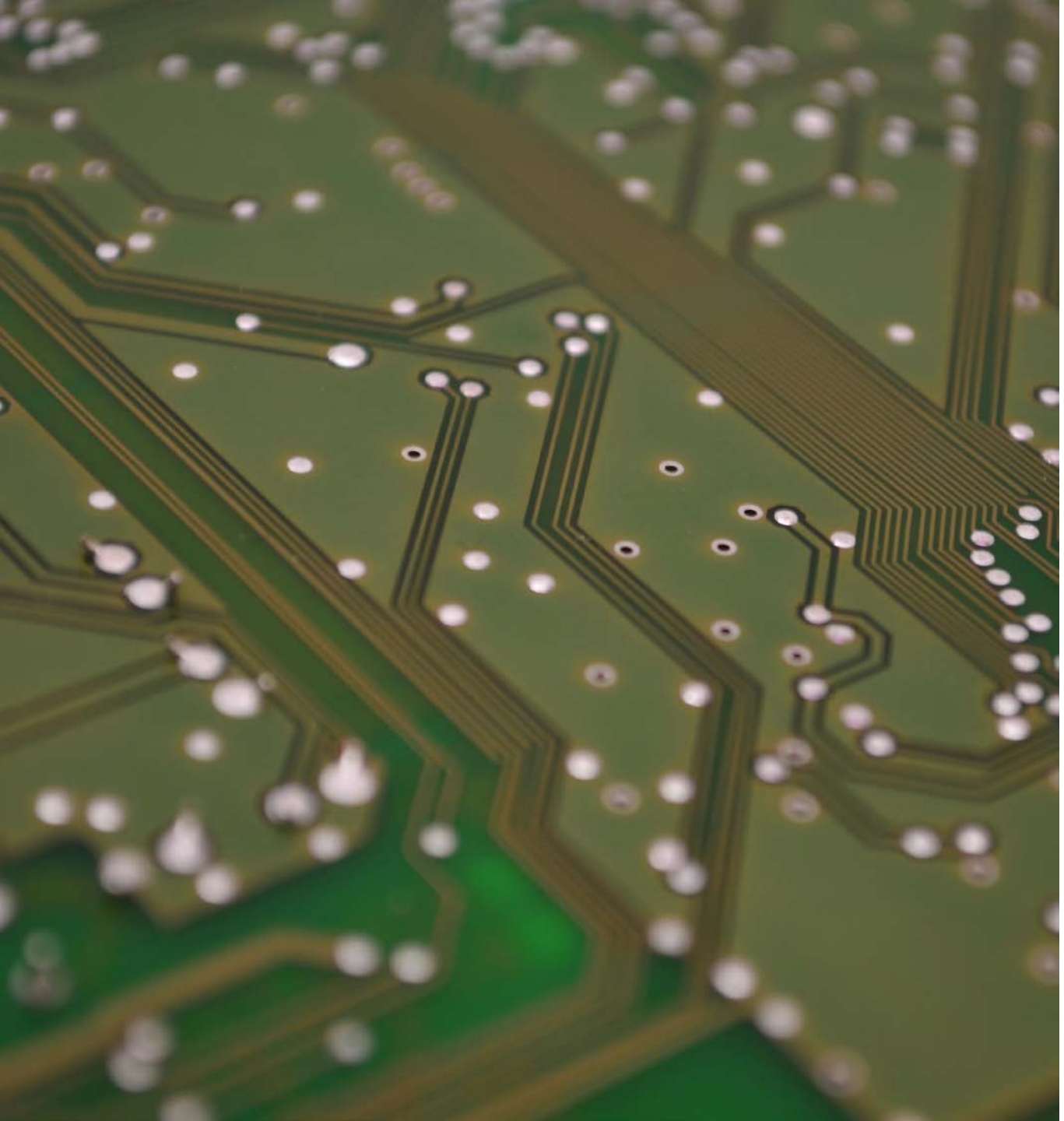

The Power of Data:

Big Data to Dashboards (and Beyond), making the most out of your data investment

Presented by:

Simon Gibbons, Technical Director (ERM)

Natasha Hausmann PhD, Senior Scientist (ERM)

Brian Henry, Principal Consultant (ERM)

Guest Speaker:

Johan De Fraye, Head of Environmental Affairs (Signify)

October 11, 2018

The business of sustainability

ERM

Today's Speakers

Simon Gibbons
Technical Director - ERM
simon.gibbons@erm.com

Brian Henry
Principal Consultant - ERM
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Natasha Hausmann, PhD
Senior Scientist - ERM
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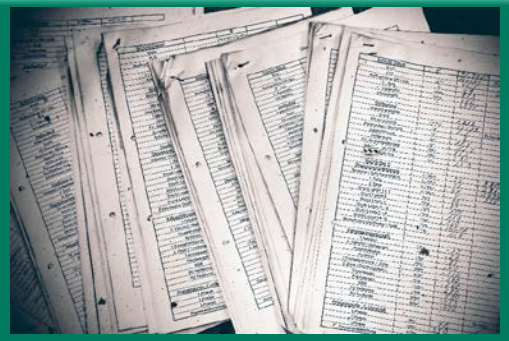
Johan De Fraye
Signify
Johan.de.fraye@signify.com

Health and Safety Moment: Insight through Visualization

- Spill modelling work has identified practical H&S risks for the workforce

Agenda



Data Management Retrospective

- Where did we come from?
- Where are we going?
- How do we most cost effectively link these together?

Speaker: Simon Gibbons (ERM)

The Value of Data Management

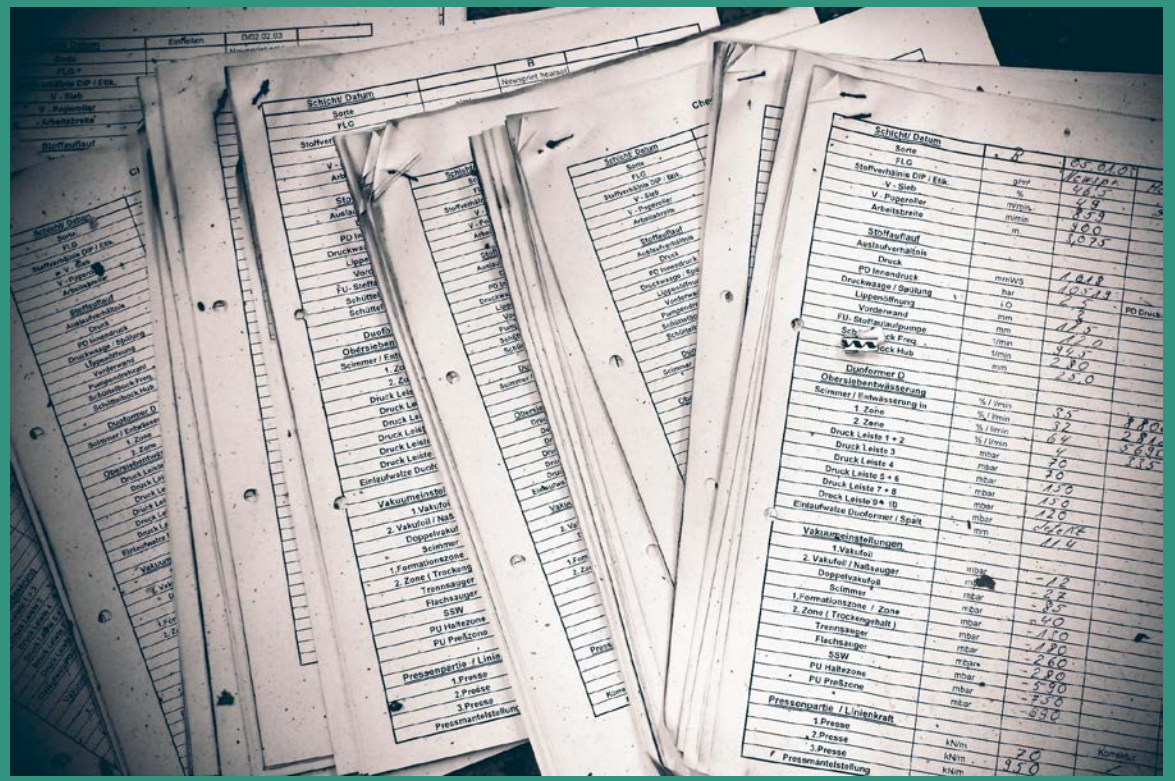
- Case Studies: Automated Reporting
- Case Study: Advanced Analytics

Speaker: Tasha Haussmann (ERM)

The Power of Dashboards

- The Value of Dashboards
- Case Study: Use of Dashboards to facilitate change

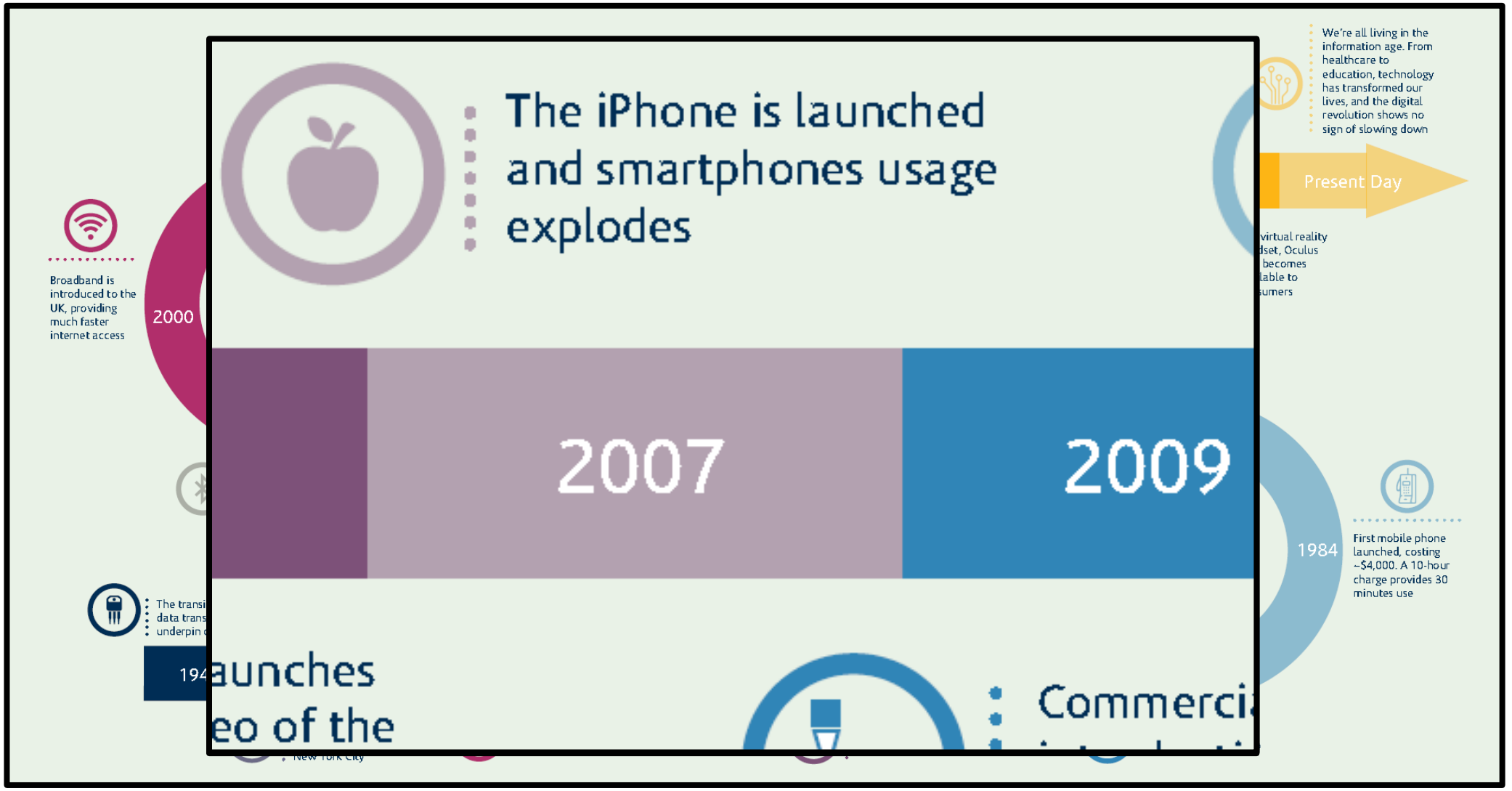
Guest Speaker: Johan De Fraye (Signify)
Speaker: Brian Henry (ERM)



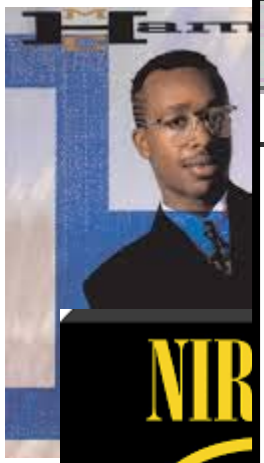
Data Management Retrospective

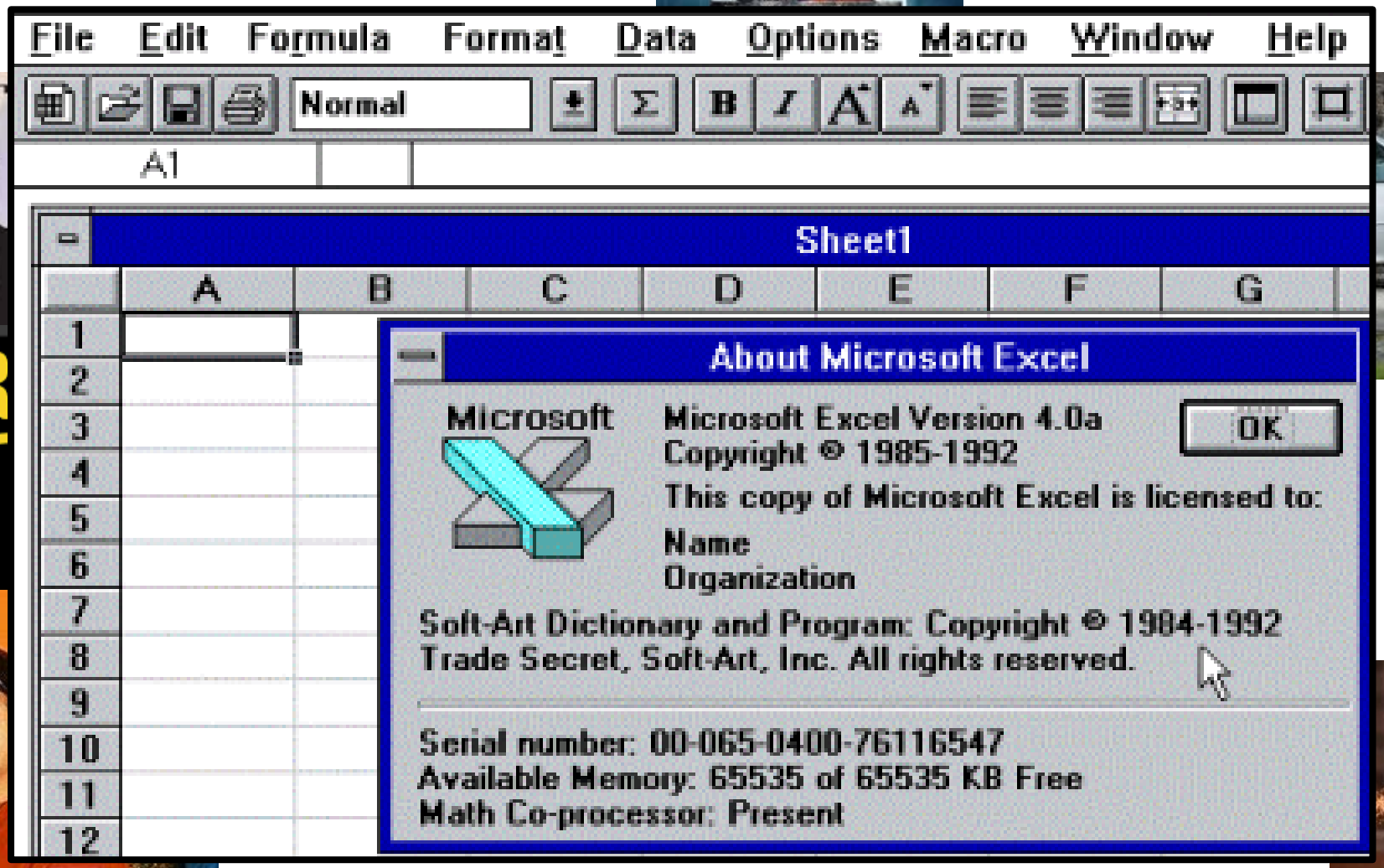
Speaker: Simon Gibbons (ERM)

Technology Age



Moving on from the 1990's

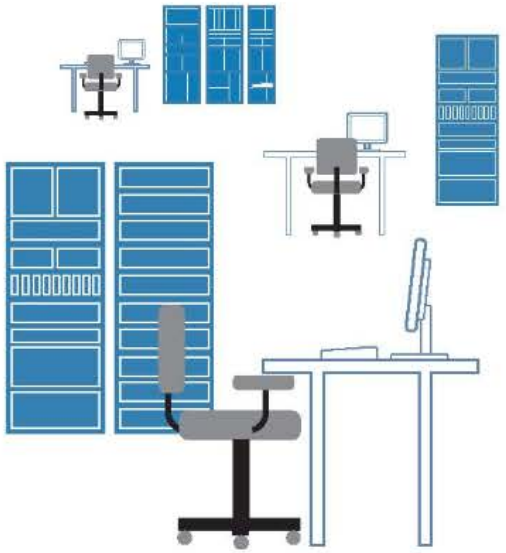




The Role of Data and the Data Manager

Data waster

Collects data but severely underuse them



Data collector

Collects data but do not consistently maximize their value

Aspiring data manager

Understands value of data and marshals resources to take better advantage

Strategic data manager

Has well-defined data-management strategies that focus on collecting and analyzing the most valuable data

Digital Maturity – a Corporate View

The benefits from working in a maturing company…

Digital Maturity Level 1
Moving from Analog

L1 Characteristics

- Isolated Data Sets
- Pen & Paper → Excel
- Bespoke Reports
- Reports On Hard Copies/Hard Drives
- Lack Of Transparency

INCONSISTENT AND INEFFICIENT

Digital Maturity Level 2
Making the Digital Leap

L2 Characteristics

- Digital Data Collection
- Single Source Of Truth
- Speed Up Decision Making Process (Real Time)
- Consistent And Efficient Reporting

RELIABLE AND EFFICIENT

Digital Maturity Level 3
Integrating on Digital

L3 Characteristics

- Connecting Business Data Sources
- Data Insights Leading To Optimization
- Better Visualization (3D) → Stakeholders
- Efficient Decision Making Process

INTEGRATED AND INSIGHTFUL

Digital Maturity Level 4
Into Data Mining

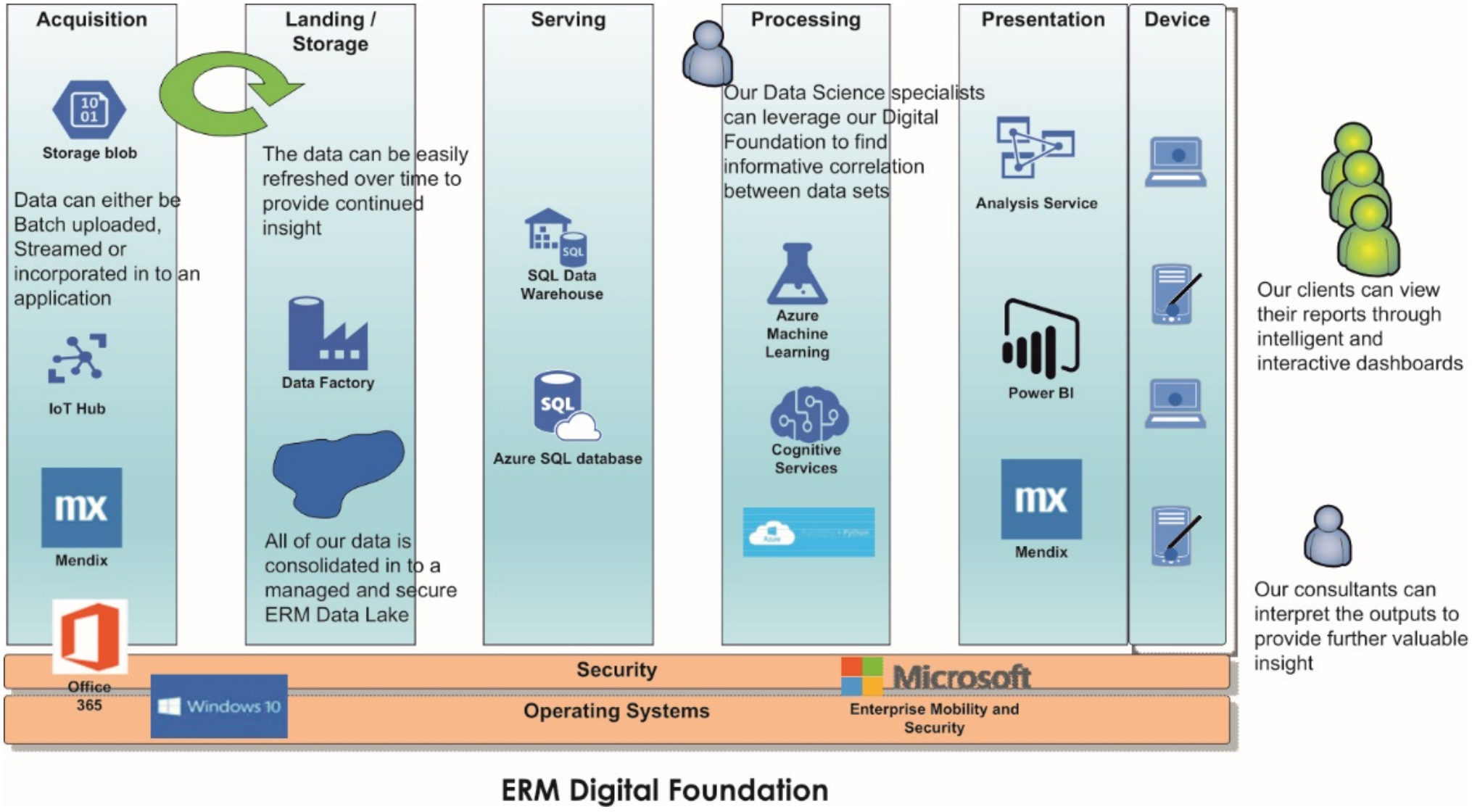
L4 Characteristics

- Predictive Analytics
- Machine Learning For Data Analysis
- Automated Decision Making

To Artificial Intelligence, Virtual Reality And Beyond

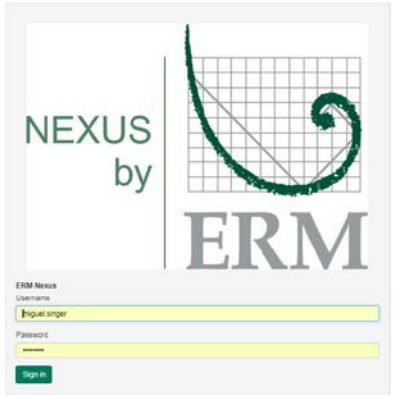
FORWARD-LOOKING AND PROGRESSIVE

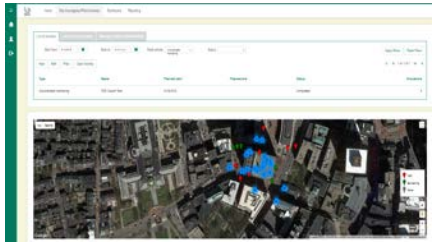
Role of a Strong Digital Foundation



An Example Data Workflow – ERM Nexus

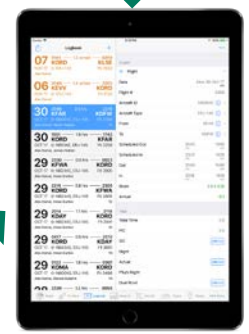
Field Planning → Field Data Collection → Data Management → Data Assessment → Data Reporting





PowerApps

Soil Sampling
Soil Borings
Monitoring Wells Installation
Soil Gas Sampling
Groundwater Sampling
Indoor Air Sampling



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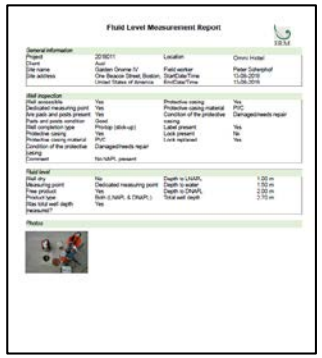
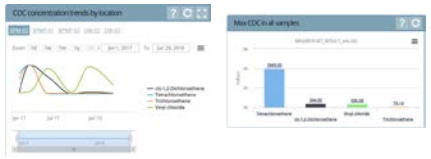




earthsoft EQuIS

esri ArcGIS Online

earthsoft EQuIS

Microsoft Azure

Power BI

Story Map ArcGIS

Power BI

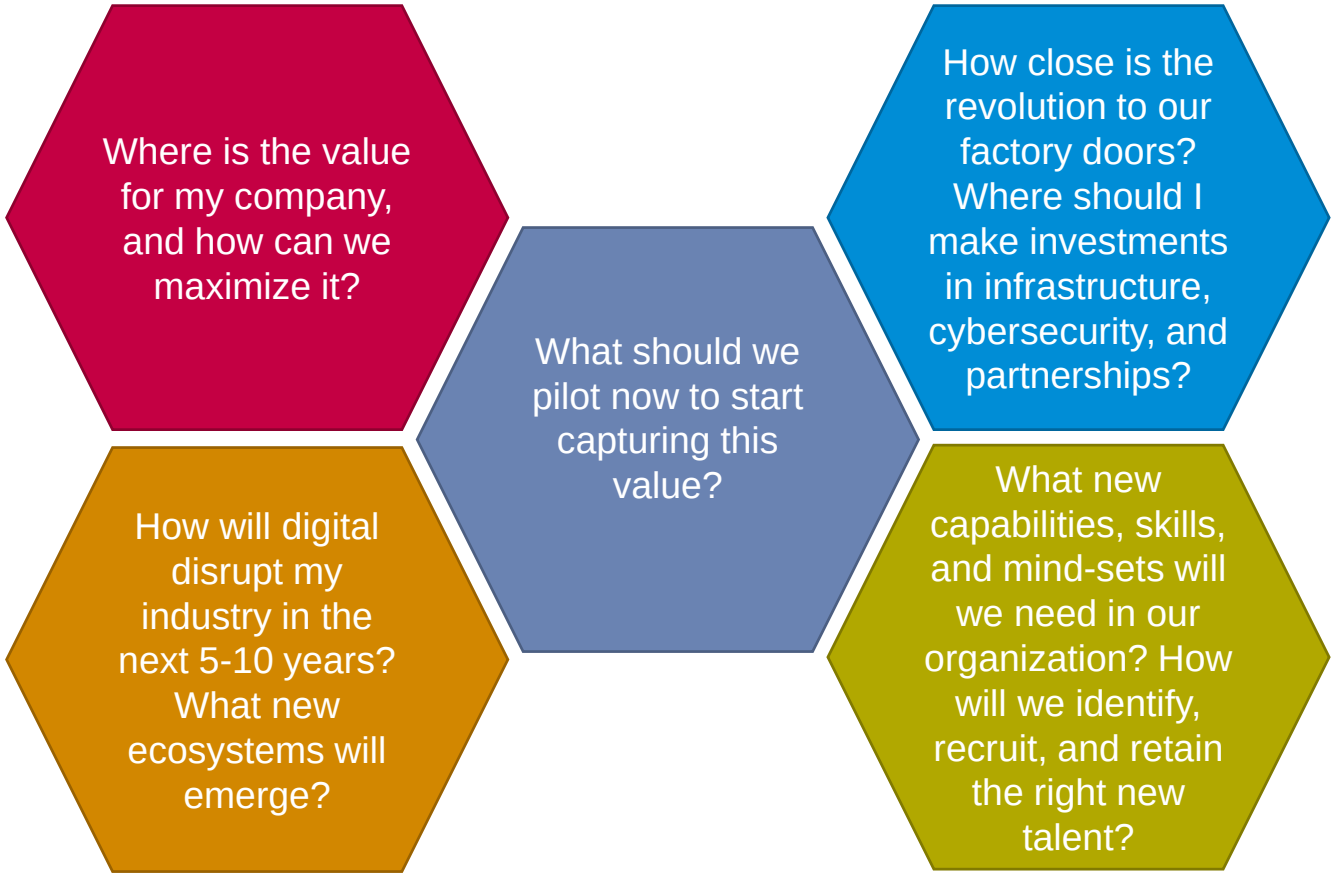
Office 365

Office ← Field → Office

NEXUS by ERM

What Should We Ask Ourselves?

McKinsey's C-Suite Questions… Digital = Data



The Value of Data Management

Speaker: Tasha Hausmann (ERM)

Automation and data analytics reduce reporting burden

Challenge:

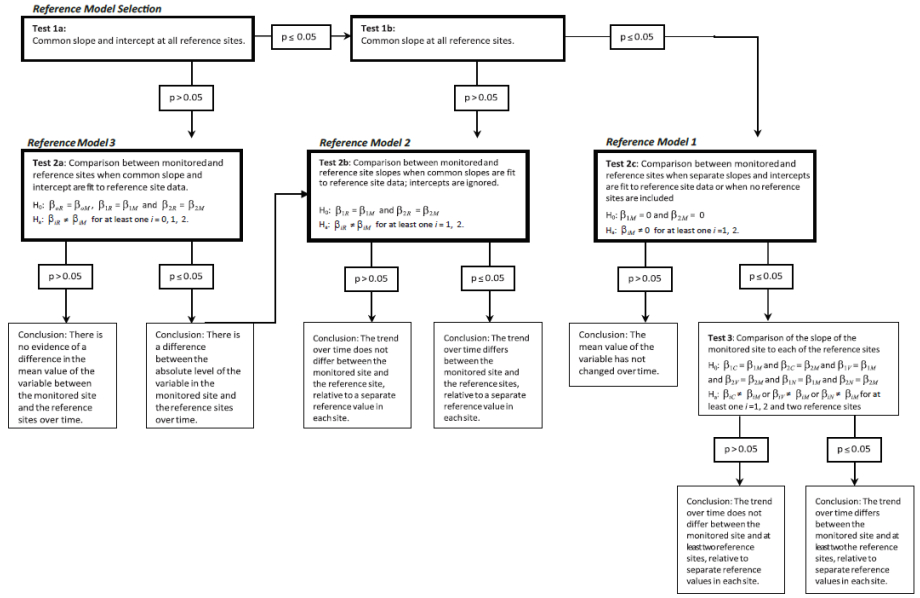
- 200 custom regulatory reports
- Must be completed annually with 4-6 weeks to complete all analyses and reports

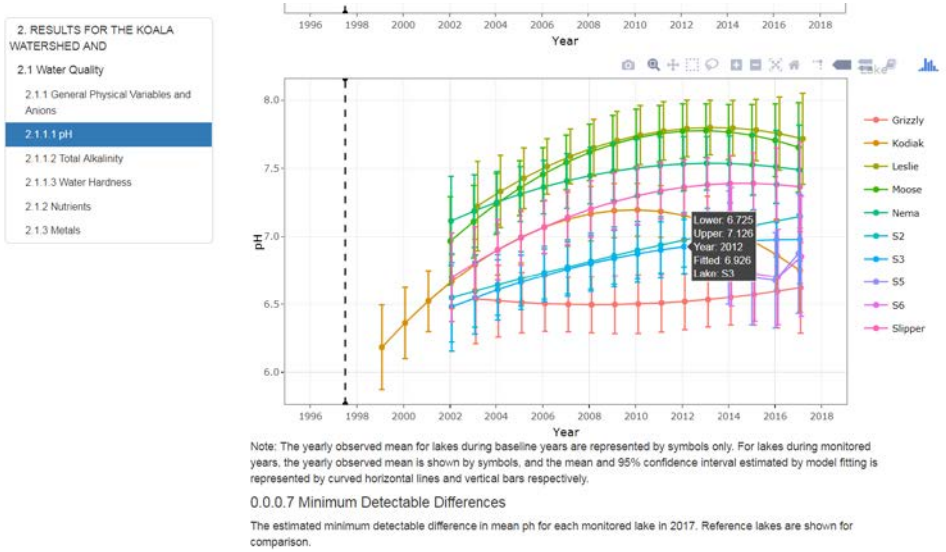
Approach:

- Leverage R and Rstudio to create a reporting template that could be automated

Benefits:

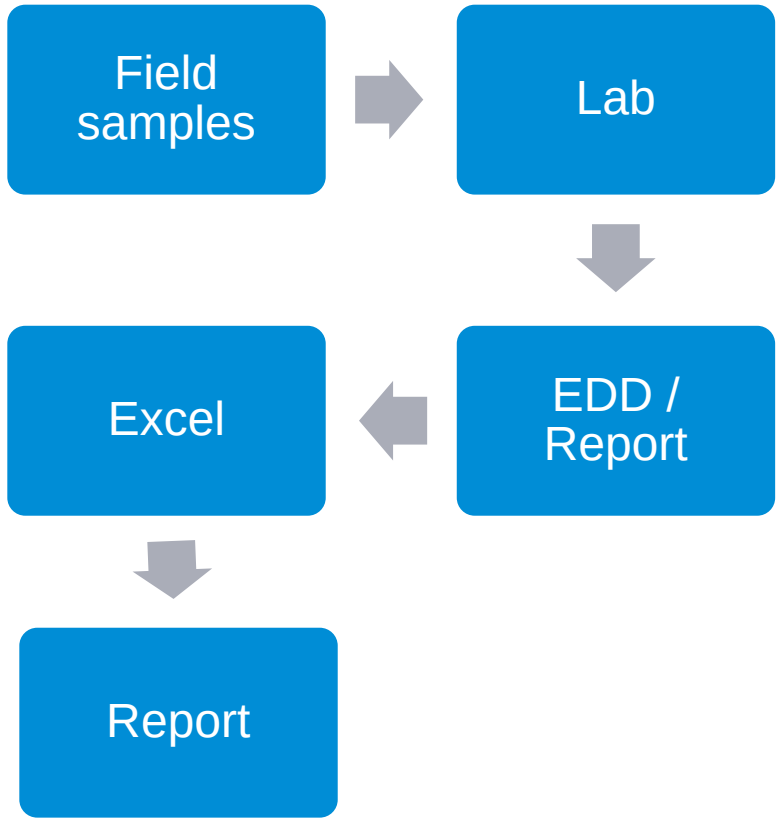
- 65% reduction in annual statistical analysis and reporting costs and 50% reduction in report production costs.
- Overall improvement in the efficiency, accuracy, quality and timeliness of reporting.



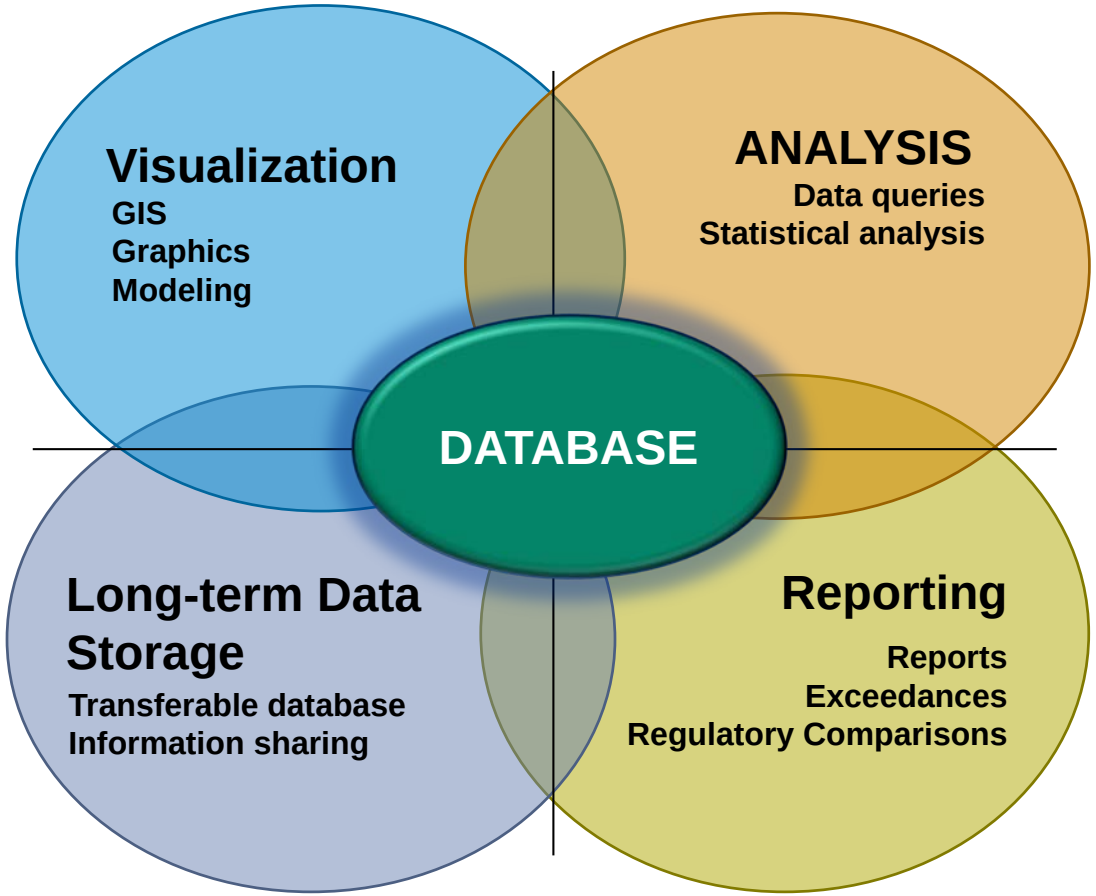


Leveraging data means modernizing work flows and processes

Manual data work flows are error prone



Move toward an Integrated Data Practice



Establishing an insights road map for Power Clients

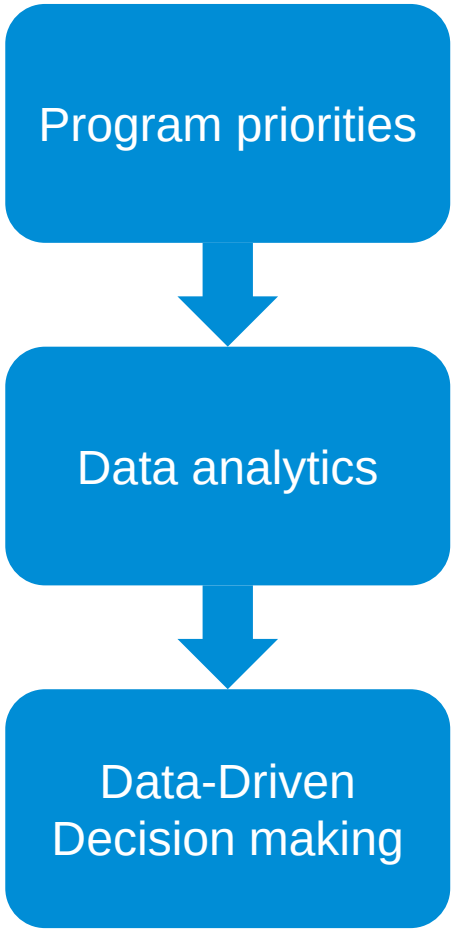
Begin with the end in mind

Client Challenge:

Establish a groundwater monitoring program for all coal ash landfills and impoundments

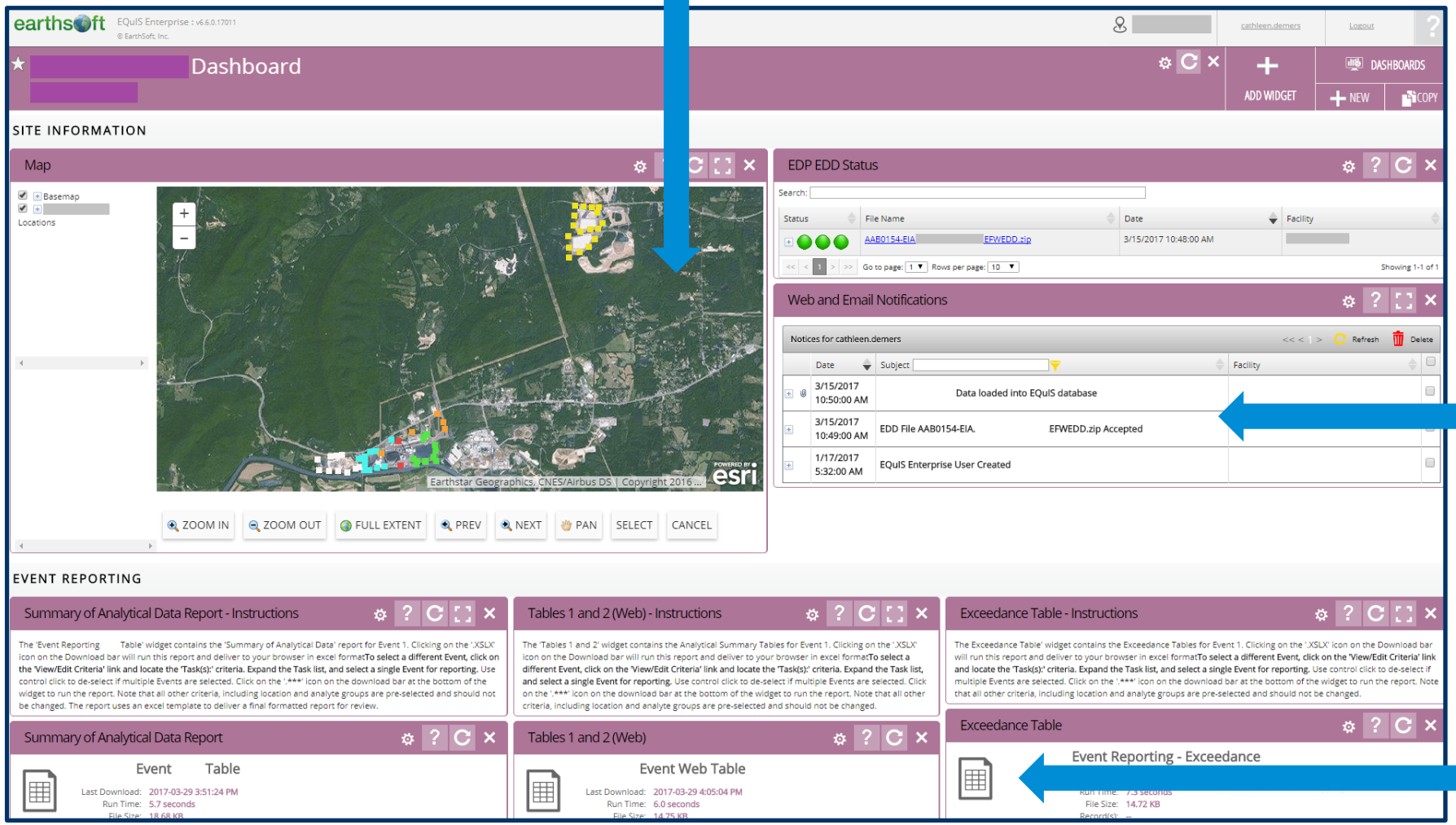
Recommendations

- Establish a compliant yet flexible decision framework and implement these with the right digital tools
- Employ data analytics at key strategic decision points
- Carefully consider regulatory timeline and program phases



Controlled, Web-based Access to Database

Real-time data views

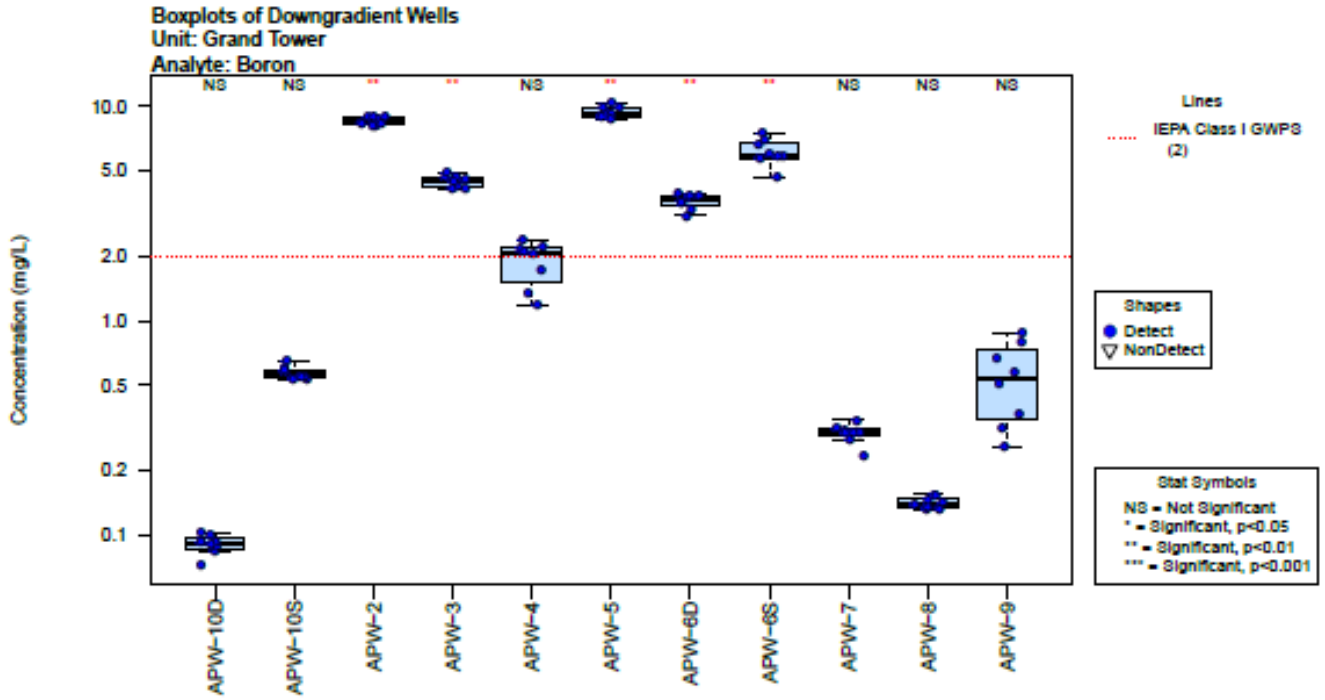


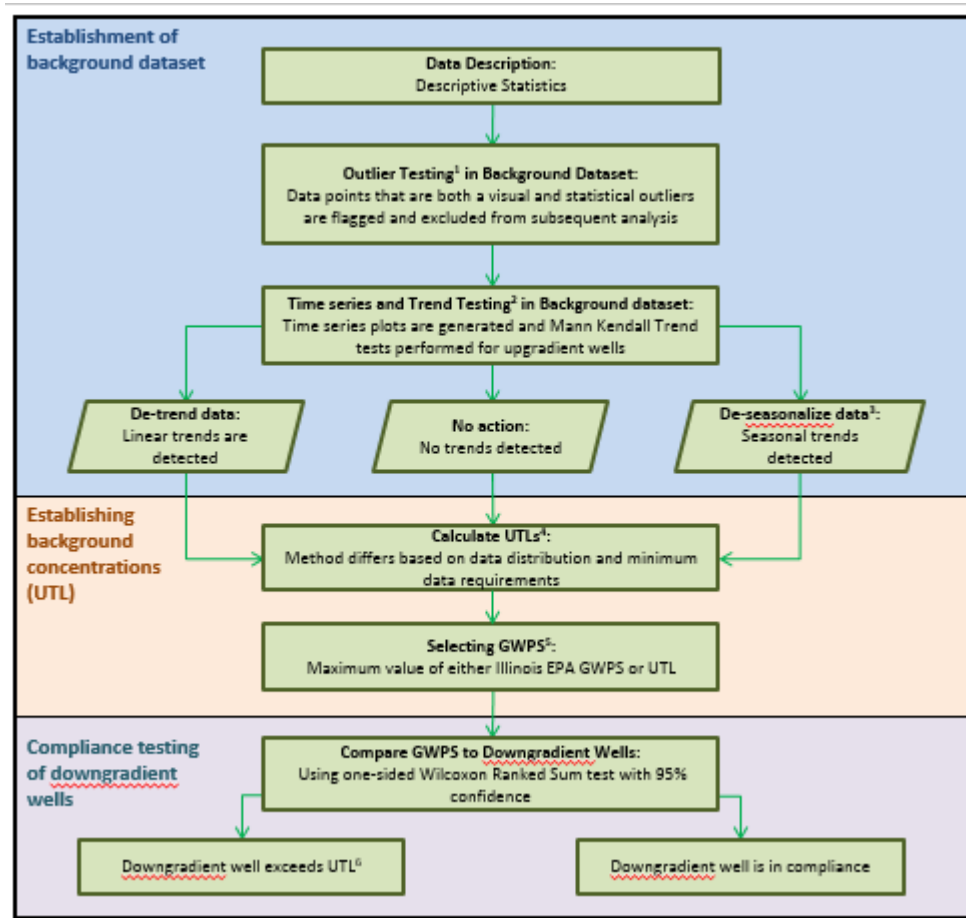
Sample tracking

Automated reporting / screening against UPLS

Automated Analysis and Reporting for Compliance Testing

- R Markdown reports executes decision framework
- Auto-population of tables, figures and text
- Comparisons to regulatory limits (UCLs, UTLs, and UPLs)



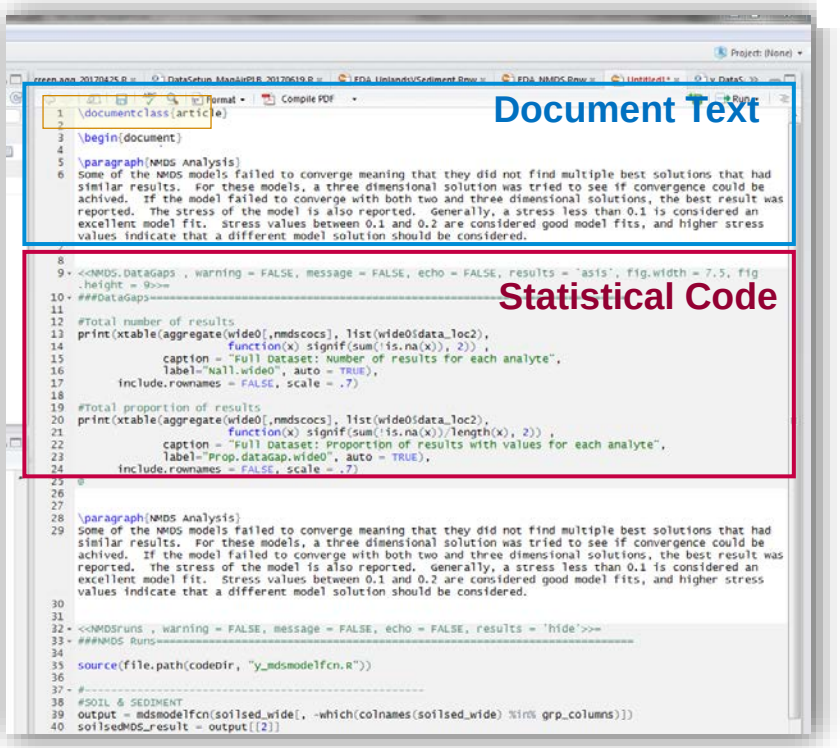


Grand Tower_-F1_OutlierPlot_2018-04-24.pdf
Grand Tower_-F2_Timeseries_Upgradient_2018-04-24.pdf
Grand Tower_-F3_Boxplots_Screening_2018-06-21.pdf
Grand Tower-Analysis_2018-06-21.xlsx
GWMR_GrandTower_20180621.docx

Dynamic Reports

Reproducible documents with appealing figures and formatted tables

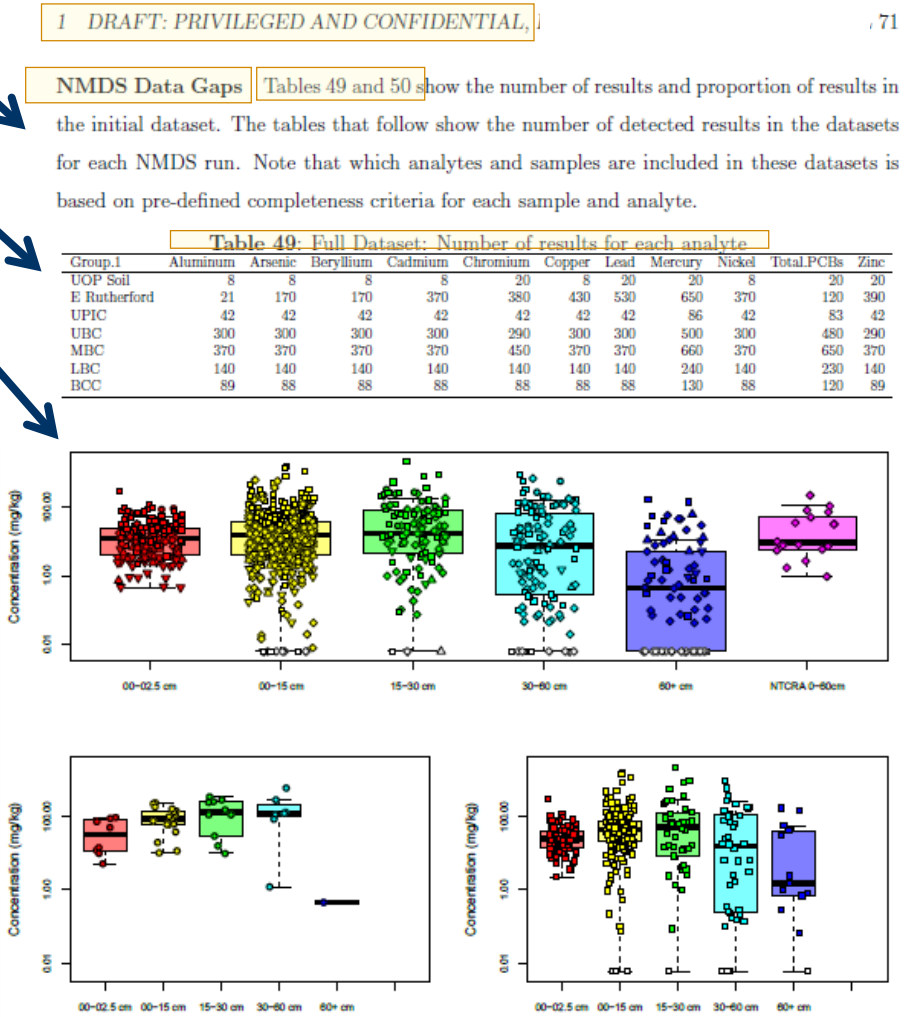
Code in R studio



Text

Tables

Figures



1 DRAFT: PRIVILEGED AND CONFIDENTIAL, 71

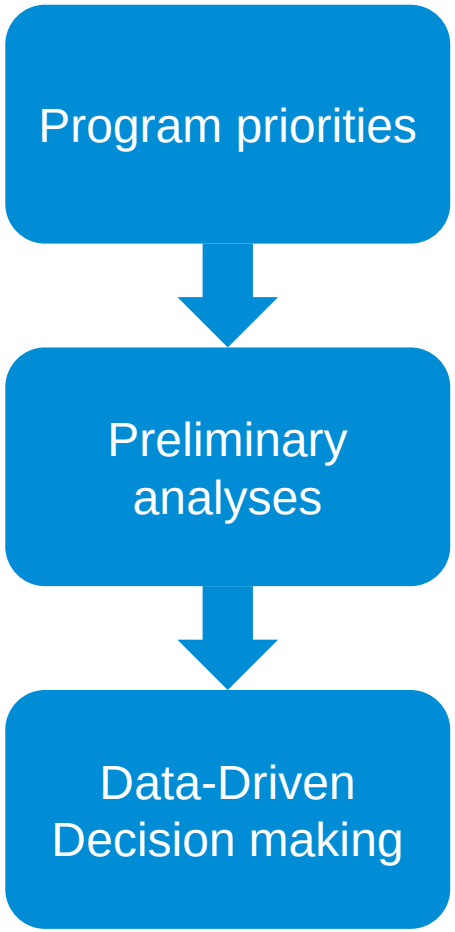
NMDS Data Gaps Tables 49 and 50 show the number of results and proportion of results in the initial dataset. The tables that follow show the number of detected results in the datasets for each NMDS run. Note that which analytes and samples are included in these datasets is based on pre-defined completeness criteria for each sample and analyte.

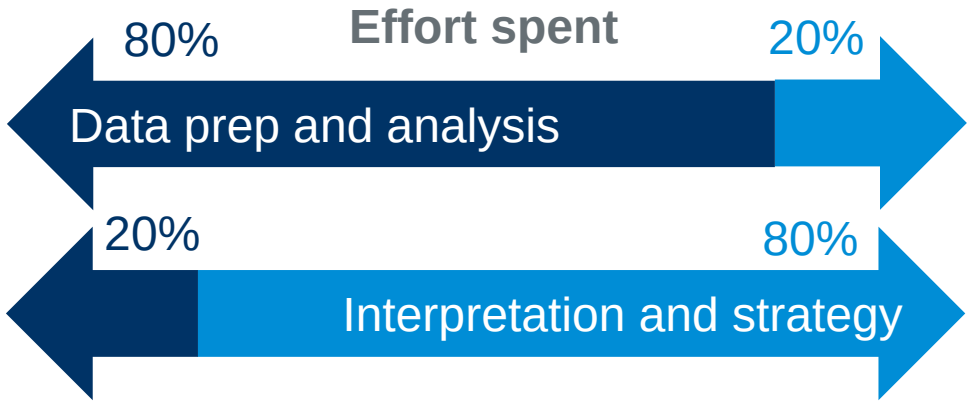
Table 49: Full Dataset: Number of results for each analyte

Group.1	Aluminum	Arsenic	Beryllium	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	TotalPCBs	Zinc
UOP Soil	8	8	8	8	20	8	20	20	8	20	20
E Rutherford	21	170	170	370	380	430	530	650	370	120	390
UPIC	42	42	42	42	42	42	42	86	42	83	42
UBC	300	300	300	300	290	300	300	500	300	480	290
MBC	370	370	370	370	450	370	370	660	370	650	370
LBC	140	140	140	140	140	140	140	240	140	230	140
BCC	89	88	88	88	88	88	88	130	88	120	89

Benefits of integrated, statistically-driven process

Flipping of the 80:20 Ratio

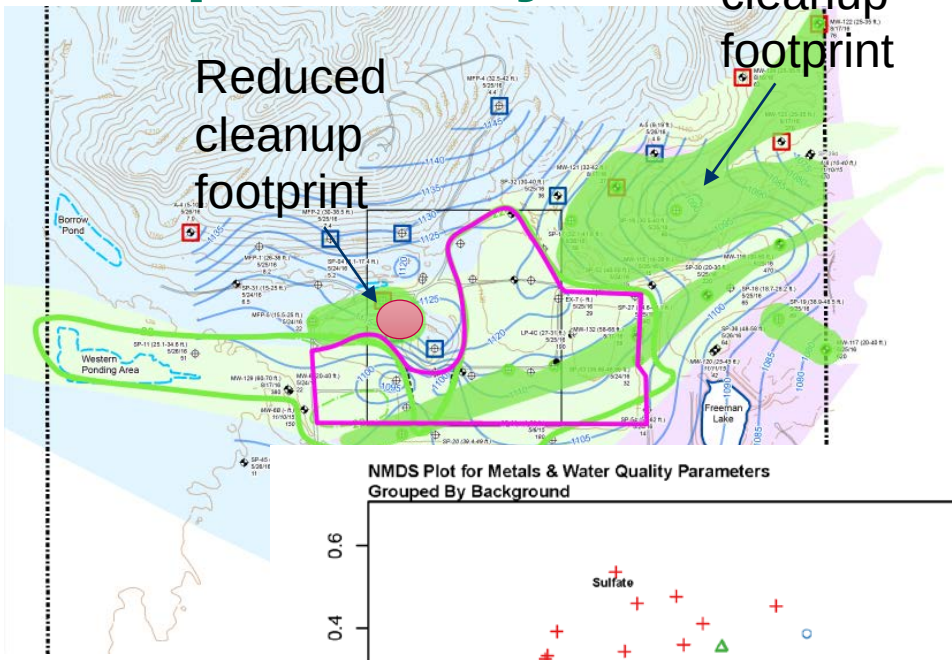




Increased value for CCR clients

- ☑ Compliance with CCR rule
- ☑ Data-driven, objective decision making
- ☑ Consistency across client sites
- ☑ Shift to proactive from reactive analysis
- ☑ Improved communication and access to data
- ☑ Increased data security and quality
- ☑ Effectively manage liabilities

Advanced Data Analytics Reduce Cleanup Liability

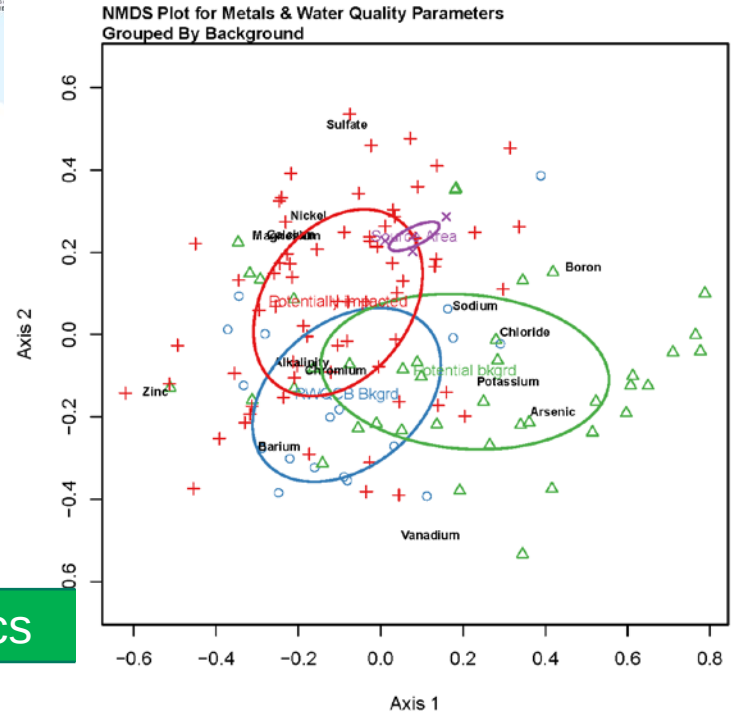


Challenge:

Background concentrations were not captured in the concentration limits for the site leading to an expansive plume for remediation.

Approach:

- Engaged multiple subject matter experts to develop multiple lines of evidence.
- Used advanced statistical techniques (chemical fingerprinting).



Outcome:

- Data-based decision making reduced bedrock impacts from 77 acres to less than 2, leading to $30MM in remediation cost avoidance.
- Techniques have been applied on other projects that require source differentiation and alternate source demonstration.

Client saved $30MM on remediation costs with a $60k investment in data analytics

The Power of Dashboards Part 1

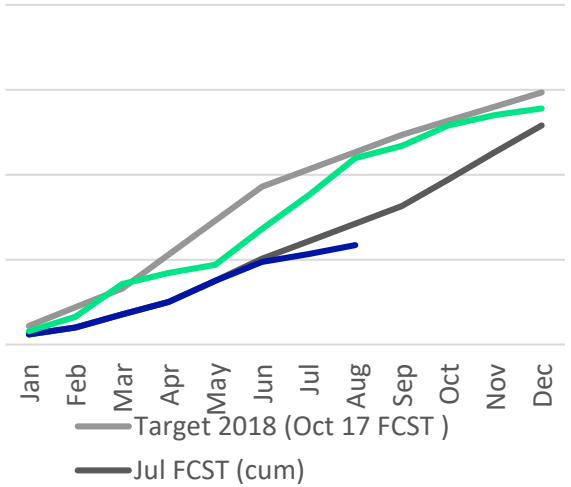
Speaker: Johan De Fraye (Signify)

Environmental Affairs Dashboard August 2018

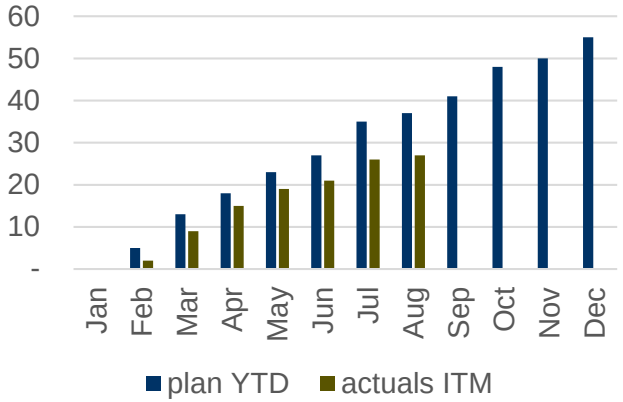
Sustainability

	KPI	Actual
Remediated sites receiving green label	2	3
Sites sold for beneficial reuse	2	2

YTD spend in M EUR



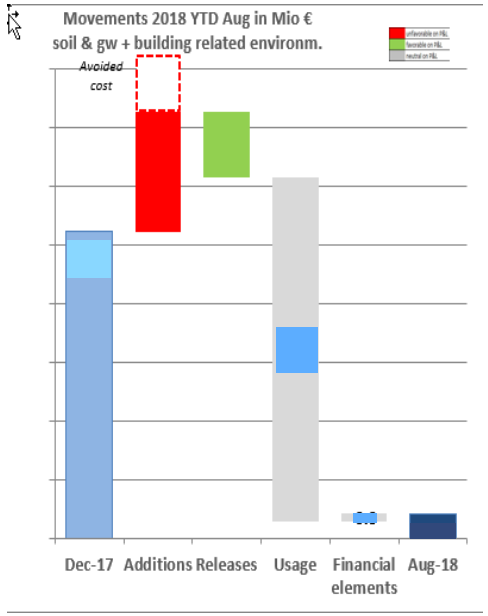
Milestones planned vs actual Top 10 sites



YTD Value Add

	M EUR	Main contributions
Avoided	J.j	Site x, y, z
Releases	k.K	Site a,b, c

YTD Financial movements



Comments

Description
Cumulative spend in July was EUR yy mil, EUR x mil below the latest forecast. We all need to work on more accurate forecasting.
Milestone compliance dropped further to uu%, in proportional relationship with the spend slow down.
Site w: Kick-off for decommissioning was conducted with all stakeholders.
Site d: Agency meeting went well and we can now start working on remedial feasibility study.

Major Risks & Issues

Risk or Issue	Impact
Site m: VI inside newly-built school	Need for engineering measures
Site n: off-site impact and exposure; more restrictive legislation	Fine and financial compensation; costly countermeasures
Site p: longer than expected redevelopment; possible additional costs for asbestos	Increase in long term costs; reputation
Site s: agency not accepting remedial closure	Additional investigations; no sale of site
Site q: bankruptcy of owner	Potential apportionment of remaining liability

Field Health & Safety

KPIs	YTD	Target
Field hours suppliers	xx,xxx	NA
# near misses	yy	NA
# incidents	W	0
Field walkthroughs	t	Rr

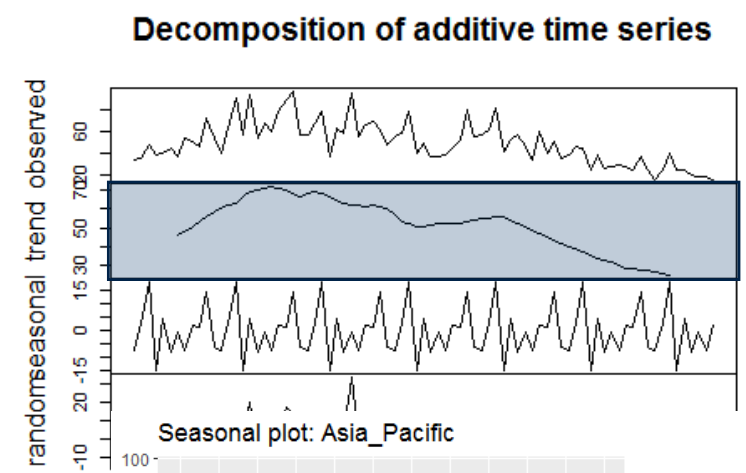
Spotlight on

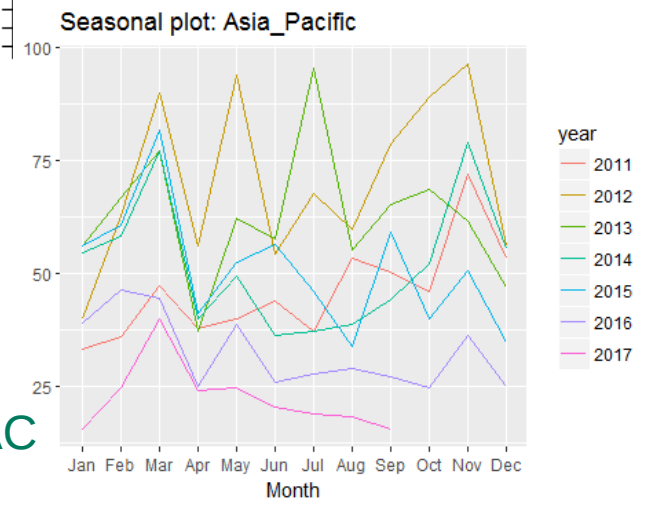
"Passion for results": **Name-surname** was able to successfully conclude negotiations with the yyy agency, to take an alternative approach to the deep impacted aquifer at site b. This led to a release of EUR nn mil.

The Power of Dashboards Part 2

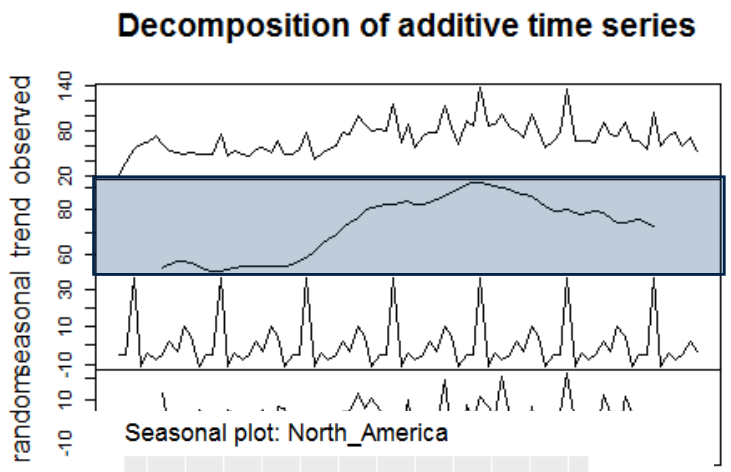
Speaker: Brian Henry (ERM)

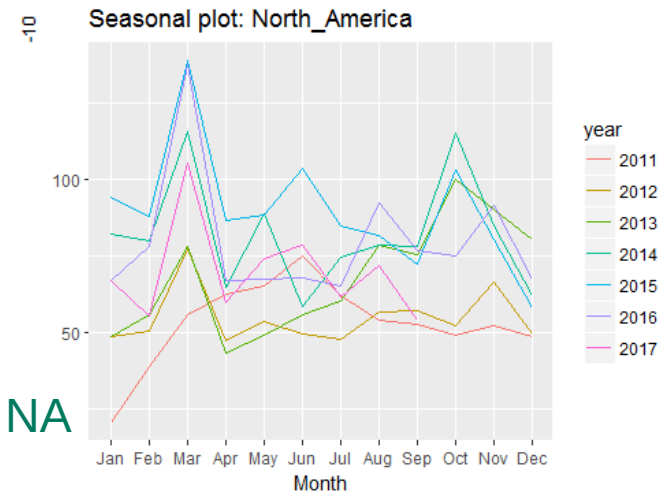
Make Your Data more Accessible



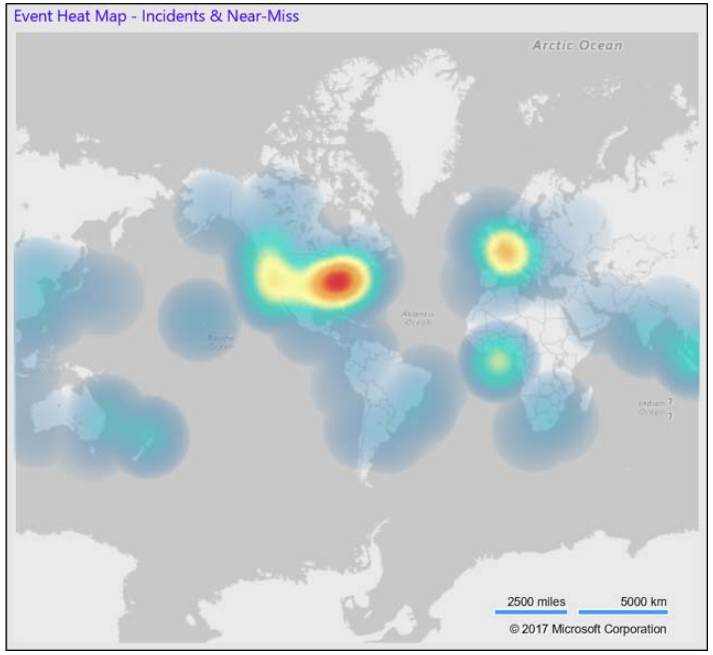


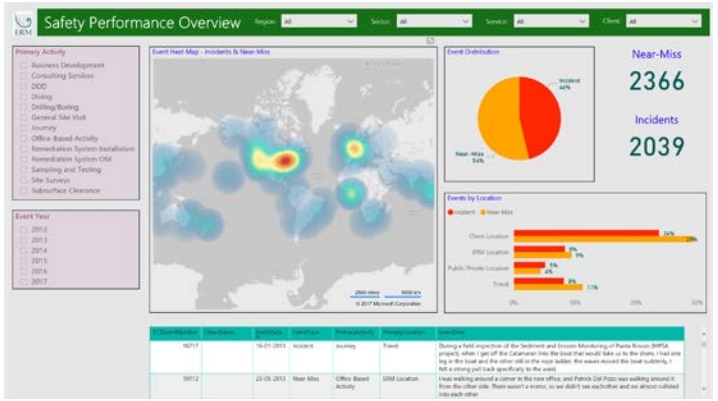
APAC





NA

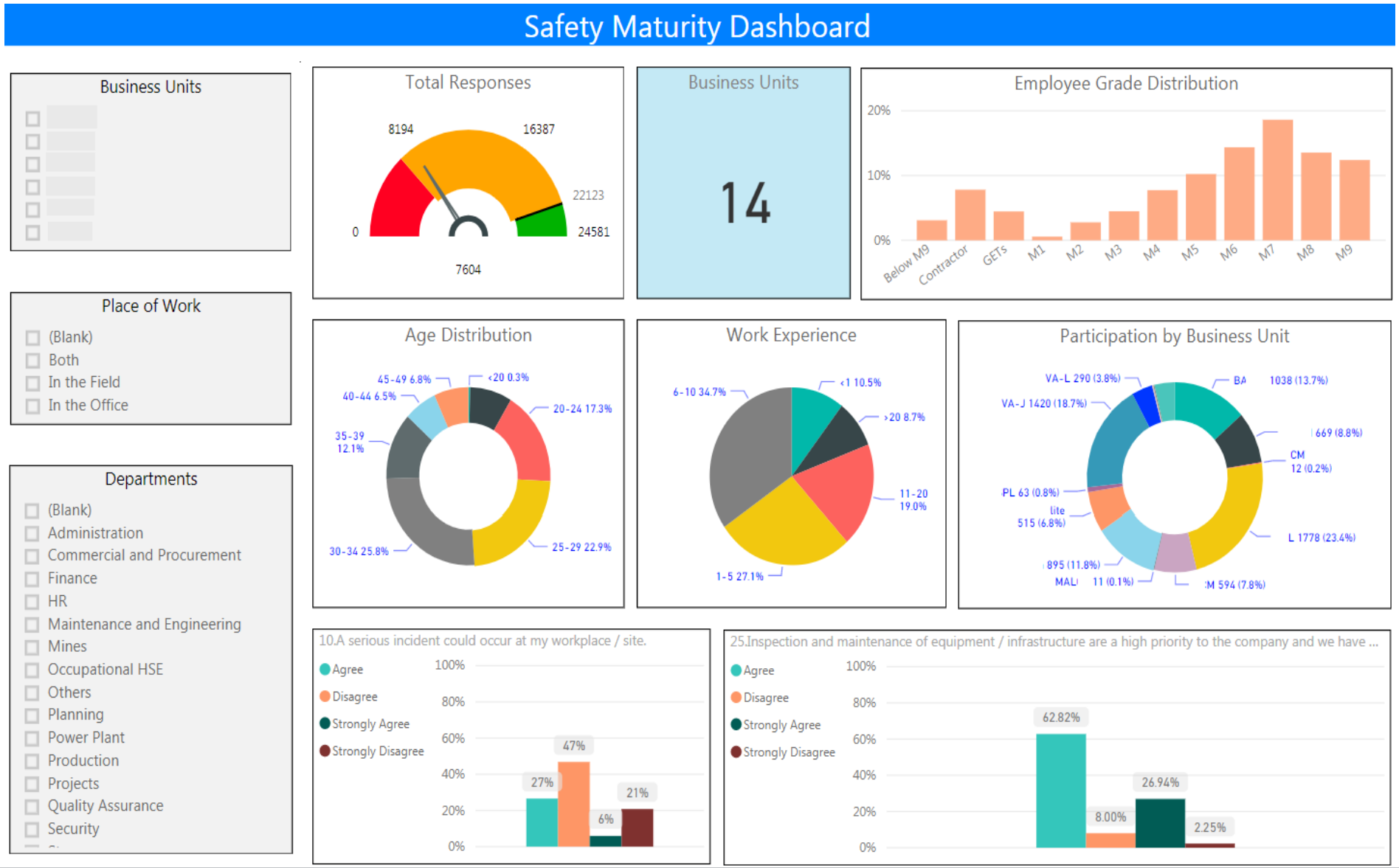




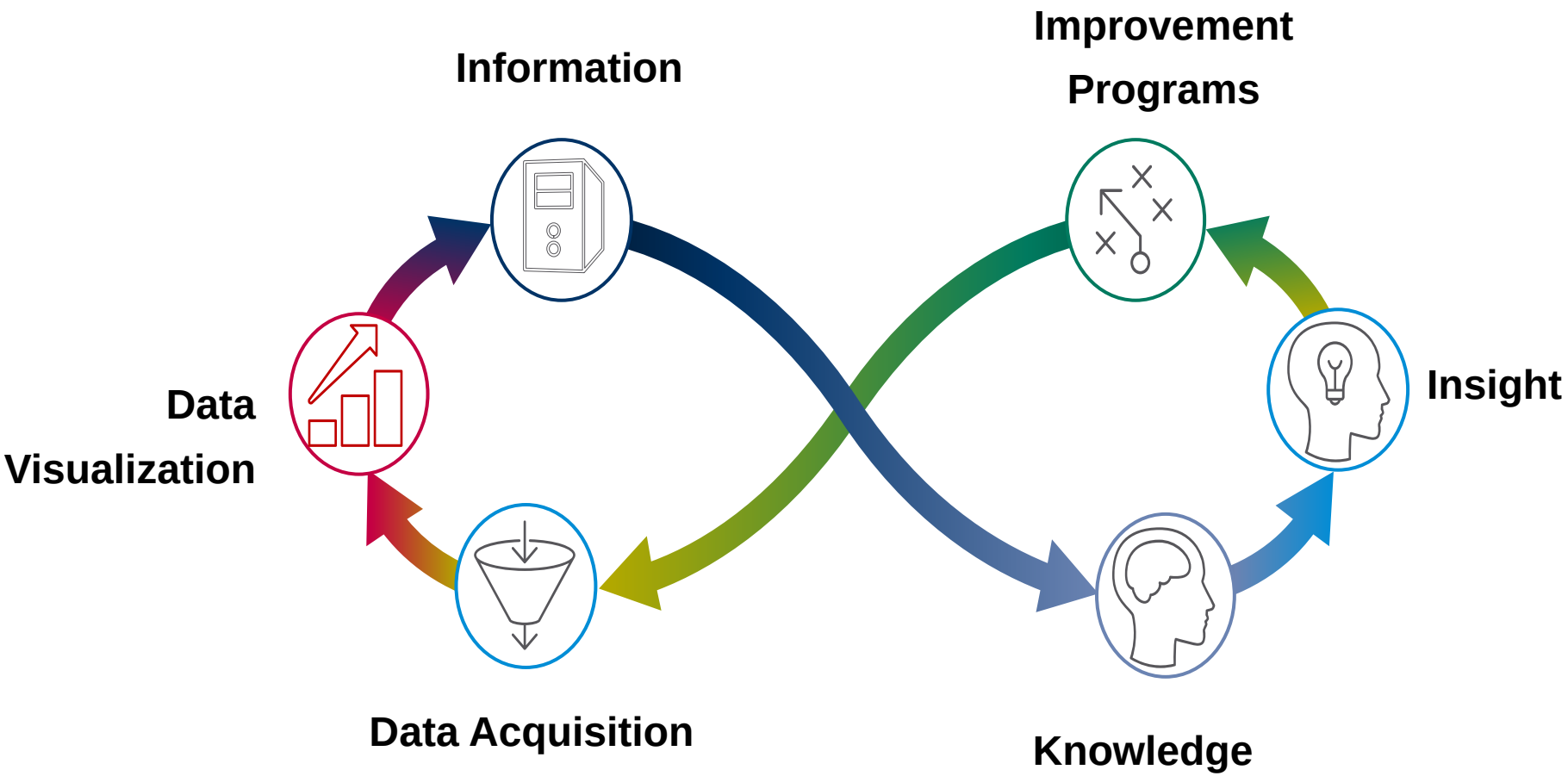
Statistical Analysis (Snapshot)

Converting to a Visual

Data…Knowledge…Insight



Virtuous Cycle of Analytics



Data Curation – Art and Science

Data Profiling

- Uncover data defects with data archeology – analyze the data for correctness, completeness, uniqueness, consistency and “sanity”

Data Cleansing

- After profiling is complete focus on cleaning the critical and important areas – need to prioritize effort

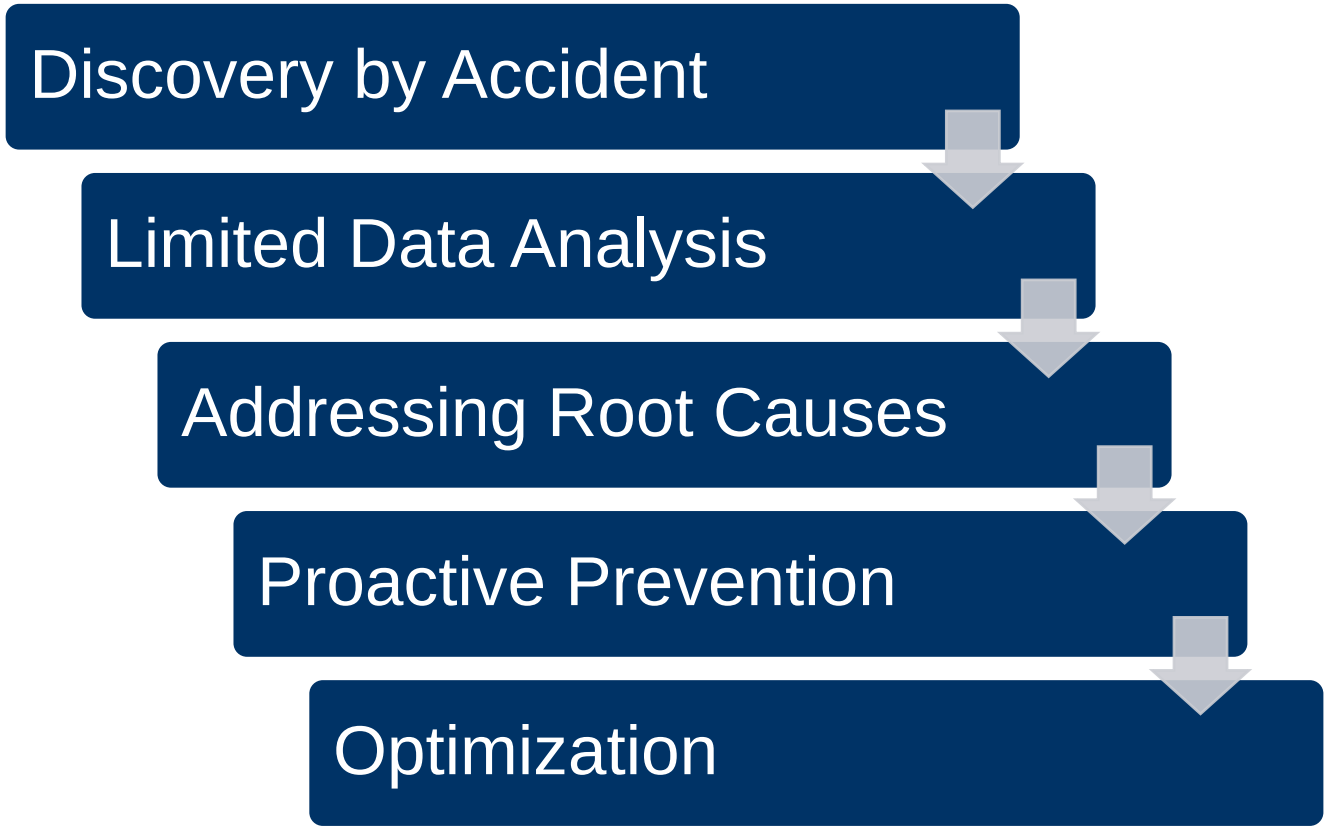
Data Quality Safeguards

- Establish logic, programming, checks to prevent future “dirty data”

Data Quality Standards and Training

- Establish governance process, data stewards and develop training to drive these standards and guidelines across the enterprise

Improving Data Quality – The Journey



Inadequate Data Quality (DQ) Process

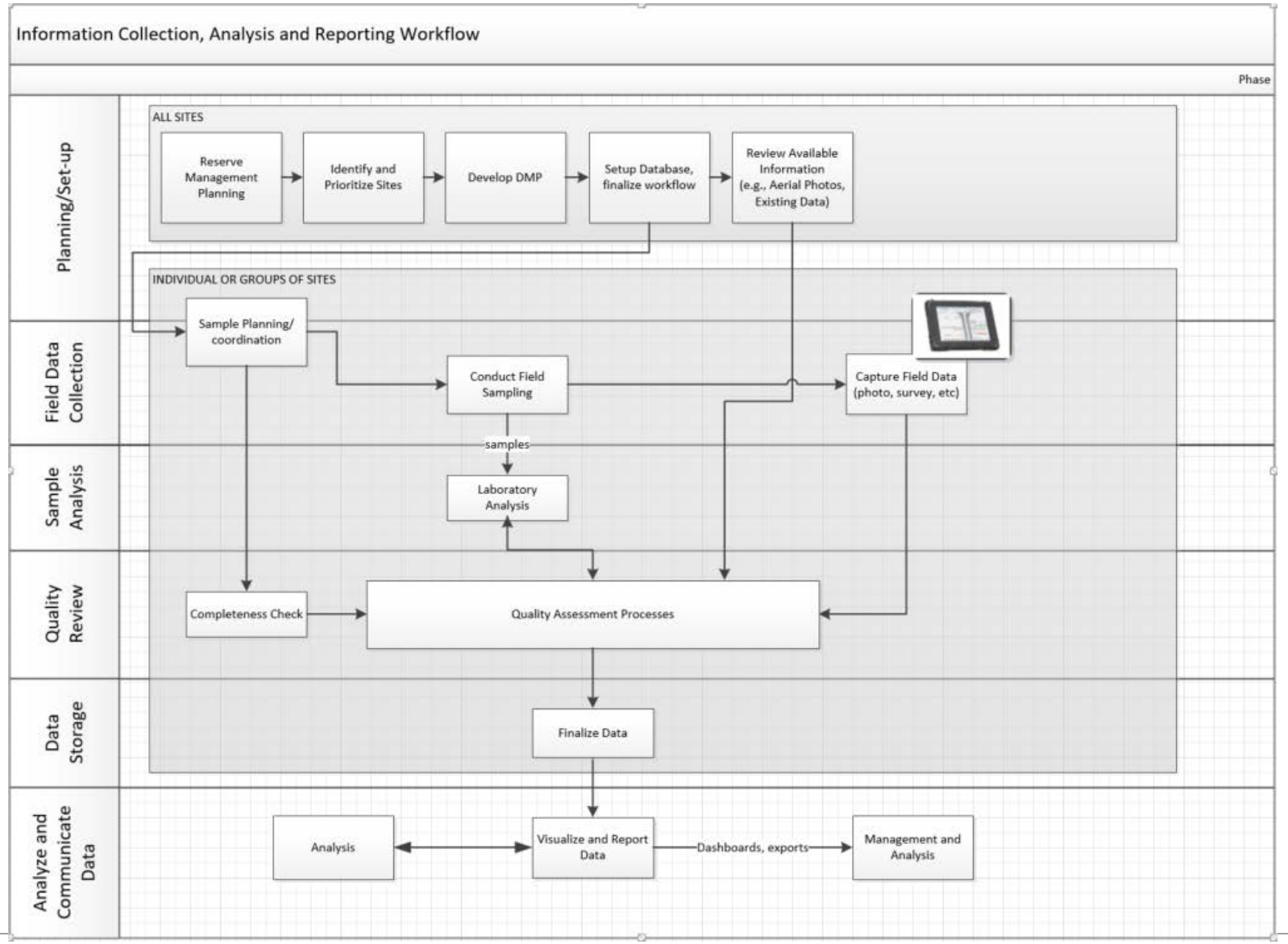
Data Profiling; Cleansing

DQ Safeguards; Training

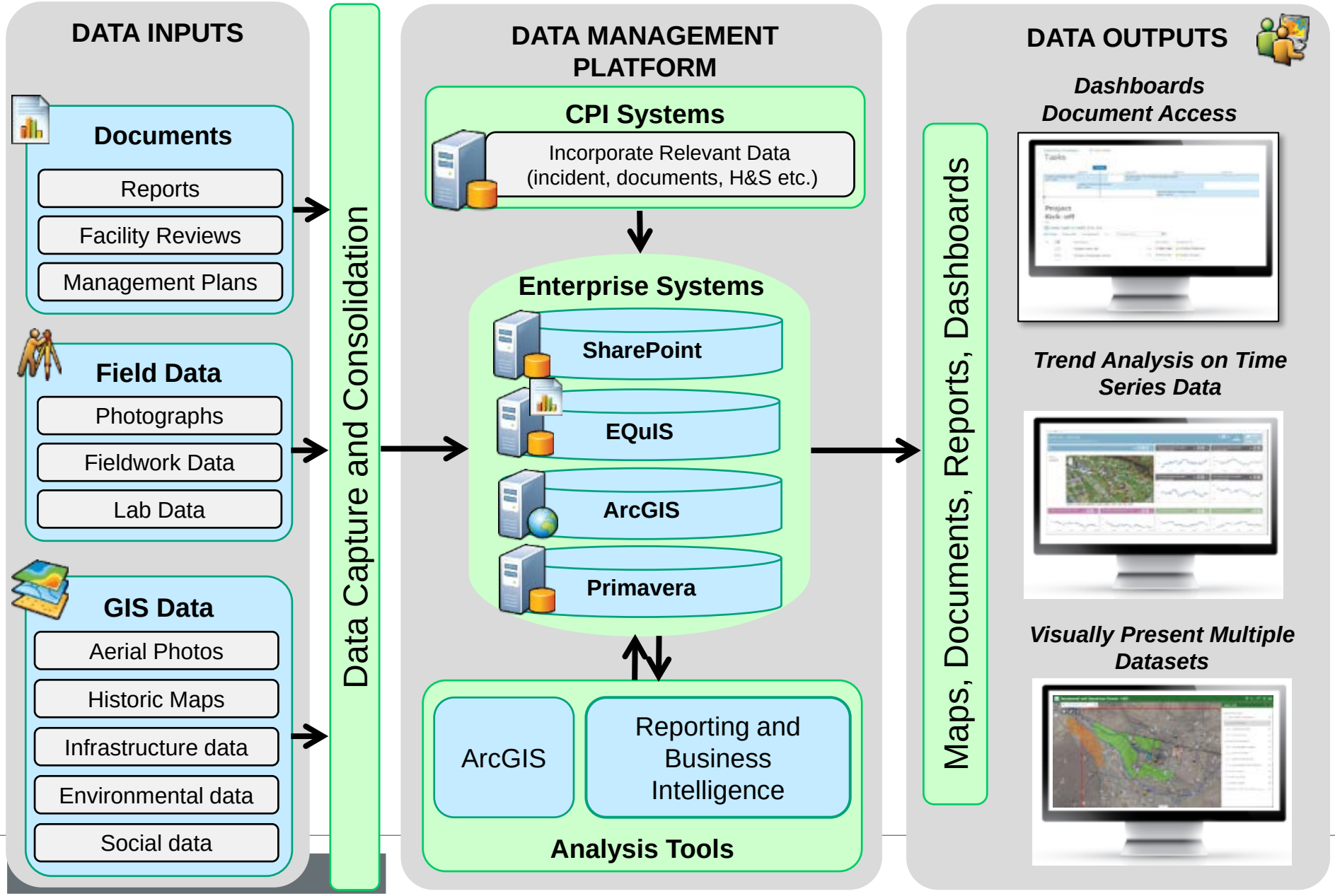
Enterprise DQ Standards and Guidelines

Continuous DQ Improvement Process

Start With a Well-Defined Business Process (People & Process)



Process Data Flow + Technology = Insight



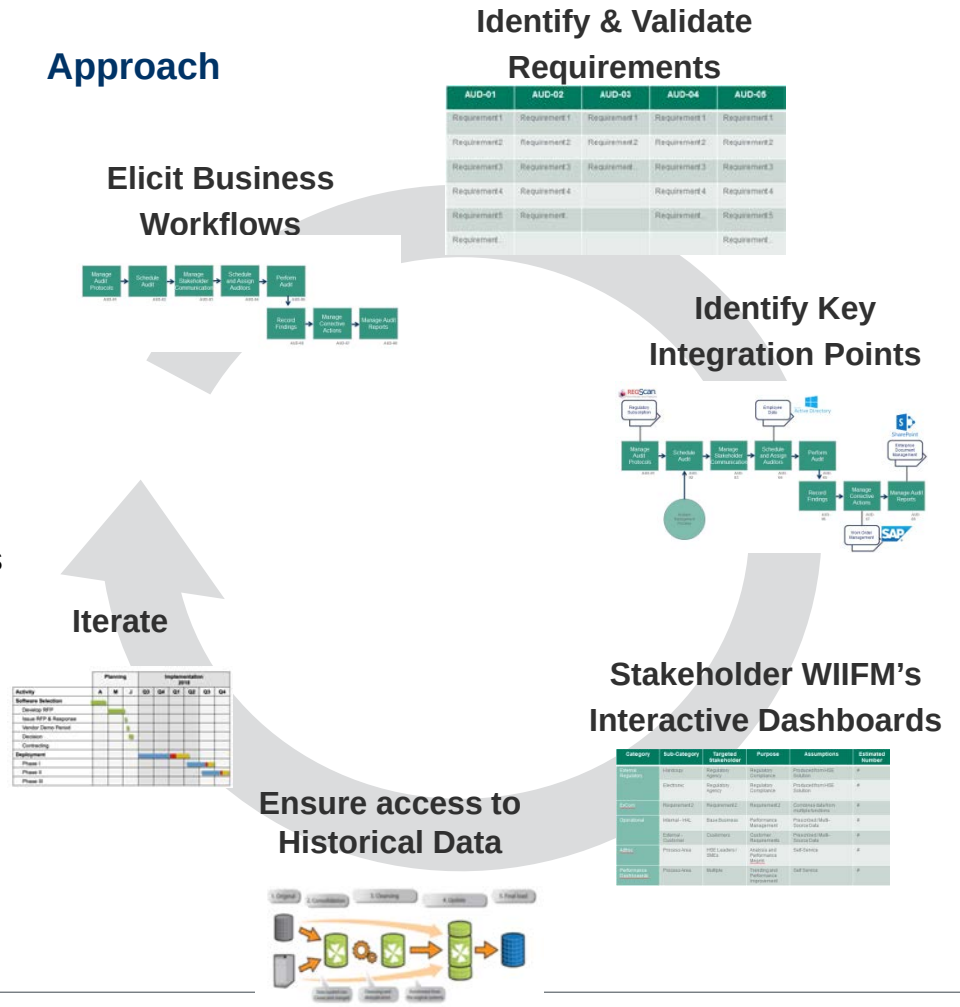
People, Process and Technology – what does your virtuous cycle look like?

Scope: Map out HSE processes and highlight common activities, measuring number of systems and communications for current state.

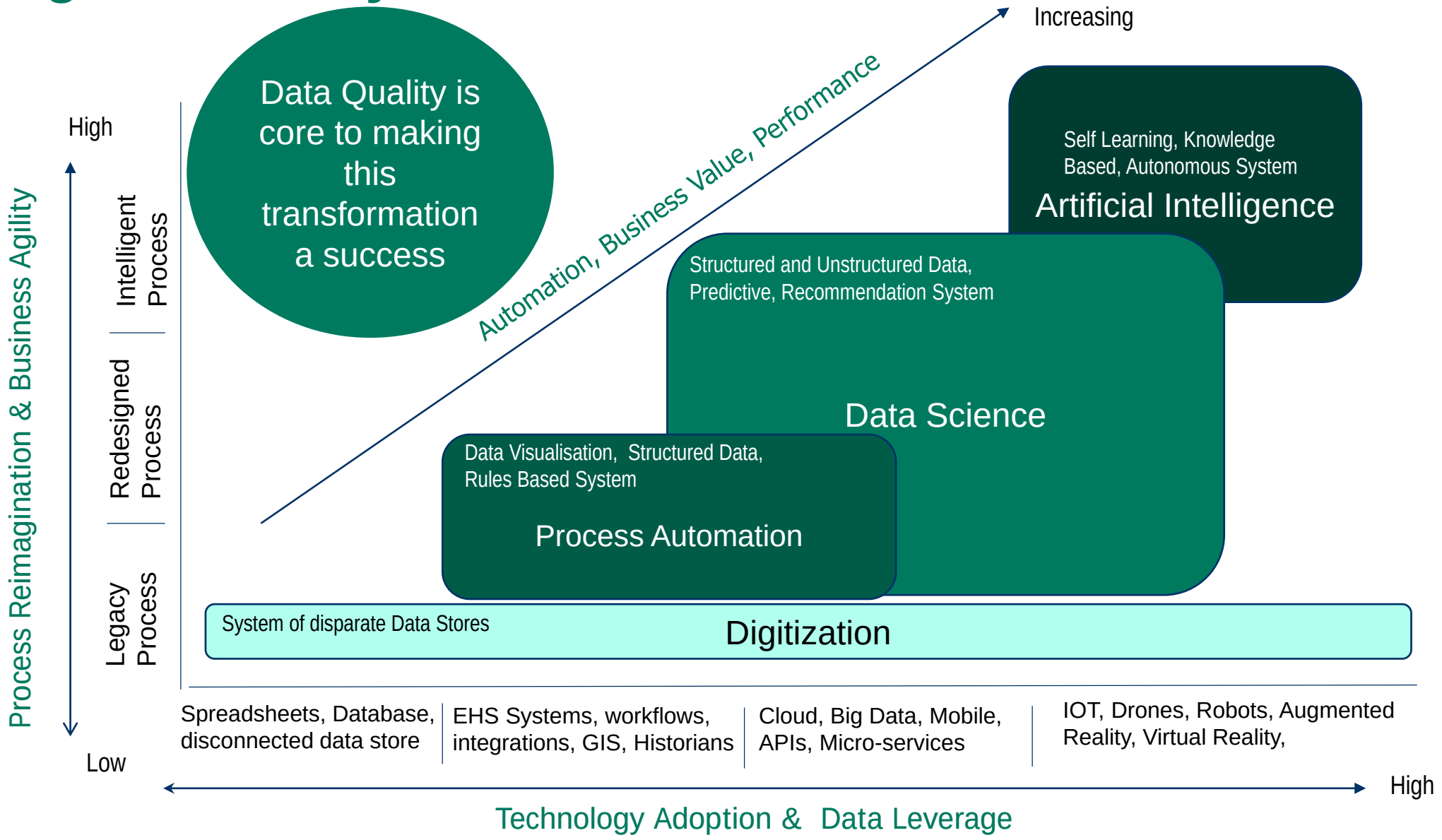
Activity

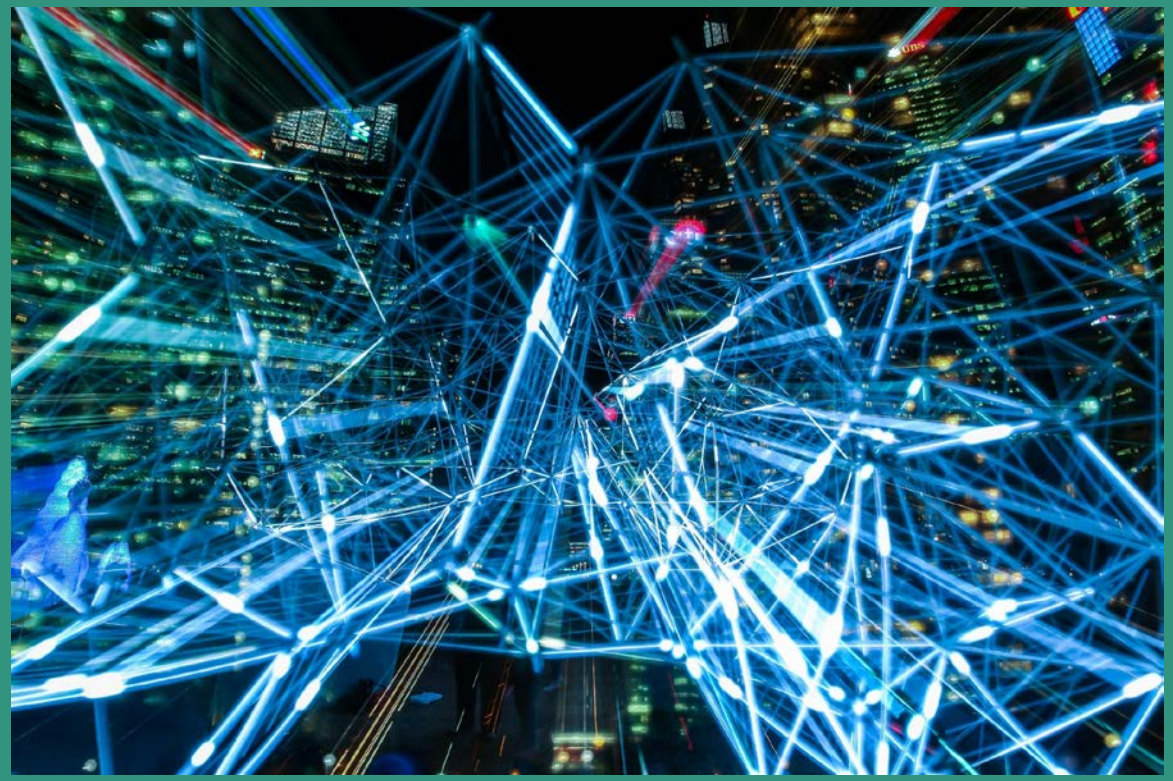
- Refine Process Workflows and High-Level Process Steps
- Validate Functional and Technical Requirements
- Identify and Document Key Integration Points
- Stakeholder WIIFM's - Interactive, Drillable, Dashboards and Reports
- Ensure Access to Historical Data – Context Matters
- Digest Learnings; Iterate

Approach



Digital Maturity Model



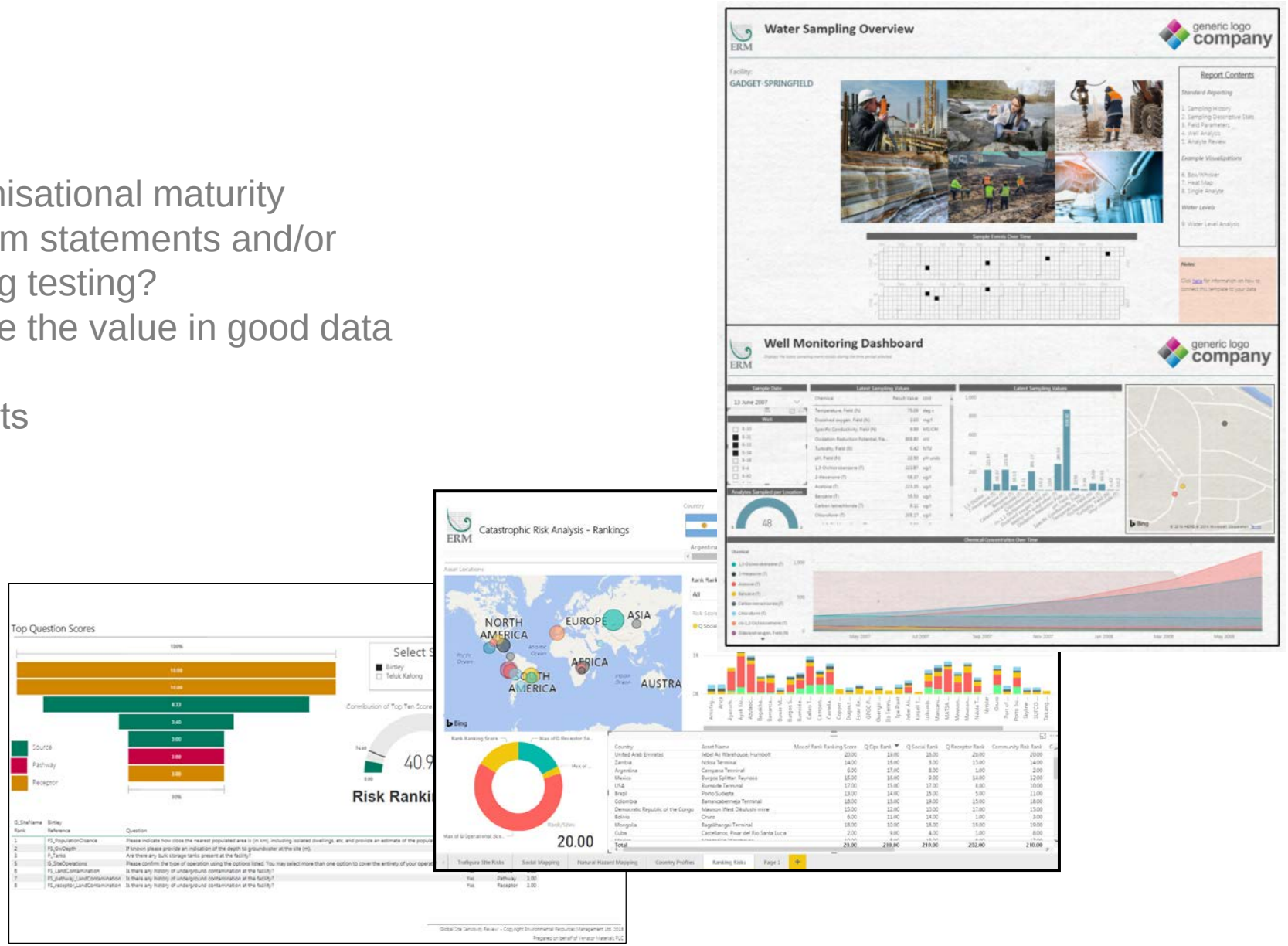


Wrap-up

Speaker: Simon Gibbons (ERM)

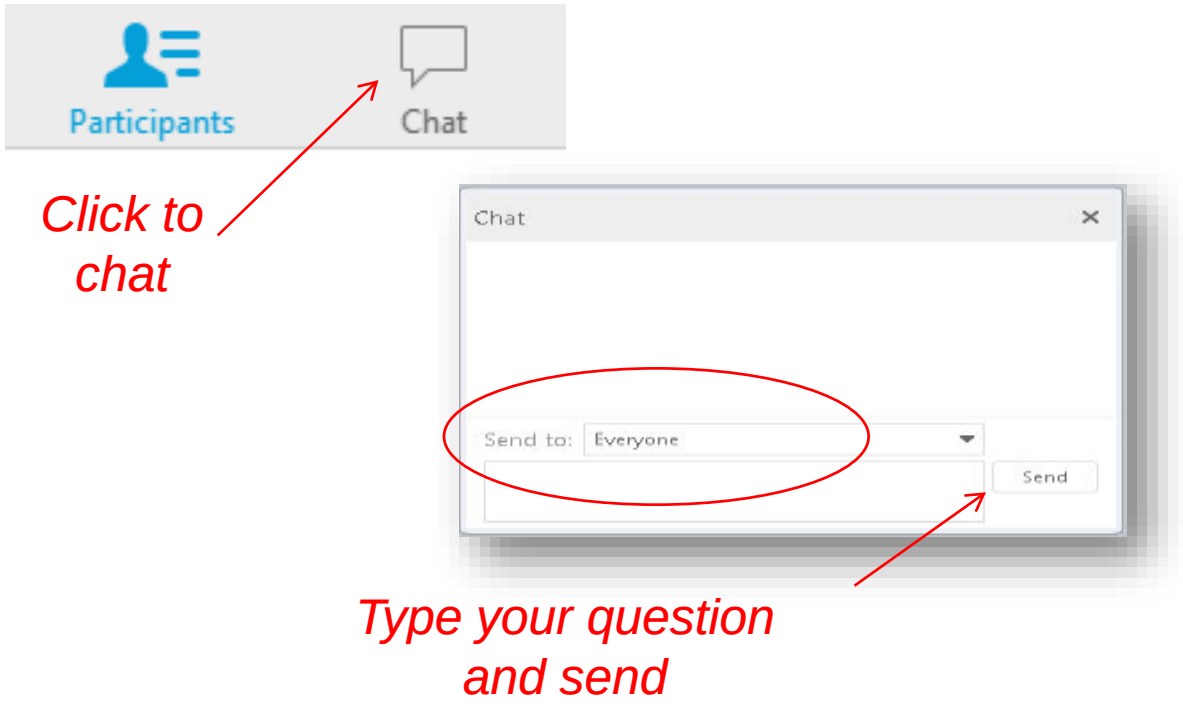
Wrap-up

1. Individual and organisational maturity
2. What are the problem statements and/or hypotheses requiring testing?
3. Don’t under-estimate the value in good data management
4. Big data ≠ Big reports
5. Data is a journey



Questions?

#6 to unmute to ask a question



All participants will receive a follow-up email with a link to this presentation recording next week.

Thank you for attending today's session!

Remediation Roundtables

Chicago
10/18 – 10/19

Speakers:
Andy Huggins, *ERM*
Denice Nelson, *ERM*
Nadine Weinberg, *ERM*
Brett Whittleton, *AkzoNobel*
Stephan Evanoff, *Danaher*
David Fischer, *American Chemistry Council*
David Tsao, *ITRC*

Houston
10/25 – 10/26

Speakers:
Andy Huggins, *ERM*
David Robbins, *ERM*
Katrina Patterson, *ERM*
Jeff Bauguss, *ERM*
Mitch Zimmerman, *ERM*
David Angle, *ERM*
John Kuhn, *ERM*
David DeCourcey-Bower, *ERM*
Jaydeep Parikh, *ERM*
David Tsao, *ITRC*
Myna Letlow, *BHGE*

Sao Paulo
11/1

Speakers:
Andy Huggins, *ERM*
Paulo Santos, *ERM*
Michael Kohnke, *Shell Global Solutions*
Antonio Chaves, *Umicore*
Leticia Monterio, *Bayer*
Rodrigo Silveira, *Tupy Fundições*
Bianca Antacli, *TozziniFreire Advogados*

More information: https://www.erm.com/en/news-events/event-registration/erm-global-remediation-management-roundtable-in-chicago/

Thank you

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