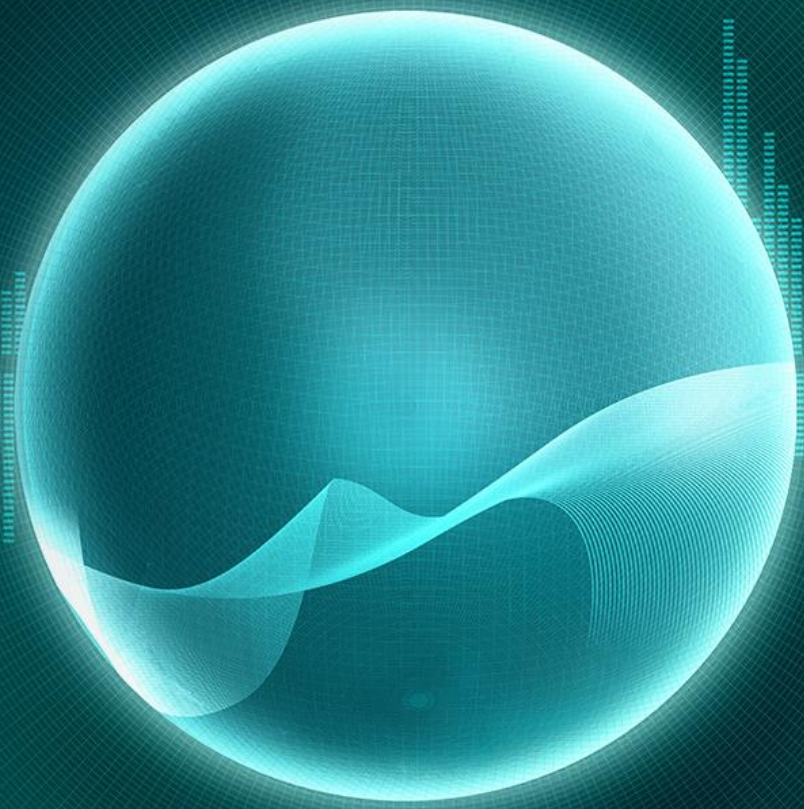
SnT 2019

CTBT: SCIENCE AND TECHNOLOGY CONFERENCE



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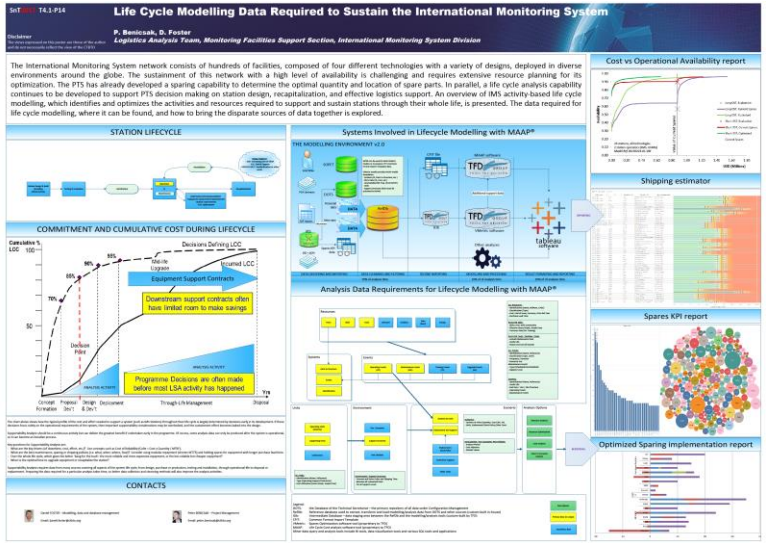
PTS/IMS/MFS

A New Approach to Supportability Analysis for the IMS, based on the Cross-Industry Standard Process for Data Mining (CRISP-DM) [T4.2-O1]

Introduction

The International Monitoring System (IMS) Division is responsible for sustaining the global network of monitoring facilities (ensuring the continuing supply of monitoring data to the International Data Centre).

Monitoring Facilities Support (MFS) Section has developed several components of a **Supportability Analysis** capability to support IMS sustainment.

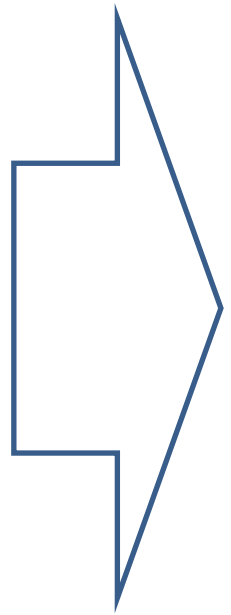


Poster presentation at SnT2017

Supportability Analysis

Supportability Analysis capability currently includes (but is not limited to):

- Sparing Optimization (at station or network level)
- Lifetime Buy Estimation (for obsolete equipment)
- Life Cycle Analysis (at equipment or station level)
- Equipment reliability analysis (e.g. MTBF)
- Visual Analytics and Reporting



Data-Driven Decision Support for Sustainment Activities

Supportability Analysis – as a service

Supportability Data for the IMS

Supportability Data includes Reliability / Availability / Maintainability measures (supporting high Data Availability of IMS monitoring facilities)

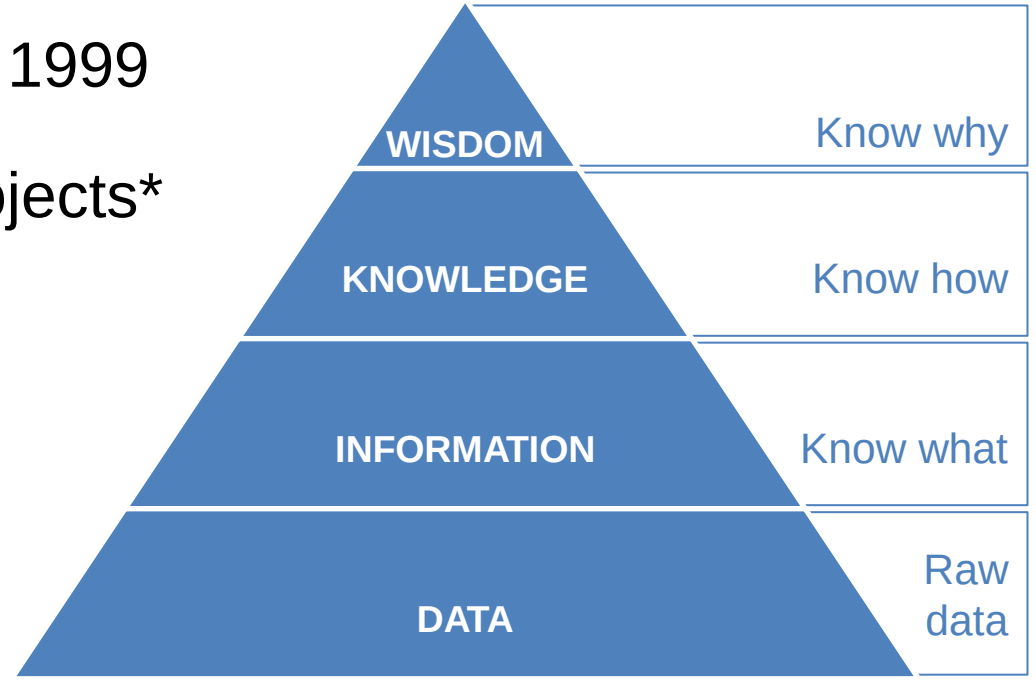
- 284 certified monitoring stations, in 76 states
- 1500+ sensor sites, central recording facilities, etc.
- 20,000+ items of equipment in use (nearly 3000 models of equipment)
- More than 60 x 10^9 total operating hours at sites since certification

Traditional and ‘rule of thumb’ estimation cannot easily use this amount of data!

What is CRISP-DM?

Cross-Industry Standard Process for Data Mining (CRISP-DM)

- Open standard process model, published in 1999
- Still the top methodology for data mining projects*
- Iterative 6-step methodology for analytics
- Flexible, scalable, application-neutral



*2014 poll by KDnuggets

Other frameworks exist (e.g. Microsoft Team Data Science Process)

Data mining is the process of discovering patterns in large data sets (knowledge discovery)

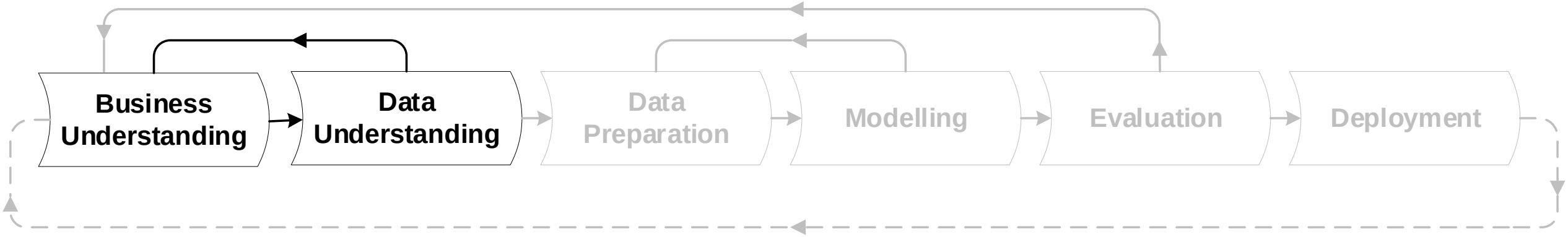
Steps 1 & 2: Understanding

Business Understanding

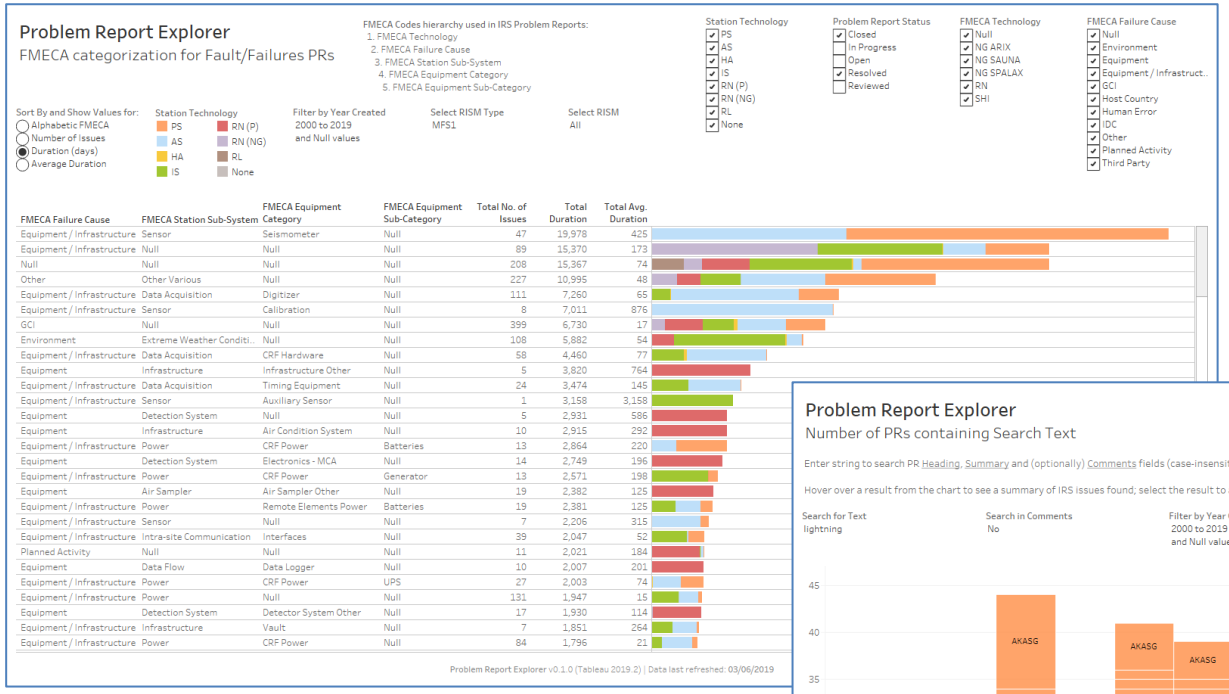
- Understand the project objectives from a business perspective
- Frame the problem (scope, project plan, success criteria, etc.)

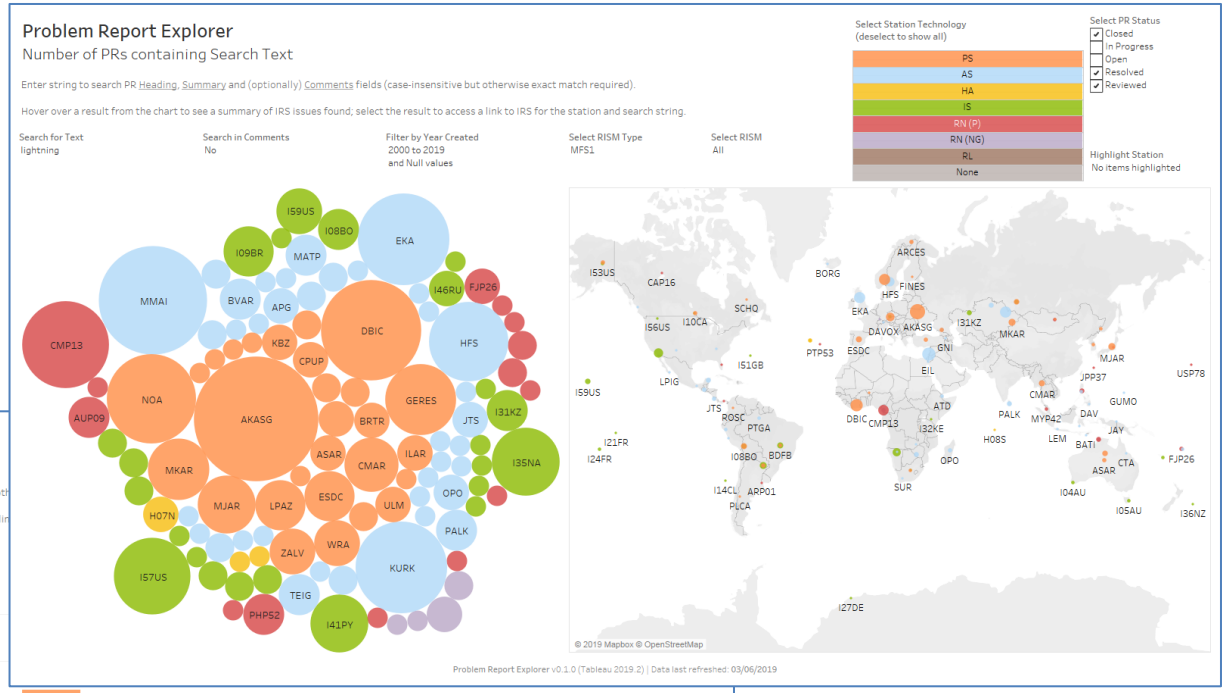
Data Understanding

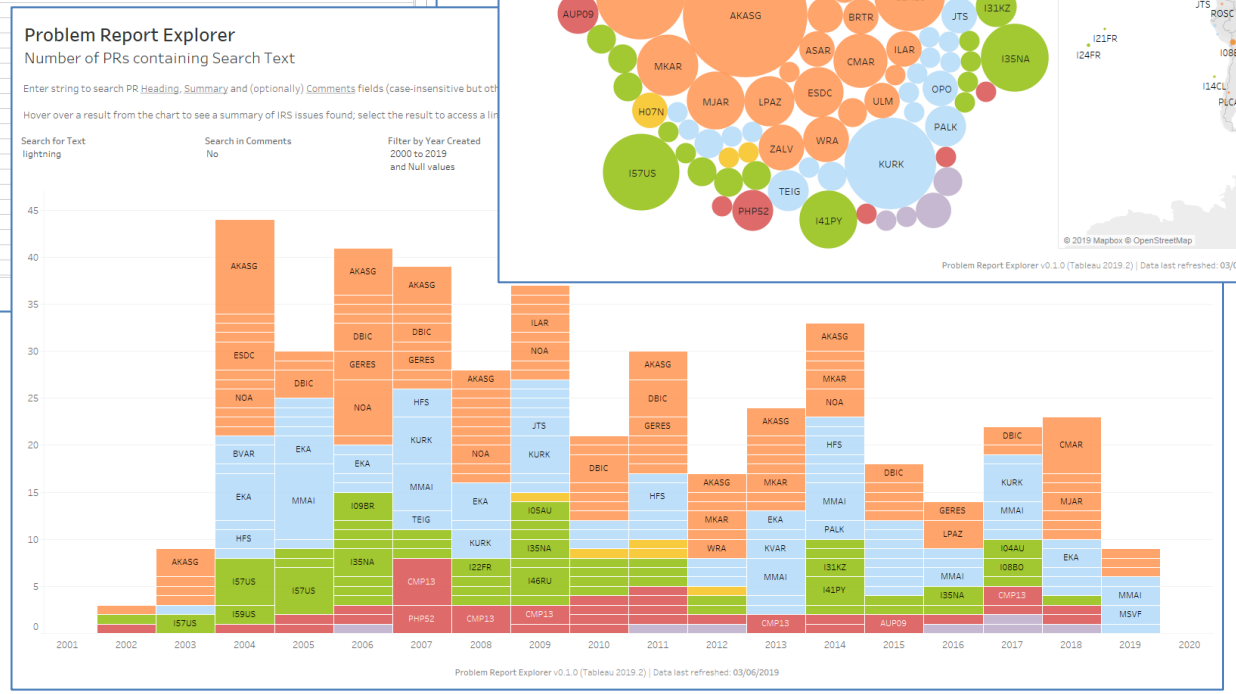
- Identify the data required
- Exploratory Data Analysis (EDA)
- Verify data quality (completeness, accuracy, etc.)



Example: Data Understanding



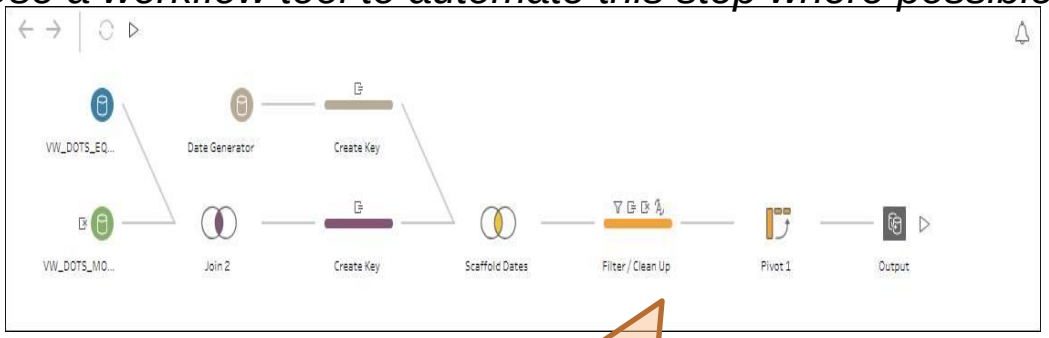




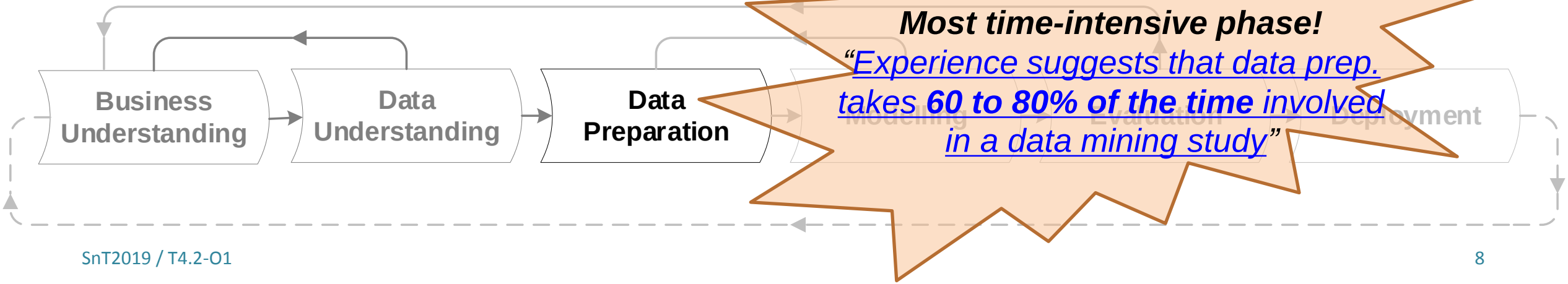
Visual analysis of the underlying data can be informative…

Step 3: Data Preparation

Use a workflow tool to automate this step where possible!



- Extract, transform and load (ETL) data
- Clean data; select or add features
- Merge and integrate data from different sources, formats, etc.
- Store prepared data

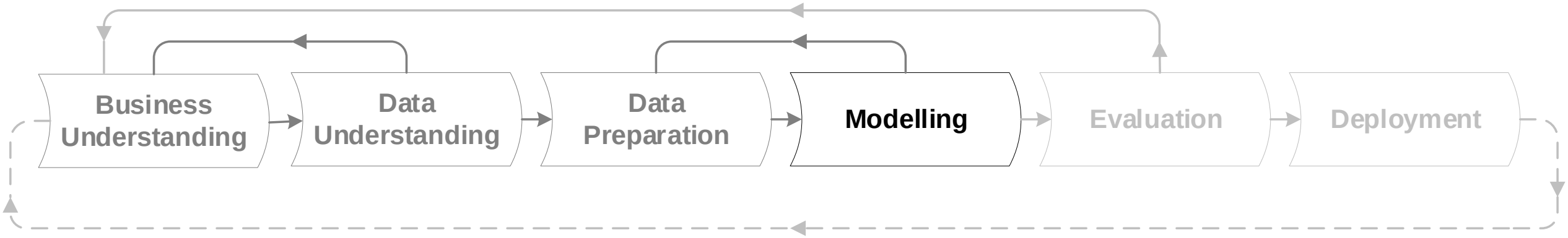


Most time-intensive phase!

"*Experience suggests that data prep. takes **60 to 80% of the time** involved in a data mining study*"

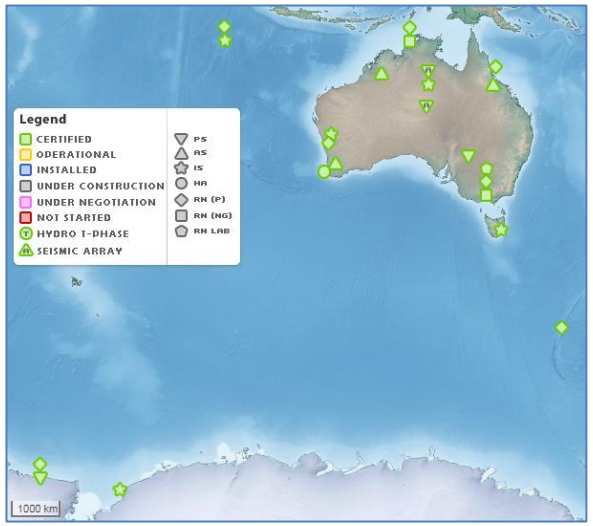
Step 4: Modelling

- Select specific modelling technique(s) and generate test design
- Build the model!
- Assess the model, tune parameters and iterate as appropriate (may require additional data preparation)

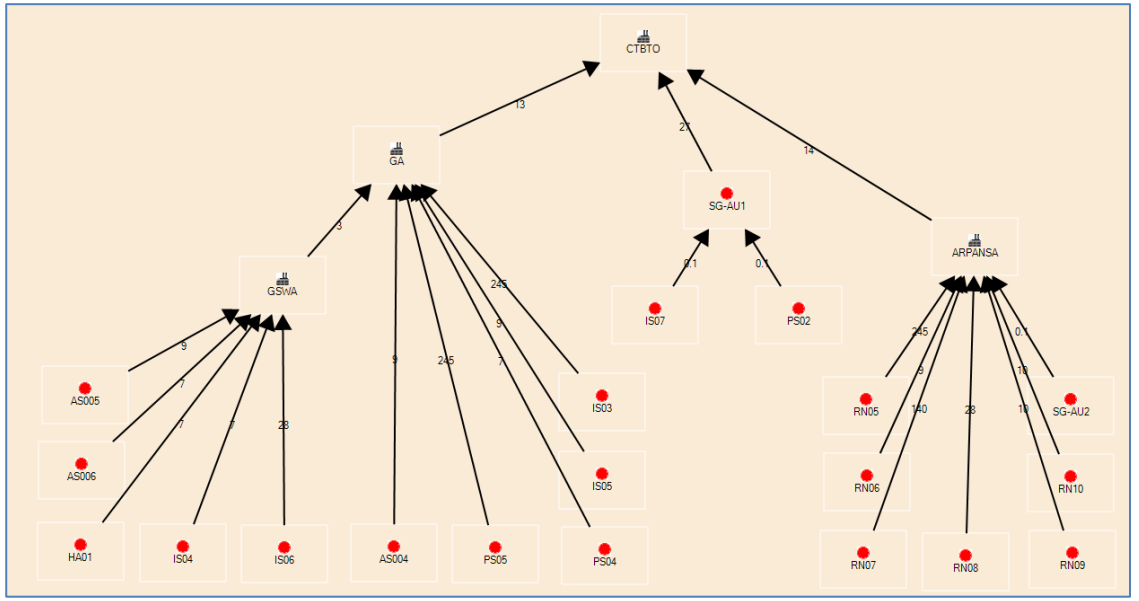


"All models are wrong, but some are useful"*

Example: two representations of the Australian segment of the IMS network



IMS Map from DOTS



Sparing Optimization supply chain

Box, G. E. P.; Draper, N. R. (1987), Empirical Model-Building and Response Surfaces, John Wiley & Sons. (p. 424)

Steps 5 & 6: Evaluation and Deployment

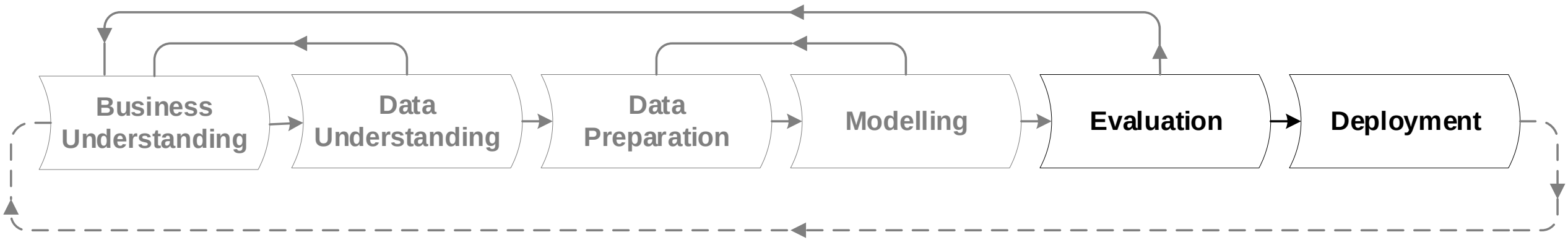
Evaluation

- Did it meet original objectives?
- Review process and performance
- Determine next steps

Deployment / Implementation

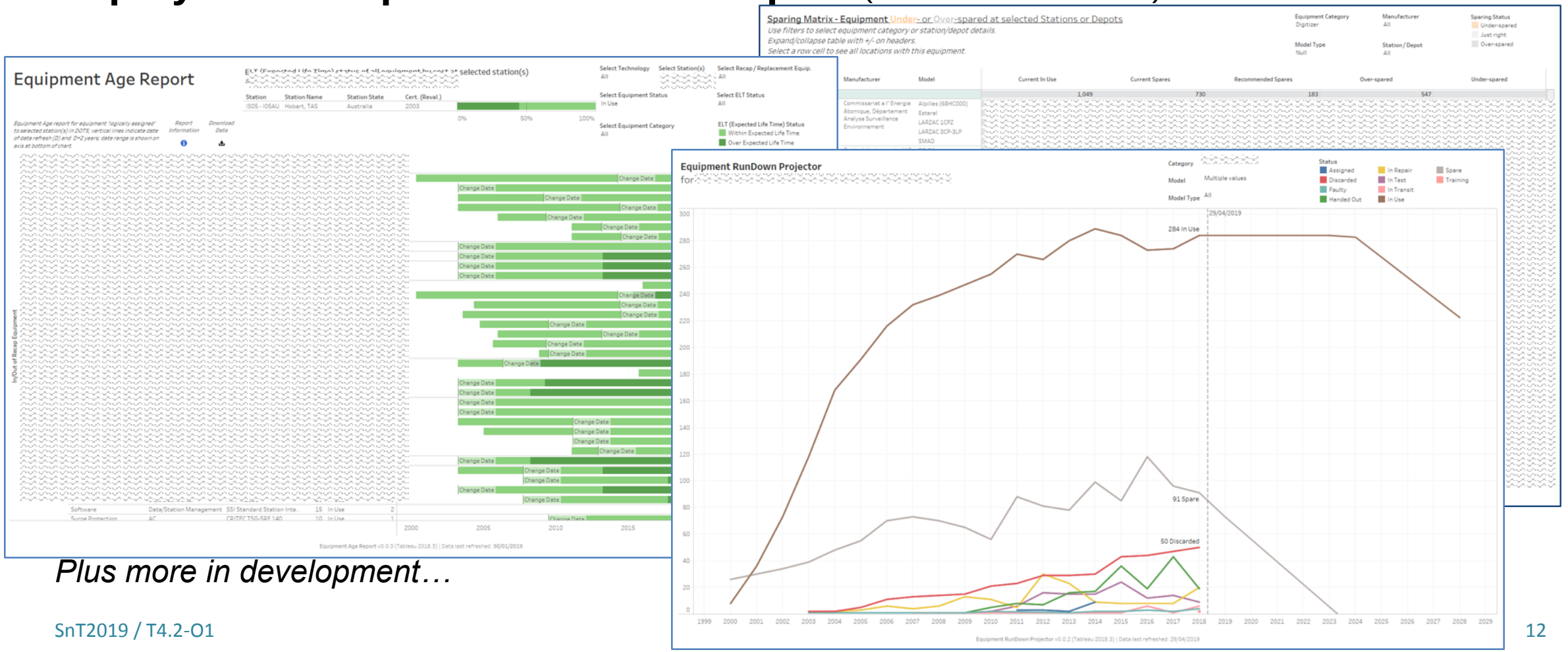
- Prepare to publish results / deploy model (with appropriate monitoring and maintenance)

And prepare for the next analysis!



Examples

Deployment / Implementation Examples (some data redacted)



Plus more in development…

Summary

Following a standard approach to Supportability Analysis enables:

- Repeatability / re-usability of analytical components and data, as part of an integrated system of standard products
- Greater understanding among stakeholders
- Contributes to delivering Supportability Analysis as a Service, underpinning Data-Driven Decision Making for Sustainment Activities

Please visit our display in the IMS exhibition area to learn more!

THANK YOU