

A New Marketplace in Space: The International Space Station

M. Belingheri

Commercialisation and Procurement Management Division,
ESA Directorate of Manned Spaceflight and Microgravity,
ESTEC, Noordwijk, The Netherlands

The objectives of commercialisation

The overall motivation for the commercialisation of the International Space Station (ISS) is to foster the economic development and exploitation of space. Commercialisation of the ISS will contribute to the creation of value for the business and research communities that choose to access it, by sending commercial payloads to and conducting innovative activities on this world-class facility in space.

- reduce the need for ESA funding for ISS operations and servicing-type activities by charging the market rate for ISS utilisation in order to free ESA resources for research and development
- keep pace with the other ISS partners, who are moving aggressively towards ISS commercialisation
- generate revenue by using the ISS image, as well as the space and ground infrastructure, for projects in the fields of education, sponsorship, advertising and entertainment
- improve the public's perception of and interest in space and space science by communicating the benefits of space-based research to a wider community in the context of promoting commercial ISS utilisation.

The ISS business case

The International Space Station provides a unique environment in that it combines the virtual absence of gravity (microgravity) with the continuous presence of humans. Such an environment allows physical processes to be observed in an experimental context without the 'distortion' that is generated here on Earth by our planet's gravity or atmosphere.

In fluid physics, for instance, the absence of gravity enables one to study the complex interactions of many different phenomena in fluid phases. The environment of a space laboratory, where sedimentation and buoyancy-induced flows are virtually eliminated, allows one to study fluid phenomena that are otherwise dominated or even completely masked by these effects. The thermo-physical properties measured under such conditions have extreme levels of accuracy, which is critical for developing new materials such as commercially attractive alloys.

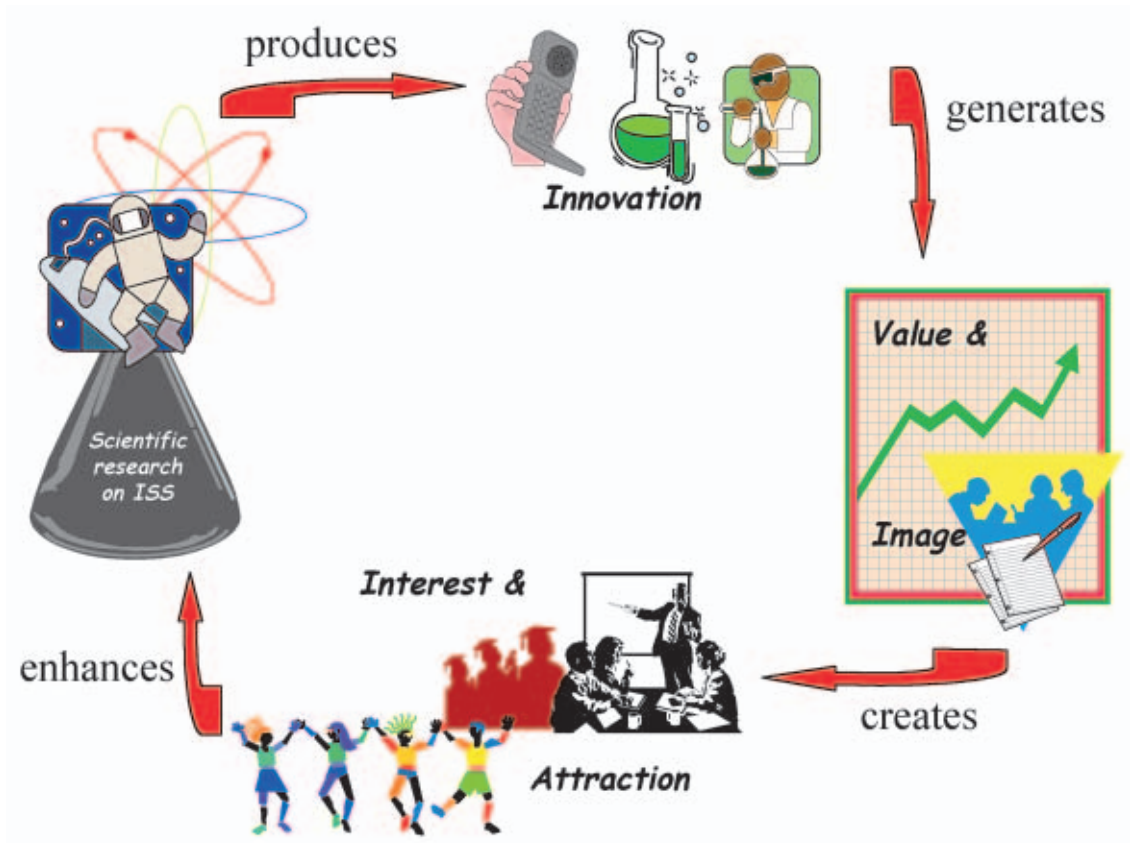
In tissue and cell engineering also, experimental data gathered under microgravity conditions or in microgravity simulation studies indicate a change in cell function that is related to the

Commercialising the European segment of the International Space Station means creating conditions that attract private entities willing to do business in the near-Earth environment. The commercialisation of the Station is based on the assumption that there is a market for low-orbiting manned infrastructures. This market is driven by customer demand and covers a wide range of applications, encompassing commercially applied research, technology development and innovative activities linked with the image of space. The commercialisation process touches upon virtually all of the facets of ESA's day-to-day business: the evaluation and selection of projects, the legal environment, the exploitation of human and technical resources, and the corporate image. This article discusses the potential markets for the Station, the potential customers, why they might want to be in space and what they need from the Agency in order to get there. It also outlines ESA's strategy for making the Space Station a new marketplace in space.

That value in turn translates into technologies, products and processes for applications on Earth as well as in space, generating prosperity and increasing European industry's competitive advantage. For Europe in particular, the primary objectives of ISS commercialisation are to:

- make full use of the European investment in ISS by stimulating applied and commercial research in space and exploiting and supporting innovative uses of the Station, thereby involving both space and non-space industry in space research and in improving products and processes on Earth and in space
- encourage investment by the private sector for future improvements and enhancements of the ISS, which will attract new users by providing new services

Figure 1. The commercialisation cycle



gravity level. The microgravity environment therefore provides new ways of isolating the various mechanisms inherent in the evolution of tissue structure. This knowledge can then be used, for example, for the production on the ground of improved artificial organs for medical purposes and for the design of bioreactors mimicking organo-typical conditions.

Moving clockwise in Figure 1 from the R&D, we see therefore that the generation of knowledge and processes in space can contribute to innovation on Earth, which generates added value for companies and a better image for the Station, which in turn serves to attract the

attention of more potential customers – both commercial and academic – and further enhances its commercial utilisation by European customers.

Market research: identifying markets and customers

Where does one start in order to identify potential customers and attract them to the Station? In initiating its ISS commercialisation activities in 1999, ESA asked three companies specialised in market research and technology development to perform independent studies of the market for, and the customers who could be attracted to, the Station. These studies identified a broad spectrum of potential markets (Fig. 2), ranging from R&D for new product and processes in weightlessness, to the novel utilisation of the attractiveness of the human presence in space for commercial communication in terms of sponsorship, product placement and advertising. The studies also showed, however, that the markets for the ISS are latent ones that need promotion and nurturing. The three major market segments identified are:

Figure 2. Promising market segments

Commercial Utilisation Development Areas	
<p>Research Field</p> <p>Health Biotechnology New Materials</p> <p>Process Improvements Fluid Physics Combustion</p>	<p>Relevant Applications</p> <p>Pharmaceuticals, medical instrumentation Pharmaceuticals, biomedical products Aerospace, automotive, consumer goods, medical instrumentation Metals, electronics Food, oil Fuel, automotive, aerospace</p>
<p>Publicity/Sponsorship Product Placement</p>	<p>Entertainment/Edutainment Merchandising</p>

(i) *Research and Development*
There is industrial market potential in the R&D area that is already being tapped through the

ESA Microgravity Application Programme (MAP), in which European non-space industry has been participating since 1995. This industrial participation is equivalent to almost one third of the total cost of the initial phase. Areas with commercial potential and interest for metal producers and refiners, car and aero-engine developers, energy producers, food and cosmetics companies, oil companies, pharmaceutical companies, medical instrumentation companies and others are:

- Innovative materials, products and processes (e.g. improved knowledge of the thermo-physical properties of metals, advanced foams, emulsions, high-quality crystals, high-performance alloys).
- Combustion processes (e.g. a better understanding of these processes leads to potential reductions in fuel consumption and pollution).
- Biotechnology and biomedical research with bioreactors.
- Research into osteoporosis.
- Tissue and cell engineering.
- Improved techniques for crew-health monitoring.

Such potential commercial applications need nurturing with pathfinder projects in order to foster their eventual growth into commercial processes and products.

(ii) Non-conventional activities

Advertising: Advertising offers short-term potential for revenue generation, but due consideration has to be given to the building-up of the ISS's image as an outpost for humanity devoted to advanced scientific and technological research.

Education: The possibility exists to broadcast lessons in real time on such subjects as physics, chemistry, biology and geography direct to schools from the Space Station. Although TV networks could pay for such ventures, it is unlikely that they will be big revenue producers. The main interest in this area is related more to image creation than to the generation of revenue.

Entertainment: Multimedia companies have already expressed strong interest in making films on the ISS, in using the ISS for broadcasting news, and in creating web-site links with real-time images involving crew members.

Sponsorship: Present indications are that the most promising market segment here is that of patronage or sponsorship of research by global companies that could benefit through association with a particular field, particularly

research that benefits mankind, e.g. health- or environment-related.

Dedicated commercial flights: If there is sufficient demand, special flights to the ISS carrying commercial customers may be considered. These spaceflight participants would primarily be professionals in particular fields, such as industrial researchers, teachers, journalists, etc. In addition, there could be the possibility to involve private individuals, fully trained and willing to pay the associated costs to experience human spaceflight.

(iii) Commercial infrastructure and services

With its numerous laboratories and external mounting sites, the ISS offers excellent opportunities for introducing new infrastructures and services on a commercial basis targeted at special-interest groups or the general public. Typical examples might be the provision of a precise time signal from the Station for watch synchronisation, or the tracking/location of items like cars and transported goods.

The studies conducted for ESA have also indicated that:

- The potential markets have different development cycles. The R&D market is a medium- to long-term market, which needs nurturing as regards knowledge diffusion and financial support. The innovative markets have much shorter time scales, as current events in terms of space tourism and advertising show, but they can also be of a boom-and-bust nature, quickly disappearing if the public's interest wanes.
- All potential markets call for an improvement in the ISS's current image. Despite its size, complexity and attractiveness, the project has yet to receive the appropriate level of recognition vis-à-vis the scope that it offers for applied research or appropriate appreciation by the general public.
- The potential customers tend to be either large companies with significant research and marketing budgets (e.g. oil, pharmaceuticals) or 'niche' companies working in very specialised technological fields (medical equipment, mathematical modelling).
- Finally, before these customers will invest in the Space Station, there is a need to provide a business-friendly environment where access to the Station is based on a reliable schedule, confidentiality is guaranteed, and intellectual property rights are protected.

Commercial projects in space

The results of the studies that ESA commissioned have also provided the basis for creating contacts with potential customers. The

current development of the Microgravity Application Programme and the issue of a Call for Interest to the private sector in mid-2000 have allowed a set of initial projects with commercial potential in several markets to be created. These projects have different levels of maturity and times-to-market, depending on the degree of complexity of the activities involved (Fig. 3). They are essentially 'pathfinders' because their objective is to demonstrate that there is an actual demand for commerce on the ISS, and to explore the compatibility of the

existing rules and procedures at ESA and the International Partners with future business needs.

The R&D-type projects originating from the MAP are currently in a pre-commercial stage, but several of them, especially those in the health, biotechnology and natural-resource exploration sectors, already look very promising for later commercialisation. The projects in the innovative-activities sector have shorter schedules, provide income, but offer a limited

Figure 3. Examples of commercial projects

Project	Market benefit	Industrial benefit	ESA contribution	Return to ESA	Countries involved
Research and Development					
Improvement of oil recovery and treatment of toxic liquid spillage	Availability of predictive models of liquid diffusion	Petro-chemical industry competitiveness and environmental protection	Sustain operational activities in the initial phase of the pathfinder project	Royalties from Intellectual Property Rights	Italy, France, the Netherlands, Norway and United Kingdom
Development of bioreactors technologies for tissue organisation / cell-matrix interaction	New bioreactor technologies allowing for commercial tissue formation, remodelling and repair	Bio-mechanical and bio-technology industry innovation	Sustain operational activities in the initial phase of the pathfinder project	Royalties from Intellectual Property Rights, products and processes	Switzerland, France, Germany
Development of treatments and monitoring equipment for osteoporosis and metabolism	Development of treatment and monitoring technologies	Pharmaceuticals and medical equipment industry innovation	Sustain operational activities in the initial phase of the pathfinder project	Royalties from Intellectual Property Rights, products and processes	France, Italy, Germany, Switzerland, the Netherlands, Finland, Canada
Physical-fitness equipment development	Development of specific exercise equipment	Medical equipment industry and leisure, sport industry	Sustain operational activities in the initial phase of the pathfinder project	Royalties from Intellectual Property Rights, products and processes	Sweden, France, Italy, United Kingdom, Germany
Non-conventional activities					
Sponsorship – Quality of life in the 21 st century	Association with outstanding research on ISS	Image promotion for European corporations	Market research, Sponsorship package development	Funds for additional research and astronaut flights	All
Product placement	Association with space and ISS	Product demonstration, validation and promotion	N/A	Funds for additional research and astronauts flights	All
Commercial infrastructure and services					
ISS camera for commercial imaging	Urban mapping Crop control Harvest insurance	Government, local authorities Agriculture sector Insurance	Sustain operational activities in the initial phase of the pathfinder project	Payments of operational costs plus fee	All
GTS – Global Transmission Services	Provision of time synchronisation and asset location services	Watch, automotive, transportation industries	Sustain operational activities in the initial phase of the pathfinder project	Payments of operational costs plus fee	All

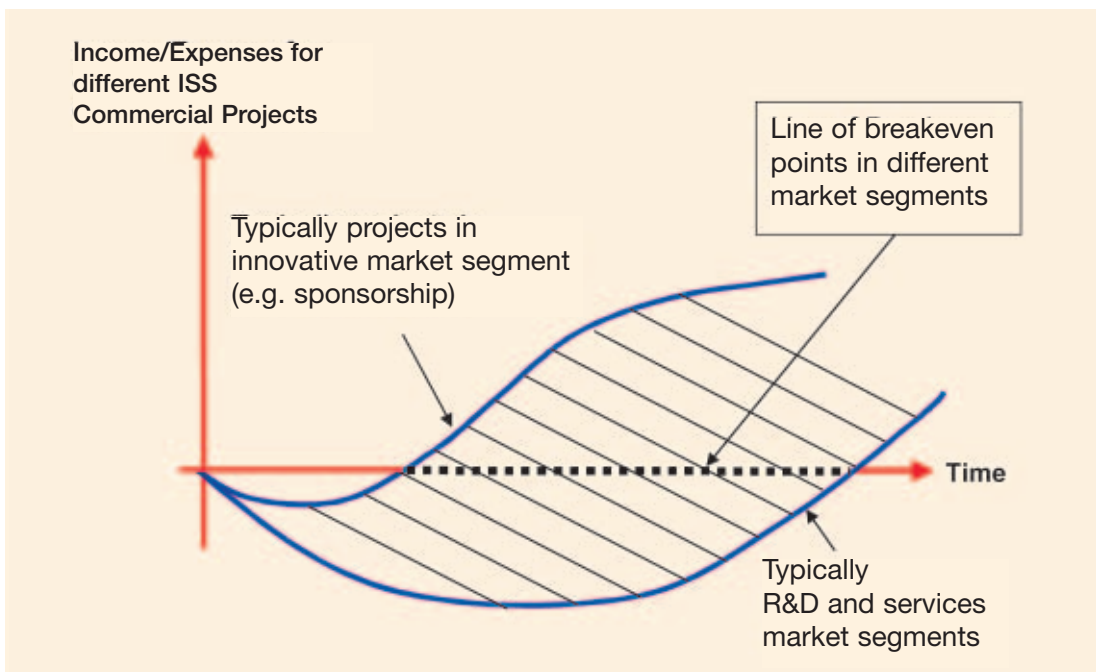


Figure 4. Income/expense model for ISS commercialisation

time window of opportunity. Together, however, they provide the commercial marketing effort for the ISS with an early start and cover the entire life cycle of the European ISS elements. Figure 4 shows the investment and return cycles for these projects; the R&D and services projects typically involve a longer and more intensive investment phase (initial part of the curve in the negative quadrant), before a balance is achieved between the expenses incurred and the income received (breakeven point).

This promising start has prompted ESA to offer further opportunities for commercial projects on a more permanent basis and the new 'Open Call for Commercial Proposals' can be found at: www.esa.int/spaceflight/isscommercialisation.

The legal framework

Attracting customers to the Space Station requires a set of commercial conditions to be put in place that provides for easy, reliable and confidential access. Figure 5 highlights the different conditions sought by commercial

Access Categories	Institutional Access	Commercial Access
Utilisation objective	Maximise scientific return Promote industrial research and development	Maximise economic return on investment
Type of Activities	Fundamental and applied research or pre-competitive technological development	Any, as long as compatible with ISS image
User Rights	Exclusive access to experimental results for one year; thereafter public access to data	Time-, market- or geographically-limited exclusivity rights Exclusive intellectual property rights
Origin	Academia, research institutes and industries from those ESA Member States ¹ which contribute to ISS Exploitation	Any user from ISS Partner States ² , who pays the full price for ISS resources and services
Evaluation	By peer or merit review	By image review By business plan review in case of deferred payments
Priority	According to scientific and/or application value	According to 'first come first served' principle
Funding Source	ISS services and resources are provided to users through the contributions of the ESA Member States to the ISS Exploitation.	Users to purchase ISS services and resources from ESA or Business Developer(s).

Figure 5. Access categories

¹ ESA Member States are Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom. States, that are underlined contribute currently to ISS Exploitation. In case of co-operative research proposals, users from non-contributing States and non-ESA Member States can also be granted access to ISS under certain conditions.

² ISS Partner States are all ESA Member States, United States, Russia, Canada, Japan. Users from other States may be granted access to ISS subject to approval by all Partner States.

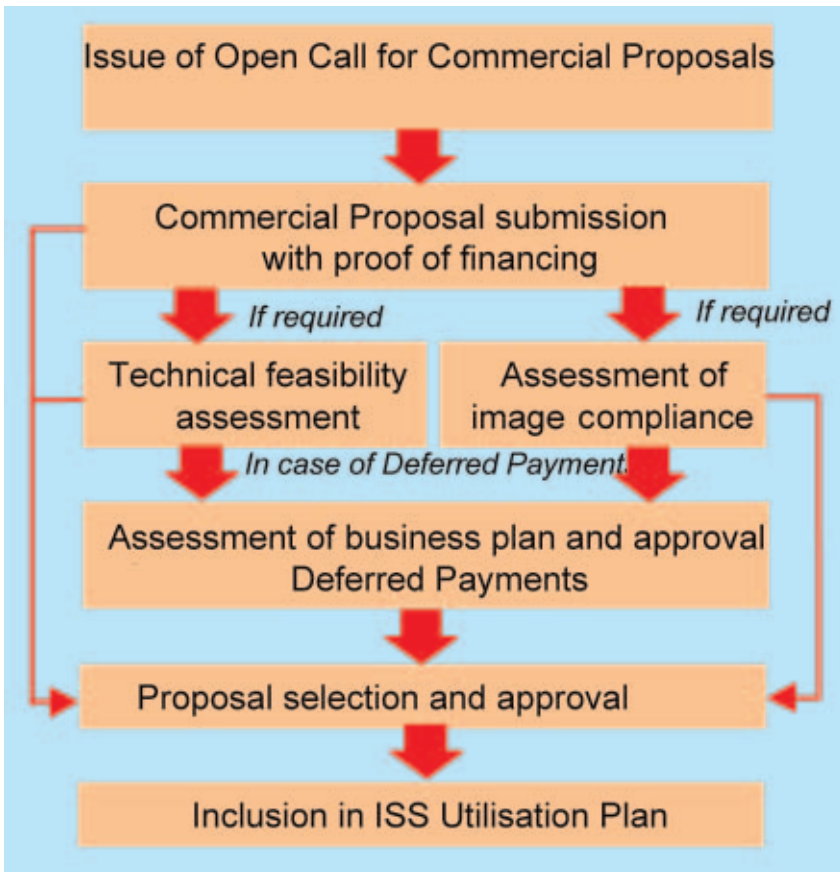


Figure 6. Commercial access route

customers compared with the traditional institutional access rights provided to programmes fully financed by the ESA Member States. Some of the major issues relating to the legal framework are highlighted below.

Evaluation and selection of commercial proposals

ESA is proposing a Commercial Access approach to potential customers, who are encouraged to respond to the Open Call for Commercial Proposals (Fig. 6). Within this process, private entities presenting commercial

projects will have to provide a minimum set of information of a technical and financial nature. If financial support from ESA is requested, the proposal will have to be supplemented with a complete Business Plan.

The evaluation process will be based on three main elements:

- *Technical Feasibility Assessment*: If the proposal requires a payload to be transported to the ISS, the technical feasibility and safety aspects will need to be assessed. ESA has to certify that payloads meet safety requirements and plans.
- *Compliance with the ISS Image*: ESA wishes to protect the image of the ISS and will therefore assess the impact of any commercial proposal on the image of the Station and that of the participating space agencies.
- *Proof of Financing*: The customer must supply proof of their ability to finance the utilisation project, underwritten where necessary by financial institutions.

Fully self-financed commercial proposals, which are both technically feasible and are compliant with the ISS's image, will be selected by ESA on a 'first-come, first-served basis'.

Schedule

Reliability of the schedule for flights to and from the Space Station is of the utmost importance for commercial customers. However, the time needed from the selection of a business proposal to the actual launch of a payload to the International Space Station is payload-specific. For simple payloads, this period will typically be one year, and somewhat shorter in the case of a re-flight. For passive payloads (e.g. no power or communication interfaces required), the time to flight can be as short as three months. What ESA can offer to

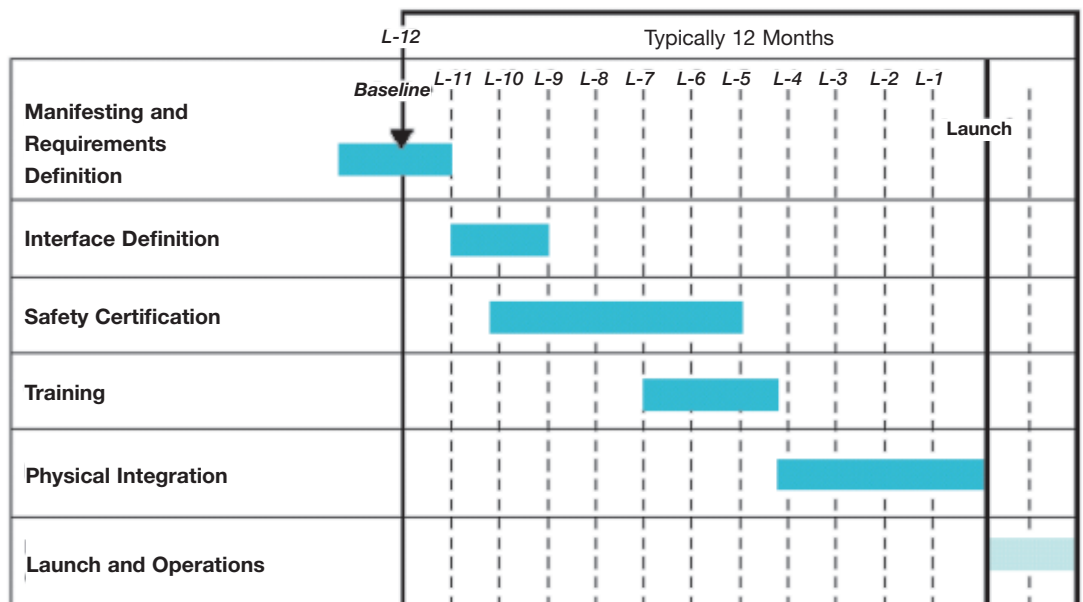


Figure 7. Access schedule

customers is, in any case, a standard set of activities for physically accessing the Station. Figure 7 shows the activities involved in preparing a simple payload for launch and their average duration. For media and commercial communications-related projects, the schedule may be much shorter, if no payload needs to be physically transported to the Station.

Intellectual property

ESA is currently in the process of reviewing its overall approach to intellectual property and defining the specific framework for ISS commercialisation in this respect. The principles envisaged in the commercialisation context are focussing on two main hypotheses:

- In cases where exploitation and project costs would be fully funded by the commercial customer, the intellectual property rights would remain with the customer.
- In cases where ESA would provide a non-reimbursable contribution, the intellectual property rights would be shared with the customer in relation to such funding, such sharing being negotiated on a case-by-case basis.

These principles remain to be confirmed within the overall ESA Intellectual Property Rights (IPR) policy, and to be elaborated in detail for implementation in the ISS commercialisation context. It is envisaged that the negotiation of IPRs will be a function of the funding being contributed by the respective customer and by ESA for each specific project.

Confidentiality

The Inter-Governmental Agreement (IGA) between the ISS Partners provides for confidentiality rules for the exchange of data within the ISS cooperation. In implementing the services carried out on behalf of customers, ESA will take all reasonable measures within this environment to provide conditions that protect customers' interests to the greatest extent possible. A minimum of information for safety certification will always have to be provided. Safeguards of confidentiality for proprietary data are also foreseen by the IGA in this respect. The IGA foresees the possibility of placing adequate markings on documents, software and equipment, to indicate the existence of proprietary information.

Product	Quantity	Price*
Accommodation:		
EDR locker, inclusive of standard services	1 locker for 3 months inclusive of: - 3 crew hours - 100 kWh	830 kEuro
EDR drawer, inclusive of standard services	1 drawer for 3 months inclusive of: - 4 crew hours - 130 kWh	1050 kEuro
Research Facility:		
ESA MFC facility or external facility	1 facility per day** including: - 15 crew minutes - 8.5 kWh	70 kEuro
Basic payload support	1 kg payload	10 kEuro
Communication Services:		
Data Rate	1 min of TDRSS link	100 USD***
Transportation Services:		
Pressurised up/downmass	1 kg (each way, passive cargo)	22 kUSD
Unpressurised up/downmass	1 kg (each way, passive cargo)	26.5 kUSD
Additional Resources and Services		On demand
Media and Commercial Communication		On demand
<i>Note: specific customers' requirements will be agreed on a case-by-case basis</i>		
* Prices are applicable for customers from States contributing to ISS exploitation. Prices for customers from other States will be agreed on a case-by-case basis.		
** Several customers may share the usage of one facility, thus reducing the individual cost.		
*** Prices in US dollars refer to services provided via NASA and are subject to NASA pricing provisions.		

Figure 8. Price list

Prices

ESA has established a transparent pricing structure for customers wishing to exploit the European portion of the ISS commercially. This pricing policy constitutes a reference for the agreement of commercial transactions with ESA. It will be updated periodically depending on prevailing market conditions and developments.

The prices quoted have been tailored to the basic facilities and services that ESA will have available on the ISS, mainly within the Columbus laboratory. They include the use of drawers and lockers by customers wishing to provide a complete payload experiment, and of the Microgravity Facilities – Biolab, European Physiology Modules, Fluid-Science Laboratory and Material-Science Laboratory – for experiments with standard samples. The prices shown in Figure 8 are valid for 2001.

Promoting the ISS's image

Awareness of the International Space Station needs to be increased within the market segments being targeted. But what are the messages about the ISS that should be spread? What makes the ISS commercially attractive for research and communication purposes? An ISS image concept has been defined by ESA focussing on:

- the great achievement of putting this first-

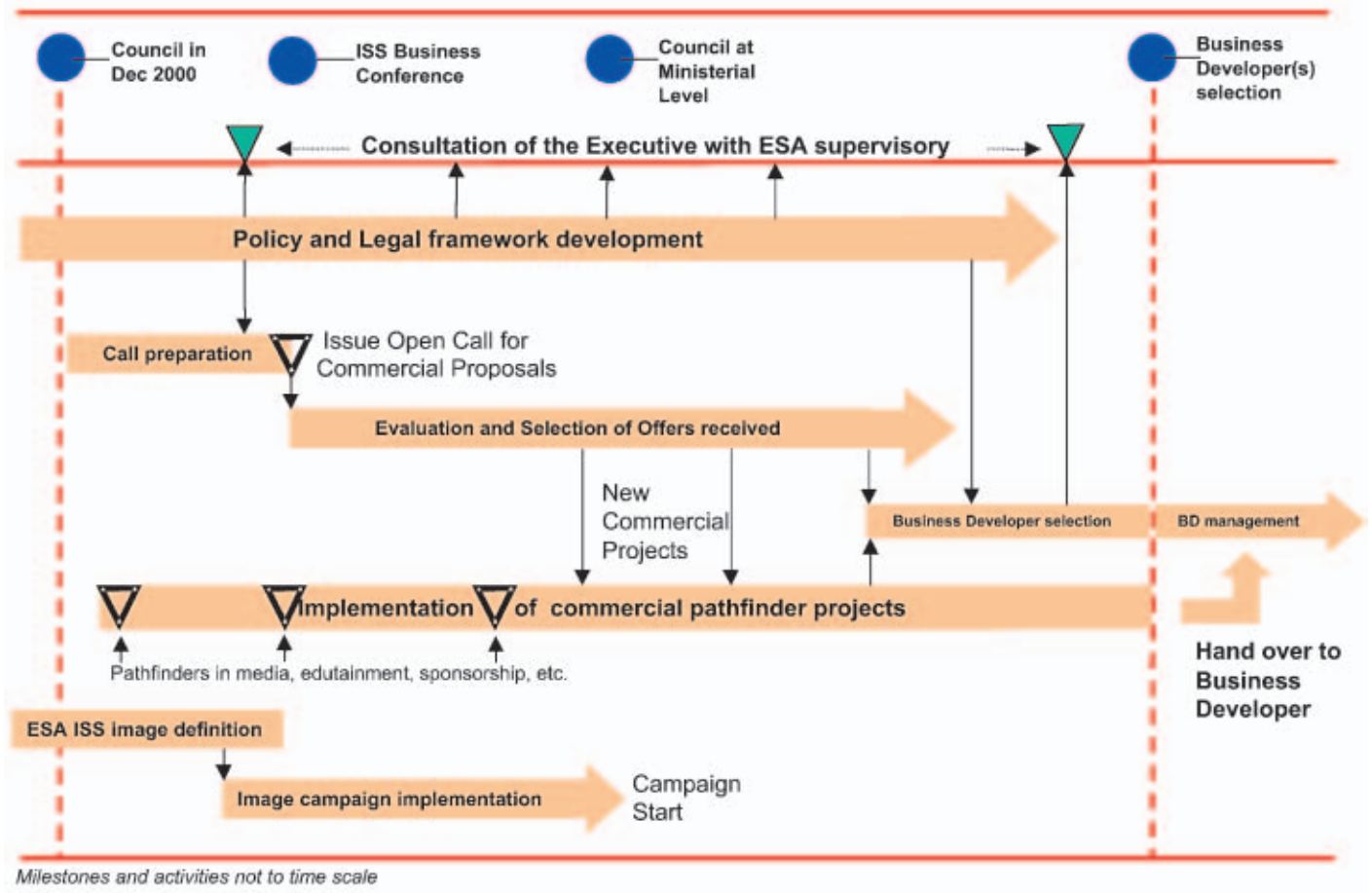
class research facility into space – the human achievement, the technology development and the global co-operation that have made the ISS a reality; the scale of the project, and the size of ISS itself are unique

- the ISS is real – it is already up there, the largest outpost in space to be permanently inhabited
- the ISS is relevant – it has potential benefits for both companies and individuals.

The communication plan has a phased approach with short-, medium- and long-term objectives, emphasising respectively: general awareness of the ISS, its potential exploitation benefits for European industry, maintenance of interest in the ISS, and the consolidation of brand values. The target audiences will primarily be the general public, the business community and the scientific community. The communication media will consist of the specialised press, specialised advertising, seminars, scientific/educational material, direct promotion, edutainment programmes, web sites and sponsorship events.

In parallel, the market-analysis effort will be maintained to monitor market evolution, to adapt the promotion strategies, and to respond to customers' demands with the development of adequate services for the major commercial ISS market segments.

Figure 9. ISS commercialisation strategy



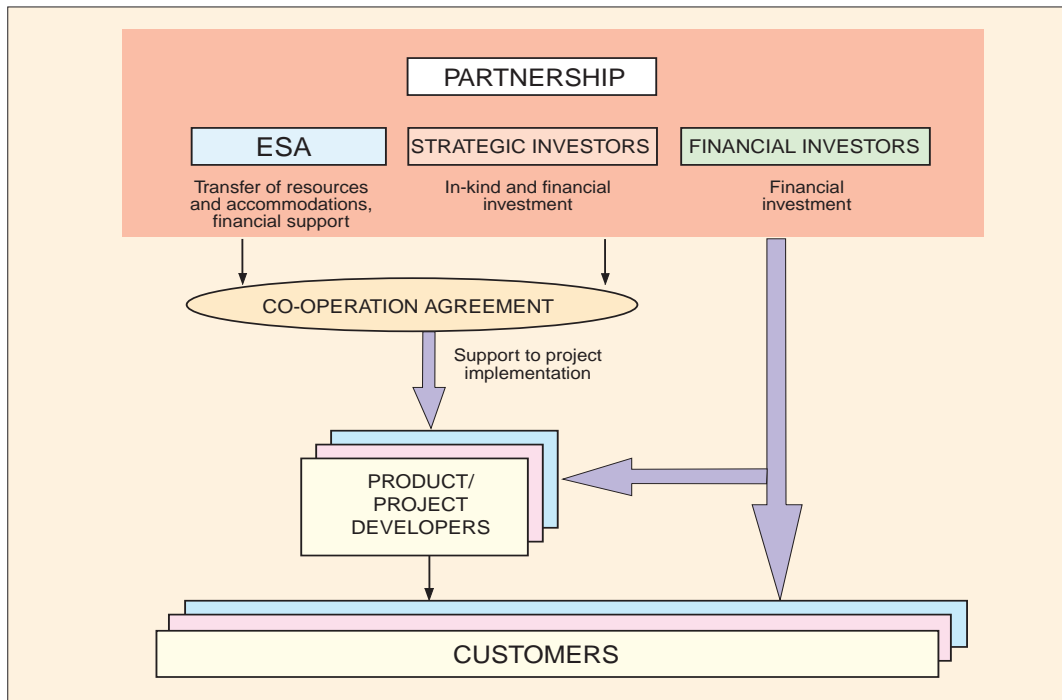


Figure 10. Public-Private Partnership model

The development and maintenance of an adequate ISS image will be safeguarded by the definition of criteria with which commercial activities will have to comply. The Agency is developing a Charter containing image compliance criteria, encompassing such aspects as the peaceful uses of the ISS, the legality of activities, coherence with agreements with the International Partners, etc.

The strategic approach

ESA's overall strategy in approaching Space Station commercialisation is founded on the activities described above and is summarised in Figure 9. The concerted actions of easing the legal environment, attracting customers and implementing pathfinder projects have the strategic objective of enabling the growth of one or more 'Business Developers' willing to assume overall responsibility for developing the European market for the ISS. In this scenario, ESA would make available the resources and facilities and the Business Developer would select the commercial projects to be implemented. This collaboration could take the form of a Private-Public Partnership (Fig.10) whereby ESA and strategic investors like the space industry, and with institutional investors such as financial entities, form an alliance to nurture the market and select and support the first commercial businesses to venture into space.

Conclusion

The potential market associated with the commercial utilisation of the International Space Station encompasses a wide set of segments ranging from pure R&D to highly innovative commercial activities. ISS commercialisation is therefore a process that is strongly

market driven, which demands that the Agency review its conventional way of doing business in order to make the customer the focus of attention. The ESA strategy therefore responds to the needs that have been expressed by the market in striving towards full utilisation of the Space Station's capabilities, carefully matching the needs of business with the wishes and objectives of the Agency's Member States. To support such a strategy, a period of market nurturing and the involvement of European Business Developers is necessary. Such support has to cover technical, human and financial means, possibly being implemented within the framework of an alliance between the Agency and private entities willing to co-invest in this process.

By harnessing all of this knowledge and expertise – political, commercial and industrial – Europe will have an excellent chance of playing a competitive role in the emergence of the International Space Station as a new market place in space.

Acknowledgement

The author wishes to thank P. Graziano, B. Hufenbach, V. Kayser and G. Peters for their contributions to the ISS commercialisation effort, without which this article could not have been written.

Feedback

Readers are invited to submit their opinions and comments on this article to:

ISS.commercial@esa.int
quoting 'ISS Commercialisation, – ESA Bulletin No. 107'.

