

# THE COMPUTERWORLD HONORS PROGRAM

## CASE STUDY

LOCATION:  
*Guildford, United Kingdom*

YEAR:  
*2006*

STATUS:  
*Laureate*

CATEGORY:  
*Environment, Energy  
and Agriculture*

NOMINATING COMPANY:  
*Cisco*

### ORGANIZATION:

Surrey Satellite Technology Ltd

### PROJECT NAME:

Disaster Monitoring Constellation

### Summary

Surrey Satellite Technology Ltd (SSTL) has made its Disaster Monitoring Constellation (DMC) fully operational with the successful launch in October 2005 of the fifth and latest international satellite contribution to this novel civil remote-sensing imaging service. The Disaster Monitoring Constellation provides a unique daily imaging capability from a coordinated constellation of five innovative, small, low cost, satellites. The DMC satellites are independently owned by Algeria, Nigeria, Turkey, the United Kingdom, and China, but operated together as a shared constellation by the DMC consortium, which is formed by these five nations.

The DMC has provided emergency imaging for disaster relief under the International Charter for Space and Major Disasters. The DMC has monitored the effects of the Indian Ocean Tsunami (December 2004), Hurricane Katrina (August 2005), and many other floods, fires and disasters. The DMC has provided imagery for a variety of civil and commercial uses, such as for mapping applications used by the United Nations for camp placement of internally displaced people in Darfur, Sudan, and for tracking locust breeding grounds and estimating population sizes in Algeria. Within Europe and the United States the broad coverage and frequent revisit of DMC allows commercial agricultural services to provide field-level crop health monitoring. DMC imagery is also used in Earth science applications, such as Indonesian peat land and Eurasian boreal forest fire monitoring. These will contribute valuable data to our understanding of global carbon dynamics.

SSTL has also set up DMC International Imaging (DMCii) to manage the constellation on behalf of the international consortium. This management includes constellation coordination, satellite positioning maintenance, and image calibration and quality control. DMCii also handles Earth imagery that is provided by individual countries' satellites and ground stations for commercial imaging contracts. These ground stations are networked together across the Internet to deliver rapid, responsive, daily imaging of any point on the Earth's surface. This creates a unique business model and a novel distributed imaging system and service that is far more than the sum of its individual parts.



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### Introductory Overview

SSTL's bold vision and execution in bringing the Disaster Monitoring Constellation to fruition and operation over the past decade has included:

- Establishing the first multi-national cooperation for shared Global Environment Monitoring, with independent monitoring capabilities for each country.
- Ultimately creating a valuable service with broad societal impact.
- Establishing broad international shared consensus and the will to create this service via negotiation and agreement.
- Successful application of a novel business model to support this service.
- Developing skills and establishing new processes to enable this service.
- Use of commercial off-the-shelf technology to provide this service.
- Contributions to cutting-edge research alongside this service.
- Support of international disaster monitoring and mitigation efforts.
- Bringing space technology and benefits to developing countries, particularly to Africa.

In successfully carrying out all of these tasks, SSTL has broken new ground in a number of areas. These areas are discussed further below.

### Benefits

The Disaster Monitoring Constellation provides emergency Earth imaging for disaster relief under the International Charter for Space and Major Disasters. Other DMC Earth imagery is used for a variety of civil applications by a variety of governments. Spare available imaging capacity is sold under contract.

The DMC provides far larger areas of imagery than, but at comparable resolution to, established government imaging satellites such as Landsat – even though the entire DMC constellation was constructed at a fraction of the cost of traditional imaging satellites. Progress in small satellite technology, pioneered by SSTL since the 1980's, has made this possible. DMC imagery was deliberately designed to be comparable to Landsat imagery, in order to leverage the expertise and software of the large established remote sensing community used to working with Landsat images. Imagery can be provided far more rapidly from the DMC than from Landsat, thanks to having multiple similar satellites in orbit ready to cross over a point of interest. This brings the responsiveness that is needed for emergencies and for disaster support, with images provided across the Internet from the responsive satellite within a day or less of a request being made.

Developing country's governments owning the satellite assets have been able to find novel uses for satellite imagery – uses that were previously considered too expensive to explore, due to the cost of buying in third-party imagery. New applications are still coming to light.

### The Importance of Technology

SSTL is a small company that is a pioneer in developing and launching small satellites and in adopting widely-used commercial terrestrial information technology to the space environment onboard its satellites.

SSTL has shown that the Internet Protocol, whose use is now ubiquitous terrestrially, can be used for communication with and onboard satellites – treating satellite payloads as

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Internet-capable computers in space. The DMC is currently unique among satellite constellations in using the Internet Protocol to command satellites and to download imagery to its ground station networks, which are connected together across the public Internet in a virtual private network. This merged space-ground architecture shows how the Internet can be extended usefully and cost-effectively into space, while also validating and demonstrating SSTL's approach to using inexpensive commercial off-the-shelf technology where it is suitable for space applications.

Information technology also plays a strong part in novel research carried out onboard the satellites. The DMC satellites carry onboard secondary experimental payloads that support further research into new areas, as described in a number of recently-published papers. For example, the United Kingdom's contribution to the DMC, the UK-DMC satellite, carries a commercial terrestrial Internet router, whose integration into the satellite and successful testing was made possible by SSTL's adoption of the Internet Protocol. The UK-DMC satellite also carries a passive GPS reflectometry sensor, where signal processing measures backscatter from ocean waves to determine wave height and wind speed. In addition, the Turkish contribution, the BILSAT-1 satellite, carries novel digital signal processing hardware to enable onboard image compression.

### Originality

The DMC was established using a novel business model. Governments of contributing countries (Algeria, Nigeria, Turkey, the United Kingdom, and China) have each been convinced to purchase a single ground station and a single remote-sensing satellite, of similar design, from SSTL to serve both national and cooperative needs. After construction and launch, these assets are then networked together to provide rapid, responsive, daily imaging of any point on the Earth's surface, creating a distributed imaging system that is capable of far more than any single satellite in the constellation. This has made each individual country's purchase highly cost-effective. An affordable and useful service has been created by shared ownership of the assets that together form the satellite constellation network.

The application of commercial technology to provide imaging services that were previously the domain of far larger, far more expensive satellites, such as Landsat, is also innovative

### Success

The DMC is meeting its intended purpose successfully. It has been recognized for providing emergency imaging for disaster relief under the International Charter for Space and Major Disasters, which the DMC has formally joined as an imaging partner as of November 2005. The DMC has monitored the effects and aftermath of the Indian Ocean Tsunami (December 2004), Hurricane Katrina (August 2005), and many other floods, fires and disasters, and has provided imagery for use in disaster relief. (This Katrina aftermath imagery was supplied to and is available from the US Geological Survey.)

In the short time that it has been operational since its first satellite launch in November 2002, the DMC has provided imagery for a wide variety of civil and commercial uses. As well as for emergencies, these include mapping applications used by the United Nations for camp placement of internally displaced people in Darfur, Sudan, and for tracking locust breeding grounds and estimating population sizes in Algeria. The benefits to populations are widespread, the



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impact is large, the effects are broad – but the many beneficiaries will likely never know of the DMC’s existence, or of its role in providing useful information for decision-making at the governmental and program level.

SSTL has now spun off DMC International Imaging (DMCii) as a separate company to help manage the DMC for the “Disasters Charter” and to sell available images and unallocated sensing capacity commercially.

### Difficulty

Manufacturing, launching and operating a number of imaging satellites requires use of a large number of disciplines, skills, and expertise in different subject matter areas.

Bringing these together successfully with processes leading to a successful outcome that requires success in each and every individual area is difficult. Taking the result further with cooperation with nonprofit organizations to establish and provide a useful service to the “Disasters Charter” is remarkable – and SSTL has accomplished all of this despite only being a small university-owned company of around two hundred people.

Convincing representatives of multiple governments to ‘buy in’ to the vision of the DMC was itself a challenging multi-year effort in negotiation and reaching consensus. This was helped by the credibility that SSTL had built up in over two decades of building and operating satellites, and in the previous contracts that SSTL had successfully completed for a number of governments.