UFO
Innovation boosted by
Small Flying Objects

UFO: ADDENDUM

BREIFING PAPERS

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BRIEFING PAPER

Application Domain - Blue Growth

The UFO project aims at supporting European SMEs to develop innovative products and services by integrating new technological solutions and know-how provided by Small Flying Objects (SFOs) (drones, high altitude platforms systems, small satellites) and related technologies such as data analytics. These innovative products and services are targeting real challenges faced by high-growth sectors. Solution providers will be able to engage with solution users, providing accessible market opportunities to drive their growth. This briefing paper outlines the challenges and potential solutions within the Blue Growth sector.

Sector profile

Blue Growth describes the sectors of the marine and maritime industries that are growing rapidly or are poised for future growth. Offshore and marine renewable energy is one key sector, where a rapid pace of investment is needed to meet Europe's carbon reduction goals. Similarly, a high rate of growth in seafood production through aquaculture is needed to meet growing global demand in a sustainable way.

Key sector challenges

Airborne surveillance platforms can play a key role in addressing some of the major challenges that our oceans are facing. Three of these challenges are described below:

- **Combatting illegal, unlicensed and unreported (IUU) fishing.** This is a critical problem for many countries that lack conventional fisheries protection infrastructure, leading to decimation of fishery resources. IUU fishing vessels disguise their identities to avoid enforcement action. Capabilities are needed: first to detect a vessel whose behaviour and lack of identifying transmissions suggest illegal fishing activities; and second to acquire visual and other data that can help identify the vessel and its flag state. This is a global and growing challenge as fish stocks are declining due to a high level of illegal fishing:

https://www.pgaction.org/pdf/campaigns/Pew_Overview_Illegal_Fishing_Project.pdf

- **Managing coastal water quality.** The coastal tourism and near-shore aquaculture sectors are both highly dependent on the cleanliness of their seawater. Contaminated water can be introduced from multiple sources, including: run-off from agricultural land; discharge from water treatment facilities after storms; and arrival of toxic algal blooms. Detection, characterisation and forecasting of such contamination risks is critical to effective management of coastal water quality. Economic impacts of poor water quality on tourism revenue are driving increased demand for solutions:

https://www.gov.scot/publications/value-bathing-waters-influence-bathing-water-quality-final-research-report/

- **Metocean monitoring and forecasting.** Accurate and localised knowledge of conditions at sea (especially wind velocity and wave height) are critical to a wide range of marine operations, including: optimisation of offshore wind turbine control to accommodate fluctuating wind speeds and wake effects; mobilisation of support vessels needed to maintain offshore assets (wind farms, aquaculture etc.); optimisation of ship routing to minimise energy consumption and risk of delayed arrival at port. Improved now-casting and forecasting services for metocean characteristics could benefit many such sectors. Demand for ship route optimisation is increasing rapidly as maritime decarbonisation gather pace:

https://www.ship-technology.com/features/ship-optimisation-vessel/

Role of Small Flying Objects

Blue Growth activities generally take place over very large areas of our seas and ocean, often far from the shore. Airborne surveillance therefore has a key role to play, covering large areas at much lower cost than a conventional vessel. In addition to conventional satellite constellations, SFOs can bring new valuable capabilities:

- Drones for surveying of modest sea areas where a high-resolution, targeted surveillance in real-time is needed
- Kites/balloons tethered to a boat or platform to provide continuous surveillance with an extended horizon
- Nanosats carrying RF receivers to enable vessel detection and other functions.

Possible solutions

Some examples of use-cases have been defined to demonstrate the wide range of innovation opportunities that could be available.

- *Use-Case 1 - Use of drones to extend the footprint of a survey or coastguard vessel.*

Manned vessels are expensive assets and it is necessary to maximise their capability. A deck-launched drone, that can also land reliably and safely on the moving deck, could allow this. Stabilised cameras and other sensors on the drone could capture high-value data on suspect boats or other features of interest. Some data could be communicated to the vessel in real-time, while other data could be accessed after the drone returns to the vessel.

A similar function could be performed by a kite tethered to the vessel, carrying a suite of cameras, radar and other sensors, whose altitude would offer surveillance over an extended horizon. The tether can provide power and communicate data.

- *Use-Case 2 - Nowcasting and forecasting of metocean conditions.*

Accurate knowledge of seastate along a vessel's path can allow optimal routing of the vessel to minimize fuel consumption and/or to avoid hazardous sea conditions. This capability would be valuable to ship operators (where fuel cost and carbon emissions are critical) and to companies using support vessel to access assets for maintenance (eg wind farm and aquaculture operators). Satellite GNSS reflectometry techniques can provide data on wave height and wind speed to supplement met service forecasts. Localised data capture (eg from platforms of opportunity) could also be assimilated.

- *Use-Case 3 - Monitoring coastal environmental quality.*

Coastal waters support a wide range of activities, including shellfisheries, water extraction for desalination and leisure. All of these are dependent on the water quality. A drone in conjunction with some in-situ monitoring can collect data (eg water colour/turbidity, current speed) efficiently over large areas of coastline. It can also measure parameters on the land (eg soil saturation and vegetation cover) that affects run-off causing contamination after heavy rain. These data resources can drive AI for forecasting of risk levels of adverse water quality.

Potential benefits

There are many ways in which the proposed use-case capabilities could be actually deployed by customers. These include the following examples:

- A fisheries protection vessel covertly launches a drone to over-fly a suspect fishing boat and collect visual evidence of its identity and fishing gear;
- A search and rescue patrol boat tows a tethered kite with infra-red imaging to detect a missing person without dependence on helicopter support;

- A forecasting services provider uses sea-surface roughness to generate high-accuracy sea-state forecasts to an operator of windfarm support vessels.

Potential end-users

The capabilities offered by systems implementing these use-cases would be valuable to multiple end users, including:

- Public authorities responsible for enforcing fisheries protection and shellfish quality
- Commercial vessel operators seeking cost-effective solutions to their marine operational needs
- Organisations active in search & rescue and environmental management

UFO Innovation Opportunities

The UFO Project is seeking to collaborate with companies interested to help implement these or other use-cases which target a blue growth market need. A range of capabilities will be required, including:

- Sensor manufacturers or developers (for mounting on satellites, drones or kites)
- Platform providers (drones, kites, cubesats)
- Satellite data service providers
- Modelling and data fusion specialists
- Application developers (for end users ranging from citizens to public authorities)

Companies interested to explore these opportunities are invited to respond to this briefing paper by providing answers to the following questions:

1) Which application market(s) are they most interested to enter or expand their presence?
2) What technology(ies) are they intending to exploit?
3) What is the present maturity of this technology(ies)?

Send an email expressing your interest to admin@mseuk.org including your contact details. A member of the team will contact you to discuss how UFO Project can help to realise these opportunities.

BRIEFING PAPER

Application Domain – Digital Creative and Gaming

The UFO project aims at supporting European SMEs to develop innovative products and services by integrating new technological solutions and know-how provided by Small Flying Objects (SFOs) (drones, high altitude platforms systems, small satellites) and related technologies such as data analytics. These innovative products and services are targeting real challenges faced by high-growth sectors. Solution providers will be able to engage with solution users, providing accessible market opportunities to drive their growth. This briefing paper outlines the challenges and potential solutions within Digital Creative and Gaming.

Sector profile

The digital era creates unprecedented opportunities for innovative, widely accepted and easy access applications in almost every aspect of human activity.

Digital Creative and Gaming sectors represent a set of industries which, due to social, cultural and technological advancements, experience a constant demand for further evolution: new cultural products, new touristic experiences and new forms of entertainment to mention a few, together with media, advertising, social interconnectivity, inspiration & creativity. Culture and Heritage is an always evolving with high growth potential sector, along with architecture / urban design, tourism/touristic experience, and Gaming.

Key sector challenges

Drones, HAPs and small satellites in line with KETs/ICT can play a key role in addressing some of the major challenges that these sectors are possessing. Three of these challenges are described below:

- **Culture and Heritage, Architecture and Urban planning.** Culture and Cultural heritage manifest not only as spiritual values that should be protected, but also as unique resources that can, and should be used for sustainable development, under the rules of market economy & law. At the same time Architecture and Exterior design are also part of our culture in a broader sense. Capabilities are needed for: collections in museums and galleries to be made more accessible; effective integration of cultural content and services; increased access to culture and cultural assets; conservation of monuments and artworks; mapping and assessing changes in urban areas.

- **Tourism / Augmented and new Touristic Experiences**. Today, tourists seek more “vivid” experiences. They are interested in unique and interesting experiences and the opportunity to broaden their knowledge and enrich their understanding of the world. Tourists seek to interact with cultural content and local habits in a compelling and personalised way and to enhance their user and visitor experience. Capabilities are needed for: value-added downstream services, immersive user experiences like “being there without being there”, storytelling and virtual interactive visits, local weather and environmental monitoring, smarter urban transport networks, upgraded urban facilities (water supply, waste management) and safer public spaces. Last but not least it is worthwhile to mention the forthcoming stratospheric touristic travels at 25Km above the ground on HAPs offering a stunning view of earth from the stratosphere.

- **Gaming.** The gaming industry has undergone a substantial evolution since the 1970s and has moved from a fringe activity into the mainstream. Nowadays the industry continues to develop demonstrating a huge range of games, applications, technology solutions, services & tools, such as Casual and Hard-core Games, Serious Games, iGaming technologies, Gamification solutions, Content designed for multiple channels (e.g. Console, PC, Mobile/ Tablet, Social, Web, Retail) etc. Capabilities

are needed for: more realistic games; advanced virtual and augmented reality; faster data communication/manipulation.

Role of Small Flying Objects

From the above described challenges, it is obvious that Digital Creative and Gaming applications, encounter large and complicated environments, require tremendous data streams and are being addressed to huge populations. Enhancing current capabilities and developing new solutions integrating the capabilities of SFOs can dramatically boost the user experience in Creative and Gaming industries.

In addition to conventional satellite constellations, SFOs can bring new valuable capabilities:

- Drones: for easy access of inspection and service equipment in large monuments and extended building structures; for remote visit of areas of interest; for extraction of information regarding urban characteristics; for taking part in an art production; for the support of gaming applications.
- HAPs: For high resolution aerial photography and monitoring; as a stable relay platform for satellite downstream for increased data speed; for stratospheric touristic travels.
- Small SATs: for Identification and Monitoring of Ancient Submerged Settlements and Ship Wrecks; for Coastal Archaeology; for monitoring of atmospheric constituents and air quality degradation and forecasting of atmospheric hazards in urban / touristic areas; for Digital Elevation Models and EO data for "land-building" in games; for Geographical and Land Information Systems (GIS/LIS) and 5DMulti -Purpose LIS for Architecture and Culture.

Possible solutions

Some examples of use-cases have been defined to demonstrate the wide range of innovation opportunities that could be available.

- *Use-Case 1 - Use of drones to facilitate laser diagnostic and maintenance techniques for monument preservation.*

Lasers and laser light are currently present in numerous human activities, however for many such applications there is increased complexity and high cost.

The development and operation of a low-cost, compact and portable laser device, mounted on a drone and based on laser-induced fluorescence (LIF) technique has apparent advantages over different application fields, like study of cultural heritage, oil spill detection, aquatic environment monitoring etc.

Such drone-based fluorosensor take advantage of the unique properties which photonic technology can bring and contribute towards the study of phenomena like biodegradation or cracking which usually take place in ancient monuments. This LIF sensor can be easily integrated with other optical subsystems (like cameras for hyperspectral imaging) and operate synergistically so that they can both provide valuable information- with good spatial and temporal resolution- regarding the evolution of the physiochemical phenomena under research, and provide mapping functionalities too. The architecture of this innovative system can be modular so that it can be easily applied (with minor modifications) to different applications, spanning from culture to water quality and food safety.

- *Use-Case 2 – Advanced 5D Land Information Systems (LISs), for architecture, civil development and tourism*

The complexity of modern urban environments has led to the introduction of 3D Land Information Systems (LISs), which tend to replace traditional 2D LIS architectures for the purposes of urban planning and regeneration, land administration and civil development.

However, there is a requirement for additional information such as time relevance and inclusion of other useful parameters. With this not only the requirements of the traditional users are fulfilled but it can be

extended to new user categories (e.g. tourism). Thus, additional dimensions, need to be supported by a modern LIS. A 5D Multi-Purpose LIS Solution will be a core system on top of which smartness related data collected according to the proposed requirements can be viewed in an accurate, consistent, timely and compliant way (e.g. 3D urban area changes, 4D on time and 5D using several data bases input for sustainable cities, tourism, different components of the Earth system and human activities).

- *Use-Case 3 – Extreme touristic experiences.*

Space tourism that sends people to space and back has been slow to get into full scale, with companies still away from entering real widespread commercial operations. These travel vehicles rely on rocket engines to escape from Earth, and they go up to 80 km high and back.

However, right now, there are few actors that propose a more leisure and eco-friendly type of travel. Instead of rockets, they are using HAPs. A balloon cruise at low speed, 25 Km above the ground, giving breath-taking view of the Earth's curvature and Earth itself.

In addition to passenger / touristic journeys, the technologies being developed facilitate and reduce the costs of stratospheric flights for scientific observation and the aerospace industry.

- *Use-Case 4 –Augmented Reality - Enhanced Touristic and Gaming experience.*

Augmented Reality (AR) allows overlapping virtual objects above the images of real objects when seen through a smart device. Due to the great possibilities this technology unlocks and to the relative simplicity of technical implementation, augmented reality applications are used more and more in many areas, including education, industrial environments, medicine and, of course, gaming. In parallel, as drones become more and more advanced in terms of hardware and accompanying software, there is an increasing interest in combining drone and augmented reality technologies. A user-story of such an application may look like the following:

"When your drone is flying, you can see the world with its eyes on the screen of your smartphone or management panel or through special glasses. Through AR you can see live not only real objects as the drone sees them, but also some additional images, text or marks over them—just as you can see lines and names of the streets on Google satellite map. Those virtual objects can appear in response to some "triggers" – special images on real objects recognized by drone software on the fly. Or they can be added in real time by special visual recognition software analyzing the objects seen."

A characteristic example in the field of gaming is games providing AR drone-racing game experiences: a gamer pilots the drone over a special mat with visual and spatial tracking to create a 3D augmented reality world. On the screen of their drone management panel (either Android or iOS smartphone/tablet), the gamer can see his drone flying in a virtual 3D world.

Another possibility would be for tourists to rent drones and maneuverer them through historical buildings or physical wonders (even in places that a human couldn't reach easily e.g. in great heights or depths) and through an AR system get additional information about recognized elements from this exploration (e.g. statues details inside a cathedral, flora details inside a canyon, etc.)

Potential benefits

There are many ways in which the proposed use-case capabilities could be actually deployed by customers. These include the following examples:

- Easier and more cost-effective inspection and conservation of monuments and buildings (amongst other applications)
- Support new requirements of LIS users and add new use and services for civil development and tourism
- New enhanced gaming and touristic experiences

Potential end-users

The capabilities offered by systems implementing these use-cases would be valuable to multiple end users, including:

- Public authorities responsible for Culture, Tourism, Architecture and Urban planning
- Regional Administration (Regions, Prefectures, etc.)
- Municipalities
- Large technology companies participating or expanding their activities in gaming and gamification
- Museums, Monument preservation authorities, Cultural Organizations
- Managed Archaeological Sites and Touristic Attractions
- Galleries and Libraries
- Tourist operators
- Citizens, Visitors and Tourists

UFO Innovation Opportunities

The UFO Project is seeking to collaborate with companies interested to help implement these or other use-cases which target a need in the Digital Creative and Gaming sectors. A range of capabilities will be required, including:

- Sensor and system manufacturers or developers (for mounting on satellites, drones or kites/balloons)
- Platform providers (drones, balloons, CubeSats)
- Satellite data service providers
- Geo-information systems developers & providers
- KET developers and providers
- Modelling and data fusion specialists
- Application developers (for end users ranging from citizens to public authorities)
- Gaming technology providers
- Infotainment technologies
- VR/AR technologies

Companies interested to explore these opportunities are invited to respond to this briefing paper by providing answers to the following questions:

1) Which application market(s) are they most interested to enter or expand their presence?
2) What technology(ies) are they intending to exploit?
3) What is the present maturity of this technology(ies)?

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BRIEFING PAPER

Application Domain—Mobility

The UFO project aims at supporting European SMEs to develop innovative products and services by integrating new technological solutions and know-how provided by Small Flying Objects (SFOs) (drones, high altitude platforms systems, small satellites) and related technologies such as data analytics. These innovative products and services are targeting real challenges faced by high-growth sectors. Solution providers will be able to engage with solution users, providing accessible market opportunities to drive their growth. This briefing paper outlines the challenges and potential solutions within the Mobility sector.

Sector profile

The mobility sector is undergoing significant changes brought by social and technological disruptors. Connected and Automated Mobility (CAM) has made substantial progress over the last decade, affecting all transport sectors. From airplanes that can land themselves, automated trains, ships, cars, and even autonomous submarines, mobility is being reimagined.

Key sector challenges

- SFO's (in combination with ICT solutions) can provide solutions to some of the most important challenges that the Mobility industry is facing. Three of such challenges are described below:

- Congestion, roadworks & asset monitoring— The advent of Autonomous Connected Electric and Shared Vehicles (ACES) is at the moment picking pace but still expected to take years until critical mass is achieved. Furthermore, most experts expect a long period of time in which these vehicles will have to co-exist with traditional ones. As such, monitoring congestion and our road networks will prove to be crucial as well as allowing for better decision-making regarding traffic flows and enforcing zero-emissions zones. Monitoring the state of the roads and roadworks as well as train lines will increase in importance. Capabilities are needed in ensuring prolonged real-time monitoring of transport assets.

- Vehicles-to-Everything (V2X) — With the overall goal to decrease the number of accidents and emissions on our transport networks as well as improve efficiency, the use of Vehicle-to-Everything communications is something that all vehicle manufacturers are currently looking into. Furthermore, V2X allows for the emergence of new business models around location-based services on board vehicles, cybersecurity, entertainment, etc. Some of the biggest challenges in V2X are given by the need to have secure, continuous communications between vehicles, infrastructure, vulnerable road users, etc. Making sure that safety critical information is being sent and received in a timely, secure manner can prove to be crucial. Another step to overcome is related to interoperability and the need for the communication systems to be operable regardless of the manufacturer. Furthermore, with the increased focus on the future of traffic control centres for our roads and railways, continuous communication between them and the rolling stock is increasing in its importance.

- Last mile deliveries — During the last few months COVID-19 has grounded most of the aviation fleet and has increased the importance of contactless deliveries as well as the ability to reach remote areas or even transport medical supplies in time crucial circumstances. It has accelerated the need for using autonomous drones for deliveries, with their operational cost of 70% less than a delivery van. Some of the challenges encountered look into the need for AI and Machine Learning for making sure that the deliveries are constantly tracked as well as making sure that the situational awareness of the drones is up to the task (sensors + communications). Furthermore, legislation hurdles still have to be overcome.

Role of Small Flying Objects

Developing new solutions through knowledge and technology transfer from SFOs into the transport sectors could prove to be extremely beneficial, accelerating the deployment of automated transport solutions as well as lowering emissions and ensuring that the backbone of our transport networks is well managed and maintained. By integrating SFO solutions in our transport networks we can bring new valuable capabilities to market as well as achieve increased safety and reduce costs.

Drones for transport asset infrastructure monitoring — for long duration of time, at reduced risks and reduced costs.

Increase connectivity between control centres, moving vehicles/ships/trains, users

Reduce congestion and green-house gas emissions

Possible solutions

Some examples of use-cases have been defined to demonstrate the wide range of innovation opportunities that could be available. (non-exhaustive)

- *Use-Case 1—Use of drones for asset monitoring*

Railways and roads are vital transportation infrastructures where SFOs and ICT technologies can work in combination to provide early detection of assets failure and guide preventive maintenance. Furthermore, having to manually inspect roads and train tracks is a time and resource consuming activity and more importantly a dangerous one that needs to be improved.

- *Use-Case 2 — V2X*

New generation of vehicles, ships and airplanes need to deliver different types of applications in various domains such as infotainment, telematics, driver assistance and autonomy with maximum reliability, safety and privacy. As a result, vehicles should be able to communicate not only with other vehicles, but also with pedestrians, roadside equipment, sensors, control centres and the internet as a whole.

- *Use-Case 3 — Last Mile Delivery*

During the last few months COVID-19 has grounded most of the aviation fleet and has increased the importance of contactless deliveries as well as the ability to reach remote areas or even transport medical supplies. It has accelerated the need for using autonomous drones for deliveries, with their operational cost being 70% less than a delivery van.

Developing new solutions through knowledge and technology transfer from SFOs into the transport sectors could prove to be extremely beneficial, accelerating the deployment of automated transport solutions as well as lowering emissions and congestion and ensuring that the backbone of our transport networks is well managed and maintained.

Potential benefits

There are many ways in which the proposed use-case capabilities could be actually deployed by customers. These include the following examples:

- Equipping drones with optical sensors in order to provide multispectral data as well as LIDAR for understanding potential structural failures can lead to minimising human intervention for asset monitoring and maintenance operations. Furthermore, large areas or long linear flight paths can be covered in a short time with Beyond Visual Line of Sight (BVLOS) Unmanned Aerial Vehicles (UAVs).

Drones are also ideally placed for monitoring and measuring air quality in both rural and urban areas in part due to their high mobility potential as well as being the ideal platforms for being equipped with pollution measuring sensors.

- By fusing together Global Navigation Satellite Systems data with V2X technology more accurate positioning can be achieved, significantly improving the safety of our transport networks. Furthermore, this will lead to a decrease in congestion on our roads, paving the way for vehicle platooning and therefore reducing the fuel consumption and pollution in our countries.

- Cargo drone deliveries between medical equipment manufacturers and hospitals or between hospitals and areas in need are a significant step in reducing the time and the costs associated with this. Communications between drones and ground control stations can be provided by using both cellular connectivity and satellite communications as well as Earth Observation data, ensuring that the connectivity coverage is continuous thus allowing for BVLOS flight.

Using drones for deliveries will also lead to the potential of using fewer delivery vans in our cities and rural areas, leading to a significant drop in the levels of air pollution.

Potential end-users

The capabilities offered by systems implementing these use-cases would be valuable to multiple end-users, including, but not limited to:

- Transport Authorities — in charge of regional or national transport systems management
- Commercial operators in charge of Road Asset Monitoring
- Vehicle Manufacturers looking at integrating new services and safety features in their vehicles.
- Transport and logistics companies
- Airlines

UFO Innovation Opportunities

The UFO Project is seeking to collaborate with companies interested to help implement these or other use-cases which target a Mobility sector need or gap. A range of capabilities will be required, including:

- Sensor manufacturers or developers (for mounting on satellites, drones or kites)
- Platform providers (drones, kites, cubesats)
- Satellite data service providers
- Modelling and data fusion specialists
- Application developers (for end users ranging from citizens to public authorities)
- Cybersecurity
- New Business Cases / Models
- Infotainment

Companies interested to explore these opportunities are invited to respond to this briefing paper by providing answers to the following questions:

1) Which application market(s) are they most interested to enter or expand their presence?
2) What technology(ies) are they intending to exploit?
3) What is the present maturity of this technology(ies)?

Send an email expressing your interest to ufo@ktn-uk.org including your contact details. A member of the team will contact you to discuss how UFO Project can help to realise these opportunities.

BRIEFING PAPER

Application Domain—Climate

The UFO project aims at supporting European SMEs to develop innovative products and services by integrating new technological solutions and know-how provided by Small Flying Objects (SFOs) (drones, high altitude platform systems, small satellites) and related technologies such as data analytics. These innovative products and services are targeting real challenges faced by high-growth sectors. Solution providers will be able to engage with solution users, providing accessible market opportunities to drive their growth. This briefing paper outlines the challenges and potential solutions within the Climate sector.

Sector Profile

The Climate sector applications are growing as the concern for renewable energy is rising. While providing alternative sources of energy, the application and use-cases of the energy transition also contribute to the improvement and efficiency of today's tools. The need for more precise and rapid applications can only be supported through innovative solutions. This is why we distinguished the Climate sector from the environment sector, also approached in UFO, with a primary target on the energy transition. It includes the needs and use-cases related to the support for the energy transition and the crisis management. We decided to take this direction as the energy transition and the crisis management are important actions to take to address climate change impacts. Therefore, the application of the sector is completed with a section on the renewable resources management.

Key Sector Challenges

We can divide in three categories the sector. The crisis management, the urban optimization, and the renewable resource management are the three main aspects of the Climate sector and to develop and increase this sector we would like to orient the technologies toward AI, high precision Earth Observation sensors, communication devices and IoT.

- **Crisis management.** The objective is to monitor EO data for detection/measurement purposes, before, during and after a natural catastrophe. We can include the observation of current flows in oceans and seas, forest fire detection and air support monitoring for interventions. In crisis management, flood mapping and reforestation cropping are also uses cases that would enable post-crisis interventions. We can include the landslide studies in cities or after earthquakes.

As an example of possible application: https://www.space-intelligence.com/

- **Urban optimization.** In the Climate Change sector, the management of energy is important to reduce the impact of human activities on its environment. The modernization of infrastructure for IoT, the autonomy of agriculture machines and monitoring of the CO2 impact are examples of use-cases. We can add the goal to get more precise farming data and cities energy consumption management.

As an example of possible application: https://www.prodroneworx.co.uk/

- **Renewable resource management.** To use the renewable resources in its maximum capacities, space and airspace management are offering the best tools. It is possible to get wind speed and direction measurement and data to optimize the solar panel with the right inclination for solar coverage.

As an example of possible application:
http://www.eohandbook.com/eohb2011/casestudy_energy.html

Role of Small Flying Objects

The Climate sector activities generally take place over diverse areas, large and very precise location with a particular need for high embedded technologies. Flexibility or adaptable use of the SFO is the key to adapt the solutions to the right needs. We have the capacities with the different SFO to collect specific and required data. A complementary between the SFO also support the sector activities.

- HAPS are useful when they are used for a precise service on a specific location for a determine period of time. It is helpful for, for instance, constant communication to the population in danger or rescuers in interventions.
- Drones can offer quickly and precisely, in centimetres, data of the soil or localization specificities to optimize the renewable resources such as solar panel and wind turbines.
- Nanosats carrying optical or SAR sensors can detect resources and use Artificial Intelligence to support the use of renewable resources.

Possible solutions

Some examples of use-cases have been defined to demonstrate the wide range of innovation opportunities that could be available.

- *Use-Case 1 — Carbon Management and deforestation for Crisis management.*

The data collected from the Copernicus program are covering lands, seas and air environment, allowing a constant and precise view of our surroundings. It supports decision makers for the protection of our ecosystems. With those tools, service providers such as a Space intelligence are using the forest mapping data from the Copernicus program, mostly from Sentinel-2, and transferring the raw data into visual intelligence. This manoeuvre, supported by machine learning, brings a clear coloured-coded mapping of the forest and the Area of Interest (AOI) and expose the environmental risks helping the companies in the conservation of wild or protected areas and avoid any potential environmental crisis.

- *Use-Case 2 — Energy studies on infrastructures for urban optimization.*

Urban optimization benefits from drones rapidity and agility. The data collected through target zones with the drones are key information to optimize the infrastructure and reduce waste of energy. The UK Company ProDroneWorx is a pioneer in such services, using drones for aerial and terrestrial surveying and also inspection and modelling of infrastructure. They are using thermal imagery cameras and 3D laser scanners mounted on drones to build high-resolution 3D models of targeted infrastructure in urban zones and their surroundings, as a service. This is helping to detect heat lost on residential or commercial infrastructure and detect temperature anomalies. The service is helping for the modernization of the infrastructure, plan any construction, and solve everyday business problems and more.

- *Use-Case 3 — Solar renewable resource management*

As the importance of alternative sources of energy is rising, the satellite data bring support to existing and new solar energy instalments. This kind of renewable resources infrastructure are particularly sensitive to its environmental conditions and depends largely on local climate and weather. This is why geostationary satellites have been used as a tool to increase the efficiency and cost-effectiveness of its systems and thereby improve their viability. Satellite support aims to provide high spatial and temporal solar irradiance data as well as information on the distributions of sunlight by the angle of incidence and spectral band. Providing those crucial data contribute to the efficiency of current terrestrial infrastructure and implementation of new ones.

Potential Benefits

There are many ways in which the proposed use-case capabilities could be actually deployed by customers. These include the following examples:

- A HAPS or drones equipped with LiDAR scanners or SAR sensors to detect or scan specific anomalies in land or sea's environment.
- A company using Space-based technologies such as remotely sensed data to enhance the understanding of water cycles, air quality, forests and other aspects of the natural environment to adapt any installation of renewable resources infrastructure.
- A forecasting services provider using high-resolution cameras embedded on HAPS for EO on specific localization and a constant period within a large area, removing the revisit period of satellites.

Potential end users

The capabilities offered by systems implementing these use-cases would be valuable to multiple end users, including:

- Public authorities responsible for ensuring a greener impact of its city
- Public authorities to assure a better protection and reaction to the environmental catastrophes
- Commercial companies who want to install renewable resources infrastructure
- Organizations active in research and who wants to valorize the energy potential of some regions and develop the use of AI

UFO Innovation Opportunities

The UFO Project is seeking to collaborate with companies interested to help implement these or other use-cases targeting the energy transition of the climate sector. A range of embedded technologies will have to be combined with services from SFO, including:

- Sensor manufacturers or developers (for mounting on satellites, drones or kites)
- Platform providers (drones, kites, cubesats)
- Satellite data service providers
- Modelling and data fusion specialists
- Application developers (for end users ranging from citizens to public authorities)

Companies interested to explore these opportunities are invited to respond to this briefing paper by providing answers to the following questions:

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BRIEFING PAPER

Application Domain — Finance & Insurance

The UFO project aims at supporting European SMEs to develop innovative products and services by integrating new technological solutions and know-how provided by Small Flying Objects (SFOs) (drones, high altitude platforms systems, small satellites) and related technologies such as data analytics. These innovative products and services are targeting real challenges faced by high-growth sectors. Solution providers will be able to engage with solution users, providing accessible market opportunities to drive their growth. This briefing paper outlines the challenges and potential solutions within the Financial sector (non-exhaustive list).

Sector profile

The application of SFO in different sectors has increased in the past few years. The banking and Insurance sector have not been the exception and they have also benefited from this trend. From instance, drones can be used to assess risk in the insurance sector or cash delivery in the banking sector. Furthermore, Small Flying Objects can also be an important additional source of information for the creation of new applications in the economic development of cities.

Next section will present some use-cases of SFO for the financial industry.

Key sector challenges

- **Insurance Sector**

In the financial sector, insurance may be the area that can be more highly impacted by small flying objects e.g. risk analysis, claims. Regarding this, risk management is part of organizations that look to *protect people, equipment, and other resources while making the most effective use of them*[1]. To achieve this, most of the insurers will calculate the insurance value based on risk management. In order to have an accurate value, they need the best tools available. The use of small flying objects can strongly contribute to a better and faster decision making.

Another problem that faces the insurance sector is the long procedures while handling claims. It can take several weeks until an expert can validate a claim made by a client. This is not only time demanding but also expensive for the insurer and counterproductive for the client. The use of small flying objects and human's expertise can result in up to 50% costs savings[2].

- **Global Finance**

Global data is key, by integrating unique data provided by SFO would get an impact on the global economy.

Access to financing is very heterogeneous from the city to the rural sector. In the agricultural area, it can take several weeks to arrange the visit of the representative that can expertise the land of agriculture to access a loan. Furthermore, this is also costly for the bank and for the client. Banks are looking for innovative ways to make this easier, faster, and cheaper for both parts of the equation.

ATMs are also less available in the rural sector, where sometimes cash is still necessary. Furthermore, ATMs installation can be expensive and inconveniently placed. SFO can be an opportunity to solve dispensing cash problems in a safe way. SFO could be used to deliver cash to customers in a safe, faster, and ecological way.

[1] https://www2.deloitte.com/us/en/pages/public-sector/articles/drone-risk-assessment.html#fn

[2] https://www.maparesearch.com/drones-place-banking/

Some countries, such as Poland, have already made available a mobile cash machine. Small business owners use a smartphone app to order a car with a built-in ATM directly to their doors at a time of their choosing. Drones could be the next step for this cash delivery evolution.

Also, data given by photos satellites can be used to track oil quantities and oil destinations to analyze cities' development. Another use of small flying objects technology for economic development will be, for instance, tracking truck's routes to build strategic hubs that will impact the development of the region.

Finally, this is a good way to show us what is going on in remote locations that are tough to monitor.

- **Smart cities**

A smart city aspires to achieve the objectives of a future city by utilizing communication technology solutions and trends. Smart city is based on the integration of ICT and its trends.

Development of smart cities is going to play a key role in sustainable development of the world. Drones and other SFO are going to play a major role in it. They will be involved in a wide range of applications and functions in smart cities. Some of these applications are monitoring traffic, key infrastructures, and monitoring development work on a regular basis. Those objects can provide several services and opportunities that can benefit smart cities.

For example, drones can be used to map commuting routes. With the need to advance smart city programs quickly, drones offer flexibility, allowing professionals to map long corridors efficiently at the start of projects and collect in-depth data to accelerate decision-making at an earlier stage.

This category also includes the real estate and construction sector. Assets managers and real estate agents need large amounts of data to make decisions. They need to consider many factors to make the right investments.

One of the newest trends in real estate is using drones and other small flying objects to take aerial images which provide a unique perspective when it comes to featuring property. Drones are being used for all types of real estate listings including residential homes, apartments, resorts, vacant land, commercial properties, and more.

Commercial real estate agents, real estate investment firms, or development companies looking to sell positions in a large land acquisition, building renovation, or construction projects, are extremely interested in using drones for real estate. These are typically larger sites where aerial images are more beneficial for capturing the entirety of the property using the same techniques but flying much higher.

Local town information has already available information regarding building and construction areas. This information combined with photo satellites data could be a great way to exploit new building construction areas.

Role of Small Flying Objects

Financial decisions are based on accurate information. In addition to conventional information gathered by institutions (own database, social media, etc.) SFO can add valuable information not accessible to everyone.

- Real time photo satellites
- Opportunity to exploit in a faster and less costly way urban infrastructure management, farming, oil, and gas exploration, etc.
- Exploit new data to generate new services

Possible solutions

- Drones could give easier and cheaper access to agricultural financing. Banks can use the information coming from drones and satellites (rainfall and average temperatures, soil hygrometry, surrounding water surfaces, plot boundaries, proximity to storage locations and markets, types of crops, sowing and harvesting periods, etc.) and assess this with their own information in order to establish not only the overall financial balance of the operation but also its seasonal cycles and its sensitivity to exceptional events.
- Drones can be used to help banks deliver cash, cards in a safe, faster, and environmental way
- SFO can use information that combined with local plan town information can result in a better way to monitor/exploit new building construction areas.
- The use of SFO (e.g. photos satellites) to find the nearest commerce and like this recommends the best strategic location for business competitors is another possible contribution of SFO.
- Using drones for large land acquisition, building renovation, or construction project for example
- Analyze the economic development of cities, smart cities
- Drones provide a dimensional view of businesses and enables customers to redefine their industries
- Create new insurance tools and extend the insurance field

Potential benefits

The potential benefits of SFO solutions include the following examples:

- Less time demanding access to financing
- Faster claims procedures
- Better risk assessment
- Safer and cleaner delivery of products (cash, cards, etc.)
- Assure greater economic stability and growth in the future

Potential end-users

These potential solutions can be of high value for:

- Banks
- Insurance companies
- Asset managers
- Public authorities
- Consultant firms
- Data providers
- Investors
- Real estate agents

UFO Innovation Opportunities

The UFO Project is seeking to collaborate with companies interested to help implement one or more of these use-cases. A range of capabilities will be required, including:

Companies interested to explore these, or other opportunities are invited to respond to this briefing paper by providing answers to the following questions:

1) Which application market(s) are they most interested to enter or expand their presence?
2) What technology(ies) are they intending to exploit?
3) What is the present maturity of this technology(ies)?

Send an email expressing your interest to lucile.anikszteJn@finance-innovation.org or gisela.sanchez@finance-innovation.org including your contact details. A member of the team will contact you to discuss how UFO Project can help to realize these opportunities.