

THE SURVEYOR OF THE FUTURE

Workshop Welcome



the **decline** in oil reserves



V



the **growth** in digital data

Monitoring and modelling changing realities is the next challenge



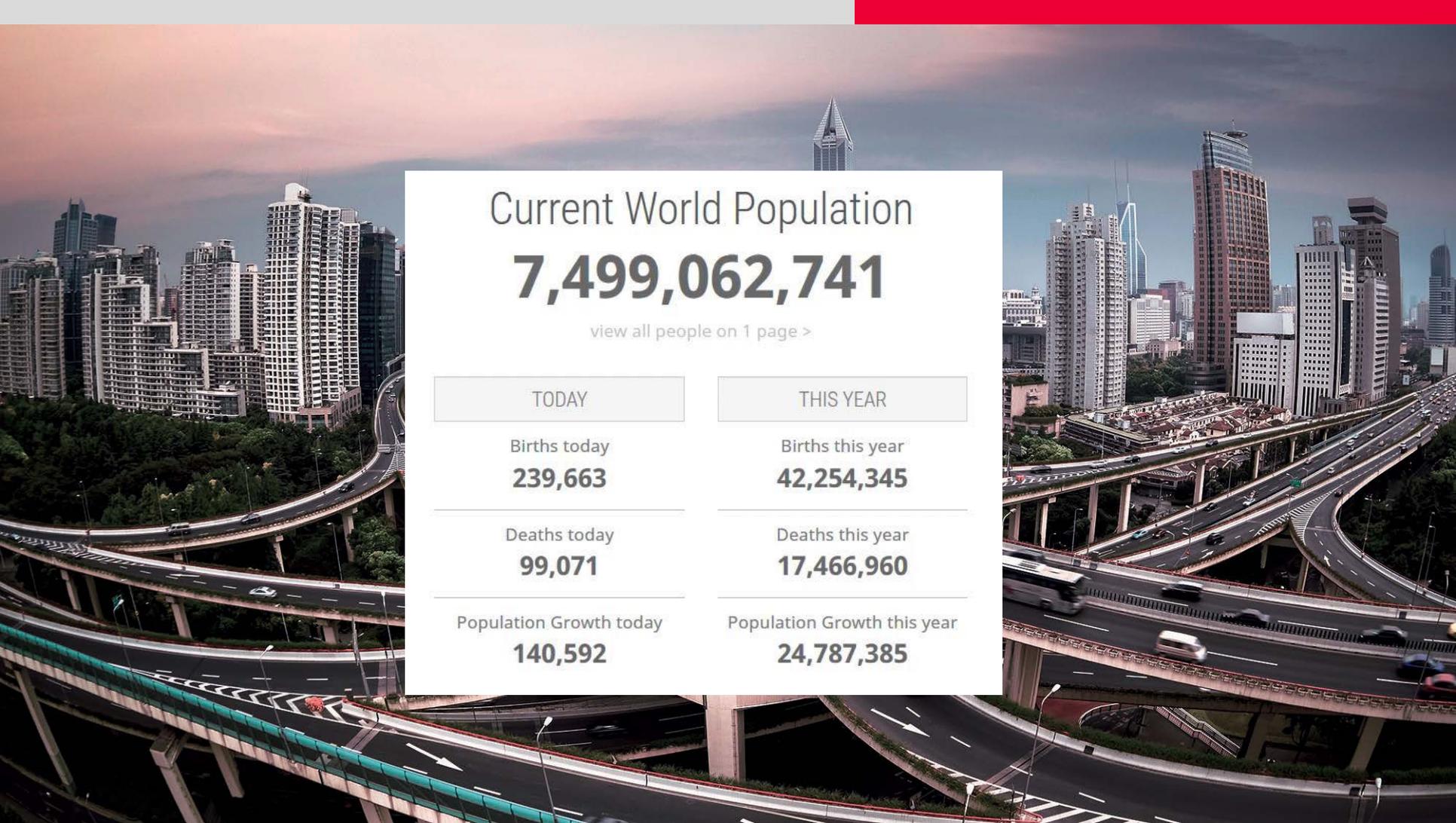
After decades spent to map, now we have to control **dynamic realities**



The data collection and processing must be faster than the speed of changes of the reality



Accuracy is referred to accurate information, **not just and only X,Y,Z**....a slow system cannot be accurate



Current World Population

7,499,062,741

[view all people on 1 page >](#)

TODAY

Births today
239,663

Deaths today
99,071

Population Growth today
140,592

THIS YEAR

Births this year
42,254,345

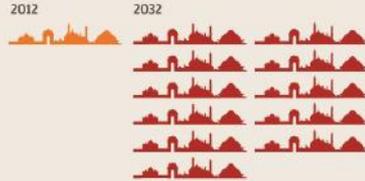
Deaths this year
17,466,960

Population Growth this year
24,787,385

The Urban Effect

Cities

In 20 years, India's cities will have to accommodate 250 million to 300 million more people than they do today. That's the equivalent of 11 New Delhis.



Electricity

Of the 1.4 billion people of the world who have no access to electricity in the world, India accounts for over 300 million.



Water

Only 74% of urban households in India are served by piped water supply. No Indian city has piped water 24 hours a day, seven days a week—4 to 5 hours of supply per day is the average.

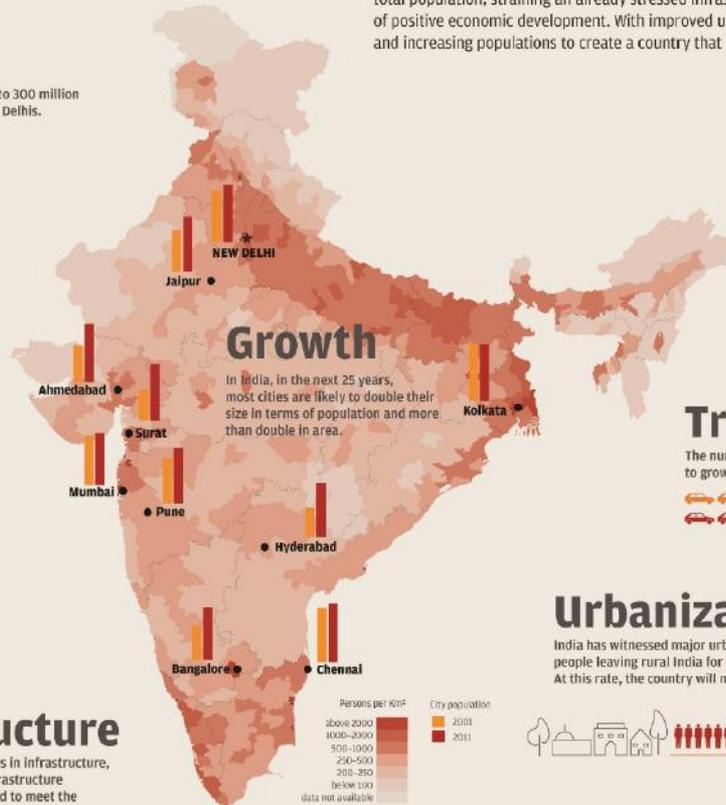


Infrastructure

Despite increased investments in infrastructure, an estimated \$1 trillion in infrastructure improvements will be required to meet the country's resource needs over the next 5 years.

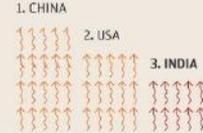
Sustaining Growth in India through Better Urban Planning

With a population of more than 1.2 billion, India is projected to be the world's most populous country by 2025. By 2050, it is estimated that India's urban population will constitute nearly half of the country's total population, straining an already stressed infrastructure. The good news: urbanization is an indicator of positive economic development. With improved urban planning, India can tackle urbanization challenges and increasing populations to create a country that is poised for sustainable growth.



Growth

In India, in the next 25 years, most cities are likely to double their size in terms of population and more than double in area.



Pollution

By 2015, India is expected to become the world's third largest emitter of carbon dioxide—it ranked fifth in 2005.

Transportation

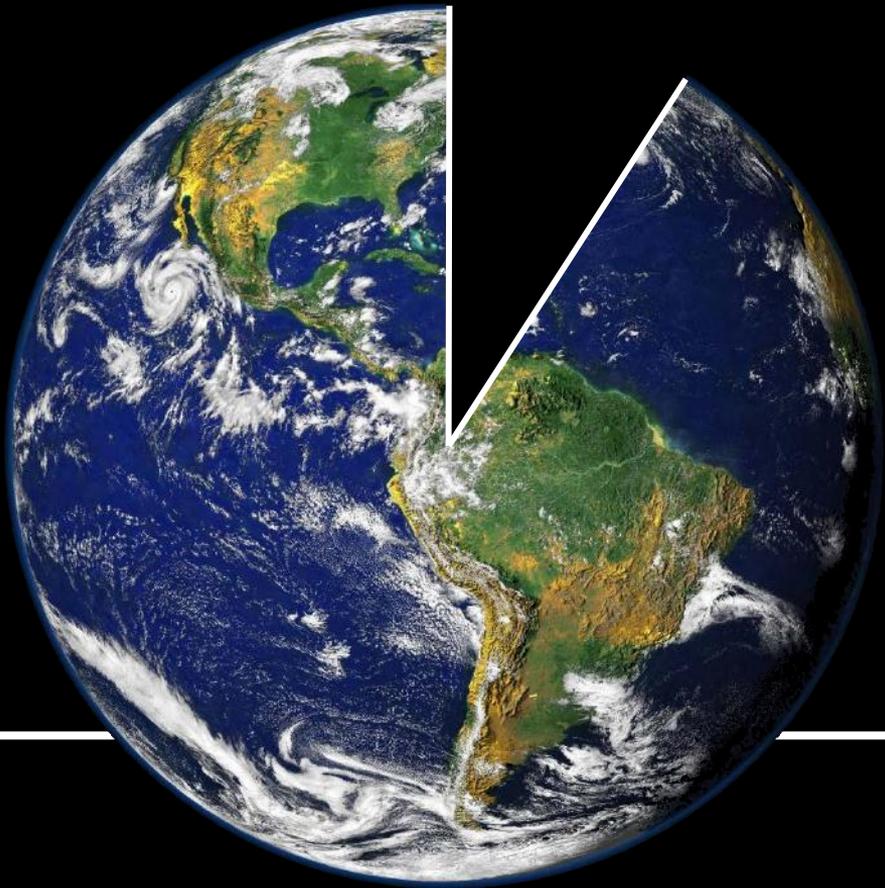
The number of private vehicles in India is expected to grow by more than 3 times by 2021.



Urbanization

India has witnessed major urbanization in recent times, with an estimated 30 people leaving rural India for urban areas every minute during the next 20 years. At this rate, the country will need some 500 new cities in the next two decades.





90% of all the data
in the world was created
in the last **2** yrs



DATA IS THE NEW **OIL**





How fast is data collection
growing in **Surveying?**



Monitoring and **modelling changing realities** is the next challenge



After decades spent to map, now we have to control **dynamic realities**

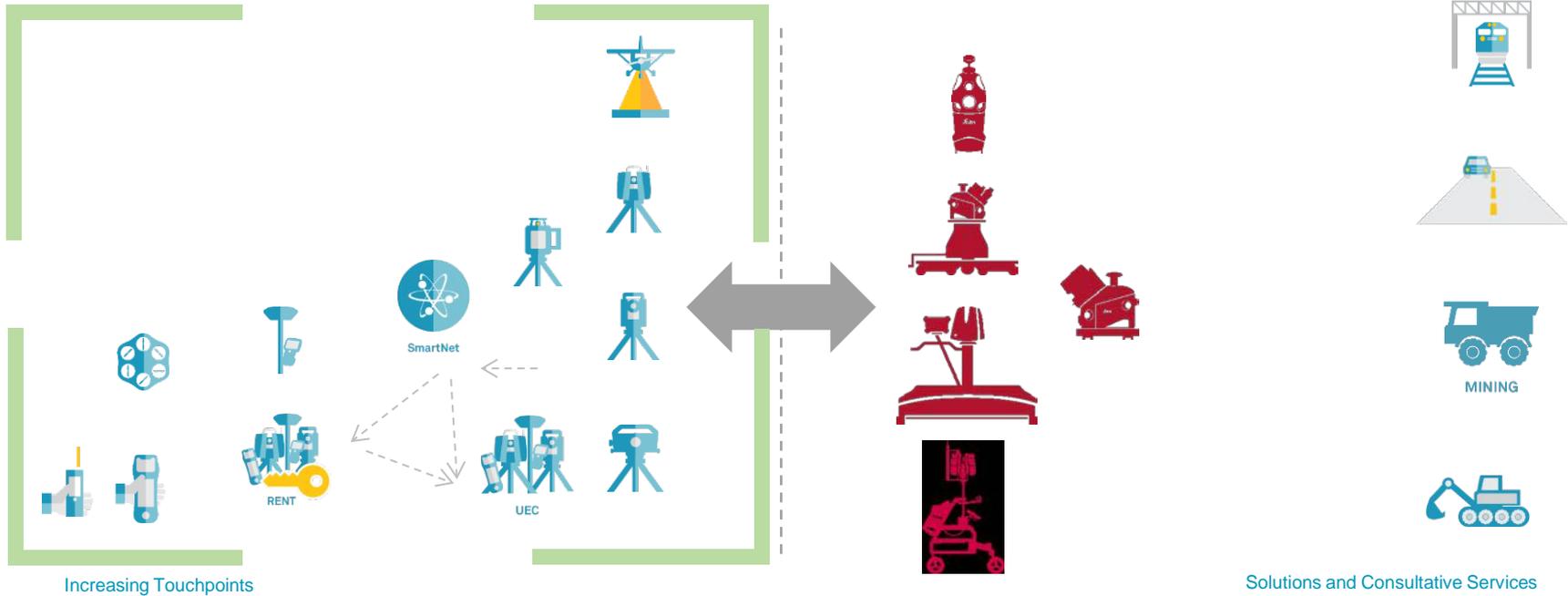


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Technology becoming commodity



Democratization

Solutions and Consultative Services

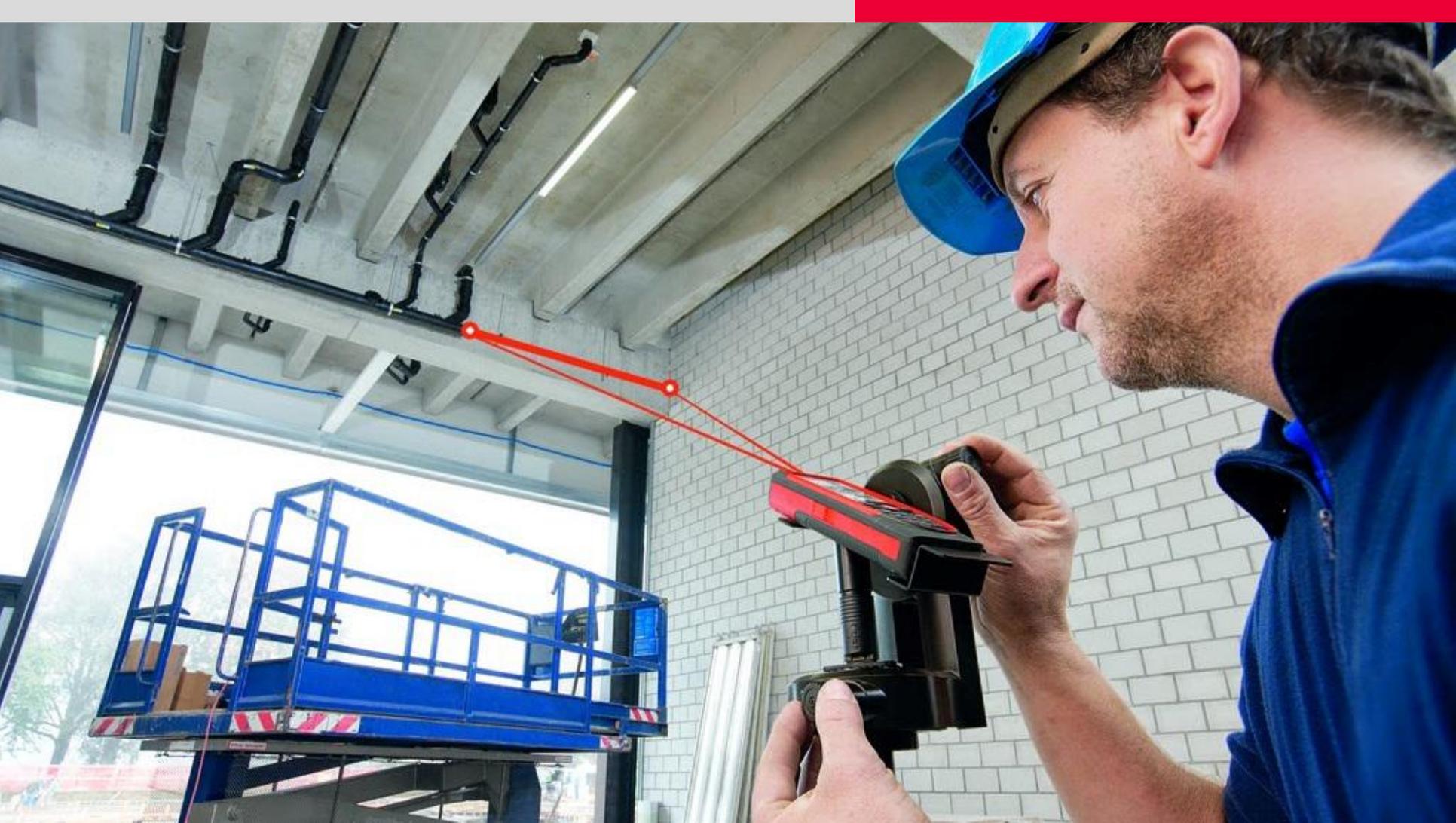
Unexplored

- when it has to be **right**

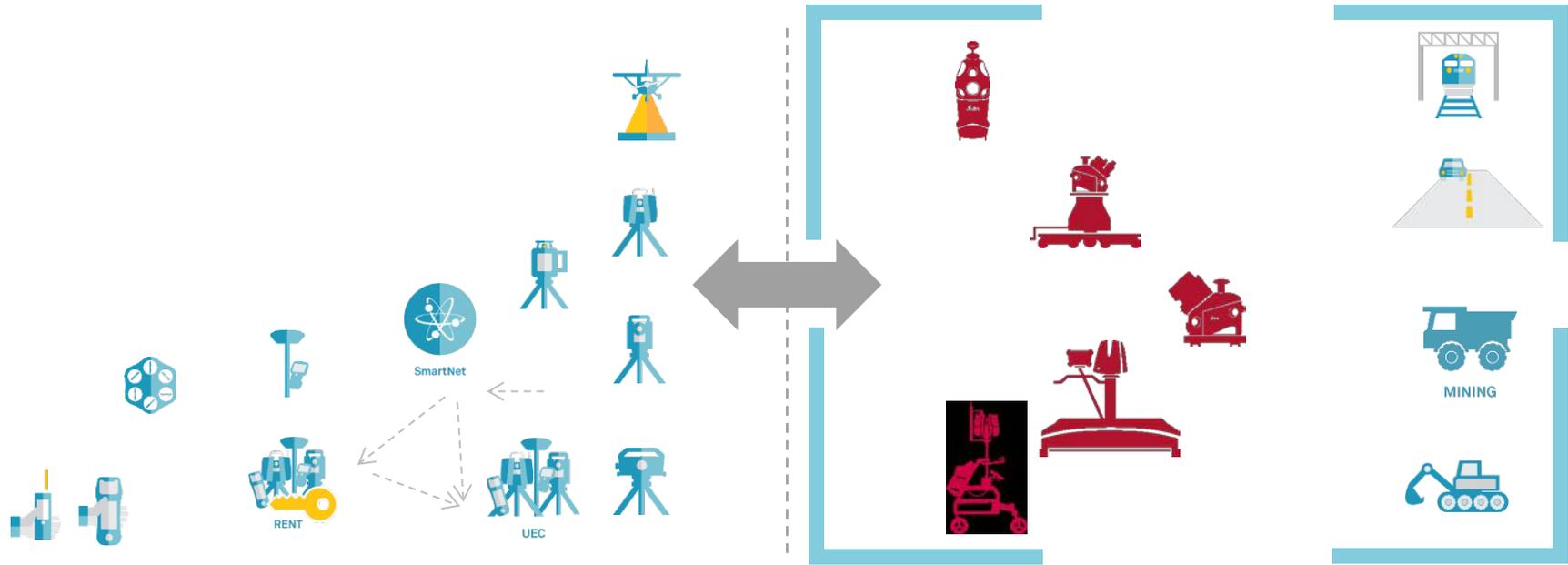
Leica
Geosystems







Technology enabling to capture the unknown



Accurate 3D and Georeferenced data for everybody

Democratization

New application areas with new technology and solutions

Unexplored

- when it has to be **right**

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RV05763

RICHETTA









Data collection speed

10 Km Traditional Surveying at 10mm Accuracy

Control 10mm

8.4 days

Staff	€3'557
- Surveyor Grade 2	4 days
- Assistant Surveyor	4 days
Expenses	€14'638
- Accomodation	8 days
- Mileage	400
-Traffic Management	€13'000

€19'677

On site survey

52.5 days

Staff	€27'788
- Surveyor Grade 2	25 days
- Assistant Surveyor	25 days
Expenses	€89'863
- Accomodation	40 days
- Mileage	1'788
-Traffic Management	€81'250

€122'785

Office CAD

10.5 days

Staff	€5'324
- Surveyor Grade 2	10 days
Expenses	€0
Equipment	€455
- Survey CAD	€455

€5'779

10 Km Mobile Mapping Virtual Surveying at 10mm Accuracy

Control 10mm

8.4 days

Staff	€3'557
- Surveyor Grade 2	4 days
- Assistant Surveyor	4 days
Expenses	€14'638
- Accomodation	8 days
- Mileage	400
-Traffic Management	€13'000

€19'677

Site Survey

2.1 days

Staff	€948
- Senior Surveyor	1 days
- Assistant Surveyor	1 days
Expenses	€624
- Accomodation	2 days
- Mileage	400
-Traffic Management	€0

€8'072

Trajectory

5.3 days

Staff	€3'130
- Project Manager	5 days
Expenses	€0
Equipment	€390
- Pegasus Suite	€390

€3'520

Office CAD

10.5 days

Staff	€5'324
- Surveyor Grade 2	10 days
Expenses	€0
Equipment	€1'300
- 3D Model CAD	€1'300

€6'624

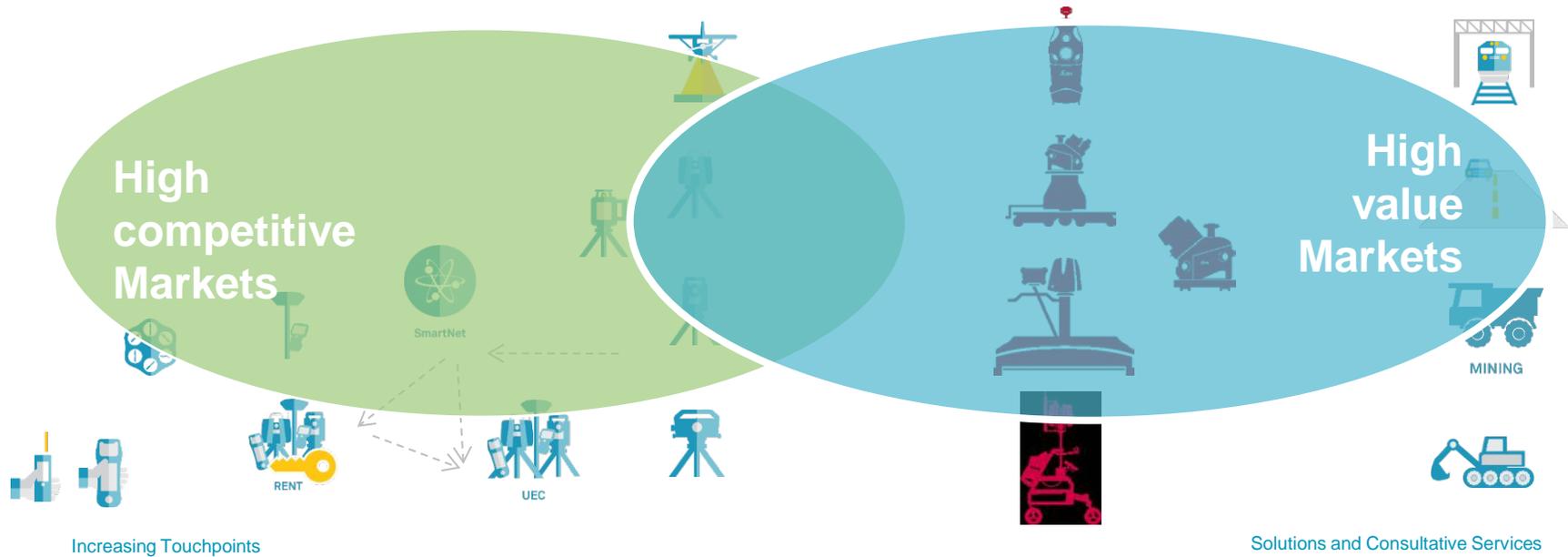


- when it has to be **right**

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Technology becoming commodity - Margin erosion

Higher supply & availability as driver for lower prices



Democratization

Unexplored

- when it has to be **right**

Leica
Geosystems

SURVEYOR OF THE FUTURE

see you tomorrow



THE SURVEYOR OF THE FUTURE

Workshop





We are all on a **digital** journey
in some form or another

A man in a white shirt is seen from the back, drawing a path through a maze on a grey wall. The maze is drawn with black lines, and the path he is drawing is highlighted in white. The path starts from the left and ends with an arrow pointing to the right. In the top right corner, there is a white text box with a red border containing the text: "The path to **success** can feel a lot like a maze".

The path to **success** can feel a lot like a maze



Unlocking the power
of a solution helps
us **predict** the future

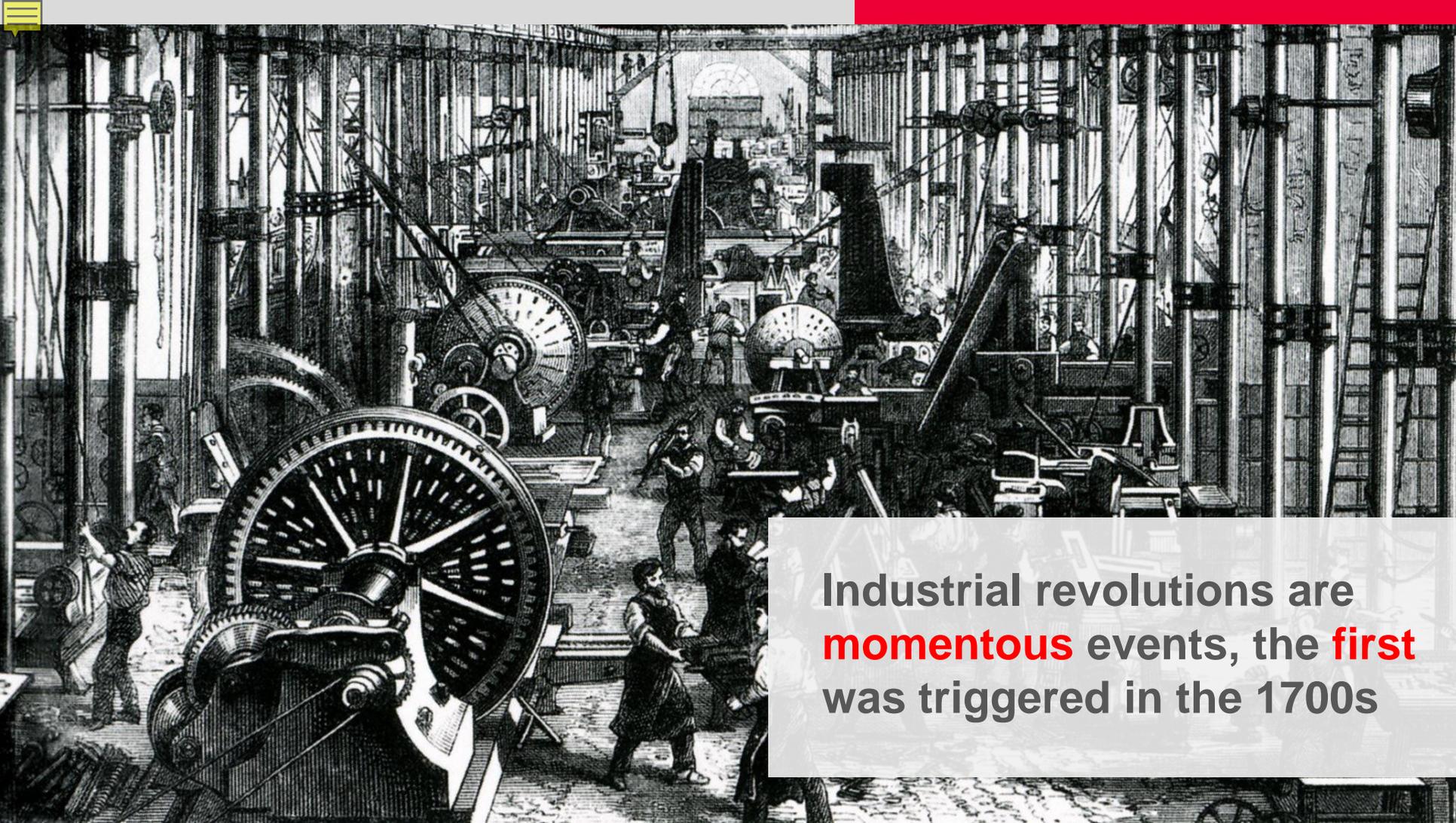
It's often said that we don't like **change**



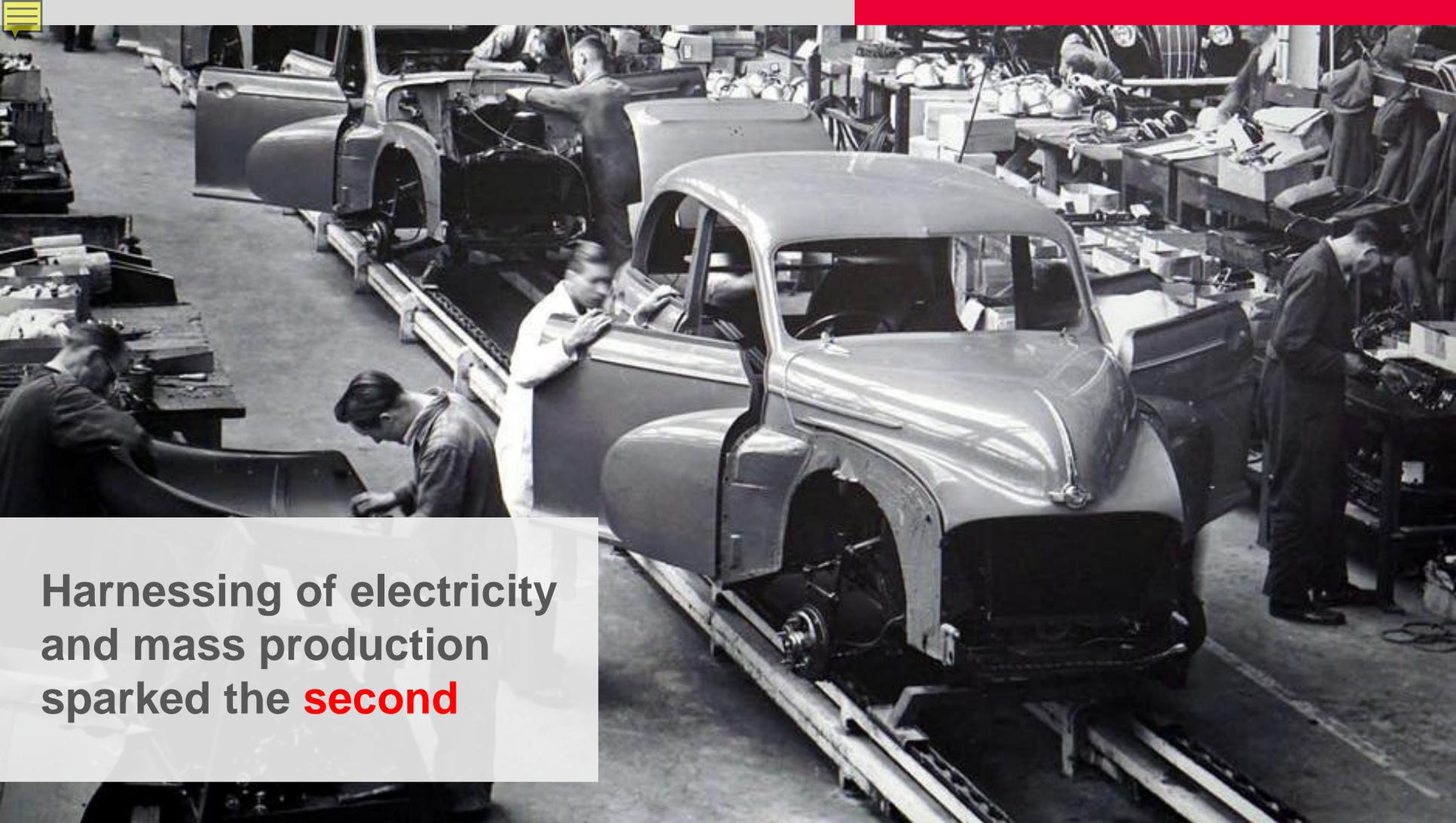


Take a look at the world
from a different **perspective**

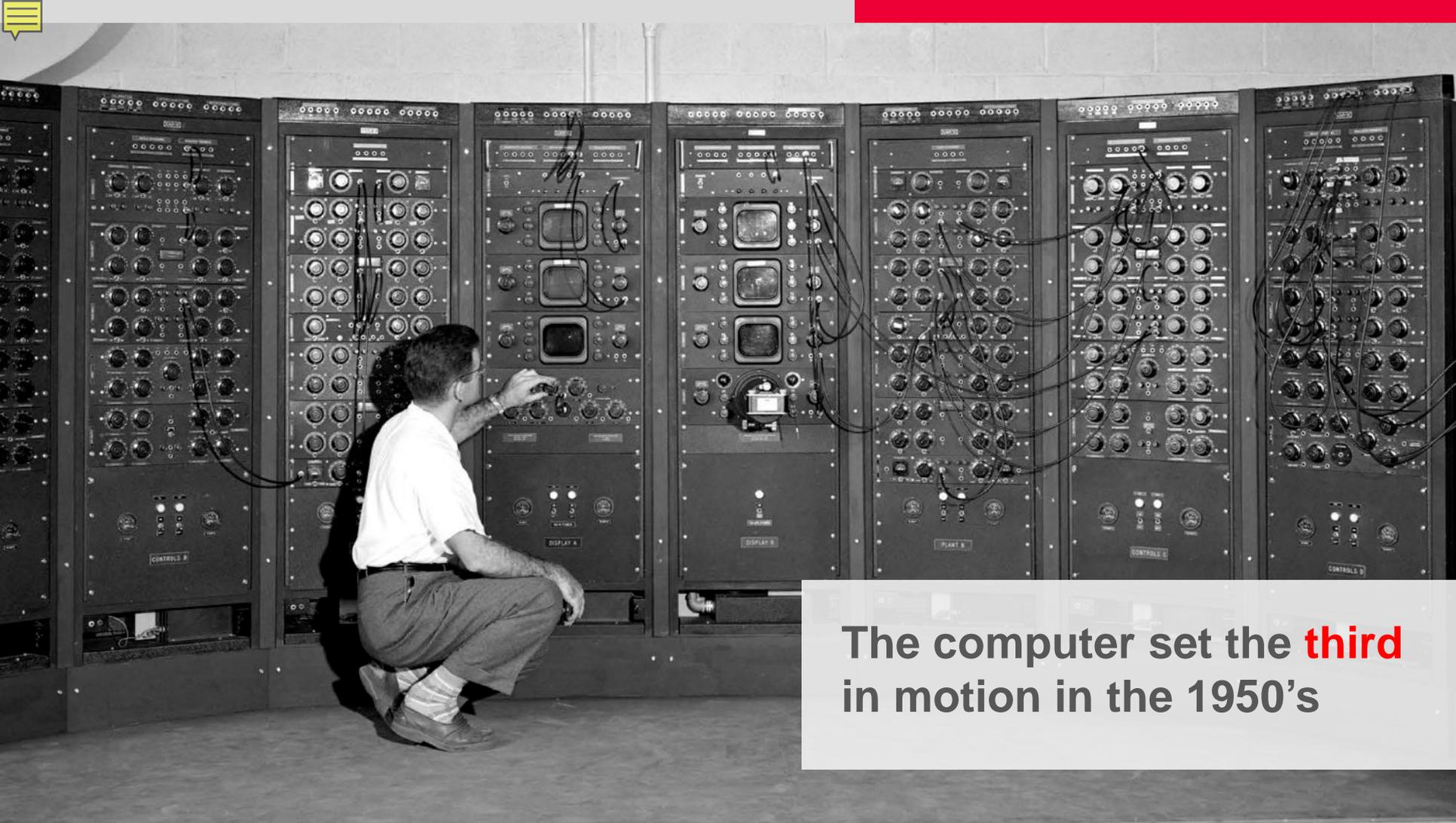




Industrial revolutions are **momentous** events, the **first** was triggered in the 1700s



Harnessing of electricity and mass production sparked the **second**



The computer set the **third**
in motion in the 1950's



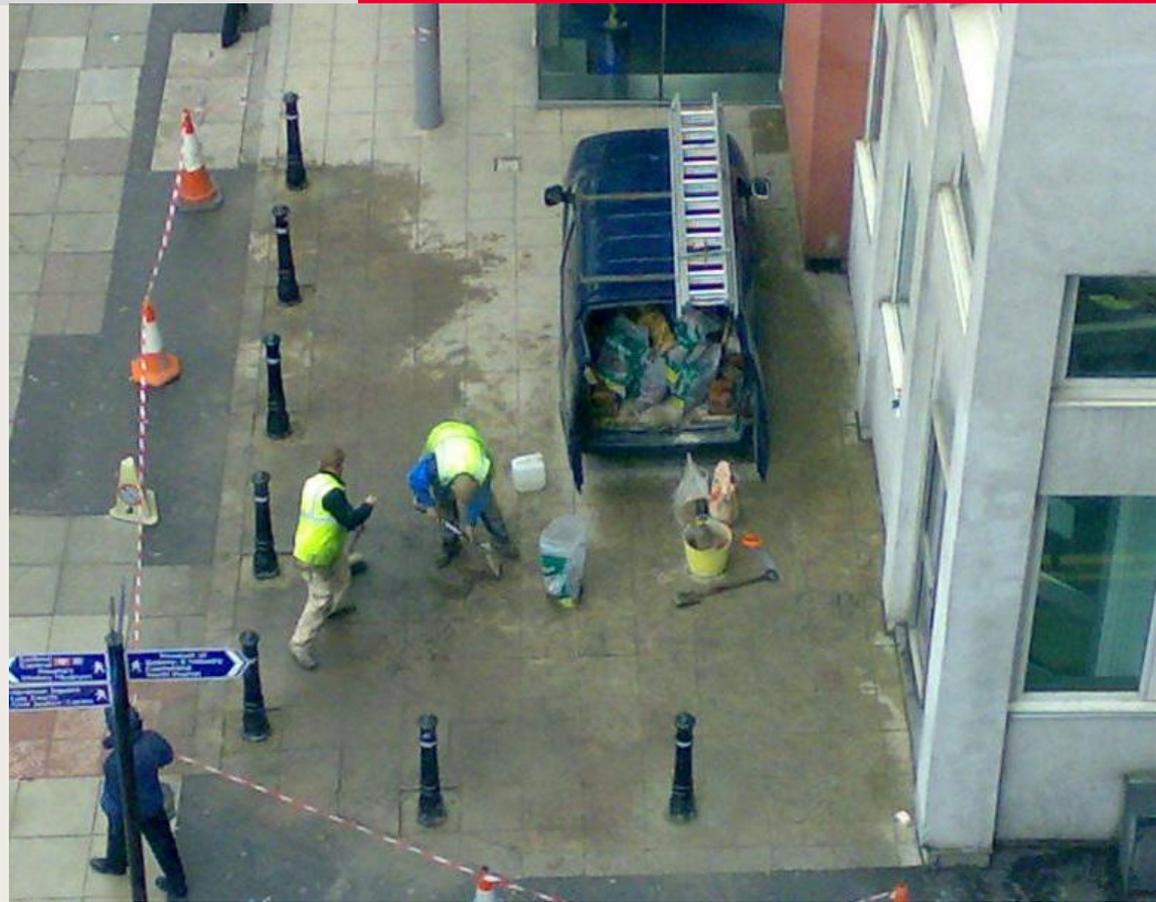
The construction industry is on the cusp of a **new** industrial age

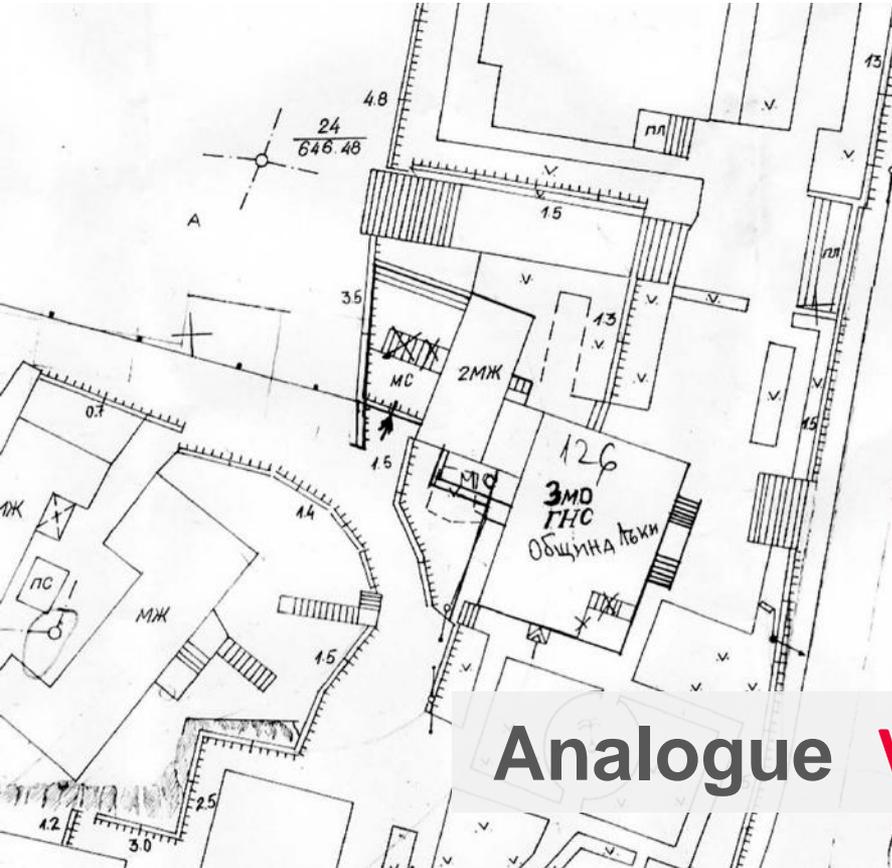


In the future we will build our world **twice**, once in digital and then in reality

Spot their **error**?

- Not following process
- Inadequate training
- Miscommunication
- The 'Human' factor
- That Friday feeling
- Analogue systems





Analogue **V** Digital



- when it has to be **right**



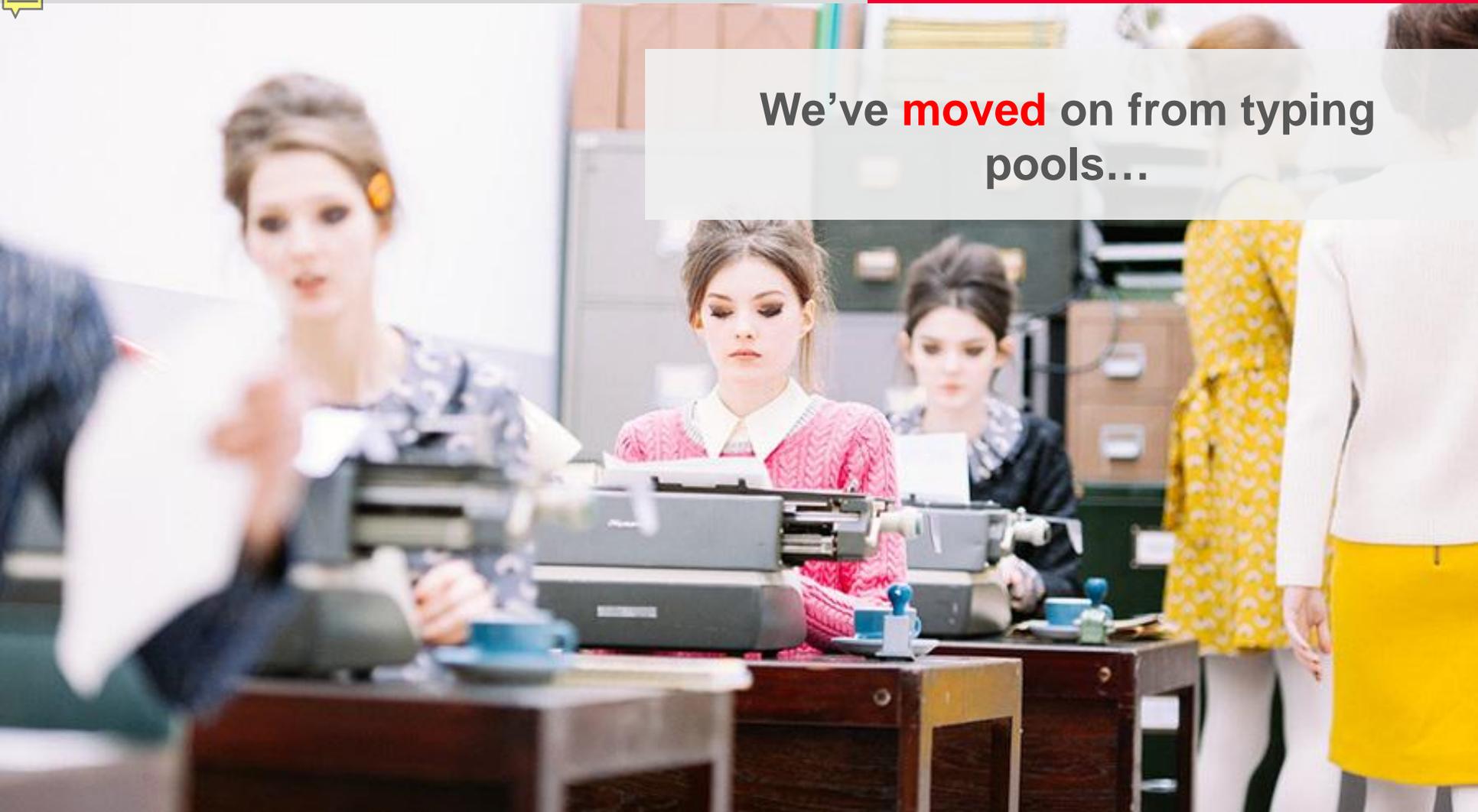
Professional working practices are subject to **change** at a rate not seen since the industrial revolution



Organisations are constantly searching for **solutions** that break down skilled jobs into simple routines or processes



We've **moved** on from typing pools...





Sometimes jobs become a part of our **everyday** work

MASTERMINDS OF CONSTRUCTION



CIOB

THE CHARTERED INSTITUTE OF BUILDING

SURVEYOR OF THE PAST



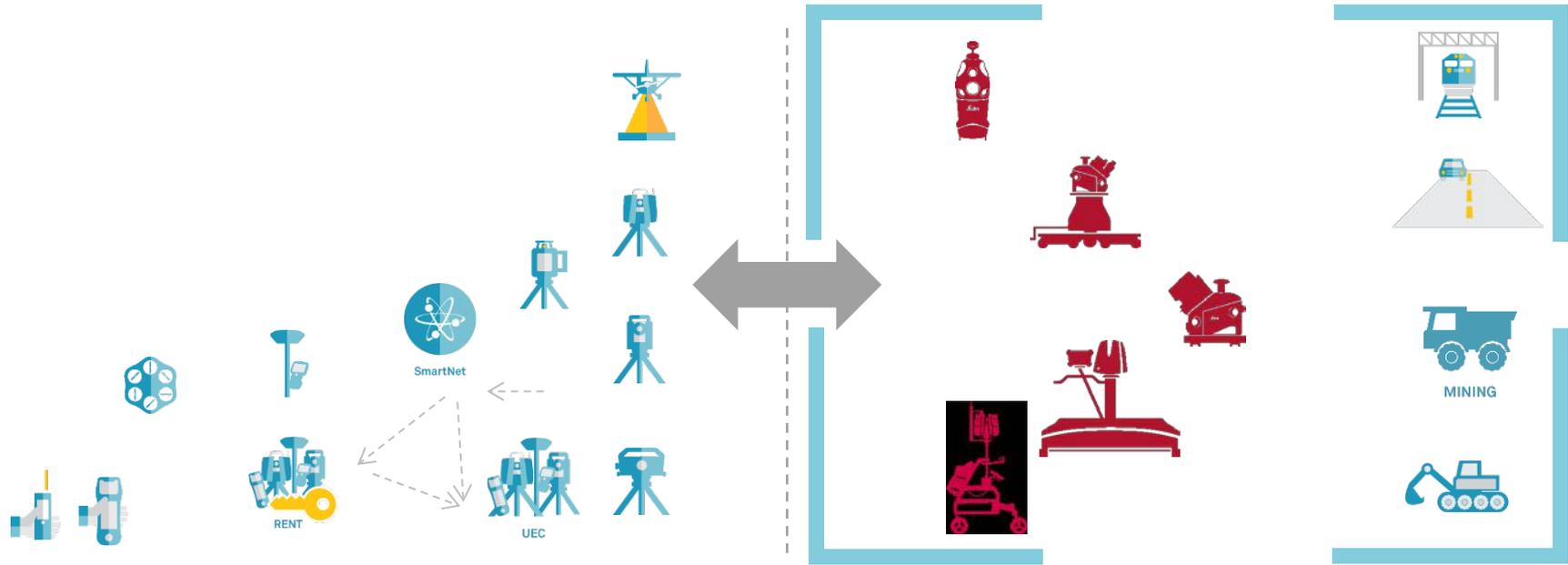
- when it has to be **right**

Leica
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SURVEYOR OF THE FUTURE



Technology enabling to capture the unknown



Accurate 3D and Georeferenced data for everybody

Democratization

New application areas with new technology and solutions

Unexplored

- when it has to be **right**

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■ Topography X,Y,Z

■ Topology

■ Database completeness

■ Information obsolescence



10km of Survey

Traditional 10mm

Mobile 10mm

Mobile 20mm

Mobile 5mm



- when it has to be **right**

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80% of our living space is
indoor



60% of today's buildings
will still be in use in **2050**



The Challenge

Disaster Management



Safety & Security



BIM



Energy



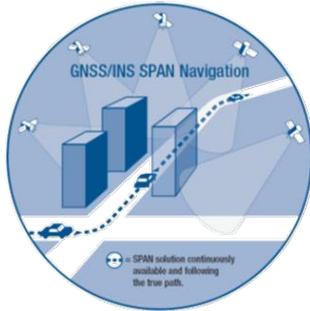
Outdoor



Indoor

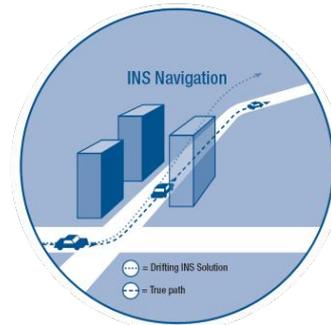
New positioning methods are needed

GNSS/INS Navigation



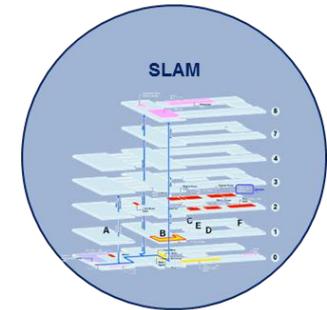
- Satellite based positioning systems is the backbone of all mobile mapping
- Requires a direct line-of-site to the satellites
- Need Orientation information

INS Navigation



- Adding an Inertial Navigation System allows us to determine orientation and navigate without access to satellite signals

SLAM Navigation



- A method of measuring the environment and determining a location in that environment at the same time

Outdoor



Indoor

What is SLAM?

Simultaneous Location And Mapping

A method of measuring the environment and determining a location in that environment at the same time.

- SLAM allows us to measure an arbitrary environment
 - No spatial context
- Mobile Mapping aims to precisely measure the environment
 - Technology limits where we can go
- Combining these techniques allows us to map arbitrary environments
 - No limits on location
 - Data has full spatial context

SLAM Approaches

Cameras

Image features are matched together and adjusted in order to determine the position and orientation of the device

- Robust adjustment
- Multiple images or pairwise (depending on algorithm)

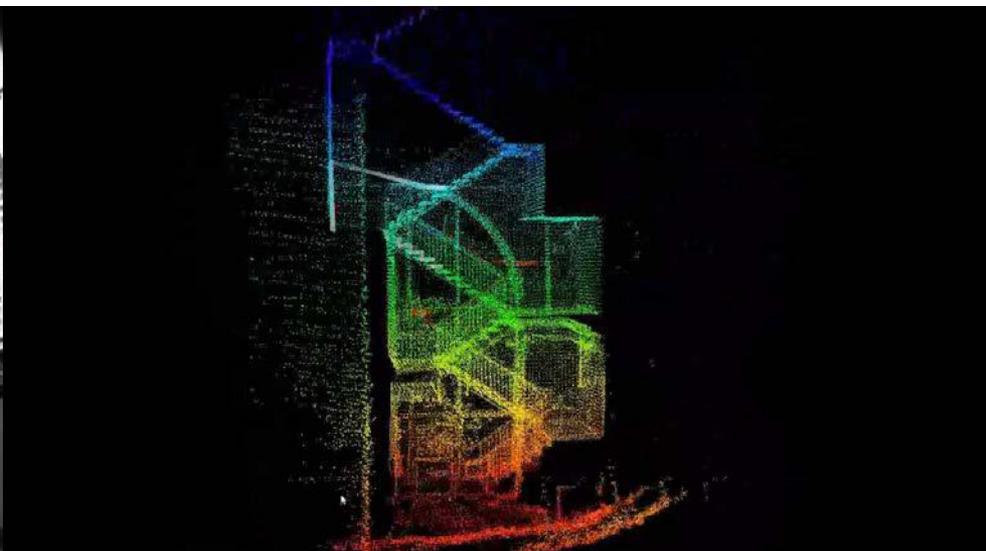


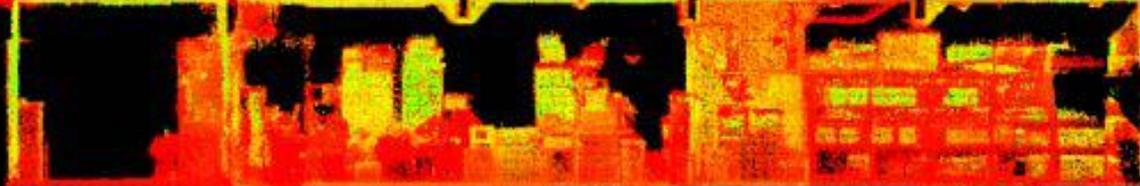
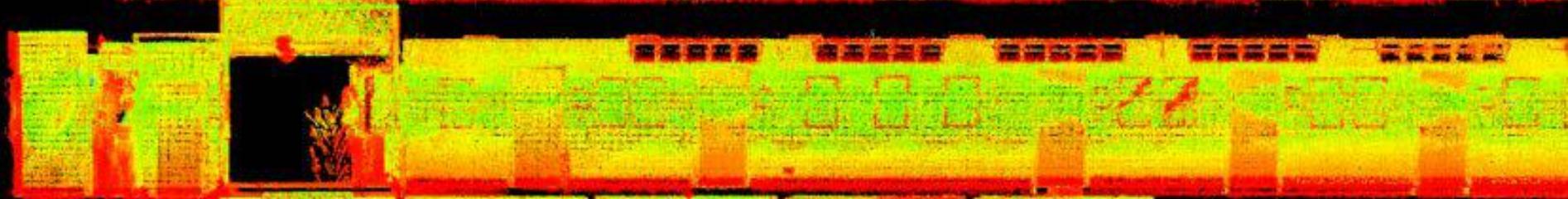
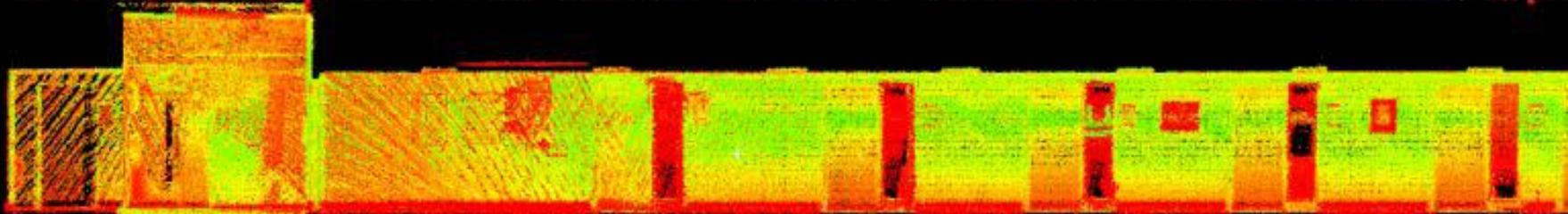
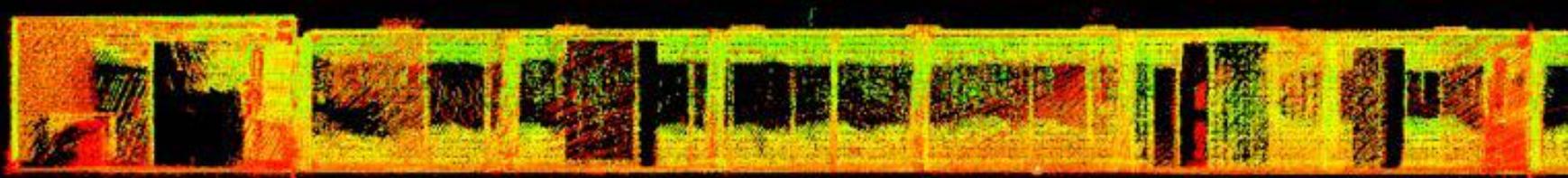
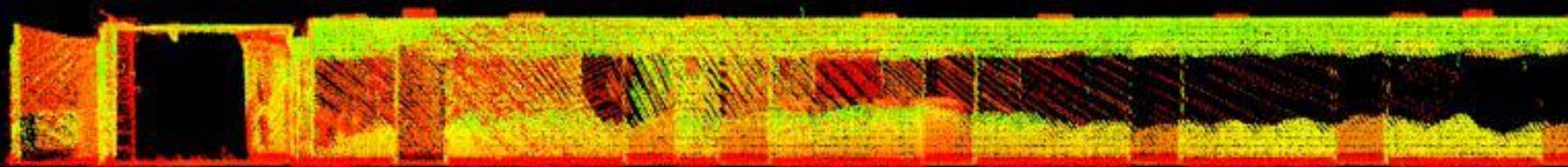
LiDAR

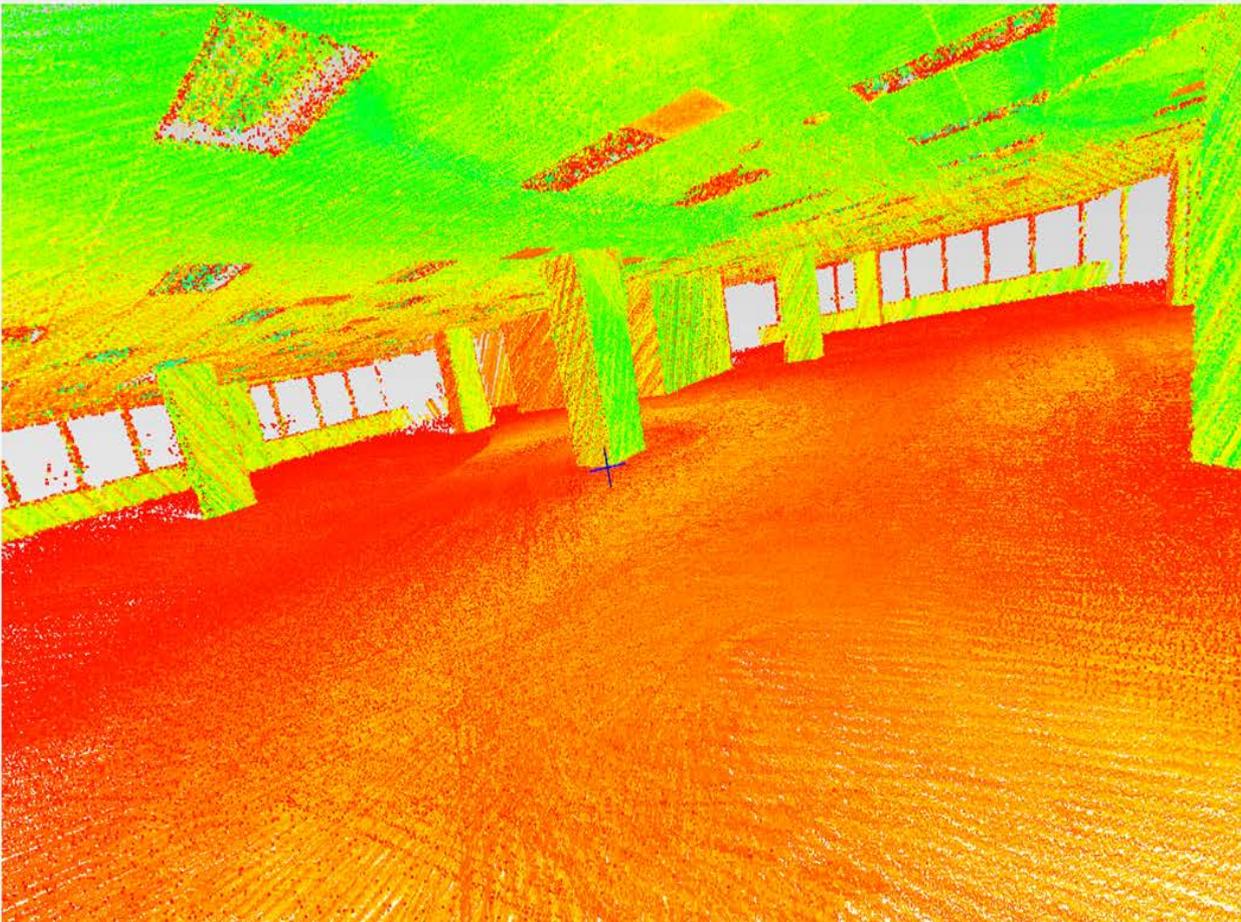
LiDAR data gives a measurement of range and bearing

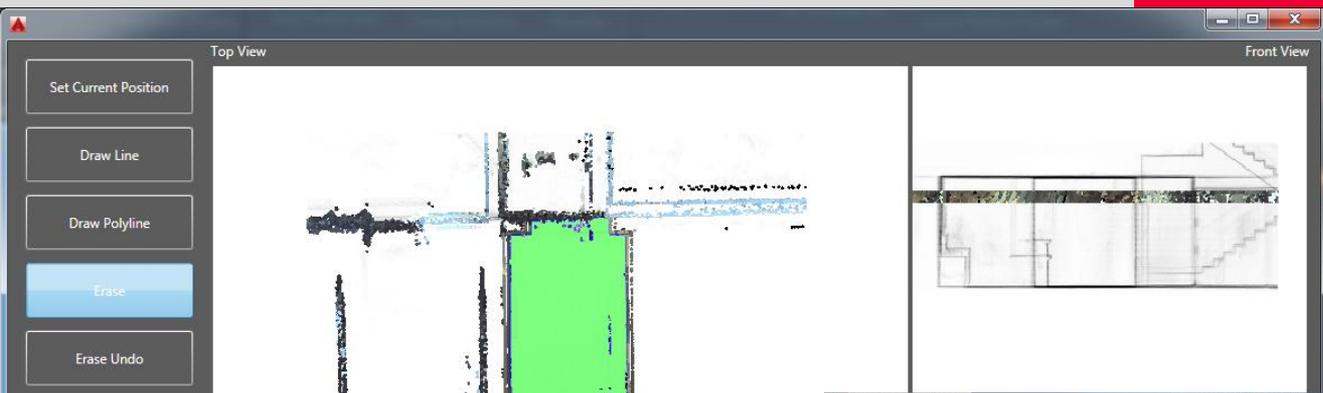
- Scale is automatically determined
- Active signal works without external illumination

To determine position and orientation, we need to measure and match planar features in 3 orthogonal directions









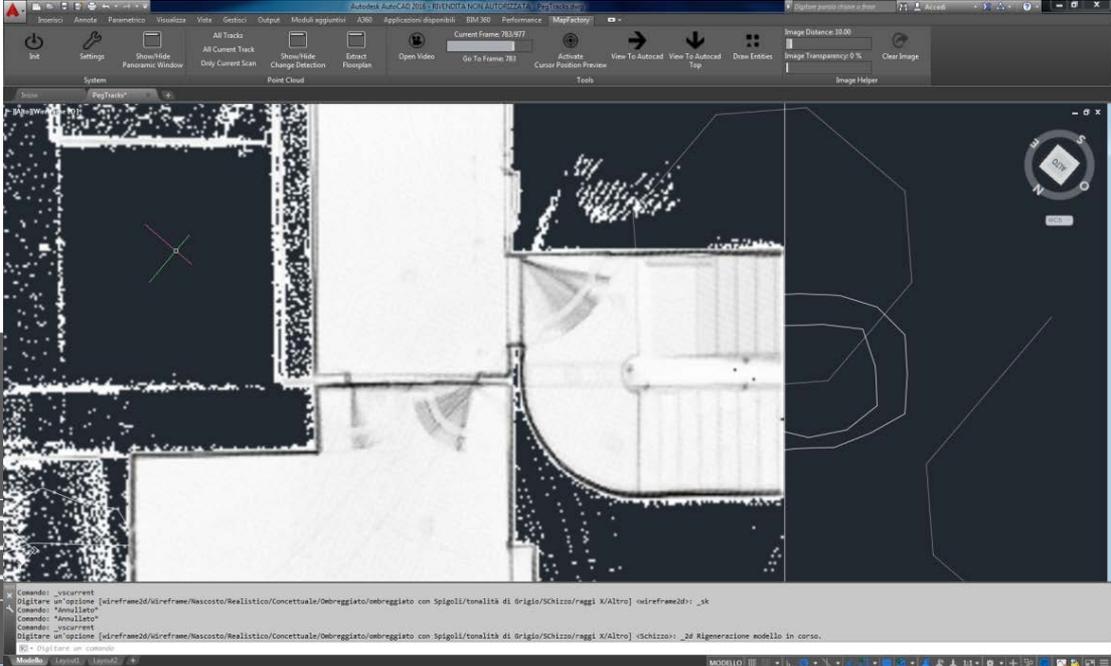
- Set Current Position
- Draw Line
- Draw Polyline
- Erase
- Erase Undo
- Set External Position
- Export Border As Polyline
- Export Point Cloud To Pts
- Export Density As Image

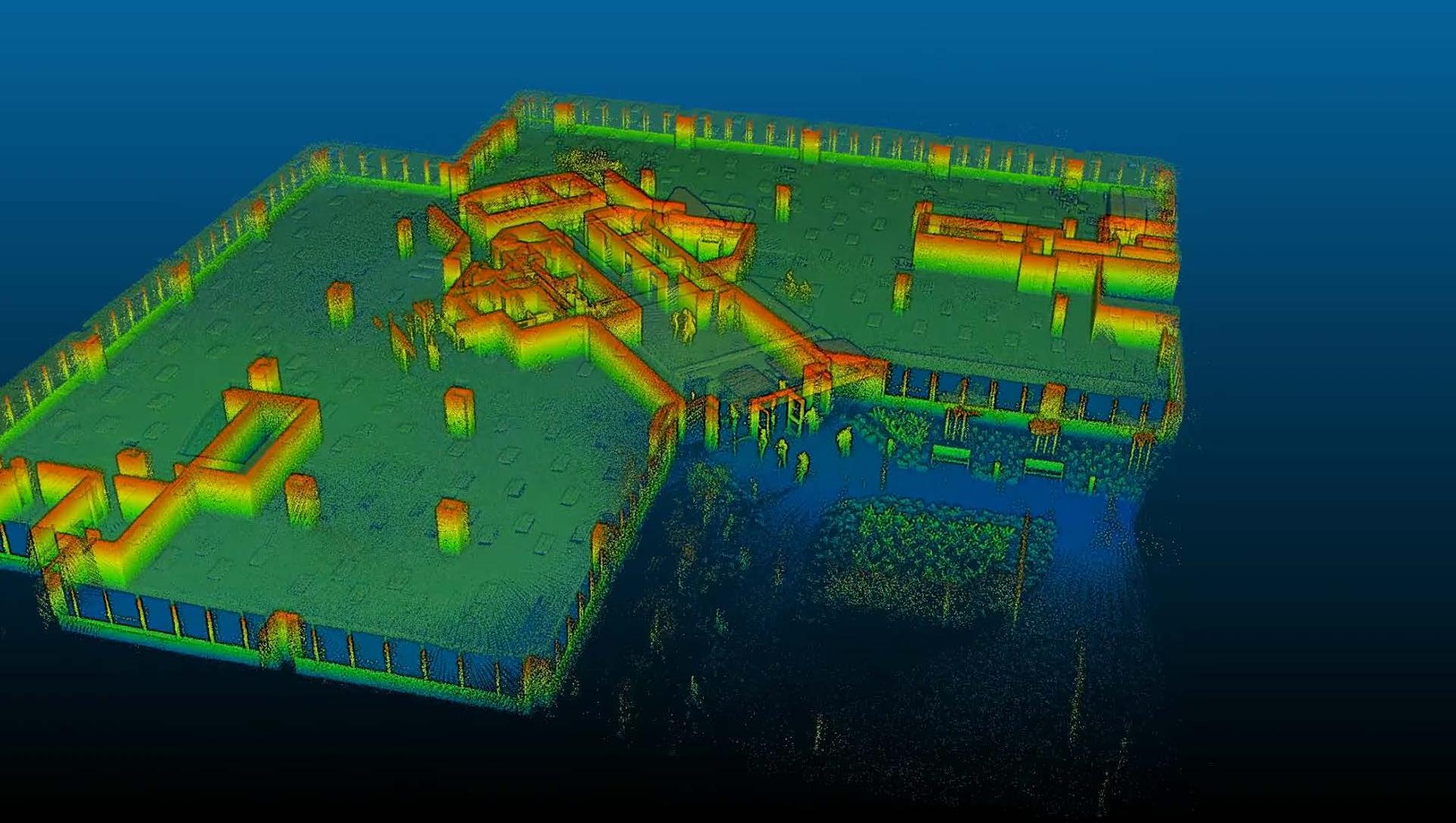
Erase
Hold **Left Mouse Button** to erase.
Scroll **Ctrl+Middle Mouse Wheel** to change size of the circle.
Use this tool to clean the point cloud from noise or unwanted objects.

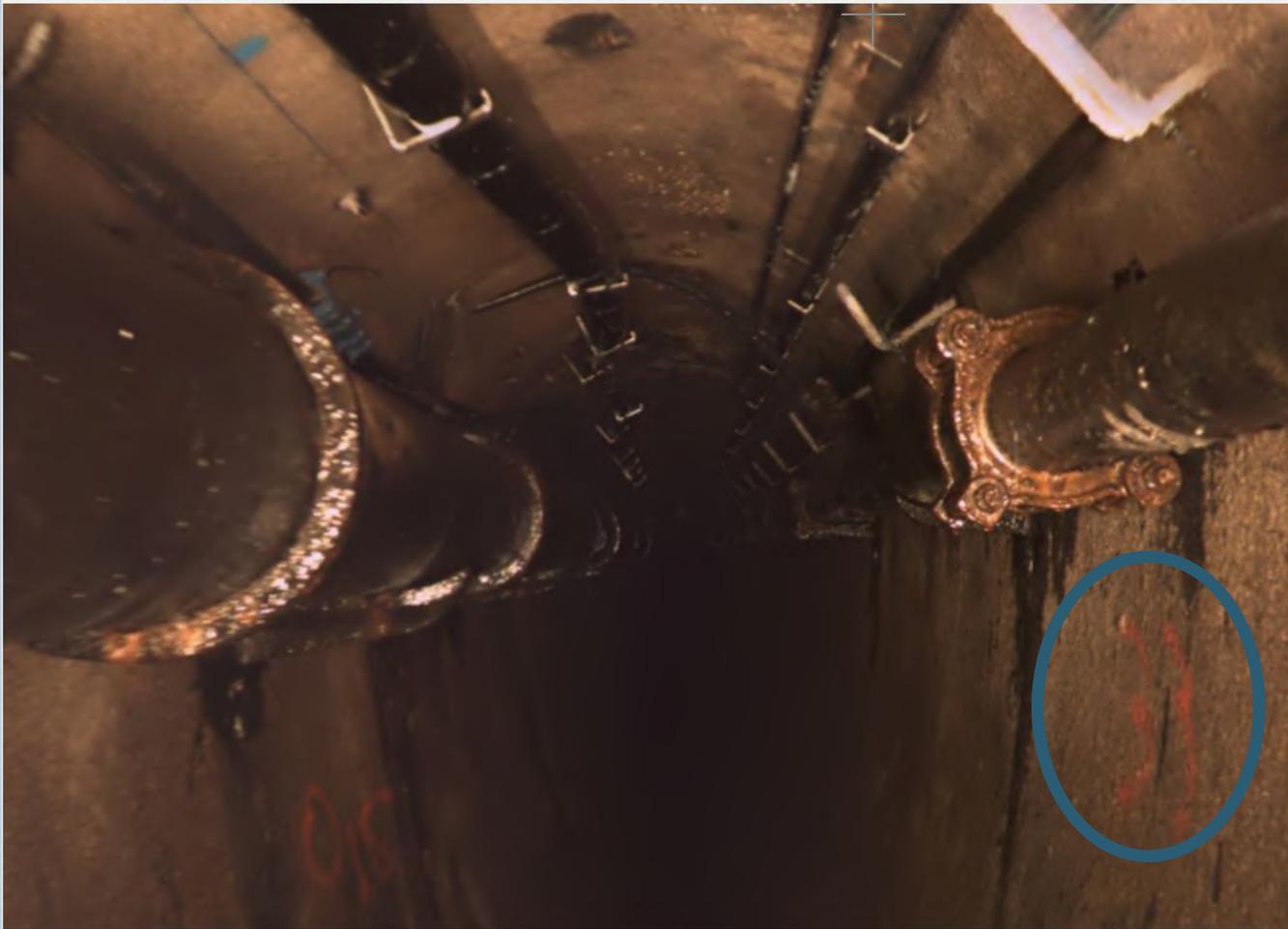
Top View

Show: <ul style="list-style-type: none"><input checked="" type="checkbox"/> Point Cloud<input checked="" type="checkbox"/> Area Map<input type="checkbox"/> Area Positives<input checked="" type="checkbox"/> Density Map<input type="checkbox"/> Erased Zone	Point Cloud 2929071 Points	Area Area Extend: 16.63 m.u.^2 Pixel Extend: 0.00 m.u.^2 Count: 18438 pixels
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Clipping Slice Z: [Slider]
Clipping Slice Thickness: [Slider]
Point Size: [Slider]



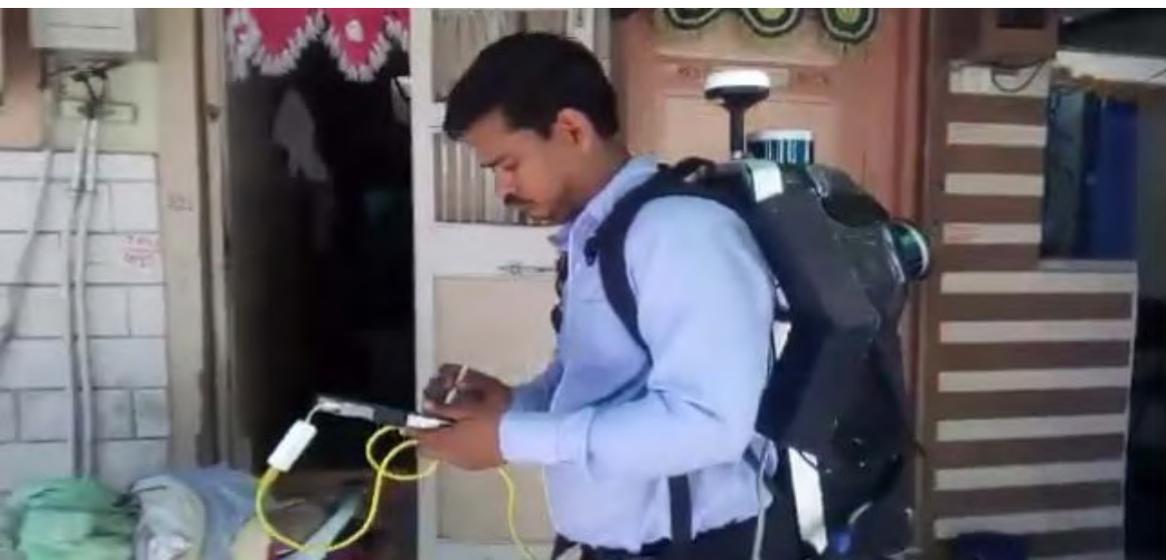
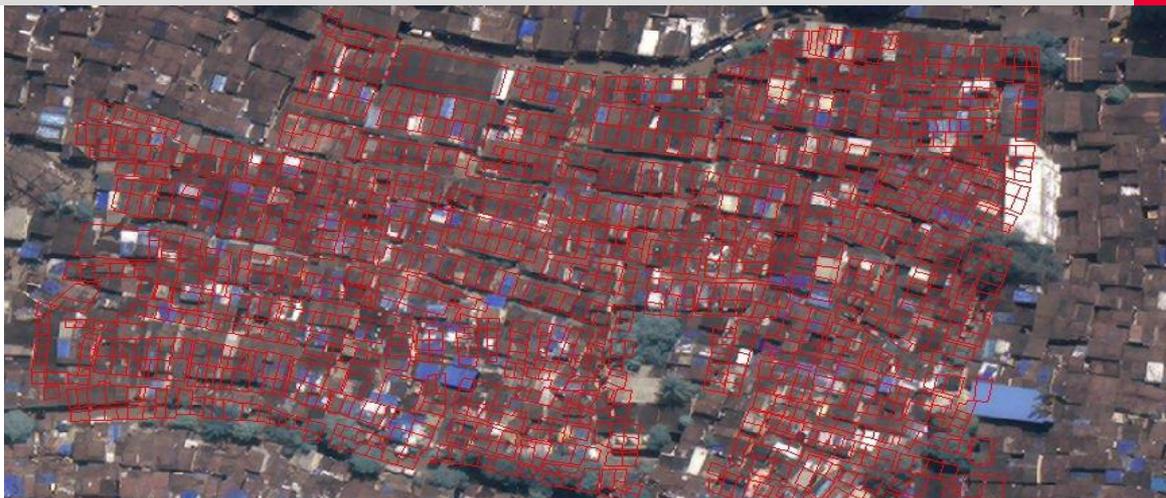




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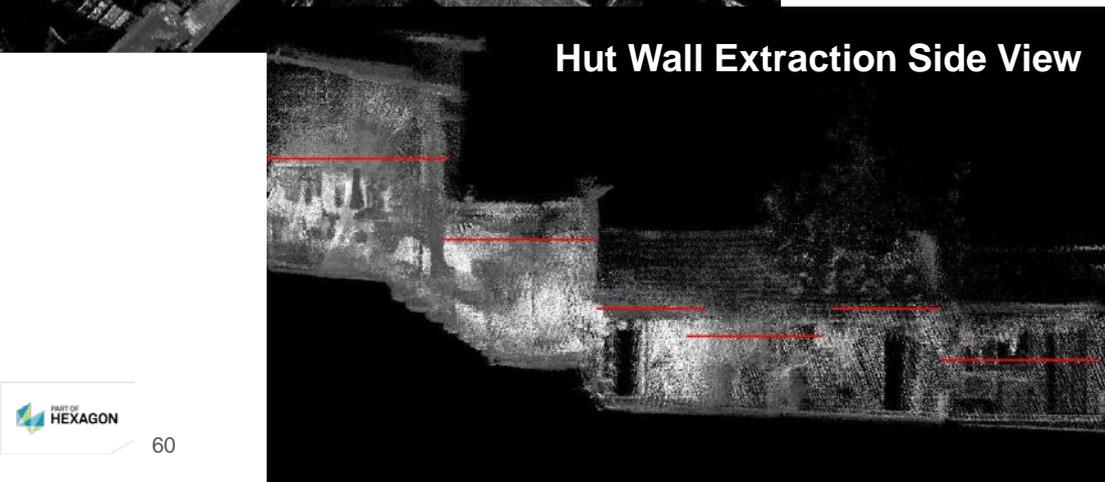
- CTRL: Accurate movements
- CTRL+Wheel: Elevation adjust
- CTRL+SHIFT+Wheel: Fast Elevation adjust



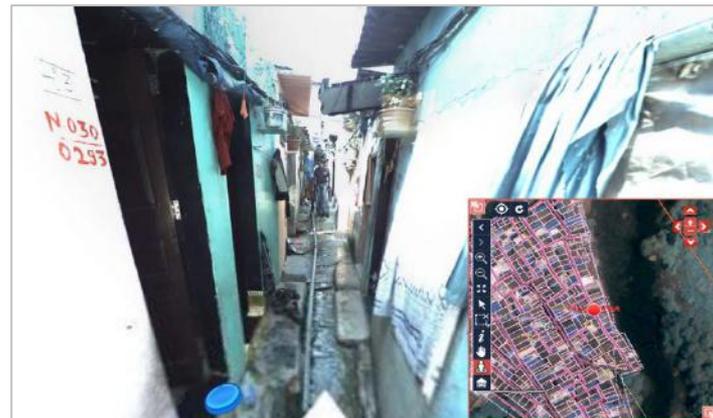
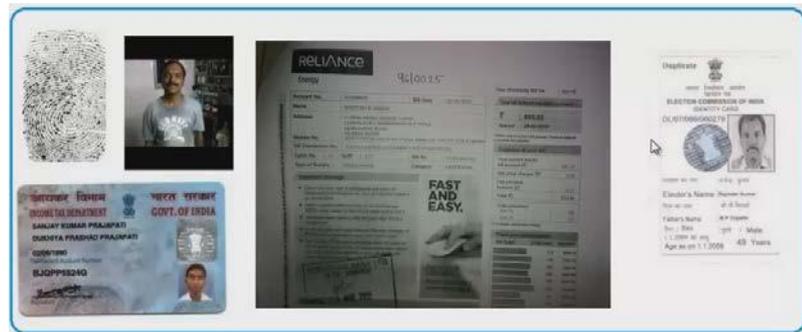




Hut Wall Extraction Top View



Hut Wall Extraction Side View



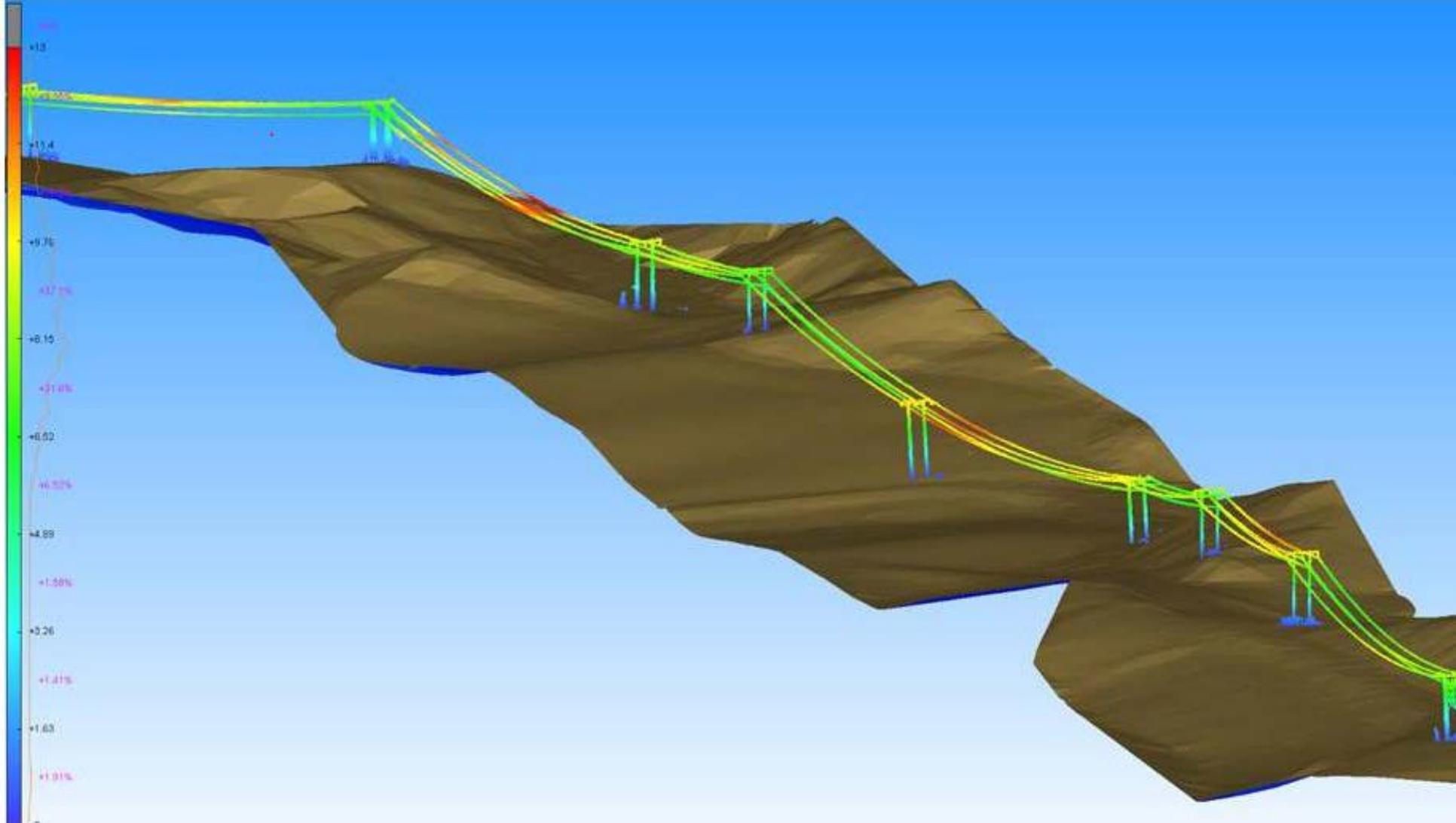


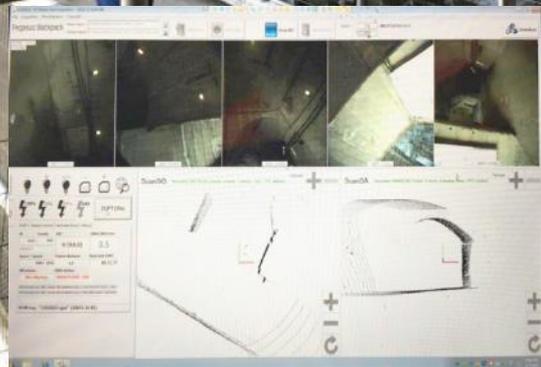


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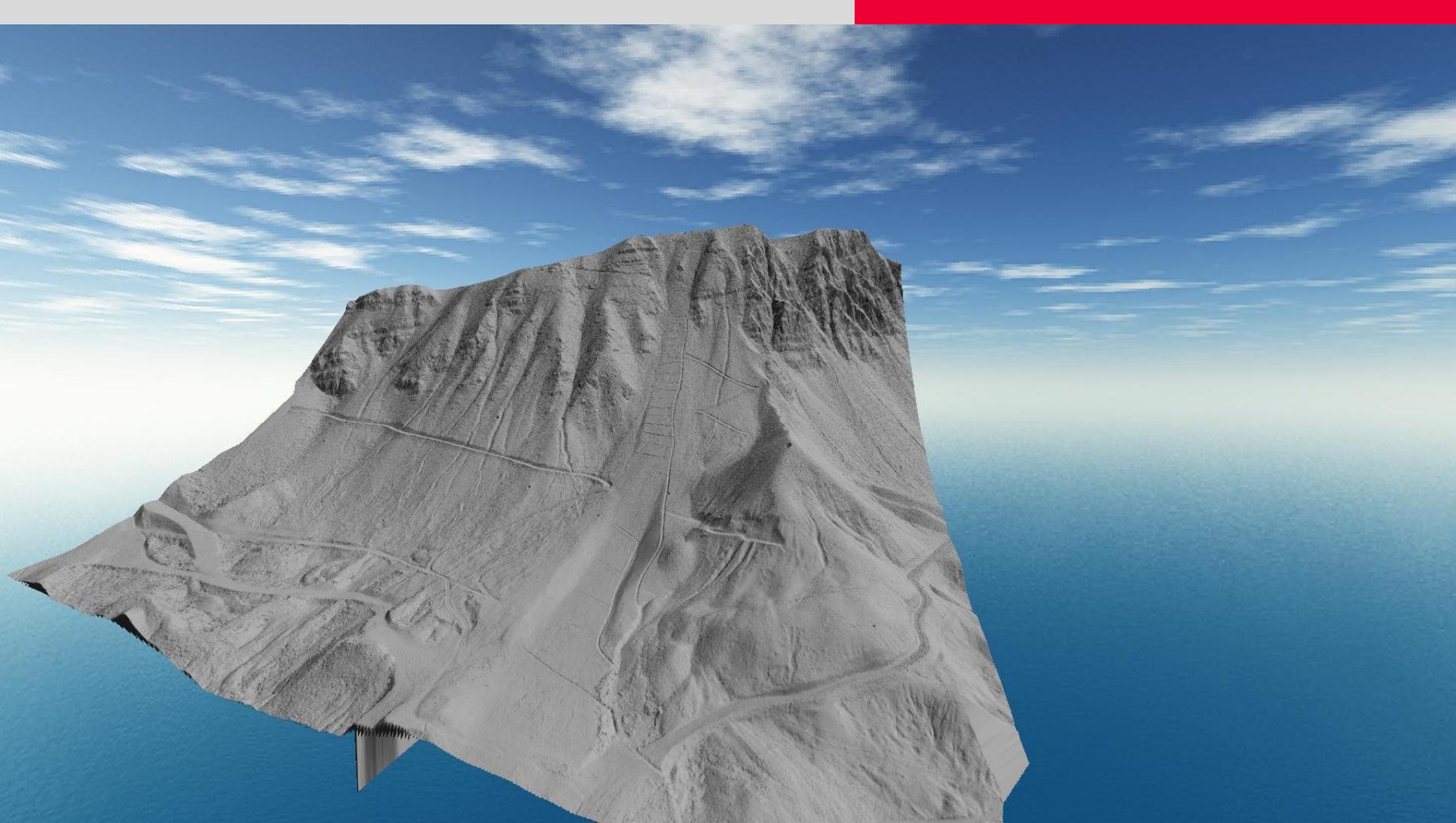
Leica
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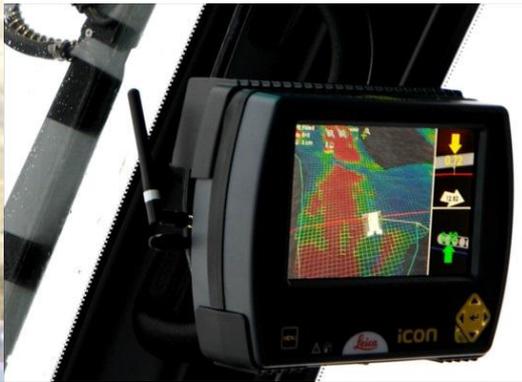






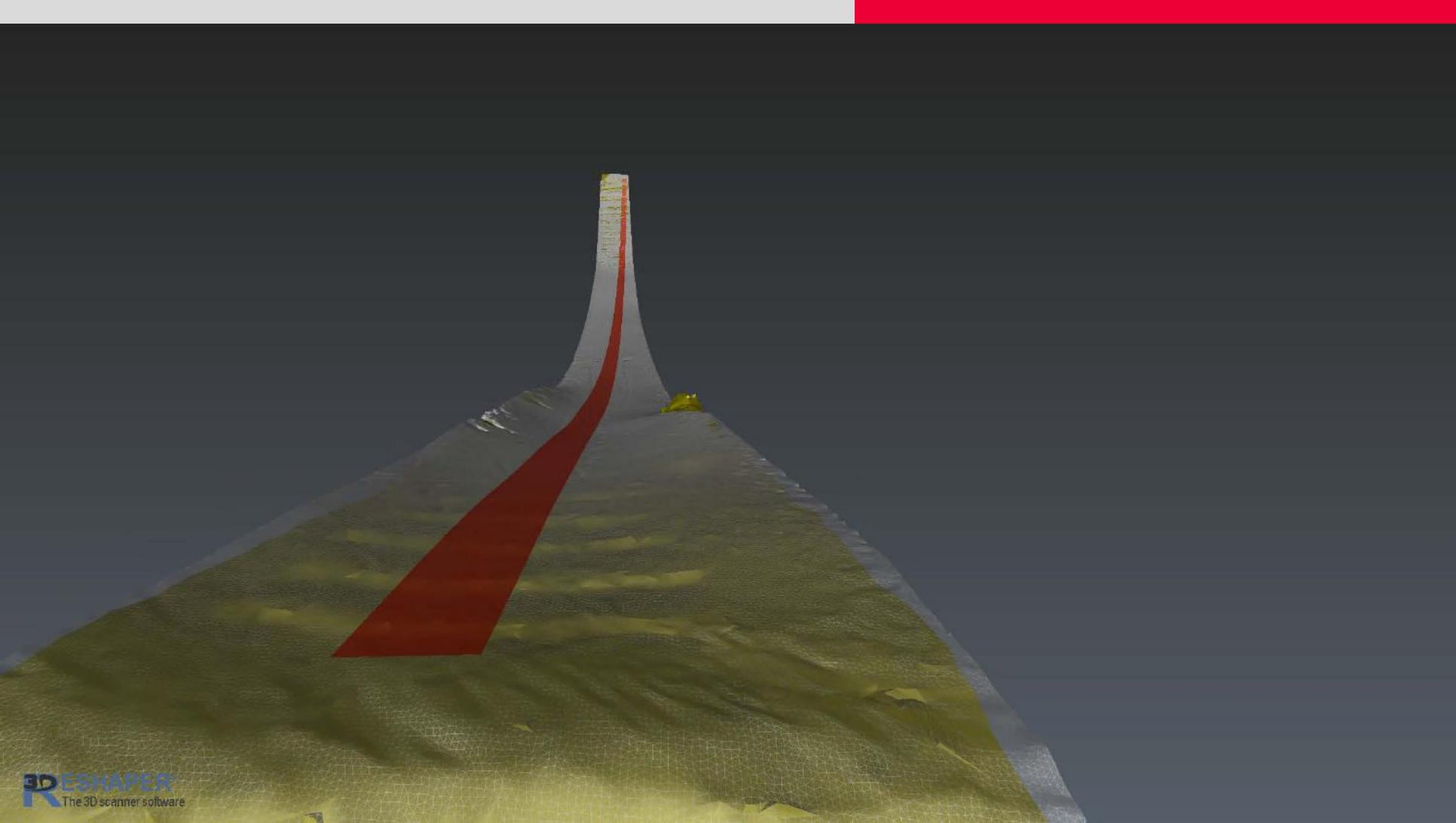


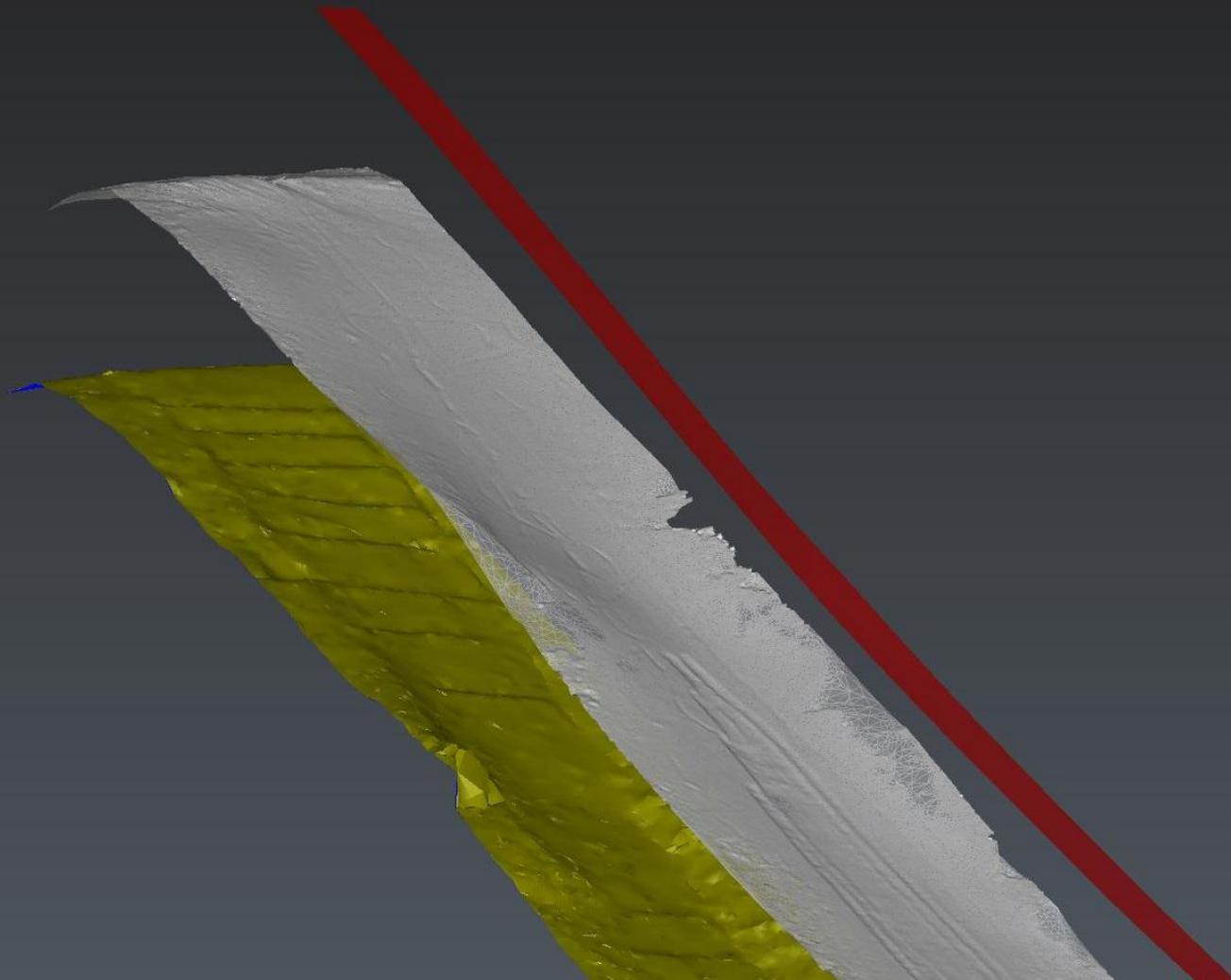
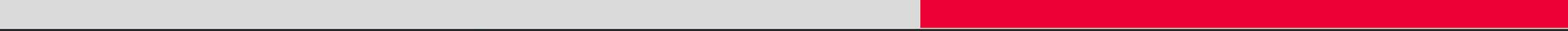




when it has to be right





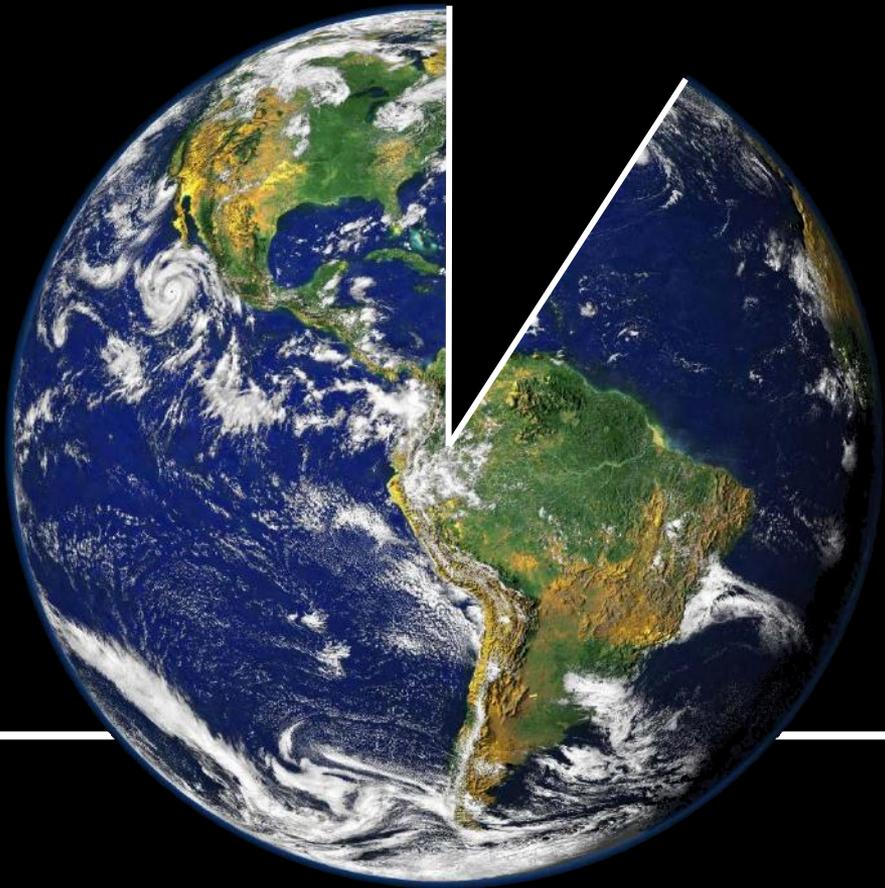


Parovoz



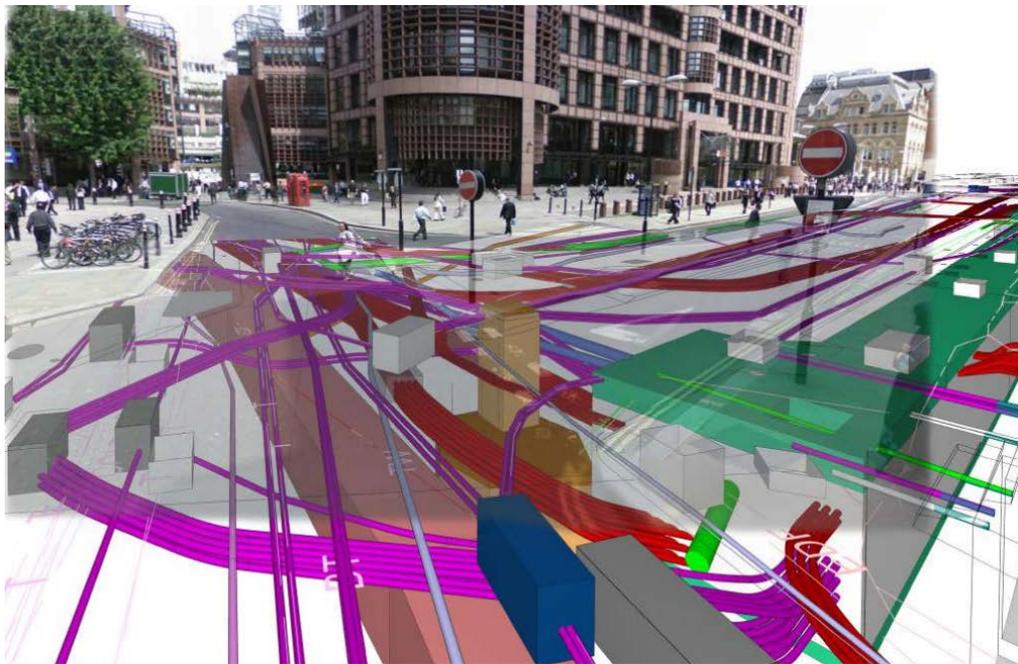
when it has to be right

Leica
Geosystems



90% of all the data
in the world was created
in the last **2** yrs

Challenging plan to connect peripheral areas



Transport

Railways and stations (Underground, Overground, light rail and national rail including high speed), roads (bus, car, cycling, pedestrian, street lighting) and global connections with a new four-runway hub airport.

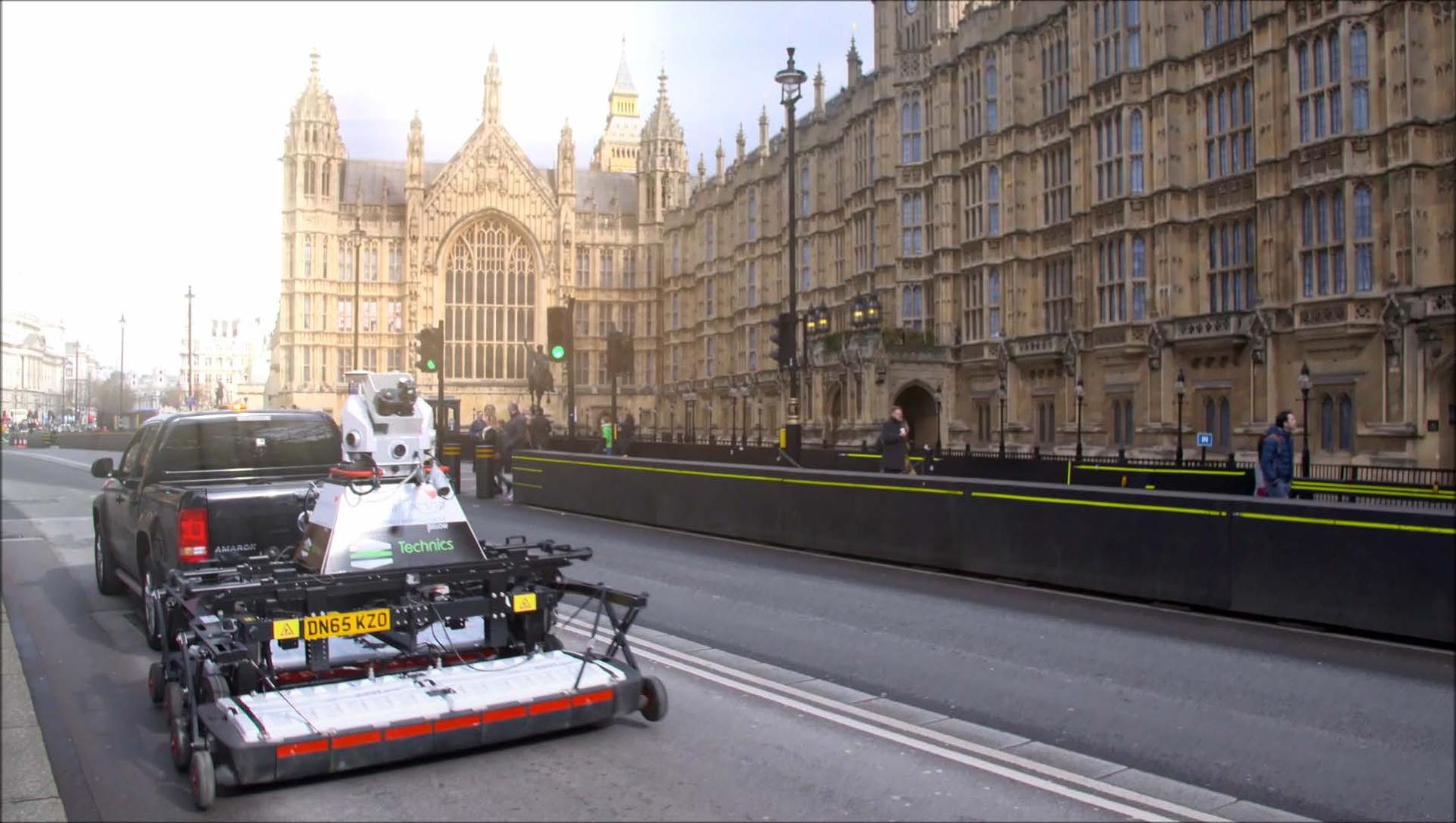
Energy

Electricity, gas and renewable, nationally and locally produced.

Water

Water supply, drainage (rain and waste water), waste water and flood risk management.

Digital Infrastructure





Umaned Reality Capture





THE SURVEYOR OF THE FUTURE?

Is already here...

Group discussions

- The next industrial revolution is here and that will affect surveyors by owning their data and the value.
- The way in which we design and construct now and in the future is more than ever be completed twice. Digital twins are allowing us to accurately build the architect digital model in the real world.
- Autonomous machines could replace heavy construction workers soon.
- SLAM allows surveyors to capture indoor buildings in a fraction of the time.
- The need for a GNSS pole for cadastre surveying could be replaced with mobile mapping.
- What is the accuracy of a wearable mobile mapping backpack. As precise as a GNSS pole for outdoor working. 1mm precision / 1m distance for camera.
- Surveyors of the future can explore hazardous environments with remote controlled mobile mapping.
- Interest from GA delegates to use our vision to educate the younger surveyors was requested.
- Technology is becoming a one button press, which means some tools are becoming a commodity and will allow everyone to perform complex measurement without the need for a traditional surveyor.