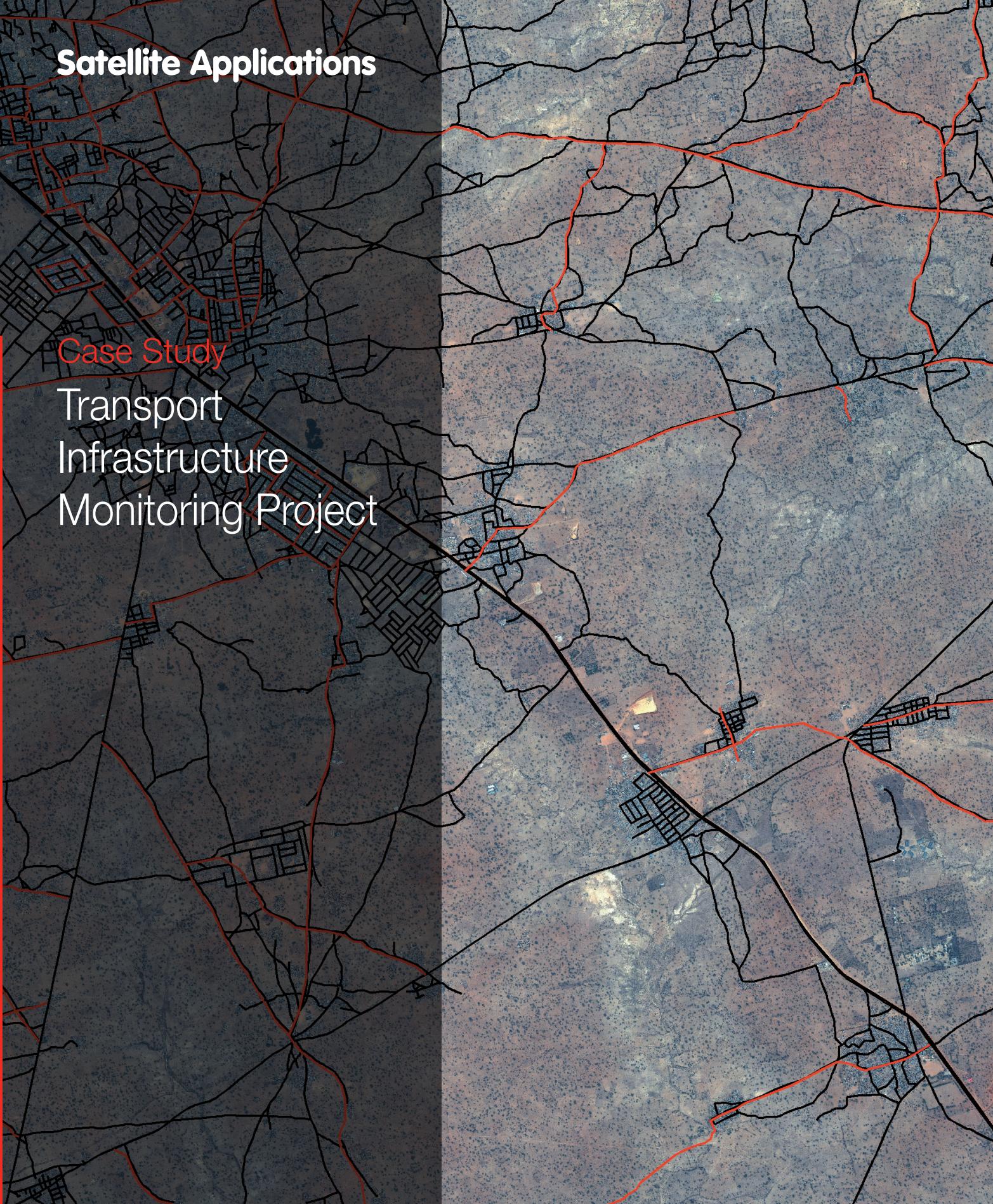


Satellite Applications

Case Study

Transport
Infrastructure
Monitoring Project



In developing countries road construction often goes unrecorded and is often in a poor condition.

Project Overview

The rising growth in the global population and urbanisation has led to a dramatic increase in road construction worldwide, enabling much needed connectivity between people for the purpose of increased economic development.

Particularly in developing countries, road construction often goes unrecorded and is subject to issues of poor quality and condition. The UK and international aid funding bodies invest significant sums of money in assessing and improving transport infrastructure in developing countries. With the global population projected to reach 9.6 billion by 2050 (UN, 2013), there is an increasing need to manage existing, and monitor the creation of new transport infrastructure.



Regions of Nigeria suffering from poor road conditions

Nigeria is the most populous country in Africa with a rapidly developing economy. It has a large road network that extends into remote areas, and in addition has serious security issues in some of its northern states, and southern Delta states.

The Nigerian Government would like to have improved visibility of their road infrastructure and currently lack a database of consolidated maps. Some regions suffer from flooding during the wet season which can result in negative impacts to the existing road infrastructure. Much of the rural population are serviced by roads that are in poor condition and run through remote or insecure areas; this is recognised as a major constraint to economic growth and poverty alleviation in these areas. Thus using satellite data to improve the monitoring and management of road infrastructure in these areas would offer major benefits.

TranMon - investigating the potential for existing and future satellite capability to assist in the management of road assets.

The Challenge Background

The Satellite Applications Catapult, in partnership with Airbus (formerly Astrium Geo Information Services) - a provider of geo-information and geospatial services - and TRL (the UK's Transport Research Laboratory – an independent research and technical consultancy in the transport sector, with over 50 years' experience of working in Africa) set up the Transport Infrastructure Monitoring Project (TranMon) to investigate the potential for existing and near future satellite capability to assist in the management of road assets.

An initial scoping study concluded that satellite data would be particularly useful in the following areas:

- Remote areas, that are difficult or expensive to access on the ground
- Areas affected by security and safety issues
- Areas of disaster; both man-made (human displacement) and natural (hurricanes, floods, earthquakes), including areas where natural events have damaged the road infrastructure, such as flooding in the rainy seasons and landslides in mountainous regions.



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Significant savings can potentially be made with regard to cost and time required to collect infrastructure assets.

The TranMon pilot project was aimed to demonstrate how satellites data can help road asset management systems.

Due to the global coverage and temporal frequency of satellite data, significant savings can potentially be made with regard to cost and time required to collect information on infrastructure assets, as well as reduced risk to life. These savings can be made through the ability of satellite data to provide the information required to map, monitor and assess road infrastructure condition and distribution as an alternative to the deployment of surveying teams on the ground.

A pilot study identified road monitoring criteria. In response, the use of satellite data was proposed to determine more accurate mapping and, if possible, condition data for the road networks. The road sector stakeholders in Nigeria pointed out that there is a particular lack of information on the extent and condition of the rural road networks in Nigeria. Taking into consideration the research challenges, a study area was selected outside the city of Kano in Northern Nigeria which contained a range of paved Federal, State and urban roads, as well as a substantial amount of rural earth road.

The TranMon Solution

The aim of the TranMon Project was to demonstrate that the capability to perform semi-automatic road detection using satellites exists, and that road information, extracted from satellite imagery, can be incorporated and exploited in an existing road asset management system (the TRL Road Asset Management System, iROADS). To do this, the TranMon project used a combination of satellite observations and in-situ ground validation measurements to resolve these transport issues via a two aspect approach:

- Mapping road location
- Assessing road condition

Assessment was undertaken using a combination of SPOT-6 data (1.5m resolution) for assessing road network distribution over large areas, and Pleiades high resolution (0.5m) data, for assessment of road condition.

Crucially, as part of this project TRL was able to use ground-truth data, gathered in situ by its image collector survey vehicle as part of the Department for International Development funded Nigerian Infrastructure Advisory Facility (NIAF). A specialist vehicle mounted with a set of cameras navigated roads in the region and recorded its observations. This valuable data set provided calibration and validation of the satellite-derived information, to ensure the TranMon method was robust. Using this ground-truth data, validation observations produced agreements of 100% correlation for paved roads, 79% correlation for earth roads in a 'fair condition' and 59% correlation for earth roads in 'fair-poor condition'.

The results demonstrated the success of the TranMon project in addressing its primary objectives.

Future Developments

Upon conclusion of the TranMon feasibility study, the outlined R&D has been passed over to TRL to allow them to begin to incorporate the newly developed techniques into the Road Asset Management System (iRoads). This will help demonstrate the results of the satellite analysis, and show how satellite observations could be integrated into an operational asset management system. Use of the resulting asset management system would be primarily aimed at local and national governments, transport agencies, and engineering firms. Additionally, long term objectives include creating employment for the local population through the provision of training to generate skilled workers to analyse satellite data, manage and maintain the transport infrastructure network.



Image collecting survey vehicle

Partner information



TRL is one of the largest, independent transport centres of excellence in the world. Established over 80 years ago, TRL has developed and implemented innovative solutions and provided impartial trusted advice to a wide range of UK and international clients. TRL has an excellent reputation for carrying out world class consultancy and research to meet the global challenges presented by transport:

- Improving the efficiency and effectiveness of the transport infrastructure
- Improving the health and safety of all transport users
- Reducing the adverse impact of transport on the environment
- Enhancing the user experience

TRL has helped to shape the modern road environment through the development of guidance, policy, manuals and strategies in all aspects of infrastructure, safety and transportation. They have over 50 years' experience of working in Africa with the international aid agencies (DFID, World Bank, European Union, UN Agencies and AfDB), helping African countries to establish and maintain their transport infrastructure and reduce death and serious injury on their roads.



Through its geo-intelligence portfolio, Airbus Defence and Space is recognized as a world leader in geo-information. They provide Earth observation satellite imagery, unique expertise and decades of experience.

Based on privileged access to Pléiades, SPOT 5, SPOT 6 and TerraSAR-X (radar and optical satellites), their portfolio spans the entire geo-information value chain.

Airbus Defence and Space provides decision makers with sustainable solutions to increase security, optimize mission planning and operations, boost performance, improve management of natural resources and, last but not least, protect our environment.

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