Earth Observation Market Development

Benefits to Industry

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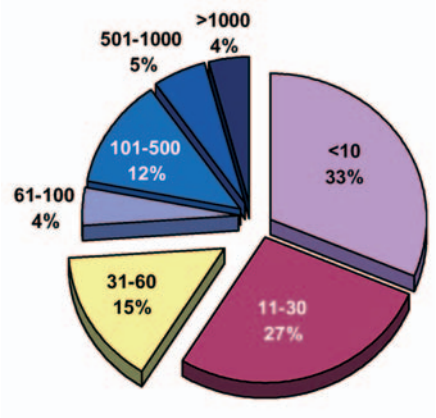
Established in 2000, ESA's Earth Observation Market Development (EOMD) activity is designed to foster the use of Earth Observation (EO) based geo-information services within various market sectors. Working in close cooperation with European and Canadian EO service companies, EOMD supports these firms in growing business by attracting new clients and encouraging the building of partnerships. The activities over the past five years have resulted in a better understanding of the EO service industry, as well as the involvement of over 120 new users and the generation of additional business revenues of some 6 million Euro. In addition to exploring new innovative prospects for EO services, future activities will address several identified challenges facing the industry as a whole.

Introduction

The potential value of EO products and services has long been well-recognised. However, despite significant progress in the techniques over the years, many actual and potential users find that these products and services still fall short of expectations, or present limitations in terms of their effective use. As a result, the market for such products and services has remained small when compared with the cost of developing space assets. Furthermore, a large portion of the demand is coming from the public sector, and some segments of the market are also faced with strong competition from terrestrial technology.



Size of EO Value-Adding Companies in terms of staff numbers

In contrast to the United States, where government military contracts (e.g. ClearView, NextView) are guaranteeing substantial revenues to private EO companies, European and Canadian EO companies do not have any such 'anchor-tenant' customers, and are therefore fully exposed to the risks involved in developing their businesses. Although the potential of the commercial market is still considered to be large, it has also become clear that the optimistic forecasts of the early 1990s regarding growth in the commercial exploitation of EO missions have not been realised. Nowadays, it is well recognised that the market is a difficult one to exploit without appropriate accompanying measures being taken.

It was in this context that the Earth Observation Market Development (EOMD) initiative was launched in 2000 as an activity within the ESA Earth Observation Envelope Programme. EOMD provides the first opportunity for specific programmatic support within ESA for activities related to the market-development and commercialisation phase in the overall evolution of satellite-based products and services. The main objective is to foster the emergence of a European downstream industry offering EO-based services, with the prospect of their becoming sustainable in the global marketplace.

To this end, EOMD has been focusing its support on small and medium-sized Value-Adding Companies (VACs) that are specialised in working with raw satellite data to turn it into the types of information services that bring major benefit to customers. The basic approach has been to engage larger non-EO companies from a range of industrial sectors (e.g. oil & gas, civil engineering, renewable energy, mining, reinsurance) to evaluate whether the types of EO services provided are of practical value in the context of their business and/or operational needs.

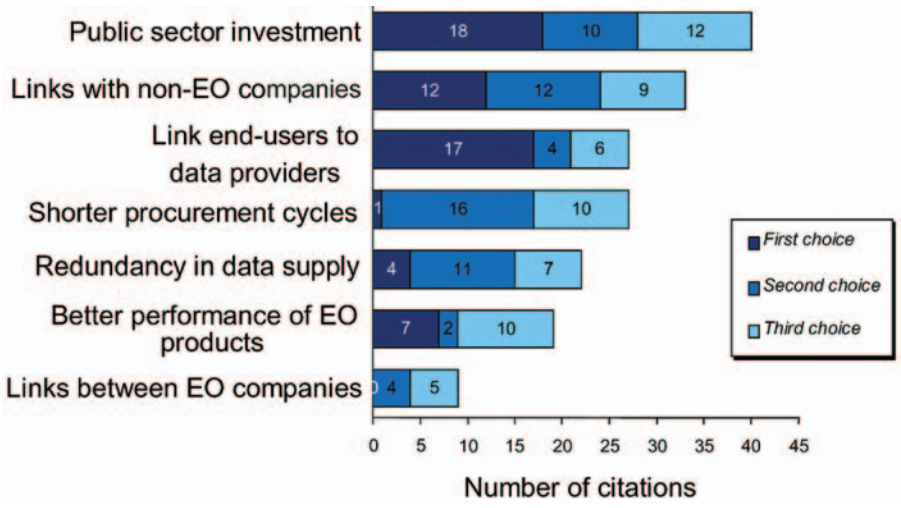
The Industry Sector

The EO service industry in Europe and Canada has typically been described as fragmented and consisting of diverse players, including many privately owned VACs, small units within the few main aerospace companies, and some larger government-financed agencies. In order to better characterise the EO services available today, as well as to better understand the working practices and financial health of the industry as a whole, a detailed industry survey was conducted for ESA by Vega Group plc and Booz Allen Hamilton in 2003/4.

This survey, which was the first extensive bottom-up study of the VAC industry, identified more than 160 companies showing evidence of EO value-adding, 45% of which subsequently participated in the study. Geographically, they are present in the majority of ESA Member States, but their main centres of operation are in Germany and France. Forty-two of them reported their actual revenues, totalling 139 million Euro. From this figure, the total annual revenue across the industry was estimated to be about 285 million Euro in 2002, which compares well with previous top-down estimates. With an estimated 2900 employees involved, the EO-specific revenue per employee is about 107 000 Euro. This figure is in the lower range for technical, labour-intensive industries (i.e. engineering services and IT are typically in the 100 000-150 000 Euro range), and below the typical returns for capital-intensive industries (e.g. fixed telecommunications and pharmaceuticals with revenues of up to 200 000 Euro per employee). As shown in the accompanying figure, the majority of companies are small, with 60% of them employing fewer than 30 people.

The products and services cover both Land (cartography, geohazards/land motion, land use/cover, natural-resource monitoring, multi-thematic services) and Ocean (met-ocean, marine surveillance, coastal charting and monitoring, multi-thematic services). Most of the products use data from more than one satellite sensor (2.7 satellite sensors per product, on average), include data from either ground- or aircraft-based sensors, and often apply further assimilation and modelling in their product generation.

Looking at the factors that influence product prices, they are mainly driven by the costs of labour and data in the production process. This is consistent with



Priority improvement goals of Value-Adding Companies

the fact that data and highly skilled staff are the main elements in the value-adding process. It was also noted that prices are under pressure from buyers, implying that the VACs have difficulty in demonstrating the value of their proposition and instead are challenged to reduce prices. The dominant customers are governments and other public bodies, which account for 78% of the products marketed. 53% of sales are national, 32% are within Europe, and only 15% are outside Europe, showing that the EO companies generally maintain a high reliance on local/national markets.

The industry's performance and practices show a high degree of competition. 75% of EO products entering the market must compete either partially or fully with non-EO products that may have been established for many years and have achieved widespread customer acceptance. Another factor constraining the industry's performance and growth is the general difficulty of meeting delivery promises. According to the VACs, these delivery problems are mainly caused by external influences, such as data-supply problems. Furthermore, the majority of the companies are very small and do not have the critical mass to absorb fluctuations in demand or to overcome unforeseen difficulties.

Several challenges have been identified which have to be addressed in order to secure the future of the EO service industry. Possible solutions are increased collaboration between VACs, to strengthen individual EO offerings, as well as more partnerships with non-EO service providers, to deliver more complete solutions. Also, customer confidence could be increased by establishing standards and methods to certify EO services, only 12% of which currently carry any form of certification. In addition, the industry needs a stronger and more coherent marketing and lobbying voice. The accompanying figure shows the major improvement goals for the industry reported by the VACs in the survey.

The Services on Offer

As noted earlier, the basic approach has been to 'plug in' EO-based information into conventional information services to improve or enhance what is already on offer. This has been done by building partnerships between VACs and larger companies currently selling information services to the market (the 'downstream' services sector). In the end, customers need to be convinced of the added benefits that EO can bring, and this means working closely with them to set up and run service trials tailored to their specific needs.

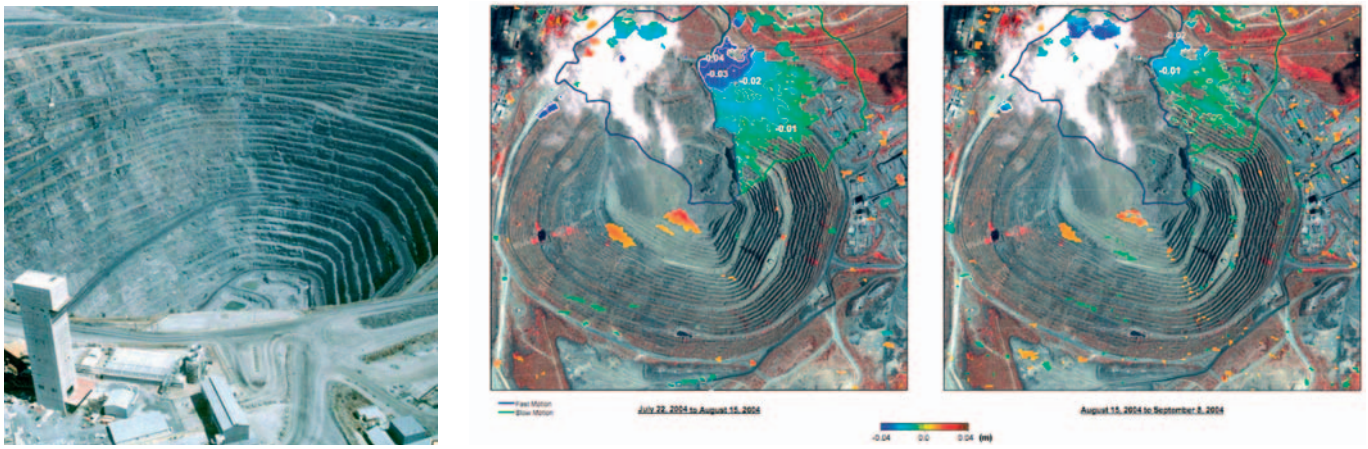
Over the last 5 years, a total of 75 service trials have been conducted, involving more than 60 VACs and 130 end-users and focusing on 20 service portfolios. For these trials, a variety of EO-based information services have been developed, including monitoring of the ocean, atmosphere, land conditions and motion. These services have been evaluated within the business operations of large companies (e.g. Shell, BP, Suez) spanning various industrial sectors, including oil & gas, renewable energy, geotechnical engineering, mining and tourism.

Three examples of EO-based information services developed within EOMD to assist mining activities, oil extraction and solar-energy-plant planning are presented in detail in the following paragraphs.

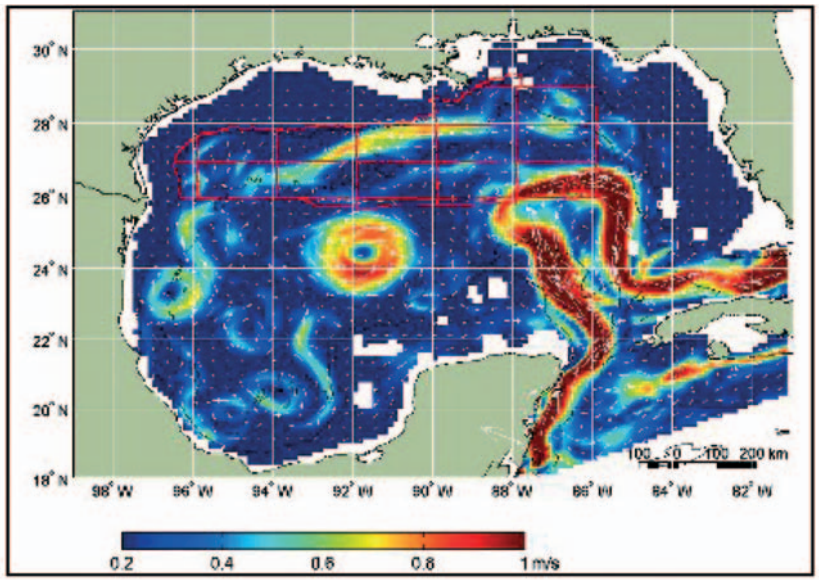
Monitoring land motion to support mining activities

Mining activities can lead to severe surface-subsidence problems. One such example is the Palabora copper mine near Pretoria, the largest 'man-made hole' in Africa, operated by the Rio Tinto company. It uses uses a highly-efficient mining method called 'block caving', which is based on extracting thin blocks of rock to induce large-scale cave-ins in the overhanging ore. Even though the excavation is being carried out more than a kilometre underground, last year surface instabilities caused more than 60 million tonnes of material to collapse into the pit from its north wall. Rio Tinto was concerned that future subsidence might threaten the installations on the pit's eastern rim.

The international geotechnical engineering company AMEC, assisted by Vexcel Canada and Infoterra UK, is evaluating the commercial possibilities of



Monitoring land motion from space. Left: The Palabora mine in South Africa; Right: Subsidence results from InSAR for two subsequent data periods, overlaid on very-high resolution imagery of the area (with cloud cover at top left). Courtesy of Vexcel Canada; Infoterra Ltd./Eurimage (Quickbird image)



Ocean eddies. Right: forecast of surface current velocities from the Ocean FOCUS service during the formation of the 'Sargussum Eddy'. Courtesy of Ocean Numerics Ltd.

a technique known as Interferometry of Synthetic Aperture Radar (InSAR) images, with which they are able to measure slow movements of the Earth's surface from space with millimetre accuracy. The InSAR technique has been used at the Palabora mine to monitor deformation around the excavations and it shows that subsidence on the northern side of the pit has tapered off and that there is zero subsidence near the smelter, refinery and other buildings on the east rim (see figure). In addition to its test-monitoring of the Palabora mine, AMEC is conducting 10 more field trials for other mining companies, for railway operators in Germany and the UK, and for a pipeline route in Western Canada.

Mapping ocean eddies to protect deep-water drilling operations

Oil & gas exploitation in the Gulf of Mexico has an enormous potential, but deep-water drilling operations there are plagued by the presence of eddies, spinning off from a large oceanic current called the 'loop'. The latter is formed when warm water from the Caribbean enters the Gulf of Mexico through the Yucatan Straits and flows clockwise through the basin before exiting through the Florida Straits to merge with the Gulf Stream. When approaching the Florida Straits, the loop current bends strongly, becomes unstable, and thereby releases energetic warm core eddies (with a typical diameter of 100 km) into the northern waters of the Gulf of Mexico, which is heavily populated with production platforms and drilling rigs.

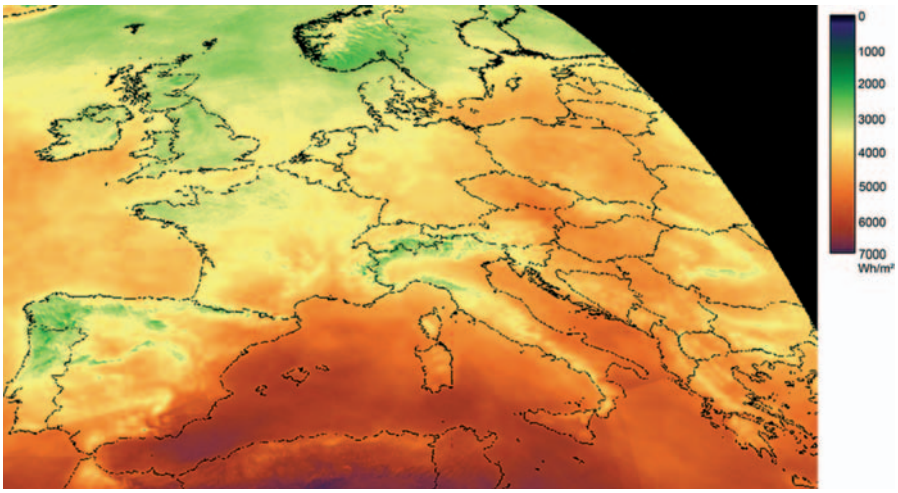
Eddies generally have strong associated currents, which can significantly disrupt offshore exploration, construction and production operations. In 2003, the so-called 'Sargassum Eddy' (see figure) crossed a heavily exploited sector and caused production losses valued at several million dollars. More recently, hurricane Katrina has highlighted the strategic importance of oil and gas production in the Gulf of Mexico for the World's economy.

Monitoring of eddies in the Gulf of Mexico is therefore of vital importance to ensure safe, cost-effective and environmentally-responsible decision-making for offshore operations. Until now, the oil & gas industry has relied heavily on the deployment of surface drifters (tracked by satellites) to monitor the behaviour of the loop current and its associated eddies in relation to the locations of offshore installations. However, this approach remains costly and can only provide an incomplete picture.

Within the EMOFOR (Envisat Monitoring and Forecasting Services for the Offshore Industry) project, Ocean Numerics – a joint venture between the Nansen Environmental and Remote Sensing Centre (NERSC), Collecte Localisation Satellites (CLS) and FugroGEOS – has developed a new eddy-forecasting system. Previous attempts to use EO data were based on Sea-Surface Temperature (SST) measurements only. However, temperature measurements in the Gulf of Mexico are limited during the summer, due to the uniform warmth of the surface layer. The new service uses an innovative approach to observe and forecast eddies, by combining satellite measurements of SST, altimeter measurements of sea-surface height (SSH), and ocean-colour measurements with in-situ data and employing a state-of-the art numerical model. In this way, it is possible to create detailed synoptic maps of sea-surface height, which show eddies detaching from the main current in near-real time (see figure).

Optimising siting and operations of solar-energy plants

The market in solar photovoltaics, i.e. the direct conversion of sunlight to electricity, has an annual turnover of 1.5 billion Euro in Germany and 5.8 billion Euro worldwide (in 2004). There are two kinds of solar-energy establishments: solar thermal plants that concentrate heat from



Monthly mean irradiance map for Europe derived from Meteosat-7 for April 2000 (irradiance measured in Wh/m^2). Courtesy of Univ. Oldenburg, Germany

the Sun, and photovoltaic plants that convert sunlight into electricity. In both cases precise, long-term solar irradiance data are needed for choosing plant locations and estimating likely energy yields for prospective investors. Then, once a plant is built, the managers need near-real-time data to check that the facility is working optimally, and that the energy output is consistent with the available sunshine.

EO-based information services for solar-resource monitoring have been developed by a pan-European consortium led by Germany's DLR. The service helps solar-energy managers to automatically assess the performances of photovoltaic plants (i.e. by comparing the actual daily or monthly solar-energy yield with the average value expected from satellite data) and rapidly detect faults, and thereby reduce costs.

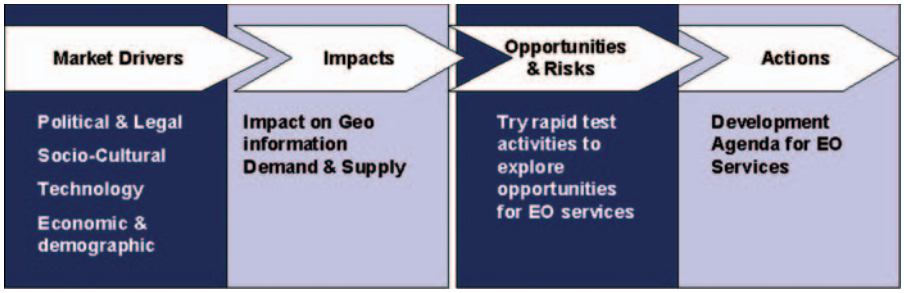
Geostationary meteorological satellites can provide global irradiance maps with high temporal resolution. Over Europe and Africa, the first-generation Meteosat satellites have an imaging repeat time of 30 minutes; the SEVIRI imager onboard the Meteosat Second Generation (MSG) satellites now provides a new image every 15 minutes. By combining the irradiance maps derived from Meteosat (see figure) with other EO products, such as digital-elevation-model and cloud-cover maps, it is possible to estimate the optimal sites for photovoltaic plants. The possibility to go back in time via the Meteosat data archive – the first-generation Meteosats have been operating continuously since the early 1980s – provides the long-term direct/diffused solar-illumination statistics necessary to quantify solar resources.

Market Intelligence

In order to gain a better understanding of the prospects for EO in emerging market sectors, a series of market-driver studies was conducted between 2002 and 2005. Led by players in the downstream service industry, these studies were designed to give VACs a broader and more complete view of upcoming business opportunities. As outlined in the accompanying figure, the overall approach was to determine the impact of the main factors or 'drivers' affecting the demand and supply of geo-information for 12 distinct market sectors. The goal was to identify opportunities and threats to EO services, and to elaborate appropriate responses by the EO industry for the short to medium term (3 to 5 years). The 12 market sectors addressed were:

- Forestry
- Coastal-zone management
- Urban mining and subsidence
- Tailings dams and mine waste monitoring
- Pipeline management
- Offshore winds
- Insurance
- Tourism
- Aquaculture
- Ports and harbours
- Location-based systems, and
- Geo-marketing.

For each of these market sectors, a separate dossier of results was compiled. Their analysis identified a set of over 200 drivers affecting the demand and supply of geo-information in these markets. Despite this complexity, some common factors affecting nearly all of the sectors emerged. An increasingly legislative environment, together with greater emphasis on



Market drivers

What the Customers Say

"While traditional survey techniques and geotechnical instrumentation can provide detailed information at specific points of interest, InSAR provides continuous data coverage over large areas to sub-centimetre accuracy within a particular timeframe of interest. These data are often available back to the early 1990s for many locations".

Tim Conley, AMEC

"Recent advances in numerical modelling, and satellite data processing techniques are resulting in the ability to locate eddies accurately, and to predit in advance their separation from the loop current and propagation towards areas of intense deep water O&G activity."

Robin Stephens, FugroGEOS/Ocean Numerics Ltd.

"We cannot set satellite-derived data aside when building and operating systems, especially with regard to the future markets like Spain, where we need solid information for investment decisions. The resolution of ground-based data is too coarse (for example in Spain there are only 30 sites available at the moment) and satellite data can therefore help a lot".

Uwe Ilgeman, S.A.G. Solarstrom AG

sustainable development, environmental reporting and security, is driving the demand for geo-information from both Industry and Government users, particularly in Europe. Globalisation is affecting industries such as forestry, mining, pipelines and shipping (ports) through issues such as public accountability, industry consolidation, and accession of countries to global markets. Economic drivers relating to the need for greater operational efficiencies, cost savings, availability of funding and willingness on the part of customers to spend are also of primary importance. The main obstacles to EO uptake are low awareness among user communities, lack of recognised suppliers, and issues concerning the reliability, accuracy, cost and usability of EO products.

Possible responses by the EO industry are specific to each market sector, but common recommendations include the development of more complete information products, which fit seamlessly into industry working practices, improved standardisation and quality control to increase product reliability, the need for lobbying, and a strong need to increase product awareness in downstream industries.

Conclusions

Over the past 5 years, ESA's Earth Observation Market Development activities have built understanding, participation and momentum in the EO service industry. They have also supported the industry in engaging with new private-sector customers and better addressing new market opportunities.

Looking at the individual projects, a total of 6 million Euro of additional business has been generated to date as a direct consequence of the EOMD activities. Most of the new business is coming from 11 service actions conducted over three years whereby EO-based VACs work with downstream industry players and their clients. An important element of these activities were service trials whereby satellite-based services have been integrated into the operations of non-EO-based geo-information companies. Such service trials give industry customers the confidence to make the first purchase, thereby opening the door for future follow-on business. So far, the services with most follow-on business have been land motion, geological mapping and maritime surveillance, with an even split between private and governmental customers.

Another way of assessing the usefulness of the EO-based services is through the collection of 'value statements' from key customers. Over the last years, a total of 28 value statements have been collected, yielding 19 positive, 7 neutral and just 2 negative responses. The accompanying panel (left) presents customer feedback associated with the service examples described earlier in the article.

The industry survey and the market intelligence studies have helped everyone involved to achieve a better understanding of the EO service industry and have highlighted commercial opportunities as well as the challenges related to its structure, offerings and presence. Realising the full potential of EO for the industry will require increased collaboration and partnerships, standards and certification, together with a stronger industry marketing and lobbying voice. Another important factor will be the long-term continuity of EO data, as customers will be wary of adopting new services for which the future supply of the raw data is not secure.

Outlook

Recent studies (e.g. OECD report 'Space 2030, Tackling Society's Challenges') confirm that the future demand for space applications is likely to be substantial, with information-intensive applications such as telecommunications, navigation and EO

offering the best prospects. Furthermore, with the European Commission (EC) placing renewed emphasis on the Lisbon Agenda for Europe to advance towards the most competitive and dynamic knowledge-driven economy by 2010, and also the new joint EC-ESA initiative for Global Monitoring for Environment and Security (GMES), the timing is right for the EO service industry to take advantage of these opportunities for growth. GMES is a major step forward in structuring public-sector demand within Europe. It offers a chance for industry to come forward with an effective framework for large-scale service provision.

In this context, future ESA activities with the value-adding industry will focus on developing the private sector's engagement with EO in three major directions. The first direction will further build and expand European EO service capabilities. In the short-term, several 'innovative contracts' have been started in 2004 and 2005 to cover new thematic areas, e.g. national-park management, tourism and public health. In the medium and longer term, it includes the integration of new EO data from ESA, Eumetsat, national and third-party missions to further strengthen EO services. The second direction will focus on establishing a strong European EO service industry in global markets, by seeking progress in the areas of industry standards, service certification and effective industry representation, as well as including initial actions to analyse and eventually access markets outside Europe. Finally, the third direction will further develop the need to integrate EO into downstream industrial operations and practices. This will involve taking EO to new industrial sectors and combining EO with other non-EO information services. As a first step, several initiatives have recently been started with large companies to assess how EO can be of help in the context of their 'corporate sustainable development'.

In summary, ESA's EOMD activities have already contributed substantially to a shift from a rather technology-pushed approach within the EO service industry, to a more market-pulled, user-oriented approach. They have provided a solid basis for a future programme of work to further strengthen and develop the functioning, credibility and acceptance of the EO Service Industry sector and help it to profit from upcoming opportunities and address the main challenges that it will face in achieving sustained growth.

More information about ESA's EOMD activities can be found at:

http://www.esa.int/eomd.