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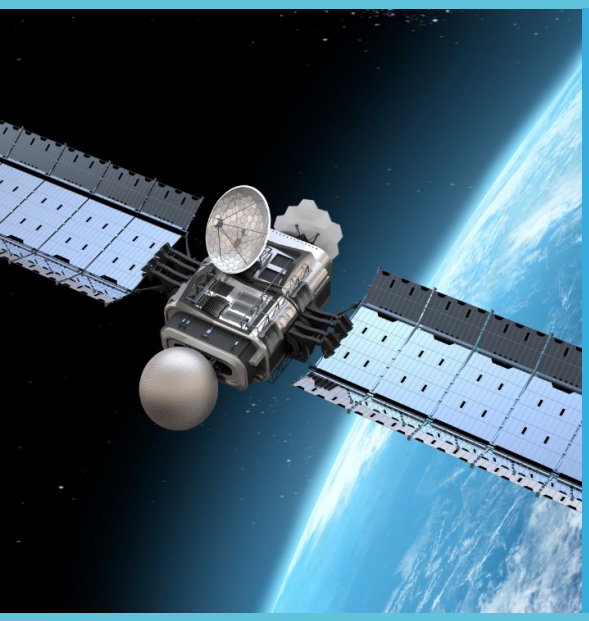
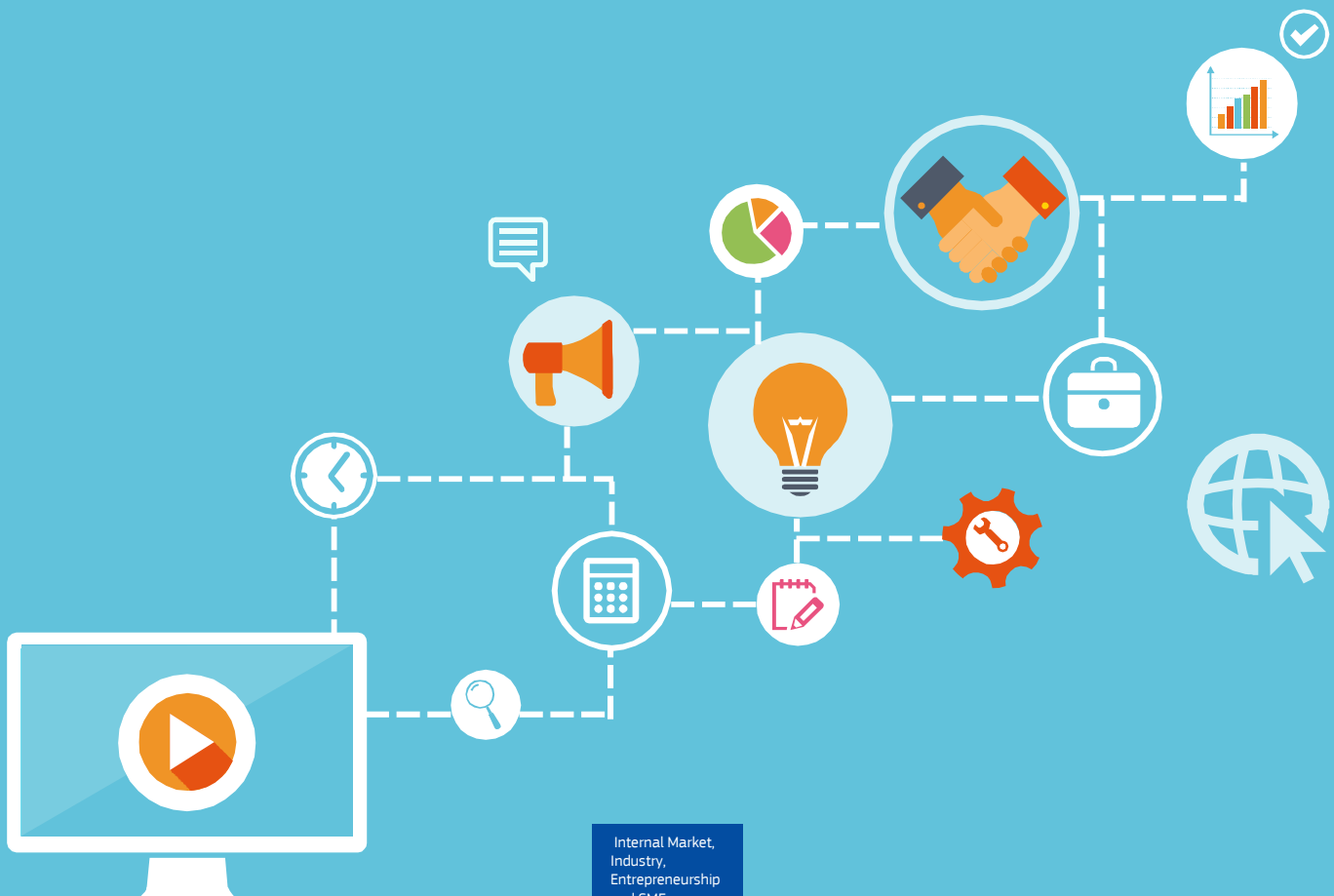


Digital Transformation Monitor

# Big Data in Earth Observation

*July 2017*



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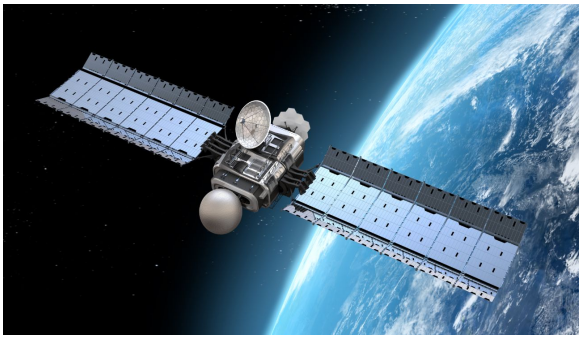

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# Big Data in Earth Observation

*Thanks to technological breakthroughs in Earth observation, businesses and public agencies are now collecting data points at all times, from an ever-increasing number of sensors connected, all over our planet thanks to satellite observation. The Earth Observation information not only fosters the economic development but also helps to create policies and to enhance decisions on a broad range of societal and business challenges.*

## 1 The Big Data Earth Observation Market

The satellite-based Earth Observation market is in an emerging state today and is expected to boom over the next decades thanks to recent technical breakthroughs regarding data collection and storage. Indeed, there is an increasing offer of high quality Earth observation data, both in terms of variety of sources and of quality of resolution.

In parallel, new actors attracted by the emerging potentials are entering the EO (Earth Observation) market and are therefore nurturing growth and creating new competition and opportunities. The dynamics of the market is also fuelled by the global recognition of EO as **an important tool to tackle the key challenges of the 21st century** such as climate change, natural resources management or disaster mitigation.

### A market with 3 segments

Earth Observation is a component of the space market and not only refers to satellites currently used for meteorology but also to remote sensing of planet Earth. EO satellites provide valuable information regarding societal challenges and industry activities in multiple sectors, such as agriculture, change detection, meteorology, resources...

This market is divided into 3 sectors:

- The EO upstream sector includes manufacturing and operations of satellites as well as their launch. Its revenues amount at EUR 1.9 billion in 2014. [1]
- The EO midstream sector gathers operators that sell or distribute EO data to customers. Data sales amounted at EUR 1.5 billion in 2015. [2]
- The EO downstream sector concerns the conversion of data into value-added products. It reached EUR 2.8 billion in 2015. [2]

### Big Data Earth Observation Value Chain

The EO data value chain consists of five main high-level activities:

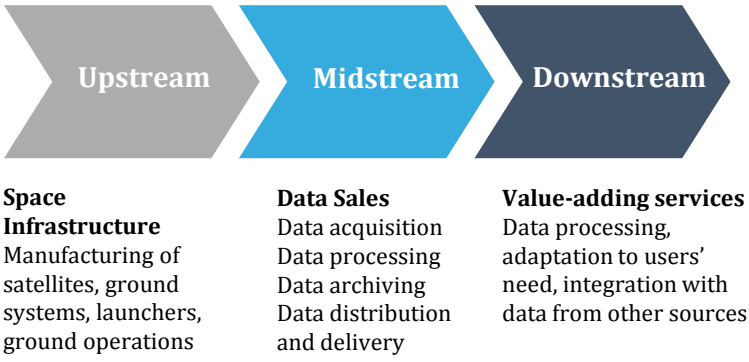
1) Data acquisition, referring to the gathering, filtering and cleaning of data before it is analysed.
2) Data analysis, which is the process through which raw data are made useful and comprehensive for a determined usage.

It has an essential place in the EO data value chain.

3) Data curation, corresponding to the control of the quality, diversity, flow and source of data in order to make the data meet the necessary requirements for its intended usage. This is a new but emerging activity.
4) Data storage, which includes storage and management the data that has previously been acquired, cleaned and cured. It is a key part of the value chain and is considered as a commodity business, especially in weather forecasting.
5) Data usage is dedicated to help business decision-making. The main players in this field are today large companies as it requires major infrastructures but opportunities are coming for SMEs in respond to the growing needs regarding data usage.

By total, **the commercial EO domain was sized at about EUR 3.7-4.5 billion in 2010.**[1]

**Figure 1: the Earth Observation market** [3]



# 2 The emergence of new actors

For many years, EO services were offered by small number of operators, financed by space industry, with governments as primary customers. New competitors and partnerships have recently emerged and are typically founded by IT and tech sector to provide web-accessible imagery. In addition, customer base is developing from an institutional base to a more commercial one.

### A new wave of actors shaking up in the upstream market

From 2002 to 2011, about 90% of the EO satellites launched were institutional, especially for military but also civil use.[1] They were large satellites with advanced and custom-design payloads.

A disruptive trend emerges with a new generation of space private companies manufacturing smaller and cheaper satellites in comparison with the existing EO data providers. They enable the development of new markets not covered by traditional EO data providers thanks to the availability of a large volume of data for an affordable costs from different types of sensors.

Many of them are now delivering their imagery at low price or even for free, such as the Sentinel-2A, recently launched by the company GIM.[5] These satellites are creating new opportunities in the whole EO market and are expected to be increasingly demanded.

### Current and coming upheaval in the midstream market

The midstream segment sees a profusion of new and smaller actors. In 2012, only three companies captured almost three quarters of the total revenue emanating from EO commercial data sales, namely GeoEye (25%), DigitalGlobe (25%) and Astrium GEO-Information services (20%).[3]

Today, the market is still dominated by those large international actors but there is scope for SME and new actors such as Amazon Web Services have hit the top of the market in a few year.

This is a consequence of the evolution of the industry structure caused by commercial operators which extend their services in order to include more value-added applications and offer complete geospatial solutions.

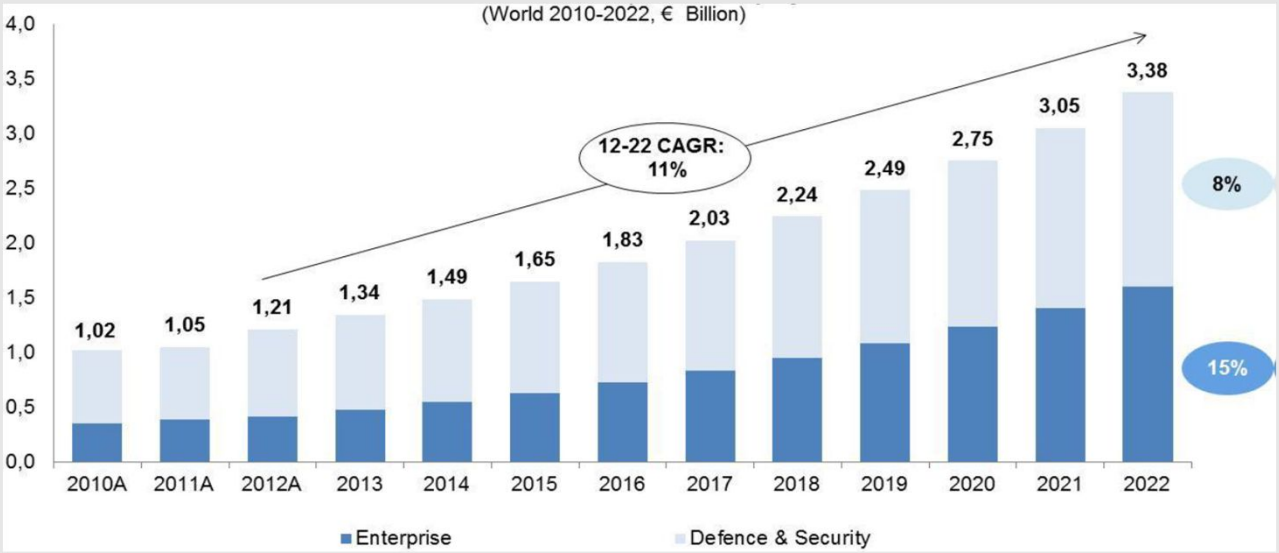
### Great opportunities for European companies in the downstream market

The downstream market, corresponding to the transformation of EO data into value-added information and services for institutional and private customers, knows a staggering growth today. It offers arguably the most interesting potential for European companies. The table below gives concrete examples of companies who already succeeded in this market thanks to the innovative services they offer and their links with the other two EO markets.

**Innovative EU companies dealing with EO data**

| Company | Activity |
|---|---|
| Airbus Defence and Space | It operates in all segment of the value chain. Thanks to exclusive radar and optical satellites, it has a large portfolio in the entire geo-information sector and provides services from data acquisition to data management and processing to a large variety of institutional and commercial clients. |
| GAF (Germany) | This company founded in 1985 is the European leader in consulting services on satellites-information. It manages more than 500 projects concerning mainly remote sensing and digital image processing. |
| Eurosense (Belgium) | Eurosense offers several geo-information services: aerial photography, processing and interpretation of satellite images, topographic maps. It aims to create accurate and technological solutions as well as trainings and consultancy to its customers |
| Blackbridge (Germany) | Blackbridge provides infrastructure, products and services to government organisations mainly and also to energy and resource industries. It focuses on providing end-to-end applications such as data centres and geo-cloud solutions. |
| CS (France) | CS develops software applications on an open source basis to process and deliver data collected via EO programmes. It has worked in collaboration with European Space Agency but also with large international clients such as Thales or Safran. |
| GIM (Belgium) | GIM selects and analyses the most valuable EO data to turn it into smart and actionable insight for its private customers. |

**Commercial EO data sales by customers in the midstream segment[3]**

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# A market with enormous opportunities

## New revenue streams and prospects

**The EO market is expected to boom in the coming year in all of its 3 segments**.

163 satellites (>50 kg) were launched for EO (excluding meteorology) over 2006-2015 from 35 countries and generated EUR 16.2 billion in manufacturing market revenues. [2] Over the next decade, 419 satellites are expected to be launched and to generate a EUR 31.2 billion revenue. [2] Small and very small satellites (LEO Satellites) massively contribute to this growth.

Moreover, commercial data market amounted at EUR 1.5 billion in 2015 and could reach EUR 2.6 billion in 2025. [1]

**Globally, the midstream sector is the one with the most important expected growth**, It is anticipated to meet a 11% growth in the 2012-2022 period. [3]

The market will be driven by emerging countries : while turnover is expected to grow at 9% in Europe and 7% in North America, it will amount at 21% in Latin America, 15% in the Middle East and Asia and 14% in Africa. [3]

## Key drivers behind the market's growth

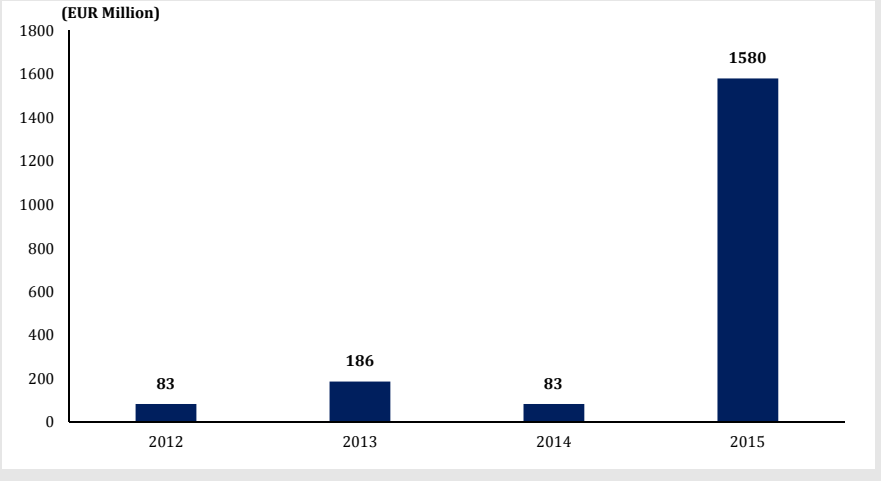
Business opportunities are arising from the increasing number of satellites and the diverse and massive amount of data they provide. Globally, natural resources management, engineering, infrastructures and defence are expected to be the main application areas supporting growth in Big Data in EO. **Private companies are boosting growth**: by 2022, commercial data sales are expected to rise by 8% for defence and security customers, that were traditional customers in the past, and by 15% for private companies. [2]

## New investment records

Moreover, massive investments driven by interests in business intelligence products from EO are acting as growth enablers. Indeed, 2015 is a record-setting year with investment in startup space ventures totalling EUR 1,58 billion.[4] Compared with EUR 600 million invested in virtual and augmented reality in 2015 and EUR 1.76 billion in IoT, SpaceTech is one of the highest VC's bet at the moment. [6]

Besides, Earth Observation receives the major part of Space Tech investment (72% in 2015). [6]

**Venture Capital investments in SpaceTech startups[6]**



The first venture capital fund, for space-related companies called Seraphim Space Fund, has been founded in 2016 in the UK and targets a EUR 90 million final value for the second quarter of 2017. [4]

On the other hand, the market is still based on public funding and global government investment reaches unknown highs: in 2015, it topped EUR 8.8 billion for the first time. [2]

### Initiatives aiming to revolutionize the market

Some keys initiatives are being developed and will disrupt the EO market by introducing new innovative products or processes. The Copernicus programme in Europe is one of them. It is currently developed by the European Union and aims to create an independent EO capacity and consists of a network of satellites and receiving stations.

Since 2014, access to Copernicus data is free, unlimited and universal and Copernicus is the 3rd largest data provider in the world.

No previous EO initiative has ever provided such volume and diversity of data at this rate (8 Petabytes per year) [3]. Therefore, the programme is expected to enhance the development of business related to the exploitation of the free-access data. It was estimated that Copernicus could generate a financial benefit of about EUR 30 billion and over 50,000 new jobs by 2030. [5]

### EO current and coming social benefits

Several programmes implemented in environmental areas at the European level are illustrating the impressive socio-economic opportunities the analysis of Earth Observation data has. The following table shows some examples of social improvement enabled by EO data and the value of their economic impact.

**Amazon Web Services (AWS)**

AWS provides an internet cloud-based platform making available Landsat (the open-data US Earth Observation system) data since mid-March 2015.

Landsat is the US Earth Observation system and provides multi-spectral open-data for applications in agriculture, cartography, geology, forestry, regional planning, surveillance and education.

Within its first year, such data have been requested more than 1 billion times globally, showing the impressive global potential of the downstream market. [9]

**Example of social achievements in Europe enabled by Earth Observation[8]**

| Areas | Description | Value |
|---|---|---|
| Climate change | Increase knowledge of sea level variables. | Reduction of 25% of uncertainty on sea levels forecasts in 2008 saving per year EUR 90-100 million in coastal protection. |
| Agriculture | FARMSTAR tool, a service pooling Airbus, land Inovia and the plant institute expertise to offer satellite-based information on crops, | Costs saving in Nitrogen fertilizers and increase in crop yield leading to a net economic benefit over EUR 5 per hectare. |
| Oil and gas | Increase efficiency in identification of oil and gas reservoirs and monitoring of oil pipelines as well as in oil spill detection. | The oil spill detection monitoring system has already been implemented since 2011 and helps to save about EUR 25 million per year, the rest is still in project. |
| Maritime | Improved ocean current modelling for in route vessel optimisation. | Cost saving in vessel fuel up to 8% for EU adopters. |

# 4 Challenges to tackle

### Dealing with the growth in data volume and diversity

Data meaning from EO programmes will continue to exponentially grow in the coming years. Therefore, there will be an enormous amount of raw data needing to be processed and made available in order to become available. EO Data analytics is becoming a key challenge.

Moreover, only a small fraction of the data produced by EO is useful from scientific research and interesting for commercial use. This is why creating systems developing online data filtering and processing of high-rate data is another challenge in the industry, [7]

### Difficulties to release sensitive data

National authorities often argue for keeping control of the dissemination of data concerning defence, security and other strategic issues. In addition, access to data is not yet entirely reliable and continuous, which poses a major threat to the sustainability of the EO market.

Indeed, an unequal distribution of data harms market development and innovation. In 2013, the EU established that "users shall have free, full and open access to GMES dedicated data and GMES service information". [8] However, a large number of restrictions concerning security, intellectual property and privacy issues were added.

### A harmful talent gap

As explained before, the ability to analyse data and filter it to extract exploitable knowledge is a key competitive advantage. However, companies face difficulties recruiting people with the appropriate quantitative and programming skills.

Besides, they sometimes need to hire different types of person than previously needed for EO in consequence of their new requirements regarding data analysis or data curation. This is why the upskilling of workforce is vital for countries or companies wishing to stand as driving innovative forces regarding EO.

### The need for a European long-term vision regarding Earth Observation

Public governments have realised the socio-economic benefits offered by Big Data in Earth Observation.

However, there is a need in the EU and worldwide for standards harmonisation. The EU does not have a space industry that reflects the specific needs of each sub-sector, such as EO and that sets a regulatory framework for the emergence of a European market for space products, data and services. [8]

Without a long-term policy, supports from governmental authorities risk to remain unsecure and changing. This situation completely harms the sustainability of the market as most of the activities of the EO market are still based on public funding. Indeed, it is estimated in the EU that 50% of the overall market is driven by public investment and this situation is worsened by the lack of clients willing to pay for EO products. [8]

### Copernicus: a major but challenged project

The Copernicus project, which is supposed to be the spearhead of European space policy, is particularly hit by those challenges. A weak data distribution system, combined with a complex government framework and insufficient European industrial and space policy support actions are the most critical barriers holding back a faster development of products and services based on Copernicus data.

**Main barriers hitting the Copernicus Project[8]**

| Type of barrier | Barrier | Impact |
|---|---|---|
| Policy and strategy issues | Lack of an EU space industrial policy. | High |
| | Insufficient and delayed support actions. | High |
| Market issues | Fragmentation of EU space markets. | High |
| | Insufficient public and private demand. | High |
| | Dependency of the market from non EU-technology. | High |
| Governance | Non-systematic involvement of industry representatives. | High |
| | Complex governance framework. | High |
| | Insufficient collaboration among Member States. | Medium |
| Lack of skills | Shortage of technical skills to manage space data, resistance to change. | Medium |
| Technical issues | Weak data and product distribution system | Critical |
| | Interoperability | Medium |
| | Differences in space data access across EU | Medium |

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# About the Digital Transformation Monitor

The Digital Transformation Monitor aims to foster the knowledge base on the state of play and evolution of digital transformation in Europe. The site provides a monitoring mechanism to examine key trends in digital transformation. It offers a unique insight into statistics and initiatives to support digital transformation, as well as reports on key industrial and technological opportunities, challenges and policy initiatives related to digital transformation.

Web page: https://ec.europa.eu/growth/tools-databases/dem/

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Authors: Laurent Probst, Bertrand Pedersen & Lauriane Dakkak-Arnoux, PwC

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