Project Breakthrough

Disruptive Technology Executive Briefs

UNMANNED AVIATION SYSTEMS (UAS)

Opening the skies to all

Unmanned Aviation Systems (UAS) are fixed wing or multi-rotor aircraft without an onboard human pilot that move autonomously or semi-autonomously. They can range from small hobbyist quadcopters to large, fixed wing aircraft.

The technology

UAS technologies are not new but their integration into a commercially viable system has provided real transformation in the tasks they can perform.

Technologies include the use of sensors to monitor the environment and collect data, as well as autopilots and flight stabilisation software that simplify remote-controlled flight. They also use software algorithms to interpret the data and plan autonomous flight.

The potential

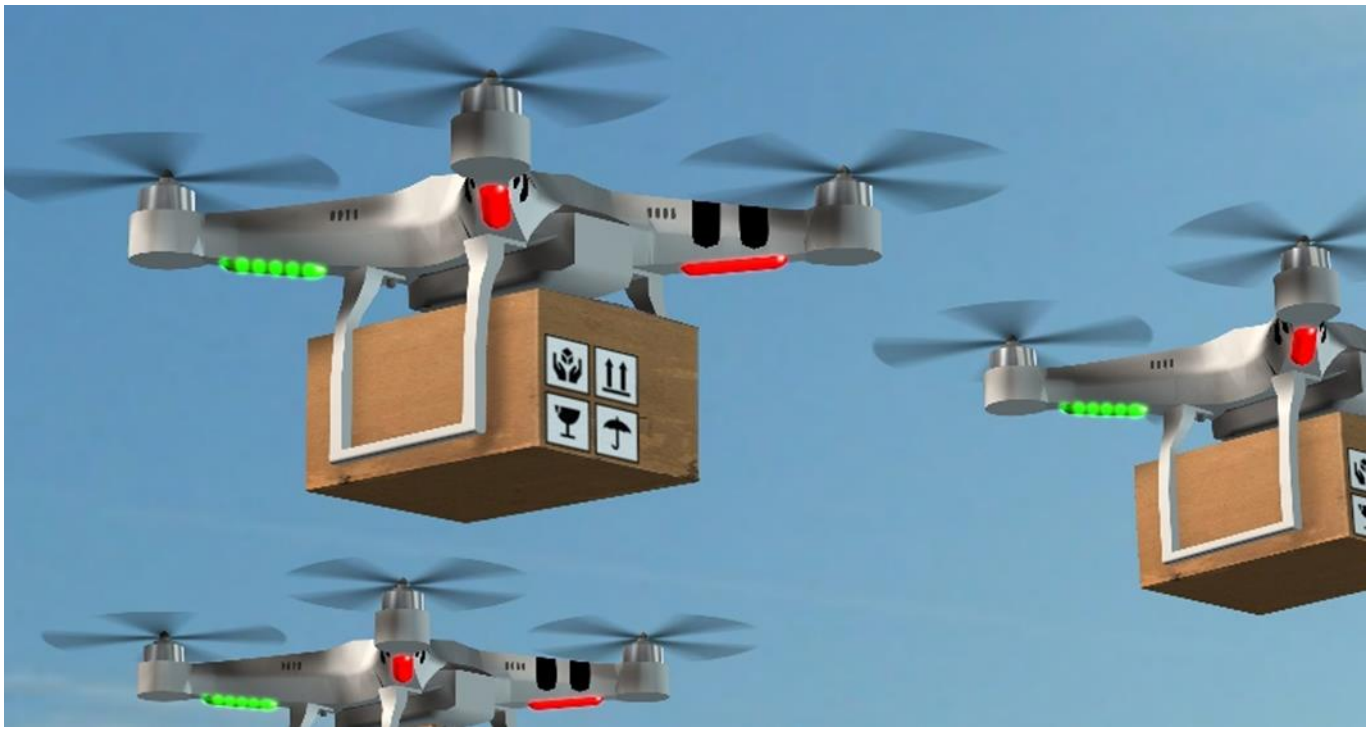
UAS can be used in a range of applications including delivery, inspection, farming, surveillance, monitoring, search and rescue, filming, logistics, law enforcement and photography. Their potential to fly in conditions that humans can't (or won't!), their ability to travel further without human intervention, and the lowering in costs resulting from these factors means there are a multitude of potential applications to consider.

The barriers

Widespread adoption is being limited by safety and security concerns, such as UAS being used illegally or recklessly. With reports of drugs being flown across borders and into prisons, as well as the already acknowledged concerns over air traffic incidents, responses to challenges like these will need to be developed and implemented before the technology can go truly mainstream.

United Nations Global Compact

Some Example Applications...



Delivery

One of the most immediate commercial applications for UAS is home delivery. By using UAS, companies can minimise the time between ordering and delivery, improving the customer experience and providing more options for time-sensitive products such as foods or medicines. Amazon is one of the higher profile examples of a company that is pursuing this development.

By avoiding traditional delivery routes, UAS have the potential to significantly reduce road congestion (and associated pollution) as well as open up previously hard-to-reach areas to services that are currently not available or are not commercially viable. As the technology improves and the supporting factors such as regulation are clarified, the range of products that can be delivered in this way could grow considerably.

Monitoring

Aerial inspection company, Cyberhawk Innovations, use Remotely Operated UAVs (ROAVs) to inspect structures that are difficult or dangerous for humans to reach, such as wind turbine blades. This can be done more regularly, at a lower cost, providing higher resolution images and without the risk of having human workers work at dangerous heights. This provides the opportunity for early intervention to rectify problems and save operational costs.

Agriculture

UAS, with near infrared sensors, have been trialed in Sri Lanka to monitor farmers' fields and provide information on their crops, such as the optimum time to harvest.

Key Numbers

$13.4 bn

Estimated market size in 2022

Source: Statista

7 mn

UASs estimated to be in the US in 2023

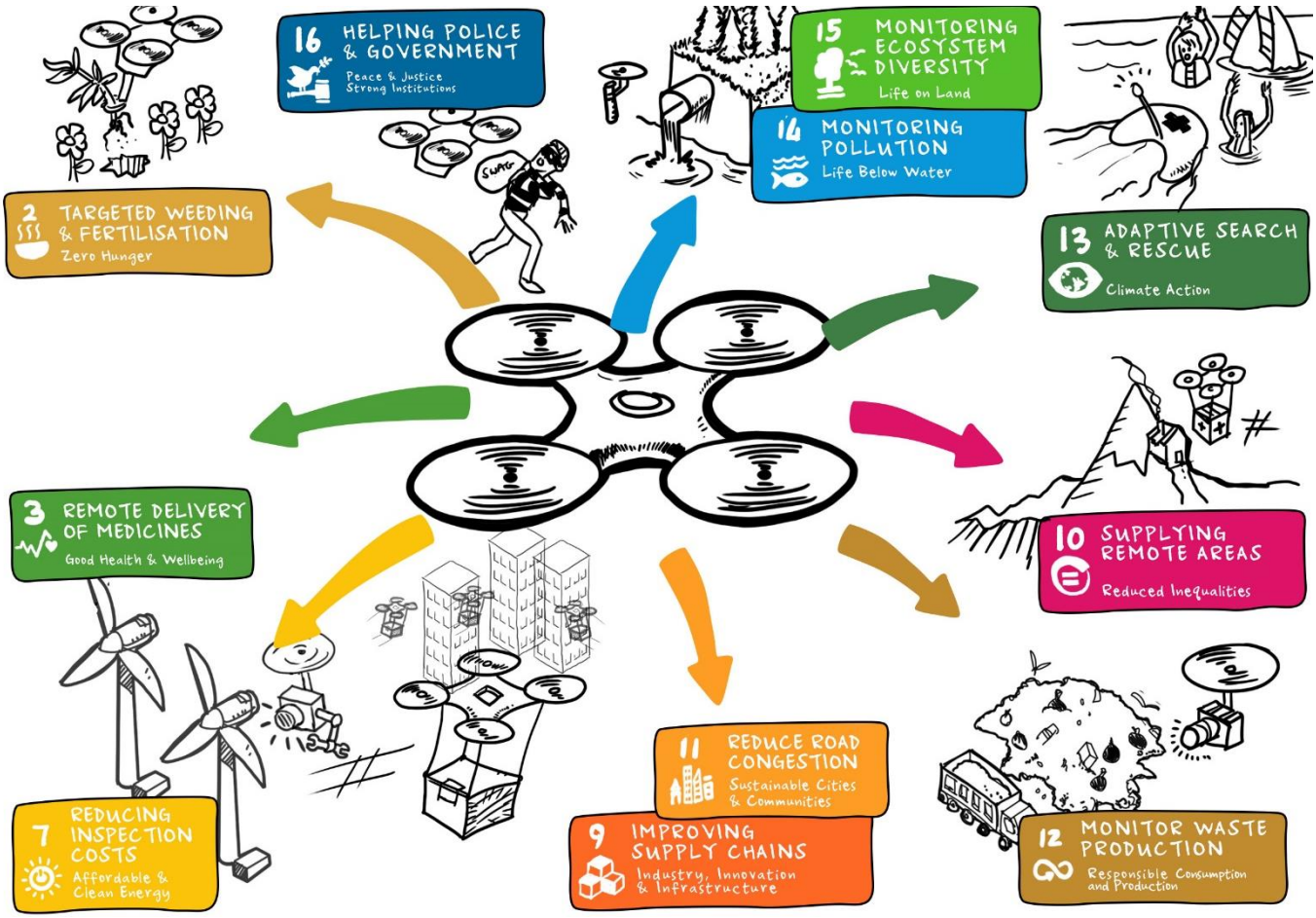
Source: FAA

$3.9 bn

Estimated R&D investment in 2020

Source: Statista

Advancing the Sustainable Development Goals (SDGs)



Unmanned Aviation Systems have the potential to advance many of the SDGs. Below are some examples of areas of application across a wide variety of sectors.

SDG 2 Zero hunger

- Provide data to increase farm productivity and enable more sustainable farming.
- UAS can be used to identify weeds and deliver herbicide only when needed, and eventually could be used to locate and remove individual weeds, removing the need for herbicides altogether.

SDG 3 Good health and wellbeing

- Deliver medical or nutritional supplies to remote areas.
- Explore environments that are dangerous for humans to explore, and detect the presence of hazardous Volatile Organic Compounds.
- Explore large areas quickly in rescue missions, for example in the aftermath of a natural disaster or searching for those lost at sea. UAS can fly in groups to rapidly cover large areas, an operation which can be costly, challenging and dangerous for manned aircraft.

SDG 7 Affordable and clean energy

- Reduce inspection and maintenance costs of renewable energy infrastructure such as solar cells and wind farms.

SDG 9 Industry, innovation and infrastructure

- Safely and continuously monitor structures or infrastructure that is hazardous or costly to reach. For example, inspect power lines using drones with onboard video cameras instead of using humans to climb them.
- Reduce costs of maintenance and monitoring of large infrastructure more generally by deploying swarms of autonomous UAS.
- Improve factory efficiency by using drones to monitor, move and deliver tools and inventory efficiently and autonomously.
- Deliver goods quickly and efficiently, which will also reduce road traffic and congestion.
- Research is also looking at ways of using UAS to construct temporary infrastructure such as bridges.

SDG 10 Reduced inequalities

- Deliver supplies, medicine or disaster relief to remote locations at a lower cost, to areas that cannot be reached otherwise, or where quick delivery is required.
- Allow for wider communications network coverage, by using UAS carrying communications nodes to extend signal reach into remote areas.

SDG 11 Sustainable cities and communities

- Reduce congestion and related emissions from road transportation and provide easier access to isolated areas by using UAS to deliver goods.

SDG 12 Responsible consumption and production

- Monitor waste production through regular autonomous inspections.

SDG 13 Climate action

- Monitor pollutants and climate.
- Provide adaptive search and rescue capacity to help with climate change-induced disasters.
- Decrease overall carbon emissions through more efficient logistics.

SDG14/15 Life above land/below water

- Monitor pollutants and ecosystem diversity.
- Monitor wildlife.

SDG16 Peace, justice and strong institutions

- Monitoring and surveillance to support law enforcement.

Potential Negative Impacts and Barriers

For a new technology to gain acceptance it must be safe and reliable but, just as important, it must be supported by the right legal and regulatory framework or there is a risk of a public backlash that will limit its use.

Privacy

Developing ways to manage intrusions into privacy, through legitimate or illegitimate collection of data, will be crucial to ensure that UAS are not misused.

Security

The potential to hack UAS is a major concern. As with many connected devices, UAS are often not designed with security as a key consideration. This leaves them vulnerable to breaches and opens the door for either a legitimate application to be hijacked (for example, stealing data that has been legitimately collected) or an illegitimate application to be performed (such as taking control of UAS and trying to use it to disrupt air traffic).

Legislation

Autonomous outdoor operation is either illegal in many places, heavily constrained or more worryingly, is not specifically legislated for. Without rapid intervention to address this, there is a risk that the technology could be used for negative activity resulting in demands to control its use. The insurance aspects of autonomous drones operating outdoors in public airspace will also need to be defined and could affect commercial use of drones for inspection and delivery.

Current regulations and legislation already greatly limit the areas in which UAS can operate and can also make the process to acquire an appropriate license lengthy and costly.

Criminal activity

The availability and lack of ownership registration for drones creates risks of crime. Drones have been reported as being used to fly narcotics over prison walls and borders. Even if the drones are captured, there is no data on who purchased or operates it. This, combined with the low cost of acquisition, makes these a very appealing way to smuggle contraband with minimal risk of capture or prosecution.

There have also been examples of UAS being modified from a legal or benign purpose to an illegal purpose, such as the reports of a handgun being attached to a UAS with a small modification to allow it to be fired by the UAS operator.

Weather

Being able to operate in difficult weather conditions such as rain, snow and high winds is a critical requirement and will be a great challenge for lighter UAS in particular. Unless UAS can rapidly become usable in all conditions (or at least the majority of those currently navigable by vehicles), their application will be limited.

Public acceptance

If not properly addressed, all of the above factors could contribute to some public mistrust of drones which will hinder their adoption and development. There is also benefit in showing that the breadth of UAS capability is broader than military operations (an area 'drones' are often associated with) and highlight their multiple civilian applications.

Technical Considerations

UAS have a huge range of potential commercial applications but for these to be viable they will need further technical development so they can fly for longer and in all conditions.

Battery life
Many of the lighter, more agile and versatile UAS have limited battery life meaning that, depending on load, flight time can be as little as 10 minutes. Whilst this may be adequate for some commercial purposes over short distances, until a longer range can be developed the commercial applications may be limited.

Autonomous flight
Fully autonomous flight requires an understanding of constantly changing obstacles and environments and the ability to reliably navigate in GPS-deprived environments. Urban areas have numerous tall buildings, commercial aircraft and other features such as power lines. Rural environments suffer from a lack of connectivity and contain features such as trees and wildlife. Managing these challenges will require further technical developments.

Communications
On-board processing power can be constrained. A good quality communications link to a base station is therefore often required – this again reduces operational range and will limit the number of commercial applications until it can be resolved.

Interface design
Intuitive user interface design is important for human users to be able to gain control of autonomous UAS if required and to be able to easily control UAS swarms. If UAS can only be operated with a significant amount of training, their ability to disrupt current approaches will be substantially constrained.

Other emerging technologies
Satellite technology and large distributed sensors networks (potentially made from biodegradable electronics) could also carry out many of the monitoring and communication roles that UAS offer. One of these technologies could become more prevalent, reducing the likelihood of widespread adoption of UAS.

Enabling New Business Models

Unmanned flight eliminates the need to design an aircraft around a human pilot.

UAS open up a whole set of new freedoms in design and operation, allowing vehicles to operate at higher speeds, in more hazardous environments and for longer durations.

They have the potential to affect many sectors, including transportation, agriculture, entertainment and security. They will also have an impact across the value chain from exploration, production and distribution, to maintenance and servicing. The opportunities are likely to be in geographies and regions where distance and physical access can be a challenge.

UAS will allow customers to be served in new ways. They will enable more effective and cheaper ways of monitoring and collecting data, maintaining and servicing infrastructure and assets, and of distributing supplies. Aviation capability can now be made available at a much lower cost, as the absence of a human pilot enables craft to be smaller and also more fuel efficient. This will also substantially reduce the risk of human errors, often attributed to fatigue.

Today small drones can be purchased off the shelf for as little as a few hundred dollars and immediately put to use. Making such technologies affordable to a much wider market has the potential to bring significant innovation in areas such as logistics, communication and monitoring.

UAS will enable a number of the disruptive business model levers identified in the Business Model section of the Project Breakthrough website, specifically:

A more personalised product or service
By collecting information, UAS will be able to personalise maintenance and servicing. They will also enable more flexible and tailored logistics and distribution to meet customer needs.

A closed-loop process
By monitoring production processes, waste, and resource usage, UAS will enable a closed-loop process within and across businesses.

An agile and adaptive organisation
The flexibility offered by UAS will allow monitoring and data collection to be adapted to meet changing circumstances. The ability to act as low cost, easily deployable, communications nodes will also aid this. They can enable more agile distribution for supplies as they can be routed as required, and are not constrained by surface infrastructure.

More Examples...

Drones to deliver medical supplies in humanitarian missions

https://pressroom.ups.com/pressroom/ContentDetailsViewer.page?ConceptType=PressReleases&id=1462760058735-442

UAVs and drones for agriculture

https://www.theguardian.com/global-development/2015/dec/26/drones-farming-crop-problems-uavs

Drones build rope bridge

https://www.youtube.com/watch?list=PL0vyE01Abq2nBsh9R-RekNtao3G-ptmCH&v=CCDIuZUfETc

United Nations Global Compact

The United Nations Global Compact is a call to companies everywhere to align their operations and strategies with ten universally accepted principles in the areas of human rights, labour, environment and anti-corruption, and to take action in support of UN goals and issues embodied in the Sustainable Development Goals.

The UN Global Compact is a leadership platform for the development, implementation and disclosure of responsible corporate practices. It is the largest corporate sustainability initiative in the world, with more than 9,000 companies and 3,000 non-business signatories globally.

Project Breakthrough

Project Breakthrough is a collaboration between UN Global Compact, Volans and partners that spotlights the best thinking in sustainable innovation. It showcases innovators across mainstream companies and next generation entrepreneurs who are developing solutions with the potential to achieve exponential impact. It features analysis and resources designed to help leaders understand the new business models and technologies that will be crucial in achieving the SDGs, catalysing action amongst today's businesses to meet the needs of tomorrow's world.

The Disruptive Technology Executive Briefs are produced in collaboration with PA Consulting Group, combining cross sector technology, innovation and business design expertise. The briefs are intended as an easy to digest introduction to disruptive technologies, to help organisations understand how they could advance the Sustainable Development Goals and business performance. These overviews explore key features, examples of applications, potential positive and negative impacts, and how they may enable the new business models.

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