

## SMART-1 industrial team

A key element in ESA's new policy in developing and constructing small satellites is to give more responsibility for the projects to the prime contractor and to the industrial teams through that obviously involves greater risks on the part of the contractors, thus less on the part of ESA.



Swedish technicians connected to the industrial team complete the final preparations in the test area at ESTEC.

Photo: NSA

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This has been used successfully with regards to Mars Express where Astrium Toulouse, France, was the prime contractor. However, there is one essential difference. Astrium is a large commercial satellite constructor with great experience from constructing commercial satellites while the prime contractor for SMART-1, Swedish Space

Corporation, has its experience from constructing national satellites in small, but very effective teams. Thus, the ESA-system might very well achieve the newest and most valuable experience in order to increase the efficiency of the management teams cutting both the time developing it and the cost. The space-related programmes suffer enough from relative high costs, something that in many cases are related to the management of the programmes, and not to the technical development itself.

As prime contractor for the team, SSC was responsible for project management, system engineering, subsystem management and subsystems development for subsystem likes avionics, attitude control, on-board application software, spacecraft simulator and electrical ground support equipment. After delivering the complete satellite to ESA, SSC will provide support for the launch campaign and in-flight operations as well as SMART-1's maintenance on-board software during the whole mission.

Key elements of the SSC approach to develop SMART-1 were firstly to acknowledge the technical risk in the project. Secondly, they carried out procurement on equipment level and avoided

subcontracting complete subsystems. Other tasks for SSC were to maximise the use of Commercial-off-the-self (COST) hardware, and tailor the data handling system to the COTS units.

### What we learn.

Peter Rathsmann, Swedish Space Corporation, was appointed to manage the project for the industrial organisation that was created to support the SMART-1 project. Peter has previously been strongly involved in satellite projects such as Freja and Odin, both Swedish projects, but with extensive international participation. It was the experience from these programmes that lead to the appointment as project manager. We met Peter at ESTEC where ESA introduced SMART-1 to the European media.

"This project has in many cases been different from the management of the Swedish national projects", Peter said. "In the small Swedish team all team members are very knowledgeable about the complete system. The documentation can thereby be strongly reduced since we are not required to produce documentation for the sole purpose of enabling detailed external review. External reviews were held, but more informally than the ESA reviews. To document complicated technical solutions for independent technical boards outside the project demand a great deal of documentation, much more than our own projects have demanded. We have had three large technical reviews where approximately sixty persons have participated. The documentation has been quite comprehensive, but it has several advantages too. We are, because of the technical reviews, quite confident that we have a very reliable construction, a construction that will work as planned for a long time".

*Are the SMART-teams more efficient than the large teams we know from the previous extensive ESA-projects?*

"Yes, I believe that. All simple solutions are more technical- and cost efficient. That goes without saying, however, the persons involved must work well together. To work at the sub-system level all subcontractors will safeguard themselves using an economical safety margin. When we work at the equipment level, much of the management costs and risk overhead for the sub-contractors thus disappear. Management now means something else, however, I believe it is for the better for all participants. I hope ESA will use the experiences from SMART-1's industrial team as a model for future projects of the same size. The industrial teams can be made even

more efficient, but that would require that ESA obtain extensive knowledge about the contractors. Building the satellite for ESA was a first time experience for our company, and we recognise ESA's need for comprehensive documentation since this is intimately linked with the external review process. However, the next time ESA will have the knowledge required, thus possibly requiring lesser documentation. ESA's problem is, however, that they need accurate and complete documentation since they are expected to "sign off" a construction or software for a project."

*Has SSC benefited greatly from the accomplishment by the Swedish small satellite programmes?*

"Yes, undoubtedly. The experience from our own satellite projects gave way for us to be allotted the project management for the SMART project. The principle for the project management is the same for all. The national programmes consist to a great extent of international participation, and to work in international team was not a new experience for the team leaders. In addition, the technical contents are also in principle the same, in spite of the fact that the satellites vary in sizes".

*The industrial teams consist of personnel from various European countries. Are there great variations within the different industrial cultures or have you noticed a more "common" European industrial "ESA-culture" in such projects?*

"The core team has been composed by about 15 persons and all of them had their working place at our main plant in Solna near Stockholm and has for the most consisted of Swedish citizens. However, the sub-contractors came, as you can tell from the organisation plan, from many different countries. There were obviously different cultures and set of temperament, but we acknowledged the fact that we act differently in different situations, independent of nations. That never constituted any problem; on the contrary, it enriched the whole team. Therefore, international composition of teams is not a new experience for us. The communication between members of the different teams, both orally and in writing, is obviously in English, so language issues do not exist in such teams."

*The experience SSC that has been established through this project, can that be used in other projects?*

"Yes, we certainly hope so. However, there are several large companies within this field in Europe, and presently we do not know when or if the possibilities to become a prime contractor for a

future satellite project may arise again. I am sure we can do a good job again, especially in terms of our past experience from this project. The experience from SMART-1 is enormous. We have not only learnt a great deal, we have also gained greater insight into how other companies ensure technical development and documentation, how their scientists and engineers work, and what demands they have. Last, but not least, we have expanded our technological knowledge. In addition, I hope the other members have learnt something from us as well", concludes a very engaged Peter Rathsmann.

## The Industrial Team.

Like most of the industrial teams in ESA's projects a team consists of a prime contractor and a number of sub-contractors. The prime contractor has the main responsibility for the project and is ESA's contract partner. The sub-contractors in the team are divided in industrial companies that mostly develop new equipment for the project, and companies that only deliver flight-ready products.

Among those who have developed and delivered new products are:

### Sweden

**Saab Ericsson Space** has been responsible for the harness, thermal control, EMC, DC-DC converters, antennas and two remote terminal units (printed circuit boards) in the onboard computer as well as for the test team.

**Omnisys Instruments** has been responsible for the Power Condition and Distribution Unit, which ensures the supply of a stabilised and protected power to the different units in the satellite.

### Switzerland

**APCO Technologies SA**, the Spacecraft Structure & Mechanical Ground Support Equipment, is the main structures of the satellite where all instruments and experiments can be fastened to, and the equipment that holds the satellite during the installation and tests in the laboratories.

**Contraves Space AG**, EP Mechanism. The mechanism can move the EP engine so that the power always goes through the mass centre of the satellite, if not, the engine can get an undesirable torsion.

### Belgium

**Spacebel SA**, OBSW data handling system. That is a part of the software onboard, specially designed for downloading data. The application software from Swedish Space Corporation is an integrated part of the software from Spacebel.

### The Netherlands

**Dutch Space**, the Solar Array for producing sufficient energy for the engine, the experiments onboard, and management of the satellite itself.

### Spain

**Astrium CRISA**, Battery Management Electronics. This equipment increases the voltage from four Volt cell voltage to the bus voltage at 50 Volt used in the satellite.

### Austria

**Austrian Aerospace**, Multilayer Insulation (Thermal Blankets) manufacturing. The black insulation blankets around the satellite protect the instruments from the low temperatures in space.

In addition to the prime contractor and the subcontractors, there are several suppliers connected to the project, mainly from Europe, but also US-based companies are represented in the team. These suppliers deliver already developed and fully tested products, products that are in the different company's products list.