclear whether it is federal or state jurisdiction , because tort law is subject matter of state courts' competence, however, the space activities are federal matters, therefore , the applicable law is not clear.

[234] It is assumed that the court in question is a federal court. And, therefore, it applies the federal law of choice of jurisdictions.

[235] *International Shoe Co. v. Washington*, 326 U.S. in R.J. Weintraub, *International Litigation and Arbitration: Practice and Planning, (*Carolina Academic Press, 1997).

The court can assert its jurisdiction over a foreigner if it finds sufficient contacts between the state and the foreign defendant.[236] Minimum standards for exercising jurisdiction are recognised as a significant protection of the individual against the arbitrary actions of government. These standards attempt to balance the needs for the parties and of government.[237]

Traditionally, Anglo-American courts classify jurisdiction: *in rem*, *quasi in rem*, or *in personam*. While the jurisdiction *in rem* or *quasi in rem* are related to the power that a court may exercise over tangible things being an object of the claim within the scope of its jurisdiction or to use these tangible things in order to reach an individual owning these tangible things, the jurisdiction *in personam* is exercised over an individual. As Justice Holmes describes action *in personam*: *"If the technical object of the suit is to establish a claim against some particular person, with a judgement which generally in theory at least, binds his body, or to bar some individual claim or objection, so that only certain persons are entitled to be heard in defence, the action is in personam, although it may concern the right to, or possession of, a tangible thing"...*[238]

Historically, Anglo-American courts first asserted in personam jurisdiction by entertaining lawsuits when the parties were present within the territorial limits of the state. However, other factors may intervene in order to establish the reasonableness of assertion of jurisdiction such as domicile, nationality, consent etc.

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[236] In the famous case *Helicopteros Nacionales de Colombia, S.A.v Hall* (466 US, 1984) it was held that in order to assert the jurisdiction, the court has *"to explore the nature of Helicol's activities within Texas to determine whether they constitute the kind of continuous and systematic general business contacts" Thus in this case the court did not find minimum contacts to assert its jurisdiction.* Thus, the test of minimum contact has been reaffirmed several times by the courts decisions, such as *Asahi Metal Industry Co., v. Superior Court*, 480 U.S. 102, 1987, *World-Wide Volkswagen Corp. v Woodson*, 444 U.S.286, 1980.

[237] E.F Scoles&P. Hay, *Conflicts of Laws*, (Hornbook Series, West, 1984.)

[238] *Tyler v. Judges of Court of Registration*, 175 Mass. 71, 76, 55 N.E. 812. 814.

In our example, an American court may decide that the jurisdiction should be asserted as a tort was committed within its jurisdiction. However, taking into consideration a particular location of the matter, and the actors involved may lead the court to refuse to exercise its jurisdiction and require the plaintiff to sue the defendant in a more appropriate and available forum.[239]

4. Doctrine of forum non conveniens

The doctrine of forum *non conveniens* is a discretionary one which attempts to balance the interest of the plaintiff, the defendant, and the forum. It permits a court to decline to exercise its jurisdiction if the court finds that it is a seriously inconvenient forum and the interests of the parties and the public will be best served by remitting the plaintiff to another, more convenient, forum if that recourse is available.[240]This decision may be dictated by several factors that appear merely in the discretionary power of the seized court. In common law the process of identification of the appropriate forum involves looking at connecting factors and "*this will include not only factors affecting convenience or expense (such as availability of witnesses) but also other factors such as the law governing the relevant transaction ...and the place where the parties respectively reside or carry on business.*[241]"

In American tradition this consideration was affirmed several times in numerous decisions. In the Gulf Oil Corp case, the Supreme Court of the United States laid out both private and public factors to weigh in determining if a motion to dismiss on grounds of *forum non conveniens* is appropriate. It included: relative ease of access to sources of proof, availability and cost of obtaining witnesses, possibility of view of the premises and all other practical problems that make a trial

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[239] E.F Scoles, P. Hay, see *supra* note 237.
[240] R. J.Weintraub, *Commentary on The Conflicts of Laws*, 3rd ed, 1986.
[241] *Spiliada Maritime Corp v Consulex Ltd*, 1987, AC 460 in Fawcett, *Declining Jurisdiction Private International Law*, (Oxford: Claredon Press, 1995).

easy, expeditious and inexpensive, interest in applying familiar law, avoidance of unnecessary problems in conflicts of laws or in application of foreign law.[242]

Although in our example it is less likely to happen, the risk still exists that the seized court would decline its jurisdiction on this basis as too many foreign elements are involved. The battery occurred between two aliens, they were present on the International Space Station according to the contracts concluded with foreign agencies, the costs and expenditures of trial are most likely discouraging from appearing before the American Court, and the risk of applying a foreign law is important. All these factors may call the court to decline its jurisdiction.

This danger is even more imminent when the trial is conducted between the Partner and its related entity over the matter that occurred on the Space Station within the jurisdiction or during a transportation to the International Space station. Article 16(d) (1) which excludes the extension of the cross -waiver of liability[243] says nothing on the resolution of problems of jurisdictions which may arise. Indeed, what is the interest for an American court to deal with a claim between a Colombian partner and a Canadian one arising from the accident that allegedly happened allegedly on the American territory?

The risk of dismissal on the grounds of forum *non conveniens* in this case is increased. Which court will recognise its jurisdiction: Colombian, Canadian ?

The situation may be worsened by the complex torts. If we take our aforementioned example of an astronaut assaulted by another and breaking the container on the territory of the ESA, we are in presence of the complex tort. The wrong's generating act was committed on American territory (battery), and the damage to the property was a direct consequence of the wilful misconduct of the

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[242] *Gulf oil Corp v. Gilbert*, 330 US 501, 508, 1947, *ibid Koster v Lumbermans* Mutual *Casualty Co, Piper Aircraft Co. V Reyno.*
[243] Art. 16 of the IGA

astronaut. Therefore, the cross-waiver of liability is not applicable and if the consultations fail the trial has to be conducted.

The States members of the ESA have ratified Brussels Convention of the 27 September 1968 which unified the rules dealing with the conflicts of jurisdictions. [244] It reifies the principle of "actor sequitur forum rei", i.e. the jurisdiction of the domicile of the defendant. Yet, it foresees special jurisdictions for several matters among which it mentions that : a person domiciled in a Contracting State may, in another State be sued in matters relating to tort, delict or quasi –delict, in the courts for the place where the harmful event occurred.

On this point we are faced with several problems. If the tort is commenced in one jurisdiction which is not the one of the Contracting State, will the Convention be applicable? Apparently the location of the occurrence of the tort should be the materialisation of the tort, therefore in our case the territory of the European partner. The situation is complicated by the fact that it is unclear from the Agreement whether an activity on a Space Station flight element registered by ESA is deemed to have occurred within the territory of any European Partner State.[245] In case of a dispute between the European Partner and its related entity, the competent court within the European Community is undetermined. What the criteria should be ? the location of the tort ? Is tort deemed to be committed on the European territory as whole?

Yet, both parties involved in our hypothetical action are not domiciled in the European Community. Therefore, the Brussels Convention can not be applicable to them in the ordinary meaning of its terms unless we should understand by the

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[244] 15 countries are members of the Brussels Convention :Austria, Belgium, Denmark , Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden and United Kingdom.

[245] In intellectual property provisions in article 21 it is stipulated that for ESA-registered elements any European Partner State may deem the activity to have occurred within its territory, see Art .21 IGA,yet nothing is expressly stated with respect to the potential claims arising out of the article 16.

provisions of the Article 5 that the courts are given jurisdiction regardless the rules of choice of jurisdictions in force on the ground. Our parties will have to fall back on the ordinary rules of conflict of jurisdictions, and in this case it is unclear which judicial system should deal with this sort of trials. It is very important for the sub-contractors of the Partner agencies to bring precision and clarification on this matter.

c.) The issue of Conflicts of laws on the International Space Station .

If a state determines that it is reasonable to assert its jurisdiction with respect to a particular dispute, it has then to prescribe the law to be applied, as well as adjudicate and enforce this law.

The Space Station Agreement does not provide guidance for making choice-of –law determinations. The most apparent reason for the lack of choice–of-law provisions is that the nations negotiating the previously existing international space law treaties were unable to agree on whether international or municipal principles should apply.[246]

As it was written above this problem of choice of law rules may arise independently from the solution made by the rules on the conflicts of jurisdiction because of the different approach made by the rules on conflicts of jurisdictions and conflicts of laws.

The judge of the seized court may have to apply a body of different rules from the law of the forum.[247] After having characterised the subject matter, a judge

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[246] M. McCord, *supra* note 4

[247] The problem of existence of conflicts of law has been elegantly explained by B. Currie in "Notes on methods and Objectives in the Conflict of Laws", Duke L.J. (1959) *171: The problem would not exist if this were one world with all powerful central government. It would not exist (though other problems of conflicts of laws would) if the independent sovereignties in the real world had identical laws. So long, however, as we have a diversity of laws, we shall have conflicts of interest among states. Hence, unless something is done, the administration of private law where more than one state*

will apply the choice of laws rule of the forum and according to it, he will designate the applicable law.

In order to determine the applicable law, traditionally in civil and common law countries, choice of law rules employ specific connecting factors.[248] Thus for different subject matters the connecting factors will diverge accordingly to the countries involved and, therefore, a solution is bearably predictable.

If we take our hypothetical case of tort committed by an astronaut against another one, we will be confronted with several issues.

1. US conflict of laws and the unpredictability of the solution,

Given the absence of choice of law rules in the ISS Agreement, we must fall back on the general choice of law principles of the Partners.

The traditional American approach in the second Restatement retains the rule of lex loci delicti[249] for torts. This original rule derived from the vested rights doctrine which called for the enforcement everywhere of rights that had been lawfully created under the local law.[250]

Yet many courts of the United States abandoned this rule in favour of "*bewildering variety of flexible modern approaches...unhited primarly in disdain for the traditional choice of law system.*"[251]

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is concerned sill be affected with disuniformity and uncertainty. To avoid this result by all reasonable means is certainly laudable objective; but how?"

[248] Connecting factors are called "criteres de rattachement" in France.

[249] The original Restatement stated that, all substantial question relating to the existence of a tort claim are governed by the local law of "the place of wrong", in § 377 it is described as "*the state where the last event necessary to make actor liable for an alleged tort takes place.*", Restatement II.

[250] Restatement II *supra* note 249.

This modern approach may be resumed as follow: the rights and liabilities of the parties in tort are said to be governed by the local law of the state which with respect to the particular issue has the most significant relationship to the occurrence and the parties. Significantly it was dissatisfaction with the mechanical formulas of the conflicts of law which led to judicial departure from similarly inflexible choice of law rules in the field of contracts, grounded like the torts rules on the vested rights doctrine.[252]

This change was explained by the Restatement as "due to a reflection of a change in our national life; state and national boundaries are of less significance today by reason of the increased mobility of our population and of the increasingly tendency of men to conduct their affairs across boundary lines."[253] In addition several scholars were disagreeing with the original position.[254]

The present approach is governed by the doctrine of "centre of gravity" or "grouping of contacts" elaborated by the case law and stated by a famous case *Babcock v Jackson*.[255]

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[251] In Helen Shin, see *supra* 85.

[252] Symposium, Comments on *Babcock v Jackson*, "A Recent Development in Conflicts of Law", n G.R. Shreve, *A conflict-of- Laws Anthology*, (Anderson's Law School Publication, 1997).

[253] Restatement II *supra* note 249

[254] The leading proponent was Brainerd Currie who developed a governmental interest analysis according to which the forum analyses the justifications for laws the legislatures in question have passed in order to identify the policies singled out as important by those legislatures. If applying a jurisdiction 's laws tot he case at hand advances that jurisdiction's policies, then it has a recognisable interest and its laws may be applied. If there is more than one "interested" jurisdiction, the case presents a 'true conflict", see H. Shin *supra* note 85

[255] In *Babcock v Jackson* the problem involved two residents of the state of New-York who left to the September 16, 1960 to Ontario and had a car accident during which Miss Babcock was seriously injured. She brought a law suit against the car owner in the court of the New-York State and claimed damages. Ontario law did not allow to pay damages to the a person carried in the owner's car. On the contrary, under the tort law of the New York state, she could benefit from the damages. The question that arose from this case was to decide whether the law of the place of the tort invariably governs the availability of relief for the tort or shall the applicable choice of law rule also reflect a consideration of other factors which are relevant to the purposes served by the enforcement or denial of the remedy? To reply on this question, the Court balanced the interests that the law of New –York may have and the law of Ontario. It revealed that I the case the issue was not the offence of the Ontarian law but the possibility for the victim to get some damages, in addition both parties were residents of New-York, they just went for short trip in Ontario.

According to this theory, the choice of applicable law will depend on the analysis of several factors and if they establish a dominant contact with a particular law, this law will be applicable.

In our case of a tort occurred within American jurisdiction, a court faced to a problem involving several international actors in an environment which is fairly different from what we are used to on the Earth. The protagonists are connected to the American jurisdiction rather haphazardly. The court may decide that most appropriate law will be Colombian or Argentinean The results seem quite unpredictable.

2. The uncertainty in European choice of law solution.

As we assumed in our example, spouting form the same action, the damage was produced on the American territory as well as on the ESA element. Ordinary, European countries admit in their respective rules the rule of lex loci delicti[256] which would lead to the application of a European substantial law. But in our case the damage is an accident of an attack occurred in another jurisdiction.

Should a court seized by the company whose property was damaged should he consider American law or the European legislation? Which law should be applicable in case of a trial between a Partner and its related entity?
Where the tort should be located? Should the liable individual be tried according to the law where he commits his first attack and presumably is aware about his breaking the local law.[257] Or should the law of the materialisation of the damage be applied?

All these factors taken into consideration, the Court decided in favour of application of New-York law therefore operating a revolution in American choice of laws rules, See Symposium, *supra* note 252.

[256] For France see arret *Lautour*, Cour Cass., Ch. Civ,25 mai 1948, Rev. crit. 1949 note Battifol,

The choice of law rules, at least in civil law countries tend to prefer the latter but as in our case, this accident happened because of unpredictable circumstances that could not have been foreseen by the author of the damage.

The situation may be even more complicated by the discrepancies between the choice of laws rules applicable by different countries.

In the example we have taken, an American court may designates a law of another country according to the interest analysis but this designated law in its conflict of law rules retains lex loci delicti and therefore it falls back on the American choice of law rules. Thus, we are faced with the problem of "renvoi"[258] and its refusal.

This situation may be even more frequent in case of the law suits between the Partners and its related entities. If they did not stipulate the applicable law in their contract there are more chances of the conflicts of laws issues that may arise in the situation when foreign elements operate on the foreign jurisdiction territory. It is not sufficient to stipulate that a partner has control and jurisdiction over an element. For a court it will only imply that he will have to take into consideration the law empowered by the State owner of the element while he applies his conflict of laws rule. In order to insure an efficient legal protection one has to avoid the uncertainty of the solution of the conflicts of laws.

The private companies willing to invest into the International Space station may be trapped by endless consultations resulting into private trials, and overwhelmed by legal nets resulting from the unclearity of the Agreement.

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[257] See Batiffol Lagarde, *supra* 223at § 561.

[258] See generally on renvoi P. Mayer, in France this doctrine was admitted by the case *Fargo* in 1878. This problem is mainly due to the different connecting factors that the countries retain. In Fargo case, it was a Bavarian citizen who left a succession in France. He has never been admitted to the legal domicile in France and therefore French court has retained the Bavarian law as applicable. But Bavarian choice of law rules has a connecting factor the domicile de facto which was in France and therefore it "renvoie" to the French law as to the applicable.

Conclusion

The commercialisation of the International Space Station appears to be difficult task.

First of all, its management structure is not at all adopted to the modern requirements of the liberal market. Its structure based on compromise and consensus is viable for a fully governmental enterprise or inter-state international organisation but it lacks dynamics that could attract potential investors.

To render it more attractive, the entire managing structure should be rethought. Dr Jakhu suggested to find a solution for the ISS similar to INMARSAT.[259] This organisation has been privatised on 15 April 1999 and its staff and assets a were transferred to INMARSAT Holding Limited which is holding company and INMRASAT Limited which is operating company, both established under the English law. The goals of the new created company have not been changed, neither were the privileges or the immunities, but its managing structure has been modified. Shareholders of Inmarsat received appropriate number of shares in the holding company; the holding company is free to raise capital and engage in all other commercial activities, it is also able to make initial public offering on the appropriate stock exchanges. Operating company has seen the transfer of Inmarsat's assets and liabilities, such as satellites and space segment facilities, finance leases, intellectual property rights and staff contracts, also the operating company is supposed to cover all commercial activities previously provided by Inmarsat.

Similar regime could be adopted for the International Space Station. The Agencies participating in this undertaking could have shares in a holding company that could run Space Station. While users will have to approach directly the operating company which would centralise the time-space allocations, establishing

[259] INMARSAT-International Maritime Satellite Organisation; the Agreement entered into 1979, the Organisation became operational in 1982, see on Inmarsat generally R.Jakhu, *Personal Notes on the Space law applications course*, McGill University, 2000, also D. Sagar, Recent Development at the

prices and draft commercial contracts. The centralised structure will help to avoid potential confusion with allocations and their barter between Partners, it will also save time for the investors by speeding up bureaucratic proceedings proper to each Agency. The partners may have their votes in the holding company, allowing them to bloc decisions emanating from the operating company if they contradict the main purposes of the Space Station.

From a legal stand point of view several proposals may be made. It is hardly conceivable that a new Agreement will be concluded. Yet drafted as it is now, it can not assure the satisfactory legal protection for the potential users. First of all implementing arrangements should bring further clarification on the application of the Liability Convention. The resolution of the disputes through the diplomatic channels and consultation are not adapted to the prompt and efficient decisions. It could be very advantageous to install an Arbitration Tribunal[260] for International Space Station exclusively, composed of Space Law professionals. This Tribunal will be competent enough to deal the specific issues related to the Space activities as long as long they remain limited to trained crew and commercial matters and it will have flexibility and promptness proper to Arbitration.

On the other hand, the issues related to the uncertainty of the choice of jurisdiction either in intellectual property provisions, criminal jurisdiction and uncovered by the cross-waiver torts law should be clarified. Certainly, the assembly of the International Space Station will take a considerable of time during which the various involved states may come up with unified system of choice of jurisdictions and similar patent requirements. However, even in the most optimistic course of event, the aforesaid problems should not be neglected.

International Mobile Satellite Organization, Annals of Air and Space Law, VolXXIII, (McGill University, 1998) at 343

[260] This proposal was advanced by H. Shin; *supra* note 85.

Since the Agreement is in its final version, it could be desirable to bring precision with detailed guidelines on the possible issues. For the purposes of the International Space Station, a unified set of rules could be developed as to indicate to the participants to which court a natural person could bring her or his action in case of injury. Eventually, the elaborated code could allow expressly the stipulation of forum selection clauses between the Partners and the related entities. The unified approach towards the choice of jurisdiction in case of conflicts in criminal matters should be adopted as well as the code of conduct for the crew. The modifications on the substantial criminal legislation for the definition of crimes in space should be considered.

Furthermore, the Agencies while concluding contracts should be very careful and clearly stipulate the applicable law to the conflicts that may arise between an agency and a subcontractor. Some authors have suggested to elaborate a special code for the conflicts of law rules based on the UNCITRAL Model Law on International Commercial Arbitration[261]. However, for the regulation of contracts the choice of applicable law should be made by the contracting parties for now.

For the purpose of patents, a centralised office for the inventions made on Space Station could be established. This office would be charged with speeding and facilitating proceedings before the national patents offices of the Partner States, and require unified conditions for the patent filing. Such an office will also encourage Partners to make en effort in the direction of further harmonisation of their legal systems.

[261] See H. Shin, *supra* note 85.

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INTERNATIONAL SPACE STATION

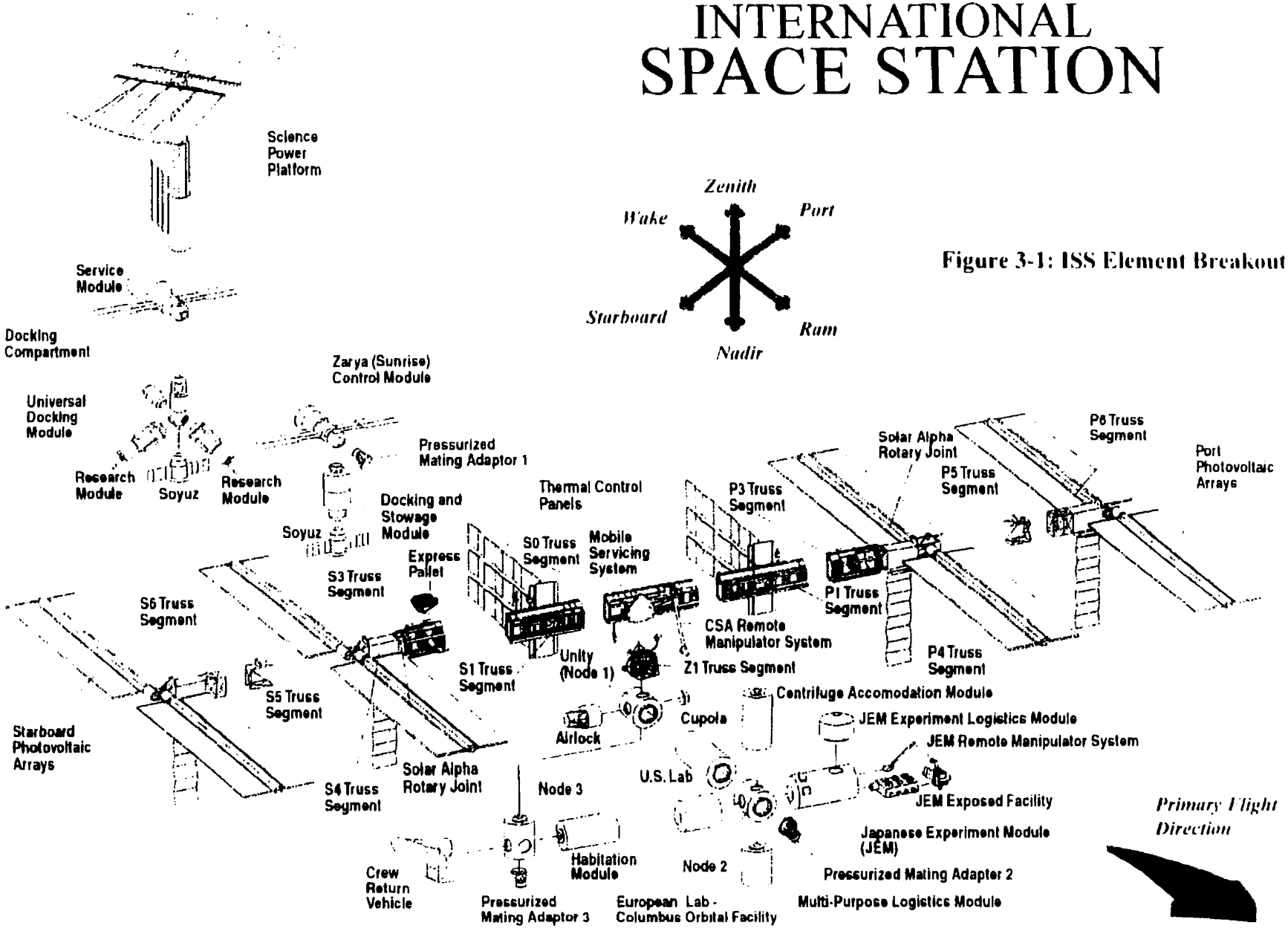

Figure 3-1: ISS Element Breakout

International Space Station Assembly Sequence: Revision E (March 2000 Planning Reference)

Date	Flight	Launch Vehicle	Element(s)
Nov. 20, 1998	1A/R	Russian Proton	• Zarya Control Module (Functional Cargo Block - FGB)
Dec. 4, 1998	2A	U.S. Orbiter STS-88	• Unity Node (1 Stowage Rack) • 2 Pressurized Mating Adapters attached to Unity
May 27, 1999	2A.1	U.S. Orbiter STS-96	• SPACEHAB - Logistics Flight
May 19, 2000	2A.2a	U.S. Orbiter STS-101	• SPACEHAB - Maintenance Flight
July 12, 2000	1R	Russian Proton	• Zvezda Service Module
Sept. 8, 2000	2A.2b	U.S. Orbiter STS-106	• SPACEHAB - Logistics Flight
Oct. 5, 2000	3A	U.S. Orbiter STS-92	• Integrated Truss Structure (ITS) Z1 • Pressurized Mating Adapter - 3 • Ku-band Communications System • Control Moment Gyros (CMGs)
Oct. 30, 2000	2R	Russian Soyuz	• Soyuz • *Expedition 1 Crew*
Nov. 30, 2000	4A	U.S. Orbiter STS-97	• Integrated Truss Structure P6 • Photovoltaic Module • Radiators
Jan. 18, 2001	5A	U.S. Orbiter STS-98	• Destiny Laboratory Module
Feb. 9, 2001	4R	Russian Soyuz	• Docking Compartment 1 (DC-1) • Strela Boom
Feb. 15, 2001	5A.1	U.S. Orbiter STS-102	• Logistics and Resupply; Lab Outfitting • Leonardo Multi-Purpose Logistics Module (MPLM) carries equipment racks
April 19, 2001	6A	U.S. Orbiter STS-100	• Rafaello Multi-Purpose Logistics Module (MPLM) (Lab outfitting) • Ultra High Frequency (UHF) antenna • Space Station Remote Manipulator System (SSRMS)
May 17, 2001	7A	U.S. Orbiter STS-104	• Joint Airlock • High Pressure Gas Assembly
June 21, 2001	7A.1	U.S. Orbiter STS-105	• Donatello Multi-Purpose Logistics Module (MPLM)
Aug. 23, 2001	UF-1	U.S. Orbiter STS-109	• Multi-Purpose Logistics Module (MPLM) • Photovoltaic Module batteries • Spares Pallet (spares warehouse)

International Space Station Assembly Sequence: Revision E (March 2000 Planning Reference) For Planning Purposes Only, Pending Space Station Control Board Approval

Date	Flight	Launch Vehicle	Element(s)
Oct. 2001	8A	U.S. Orbiter	• Central Truss Segment (ITS S0) • Mobile Transporter (MT)
Jan. 2002	UF-2	U.S. Orbiter	• Multi-Purpose Logistics Module (MPLM) with payload racks • Mobile Base System (MBS)
Feb. 2002	9A	U.S. Orbiter	• First right-side truss segment (ITS S1) with radiators • Crew & Equipment Translation Aid (CETA) Cart A
May 2002	11A	U.S. Orbiter	• First left-side truss segment (ITS P1) • Crew & Equipment Translation Aid (CETA) Cart B
June 2002	9A.1	U.S. Orbiter	• Russian provided Science Power Platform (SPP) with four solar arrays
Sept. 2002	12A	U.S. Orbiter	• Second left-side truss segment (ITS P3/P4) • Solar array and batteries
Oct. 2002	12A.1	U.S. Orbiter	• Third left-side truss segment (ITS P5) • Multi-Purpose Logistics Module (MPLM)
Jan. 2003	13A	U.S. Orbiter	• Second right-side truss segment (ITS S3/S4) • Solar array set and batteries (Photovoltaic Module)
TBD	3R	Russian Proton	• Universal Docking Module (UDM)
TBD	5R	Russian Soyuz	• Docking Compartment 2 (DC2)
Feb. 2003	10A	U.S. Orbiter	• US Node 2
May 2003	10A.1	U.S. Orbiter	• Propulsion Module
June 2003	1J/A	U.S. Orbiter	• Japanese Experiment Module Experiment Logistics Module (JEM ELM PS) • Science Power Platform (SSP) solar arrays with truss
Sept. 2003	1J	U.S. Orbiter	• Kibo Japanese Experiment Module (JEM) • Japanese Remote Manipulator System (JEM RMS)
Oct. 2003	UF-3	U.S. Orbiter	• Multi-Purpose Logistics Module (MPLM) • Express Pallet
Jan. 2004	UF-4	U.S. Orbiter	• Express Pallet • Spacelab Pallet carrying "Canada Hand" (Special Purpose Dexterous Manipulator)
Feb. 2004	2J/A	U.S. Orbiter	• Japanese Experiment Module Exposed Facility (JEM EF) • Solar Array Batteries
TBD	9R	Russian Proton	• Docking and Stowage Module (DSM)
May 2004	14A	U.S. Orbiter	• Cupola • Science Power Platform (SPP) Solar Arrays • Zvezda Micrometeroid and Orbital Debris (MMOD)

			Shields
June 2004	UF-5	U.S. Orbiter	• Multi-Purpose Logistics Module (MPLM) • Express Pallet
Sept. 2004	20A	U.S. Orbiter	• US Node 3
Oct. 2004	1E	U.S. Orbiter	• European Laboratory - Columbus Attached Pressurized Module (APM)
TBD	8R	Russian Soyuz	• Research Module 1
Jan. 2005	17A	U.S. Orbiter	• Multi-Purpose Logistics Module (MPLM) • Destiny racks
Feb. 2005	18A	U.S. Orbiter	• Crew Return Vehicle (CRV)
March 2005	19A	U.S. Orbiter	• Multi-Purpose Logistics Module (MPLM)
May 2005	15A	U.S. Orbiter	• Solar Arrays and Batteries (Photovoltaic Module S6)
TBD	10R	Russian Soyuz	• Research Module 2
June 2005	UF-7	U.S. Orbiter	• Centrifuge Accommodation Module (CAM)
July 2005	UF-6	U.S. Orbiter	• Multi-Purpose Logistics Module (MPLM) • Batteries
Sept. 2005	16A	U.S. Orbiter	• Habitation Module

Notes: Additional Progress, Soyuz, H-II Transfer Vehicle and Automated Transfer Vehicle flights for crew transport, logistics and resupply are not listed.