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Reproducibility: A New Phenomenon in Space Barter Agreements

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A new strain of space barter agreement is underway. The European Space Agency (ESA) and the National Aeronautics and Space Administration (NASA) are partners in the construction of the Orion Multi-Purpose Crew Vehicle (MPCV). ESA will design and deliver the Service Module element of the MPCV as part of a barter contained in an Implementing Arrangement within the broader legal framework of the International Space Station partnership. A notable novel feature of the MPCV Implementing Arrangement is the inclusion of provisions concerning 'reproducibility'. The purpose of reproducibility is to enable NASA's ability and minimise NASA's costs to reproduce the ESA designed and delivered Service Module units for future MPCV missions. This paper offers the first detailed examination of the reproducibility provisions of the Implementing Arrangement. The general and specific responsibilities assumed by both parties are identified and discussed critically in the context in which the barter arose. The paper then examines certain legal aspects connected with the implementation of reproducibility, in particular the interaction between reproducibility and intellectual property rights and export control regulations. The paper concludes with a discussion of the utility of 'reproducibility' as a bartering instrument.**

I. Introduction

The Orion Multi-Purpose Crew Vehicle (MPCV) is a spacecraft being developed by NASA for the post-Shuttle era. The MPCV is primarily intended for crewed missions to lunar orbit, asteroids and potentially to Mars. It will also provide the capability for a back-up means to carry crew and cargo to the International Space Station (ISS) on resupply missions.[1]

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The MPCV design foresees two core modules. The habitable Crew Module is being developed by NASA and US industry. The unpressurized Service Module is being designed and developed in Europe by ESA and its industry partners building upon the technological heritage of the five European Automated Transfer Vehicles (ATV)[2]. The Service Module provides a variety of mission-critical functions including in-orbit propulsion and manoeuvrability, thermal control, electrical power generation and consumable storage. For ISS missions, the Service Module provides the capability to perform docking and departure manoeuvres.[3]

The MPCV cooperation provides a bartering platform upon which NASA shall offset the remaining ESA obligations in respect of ISS Common Systems Operations Costs (CSOC), cargo transportation costs and other services until at least 2020. This bartering function had previously been carried out through the provision of cargo to the ISS on board European ATVs. The ATV Programme, culminating in the fifth and final ATV mission starting on 29 July 2014, offset ESA's obligations as far as 2017. The MPCV cooperation was negotiated concurrently with the ATV cooperation as the preferred follow-up bartering option so as to avoid a direct exchange of funds between Europe and the US in respect of ESA's 8.3 per cent share of the operating costs of the ISS between 2017 and 2020. Details of the barter are contained in an Implementing Arrangement between ESA and NASA which entered into force on 18th December 2012[4].

In overview, the Implementing Arrangement lays the ground for the following barter: ESA accepts responsibility to develop, manufacture and deliver to NASA one Service Module, subsystems and spares in time for the first unmanned MPCV lunar-flyby mission planned for December 2017. NASA undertakes to provide ESA consideration by offsetting its aforementioned ISS obligations up to 2020. The Implementing Arrangement also explicitly identifies, in its Annex, the basis on which a second European Service Module could be manufactured and delivered in time for the proposed first crewed mission to lunar orbit at the end of 2021. This is formulated as an option left open to NASA until 31 March 2016. If NASA exercises the option then the Parties will need to elect the most suitable form of consideration. The Annex foresees the possibility of barter, procurement

1 Wilde, D., et al., *Building Transatlantic Partnerships in Space Exploration - the MPCV-SM Study*, GLEX-2012.15.1.10x12509 (2012) at 1-2

2 NASA's prime contractor for the MPCV project is Lockheed Martin Space Systems. ESA's prime contractor for the Service Module is Airbus Defence and Space.

3 *Ibid.* at 3

4 Implementing Arrangement between ESA and NASA concerning the Provision by ESA of Elements for NASA's Multi-Purpose Crew Vehicle as a contribution to the offset of ESA's Responsibility for the International Space Station Common System Operations Costs, and to compensate NASA for Transportation Costs and other Supporting Services, 18 December, 2012 (MPCV-IA)

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or mixed (part-barter, part-procurement) consideration. If the ESA Member States decide to prolong the Agency's involvement in the ISS programme beyond 2020 at the ESA Council at Ministerial Level planned for December 2016 then a barter offsetting ESA's continuing CSOC obligations would appear to be a likely candidate for the purposes of consideration.

The Implementing Arrangement does not explicitly refer to the third and subsequent MPCV missions and the provenance of their respective Service Modules. However, it states that activities pursuant to the Implementing Arrangement will enable NASA's ability and minimise NASA's costs to reproduce the ESA designed and delivered Service Module units for future MPCV missions[5]. These activities are collectively referred to as 'reproducibility' and contemplate the possibility of Service Module manufacture moving to the US at an as yet indeterminate point in the future. Reproducibility is a novel - and it is submitted, unusual - feature of barter agreements. Bartering is a common feature of cooperative space projects, especially the ISS. However, such barters have typically involved the design, manufacture and delivery of a finite number of technical items or the provision of services. This is the first time that reproducibility has been used as a 'bargaining chip' in a barter agreement. It is unusual in that it appears to send mixed signals about the longevity of the Partnership. On one view ESA and NASA are forging a new interdependent alliance with the Orion MPCV cooperation with each party contributing integral parts[6]. By contrast, reproducibility appears to offer in-built independence for the NASA in the long-term.

The purpose of this paper is to examine the reproducibility provisions of the MPCV Implementing Arrangement. Reproducibility has not been the focus of attention in prior industry papers concerning the MPCV Cooperation. The starting point will therefore be an exposition of the relevant provisions to establish the basis, type and scope of the responsibilities pertaining to reproducibility.

It is the further objective of this paper to offer some insights, by way of a critical and contextual analysis of those provisions, into the practical efficacy of reproducibility as an instrument of barter. The premise is simple: If reproducibility cannot readily be achieved then it is not a workable bartering option. Two key issues will be addressed: What does it mean to 'achieve' reproducibility? What are the legal issues surrounding its implementation? Of course the MPCV Implementing Arrangement offers only one model of

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5 Article 1(4), MPCV-IA

6 *See,* de Selding, P.B., *DLR Chief Confident Europe Will Keep Building Orion Prop* Modules, Space News, Jan. 24 2013, accessed at <http://www.spacenews.com/article/civil-space/33310dlr-chief-confident-europe-will-keep-building-orion-prop-modules> and *Orion's European Service Module Back on Track*, Space News, May 23 2014, accessed at <http://www.spacenews.com/article/civil-space/40669orion's-european-service-module-back-on-track>

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reproducibility which arises within the broader legal framework governing the ISS cooperation. However, this paper hopes to offer both specific and general observations on reproducibility. In this way it provides a starting point for discussion should reproducibility gain momentum as a feature of future space barter agreements.

II. Legal Basis within ISS Framework

At first glance it is somewhat curious that the MPCV cooperation was implemented within the ISS legal framework. The MPCV is first and foremost an exploration vehicle to carry out human spaceflight missions beyond low earth orbit. It is only intended to serve as a backup supply vehicle to the ISS if other commercial or partner-supplied vehicles are unable to fulfil this function[7]. However, since NASA's consideration under the barter involves offsetting ESA's ISS obligations and providing one extra ESA astronaut flight opportunity, it has been implemented within the ISS legal framework rather than as a standalone agreement.

Implementing Arrangements are the third tier in the hierarchy of legal instruments which structure the relationships between the ISS partners[8]. Though the exact legal status of a technical 'Arrangement' may be a matter of some debate, they should be read and applied consistently with the Intergovernmental Agreement 1998 (IGA)[9] as well as the bilateral Memorandum of Understanding (MOU) reached between NASA and the ISS Partner concerned.

The IGA states in general and speculative terms that the Partners shall make available launch and return transportation services in accordance with the MOUs and Implementing Arrangements[10] and it envisages other transportation systems coming into existence to replace the US Shuttle and the Russian Soyuz. However, neither the provision by ESA of a Service Module for the MPCV nor the specific provisions relating to reproducibility are foreseen in the IGA or in the MOU reached between NASA and ESA[11]. This level of detail is always left to the Implementing Arrangements which are regularly put in place.

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7 Article 1(4), MPCV-IA

8 *See generally* Farand. A., *The Space Station Cooperation Framework,* ESA bulletin 94 - May 1998

9 Agreement Among the Government of Canada, The Governments of Member States of the European Space Agency, the Government of Japan, the Government of the Russian Federation, and the Government of the United States Concerning Cooperation on the Civil International Space Station, January 29, 1998 (IGA)

10 Article 12.1, IGA 1998

11 Memorandum of Understanding Between the European Space Agency and National Aeronautics and Space Administration of the United States of America Concerning Cooperation on the Civil International Space Station, January 29, 1998 (NASA/ESA MOU)

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The use of barter as means of offsetting ISS CSOC obligations is encouraged in both the IGA and the NASA-ESA MOU[12]. Barter has several advantages. It avoids a direct exchange of funds and a commercial-style relationship, it creates a more visible partnership with each Partner providing tangible goods or services and it often precipitates domestic investment in research and development projects[13]. Barter is defined in the NASA-ESA MOU as the exchange of goods or services[14]. Therefore, to the extent that reproducibility involves an exchange of goods or services, it will not conflict with the terms of the IGA or the NASA-ESA MOU. However, as it is not specifically contemplated in either of those documents, the legal basis for reproducibility is the will of the Partners as it appears in the Implementing Arrangement to which this paper now turns.

III. Reproducibility in the MPCV Implementing Arrangement

III.I. General Responsibilities (Article 5)

Article 5 of the Implementing Arrangement sets out the overarching responsibilities of both Parties in the barter. With specific reference to reproducibility, Article 5(1)(l) states that ESA shall use reasonable efforts to provide NASA with data, licensing and binding proposals for the purpose of allowing reproducibility of the Service Module units by NASA and/or NASA's Related Entities under the terms and conditions set out in Article 15. 'Related Entities' is accorded the same broad definition as is found in the IGA which encompasses a contractor or subcontractor of a Partner at any tier and includes suppliers of any kind[15].

In order to provide further details on the scope of the responsibilities in Article 5(1)(l) the Implementing Arrangement requires that the Parties establish and keep updated a Document for Reproducibility (DFR)[16]. The DFR documents the Parties' agreed approach to capture the complete list of Service Module products consistent with the current hardware and software configuration and the data necessary to assess the reproducibility of the Service Module by NASA and its Related Entities. In practice, this is a document mostly prepared by ESA during the Preliminary Design Review phase (now complete[17]). The DFR is the primary or basic deliverable in connection with reproducibility.

Article 5(3)(b) further states that both Parties will use reasonable efforts to evaluate US hardware (produced by NASA or its Related Entities or

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12 Article 16.4, NASA/ESA MOU

13 *See* Veldhuyzen, R., and Grifoni, E., *No Exhange of Funds - The ESA Barter Agreements for the International Space Station,* ESA bulletin 99 - September 1999 (No Exchange of Funds)

14 Article 16.4, NASA/ESA MOU

15 Article 3(1), MPCV-IA

16 Article 4(1)(e), MPCV-IA

17 *Supra,* note 16

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commercially available in the US) in order to minimise reliance on European sources for the purposes of reproducibility[18].

III.II. Specific Responsibilities (Article 15)

Article 15, entitled 'Reproducibility', provides more detailed responsibilities corresponding to the overarching responsibility set out in Art. 5(1)(l). It divides ESA's responsibilities into two categories based on:

- Those items identified in the DFR which are not subject to proprietary rights of the original supplier
- ESA items identified in the DFR which are subject to the proprietary rights of the original supplier

For items in the former category, for example some mechanical items, the design documentation to be exchanged by the parties in order to enable reproducibility is defined in the Bilateral Data Exchange Agreements, Lists and Schedules. The items may be freely used by NASA or its Related Entities[19]. ESA's corresponding responsibilities would be to furnish such design information and not to unduly hinder free use by NASA or its Related Entities.
However, where ESA items *are* subject to the proprietary rights of their original supplier the situation is more complex. Article 15(2) offers two means through which reproducibility may be achieved:

(a) Licensing the necessary foreground and background IP; or
(b) Procurement by NASA or its Related Entities directly from ESA's Related Entities.

The DFR predetermines which of these means is appropriate for each Service Module item concerned and set out any further conditions that apply[20].
ESA's detailed responsibilities in either case are elaborated in the subsequent provisions of Article 15: Where licensing is the indicated means to achieve reproducibility in the DFR, ESA will either directly grant such licences to NASA (where it is in a position to do so) or negotiate a licence for the benefit of NASA with the ESA Related Entity concerned. It is further stated that such licences should be negotiated at equivalent conditions to those ESA has with its Related Entities[21]. Where procurement is proscribed in the DFR, ESA shall ensure that its Related Entities provide binding proposals to NASA, for procurement of those items, at ESA-equivalent conditions, by NASA or its Related Entities[22].

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18 In practice this obligation relates to the preliminary design phases and is not an ongoing obligation beyond the point at which ESA delivers the final design (DFR) to NASA and its Related Entities.
19 Article 15(1), MPCV-IA
20 Article 15(3), MPCV-IA
21 Article 15(5), MPCV-IA
22 Article 15(6), MPCV-IA

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The Parties shall provide information on any restrictions which may be necessary to define the terms of any licence or binding proposal as above[23].

III.III. Uncertainty at The Level of Implementation

ESA must furnish data, licences and binding proposals in the DFR *for the purpose of allowing reproducibility*. It is previously stated that *the purpose of reproducibility* is to enable NASA's ability and minimise NASA's costs to reproduce the Service Module. Yet no working definition of reproducibility is given in the Implementing Arrangement.

The absence of a clear definition of reproducibility – and in particular what it means to *allow reproducibility* – are a potential source of conflict when it comes to determining whether the party furnishing the design information has fully discharged its responsibilities. ESA may consider that it has fulfilled its responsibilities with regards to reproducibility as soon as the content listed in the DFR is delivered. On the other hand, if NASA takes the view that the design documents, licences and offers it refers to do not adequately enable its ability and minimise its costs to reproduce the Service Module, then it is in theory possible that the DFR would not be accepted.

Consider, for example, the hypothetical scenario in which the DFR listed a significant number of key Service Module components for procurement from European industry: In such a case ESA could argue that it will have fulfilled its responsibilities as soon as it has provided corresponding binding proposals (at ESA-equivalent conditions let us assume) from its Related Entities to ensure continuous supply of the relevant components to NASA and/or its Related Entities. NASA could respond that significant ongoing reliance on European suppliers does not enable its ability to reproduce the service module in the US[24].

The foregoing hypothetical conflict is illustrative of competing models or views of reproducibility. On one view 'reproducibility' is simply a label given to the obligation to complete the DFR and deliver its content. On another view 'reproducibility' is assessed and defined by reference to its purpose – i.e. to enable the recipient to reproduce the technology.

As a second point, it is not stated in the Implementing Arrangement what specific consequences would attach to a failure on ESA's part to provide the data, licensing and binding proposals necessary for reproducibility. The Implementing Arrangement provides for proportional consideration to be provided by NASA in the event of termination by either side[25] so it may be possible to infer that ESA would receive zero offset or partial offset for non-compliance with its part of the barter. However, if ESA delivers the first Service Module but does not fulfil its responsibilities in respect of

[23] Article 15(7), MPCV-IA

[24] This example illustrates two competing models of reproducibility. The 'continuous availability/supply' model and the 'independent manufacturing capability' model.

[25] Article 21(2), MPCV-IA

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reproducibility, it is not clear on what basis any reduction to the offset should be calculated. It is not clear what proportion of the bargain reproducibility represents. The outcome would have to be determined by diplomatic consultations in accordance with Article 23 of the IGA.

The criticism outlined here is largely theoretical, based on construction of the terms of the Implementing Arrangement, rather than problems actually encountered by the Parties carrying out its provisions. The criticism is that definitional ambiguity leaves open 'grey areas' or potential sources of disagreement which would have to be resolved via further discussion or negotiation, thereby hindering legal and strategic certainty. On the other hand, obligations framed in general rather than precise terms are characteristic of high-level cooperative agreements. The provisions, especially those concerning the responsibilities of the Parties, are not intended to provide a contractual level of detail (which is usually left to subsequent external documents listed in the Implementing Arrangement). Moreover, this is a necessary constraint where new technology is being developed, because at the time the international agreement is reached the design and contractual negotiation phases will not have commenced or be incomplete. The complete list of components is not yet known nor are the terms of the licences that are to be concluded with industry. In the midst of all these 'unknowns', the Parties strive to define the contours of the cooperation with sufficient clarity and certainty to enable them to enter the agreement in the first place.

IV. A New Phenomenon

The conclusion of the previous section was that some textual ambiguity often has to be accepted in order to push forward with an international agreement. Even so, lack of certainty can cause difficulties at the level of implementation. One way of counteracting this problem is to examine previous instances in which reproducibility has been practically implemented in analogous cooperative space agreements.

Barter is now an established mechanism for cooperation within the ISS framework[26]. However, none of the preceding barter arrangements offer a convincing precedent for reproducibility. Barter agreements have centred around the exchange of transport services (e.g. ESA/NASA ATV Barter[27]), negotiation services (e.g. ESA/NASA Super Guppy Barter[28]), finite

[26] *See, No Exchange of Funds*, *supra* Note 12

[27] Implementing Arrangment between ESA and NASA concerning Offset of ESA's Responsibility for Common Systems Operations Costs and Compensation for the Transport of ESA Cargo to and from the ISS, 13 December, 2012 (ATV Barter)

[28] Barter Contract for the ESA Provision of a Super Guppy Transport in Exchange for NASA Provision of Shuttle Services, August, 1997

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goods/hardware (e.g. ESA/NASA Cupola Barter[29], ESA/JAXA MOU on Hardware Exchange[30]) or a mix of goods and services (e.g. ESA/NASA Barter of Goods and Services in Support of ISS Operations). In one sense reproducibility does constitute a barter for goods (the DFR itself, mechanical designs and other documentation) and services (ESA's negotiation services with its Related Entities). However, reproducibility differs in two essential aspects. First, data, licences and binding proposals are intangible assets and therefore merit different treatment. Second, the provision of the goods and services is tied to the overriding purpose of enabling NASA ability and minimising its cost to reproduce Service Module technology.

The closest parallel with reproducibility can be found in the 1973 Agreement between the US Government and the Member States of ESA's predecessor, the European Space Research Organisation (ESRO), for the development, procurement and use of a space laboratory in conjunction with the space shuttle system (the SpaceLab Agreement). The baseline for this agreement was that NASA should procure from ESRO the first and subsequent SpaceLabs as needed. However, the Agreement contained a provision in the event that the European partner failed to produce the first or subsequent SpaceLabs. In those circumstances ESRO undertook to "provide for the necessary contingency arrangements" to enable production of the SpaceLab in the US[31]. This is reproducibility on a contingency basis. However, no further details appeared in the Agreement and Europe was able to supply the SpaceLab modules and components during the lifetime of the programme. It therefore cannot offer any guidance on how best to implement reproducibility.

The conclusion is that reproducibility in its current form is a new phenomenon in space barter agreements. Some explanation may be offered as to why reproducibility has appeared for the first time in the NASA-ESA MPCV cooperation by reflecting on the context in which the barter arose. ESA was contemplating a future debt to NASA in respect of its ISS obligations between 2017 and 2020. For a barter arrangement to be successful it must be beneficial to both parties. However, where it is set against the backdrop of a debt the barter arrangement must be especially attractive to the creditor in order to incentivise the choice of barter over a transfer of funds. Reproducibility is one of the elements which makes the Service Module barter particularly attractive to NASA. The Service Module is technology which NASA may well look to reproduce many times over a long period even after the ISS project is finished. Reproducibility offers NASA the

[29] Agreement Between NASA and ESA concerning ESA's Provision of a Cupola in Exchange for NASA's Provision of Shuttle Launch and Return Services for Five External European Payloads, 3 August, 2000

[30] Memorandum of Understanding between NASDA of Japan and ESA on Hardware Exchange for Utilisation of the ISS, 5 November, 1997

[31] Article 4(4), The SpaceLab Agreement

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flexibility to continue producing the Service Module in the US if no further barters with ESA are identified; if European industry deems it no longer desirable to continue production; or if political developments constrain NASA from spending US dollars abroad. Reproducibility, even if it is never implemented, provides crucial in-built independence for NASA in the MPCV strategic project. This reduces risk and makes the barter option altogether more attractive[32].

V. Legal Aspects of Implementing Reproducibility

As it is not possible to draw upon prior barter agreements for guidance on how to implement reproducibility, this section attempts to consider certain legal issues which may arise. As the core of reproducibility is the provision of data, licences and binding proposals between actors in different jurisdictions, the focus of this section shall be on intellectual property and export control aspects.

V.I. Intellectual Property Rights

Intellectual property (IP) rights grant the author of an intellectual creation exclusive rights for exploiting and benefiting from his intellectual creation. These monopoly rights of exploitation are limited in scope, duration and geographical extent. Generally speaking, they are rights conferred by virtue of domestic law and therefore the author or creator has exclusivity over his intellectual creation in jurisdictions where he has acquired IP rights. Thus, if a European company registers its intellectual property rights in the US, it may exclude a US company or individual from the use of its intellectual creations except under licence.

NASA is also bound to respect the intellectual property rights of European industry registered in the US. In the context of ISS activities, Article 16 of the IGA holds that the Partner States are not sheltered from IP claims brought by Partners or their Related Entities arising out of Protected Space Operations. The general cross-waiver of liability does not apply in such cases. Article 11 of the Implementing Arrangement clarifies that although the MPCV is essentially an exploration vehicle, the activities under the Implementing Arrangement are nonetheless Protected Space Operations and that "for the avoidance of doubt" this includes all activities in connection with reproducibility.

Therefore both NASA and its Related Entities are required to respect the intellectual property rights of ESA's Related Entities (registered in the US). This is the rationale for Article 15(2) of the Implementing Arrangement

[32] Another example can be found in Article 8 of the Implementing Arrangement whereby ESA agrees to bear the financial risk of any mission anomaly attributable to ESA-supplied hardware, software or systems. This guarantee considerably reduces the risk to NASA of outsourcing the Service Module.

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(requiring valid licence agreements to be negotiated in respect of foreground and background IPR).

However, rather than have NASA or its Related Entities negotiate licences directly with European industry, NASA and ESA have agreed that ESA shall negotiate licences on NASA's behalf at conditions equivalent to those received by ESA. Thus there are two distinct relations running in parallel: ESA-NASA (public international law) and ESA-industry (private law). The private law obligations must therefore be framed in such a way as to enable ESA to comply with its responsibilities.

This is not always straightforward when it comes to intellectual property. Space agencies tend to have specific rules for technology and research contracts concerning the acquisition and registration of IP rights, as well as access to IP for the agency itself and third parties. ESA's Council has adopted Rules on Information, Data and Intellectual Property[33] (ESA's 'IP Policy') which prescribe the terms under which ESA shall conduct business with its Related Entities in respect of IP allocation and access; they provide the baseline for the General Clauses and Conditions (GCC) for ESA contracts with industry[34].

ESA's responsibilities under Article 15 of the Implementing Arrangement should therefore be read against the Agency's standard contractual rights and obligations concerning intellectual property to see whether they are mutually compatible. That is the objective of the following sections.

In research and development collaborations between Agencies and their Related Entities an ordinary distinction is made between 'foreground IP' and 'background IP'. Foreground IP is the IP generated under the development contract. Background IP is the IP that each party has when it comes to the bargaining table, generated prior to the development contract.

V.I(A) Foreground IP

For intellectual creations generated in the course of an ESA contract, the contractor shall retain ownership of any resulting IP since ESA considers that the originator of the said work is best placed to exploit it. It is only when an ESA staff member creates a work that it belongs to ESA outright.

Notwithstanding the general principle regarding ownership outlined above, ESA's IP Policy further states that the Agency shall reserve certain rights of access to information, data and the use of IP. These reservations are explicit terms in the General Clauses and Conditions (GCC) for ESA Contracts with industry. This is highly relevant to reproducibility because of the requirement of equivalence in respect of licences ESA negotiates on NASA's behalf.

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[33] Resolution on the Rules Concerning Information, Data and Intellectual Property, adopted by the ESA Council on 19 December 2001, ESA/C/CLV/Res.4 (Final), ESA/REG/008, April 2014.

[34] General Clauses and Conditions for ESA Contracts, ESA/REG/002, rev.1 (2013), (GCC) accessed at <http://www.esa.int/About_Us/Law_at_ESA>, Clause 41 & 55.

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The access rights described in the preceding paragraph vary depending on whether a contract is partially or fully funded by the Agency. However, in either case ESA shall receive a licence, free of charge, *for the Agency's Own Requirements*[35]. For fully-funded contracts, this explicitly includes a worldwide right to grant sub-licences *for the Agency's Own Requirements*[36]. By contrast, where a Third Party seeks access to foreground IP to use for purposes other than the Agency's Own Requirements, the ESA IP Policy and GCC provide that a licence shall be granted on Market Conditions provided that the contractor agrees that such use is not contrary to its legitimate commercial interests[37].

The central question therefore is whether use of foreground IP for the purposes of reproducibility as part of a barter arrangement falls within the scope of 'ESA's Own Requirements'? It should be recalled that reproducibility was not in contemplation at the last revision of ESA's IP Policy in 2001 and this is therefore not a settled issue. A broad interpretation might suggest that *any* use within the framework of an Agency Programme would qualify. However, a more restrictive view is preferable. Use for the purposes of reproducibility involves exploiting the barter value of the IP rather than the intellectual creation it embodies. Instead it is a Third Party (NASA or its Related Entities in this case) who will make practical use of the intellectual creation; the IP is being used in a meaningful sense for ESA's *benefit* but for the Third Party's *requirements*. It is the same logic that makes it illegitimate for ESA to sub-license for a fee even if the money it received was then put towards an Agency Programme.

This brings us back to the requirement in Article 15(5) that ESA negotiate licences on conditions equivalent to those it receives with its Related Entities. In the previous paragraph it was observed that ESA shall benefit from a free of charge licence. Therefore, equivalent conditions for NASA would presumably also be free of charge. However, ESA's licence only extends to uses corresponding to the Agency's Own Requirements. It was further suggested that using IP for bartering purposes may be outside the scope of the Agency's Own Requirements. If this point is accepted then on a correct analysis ESA is negotiating a licence for a Third Party to use foreground IP *for purposes other than the Agency's Own Requirements*. Following the GCC, the Related Entity shall still provide a licence for third party use but it may choose to do so on Market Conditions and provided that such use is not contrary to its legitimate commercial interests. Thus the conditions offered for ESA (free) would appear to differ from those offered to the Third Party

35 Clause 41.1(a), 55.1(a), GCC

36 Clause 41.1(a), GCC

37 Clause 41.1(d), 55.1(c), GCC; *See also*, Molineaux, M., Eisermann, K., *ESA's New Intellectual Property Policy,* Space Policy, Vol. 20, Issue 4, November 2004, at 253-257

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(market) i.e. NASA or its Related Entities. On this analysis ESA's contractual position is not necessarily aligned with its responsibility to provide foreground IP licences at equivalent conditions.
On the other hand, ESA may consider that the Implementing Arrangement takes priority over the IP Policy as it is the more recent document to be approved by Council. The Implementing Arrangement could be viewed as implicitly authorising a special contractual relationship to be negotiated with industry for the Service Module whereby ESA can negotiate equivalent (free of charge) licences for a third party for purposes other than the Agency's Own Requirements.

V.I(B) Background IP

In the case of background IP, ESA shall be granted free access (fully funded contracts) or access at favourable conditions (partially-funded contracts) to background IP for the project specified in the contract but not for any other purpose and does not include a right to grant a sub-licence. Third Parties are only entitled to receive a licence under Market Conditions if the use corresponds to ESA's Own Requirements and the contractor may still assert a conflicting legitimate commercial interest[38]. The difference as compared with foreground IP is subtle but important: ESA's IP Policy, reproduced in the GCC, does not compel a contractor to grant a Third Party licence *for purposes other than the Agency's Own Requirements* on Market Conditions *or at all*. ESA will instead have to rely purely on its capacity to negotiate a licence with the Related Entity in order to fulfil its responsibility under Article 15(2)(a).
ESA cannot insist on a free licence for NASA as the rights are held independently by the contractor. However, it can minimise the use of background IP in the first place. The GCC requires background IP to be identified when negotiating the contract[39]. This provides ESA with an opportunity to agree clear licensing terms on behalf of NASA in respect of background IP deemed necessary to develop the Service Module. If these licences require NASA to pay the market rate this is not inconsistent with the purpose of reproducibility, which is to *minimise,* not obliterate, NASA's costs of reproducing the Service Module. Therefore NASA may have to pay licence fees in some circumstances.

V.I(C) Summary

This section has presented arguments and counter-arguments on the relative impact of intellectual property rights in the implementation of the reproducibility provisions of the Implementing Arrangement. The question is whether ESA's standard contractual terms with European industry,

[38] Clause 43, 57, GCC
[39] Clause 43.1, GCC

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concerning IP, support the responsibilities it has assumed under the Implementing Arrangement? I have identified potential difficulties reconciling ESA's IP Policy with the requirements of Article 15(5) (equivalent licences) in respect of foreground IP and Article 15(2)(a) (provision of licences) in respect of background IP.

Of course the foregoing conclusions only refer to the relationship between reproducibility in the one form in which it currently exists (the Service Module barter) and the specific provisions of the IP Policy of ESA. Furthermore, compelling counter-arguments can be presented against each of the potential conflicts identified above. However, this section is illustrative of the uncertain legal territory into which parties are entering – and the potential legal obstacles, including IP – when implementing a reproducibility barter.

V.II. Export Control Regulations

Recalling Article 19 of the IGA, a Partner is obliged to proceed with the transfer of technical data or goods to another Partner if these are considered necessary to comply with responsibilities under an Implementing Arrangement *but not where to do so contravenes its national laws or regulations*. Reproducibility involves the transfer of technical data and design information overseas. Therefore national laws and regulations, particularly those relating to export controls, may not always be compatible with reproducibility.

It is hard to draw any general conclusions about the extent to which national export control regulations impede the implementation of reproducibility. It will depend in each case on the originating state and its particular laws, the type of components or technology, the launch site and the end-user. Where data or information to be transferred concerns industrial knowledge or manufacturing processes deemed strategic or sensitive by a national authority it may not be possible to obtain export authorisation. For example a reproducibility barter in respect of launcher or navigation technology might be unattainable or unrealistic as a result of stricter national export control regulations. Even where export licences can be obtained, compliance procedures can be burdensome with the risk of heavy sanctions for non-compliance. In some cases the better solution may be to procure the end product (hardware) directly from the manufacturer rather than the design information.

In the particular context of the Service Module barter export control regulations are unlikely to undermine ESA's responsibilities to provide data, licensing and binding proposals. The Implementing Arrangement was negotiated subject to the Member States' approval and export control restrictions will be taken into account prospectively. Furthermore, in the case of the Service Module, a large number of subsystems such as gas storage and solar rays, are not protected technologies. The European design also employs a number of components coming from the US, notably a Shuttle engine and

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Aerojet Auxiliary Thrusters[40]. Where export control regulations *do* apply (one possible example is the Reaction Control System 220N Thrusters which were previously used on the ATV to control altitude) the Implementing Arrangement clearly envisages that NASA may have to resort to procurement[41] unless equivalent technology already exist in the US.

VI. Utility of Reproducibility in Barter Agreements

Reproducibility is not a 'precise instrument' for the purposes of barter. The more innovative the technology concerned, the harder it is to estimate the value of what is being bartered. Even if it is possible to accurately assess the development costs for a given technology, it may be hard or impossible to make an accurate assessment of the future utility of the IP which is being bartered. This uncertainty affects both parties to the 'bargain'.

Depending on the lifetime of the Orion MPCV Programme, private sector space flight development and future NASA spending decisions, the European Service Module could be reproduced in the US any number of times. Consider that between 1981 and 2011 the Space Shuttle flew 135 missions. On the other hand, MPCV reproducibility may be little more than a footnote in history: It may prove advantageous to continue procurement of the Service Module, in whole or in part, from European industry if it continues to offer a lower price per unit owing the competitive advantages it enjoys in terms of manufacturing infrastructure and know-how.

One response might be that inter-agency cooperation in an ambitious space exploration programme responds to higher ideals. Ensuring a barter is 'fair' is secondary to the overall benefit of participation. However, in an age where every spending decision must be meticulously justified at a political level, achieving a fair barter assumes a high degree of importance. Evidence for this assertion can be found in other contemporaneous barter agreements within the ISS framework. For example, the ATV Barter annexes a Joint Accounting Document which is an instrument of mathematical precision. Evidently each party is concerned with careful quantification of the value of goods and services bartered. As argued above, reproducibility does not respond to this concern.

VII. Conclusion

The following conclusions have been reached in this paper: (i) The Service Module barter is implemented within the legal framework of the ISS cooperation. However, the provisions regarding reproducibility are exclusively

[40] Berthe, P., Schubert, K., et al., *The Multi-Purpose Crew Vehicle European Service Module: a European Contribution to Human Exploration*, paper presented at the American Institute of Aeronautics and Astronautics Space Conference, September 12, 2013, at page 12

[41] Article 15(6), MPCV-IA

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contained in the Implementing Arrangement; (ii) The absence of a clear definition in the Implementing Arrangement raises questions about what it means to successfully implement reproducibility. This creates potential conflict between competing views. However, it is rarely practical or possible to define *a priori* every aspect of an international cooperation agreement where new technology is being developed. Rather we define objectives of cooperation at a general level; (iii) Reproducibility is a new phenomenon in space barter agreements. There is no convincing precedent to guide us in its implementation; (iv) Reproducibility denotes responsibilities to use reasonable efforts to provide data, licensing and binding proposals. To assess whether those responsibilities may be readily complied with, attention must be given to other legal aspects arising at the level of implementation. Private law intellectual property rights and national export control regulations are arguably capable of restricting the ability of one party to provide certain data, licensing and binding proposals; (v) The value of reproducibility can be hard to quantify precisely. It may therefore be of limited utility in future space barter agreements. On the other hand, it supports continuity and long-term planning which may be pivotal in forging international cooperation in ambitious, costly, high-risk endeavours.