

Enabling Digital Transformation with Drone Technology

The Drone Technology

The first commercial UAVs (Unmanned Aerial Vehicles) a.k.a. drones were used by Japan in the 1980s to spray pesticides on rice fields. Technology has since come a long way, and though drones are still used in agriculture, drone-powered solutions are allowing companies to create new, disruptive business models.

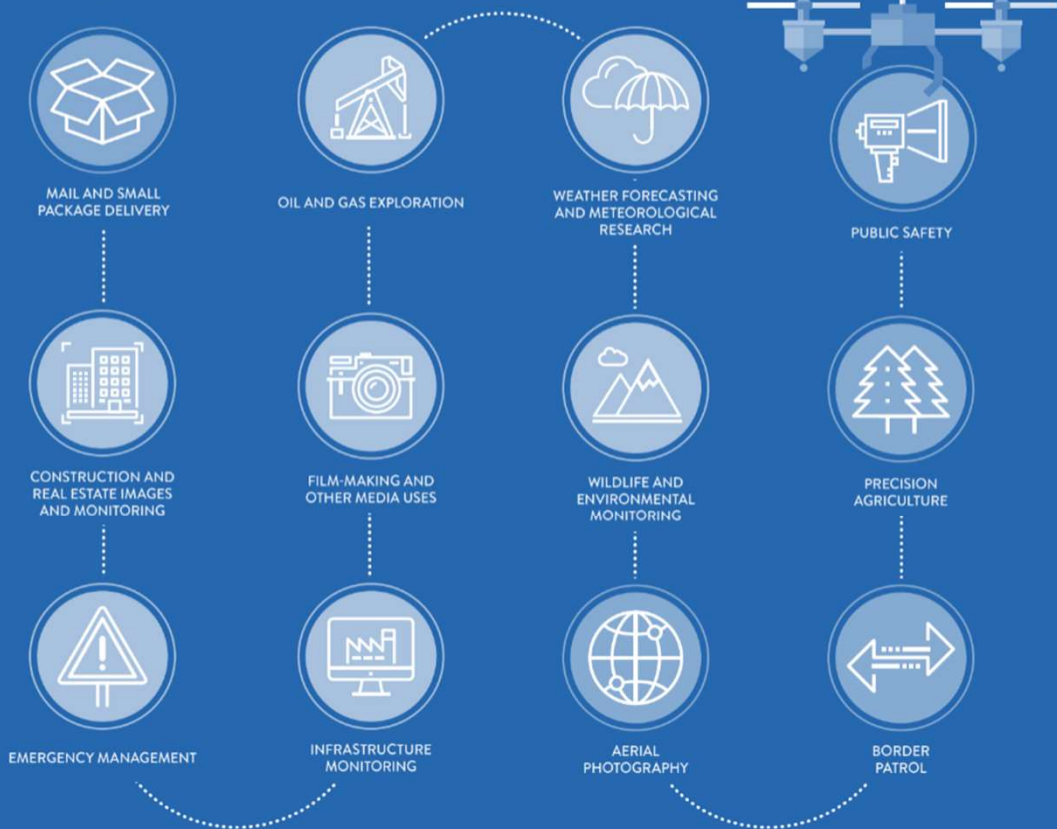
Drones are not only set to improve business efficiency through the lowering of labor and service costs, but they also have the potential to deliver real-time data that could benefit every sector from the military to transport.



DRONE MARKET OUTLOOK

MATURITY LEVEL OF COMMERCIAL DRONES USED IN DIFFERENT SECTORS

STAGE: ● Early ● Middle ● Late



Source: Oppenheimer & Co 2016

LEISURE AND COMMERCIAL USAGE FOR SMALL REMOTELY PILOTED AIRCRAFT (RPA) IN THE UK

○ Commercial ○ Leisure

01 RISKS

Collisions with other airborne or stationary objects and risk of injury to people on the ground

Collisions with other airborne or stationary objects and risk of injury to people on the ground

02 PERMISSION

Permission from the Civil Aviation Authority (CAA) is required for commercial flights. Permission can be withdrawn in cases of misuse

Permission from the Civil Aviation Authority not required for short flights away from people/property/congested areas

03 FLYING RESTRICTIONS*

RPA system pilots can now apply to the CAA for permission to fly over congested areas and people. Flights are prohibited near restricted areas

No flights above 400 feet, closer than 50 metres to people/building or near restricted areas such as airports

*under Air Navigation Order 2009

04 PILOT QUALIFICATION

Pilot's ability is assessed as part of the CAA granting a permission to fly

None

05 DATA PROTECTION

UK Data Protection Act 1998 applies to commercial RPA use

UK Data Protection Act 1998 does not apply to data purely for personal or household use

06 LIABILITY INSURANCE

EU regulations require all commercial RPA pilots to purchase third-party liability insurance

None required

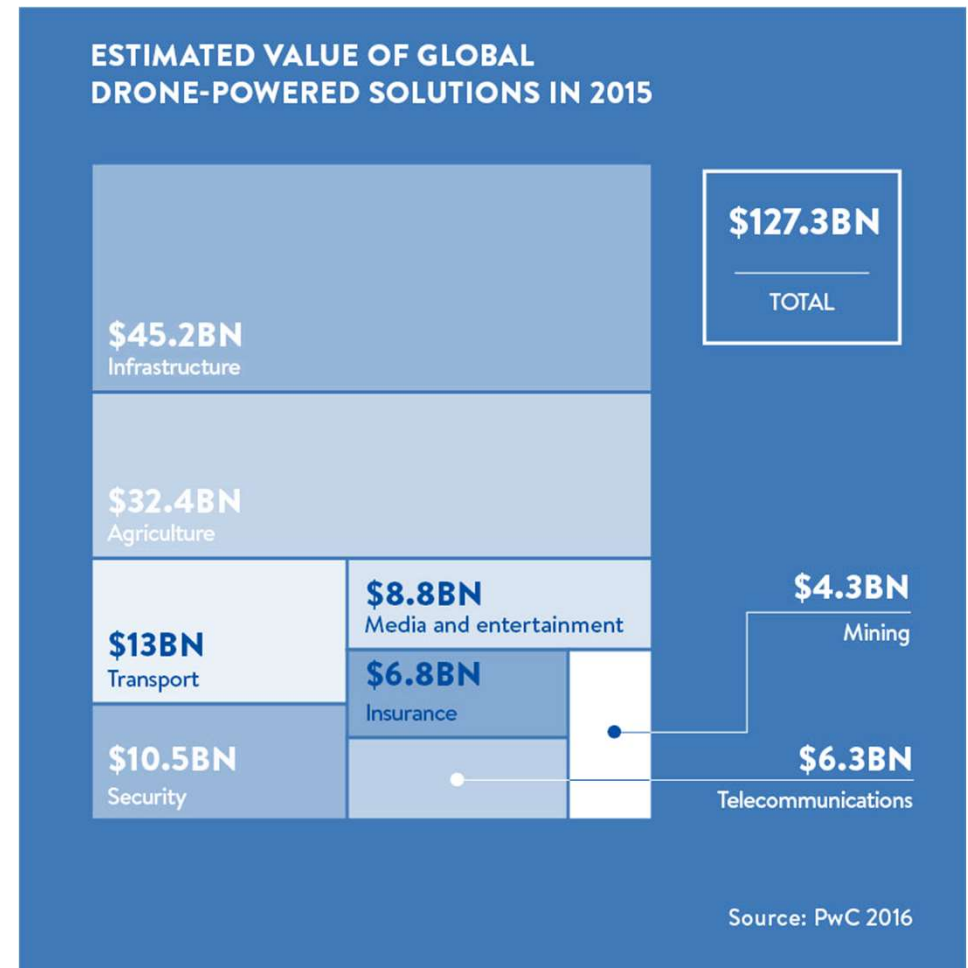
Source: European Union Committee/House of Lords 2015

Value Of Global Drone-powered Solutions

According to Big Four accountancy firm, PwC's 'Clarity from Above' report, the value of global drone-powered solutions was over \$127billions in 2015.

Infrastructure has the highest value of drone solutions followed closely by agriculture where drones analyze data on land and crops and ensure that crops are sprayed with the highest precision.

Transport has also seen significant disruption by drones, specifically in 'last mile services' or the final leg of the supply chain. Ecommerce company Amazon is set to launch Amazon Prime Air in the near future that will see packages delivered to customers in 30 minutes or less using drone technology.

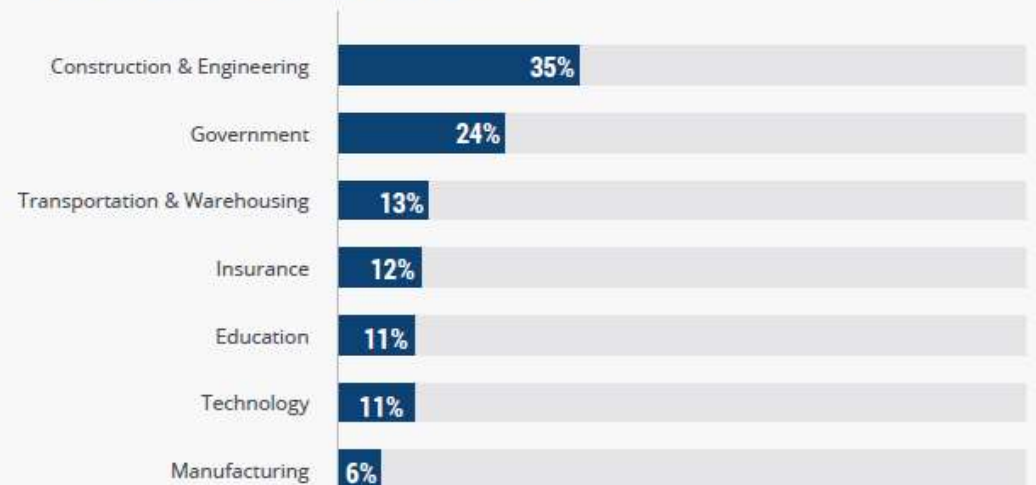


State of Drones in Big Business

Based on the research done by Blue Research, they sampled 1,736 individuals working for a random mix of US companies with \$50 million or more in revenue.

One in 10 companies with revenue of \$50 million and over use drones with the highest adoption in construction and engineering.

DRONE ADOPTION BY INDUSTRY

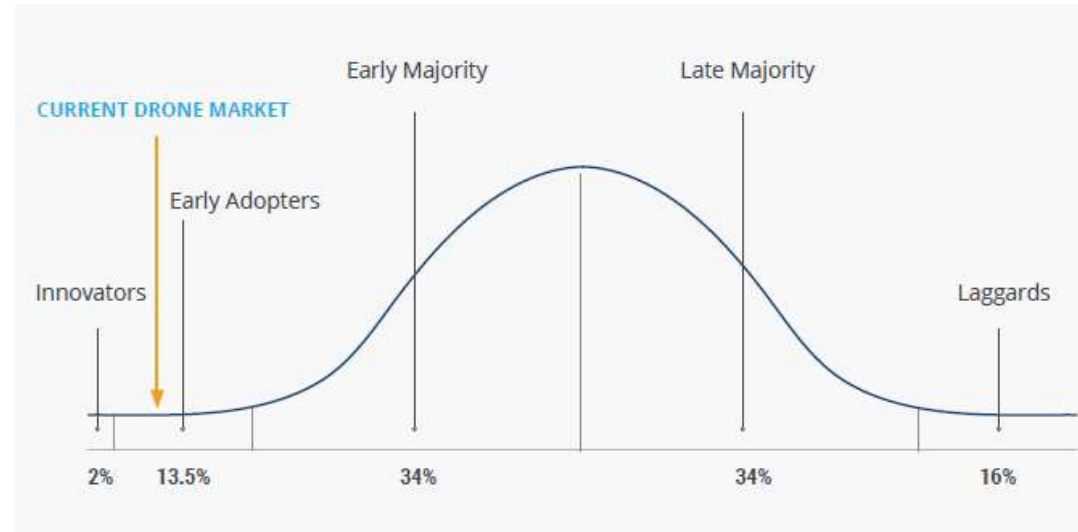


State of Drones in Big Business

There are 5 phases of technology adoption

- Innovators
- Early adopters
- Early majority
- Late majority
- Laggards

According to Everett Rogers, medium and large companies that have adopted drones are well within the innovator and early adopter categories as of early 2018



Stakeholders

Drone Ecosystem

Stakeholders in drone ecosystem

Drones may become a common sight in coming years and people will use them for all sorts of purposes:

- kids to play
- adults to take aerial vacation selfies
- companies are training their personnel in drone use
- and multinationals are investing in drone equipment and software development.



Commercial Applications

Drone Technology

Mapping & Surveying



Case study

Mapping and Surveying

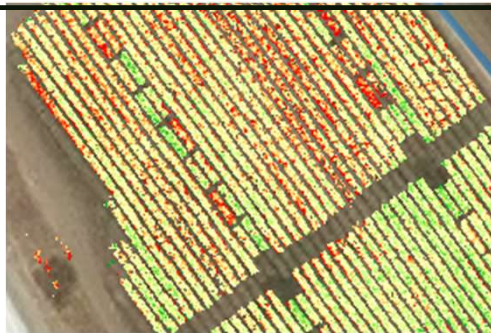


Agriculture

The NDVI algorithm takes advantage of the fact that green vegetation reflects less visible light and more NIR, while sparse or less green vegetation reflects a greater portion of the visible and less near-IR.

The range of values obtained is between -1 and +1.

Only positive values correspond to vegetated zones; the higher the index, the greater the chlorophyll content of the target.



NDVI

Uses

1. plant vigour
2. differences in soil water availability
3. foliar nutrient content (when water is not limiting)
4. yield potential

$$NDVI = \frac{(NIR - Red)}{(NIR + Red)}$$

A colour composite and not an Index.

Colour Infrared Composite (R: NIR, G: RED, B: GREEN). This colour composite highlights the response of the Near-infrared band to crop health and water bodies.



CIR Composite (Colour Infrared)

Uses

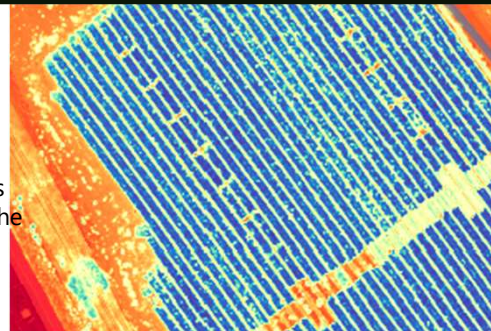
1. assessing plant health
2. identifying water bodies
3. variability in soil moisture
4. assessing soil composition

NDRE is an index that can only be formulated when the Red edge band is available in a sensor.

High values of NDRE represent higher levels of leaf chlorophyll content than lower values.

Soil typically has the lowest values, unhealthy plants have intermediate values, and healthy plants have the highest values.

Consider using NDRE if you are interested in mapping variability in fertilizer requirements



NDRE (Normalized Difference Red Edge)

Uses

1. leaf chlorophyll content
2. plant strength
3. stress detection
4. fertilizer demand

$$NDRE = \frac{(NIR - RE)}{(NIR + RE)}$$

Agriculture

The Chlorophyll Map is a layer that is less sensitive to leaf area than NDRE.

This layer isolates the chlorophyll signal from variability in leaf area as a function of changes in canopy cover. Relationship between canopy cover and canopy nutrient content.

This layer is less useful for row crops and more useful for vineyards and orchards, as the dense canopy is better at differentiating the Chlorophyll signal.



Chlorophyll Map

Uses

1. Detect chlorotic crops
2. Stress detection
3. Identify vigorous, healthy crops
4. Estimate chlorophyll content
5. Estimate N content if you know that N is limiting

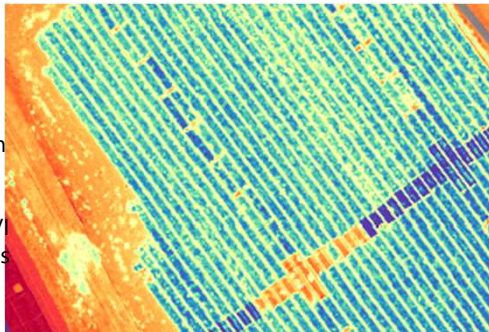
OSAVI maps variability in canopy density.

It is robust to variability in soil brightness.

This index is best used in areas with relatively sparse vegetation where soil is visible through the canopy and where NDVI saturates (high plant density).

OSAVI is a special case of the Soil Adjusted Vegetation Index (SAVI). The soil adjustment coefficient (0.16) is selected as the optimal value.

OSAVI values can range from -1 to 1. High OSAVI values indicate denser, healthier vegetation whereas lower values indicate less vigour.

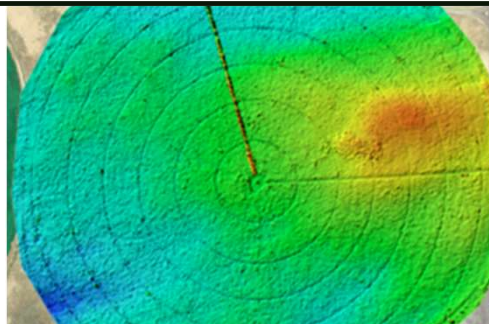


OSAVI (Optimized Soil-Adjusted Vegetation Index)

Uses

1. Differentiate soil pixels
2. Related to LAI at some levels where NDVI saturates
3. Accounts for non-linear interactions of light between soil and vegetation
4. Used as a structural index for some combined indices designed for chlorophyll detection

DSM resembles laying a blanket on your imagery. It represents top faces of all objects on the terrain, including vegetation and man-made features, and highlights the different elevations of the features



DSM (Digital surface Model)

Uses

1. estimate relative crop volume
2. identify surface properties
3. model water flow & accumulation

Agriculture

Crop type & area estimations

Different crop type can be classified by semi automated segment based classification techniques

Area of different types of crop can be automatically estimated

Crop area can be used:

1. Yield prediction
2. Damage assessment
3. Insurance claim etc.

CROP TYPE CLASSIFICATION

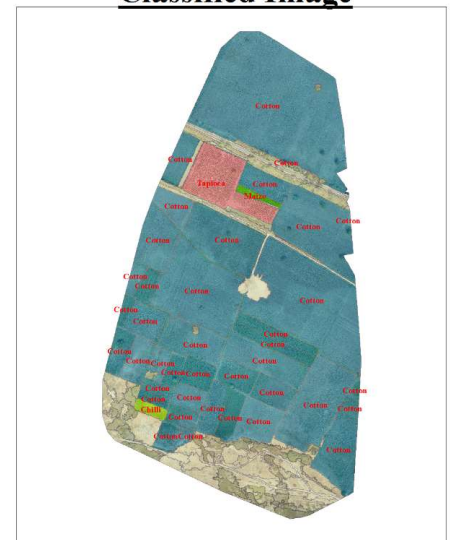
Base Image



Segmented Image








Classified Image



<u>Crop Type</u>	<u>Area (ha)</u>
Total Area	- 40.46 ha
Chilli	- 0.17 ha
Cotton	- 31.21 ha
Maize	- 0.12 ha
Tapioca	- 1.50 ha

Legend

	Others
	Chilli
	Cotton
	Maize
	Tapioca



Agriculture

Faster detection of disease

- Agricultural diseases, can have devastating and costly consequences
- If not detected early, the bacteria/virus can destroy a whole orchard
- Drones are seeing significant usage in the detection of such diseases
- Equipped with a hyperspectral/multispectral camera

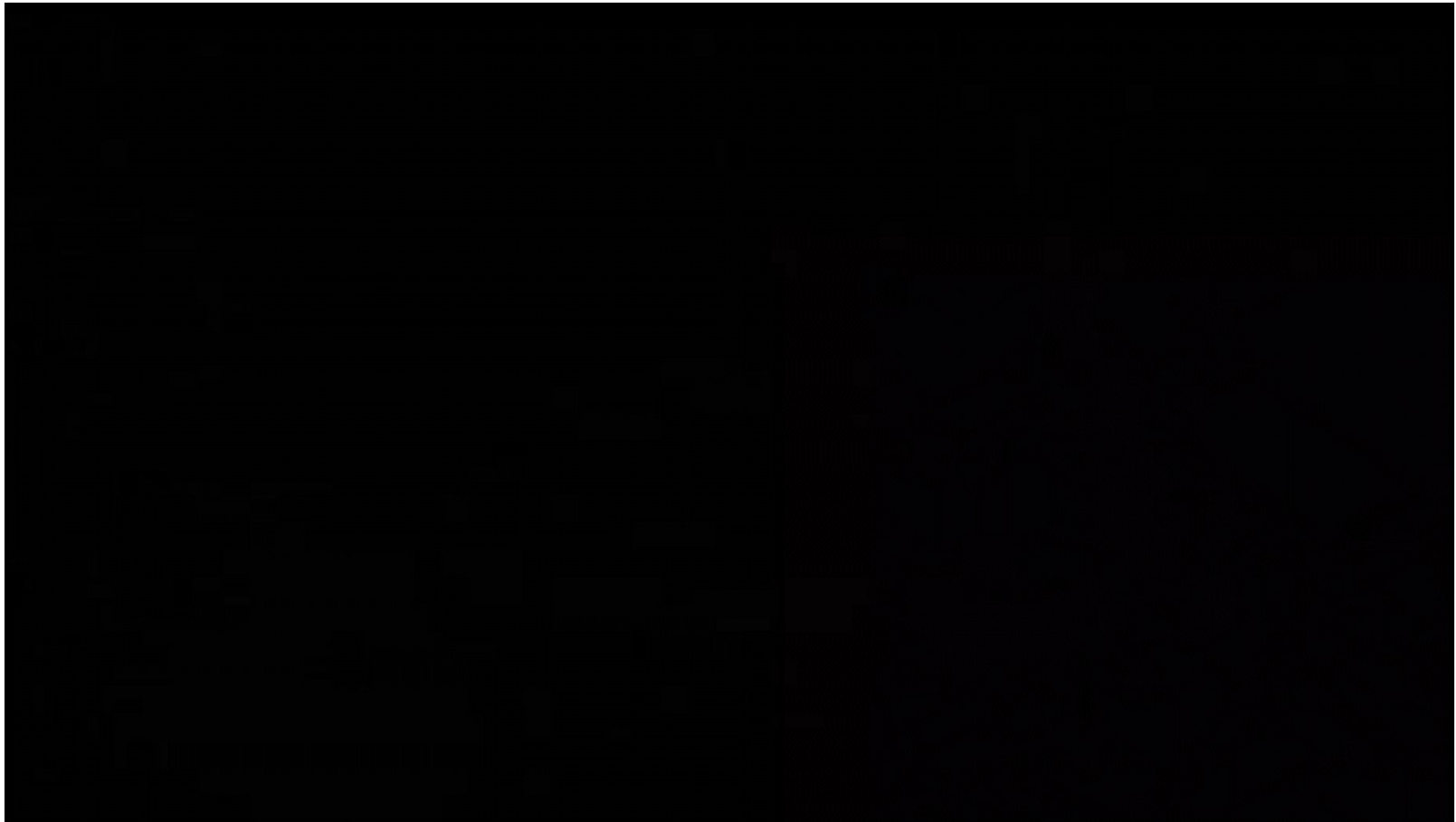


Agriculture



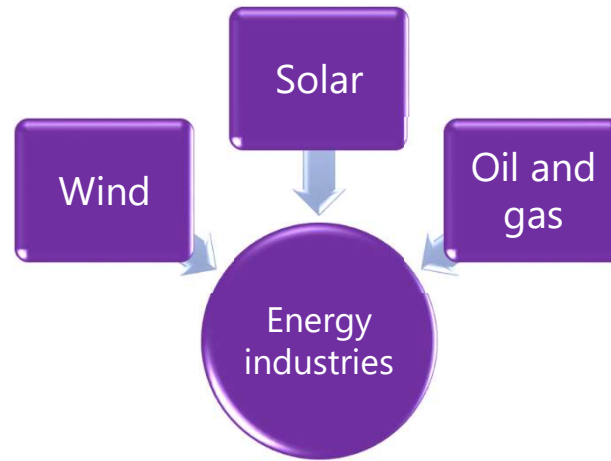


Agriculture



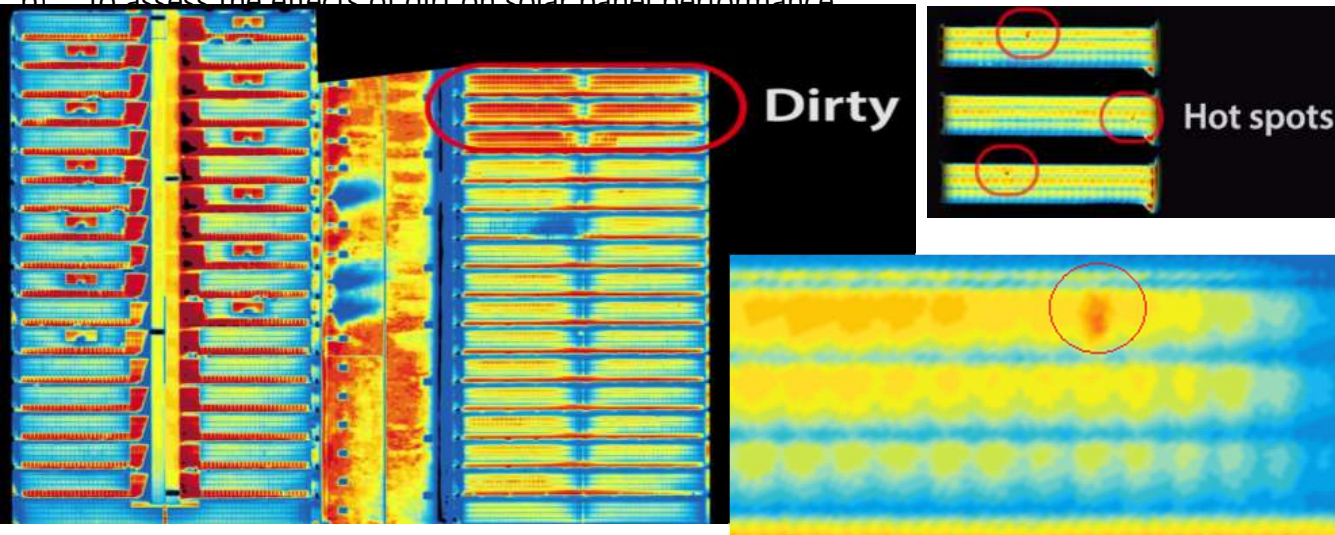
Energy

- abnormalities
- damage
- performance progress



Thermal Solar Panel health monitoring

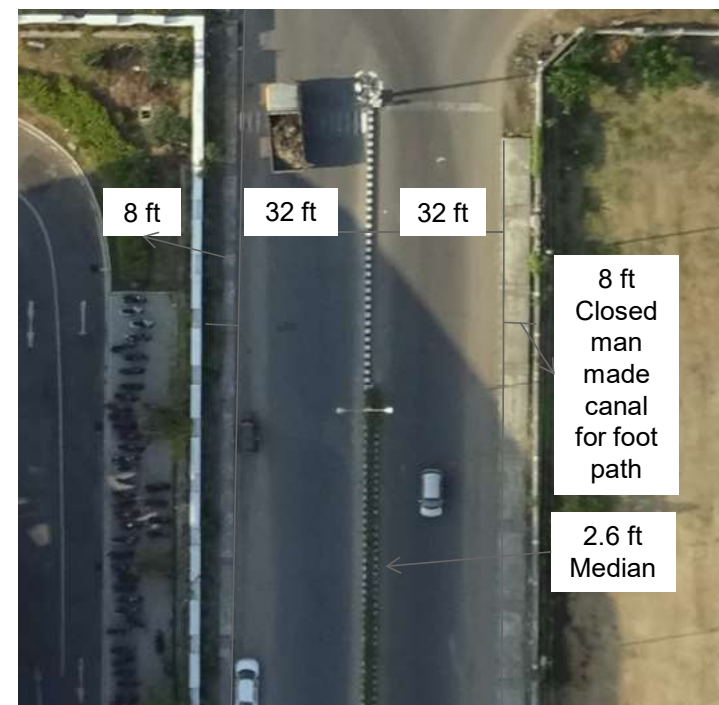
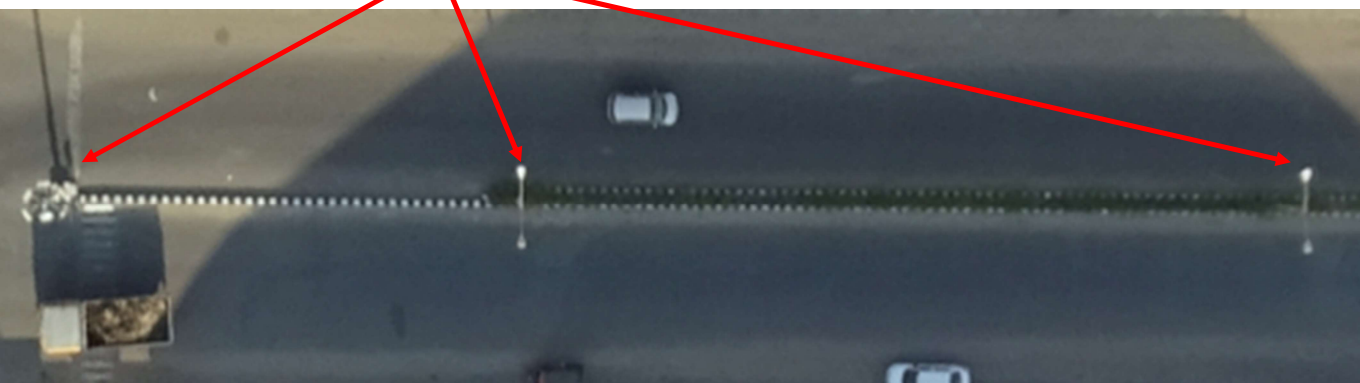
- to identify hotspots (indicating panels that, for some reason, are not working properly, or are completely turned off)
- to assess the effects of dirt on solar panel performance



Utilities

Drone Mapping for high resolution Utility Feature extraction

Street Lights



Infrastructure

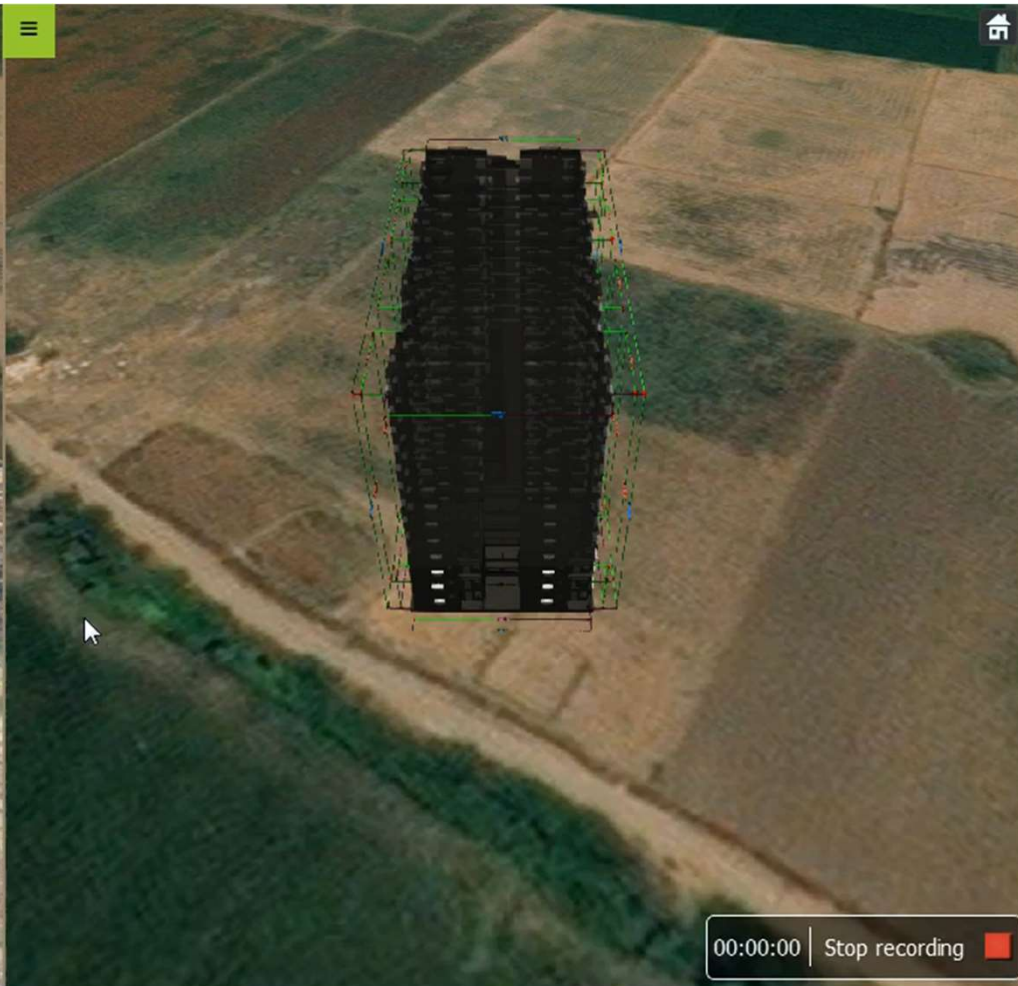
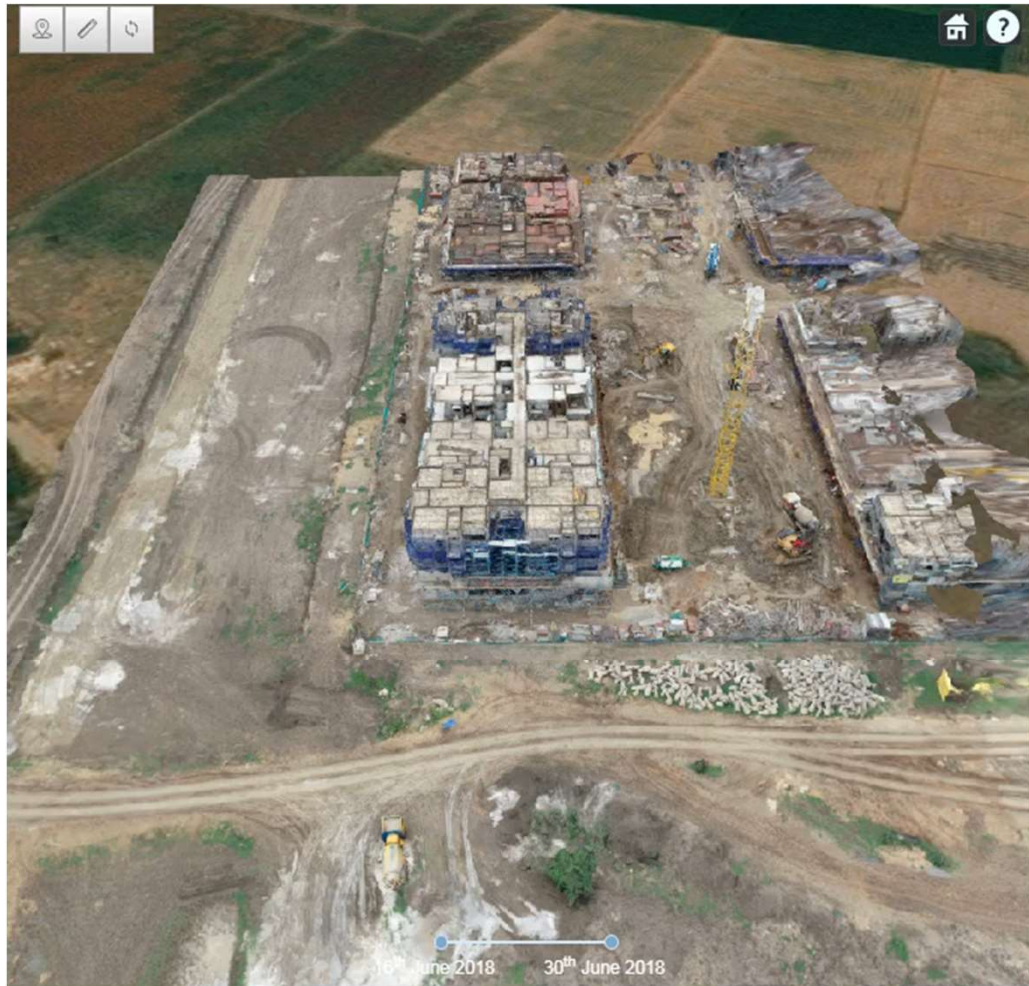
- Using drones to help manage infrastructure makes real sense.
- The construction industry – for construction sites, roads and railways – has already discovered the many ways in which drones can add value and is already reaping the rewards.
- Not only can drones perform hazardous work, but they also collect data accurately and in a cost-efficient way.



Infrastructure



Infrastructure



Mining

- Mine Surveying
- Area Estimation
- Volume Estimation
- Cut and Fill analysis
- Easy Updating
- Stockpile evaluation & volume calculation
- Works monitoring
- Distance & cross-section measurement
- and much more

SHORT-TERM PLANNING

- Pit & dump management
- Communication of daily/weekly mining plans
- Haul route surface optimisation
- Storm damage assessment & control

LONG-TERM PLANNING

- Haul road, dump and pit design
- Geotechnical
- Surface stability monitoring
- Joint mapping
- Control for mining in void areas
- Mapping of steep inaccessible inclines

DRILL & BLAST

- Up-to-date surfaces for optimised blast designs
- Pre- & post-blast data
- Identification of misfires & wall damage

GEOLOGY

- Stock pile management
- Grade control & exploration planning

HYDROLOGY

- Drainage and water management
- Watershed, drainage basin & water flow mapping
- Thermal detection of ground water inflows
- Tailings dam management

CONSTRUCTION

- Feasibility studies
- Leach pad, dam wall & platform construction quality control
- Progress monitoring & reporting

Challenges

Drone Technology

Challenges in Malaysian context



Proving positive ROI

Rules and regulations

Challenges

Finding qualified drone operators

Internal policies/ procedures



Challenges in Malaysian context

Rules and regulations

- Staying up to date on rules and regulations
- Obtaining access and permission to fly at controlled air space
- Having the most current info about where drone can fly

Internal policies / procedures

- To ensure drone operators to follow a standard internal policies such as pre-flight checklist, flight procedures, data storage etc.
- Minimizing the amount of time doing pre-planning

Challenges in Malaysian context

Finding qualified drone operators

- To look for the right man with proper training and right attitude to operate valuable drone for the company and clients
- The job is not only ensure safe flight but also included with successful capture of right data.

Proving positive ROI

- To calculate the cost and revenue to prove that drones can help increase revenue and reduce the operating cost which lead to positive ROI

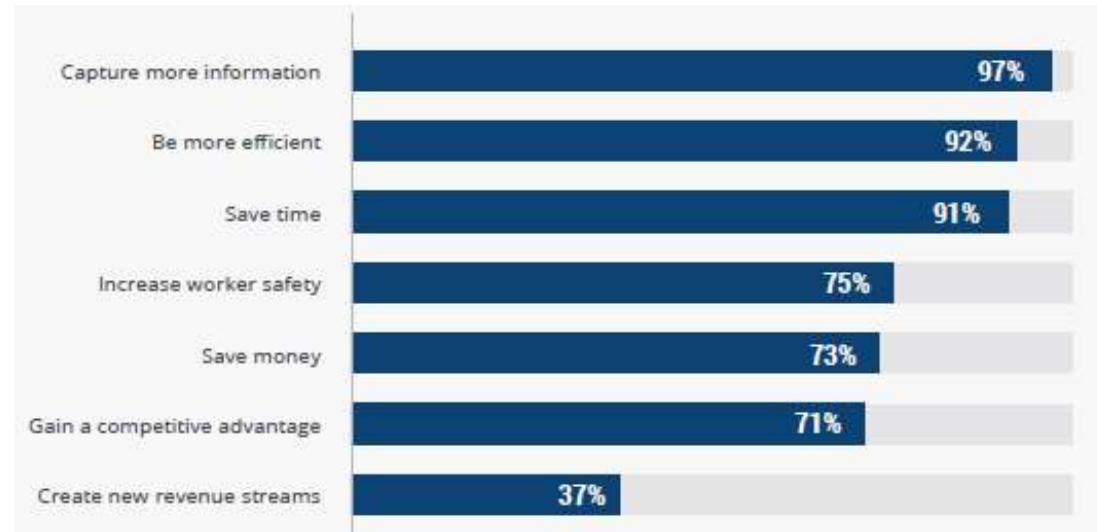
Benefits & Opportunities

Drone Technology

Drones value added to the company

Most people identified capturing more information, greater efficiency and save time are the important add-on values to their company and clients.

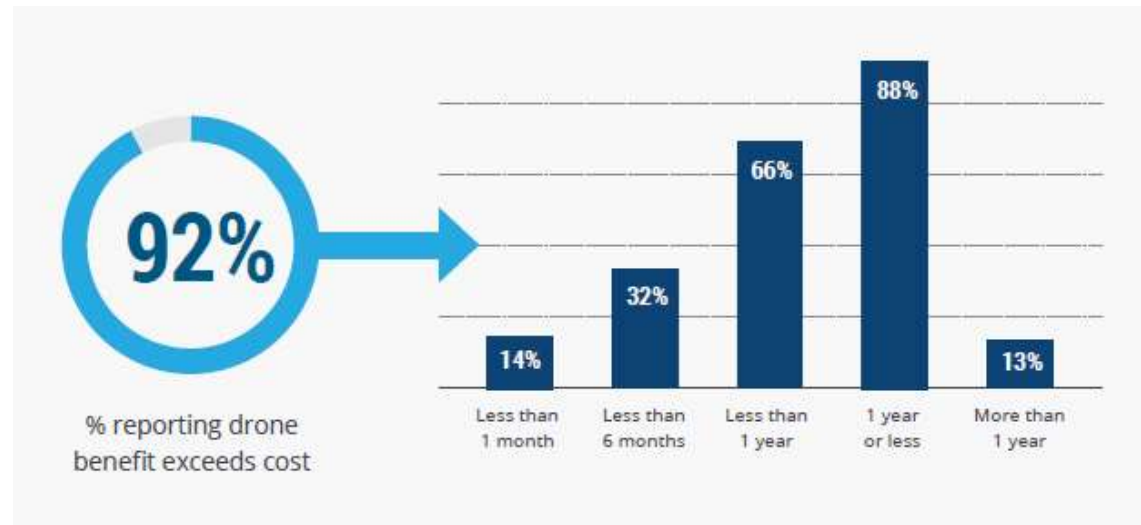
More than 70% acknowledged worker safety, save money and give competitive advantage.



Positive ROI on drones

Vast majority of respondents report that:

- The benefits of having drones exceed the cost
- Positive return on investment in drones in one year or less



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