Drones in Surveying and Spatial Science Projects

ACE AVIATION
AEROSPACE ACADEMY

How to make the best use of RPAS Technology

Table Of Contents

Acronyms

RPAS / Remotely Piloted Aircraft Systems

GCP / Ground Control Points

RTK / Real Time Kinematic

UAV / Unmanned Aerial Vehicle

RePL / Remote Pilot License

ReOC / Remote Operator Certificate

PPK / Post Process Kinematic

RGB / Red Green Blue Camera

Overview

RPAS (Remotely Piloted Aircraft Systems), also known as UAV (Unmanned Aerial Vehicle) or Drones, are experiencing exponential growth as a new tool for data acquisition in many different environments and applications. Given their great aerial advantage, simplicity to deploy and reliability, there is no doubt drones are taking over the scene in many industries. Surveying and Spatial Science related projects are no exception.

RPAS Technology Advantages

1. Precision and Accuracy

2. Autonomy and Repeatability

3. User Friendly

4. Efficiency and Productivity

5. Safety

6. Cost Effective

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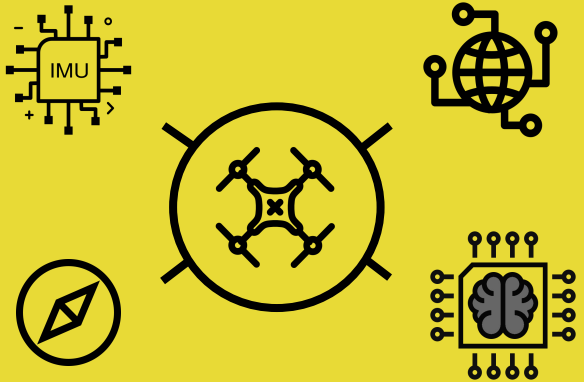
Precision and Accuracy

Internal



External

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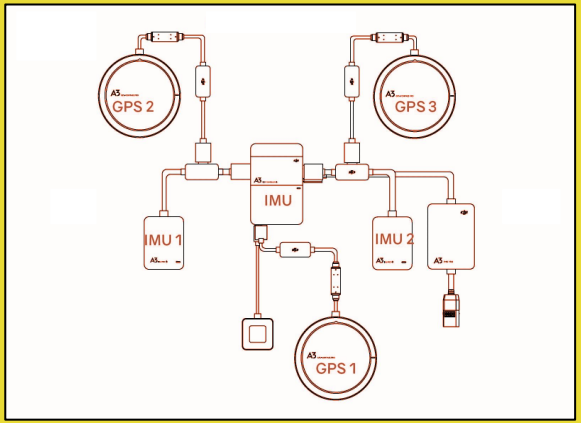
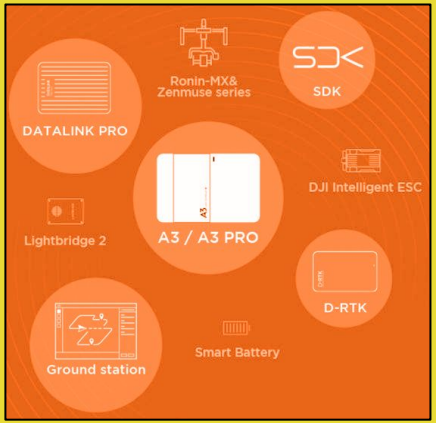
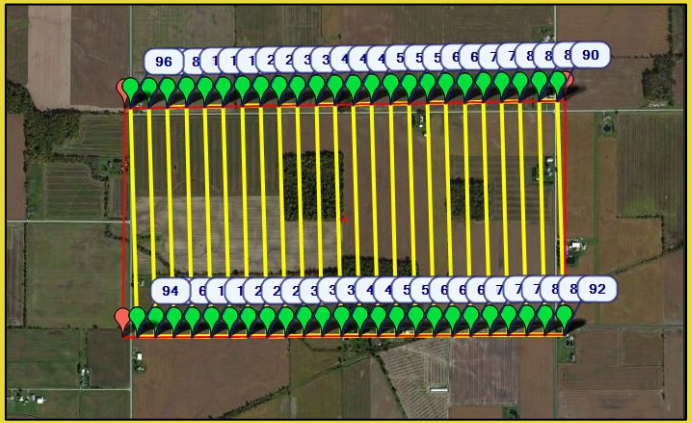
Autonomy and Repeatability







User Friendly

PRECISION FLIGHT

PIX4D CAPTURE

AP

GSP

dji 4.0

eMotion
senseFly

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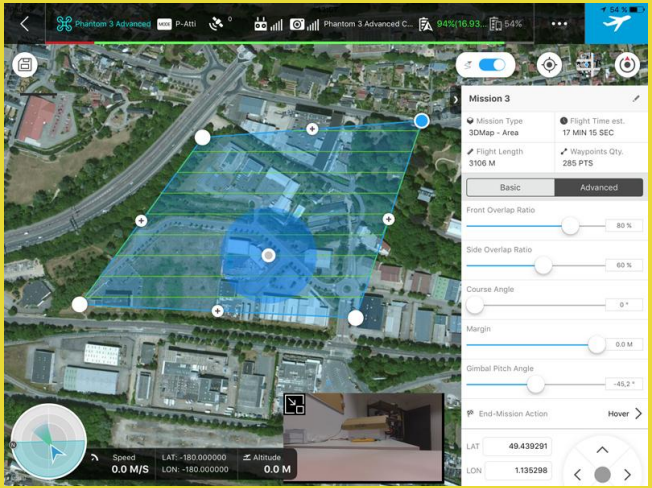
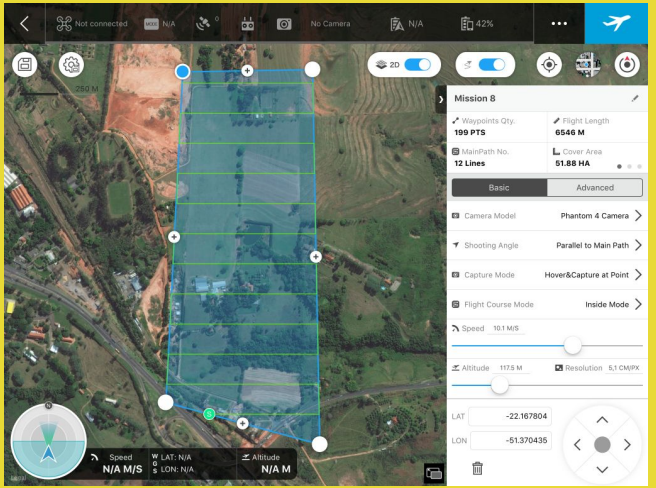
Efficiency and Productivity



Average area coverage per flight

20Ha



Safety

High Human Interaction

Limited Human Interaction

Remote Interaction

Cost Effective

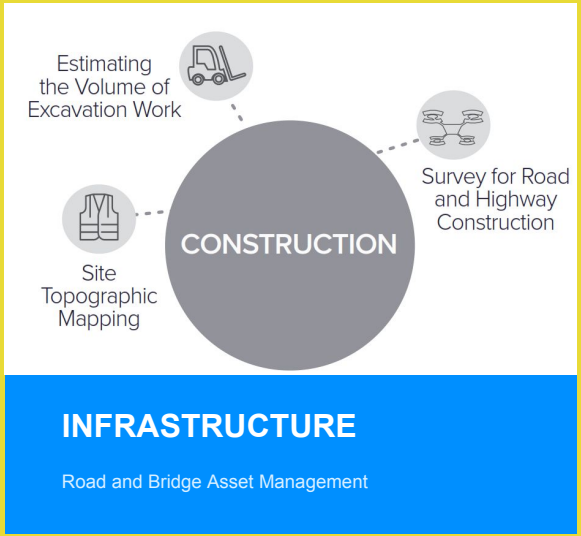
Average setup cost

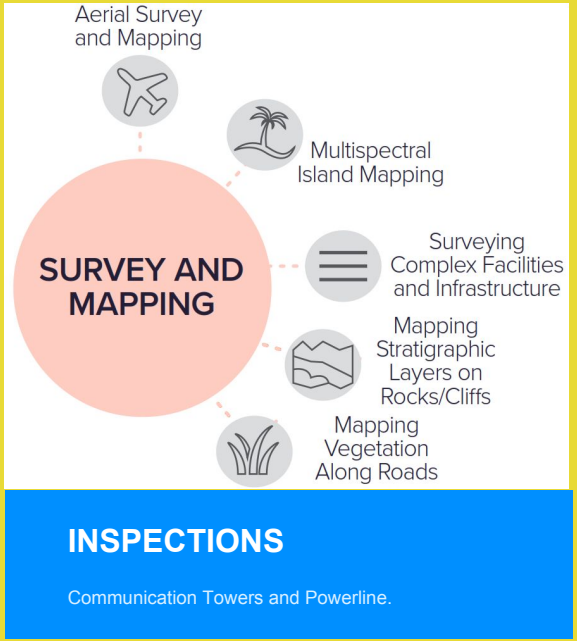
$20K

RPAS Tech In The Surveying Workflow

UAV Market trends

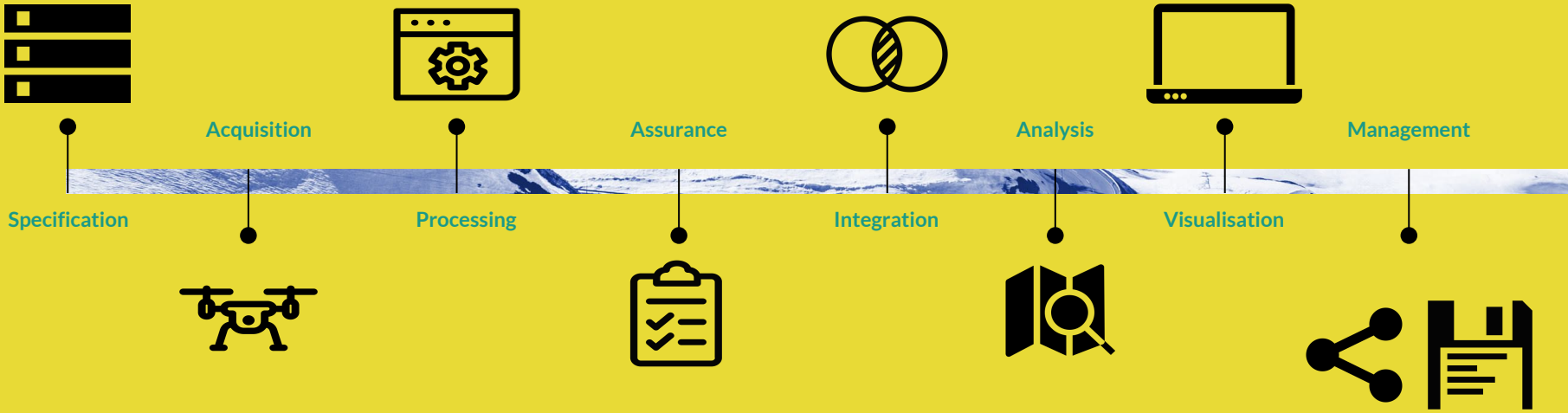
2018





Source: FrontierSI UAV Data Acquisition In Australia And New Zealand User Needs Report August 2018

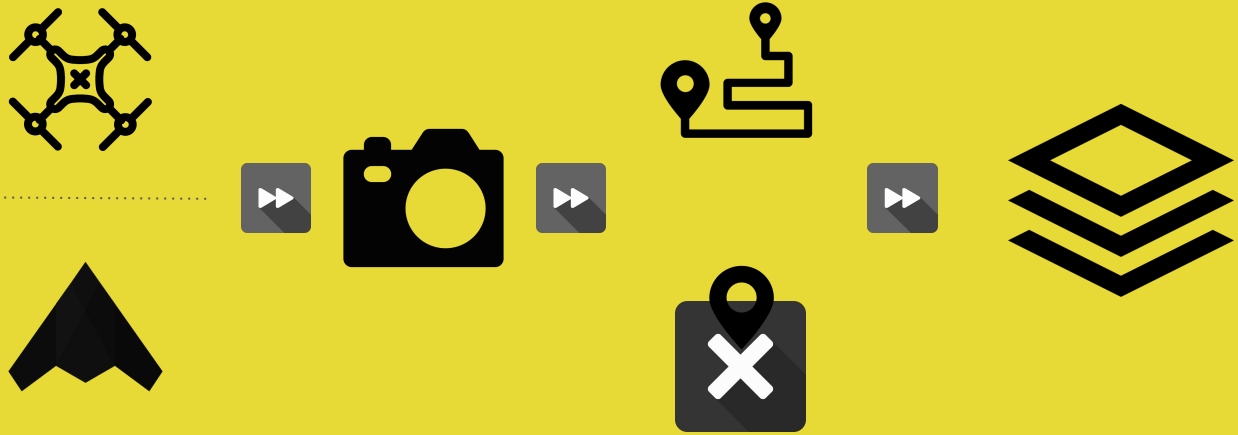
UAV/RPA Project Workflow



Source: FrontierSI UAV Data Acquisition In Australia And New Zealand User Needs Report August 2018

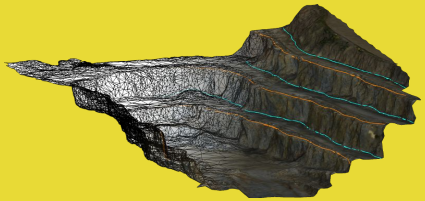
Acquisition workflow

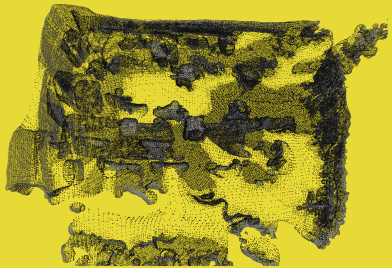
02



Processing Workflow

03





RPAS Platforms and Sensors

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Multirotor and Fixed Wing Manufacturers

Commonly used Platforms

AUD 18000.-

XAG C2000

12Mp
133Ha

RTK + AI + Data Integration
with other XAG quadcopters

AUD 11000.-

Sensefly eBee RTK/PPK

20Mp
220Ha

Long Range/Endurance
consolidated Fixed Wing

Commonly used Platforms

AUD 5000.-

DJI Phantom 4 Pro

20Mp
16Ha

Most common quadcopter deployed

AUD 2500.-

Yuneec Tornado H920

16Mp
12Ha

Highly portable hexacopter

Commonly used Platforms

AUD 5000.-

DJI M210 RTK

20Mp*
16Ha

Widest payload range, Upward Gimbal, Dual Gimbal array

AUD 13000.-

DJI Inspire 2

20Mp*
16Ha

Interchangeable payloads, supports X4S gimbal camera, robust and stable platform

Commonly used Platforms

DJI M600 Pro

16Mp*

20Ha

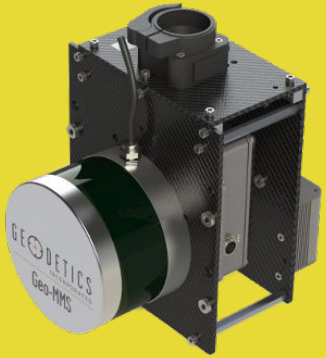
Heavy lift platform, Superior stability and redundancy, LiDAR

AUD 7000.-

Commonly used RGB Sensors

Camera	Megapixels Mp	Sensor Size (mm)	Focal Length (mm)	Compatibility	GCD Ground Sample distance at 120m cm/pixel	Shutter
Phantom 4	12.0	12.0	6.27x4.55	Phantom 4	**5.2**	Rolling Shutter
Phantom 4 Pro	20.1	20.1	12.8x9.6	Phantom 4	**3.2**	Mechanical Shutter
DJI Zenmuse X3	12.0	12.0	6.27x4.55	Inspire 1/M100/ M600	**5.2**	Rolling Shutter
Canon 5Ds	50.6	50.6	36x24	M600/ALTA 8/ Altura Zenith	With 35mm lens **0.9471**	Mechanical Shutter
Canon 5D Mark 3	22	22	36x24	M600/ALTA 8/ Altura Zenith	With 35mm lens **1.3714**	Mechanical Shutter
DJI Zenmuse X5	16.0	16.0	17.3x13	Inspire 1/M100/ M600	With 15mm lens **3**	Rolling Shutter
DJI Zenmuse X5S	20.1	20.1	17.3x13	Inspire 2	With 15mm lens **2.7**	Rolling Shutter
DJI Zenmuse X4S	20.1	20.1	12.8x9.6	Inspire 2	**3.3**	Mechanical Shutter
DJI Zenmuse Z30	20.1	20.1	6.27x4.55	M100/M600	**3.4-0.3**	Rolling Shutter
DJI Zenmuse Z3	20.1	20.1	6.27x4.55	Inspire 1/M100/ M600	**4.8-1.4**	Rolling Shutter
Sony RX100 VI	20.13	20.13	24-70	M600	**3.3-2.15**	Mechanical Shutter

propeller



Other Sensors available

LiDAR X30Z Thermal

GCP vs RTK / PPK

GCP & GPS Correction Technology

Ground Control Points (GCP)

Real Time Kinematic (RTK)

Post Processed Kinematic (PPK)

GCP Advantages & Limitations

Average Operation Time

>1-3Hrs

Placing and removing GCP's

Safety Limitations

Medium

Requires access and transportation to each GCP on the whole site

Propeller Aero Points

AUD9K

Smart Ground Control Points

RTK Advantages & Limitations

Average Operation Time

1-3Hrs

Should a dropout in the signal occur, the whole data acquisition needs to be restarted

Safety Limitations

Medium

Requires robust link conditions for Aircraft position corrections

GNSS Base Station and Receiver

AUD12K

Ground Control Points

PPK Advantages & Limitations

Average Operation Time

<1Hrs

Flight time determines the operation's duration

Safety Limitations

Low

Only requires access to area of deployment to maintain VLOS

Klau PPK

AUD12K

PPK Integration Kit for DJI RPAS

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Trend analysis

GCP

PPK

Software & Deliverables

Post Processing Software

DroneDeploy

TERRA MAPPER

PRECISIONMAPPER

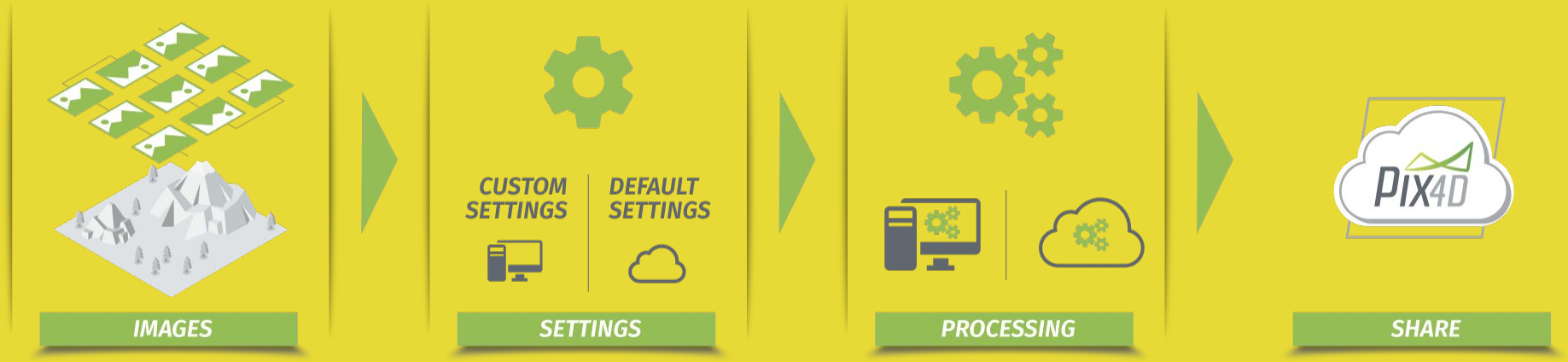
PhotoScan
3D Modeling and Mapping
Agisoft

propeller

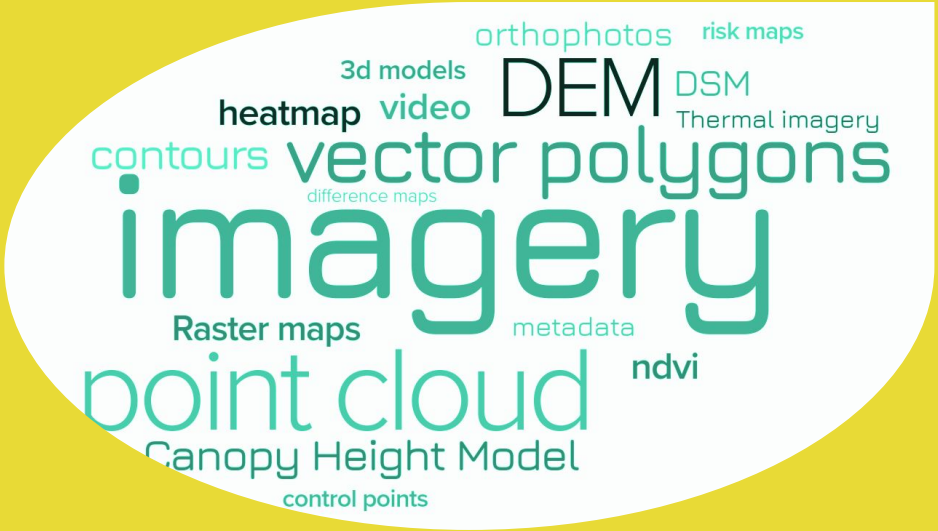
PIX4D MAPPER

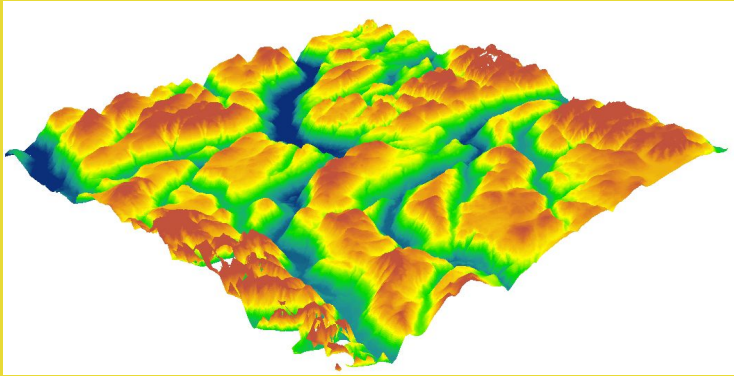
Botlink

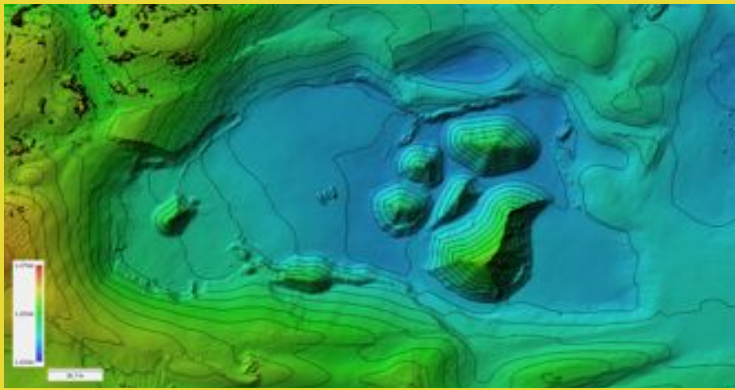
Software workflow



Deliverables







Source: FrontierSI UAV Data Acquisition In Australia And New Zealand User Needs Report August 2018

Densified Point Cloud

File format	Software	Use
.las	Quick Terrain Reader	Visualization
	Global Mapper ArcGIS	Visualization
	VRMesh	Visualization Point cloud classification
	LAStools	DTM generation
.laz	Quick Terrain Reader	Visualization
	Global Mapper	Visualization
	LAStools	DTM generation
.xyz (very large file)	AutoCAD AutoCAD Civil 3D Global Mapper Virtual CRASH	Visualization
.ply	Meshlab	Visualization
	VRMesh	Visualization Point cloud classification
	Sketchfab	Web viewing and sharing

Digital Surface Model (DSM)

Grid DSM

File format	Software	Use
.las	Quick Terrain Reader	Visualization
	Global Mapper ArcGIS	Visualization
	VRMesh	Visualization Point cloud classification
	LAStools	DTM generation
.laz	Quick Terrain Reader	Visualization
	Global Mapper	Visualization
	LAStools	DTM generation
.xyz	AutoCAD Global Mapper	Visualization

Pix4D main output formats

For more formats please visit pix4d.com

Digital Terrain Model (DTM)

Raster DTM

File format	Software	Use
.tif (GeoTIFF)	Global Mapper ArcGIS Quantum GIS	Contour lines generation Distance and area measurements

Orthomosaic

Orthomosaic GeoTIFF

File format	Software	Use
.tif (GeoTIFF)	Global Mapper ArcGIS Quantum GIS AutoCAD	Distance and area measurements 2D digitization

Orthomosaic KML file

File format	Software / Web Application	Use
.kml	Google Earth	Visualization

Pix4D main output formats

For more formats please visit pix4d.com

3D Textured Mesh

File format	Software	Use
.obj	Meshlab, Global Mapper, Rhino, 3ds Max, 3DBuilder , Autodesk Maya	Visualization
.fbx	Rhino, 3ds Max, AutoCAD 3ds Max, Blender Autodesk Maya, Cinema 4D	Visualization
.dxf	Global Mapper ArcGIS Quantum GIS	Visualization only the triangle mesh
.dxf (polylines)	AutoCAD Global Mapper	Visualization only the triangle mesh
.ply	Meshlab	Visualization
	Sketchfab	Web viewing and sharing
	Blender, Meshmixer	3D printing
.pdf	Adobe Acrobat Reader	Visualization
.osgb	Skyline TerraBuilder, SuperMap, Acute3D	Visualization
.slpk	ArcGIS Online, ArcGIS Earth	Web Viewing

3D Digitized objects

Polyline, Surface, Volume (base surface)

File format	Software	Use
.shp	Global Mapper ArcGIS Quantum GIS AutoCAD	Visualization Editing
.dxf	Global Mapper ArcGIS Quantum GIS AutoCAD	Visualization Editing
.kml	Google Earth	Visualization
.dgn	MicroStation	Visualization Editing

Contour lines

File format	Software	Use
.shp	Global Mapper ArcGIS Quantum GIS	Visualization Editing
.pdf	Adobe Acrobat Reader	Visualization
.dxf	AutoCAD Global Mapper ArcGIS Quantum GIS	Visualization Editing

Video animation

File format	Software	Use
.mp4	VLC Windows Media Player	Video animation viewing
.mkv	VLC Windows Media Player	Video animation viewing
.avi	VLC Windows Media Player	Video animation viewing

RePL Training & Licensing

AUSTRALIA'S LARGEST MULTI CAMPUS TRAINING FACILITY

TRAINING | ENGINEERING | EDUCATION

Students trained

>1000

Australia wide and Singapore

Campuses

5

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Corporate Training

tafe Queensland

SES RESCUE

Moreton Bay College
Breadth of mind. Depth of heart.

JFOP URBAN CONSULTANTS

SHELDON COLLEGE

PUB SINGAPORE'S NATIONAL WATER AGENCY

seqwater WATER FOR LIFE

ADVANCE QUEENSLAND

Licensing growth

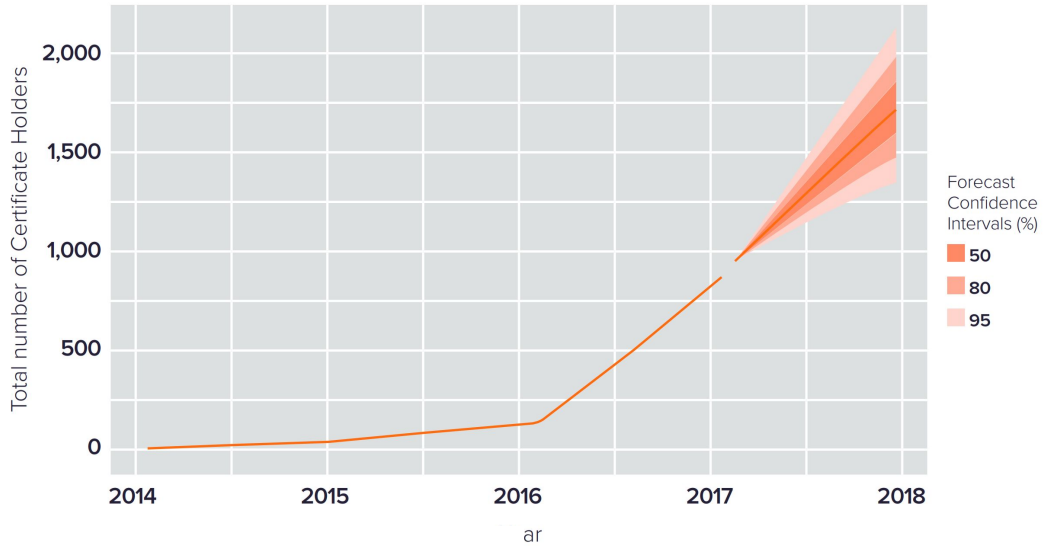

Figure 4: Total Number of CASA registered UAV certificate holders (Jan 2014 to Jan 2017)2 (Source: ATSB [22])

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Pricing

$1295

Remote Pilot's License Online

Self study + 2 Days in class.

$2295

Remote Pilot's License

Suitable for individuals looking to enter the commercial RPA industry

$3395

Remote Pilot's License
+ Express ReOC

Suitable for individuals looking to enter the commercial RPA industry & start their own drone business (ReOC)

$3695

Remote Pilot's License
+ Express ReOC
+ Type endorsement

Suitable for individuals looking to fly heavier equipment & start their own drone business

$4695

Remote Pilot's License
+ Express ReOC
+ Type endorsement
+ Certificate III

Our ultimate package, check inclusions and compare savings by bundling all together

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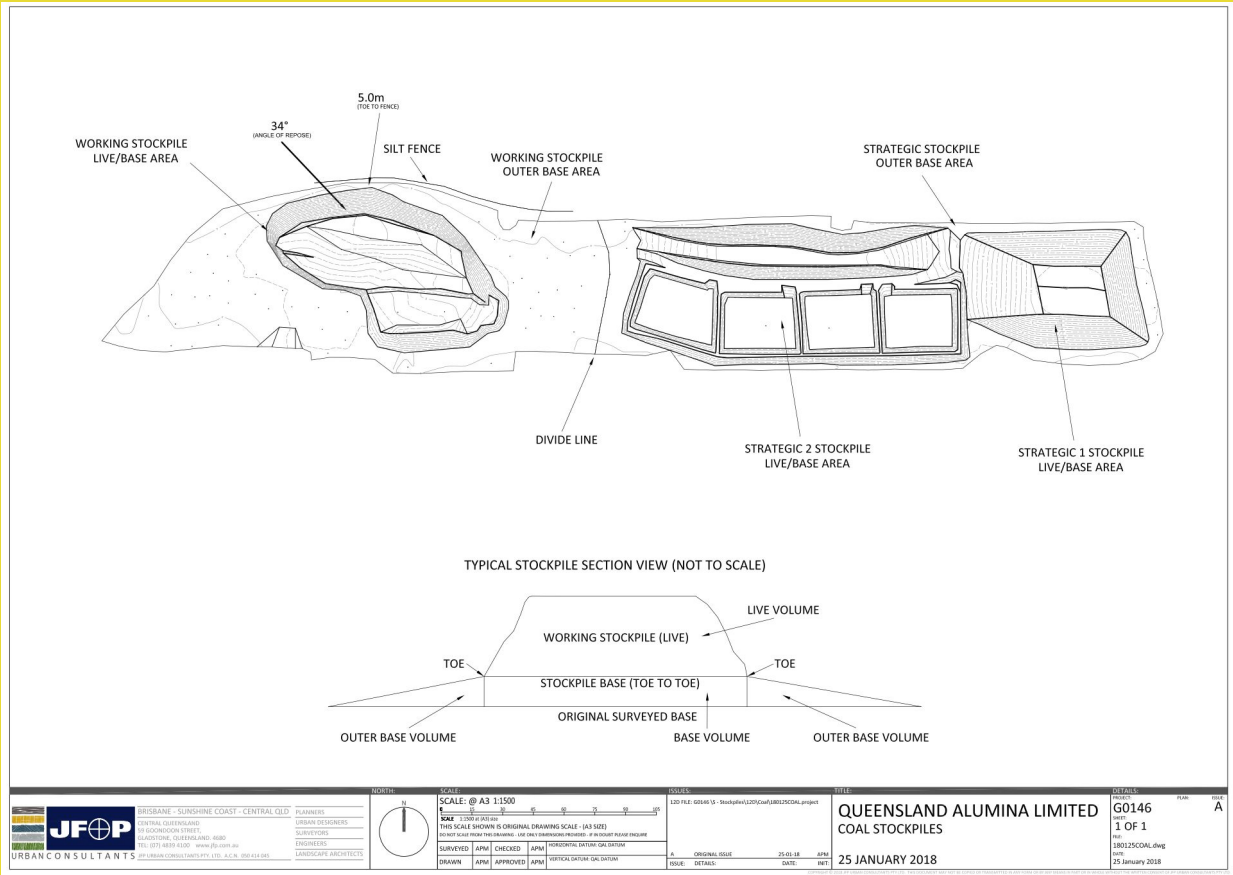
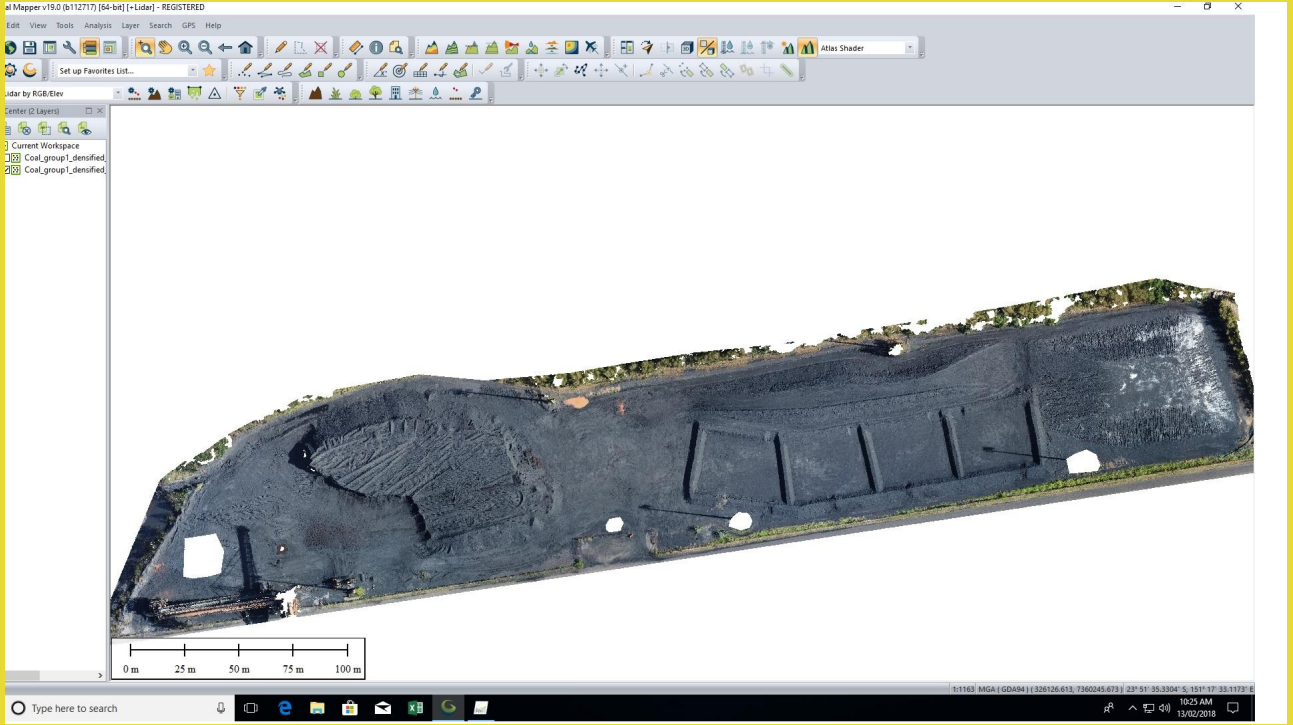
Case Study

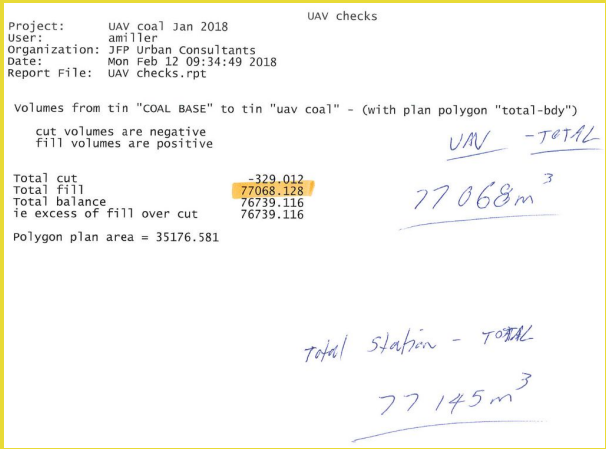
Volumetric comparison



Volumetric comparison



Volumetric comparison



UAV checks

Project: UAV coal Jan 2018
User: amiller
Organization: JFP Urban Consultants
Date: Mon Feb 12 09:34:49 2018
Report File: UAV checks.rpt

Volumes from tin "COAL BASE" to tin "uav coal" - (with plan polygon "total-bdy")

cut volumes are negative
fill volumes are positive

Total cut	-329.012
Total fill	77068.128
Total balance	76739.116
ie excess of fill over cut	76739.116

Polygon plan area = 35176.581

UAV - TOTAL
77068m³

Total Station - TOTAL
77145m³

Difference

0.09%

77m³

Total Station

77,145m³

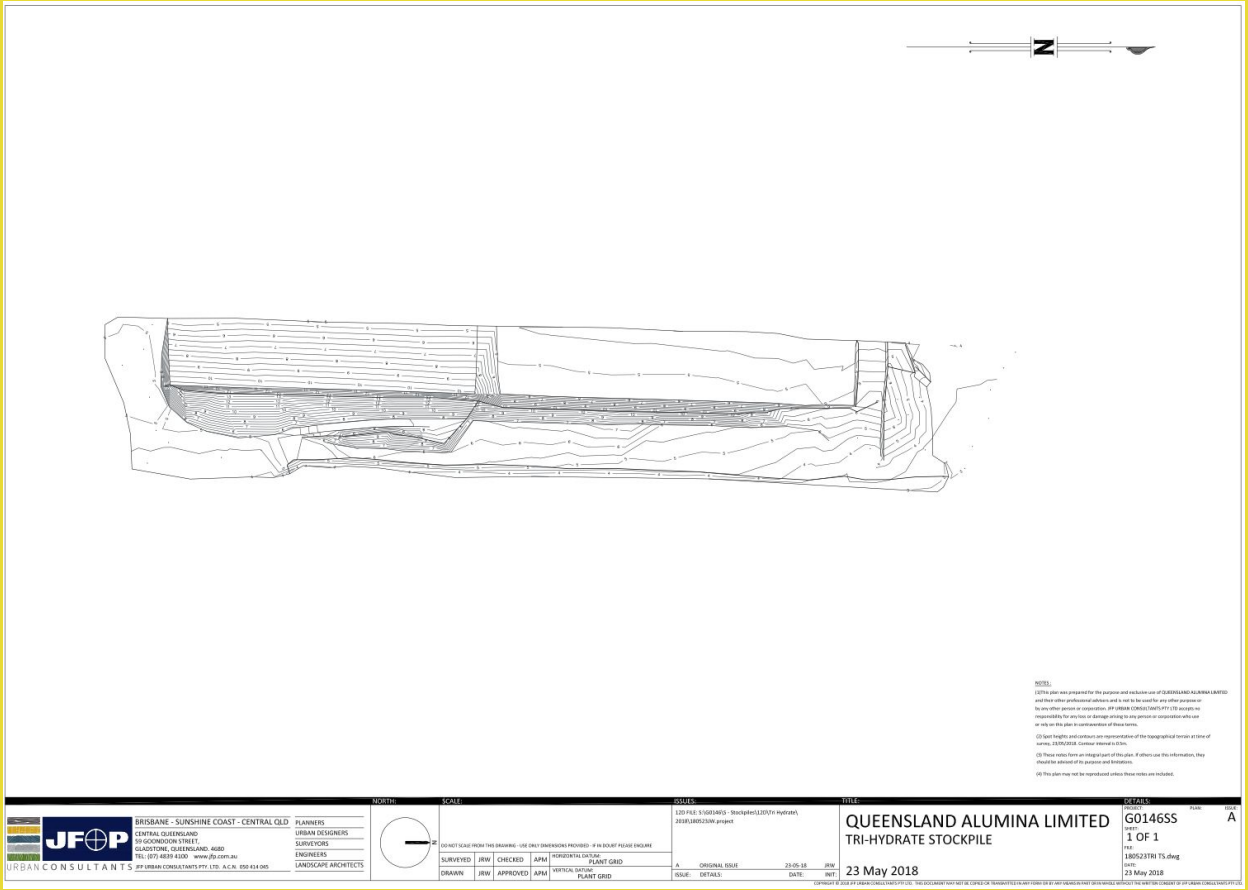
Leica TS

UAV

77,068m³

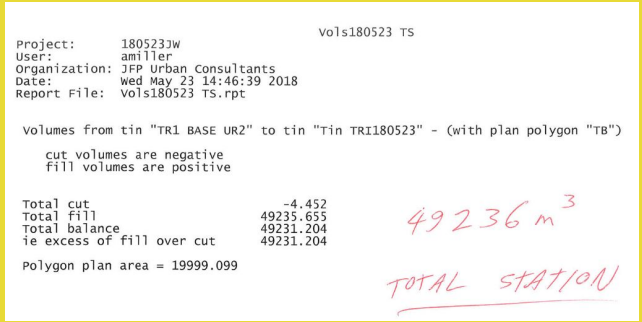
GCP + Inspire 2 + X4S cam

Volumetrics comparison



Volumetrics comparison

Volumetric comparison



Vols180523 TS

Project: 180523JW
User: amiller
Organization: JFP Urban Consultants
Date: Wed May 23 14:46:39 2018
Report File: Vols180523 TS.rpt

Volumes from tin "TR1 BASE UR2" to tin "Tin TRI180523" - (with plan polygon "TB")

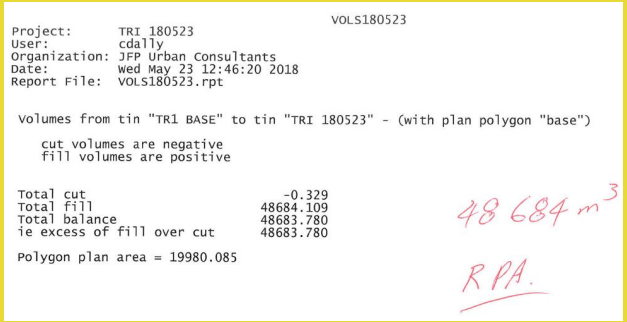
cut volumes are negative
fill volumes are positive

Total cut	-4.452
Total fill	49235.655
Total balance	49231.204
ie excess of fill over cut	49231.204

Polygon plan area = 19999.099

49236 m³

TOTAL STATION



VOLS180523

Project: TRI 180523
User: cdally
Organization: JFP Urban Consultants
Date: Wed May 23 12:46:20 2018
Report File: VOLS180523.rpt

Volumes from tin "TR1 BASE" to tin "TRI 180523" - (with plan polygon "base")

cut volumes are negative
fill volumes are positive

Total cut	-0.329
Total fill	48684.109
Total balance	48683.780
ie excess of fill over cut	48683.780

Polygon plan area = 19980.085

48 684 m³

RPA.

Difference

1.12%

552m³

Total Station

49,236m³

Leica TS

UAV

48,684m³

GCP + Inspire 2 + X4S cam

Useful links

01 | **eBee RTK Accuracy Assessment** https://www.sensefly.com/app/uploads/2017/11/eBee_RTK_Accuracy_Assessment.pdf

02 | **FrontierSI UAV Report 2018** https://frontiersi.com.au/wp-content/uploads/2018/04/FrontierSI-overview.pdf

03 | **KLAU Geomatics PPK Positioning Systems** http://geomatics.com.au/

04 | **Propeller Blog on cameras** https://blog.propelleraero.com/what-makes-a-good-camera-for-drone-surveys-and-inspections-460fb9fb7099

05 | **Ace Aviation Aerospace Academy** https://aceaviation.com.au/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Q&A

Thank you.

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n.austin@aceaviation.com.au