Optimal recycling, big data from space, and blockchain applications: disruption and policy response.

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Business Innovation Observatory

Trend report

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Internal Market, Industry, Entrepreneurship and SMEs

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Optimal recycling, big data from space, and blockchain applications: disruption and policy response

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Executive summary

This report gives a quick glance on the most interesting findings of the 6th semester of the Business Innovation Observatory.

Three Innovation trends synthesized

The trend of **Sustainable supply of raw materials** relates to the development of new intelligent means to mine and process raw materials. Their aim is to provide a sustainable supply of raw material that would both reduce the dependency of EU companies on foreign providers and would allow the efficient exploitation of the resources. Which type of resources? Those available in European mines (case study on innovative mineral and metallurgical extraction and processing), resources available in waste (case study on optimal recycling), and resources available in European forests (case study on smart wood harvesting).

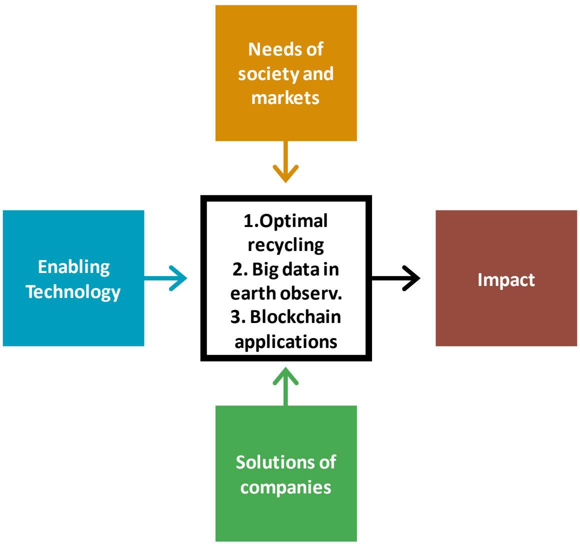
The trend of **Space tech and services** describes the technologies and services that can be transferred from the public funded space programmes to other market sectors not directly related to space domains. The First case study under this trend deals with the applications related to navigation. In this context, thanks to its encrypted service (public regulated service), Galileo is considered a safer application compared to other systems (e.g. GPS). The data it provides can be used in various domains, such as transport, communication, agriculture, environment protection, tourism, etc. The second case study talks about applications related to Earth observation data from the Copernicus programme, which can bring benefits of about €30 billion and over 50,000 new jobs by 2030. The free and open access to data from the Sentinel satellites (developed for the Copernicus programme) enhances the development of businesses related to the exploitation of Earth observation data. Finally, a third case study describes electric propulsion as a promising sector of space technology and services. In the near future electric propulsion will provide satellites with better autonomy and improve their security of operation, therefore providing better value, extending operability and further reducing costs.

Servitisation describes the move from product-based business models to the development of product-related services. This change is accompanied by market transformation from product centricity towards customer centricity. What does it mean in practise? The sale of maintenance contracts for capital goods or the pay-per-use revenue model are examples of servitisation, and are further explained in case studies.

Three disruptive innovations highlighted

Looking at the potential to disrupt and transform markets, sectors, value chains, and innovation systems we decided to highlight three innovations which address major societal and business challenges.

Optimal recycling, as a part of the circular economy, can have a multi-faceted positive impact on both the economy as such and the environment. Its impact on the EU economy is estimated for: net savings of up to EUR 600 billion, 2 million new jobs, as well as reduction of greenhouse emissions. Stricter regulation is a main driver for optimal recycling, while exporting of waste is a key obstacle.



Big data in Earth observation describes technological breakthroughs in Earth observation which gave rise to a constant flow of large volumes of diverse types of data. Different stages of the Earth observation data value chain offer completely new business opportunities: data acquisition, data analysis, data curation, data storage or data usage. Moreover, Earth observation information not only fosters the economic development but also helps to create policies and to make decisions on a broad range of societal and business challenges.

Blockchain very recently became a topic creating a lot of media buzz. Blockchain applications use innovative open source IT architecture that allows financial transactions to be carried out automatically and maintain an authoritative record of all the changes made. It was originally developed for peer-to-peer digital payment systems such as Bitcoin, which allows for the implementation of decentralised and verifiable exchanges, without the verification provided by a trusted third party, e.g. a bank.

Three policy challenges explained

- Need to create public accelerator programs, which boost supply and demand for optimal recycling in a co-evolving, systemic way
- Shaping long-term vision of space Big Data policy
- Developing regulation and standards to support blockchain application

1. Three trends in business innovation

1.1. Sustainable supply of raw materials

This trend consists in the development of new intelligent means to mine and process raw materials. They aim to provide a sustainable supply of raw material that would both reduce the dependency of EU companies on foreign providers and would allow the efficient exploitation of the resources still available in the European mines.

The case studies envisaged in the context of this trend are:

- Innovative mineral and metallurgical extraction and processing (Case study 59)
- Optimal recycling and (Case study 60)
- Smart wood harvesting (Case study 61)

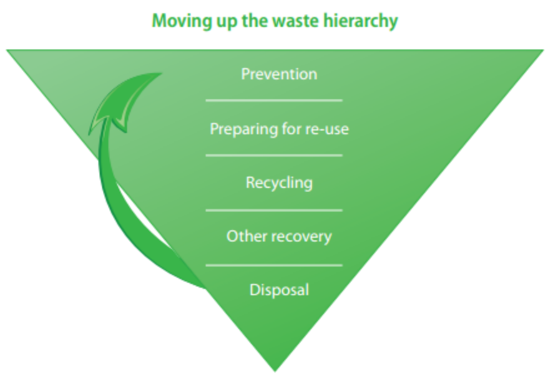
Table 1: Examples of sustainable supply of raw materials

Company	Business innovation and success signals
AGQ Mining & Bioenergy S.L. (ES)	AGQ is an analytic laboratory and technological centre offering solutions to decrease the environmental impact of mining effluents. AGQ has received Horizon 2020 support and has received ISO certification for mining laboratory analyses.
AkkuSer Oy (FI)	Recycles batteries through a method called Dry Technology that does not need heating nor generate any waste water or other pollution. It has the European Responsible Care Award 2011. It also cooperates with large recycling organisations in the Nordic countries. Its main markets are Finland, Sweden and Germany, but they also process waste in New Zealand, Austria, Lithuania and Estonia.
Arbonaut (FI)	Arbonaut, is a world leader in developing information gathering and GIS solutions for forest inventory and natural resource management. The company provides its proprietary ArboLiDAR forest inventory technology which produces estimates such as timber volume and height to serve for forest operational planning and decision-making in boreal zone, as well as in tropical and subtropical plantation environments. It has Involved in several large public projects including UN-REDD projects. Recipient of multiple research grants.

Innovations in mining involves both improvements in the extraction of minerals, notably through greater automation of work, and post-extraction processing, through the use of new technologies, including nanotechnologies, that allows for more efficient use of energy and the reduction of waste.

Concerning **recycling**, the aim is to improve the energy efficiency of industrial production processes; to reduce production costs and carbon emissions. An important innovation in this context would be the development of innovative technological solutions that will improve the recovery of raw materials from novel sources such as the recycling of metals from complex end-of-life products.

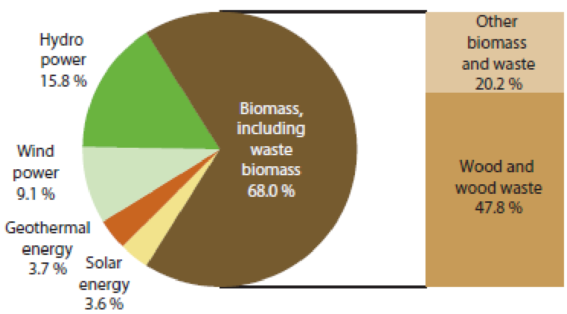
Figure 1: Waste hierarchy



Source: European Commission[1]

The forest sector in Europe can also be a source of energy innovation. It is already an important provider of many different products such as paper furniture, etc. Forestry is also becoming Europe's biggest producer and user of bio-based energy. To achieve this aim, innovations are being pursued in **wood harvesting** processes.

Figure 2: Share of renewable energy consumption in 2011 across the EU-28



Source: Eurostat

Table 2: Main drivers and obstacles for the innovation trend of sustainable supply of raw materials

Drivers	
Innovative mineral and metallurgical extraction and processing	• Easy-to-access raw materials in Europe are depleted • Energy and labour costs are high in Europe • Environmental regulations • Raw materials are vital for modern-day technologies • Dedicated EU initiatives
Optimal recycling	• Regulated waste collection • Sustainability has become a business imperative • Stricter waste regulation • Resource price and scarcity
Smart wood harvesting	• Environmental and forest policy • Carbon pricing and other financial instruments • Innovations and new wood products
Obstacles	
Innovative mineral and metallurgical extraction and processing	• Conservatism, industry's hesitations in adopting innovative solutions • Lack of proper communication and trust between relevant stakeholders • Lack of knowledge about mineral endowment and the sector
Optimal recycling	• Export of waste • Multiple definitions and unclear regulations concerning waste: what is it, who owns it, etc.
Smart wood harvesting	• Declining demand from construction, and paper & pulp markets • Non-alignment of wood standards across EU Member States

1.2. Space technology and services

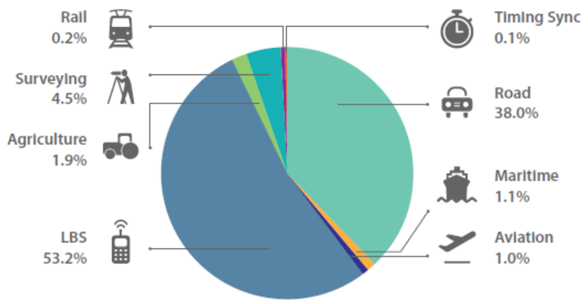
This trend encompasses the technologies, innovations and services that can be transferred from the public funded space programmes to other market sectors not directly related to space domains. The main aim of the European space policy is to use space-related technology to tackle some of the most pressing challenges of today, such as fighting climate change, helping to stimulate technological innovation, and providing socio-economic benefits to citizens. Another key objective of the European space policy is to encourage the take up of new technologies, such as satellite propulsion, and to attract greater investment from the private sector.

This trend includes cases studies related to:

- Application related to navigation (Case study 62)
- Applications related to Earth observation (Case study 63)
- Big Data in Earth observation (Case study 64)
- Electric propulsion (Case study 65).

Galileo is a European initiative (European Global Navigation Satellite System – GNSS), operational since 2011, that consists in a global civil operated satellite-based navigation system. Its applications may include both public and private domains, such as transport and logistics, communication, land surveying, agriculture, fisheries, environment protection, tourism and leisure, etc. (Figure 3). It is also a very efficient instrument for meteorology. Thanks to its encrypted navigation service (public regulated service), Galileo is considered a safer application compared to other systems (e.g. GPS). For the time being, the use of the public regulated service is limited to European public safety and emergency services as well as law enforcement, internal security and customs authorities.

Figure 3: GNSS market - Cumulative core revenue 2013-2023



LBS – location-based services. Source: GNSS Market Report[2]

Copernicus is the European Earth Observation Programme. It consists of a network of satellites and receiving stations. Its main aim is to provide sustainable, precise and reliable information about the environment and citizen's security and to create business opportunities for European companies. Copernicus users have free, full and open access to environmental data from the Copernicus programme, including data from Sentinel satellites (Figure 4). The free and open access to Sentinel data enhances the development of business related to the exploitation of this data. Indeed, it is estimated that Copernicus could generate a financial benefit of about €30 billion and over 50,000 new jobs by 2030.[3]

There is an increasing offer of high quality Earth observation data, both in terms of variety of sources and the higher resolution. Therefore the market potential for the **development of applications related to Earth observation** data is high. The activities related to the sale of data for use by providers of value-added services in different areas include: raw image acquisitions, the processing and archiving of enormous quantities of data, as well as the dissemination and delivery of the processed data.

Figure 4: Earth observation satellite Sentinel-2

Source: ESA/P. Carril[4]

Electric propulsion is a promising innovation in the sector of space technology and services. It will provide satellites with better autonomy and improve their security of operation therefore providing better value, extending operability and contributing to further reducing costs. Europe is still lagging behind in this promising new technology. The deployment of this technology requires significant investments that are still largely publicly funded. There is therefore a need to further support demonstration of electric propulsion solutions through In-Orbit Demonstration & Validation (IOD/IOV) projects. At the same time there is a need to stimulate investments from the private sector.

Table 3: Examples for space tech and services

Company	Business innovation and success signals
GIM (BE)	GIM analyses and selects the most valuable Earth observation data, information and images for its customers. It received FP7support and has worked with international donors (WB, WHO, Gates fund).
Globesar (NO)	The Company turns abstract satellite measurements into valuable and useful geospatial information. It has received support from the Norwegian government and has already achieved an international presence.
Qascom (IT)	A software and systems technology provider of applications in the satellite navigation and communications domain. It has very specific and rare skills and holds several patents.
Mars Space (UK)	A fast growing innovation-focused SME providing services and consultancy on space propulsion and plasma engineering and science. MS foresees to triple its turnover in the next 5 years

Table 4: Main drivers and obstacles for space tech and services

Drivers	
Applications related to navigation	• Sustainable partnerships with other companies or institutes
Applications related to Earth Observation	• Harmonised regulations related to Earth observation help drive the market • Public support fosters innovations in the Earth observation sector
Big Data in Earth Observation	• Earth observation Big Data is becoming recognised as an important way to tackle current challenges • Business opportunities will arise to capitalise on ever-increasing amounts of Earth observation data
Electric propulsion	• The involvement of SMEs is essential in higher risk activities • The electric propulsion market is driven by commercial market needs
Obstacles	
Applications related to navigation	• Strongly regulated market • SMEs face technological barriers to enter Galileo public regulated service market • Limited visibility on the needs of users inhibits any assessment of the Galileo public regulated service market
Applications related to Earth Observation	• Regulatory hurdles creates unnecessary administrative burden • The fragmented market generates poor awareness of the innovations
Big Data in Earth Observation	• Evolving priorities cause an unsecure public investment in the Earth observation midstream market • A lack of public support initiatives early along the value chain
Electric propulsion	• Developing a competitive electric propulsion system requires a considerable investment • Innovation is at the heart of competitiveness but is limited by sector conservatism

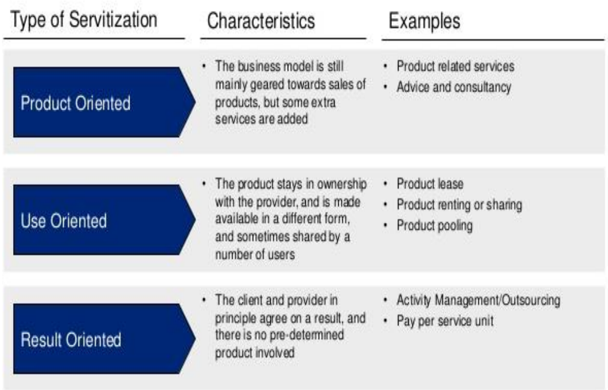
1.3. Servitisation

The trend covers the move from product-based business models to the development of product-related services. This tendency is commonly referred to as “servitisation”, which has led to a market transformation from product centricity towards customer centricity. The sale of maintenance contracts for capital goods or the pay-per-use revenue model are examples of servitisation.

This trend encompasses case studies on:

- **Service and predictive maintenance contracts (Case study 66)**
- **Pay-per-use (Case study 67)**

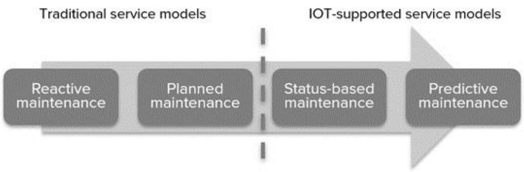
Figure 5: Pay-per-use shifts focus from the product to results



Source: Copenhagen Business School[5]

Innovation in maintenance services are related to the inclusion in the product sales of preventive services such as mandatory servicing at pre-defined intervals. It also involves the use of predictive algorithms and innovative remote diagnostics, via review of data from sensors monitoring machines, in order to pick up any patterns that indicate a possible fault.

Figure 6: Offering advanced services as part of service contracts in servitisation



Source: Reply[6]

The **pay-per-use model** includes any type of payment structure in which the customer has unlimited access to resources but only pays for what he actually uses. Two examples of such model are utility computing and water recycling.

Table 5: Examples for servitisation

Company	Business innovation and success signal
Rendicity (IE)	The company allows customers to create cloud render farms on demand. It provides end-users of applications requiring intensive computer power with access to high performance computing power via the cloud on a pay-per-use basis and with a user friendly interface. It has over 40 customers worldwide. It has received approximately EUR 200,000 in investments from Enterprise Ireland, the 30/60 Partnership and the DCU Ryan Academy. Rendicity won awards from investors and venture capitalists.
MUD Jeans (NL)	MUD Jeans leases out jeans for a monthly fee, and after 12 months customers are given the option of trading in the existing pair of jeans for a new pair at a slight discount. During the leasing period, jeans are repaired for free. Returned jeans are upcycled or recycled into new pieces of clothing. It has operations in the Netherlands, Germany and Norway, with 2,000 leasing customers and 10,000 visitors to its website without any external marketing. It partners with 30 retail stores who are selling MUD Jeans, and has suppliers in Tunisia, Italy, Turkey and Egypt.
Aircrete Europe (NL)	It operates in the industrial construction sector offering their clients complete solutions for design, manufacture and operations of lightweight environmentally friendly concrete. Heavy focus is placed on remote control and preventive maintenance services for fixed periods based on technology developed in-house. The company has 40 years of experience and operates world-wide; the total turnover has doubled the last 5 years; and services provide 25 % of its yearly revenues.

Table 6: Main drivers and obstacles for servitisation

	Drivers
Service and predictive maintenance contracts	• Changing customer preferences and the need to better understand the customer are driving the demand for service contracts • Internet of Things and Industry 4.0 enables advanced maintenance services
Pay-per-use	• Concerns relating to cost and business competitiveness are facilitating the shift to servitisation • Technologies such as cloud computing, the Internet of Things and Big Data analytics • Environmental concerns
	Obstacles
Service and predictive maintenance contracts	• Product-as-a-service is viewed as a premium rather than a necessity • Service contracts that span geographies rely on local partnerships and workforce abilities • Lack of knowledge on how to shift towards servitisation
Pay-per-use	• Cracking the mind-set, institutionalised ways of working and thinking are difficult to change • Procurement, tax and accounting favour traditional business models • Shifting of risks and large upfront capital expenditure may limit SME growth

2. Three disruptive innovations

A selection of three disruptive innovations is discussed in this paragraph:

- Optimal recycling
- Big data in Earth observation
- Blockchain applications

They were selected because they are likely to disrupt and transform markets, sectors, value chains, and innovation systems. They also relate to major societal and business challenges, e.g. scarcity of raw materials, pollution, dealing with data volume, and transforming the financial sector. Concrete existing examples in terms of the new products/services, companies, sectors, and business opportunities are discussed, as well as the transformative socio-economic impacts and related policy challenges.

2.1. Optimal recycling

Given the increasing scarcity of raw materials in today's world, the need for more effective recycling is becoming imperative and in order to achieve this, it is necessary to change the ways in which we produce, consume and create waste. This disruption of traditional ways and habits, is what Schumpeter referred to as 'creative destruction', because with the new, and better ways, also new markets, industries and jobs are created (Table 7).

The application of optimal recycling technologies can have a multi-faceted positive impact on the economy and environment, including a reduction in energy consumption and greenhouse emissions. Sustainability is becoming a business imperative with pressure from consumers and investors for companies to adopt more corporate socially responsible practices. In turn, price and resource scarcity concerns will continue to drive demand for high quality recycled materials, as well as stricter regulation which impose costs on disposal and subsidies which provide incentives for recycling efforts.

One of the main challenges that optimal recycling technologies need to address is the generation of high quality recycled material so that the demand for it will rise, leading to an increase in potential profitability. Furthermore, a key challenge lies with making recycling more accessible to individuals, so that it seamlessly becomes part of their everyday lives. Another obstacle is the separation of certain waste types in order to move on to the recycling of the raw material.

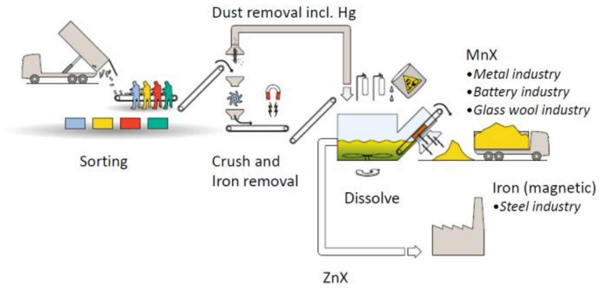
Table 7: The disruption of optimal recycling

Disruption	Optimal recycling drastically reduces pollution from landfill, energy consumption and greenhouse gas emissions recovers raw materials, changes the ways of production and consumption, and creates new markets and jobs
Challenges	Increased scarcity of raw materials Prevent negative environmental impact Create demand for recycled material through effective recycle processes Make recycling more accessible to individuals Separating certain waste types
Market opportunity	Moving towards a more circular economy can result in estimated EU business net savings of up to EUR 600 billion and 2 million new jobs
Policy challenges	Promote/set up efficient waste collection and sorting systems Focus of incentives placed on quality and not quantity of recycled materials Development of accelerator programs
Relevant case studies	Optimal Recycling (Case Study 60)

The potential impact on the economy is also very significant, since it is estimated[7] that moving towards a more circular economy can result in net savings for EU business of up to EUR 600 billion, while also creating 2 million new jobs.

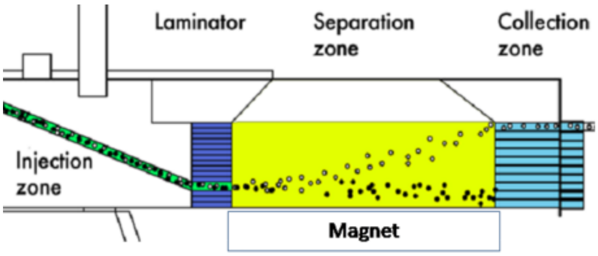
A first example is a solution to recycle alkaline batteries provided by the Finish company AkkuSer. It involves chemical processes that take place at room temperature and this makes the process more environmental friendly and cost effective than current processes. It will produce manganese and zinc, minerals for which the global demand is high as they can be used as natural fertilisers (Figure 7).

Figure 7: Recycling of batteries by AkkuSer



Source: AkkuSer

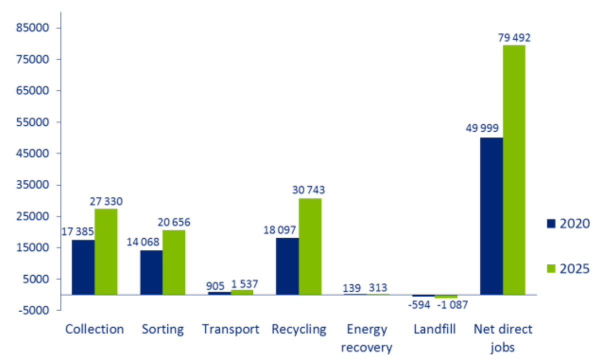
Figure 8: Separation of plastic materials



Source: Urban Mining Corp

A second example is a solution developed by Urban Mining Corp. The technique involves separating different shredded plastic materials in a diluted mixture of water and ferrous oxide and takes place in a magnetic field where the placement of the magnet determinates the density of the water in the tank. The denser the particle, the deeper it will sink. (Figure 8). The main advantages is the ability to directly sort up to five different kinds of materials without using chemicals while not compromising on accuracy. In addition, the process is cheaper and more efficient than other processes used today, as well as scalable to meet the increased demand for high quality recycled plastic.

Figure 9: Number of direct jobs created along the plastic recycling value chain in Targets 2020 and Targets 2025 compared to respective BAU (Business As Usual)



Source: Plastic recyclers[8]

There currently exists a lack of capacity for recycling of plastic material and a lot of plastic waste is thereby exported outside of Europe.[9] Adopting optimal recycling solutions which are closer to the consumer can therefore positively impact employment in recycling and waste management industries, as well as decrease Europe's dependency on imported raw material from other parts of the world.[10] Europe is the second largest producer of plastics materials globally[11], and with refining capacities decreasing in Europe the demand for high quality plastic materials will continue to rise. Optimal recycling solutions which produce high quality recycled plastic that is on par with virgin plastic will therefore be essential.[12] The recycling of waste in Europe instead of outsourcing this outside of the continent would help create employment, as shown in Figure 9 .[13]

2.2. Big data in Earth observation

Technological breakthroughs in Earth observation have given rise to a constant flow of large volumes of diverse types of data. A new landscape emerges from the disruption (Table 8) in different stages of the Earth observation data value chain: data acquisition, data analysis, data curation, data storage and data usage. Earth observation information gathered from spacecraft provides substantial benefits supporting economic development and helps supports informed policy and decision making on a broad range of societal and business challenges.

Table 8: The disruption of big data in Earth observation

Disruption	New technologies have generated massive potential for new ways of acquiring, analysing , curating, storing and using the huge volumes of affordably available data in Earth observation
Challenges	Dealing with the exponential growth in data volume and diversity Provision of cloud-based Earth observation data
Market opportunity	Global Earth observation midstream turnover projected to reach EUR 3.4 billion by 2022 Wide range of sectors increasingly turning to Earth observation big data, creating need for companies with new, efficient and secure products and innovative business models Untapped opportunities for data brokering actors
Policy challenges	Harmonise regulations of Earth observation data access Provide online tools to enhance data accessibility Establish long-term strategy for the Copernicus programme
Relevant case studies	Big Data in Earth observation (Case 64) Applications related to Earth observation (Case 67)

Remaining technological and business challenges for companies in the field lies with effectively bridging the gap between acquiring raw, diverse and constantly flowing data and providing value-added insight. Such tasks are rendered increasingly demanding by the fact that the volume of Earth observation data is growing exponentially, due to the rapid advances in related technologies such as satellites, sensors and software.

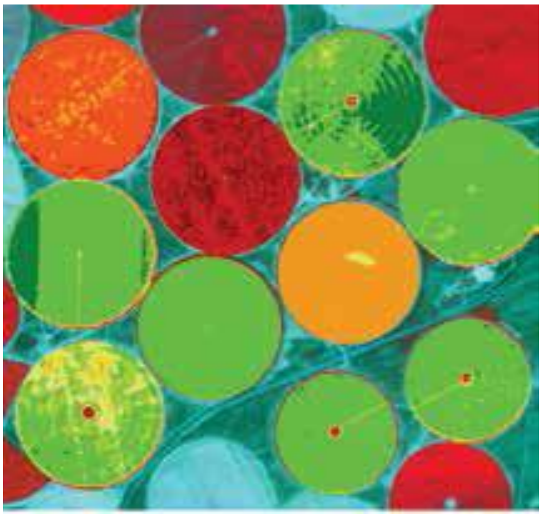
GIM is a company that provides such services, by gathering data from different sources and analysing it in order to provide tailored information and high resolution images to its customers (Figure 10).

Figure 10: Satellite image pre-processed by GIM

Source: GIM[14]

Blackbridge is another example. This company is specialised in providing high-quality information in a cloud environment for field management on large agricultural areas. Blackbridge developed monitoring programmes for agriculture based on a cost-effective satellite imaging solution (Figure 11). This innovation has a tremendous collection capacity, since it can capture more than 5 million square km per day. The data collected is set up in a cloud environment and available within 24 hours to all subscribers.

Figure 11: A capture of fields near Washington in the US using the Normalized Difference Vegetation Index (NDVI)



Source: Blackbridge[15]

The European Union's Copernicus programme is a major player within this context, since it is the 3rd largest data provider in the world. The EU will commit over EUR 12 billion[16] to Earth observation from 2014 to 2020, of which more than EUR 4 billion specifically to Copernicus.

The increased availability of Earth observation data has led to higher demand from a wide range of sectors such as defence, agriculture, oil and gas and health. The global Earth observation midstream turnover is projected to reach EUR 3.4 billion by 2022[17]. Data brokering, i.e. the collection and selling of personal information, presents an untapped opportunity in the European market.

In case study 67 on applications related to Earth observation there are various studies mentioned which also report on several other kinds of social and economic impact. For instance, a study performed in 2009 shows that the economic benefits due to improved weather forecasts in the UK correspond to EUR 2.5 to 4.5 billion. Earth observation applications help manage humanitarian crises caused by natural disasters. In Europe, floods cause approximately EUR 4.7 billion's worth of damages.[18] Satellite data increases efficiency in terms of preparedness, emergency response and recovery. Between April 2007 and January 2011, oil CleanSeaNet has detected approximately 2 spills per day in Europe.[19] Road networks can be more efficiently and effectively managed by drawing up on quantitative and qualitative real time information, helping reduce congestion which costs the EU economy more than 1 per cent of its GDP. Earth observation satellite data contribute to a safer and more efficient maritime transport via a cost reduction in vessel operation – daily costs can be reduced up to EUR 2,000 per ship.[20]

European policy needs to evolve in order to stay in step with the developments in this particular industry. A first major step that is required is to harmonise regulations for the access to Earth observation data, in order to tackle the current differentiation among EU Member States. Furthermore, given the aforementioned huge volumes of data gathered from different sources, online tools are needed to provide easy, reliable and continued access. Finally, if sustainable applications based on data provided by Copernicus are to be developed, the EU needs to guarantee a certain level of consistency regarding the programme which goes beyond the usual seven-year period.

2.3. Blockchain applications and services

Blockchain technology is disrupting established business practices in industries where transactions play a central role, such as banking and insurance (Table 9). It also holds the potential to provide the most efficient model of operation for Internet of Things communications and transactions.

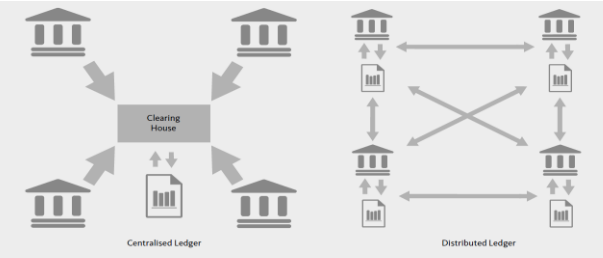
Table 9: The disruption of blockchain applications and services

Disruption	Blockchain technology provides a safer, faster and more cost-effective way to implement transactions
Challenges	Optimise cost and time efficiency in the financial sector Enhance the operability of Internet of Things networks Facilitate blockchain-based transactions by a large portion of the population

Disruption	Blockchain technology provides a safer, faster and more cost-effective way to implement transactions
Market opportunity	Reduction of banks' infrastructure costs by EUR 13.8-18.4 per annum by 2022 Fintech related business estimated contribution of more than 28.2 billion to the UK economy in 2014 Potentially integral part of Internet of Things networks Opportunities in industries such as finance, insurance, engineering, manufacturing Can redefine role of cloud based computing
Policy challenges	Stable and clear regulatory framework Provision of support for creation of standards Fostering awareness
Relevant case studies	Blockchain Applications and Services (Case 68)

Blockchain applications use distributional computational principles in an attempt to guarantee the integrity, uniqueness and validity of the exchanged object, overcoming the need for verification processes provided by a trusted third party (Figure 12). This allows for the implementation of decentralised and verifiable exchanges.

Figure 12: The change in the model of clearing and settlements through distributed ledgers



Source: Santander (2015)[21]

So far, the most extensive application of blockchain technology has taken place in areas related to virtual currency and finance. The former cases are often connected to the widely-publicized bitcoin, generating challenges that have to do with facilitating its use by a larger portion of the population. Companies like Blockchain.info aim at contributing towards this direction by providing open source digital wallets, as well as platforms for the development of applications for bitcoin transactions.

Eris Industries is an example of a platform for building, testing and operating distributed applications with blockchain backend (smart contracts). Historically, the founding project started as a way to experiment in the design and implementation of smart contracts, which then turned into a scalable business. Smart contracts are currently generic and applied across several vertical industries with the objective of automating business processes and applications by cutting across the duties of general stakeholders. Eris has experienced demand from clients located mainly in the US and the EU. In the near future the company will include an expansion in Asia and other global markets for business automated processes.

This is an ongoing process facilitated by the fast diffusion of applications in the financial sector, by the recent spur of fintech start-ups, and by the interest financial institutions have in these applications and start-ups. Accessing the market of smart contracts for the financial sector represents a challenge from the perspective of organisational change. In terms of internationalisation and networking events for market access, the industry size is still relatively small, which leads to the advantage of not requiring a strong marketing effort to continue on the scaling strategy. At the moment, only global financial institutions have expressed an interest in the technology, although Eris Industries' objective is to reach the market of regional ones.

In the financial sector, blockchain technology has, in recent years, presented indications of highly disruptive potential regarding the optimisation of cost and time efficiency. It has been estimated[22], for instance, that distributed ledgers supporting smart contracts can reduce bank infrastructure costs by between EUR 13.8 to 18.4 billion per annum by 2022. The broader role of fintech is growing, as demonstrated by the fact that in the UK alone, the sector's contribution to the economy for 2014 was estimated[23] at more than EUR 28.2 billion, pointing towards the emergence of new markets for innovative services.

Apart from the aforementioned areas of application, blockchain technology may, in the future, prove disruptive at a much broader scale. This includes providing the basis for a framework for decentralised transactions and communications among Internet of Things devices that will be reliable, transparent and efficient.

The industry related to blockchain technology is currently very young, and while this helps fuel the current hype surrounding it, it also means that there are many significant obstacles that have to be overcome in order to allow for it to grow. From a policy perspective, this translates first of all in a need to establish a clear and stable regulatory framework which will provide the necessary confidence to investors and users alike. Uncertainty must also be tackled via the adoption of common standards, something which has been pursued, for example, by R3[24], a consortium of financial companies focusing on the development of distributed ledger technologies for global financial markets. Finally, fostering awareness for the technology is crucial for broadening its adoption.

3. Policy challenges and recommendations

3.1. Need to create public accelerator programs which boost supply and demand for optimal recycling in a systemic way

Background

The European Union is taking steps towards becoming a circular economy, where the value of products, materials and resources is maintained for as long as possible. One of the main ways to make this happen is through the development and adoption of optimal recycling technologies, leading to a minimization of waste generation and, consequently, enhanced sustainability. In December 2014, the Commission decided to withdraw its legislative proposal on waste, but committed at the same time to use its new horizontal working methods to present a new package by the end of 2015 which would cover the full economic cycle, not just waste reduction targets.

In December 2015 the EC adopted a Circular Economy Package, which includes revised legislative proposals on waste to stimulate Europe's transition towards a circular economy which will boost global competitiveness, foster sustainable economic growth and generate new jobs. The Circular Economy Package consists of an EU Action Plan for the Circular Economy[25] that establishes a concrete and ambitious programme of action, with measures covering the whole cycle: from production and consumption to waste management and the market for secondary raw materials.

The proposed actions: "will contribute to "closing the loop" of product lifecycles through greater recycling and re-use, and bring benefits for both the environment and the economy. The adopted actions include:

- Funding of over €650 million under Horizon 2020 and €5.5 billion under the Structural Funds;
- Development of quality standards for secondary raw materials to increase the confidence of operators in the single market;
- Measures in the Ecodesign Working Plan 2015-2017 to promote reparability, durability and recyclability of products, in addition to energy efficiency;
- Revised regulation on fertilisers, to facilitate the recognition of organic and waste-based fertilisers;
- Strategy on plastics in the circular economy
- Series of actions on water reuse.

The revised legislative proposals on waste set clear targets for reduction of waste and establish an ambitious and credible long-term path for waste management and recycling. Key elements of the revised waste proposal include:

- A common EU target for recycling 65% of municipal waste by 2030;
- A common EU target for recycling 75% of packaging waste by 2030;
- A binding landfill target to reduce landfill to maximum of 10% of all waste by 2030;
- A ban on landfilling of separately collected waste;
- Promotion of economic instruments to discourage landfilling;
- Simplified and improved definitions and harmonised calculation methods for recycling rates throughout the EU;
- Concrete measures to promote re-use and stimulate industrial symbiosis - turning one industry's by-product into another industry's raw material;
- Economic incentives for producers to put greener products on the market and support recovery and recycling schemes (e.g. for packaging, batteries, electric and electronic equipment, vehicles).

The supply of technologies can affect all the stages of the circular economy, from product design and production to consumption, re-use and recycling (Figure 13).

Figure 13: Circular Economy

Source: European Commission[26]

Within the context of the circular economy and optimal recycling the European Union is promoting the concept of waste hierarchy, an integrated approach to waste management which assigns first priority to waste prevention, hence paving the way for the development of technologies with an upstream targeting.

One of the main challenges is the generation of high quality recycled material to increase the demand and profitability. In this respect stricter regulations have been a key driver of recycling markets. E-waste market is a good example: stricter regulation, increasing landfill prices and awareness of the environmental impacts, have increased the demand for recycling of e-waste.

However, regulations sometimes promote current methods which involve down cycling, instead of innovative solutions that better optimise recycling. For instance, the regulation regarding plastic recycling in the Netherlands where the recycling companies is reimbursed per kilo plastic recycled, regardless recycling method. Different polymers and colours are mixed in the process, resulting in a grey plastic of lower quality than virgin plastic and with limited areas of use. The recycled plastic is of such low quality that the companies are selling it for less than the cost of the process. It would actually be more profitable to use it as energy recovery, but the subsidies are large enough to make it worth recycling.

Furthermore, a key challenge lies with making recycling more accessible to individuals, so that it seamlessly becomes part of their everyday lives.

A crucial aspect of optimal waste management has to do with organizing efficient waste collection and sorting systems. Policy and regulations have a central role to play in this respect, regardless of whether or not the related initiatives are strictly public in nature. Policymakers should also focus on providing incentives that are not restricted to promoting recycling in general but also aim at achieving a higher quality of recycled products. This requires more sophisticated data collection.

According to the 'Closing the loop' action plan the transition to a circular economy is a systemic change in which innovation will play a key part. "In order to rethink our ways of producing and consuming, and to transform waste into high value-added products, we will need new technologies, processes, services and business models which will shape the future of our economy and society". To this end:

- Horizon 2020 Work Programme for 2016-2017 includes a major initiative on 'Industry 2020 in the circular economy', with funding of over € 650 million;
- Commission will launch a pilot approach for "innovation deals" to identify and address potential regulatory obstacles for innovators;
- Commission will step-up its action to mobilise stakeholders on the circular economy and in particular for the implementation of this action plan. It will also carry out targeted outreach to help the development of circular economy projects for various sources of EU funding, in particular Cohesion Funds.

Conclusions and policy recommendations

Due to the nature of the industry, many recycling companies need to collaborate with local governments, since they require access to waste in order to develop their products and eventually achieve scale. Moreover, innovators need to demonstrate proof of concept in order to convince markets of the benefits of the new approaches.

A good way to drive such a process could be to create accelerator programs that link up innovative SMEs and local government, and including both the innovation supply-side as well as innovation demand-side of circular economy innovations.

A systemic approach involves communicating the diverse foreseen impacts that transformative innovative solutions can have on the economy, environment, and society at large. Side-effects of innovative practices on other stakeholders must be discussed and addressed. Bringing end-users closer to the design and production phases in demonstration projects, and customising the production and delivery of goods and associated services can accelerate new recycling approaches.

In the process of inventing new recycling processes, companies are often reliant on funding from private investors or public support initiatives. Policy to support the supply of new technologies often come from different policy sources (e.g. the Horizon 2020 Work Programme) than public support for the up-take (e.g. the EU Structural or Cohesion Funds). For most recycling companies, finding the necessary funding to build and run their factories or machines is one important obstacle. Another is getting access to enough waste to demonstrate their proof of concept at an industrial scale. Encouraging close collaborations with local governments and access to their waste could be one way to support the innovative recycling companies as they scale up their processes. This is not only helping the recycling company to scale up but also give the public sector an insight in relevant recycling opportunities. One way to achieve this goal is to create an accelerator program offering innovative SMEs the opportunity to scale up their recycling process in close collaboration with the local waste organisation.

Indeed, as mentioned in the 'Closing the loop' action plan, various sources of funding and various stakeholders in innovative recycling have to be mobilised and involved. Pilot 'innovation deals' which are agreements with stakeholders and public authorities which address regulatory obstacles for innovators could serve such demonstrator and accelerator programmes.

The program should be implemented at a national level, given the differences in waste management practices between EU member states; however, such a program should be promoted at an EU level to also provide the opportunity for the sharing of best practices.

3.2. Shaping long-term vision for space Big Data policy

Background

The IT developments in compression of information and data storage, bigger precision and resolution of data from satellites' surveillance sensors and bigger number of platforms orbiting the Earth contributed to generating a vast amount of information. Originally relegated to military use, mostly for surveillance and meteorological purposes, the functions of Earth observation techniques has expanded to many other sectors such as agriculture, geology, hydrology, transport, environment protection, etc. Technological breakthroughs in hardware and software developments, multi-temporal data analysis and data management are key accelerators of space technologies and applications in the field of Big Data.

"Europe need to foster a Copernicus dissemination infrastructure spurred by a vibrant European downstream sector taking advantage of the timely availability of the Copernicus data and information to provide innovative Earth Observation information products on a worldwide basis based on European Internet platforms using advanced big data technologies and serving a worldwide market" (Horizon 2020 work programme)

Increasingly the information becomes available to the general public due to the following factors: it is not considered militarily sensitive, it is in many cases publicly financed, its costs has decreased significantly, and at the same time private organizations, SMEs or even private citizens have gained access to the computing power and data storage capacity to handle the Earth observation data. This trend has also been encouraged by the decision of organisations such as the EU through its Copernicus programme to make the data generated by the programme free, unlimited and universally available to the general public.

Since 2005, the Group of Earth Observation (GEO) has been set up voluntarily by various governments and organisations to encourage, coordinate and support Earth observation initiatives.[27] The GEO Strategic Plan 2016-2025, constitutes the main policy basis for developing different initiatives in the GEO members.[28]

Enabling the exploitation of space data is one of the main objectives of the Space component of the EU Horizon 2020 programme.[29] Through this component the EU has allocated significant resources to Earth observation capacity and the exploitation of the Earth observation data. Notably the Earth Observation call 2015 has been specifically focused on "bringing Earth observation applications to the market".[30] Additional call have been launched to stimulate wider research use of Copernicus Sentinel Data, in order to facilitate i.e. the uptake of Earth observation data, and to prepare data processing chains, develop specific software tools, research into efficient information retrieval from satellite data repositories and dissemination; advanced visualisation techniques, etc.[31]

The Horizon 2020 Work Programme for 2016-17 has provided further emphasis on fostering Earth observation downstream applications and services. The expected results are the establishment of sustainable supply chains for innovative Earth observation value added products and services.[32] Another call has already been launched concerning Earth observation big data shift to address the Big Data exploitation challenges and to address the full data cycle needs (e.g. standardised data query, retrieval, data exchange methods, processing).[33]

Conclusions and policy recommendations

Numerous initiatives have been undertaken at the European level in the context of Copernicus and through Horizon 2020 for the downstream adoption of new services and products related to Earth observation data. The existing and planned measures should be further integrated into a comprehensive approach for uptake of space big data.

The market still expects that the public sector will provide the necessary tools for Earth observation data companies to efficiently manage the flow and diversity of the information collected and ensure equal access to data. In this context one possible approach would be to link the space big data to the measures envisaged for the EU strategy for a data-driven economy adopted in 2014[34] which should be extended to the requirements of the Earth observation sector, notably as regards ensuring the availability of good quality, reliable and interoperable datasets and enabling infrastructure, as well as the adoption of open standards to support the development of a striving Earth observation big data sector in Europe.

The regulations governing access to data differ from one EU Member State to the other. In this context, a Directive on the dissemination of Earth observation satellite data for commercial purposes was proposed in 2014.[35] Its main purpose is to establish a more reliable access to high-resolution satellite data while safeguarding security interests. This Directive should be adopted and enforced as quickly as possible for the benefit of all players of the midstream sector.

In order to deal with the flow and diversity of data collected via Earth observation satellites, the EU should facilitate access to data through dedicated online tools, such as a single access point via the creation of an online data portal. The deployment of a cloud solution could also be envisaged in order to secure access to data accompanied by workshops and seminars to showcase how to access and use the available data.

3.3. Developing regulation and standards to support blockchain applications

Background

Blockchain technology is disrupting established business models in the banking and insurance industries. The old-fashioned characteristic of those sectors can be illustrated by the time it currently takes to move funds between different institutions and geographic zones even though these are only records apart within databases.

Even though companies, customers, and governments slowly start to understand the potential benefits of this technology, its future is still not defined. Its development requires industry consolidation and community collaboration, which should lead to the establishment of standards and appropriate regulatory framework.

Moreover, development and commercialisation of blockchain applications poses difficulties for both developers and customers. On the demand side, business models associated to the transfer of benefits coming from goods and services have historically been the stronghold of the traditional banking institutions in the financial sector. Therefore, lobbying pressures from established organisations may put the uptake process at risk, even though some institutions have recently started to gain interest and experiment with the technology. On the supply side, blockchain start-ups face uncertain regulation that limits their scope of action and imply a risk for their growth.

The 2015 “green paper” from the European Commission ‘Building a Capital Markets Union’ launched a public consultation on how Europe could leverage its single market to improve financial services, increase consumer choice, as well as access to capital for European businesses. New technology is acknowledged as “an important driver of integration of capital markets”, but it remains vague on how this transformation will affect the sector. In this context, a report by Filippov[36] (2015), prepared by the European Digital Forum as part of the Capital Markets Union consultation, looks at the way digital technology can give consumers and businesses greater access to capital and make Europe a bigger, more efficient and better regulated capital market. This calls for discussion on the prospects of blockchain technology in financial services and its contribution to the Capital Markets Union.

Conclusions and policy recommendations

Following the interest of large corporations and media, decision makers have also recently increased their awareness of the industry. As an example, Luxembourg’s agency responsible for the regulation of the financial sector (Commission de Surveillance du Secteur Financier) took the decision to adapt the regulatory framework to the advances and applications of this technology. Governments start to understand the potential of the technology, and change the regulatory views on blockchain-based products and services, especially within the financial sector.

“Compared to other jurisdictions which have regulated first and asked questions later, most EU member states have taken a more thoughtful and considered approach to policy for the industry”. – Blockchain.info

However, legal frameworks in most Member States are still difficult to apply to blockchain companies. Therefore, instead of modifying the existing regulation, public authorities should develop new adjusted frameworks taking into account the characteristics of the technology. Such regulatory frameworks need careful observation and lessons learnt during the early diffusion process of the technology. Few EU Member States (such as Luxembourg and the UK) have started moving forward towards this type of regulation.

The development of tailored regulatory frameworks will facilitate close collaboration between industry and consumer’s representatives, and regulatory agencies with the objective of building coherent regimes for the application of blockchain technology. Collaboration between these principal actors needs to address the key areas such as security and safety in goods and services provided, competition, consumer protection, privacy and data-protection.

Development of standards is also important for the future of blockchains.

In an effort to collaborate and define the future of blockchain technology, 22 banks have recently joined efforts to participate in the blockchain-initiative consortium. R3 CEV aims at designing common standards to apply distributed ledger technologies to global financial markets.

The short term future of the blockchain industry will require some degree of consolidation, some companies will fail and some will succeed in securing revenues. But most importantly, standards regarding the management of the blockchain public ledger will be developed. The development of the World Wide Web followed a similar trajectory, with closed networks that eventually interacted with each other.

In essence, the future of blockchain technology, especially the blockchain public ledger will require the development of a common language with specific rules for interaction, which will be achieved through standardisation processes.

Standards may appear as the diffusion and uptake process speeds up. Today many organisations understand the cost efficiency problem blockchain applications address, and are willing to invest in the development of solutions. However, there are also currently too many blockchain projects for problems that do not necessarily need the application of blockchain technologies.

Policy makers can provide help and support for the development of standards by not only encouraging the coordination among key actors, but also recognition of initiatives that work towards the adoption of common standards within the industry. That can take the form of public demonstration events or the sponsorship of hackathons that facilitate collaboration.

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