Deutsches Zentrum
für Luft- und Raumfahrt e.V.

TerraSAR-X – First Satellite Funded by Public and Private Sector

The launch of TerraSAR-X on June 15th, 2007 marks the first time a German satellite lifts off into space that was funded jointly by government and industry. The space agency of the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt, DLR) which placed the satellite contract provided about 80 per cent of the finance. The remaining 20 per cent were contributed by Astrium, the space company that actually built the satellite. The DLR's German Remote Sensing Data Center (Deutsches Fernerkundungsdatenzentrum, DFD) coordinates the scientific use of the satellite's Earth observation data. The commercial marketing of the data will be handled by Infoterra GmbH, a wholly-owned subsidiary of Astrium. With this first public-private partnership (PPP) in the space sector up and running, Germany has accomplished something of a pioneering feat.

The long-term goal of the venture is to keep users supplied with remote sensor data on an ongoing basis. A successor for TerraSAR-X is already in its planning stages, this time to be entirely funded from Infoterra earnings and operated by the company alone. A further radar satellite called TanDEM-X is being implemented as part of another public-private partnership which will deliver additional innovative data products.

How the Public-Private Partnership began

Implementing a German satellite in a public-private partnership is a first-time experience. So far, remote-sensing and climate research satellites have been funded entirely with public money. But when, nearly ten years ago, Astrium had completed its two big satellites, Envisat and Metop, which had been built under its aegis, the company decided to look around for a good follow-up project. "This is when the idea came up in Astrium to offer Earth observation data as a commercial service ", Jörg Herrmann remembers. He was working for Astrium at the time and was later appointed as Infoterra's general manager when Infoterra was spun off as a separate business.

Initially, several follow-up options were discussed at Astrium. One of them was to join a number of large-scale projects in North America as a partner. But then, acting on behalf of the the Federal Ministry of Research, the DLR's space agency suggested that the company submit a proposal for a national pilot project. "At this time the request came up in the ministry to have the industry make a financial contribution to the satellite cost," says Rolf Werninghaus, who is now the project manager in charge of TerraSAR-X at the DLR. This is how the two parties, each pursuing their own interest, contribute their own resources, carry out the project together and use its results. The advantage is that the project can be of service to science while simultaneously being available for commercial exploitation. This makes the project a secure investment, whereas it would have been too costly for either one of the two partners to fund on their own.

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Radar satellite technology was the obvious choice because the DLR has for a long time been funding research for this type of technology and, together with Astrium, already owns considerable know-how on the subject. During the run-up phase a detailed market analyses has been performed, involving a large number of expert opinions.

The result was good news: The business prospects for selling remote sensing data were favourable. What remained unclear for a long time though was what type of measuring technology would be the most suitable for its purpose while being affordable at the same time. Initially the plan was to build a SAR system (Synthetic Aperture Radar) as well as an imaging spectrometer. Also, the initial plan was a SAR working on two frequencies, i.e. the so-called X-band at a wavelength of about three centimetres (frequency of 9.65 gigahertz) and the L-band at a greater wavelength of 24 centimetres (1.25 gigahertz). Yet the implementation of this system – which might have been feasible only in a bigger constellation involving international partners – was finally abandoned. In the end it was agreed to limit the system to one single frequency and to build a SAR, i.e. mapping radar system. This is how the project could be realised at a national level and at affordable cost.

In terms of the legal contract work involved, there was as yet no established procedure for this type of cooperation between government and industry. "It took all of five years' intense studies as well as an in-depth scientific, economic and legal debate until the PPP agreement was finalised in its present form," Werninghaus remembers. The concept can now serve as a blueprint for similar partnerships between government and industry. One obvious pre-requisite for such ventures is for the company involved to be able to recoup its financial outlay. Selling remote sensing data is a service increasingly in demand, and likely to become a successful line of business for public-private partnerships.

The outcome of all these studies is TerraSAR-X. The satellite will transmit images from its 514 kilometre high orbit at resolutions of 16 metres, three metres and one metre respectively – by day and by night and even through a cloudy sky. This makes the satellite very useful for a whole range of applications both scientific and commercial. "We are hoping that our measuring technology will satisfy the requirements of science as well as being commercially attractive on the marketplace," Werninghaus and Herrmann agree.

Shared Cost and Shared Responsibilities

The official go-ahead for TerraSAR-X was given when the cooperation agreement between DLR and Astrium was signed on 25 March 2002. The total cost of building and launching the satellite was 130 million Euros, of which the space agency contributed 102 million Euros and the space company Astrium invested 28 million Euros from its own resources. Developing the ground segment and operating the satellite for five years will cost another 55 million Euros. 45 million Euros will come from the DLR's research institutes, the rest will be paid by Infoterra. Additionally, the company funded the development of the geo data products and their market introduction.

The DLR research institutes contributed the ground segment responsible for satellite control, radar operation and calibration and data reception. They will run the mission for a period of five years, process the data, archive them and distribute them to scientists. Astrium has built and tested the satellite, and its subsidiary Infoterra is already in touch with interested buyers and re-sellers of their data products.

A Commitment to Sustainability – TanDEM-X and TerraSAR-X-2

One component of the PPP agreement is an overall obligation to keep the project sustainable. This means that the project is not a one-off exercise, but is intended for a long-term observation of planet Earth. Space-based radar is to become established as a permanent operational system, much like weather satellites have been for a long time.

A further step in this direction was taken in August 2006, when the DLR space agency and Astrium signed the PPP-agreement on another project called TanDEM-X (TerraSAR-X add-on for Digital Elevation Measurement). It will include the building of another satellite, largely identical to TerraSAR-X, to be launched by early 2009 and placed in an orbit close to that of its elder brother. The two satellites will fly side by side, between 300 metres and two kilometres apart from each other.

Like human vision is spatial because man uses two eyes, TanDEM-X with two SAR antennae will be able to produce a three-dimensional elevation model of the entire land-surface of the globe. Within only three years the satellite duo could survey and map the entire 150 million square kilometres of the Earth's land surface.

The almost 85 million Euro satellite will be financed by a similar PPP venture as TerraSAR-X; in this case the space agency will contribute 56 million Euros, and Astrium 26 million Euros. A further three million will be raised from the sale of additional payload capacity on the satellite. In addition, the DLR's research institutes will once again build and operate the necessary ground segment for the operation of the mission.

However, deliberations are already reaching far beyond this tandem. The plan is to launch a third radar satellite in about five years' time, TerraSAR-X-2. This, ideally, should be wholly paid for by industry. The funds required will have to be raised from the profits that Infoterra will have earned from the sale of TerraSAR-X data. "We invest into innovation. This is the only way to stay on top," says Jörg Herrmann. The intended project is being watched closely all over the world. If the business plan works out, copiers, and hence competitors, will soon appear on the market. If the Friedrichshafen-based company wants to survive this global battle it will always have to stay one step ahead of its competitors in terms of its engineering efforts as well as its services and its timely handling of orders.

TerraSAR-X-2 is intended to pick up from its predecessor, which has been designed for a service life of five years. Its launch is envisaged for the year 2012. In order to guarantee sustainable service delivery beyond the year 2017 the experts are even now considering a

successor for TerraSAR-X-2. Almost certainly by that time any successor would carry some entirely new technology on board. “We are already studying the options,” says Rolf Werninghaus “What we especially want to achieve is an even greater resolution and a wider swath of terrain scanned by the satellite with each overpass. This would help shorten the SAR’s “access time” to data from a desired area.

For the moment, this is all a vision. The first two crucial steps that need to be mastered are a successful launch of TerraSAR-X on June 15th 2007 and the building of a profitable service business for Earth observation data.