# Embracing the possible: applying cross-transferable innovation from other industries

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## POLL QUESTION

What is your job title?

## POLL QUESTION

Who is your employer?

## POLL QUESTION

How many years of experience do you have?

## POLL QUESTION

What geographic region are you from?

## The Digital Revolution

Revolution v. Evolution

## New UK MER Landscape

**UK Oil and Gas Authority**

- technology plans, behaviour and R&D spend measurement
- OGTC matched-funding of innovation projects
- Operator evaluation; leader, fast follower, informed buyer
- NDR (National Data Repository)
  https://www.ogauthority.co.uk/media/4807/documentsscottish-oil-club-presentation.pdf

*"we've now taken all the excuses off the table* ***to allow Digitalisation to happen and improve productivity in the UK CS"***
Andy Samuel, CEO UK OGA

## The REAL reasons

- Company culture
- Workforce skill shortages
- Existence of silos

*Source: Upstream Intelligence*

## The REAL reasons

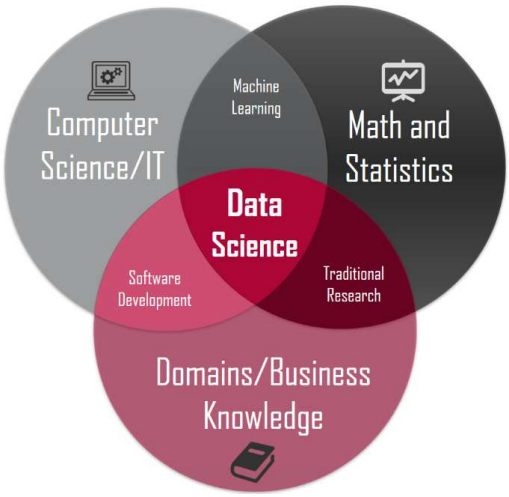
### Defining Machine Learning

"A computer program is said to learn from experience 'E', with respect to some class of tasks 'T' and performance measure 'P' if its performance at tasks in 'T' as measured by 'P' improves with experience 'E' : Professor Tom Mitchell

Another definition is: "The ***extraction of learning*** from data"

Put simply, if a computer program improves with experience then we can say that it has learned.

## Digital Skills and Resource Model



## Example : 'Trusted' Decision Support Systems with *Dynamic Situation Awareness*

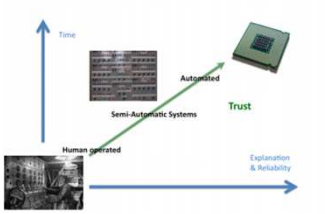
***TTM's* Trusted Reasoning Architecture (TRA)** *is* ***a novel mathematical architecture*** *for semi-autonomous* ***(man-in-the-loop)*** *'command and control' decision aids, intelligent cockpit, urban search, drones... (UK Ministry of Defence)*

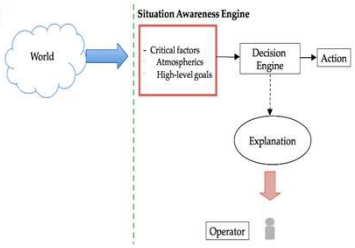
**TRA-based systems :**

- *non rule-based*
- *learn (capture the world real-time and update their situational awareness),*
- *flag up subtle anomalies in static and real-time sensor data*

**Why 'trusted'?**

- they *explain their reasoning to the human operat*




Fundamental change:
avoid siloed teams, siloed data and isolated programmes

## Example : 'New Space' or Space 4.0

from Air Traffic Control to Smart Airports and Cities

Airbus
- utilising existing core engineering and I.T. competencies
- breaking the traditional organisational and domain expert siloes
- creating new (versatile) capability, not (static) products
- capturing value and opportunity of 'data'
- create new working partnerships with innovative small companies (e.g. A.I., data analysis, machine learning, etc)

## Example : Aerospace

'The Conscious Aircraft' or Digital Twin

Consortium (JIP) Aspirational Projects are great as a sector call to action, ….it's the deliverables in the road-map that count

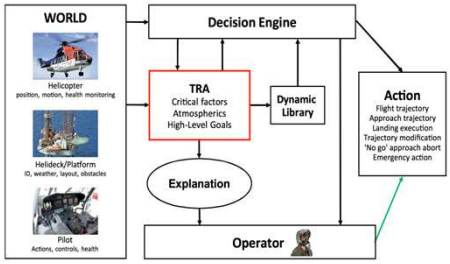
Companies can explore 'the art of the possible' as a sector
– shared ideas, costs & risks

## Example : Heli-flight Safety - Human Factors

### Think Tank Maths (TTM) Ltd Trusted Reasoning Architecture (TRA)

**Decision Making and Explainable Guidance**

- Real-time monitoring and decision making
  - System incorporates historical data from prior flights
  - Current data from helideck, a/c and pilot
  - Appropriate action or flight path identified and refined
- Flexible dynamic system beyond 'rule based decisioning'
  - Continuous updating and refinement of "Dynamic Library"
  - Assess impact of a/c and helideck conditions on flight plan
  - Identify 'critical factors' in incidents for improved early warning
- Augmented pilot/system interaction
  - Avoid overwhelming pilot with irrelevant or unclear data
  - Atmospherics and high-level goals used to explain decisions




**Reduced Pilot Workload Through Trust**

- Pilot can prompt the creation or modification of a flight plan or action list by inputing or updating high level goals
- When a critical flight change is necessary the pilot is informed, provided with a course of action and can request an explanation
- General pilot feedback regarding potentially critical inter-dependencies between flight trajectories, pilot action and environmentals

## Example: National Railway Network

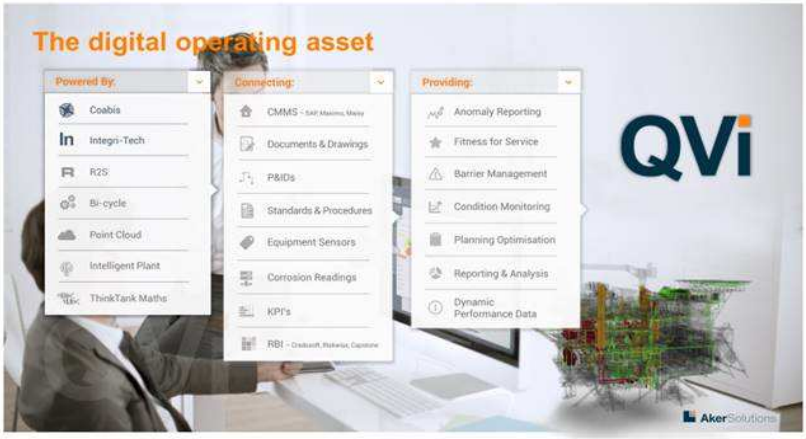
A major European National Railway Network,
- needs **smarter scheduled maintenance** of its very old and rapidly ageing assets
- use its huge array of sensor data streams to do **predictive maintenance.**

…recognising the immense Opportunity Cost of not doing the project...
more than 500,000 commuters all shouting at you at once …to be avoided.

## Cross-over capability from Military and Aerospace to the Oil and Gas industry

- **Asset Integrity**; through-life monitoring and risk assessment (CBM), anomaly detection, root cause analysis, prediction of failure (integrity kick) for timely maintenance
- **Manage Drilling Operations;** dynamic wellbore positioning accuracy, wellbore planning, relief well planning, wellbore stability prediction – preventing troubles while drilling (e.g. avoiding stuck pipe ...)
- **P&A;** identify viable cost savings, predict leakage to surface (HSE compliance)
- **Subsurface Workflows**; a "Through-Life Subsurface Management System", optimising from Exploration to Plug & Abandonment

## Example 1: The digital operating asset moving from preventative to predictive solutions



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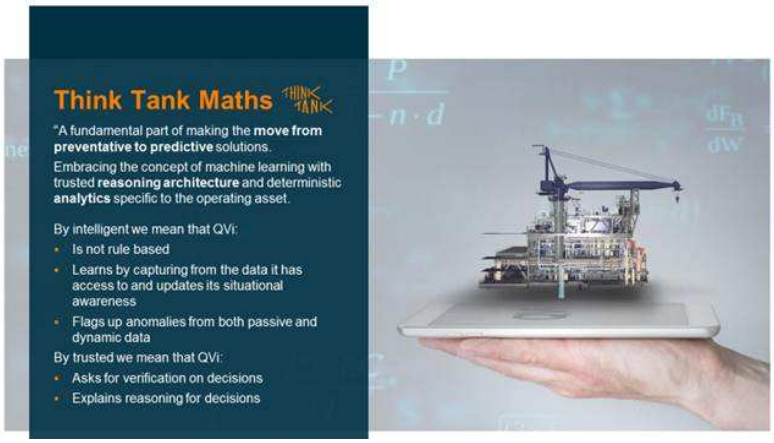



Creating new skills and resource partnerships

## Example 2: (Proven capability – Operationalisation – Drilling Ops Centre)

**Dynamic System for Wellbore Positioning Quality Control**

**ThinkTank Maths and Norwegian Operator**

**4-year R&D collaboration**

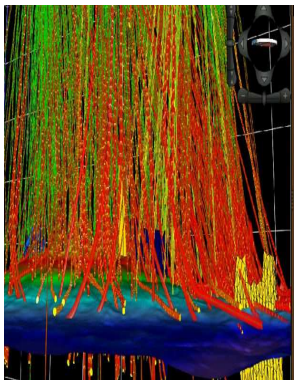
**£ 8 million investment to-date (UK MoD, O&G Operator and TTM)**

## Example 2 : Dynamic System for Wellbore Positioning Quality Control
## Project Overview

**Identified critical aspects in standard procedures**
- Path construction
- Magnetic Quality control
- Position uncertainty

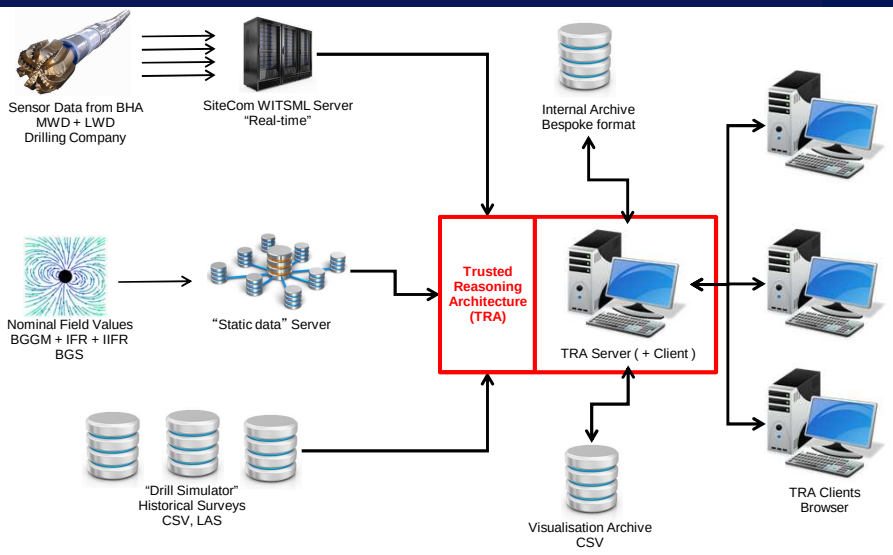
**Development of *New* Mathematics and Novel Data Analysis**
- Use of Broad range LWD & MWD ***raw* data from 80+ wells**
  **i.e. many thousands of data points**
- *Alternative* path construction Methods
- Refined correction procedures
- Positional and uncertainty assessment
- Alternative source of information for magnetic QC

**Addressing concerns and requirements of Industry**
- Real-time localisations and quality control
- Safety factor compliance when planning in dense mature environments…. and **new oil field 'through-life' management**

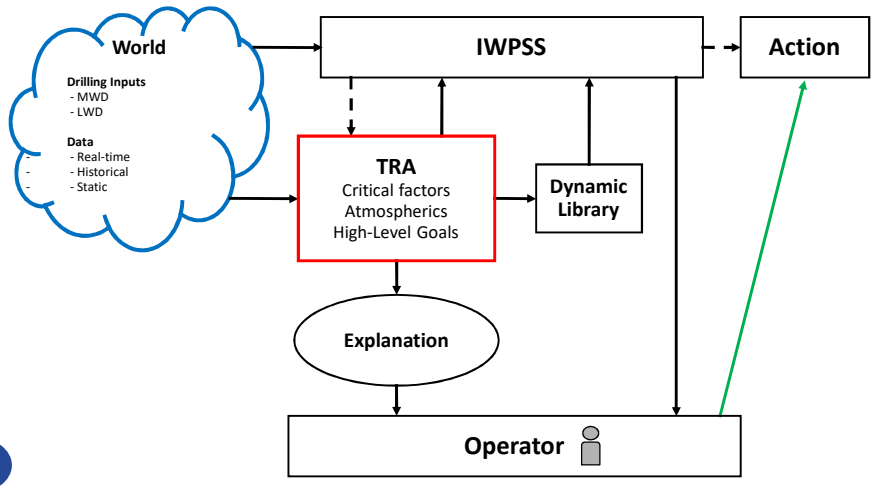


**Benefits**
- Better well planning and more accurate targeting in reservoir **(>5% extra recovery)**
- Dynamic Directional Drilling Decision Support
- Deliberate wellbore interception (relief well planning)
- Collision Avoidance Procedure
- Virtual Resurvey of offset Wells
- New Geology Insight

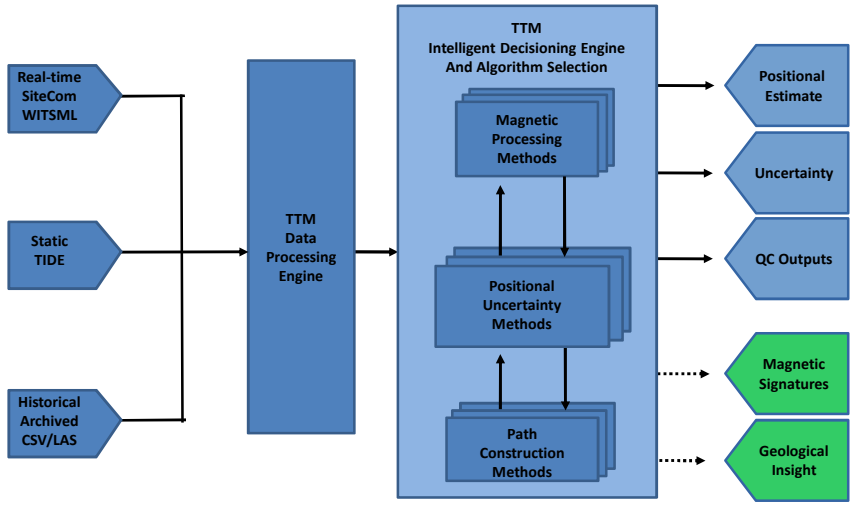
## Example 2: Dynamic System for Wellbore Positioning Quality Control
## Trusted Reasoning Architecture (TRA) Workflow



## Example 2: Dynamic System for Wellbore Positioning Quality Control
TRA Enabled Intelligent Wellbore Positioning Support System
Situational Awareness Engine

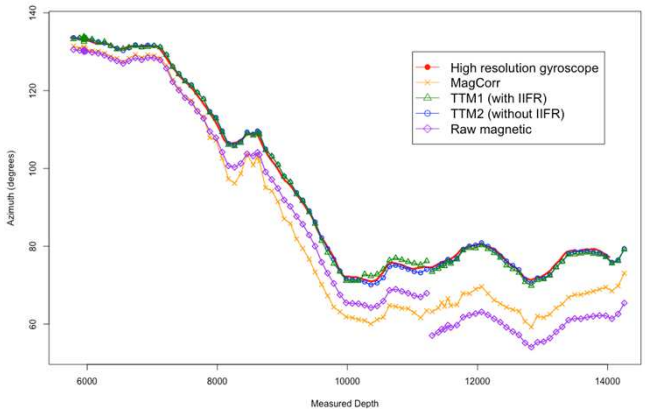



## Example 2: Dynamic System for Wellbore Positioning Quality Control
Internal Data Infrastructure



## Example 2 : Dynamic System for Wellbore Positioning Quality Control
## Decision support: Output Visualisation Screen and Dashboard

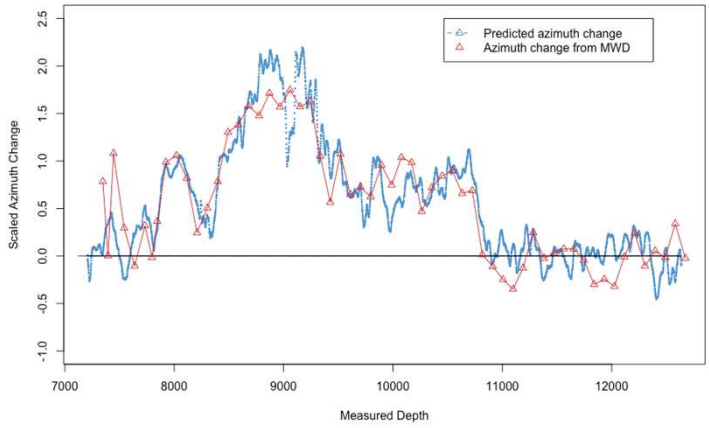

## Example 2 : Dynamic System for Wellbore Positioning Quality Control
## Novel Magnetic Processing Suite – Sparse and Unavailable Data




Through the identification of **hidden structures** within the **magnetic environment** a suite of magnetic processing methods were developed to **avoid the use of Interpolated In-field Referencing (IIFR) data**

- Algorithm adapts to amount of available data
- Immediate output, avoiding lengthy wait for costly 3rd Party IIFR data
- Additional information provided about magnetic and geological environment

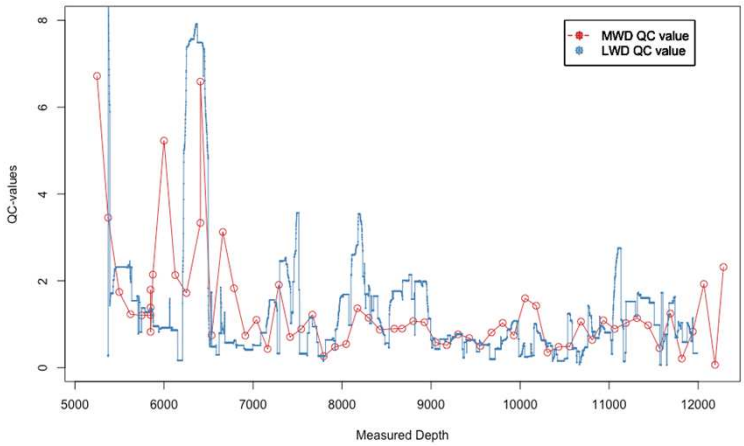
## Example 2 : Dynamic System for Wellbore Positioning Quality Control
## High Resolution LWD-based Directional Information




Structures within the **LWD data** provide information about **azimuthal change**

- High frequency/resolution
- Directional information **between MWD surveys**
- Additional information about **magnetic environment**

## Example 2 : Dynamic System for Wellbore Positioning Quality Control
## High Resolution LWD-based Quality Control – *Using Different Data*




Quality Control from L**WD data** provides information about the magnetic environment **at higher resolution than sparse MWD surveys.**

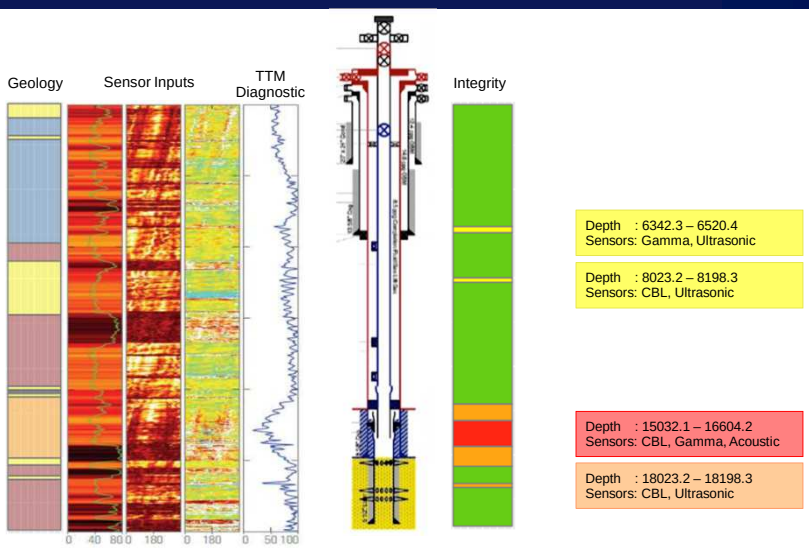
- **Additional information about geological environment**
- **Provides information to refine magnetic processing methods**

Example 3:

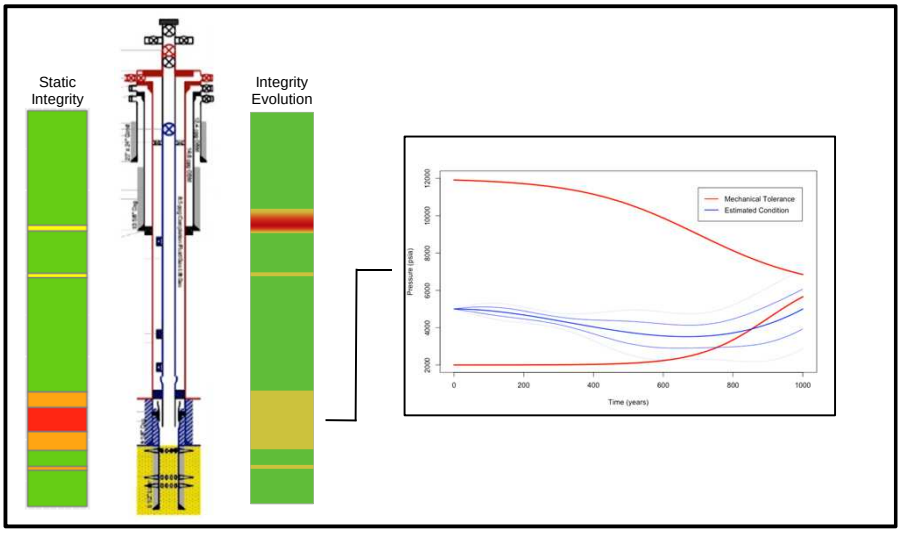
## Prediction of Well Integrity and Leakage to Surface

Intelligent Diagnostic and Decision Support System
Optimised Plug and Abandonment

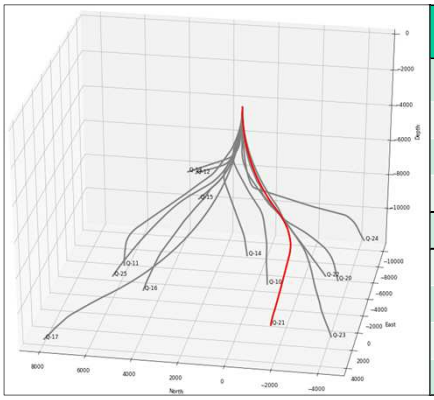
## Plug and Abandonment
## Output Dashboard – Single Well Current Conditions



## Plug and Abandonment
## Output Dashboard – Single Well Future Conditions



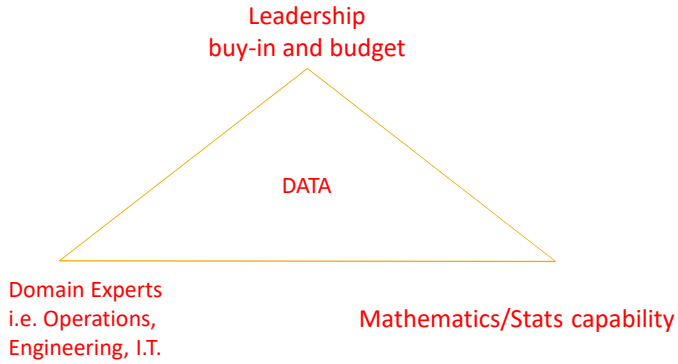

## Plug and Abandonment
## Output Dashboard – Multi-Well Assessment



| Well | Current Integrity | Predicted Condition | Rigless Procedure |
|---|---|---|---|
| Q-14 | | | |
| Q-20 | | | |
| Q-17 | | | |
| Q-23 | | | |
| **Q-21** | | | |
| Q-16 | | | |
| Q-13 | | | |
| Q-15 | | | |
| Q-10 | | | |

The shift from strategy to action implementation

## The Essentials



## Getting started

- identify and prioritise business issues of strategic importance with a significant value-gain opportunity
- define target outcomes; value gain, savings, efficiency goals
- Leadership engagement; resource and budget commitment
- create an empowered, multi-skilled expert team with shared vision and goals
- create or partner to fill skills gap (Mathematics/Stats)
- agree a project 'challenge statement'
- gather existing data and check what you can do with it
- use Agile project management processes

## Thank you

Contact: Angela Mathis, CEO
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ThinkTank Maths Limited
www.thinktankmaths.com

Webinars

Discussion and questions