IISL-00-IISL.3.11

REUSABLE LAUNCH VEHICLES REGULATIONS: FIRST STEP TOWARDS AN INTERNATIONAL FRAMEWORK

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ABSTRACT

The space launch activities are overlapping more and more international public law and international private law, as commercial space activities are increasing. Reusable Launch Vehicles (RLV), whether governmentally or privately developed, are becoming a reality and may have global impacts that need to be addressed not only in national legislation but also in international ones. This paper will present the main reasons why an *international* framework for RLV regulations should be discussed. It will also offer some suggestions on how an international regulatory framework could be started as reusable technologies start emerging.

INTRODUCTION

Reusable launchers are studied and developed slowly - but surely - worldwide. One of the main lesson from the latest ISU Annual Symposium entitled 'The Space Transportation Market: Evolution or Revolution?' in Strasbourg France,[1] is that Reusable Launch Vehicles (RLV) have indeed internationally become 'a given'. The industrial and political push to develop the reusable technology is too strong to be denied, not only in the United States, but also worldwide. RLVs will become a reality in the next two decades, coming probably in various shapes for different types of space transportation operations. It is time to start discussing the global impacts those RLVs operations may have in the near future and the international regulatory framework they may need to operate safely.

A REALISTIC FUTURE NEED FOR REGULATIONS

This paper is a follow up to another paper presented in May 2000 at the International Space University's Annual Symposium[2]. The following points present briefly the reasons why an *international* framework for RLV regulations should be discussed.

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Explosion of RLV Developments Efforts

Not so long ago, it seemed premature to envision the need to create specific reusable launchers' regulations. However, the development of reusable technologies in space transportation activities has become in the last five years a priority for many space industries worldwide. American governmental agencies are already at the stage of developing demonstrators with industrials, while companies in Europe and Japan are also investing in research and development for reusable launch vehicles technologies. Even though RLV developments might take longer in Europe and the rest of the world than in the United States, their research programs might result in operational RLVs that need to be taken into account in the future space launch environment.

In May 1999, the European Space Agency (ESA) Council at ministerial level approved the FLTP (Future Launcher Technologies Program), which is an optional program investigating concepts and technology requirements for future reusable launch vehicles or semi-reusable launch vehicles. Seven ESA national delegations have committed themselves to participate in the FLTP (France, Belgium, Netherlands, Spain, Austria, Sweden, and Switzerland). Germany is pursuing a national program of its own but might participate in a later phase of the European program.

Other actors in Asia are investing in RLV technology.[3] Japan is exploring numerous technologies (i.e. air breathing propulsion) through specialized development programs. China, in its endeavor to make human spaceflight missions, is developing recoverable Soyuz-type capsules and has plans to develop a space plane in the future. Meanwhile, India has also declared an interest in reusable space technology.

Though with highly different levels of financial and technical commitments, countries interested in RLVs have never

Companies (Countries)	**RLV**	**Comments** *(SSTO Single-stage-to-orbit, TSTO Two-stages-to-orbit)*
Lockheed Martin (USA)	VentureStar	- SSTO – start of operations 2012-2015 - Follow on to X33 demonstrator, decision to develop or not in 2001
Kistler Aerospace (USA)	K-1	- TSTO – start of operations in 2001-02 - Private initiative facing financial rather than technical problems
Rotary Rocket (USA)	Roton	- SSTO – start of operations 2002-2003 - Technical feasibility still under debate
Aerospatiale Matra (France)	Taranis	- Three step program to develop a RLV (ESA's Future Launcher Technology Programme) towards 2015-2020 - 2 experimental aircraft ARES (suborbital and transonic air-dropped demonstrators) and THEMIS (cryogenic-powered demonstrator)
Dasa (Germany)	Hopper	- TSTO – potential operations in 2012 - Follow on to Phoenix demonstrator
Mitsubishi, Kawasaki (Japan)	Hope X demonstrator	- Objective is to develop a SSTO - Operations in 2015-2020

Overview of RLV Developments worldwide

been so numerous. Those new space vehicles, combining airplanes and rockets *modus operandi*, will be demonstrators at first then will progressively become operational spacecrafts. Their future impacts should be studied.

Worldwide Impacts of RLVs

If we consider the future activities of RLVs, such as transportation between the Earth and orbits around the Earth, and transportation between places on Earth via outer space, different national and international liability issues will have to be considered. Cargo and crew transfer to and from the International Space Station (ISS) are examples of future potential RLV missions, as are fast package-delivery or 'space tourism' sub-orbital flights.

Access to and from the ISS is defined in the different international agreements signed by the five Partners States (USA, Russia, Europe, Japan and Canada), in particular the Article 12 of the Intergovernmental Agreement (IGA). In this Article, the participation of non-traditional actors, such as 'private sector space transportation systems', is mentioned and opens some ISS bidding opportunities for commercial launch companies.

Article 12 of the MoU between NASA and ESA goes even further. It states that one can "buy" the services of launchers, whether private or not, for transport to and from the ISS:

"12.1.e. Except as otherwise agreed, each partner provides or arranges with other partners on a reimbursable basis for the provision of launch and return transportation services for the flight elements it provides including assembly and logistics requirements. With regard to utilization activities, each partner provides or arranges with other partners on a reimbursable basis for the provision of launch and return transportation services in connection with its Space Station users. The right to obtain launch and return transportation services for Space Station utilization activities is as provided in Article 8.3.d. Reimbursement for such services may be in cash, or agreed kind. All reimbursable transportation services will be provided under launch services agreements."

The legal implications of having in the future a commercial RLV bringing cargo to a space station have not yet been fully studied. A new international liability regime, more complex than the one currently used for commercial expendable launchers, should cover not only the increased risk associated with the space segment (i.e. potential damages to the station while docking) and earth segment (i.e. flights over populated areas).

Also, a domain that will need to be carefully regulated will be the future aerospace traffic system. In the next twenty years, some reusable launch vehicles will transit to and from space using the same airspace that is currently the exclusive domain of aviation traffic.

In the United States, the Federal Aviation Administration (FAA) is working on its *Concept of Operations for Commercial Space Transportation in the National Air Space in 2005.*[5] This document has been developed by the Associate Administrator for Commercial Space Transportation

(AST) in anticipation of the evolution of the future American aerospace environment, which will need to integrate an increasing air-traffic with commercial space operations. The creation of special "Space Transition Corridors" is already anticipated in order to provide reserved airspace that allows space vehicles to travel through the American air traffic system. This is an important national step, but it is the *global* air traffic that might be affected by RLV operations.

Indeed, future RLVs' flight profile might have impacts, not only in the countries that are developing the technology (i.e. flights over populated areas, environment, noise) but in the rest of the world. Already, in the late seventies, the space Shuttle's lack of maneuverability when landing had been foreseen as having potential impacts on the international air-traffic.[6]

Another important issue on the legal front will be whether RLVs are allowed to be manned and transport passengers. This issue regulated at first on a national basis (i.e. launcher licensing and specific launch's licensing), may have to be also impacts internationally. In the aviation world, agreements had to be created and signed by both governments and private operators alike, so that a legal framework could protect not only the passengers' rights, but the operators themselves in case of accidents.

All those issues, dealing with private and public liability, will probably bring in the coming years the need for national reusable launch vehicles' laws and policies (i.e. national licensing process in every country operating RLVs) but a revised international legal framework should accompany those national regulatory developments.

TOWARDS A GLOBAL REGULATORY PROCESS

A future international framework should not be seen as an arbitrary set of regulations put in place to prevent creativity or spacecraft design originality. It would be more of a safety net, not only for the non-developers of the technology, who shouldn't be potential 'victims' of RLV operations, but for the developers themselves, States and industries, who would help draft common safety standards.

Current Regulatory Framework

Space launch activities are regulated by national space laws (i.e. national licensing, regulations of spaceport activities) and by international treaties (i.e. registration of space objects, international liability of State of registry). But the new wave of space transportation activities, which comprises new RLV technologies and an increasing number of public-private partnerships will bring new sets of regulatory issues that have to be addressed.

In the United States, the development of reusable vehicles in the mid-nineties prompted the need for new sets of regulations. The Commercial Space Act (CSA) of 1998 was approved by Congress in fall 1998 extending the Federal Aviation Administration's licensing authority to include reentry of reusable launch vehicles and also extending the financial responsibility and

risk allocation provisions of the Commercial Space Launch Act of 1984 to reentry operations. Indeed, before the CSA of 1998, only the launch aspect of private space vehicles was regulated because, until the last two years or so, there was no need to get concerned about the landing operations of private launchers. The only operational ones still are the expendable launchers, which stages basically 'explode' a short time after taking off.

With the increasing number of private RLVs companies, procedures to regulate the reentry and landing of reusable vehicles seemed suddenly urgent. But that need for regulations prompted a fear in the industry that a regime too restrictive would "either bind the creative aspects of a company's particular RLV design, or delay a project and put the backing company out of business."[6]

Therefore, a flexible licensing regime has been approved by the FAA, to allow the regulations to develop along the RLVs' developments.[7] This set of amendments to the current commercial space transportation licensing regulations will be effective on November 20, 2000. The respective RLV systems configurations will be evaluated individually by the FAA, and negotiations should follow in order to file an agreed Licensing plan.[8] The process is, for now, very individualistic and its efficiency has yet to be proven, each company being able to interact and negotiate with the FAA on a bilateral basis.

Other interesting developments concerning space launch licensing have occurred in Australia and the United Kingdom. Seeing an increasing number of private American launch companies interested in their launch facilities (i.e. spaceport in Woomera, Australia), the two governments have created new space policies in order to accommodate and attract the new RLV firms.

Those national steps towards the enactment of reusable launchers' regulations have been taken with a long-term vision. As more countries – not only developers of the technology – prepare their legislation for RLV operations, the need to internationalize some of those regulations seems to be the next logical step.

Internationalizing regulations

Companies in Europe and Japan are investing in research and development for RLV technologies. We can assume that, even though their developments might take longer than in the United States, their research programs should result in operational RLVs. Those vehicles will need new sets of national regulations in order to operate, which may be largely inspired by the American ones. But it might be very useful in the long term to internationalize some of those regulations to ensure safe operations of RLVs on a worldwide basis.

The example of Aviation

There are many international structures regulating air transport like the International Civil Aviation Organization (ICAO), the International Air Transport Association (IATA) and the Airports Council International (ACI).

The air transport regulations are contained in the 'Convention on International Civil Aviation' and its 18 Annexes. They are referred to as Standards and Recommended Practices (SARPs) and deal with such issues as personnel licensing, aircraft operations and airworthiness of aircraft. Under this international Convention, responsibility for implementing the SARPs rests with the 185 Members States of the ICAO.

But an Universal Safety Oversight Audit Program is regularly conducted by the organization and consists of regular, mandatory, systematic and harmonized safety audits performed in all of the Member States. This audit assesses the degree to which the countries have implemented the SARPS with a view to identifying and correcting deficiencies and shortcomings in safety-related areas.

Because of its international influence and its expertise on international aviation issues, the ICAO might be a good organization to start from, in order to draft common international rules for future RLV operations. Indeed, in the late 1970s, Dr. Menter had suggested that the ICAO be made competent to regulate some of the space flight profiles of future space vehicles, so that the day-to-day international air-traffic would not be interrupted.[5]

In a very practical manner, ICAO already provides a forum of discussion and a source of globally agreed regulations for the aviation community... extending this forum to the space launch sector could be practical in the short term.

Indeed, cooperating with its members States and the International Air Transport Association (IATA), a non-governmental organization representing the aviation companies, the ICAO deals already with key issues such as:

- The aviation security (implementation of ICAO standards and recommended practices on national levels)
- The establishment of air corridors and new air routes (i.e. current discussions about a corridor across the trans-Caucasus States of Armenia, Azerbaijan and Georgia, linking Europe and the Far East and establishment of a new route across Asia, Siberia and the North Pole)
- The promulgation of common air traffic services (ATS) throughout regional airspace (i.e. a new multinational facility in Thessaloniki, Greece, will soon coordinate and implement air traffic services and will support development and integration of the air traffic control systems for Albania, Macedonia and Greece)
- The normalization of the management of regional air traffic (i.e. in the Balkan area, with recent agreements reopening the upper airspace of the Sarajevo flight information region to international civil aviation)
- The protection of the environment, which constitutes a sensitive subject for aviation and space activities alike, where the focus remains on noise and particles emissions.

All those issues could be related to future RLV operations. Dr Kotaite, ICAO Council President, stated recently that ICAO was the "logical international

institution to lead the way into space, and should work with its member States and other international organizations to provide the guidance on space management".[9]

Where to start?

The main principle that this paper advocates should be to internationalize in time common global safety practices, while protecting the diversity of the vehicles under development.

For instance, in order to facilitate the validations of aircraft certifications between Europe and the United States, the FAA and the European Joint Aviation Authorities (JAA) have developed a procedure called "Co-operative and Concurrent Certification", which allows an harmonization of the decision process and a final concomitant approval from both organizations.

In the recent past, a European aircraft had to be certified by the FAA before operating over the United States' territory, even though it was already fully certified by the JAA. In order to reduce the lengthy and costly double certification process, the joint certification procedure currently allows the recognition of the aircraft's navigability certificate in the United States and in Europe, whether the aircraft was first certified in the US or Europe.

Those regulatory standards are of course not yet applicable to the international space launch industry. New technologies are still emerging and the fierce industrial competition and the strategic aspects of launchers would certainly allow international cooperation only on basic public matters.

A first imperative step would be to create an international specialized workgroup, whose mission would be to discuss future space vehicles. This workgroup on reusable space launch vehicles, inspired by similar existing co-operation structures in the aviation community, could identify the main safety and liability issues that could arise when operating RLVs from different parts of the world. It might be created under the aegis of the ICAO to facilitate interactions between the aviation and the aerospace communities.

Constituted of space industry professionals with legal and political experts, this workgroup could start assessing the main RLV designs currently studied worldwide and their respective future civil mission statements (i.e. cargo transport to the International Space Station, repetitive sub-orbital 'tourists' flights), in order to prepare plans to integrate potential future RLVs operations in the international air-traffic.

This workgroup could also compare existing space launch regimes (i.e. licensing process) and draft common safety procedures and liability issues that would be important to discuss globally.

Indeed, reusable space technology may still be only emerging, but as we have seen in this paper, there are already many legal and political issues that could be touched upon already now through an international cooperative effort.

CONCLUSION

Reusable launch vehicles, whether they may be American, European or Japanese ones will have impacts nationally but also globally once they are in operations. All the national current safety measures may not suffice (i.e. launch pads near ocean, flight termination systems...). Some RLVs may be manned and may fly over populated areas. It is clear that RLVs are the subject of many discussions worldwide. Technological developments are taking place and national space policies are slowly being adapted. But, as for Aviation Law or the Law of the Sea, sooner or later, an international framework for aerospace operations will need to be created.

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