# Interspace – design for an international space agency

**Bruce Cordell**

*The future exploration, utilization and eventual human settlement of space should be carried out in peace for all humankind. Thus major space programmes should offer participation to all interested and qualified countries. Likewise, commercial space ventures should be encouraged and open to a wide variety of international participants and investors. Interspace, a management concept developed in 1990 for the international planning, coordination and operation of large-scale space programmes, looks even more intriguing in the geopolitical context of the post-Cold War world. Ambitious future multinational macroprojects – eg a Lunar Power System – would require international planning and oversight and could naturally lead to the establishment of an Interspace-style organization.*

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The post-Cold War global economic and environmental landscape features increasing national interdependence coupled with mushrooming multinational competence and interest in space technology, space science and related fields. There has never been a better time to think seriously about the potential for real international cooperation in space. In a 1990 study, Otto Steinbronn of General Dynamics and I proposed a specific organizational concept – Interspace – for the coordination and management of future major international space activities.[1] This Viewpoint updates the concept and shows how it fits into the current geopolitical context. It will also relate the function of Interspace to a particularly intriguing early 21st century candidate macroproject: the Lunar Power System (LPS).

Interspace is designed to maximize broad international participation in the planning, development, production and operation of future space programmes of global scope. Modelled after the European Space Agency, Interspace's focus is on facilitating major scientific, technological, commercial and cultural activities. Through appropriate mechanisms, all qualified nations can participate directly in Interspace planning and programmes and share in its benefits and profits.

Although still future-oriented, this highly international approach seems much less far-fetched than it did only two to three years ago.[2] The long-term viability and attractiveness of a coalition like Interspace is thus predicated on the likelihood of increasing global interdependence in the future.

## The approach

Interspace is basically an organizational framework within which global resources can be efficiently focused on the goal of multinational space exploration and utilization. Studies of Interspace-style organizations have already begun and should be intensified and broadened.

The fundamental planning and coordinating group is shown in Figure 1. It consists of an ESA-style Authorization Board, a Council and a Headquarters staffed by high-level individuals from the participating countries. These entities are expected to establish top-level policy, plan programmes, authorize and allocate budgets, arbitrate disputes, coordinate all Interspace organizations and manage specific programmes.

It is interesting to speculate about potential locations for the Interspace headquarters. I suggest that it be in a developing space nation; definitely not in one of the major space powers (ie the 'core' nations discussed below) like the USA. This would send a symbolic message to the world that developing space nations are of im-

[1] Otto Steinbronn and Bruce Cordell, 'International human missions to Mars – suggestions and mechanisms', paper presented at the Case For Mars IV Conference, Boulder, CO, July 1990.

[2] For confirmation, see almost any international relations journal, as well as the highlight in *Space Policy*, Vol 8, No 3, August 1992, pp 195–244.

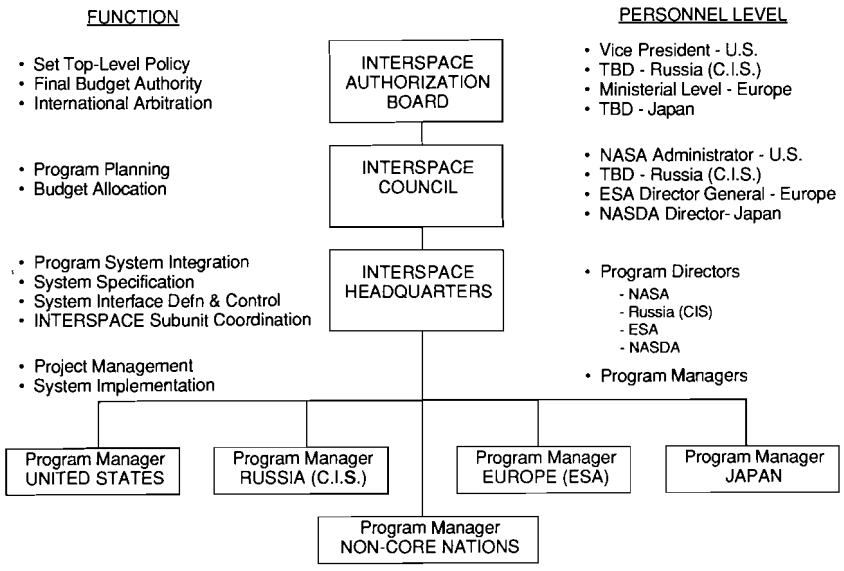


**Figure 1.** The Interspace Headquarters Organization (IHO).

*Source*: Modified from Steinbronn and Cordell, *op cit*, Ref 1.

**'One particularly attractive candidate for Interspace headquarters is Brazil'**

portance to Interspace. Proximity to an equatorial launch site with growth potential might be an advantage, because it would add excitement, immediacy and economic benefits to the city and country.

One particularly attractive candidate country for Interspace headquarters is the world's seventh spacefaring power: Brazil. Rio de Janeiro would be an ideal headquarters city, even though it is 2000 km south of Brazil's launch site at Natal, and more than 3000 km south of the French Guiana site. Brazil's space stature is likely to continue rising because of its interests in a satellite communications network and the need for orbital remote sensing of its natural resources, including the Amazon jungle.

Several other cities certainly also deserve mention; a partial list includes:

- Singapore, a cosmopolitan city-state and Pacific Rim trading hub with the second highest GNP in Asia, is relatively close to a near-equatorial Indonesian launch site (near Bandung).
- Bangalore, headquarters of India's dynamic, growing space organization that aims to be second to none in applications of space to real problems,[3] is only a few hundred kilometres west of India's island launch site on Sri Harikota in the Bay of Bengal.
- Nairobi, capital of Kenya, the most industrialized country in East Africa as well as a major tourist destination, is also not far from an off-shore, equatorial launch site currently maintained by Italy.

The choice of a 'World Space Centre City' will be controversial and hard fought. And it should be. Interspace headquarters must be located in a country and city that is eager to become the world symbol of the exploration and utilization of space for the benefit of all humankind.

Five core members – with equal voting privileges – would comprise the fundamental governing unit of the Interspace Headquarters Organization (IHO); four are the USA, the CIS (former USSR), Europe (represented by ESA) and Japan. It is likely that these entities will be the predominant space powers of (at least) the early 21st century, and therefore they will be the most qualified and interested in major space activities. The fifth core member is to be an elected representative of the non-core nations (NCNs). Although it would be preferable, in principle, to have equal representation in Interspace of all the interested nations of the world, as a practical matter it is difficult to envision a large organization (consisting of several dozens of nations) functioning expeditiously and having the capability to plan and manage global space policy or macroprojects. Extensive discussions must precede any Interspace

[3]Nathan C. Goldman, *Space Policy – An Introduction*, Iowa State University Press, Ames, IA, 1992.

policy or programme decision. The decisions themselves will be established by a 60% majority (any three) vote of the five core members.

The fifth core member may be chosen from any of the developing space nations – in other words, from any of the NCNs; the NCN country where Interspace headquarters is located would always be eligible for this position, although it would receive no special privileges. The fifth core member would, however, provide a powerful, formal mechanism for the NCNs to participate directly in top-level global space policy discussions and to have a direct vote in the proceedings. The NCNs would elect their IHO representative according to their own selection procedure. The term of office for the fifth core member should be between two and five years. The NCNs might choose to have an emergency mechanism where (for example) a two-thirds 'no confidence' vote of participating NCNs would remove the current fifth core member (for whatever reason) and immediately replace it with a new NCN representative.

The other four national entities have 'permanent' membership in Interspace, until they are no longer willing or able to abide by its regulations relating to investment and/or participation in global programmes. If a non-core country has experienced exceptional growth and maturation of its space activities, it might petition Interspace for admission to the group of core members. Permanent core member status can be granted to an NCN only by unanimous vote of the current core members. Countries like China, India and Brazil would be obvious candidates for future core membership in Interspace if their space activities continue to expand. Importantly, countries would retain the right to develop and maintain their own private space programmes independent of their participation in Interspace. Any entity may privately contract with Interspace for use of its facilities.

By analogy with ESA, participation in Interspace programmes would be voluntary for the core members (and any other participating members) except for one activity: the space science programme. Space science is highly important to the exploration and utilization of space, and administration of this programme would be the direct responsibility of the Director General at Interspace headquarters. Headquarters science programme personnel would ensure that the interests of science and exploration – as defined by the international science community and approved by Interspace – were always given high priority in any Interspace activity. Science within Interspace would be broadly defined to include the acquisition of new knowledge – theoretical, observational, experimental or applied – that relates directly to the exploration, utilization and/or settlement of the Solar System. This would include biomedical and psychosocial studies of humans preparing for interplanetary voyages. In the case of commercial ventures, the R&D associated with *in situ* resource processing would be within the scope of Interspace science, while commercial operations themselves (including facility and vehicle maintenance) would not.

## Regional and programme organizations

Eventually Interspace operations will involve facilities and operations near the Earth, Moon, Mars and even beyond.[4] Interspace Regional Organizations (IROs, shown in Figure 2) would be responsible for managing and coordinating all Interspace activities at their particular location including on a given celestial body, in the body's vicinity, or in the space separating the body and Earth. For example, the lunar surface IRO – Intermoon – would coordinate all phases of lunar surface operations. Likewise, Interareo (from 'Ares', the Greek for Mars) would govern all Interspace operations in the vicinity of Mars (but not on Mars or either of its satellites). And Interplanet would manage the development and operations of the interplanetary transportation system linking Earth (and possibly the Moon) to other Solar System bodies. (In a more advanced timeframe, a more robust Interspace might have execu-

**'countries would retain the right to develop and maintain their own space programmes'**

[4]Bruce Cordell and Otto Steinbronn, 'An analysis of possible space strategies featuring the role of space resource utilization', *Acta Astronautica*, Vol 26, No 1, 1992, pp 19–27; and Bruce Cordell, 'Manned Mars mission overview', AIAA-89-2766, 25th Joint Propulsion Conference, Monterey, CA, 1989.

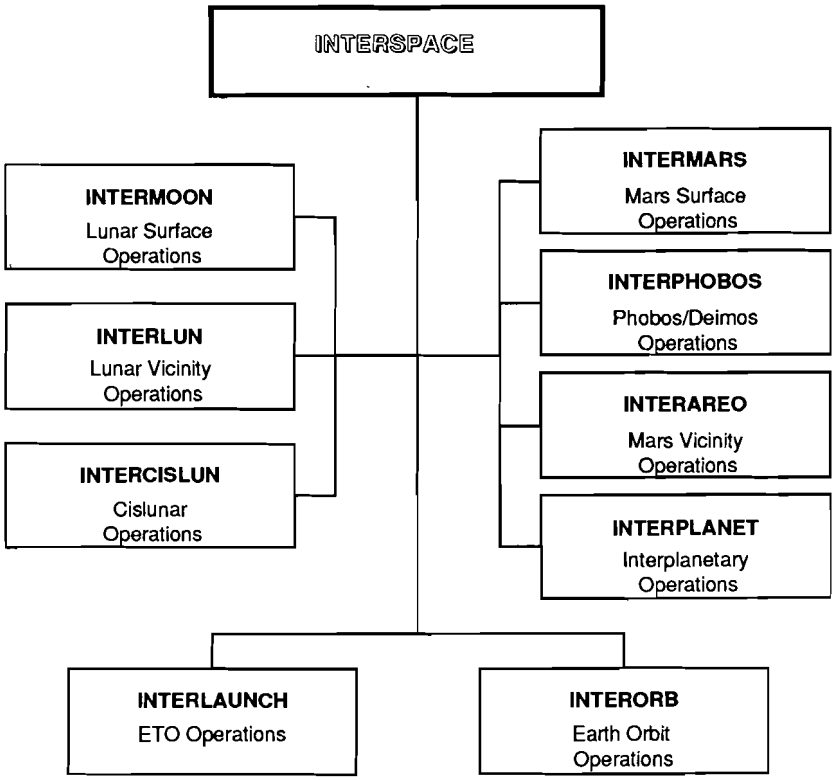


**Figure 2.** Interspace Regional Organizations (IROs) from the Earth to Mars.

tive authority over all activities – as opposed to merely Interspace activities – in each of its regions.)

It is easy to imagine exploration and development scenarios where, in certain regions, almost all activity is part of a single programme possibly managed by a corporation established by Interspace. An example is the major commercial development of lunar resources, eg the Lunar Power System (LPS).[5] In this case, the LPS programme organization would eventually dwarf the IRO in both personnel and funding. As operations become more diverse, there could be several programme organizations (POs) in a single region. However, POs – whether private companies or arms of Interspace – would remain subordinate to the overall management authority of the IRO; and each IRO would be responsible for coordination with Interspace headquarters. (Special rules would apply to non-Interspace POs that simply contract with it for use of its facilities and/or personnel.) In particular, the IHO (ie the five core members) would be able to order the Interspace Director General to communicate any IHO directives or other information to any IRO regarding the plans or operations of any PO within its jurisdiction.

In time, the IHO may preside over a complex matrix organization consisting of several IROs plus a variety of POs (both Interspace and non-Interspace) with activities that physically extend across several IRO boundaries, ie multiregional POs (the Lunar Power System is a good example). In this case, the IHO's coordination of IRO affairs would become a key headquarters activity. The required activities of each of the IROs depicted in Figure 2 are initiated sequentially as driven by the overall Interspace programme strategy and schedule requirements and as the necessary budgets are authorized. This sequential implementation allows working relations to develop prior to the commitment of major funds.

## Definition of programme options

Interspace would not only coordinate and (eventually) manage existing global space programme operations, but it would also be the key mechan-

[5]See, for example, R.D. Waldron and D.R. Criswell, 'Concept of the Lunar Power System', *Space Solar Power Review*, Vol 5, 1985, pp 53–75.

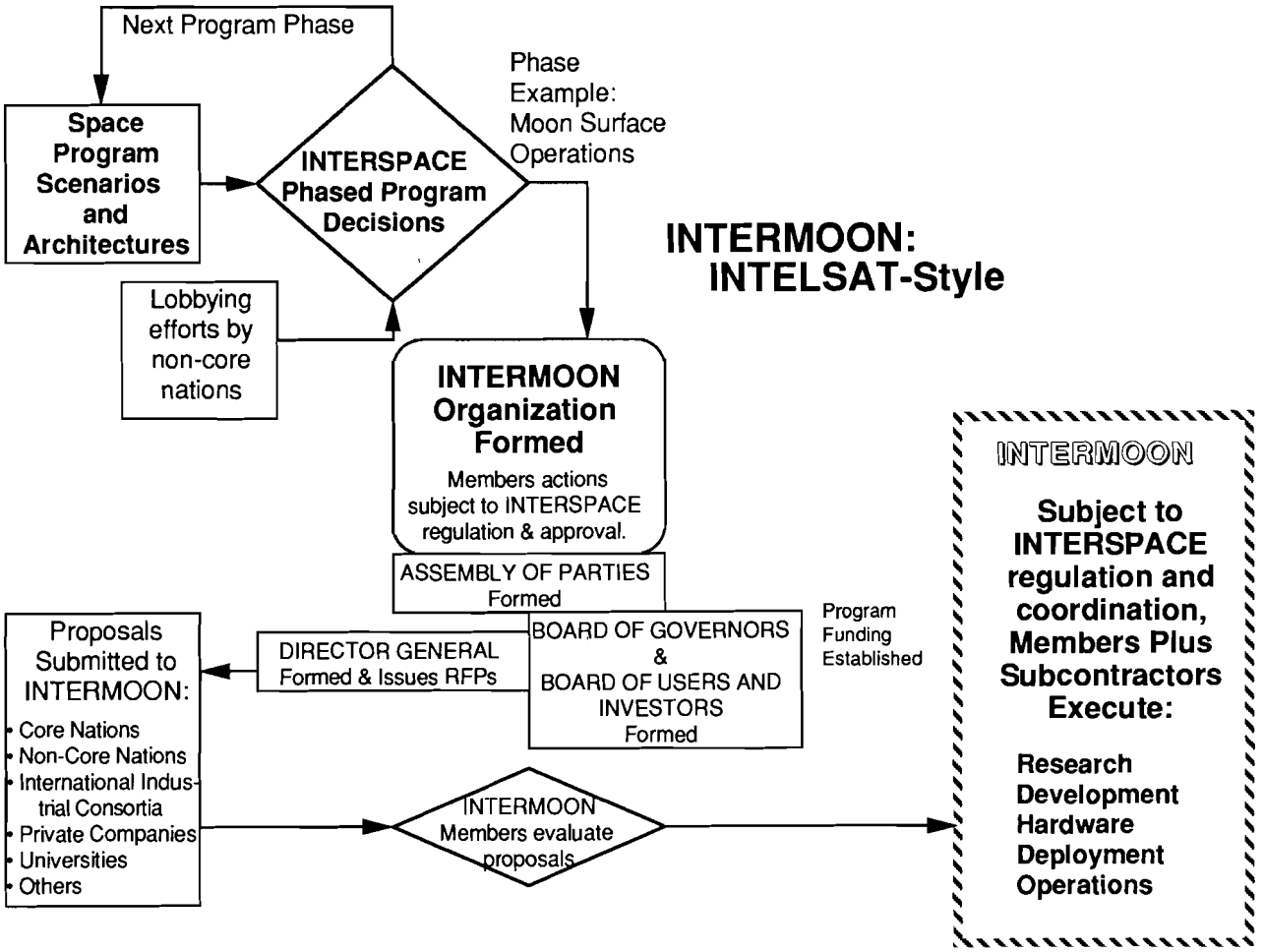


**Figure 3.** Intermoon, the Intelsat-style Interspace Regional Organization for the lunar surface.
*Source*: Modified from Steinbronn and Cordell, *op cit*, Ref 1.

ism for programme definition and planning of future activities. Figure 3 illustrates a possible path for definition of the programmes within Intermoon, the lunar surface IRO. The management structure adopted for Intermoon is based on Intelsat because this would allow numerous countries to participate equitably (ie with programme influence proportional to investment) in lunar surface operations.[6] In its use of an Intelsat-like organization, Intermoon is reminiscent of Interlune (hopefully never to be confused with Interlun, the lunar vicinity IRO!), a concept suggested by Schmitt for Helium-3 development on the Moon.[7] An Interlune-like organization can be thought of as a programme organization that would operate under the jurisdiction of the IRO Intermoon. The Lunar Power System has already been mentioned as a potential Intermoon programme organization.

While it is likely that many countries will want to participate in lunar and/or Mars surface operations once they become possible, it seems less likely that they will all be technically or financially able to build and operate the interplanetary transportation system(s). Thus Interplanet (Figure 4) is assumed to be an ESA-style organization comprising only a few entities (eg the USA and Russia). Organizationally, Interplanet is a miniature version (and a subunit) of Interspace Headquarters Organization. Individuals may only work in a single Interspace organization at a given time. It is reasonable to expect that the USA would want to be a permanent member of Interplanet. Other entities,

[6]Steinbronn and Cordell, *op cit*, Ref 1; and J. Alpher and J.N. Pelton, eds, *The INTELSAT Global Satellite System*, AIAA Press, New York, 1984.
[7]Harrison H. Schmitt, 'Interlune concept for Helium-3 fusion development', in W. Sadeh, ed, *Engineering, Construction, and Operations in Space III*, American Society of Civil Engineers, New York, 1992, pp 804–814.

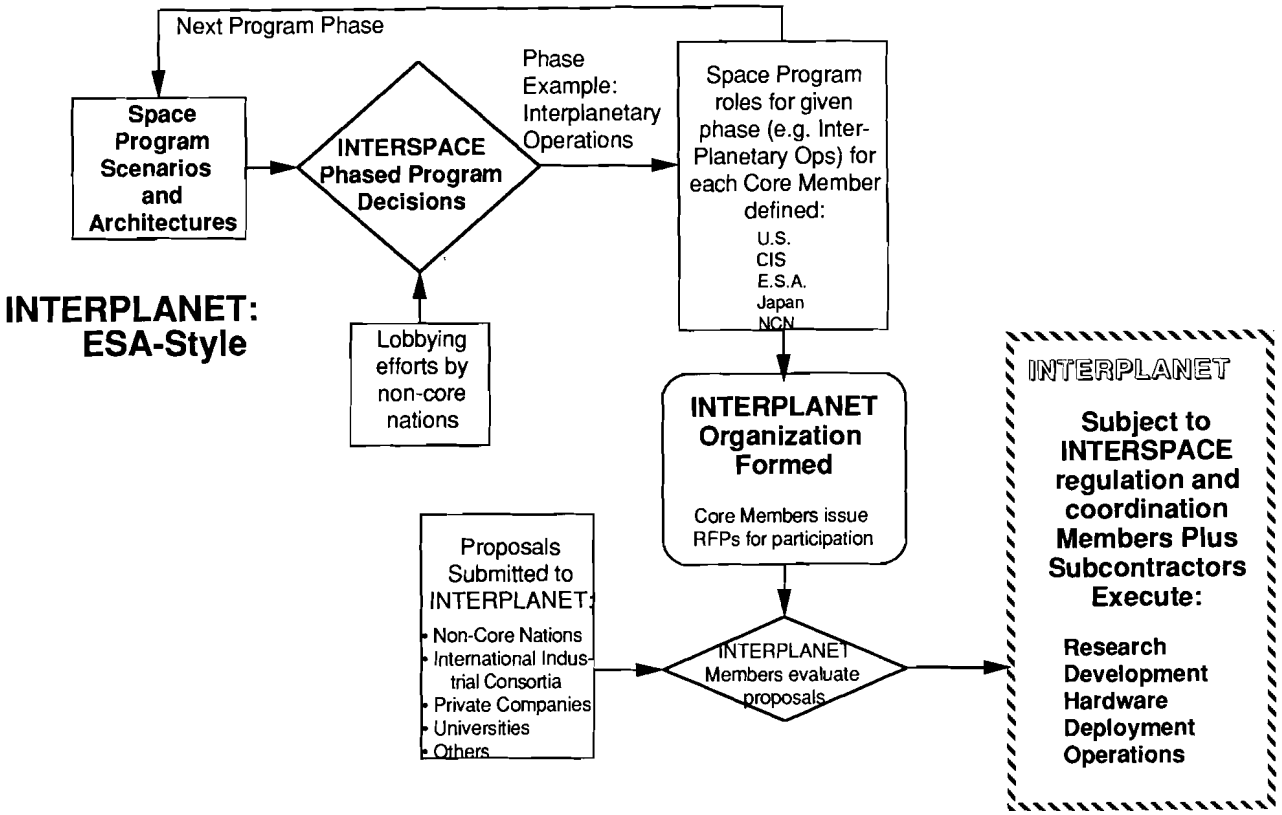


**Figure 4.** Interplanet, the ESA-style Interspace Regional organization for the Interplanetary Transportation system.

including NCNs, can participate by responding to requests for proposals (RFPs) issued by Interplanet.

Based on the numbers of anticipated members and the goals of the organization, Intermoon and Interplanet would feature fundamentally different management structures, ie Intelsat- and ESA-style, respectively. However, for a variety of real-world reasons, it might be useful for a mechanism to exist within Interspace that automatically selects the style of management structure assigned to a given IRO. Steinbronn and Cordell have discussed such a mechanism based simply on the number of qualified non-core applicants for inclusion in a given IRO.[8] For example, when the number of countries exceeds a 'critical number', the given IRO automatically becomes an Intelsat-style organization.

## Interspace programmes and national planning

One of the most important unaddressed issues relating to Interspace is its relation to space programme planning within member countries or NCNs. Figure 5 hints at the mechanics of such an interaction for the USA, although it might also apply to other nations.

At least seven major plans are needed to support any major space programme with substantial international participation as shown in Figure 5. Major inputs to the Master Plan synthesis process come from US stakeholders – these include NASA, Congress, the President, other governmental agencies (eg DoD, DoE), scientists, educators, many other public constituencies – and from the Interspace plan itself. For the USA, Interspace influences the 'International Plan', including the requirements for US participation and interfaces with other nations and entities. This feeds into architecture and technology planning and forms the basis for management and funding plans. Ultimately, these and other influences form the US Master Plan for space that becomes a major input into Interspace nego-

[8]Steinbronn and Cordell, *op cit*, Ref 1.

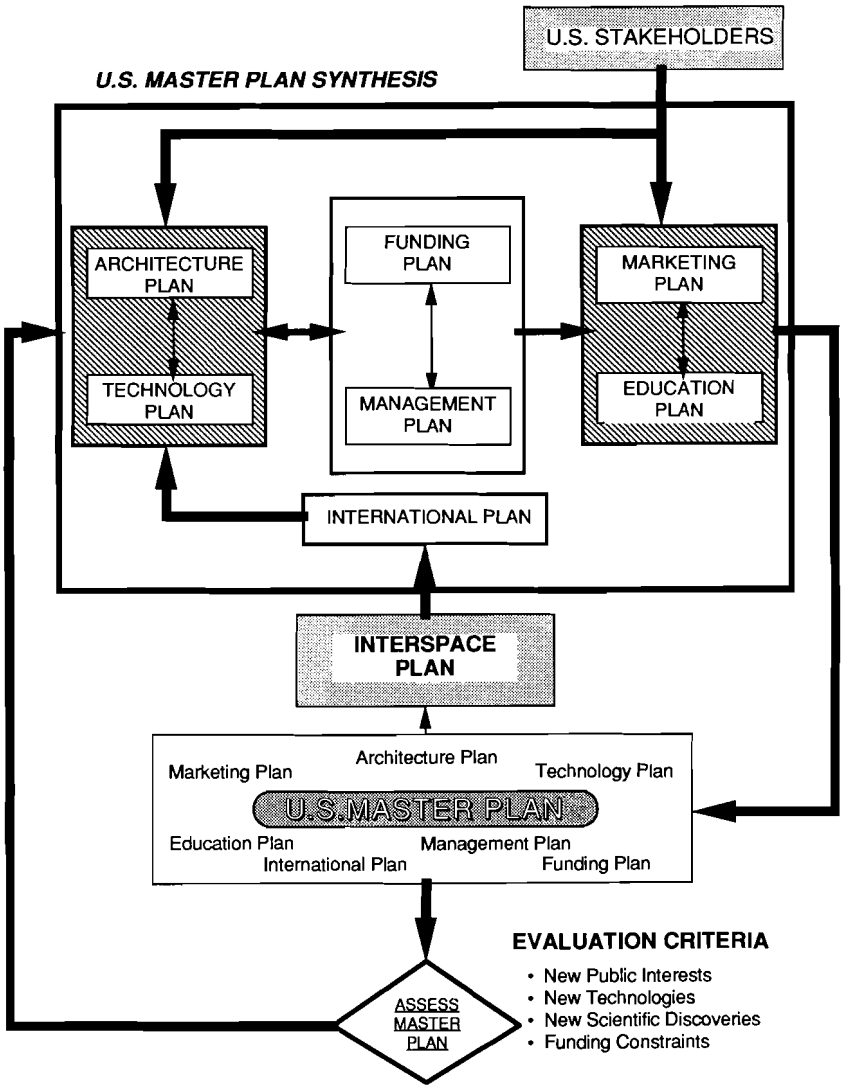


**Figure 5.** The relationship between Interspace programme plans and the US Master Plan for space.

tiations. The Master Plan should also be regularly evaluated with respect to criteria such as public interests, new technologies and funding.

## Interspace and lunar development

Interspace is an idealized concept for the planning, coordination and operation of major global space programmes under the supervision of a large international organization. Despite the fact that Interspace is based on currently existing management structures, it would be politically and organizationally complex. Assuming an umbrella organization like Interspace is workable and desirable, under what circumstances might the world make the transition from a US- or Russian-dominated model to a multipolar style executive authority more diffused throughout the international community?

As mentioned above Schmitt has suggested that extracting Helium-3 from the lunar regolith might benefit from the formation of an Intelsat-style organization (Interlune) where sovereignty and opportunity are shared by many nations in the context of free enterprise.[9] It is not too difficult to imagine how Interspace, in response to a large-scale lunar development effort, might eventually evolve from such an arrangement.

The Lunar Power System is another potential 21st-century macroproject that, perhaps even more than the Helium-3 scenario, would stimulate international participation. Criswell and Waldron discuss LPS in the con-

[9]Schmitt, *op cit*, Ref 7.

text of an international lunar base effort.[10] They see the major challenges as start-up costs and public confidence. Research, development and production of LPS elements could be done by an international consortium (eg a corporation governed by an Intermoon-type organization). Many lunar bases would be needed. In summary, by 2050 LPS could theoretically supply the Earth's entire demand for electricity (20 000+ billion watts) by collecting solar energy on the Moon and microwaving it Earthwards.

For LPS, as for many space macroprojects, the start-up costs practically require international cooperation and a shared, multinational investment.[11] The macro-scale of LPS lunar surface operations – using hundreds of lunar surface workers – indicates a plethora of opportunities for international involvement. Perhaps most importantly, the global public – if it is ever to depend routinely on LPS for its electricity – must believe in the safety, reliability and efficiency of the system. This will involve studies of: 1) LPS element reliability under lunar conditions; 2) LPS microwave beam effects on the terrestrial environment (if any); 3) the vulnerability of LPS to terrorist or military assaults; and other factors.

Only by the initial detailed involvement of the international community will these potential challenges be overcome to the satisfaction of LPS's customers – the global public. A multinational office like Intermoon would probably be necessary to coordinate the numerous, diverse consortia and governments involved in all aspects of LPS development (including lunar bases themselves). The success of Intermoon might then lead to the establishment of its upscale cousin – the Interspace Headquarters Organization – and its associated IROs. In addition to the global environmental benefits previously cited for LPS, the apparent requirement for significant international cooperation – including the potential emergence of an Interspace-type body – can be thought of as one of the most important fundamental rationales for the development of space.

[10]D.R. Criswell and R.D. Waldron, 'International lunar base and lunar-based power system to supply Earth with electric power', IAA-91-699, 42nd Congress of the IAF, Montreal, October 1991.
[11]Philip R. Harris, *Living and Working in Space*, Ellis-Horwood, New York, 1992.