A Different Approach to Project Procurement

G. P. Whitcomb & J.C. Credland
Scientific Projects Department, ESA Directorate for Scientific Programmes, ESTEC, Noordwijk, The Netherlands

This article introduces the projects that are described in the following two articles in this ESA Bulletin, namely the Mars Express and the SMART-1 missions. Both are test cases for new approaches in technology development and project management which are being introduced into ESA's Science Programme. The overall aim is to reduce the cost of missions, but at the same time maintain the high scientific quality that has been achieved in past.

Background

The European science community is, in the main, a strong supporter of the ESA Science Programme and recognises its value and its ability to launch and operate World-class scientific missions. In recent years, however, there has been increasing concern that space missions take too long to implement and generally are too expensive. More tangibly, the budget for missions has been decreasing to a level at which missions of high scientific value are becoming more and more difficult to support, unless cheaper procurement approaches are identified and adopted. Other factors such as the emergence of a small-mission culture, advances in lightweight technology and the improved ability of European manufacturers in general to provide cheaper hardware, offer the possibility of cheaper missions if the management approach that was used until recently is modified.

The new challenge for the Science Programme, therefore, in seeking a new and more innovative approach, is to launch missions at least as often as in the past, whilst remaining within the decreasing budget envelope and whilst maintaining the record of excellence that ESA has established as a World leader in space science.

Considerations

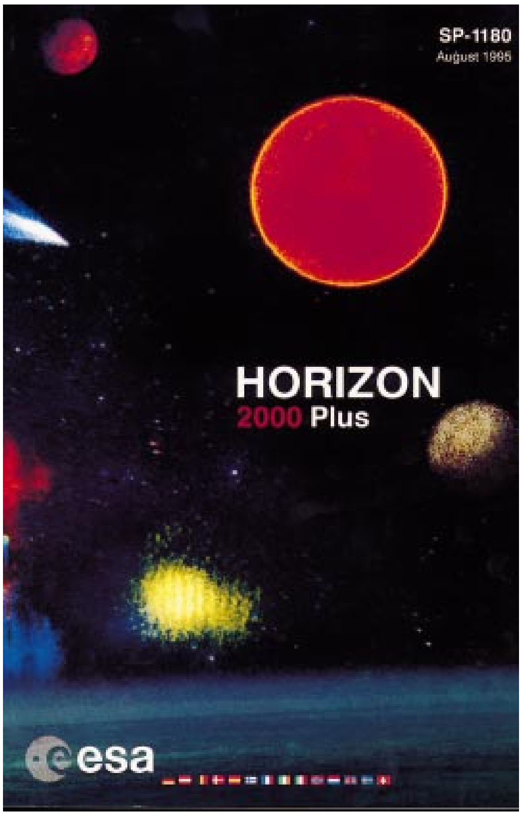
The first question is: "How can missions be made cheaper?"
"Cheapness", being a comparative term, implies that there is an accepted cost reference. However, the scientific satellite business tends to be of a "one-off" nature, with the same type of satellite rarely being flown twice, making direct comparisons difficult. Comparison with NASA or other space agency missions is another option, but this approach is not without its pitfalls, due to the quite different accounting procedures used by other organisations. Such comparisons tend therefore to be subjective and at best imprecise.

Experience has shown that, rather than trying to define an absolute reference, the best means of achieving value for money is first to identify the cost-driving elements of a particular mission. Appropriate management procedures can then be applied to minimise both the baseline cost and the risk of cost increases due to changes in these elements. This is the approach that has historically been taken within the ESA Science Programme. The question now is whether, in order to satisfy today's demands, this approach can be improved to give cheaper missions than hitherto? The answer may be yes, if the spacecraft can be developed over a shorter time scale and at a lower management cost by accepting a higher degree of risk.

Achieving shorter time scales

A shorter overall development time is possible if, before the main development is started, the design architecture for the project is already well established, the hardware elements and software are readily available, and no changes to payload or mission requirements are allowed after contract signature. The down side is that the Agency becomes less flexible in response to requests for change brought about by changing requirements, scientific or otherwise.

Technology preparedness is a key item. Pre-development of the correct technology simplifies the design process, and it ensures that the hardware/software elements that will be needed are indeed available and well understood, thereby reducing the risk of time-consuming changes being required at a late stage. However, technology preparation involves more than just showing that a given technology is feasible. To be useful, it has to be available exactly when needed. The current dilemma is that technology development requires time and funding. Funding is not normally released until project approval, which means that new technology, until now, has been developed from the feasibility to the flight-readiness stage during the actual project development. This process inevitably introduces the risk of an increase in the overall project cost, as large teams are employed on the project, so any delay due to late technology availability translates directly into an increase in overall cost.



To break this cycle of events, the new approach foresees key technologies being developed to flight standard in advance of mission approval. This implies that the requisite technology is identified in advance and the necessary funds allocated to the development effort. It also means that a mission would not be approved unless the technology is available. The down side here is that funds could be spent on technology for a mission which may eventually not be selected, but the amount involved would be small compared to the potential costs associated with project over-runs. The technology needs will be identified via system studies of projects that have been identified by the scientific community as good candidates for future missions.

Achieving lower management costs

This aspect is perhaps the most controversial. The aim is firstly to compress the project-selection process from its current five-year cycle (average) to less than two years; and secondly to constrain the design and development phases to less than five years, giving a mission concept-to-launch time of some seven years. This is to be compared with the 11 years that has sometimes been the case for past missions. Also, more responsibility will be delegated to industry, thereby reducing the cost associated with management interactions between the Agency and the Contractors.

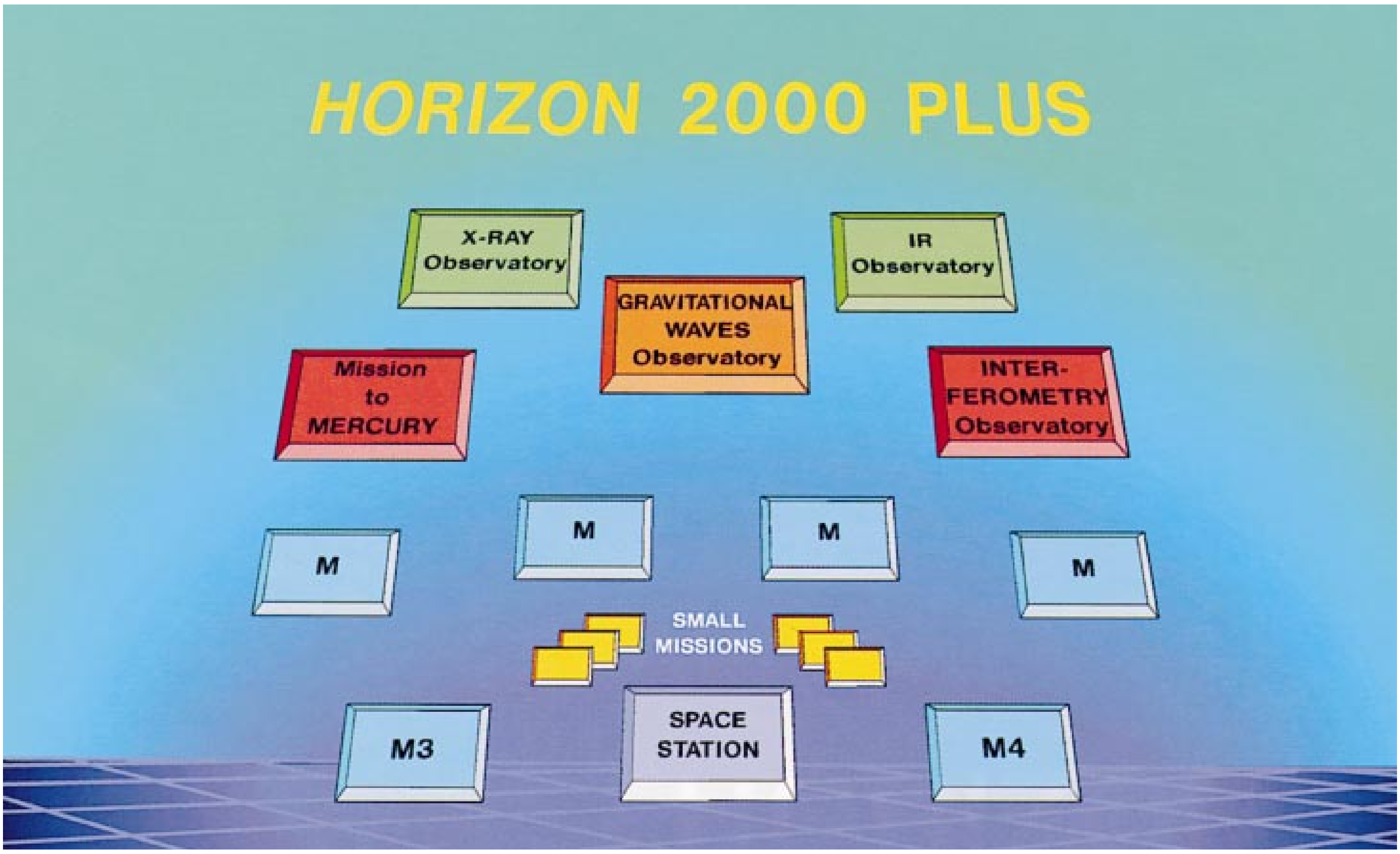
A number of key considerations must be addressed if this approach is to be successful.

Firstly, one must be more critical when selecting projects, particularly as far as proposed time scales are concerned, i.e.- Can the proposed instruments actually be developed and delivered in time?

- Are the scientific specifications well defined and properly framed?
- Are all of the technologies needed actually available?
- Can the project be well enough defined for ceiling-price contracts with industry to be applied?

Such considerations imply a subtle change in mission assessment criteria. In the past, the value of the science was usually the overriding determinant in the choice of a mission, and so mission ideas from all disciplines of space science could be proposed for assessment and eventual selection. Now the feasibility of implementing a project within strict time and cost constraints will have more weighting in the selection. This means that although a good scientific return remains essential, the choice of project is essentially limited to those missions that can be implemented within a short time period. The traditional calls for mission proposals will be more focussed than hitherto, with preference being given to proposals that can be clearly shown to meet the imposed time and cost constraints. This implies that the essential hardware elements already exist, either via another project development or from a pre-development activity such as the SMART missions (see accompanying article).

Secondly, more responsibility must be given to Industry, so that ceiling-price contracts can be agreed, with the Contractor taking responsibility for the interface management of the science payload elements of the mission. Giving more responsibility to Industry means taking more risk on the Agency side, as there will be less visibility of the Contractor's work.



Consequently, the cumulative experience in ESA across many projects and missions cannot be used to the same extent to identify potential problems at an early stage. The fact that today space industry also has accumulated wide experience should help to keep this risk acceptable.

It also means that the scientist will interface directly with Industry and must therefore accept all of the limitations that the strict budget ceiling involves. Industry will have the right to agree or veto changes to the interfaces within the cost ceiling. To help avoid conflict situations arising between the scientist and Industry, the potential Prime Contractors will strongly support the instrument-selection process. This should ensure that both Industry and the instrument provider have a good mutual understanding of each other's requirements and constraints.

Last but not least, the new approach will mean freezing the design interfaces early, so that Contractors can proceed with the hardware implementation without expensive and time-consuming negotiations associated with changes in requirements or in interfaces. This means that mission requirements and payload interfaces will have to be agreed prior to the main contract signature, and that no changes will be accepted thereafter if they result in increased cost.

The benefits

The SMART-1 and Mars Express projects, described in the two articles that follow, are expected to demonstrate the benefits of the new approach. In the case of SMART-1, the technology for future deep-space missions will be developed and flight-tested, thus enabling later, more sophisticated missions to be implemented at lower cost and without the risk associated with new technology development during the main industrial contract. SMART-1 will demonstrate the feasibility of deep-space electric propulsion and prepare the ground for future missions to Mercury and the asteroids, and for astronomy missions that need to be conducted at large distances from Earth.

The Mars Express mission is pioneering a new management approach, which if successful will be applied to future scientific missions. The benefits are to some extent already being demonstrated in that the decision cycle has been successfully compressed to some 18 months from concept approval to the start of the main industrial contract (about one-third of the time needed for previous missions).

It is also evident that, for both Mars Express and SMART-1, the ESA and industrial teams are already highly motivated by the challenge, and a motivated team is crucial to project success!