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Real-Time Wastewater Process Risk Assessment:

Using Data More Effectively

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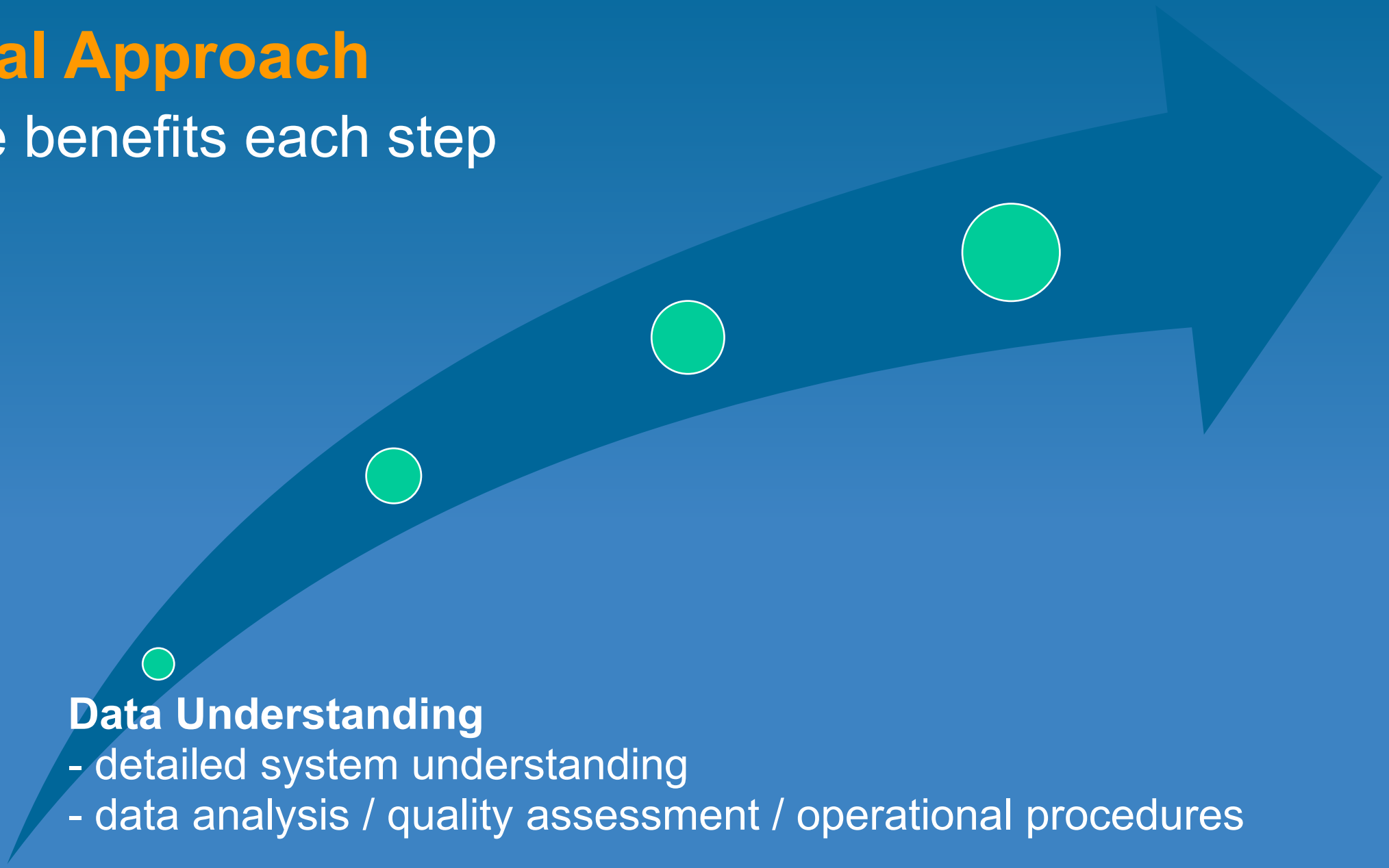
Towards a Digital Solution

➢ General Approach

- Realise benefits each step



Data Understanding
- detailed system understanding
- data analysis / quality assessment / operational procedures

Towards a Digital Solution

➢ General Approach

- Realise benefits each step

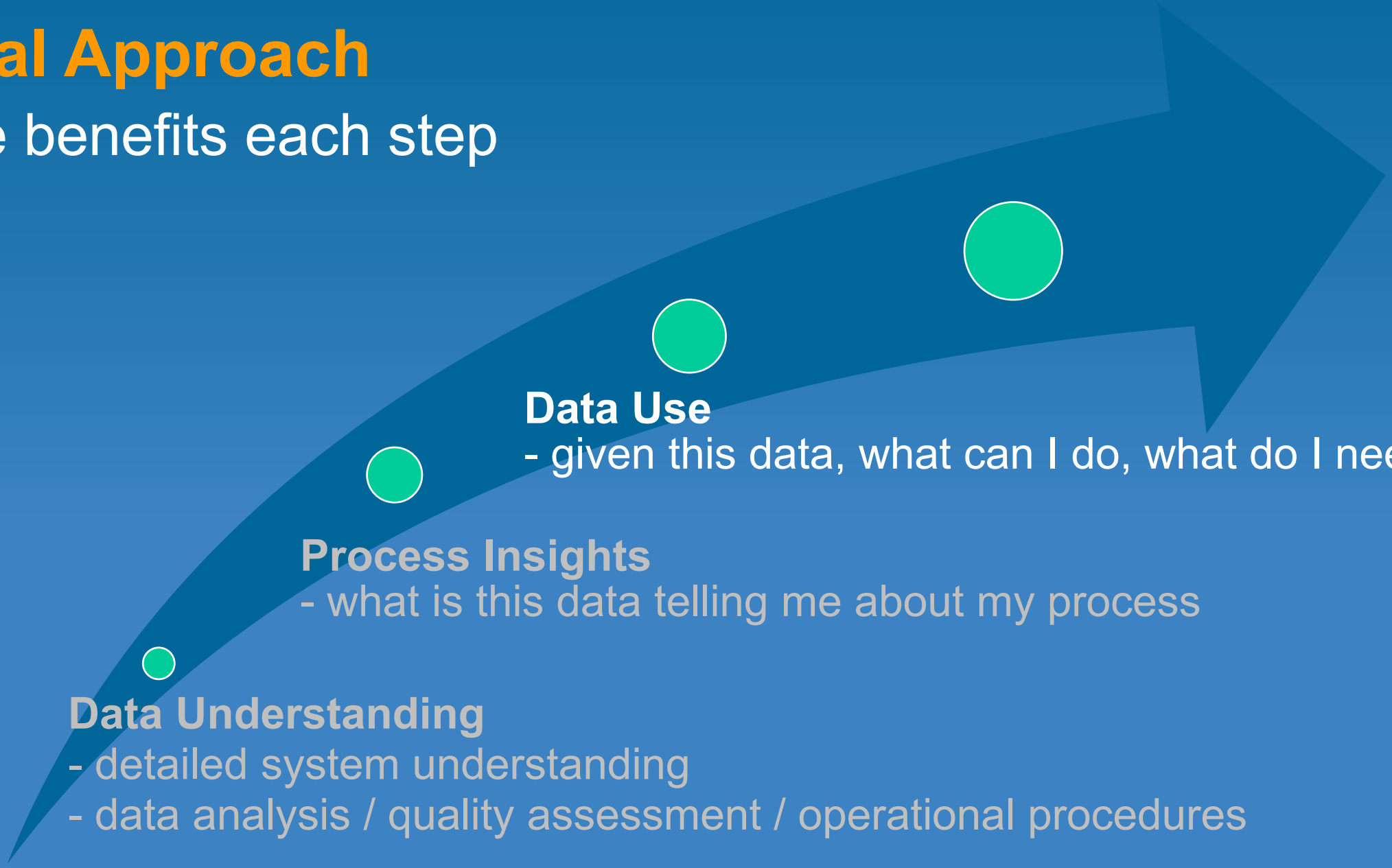
Process Insights
- what is this data telling me about my process

Data Understanding
- detailed system understanding
- data analysis / quality assessment / operational procedures

Towards a Digital Solution

➢ General Approach

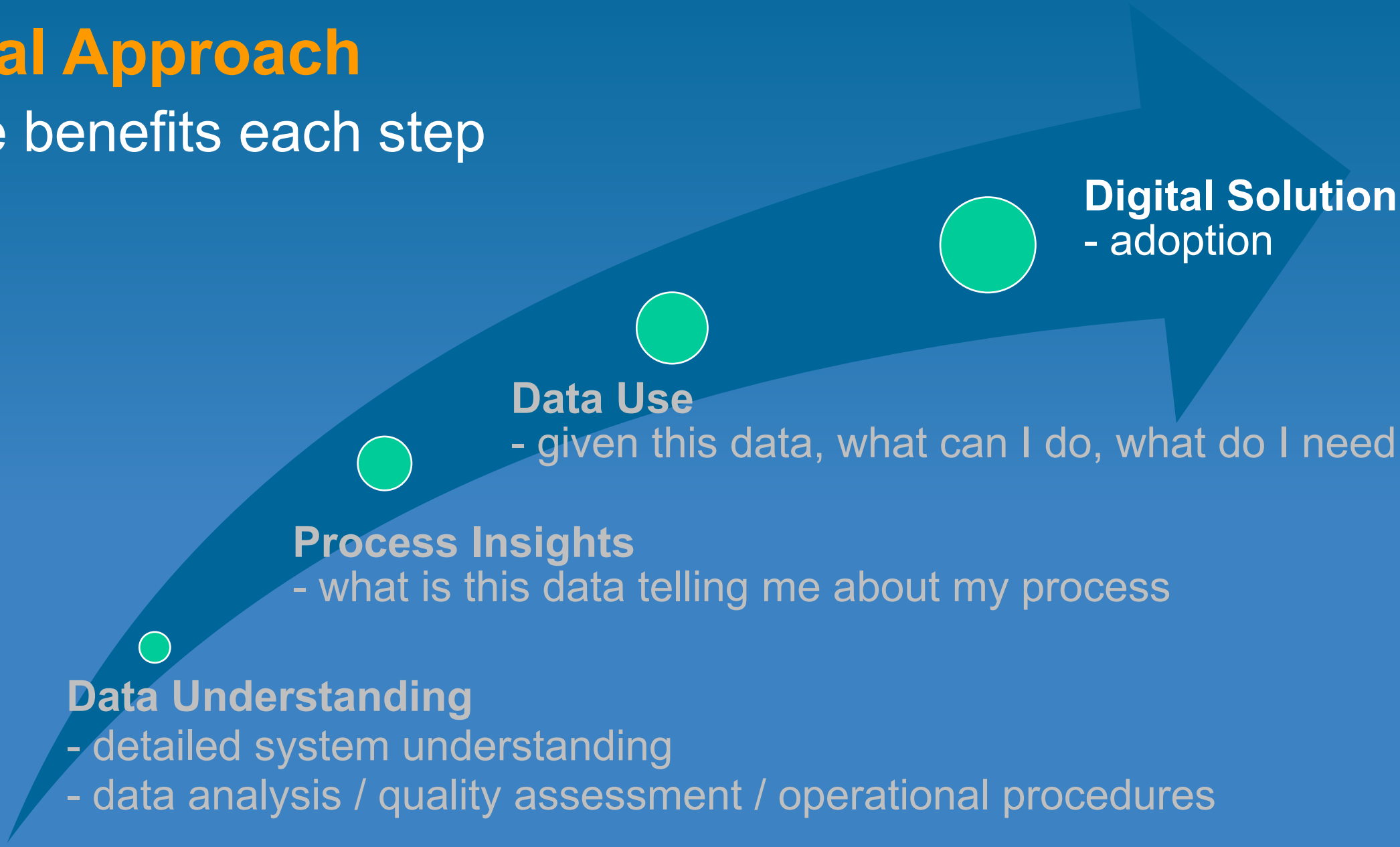
- Realise benefits each step



Towards a Digital Solution

➢ General Approach

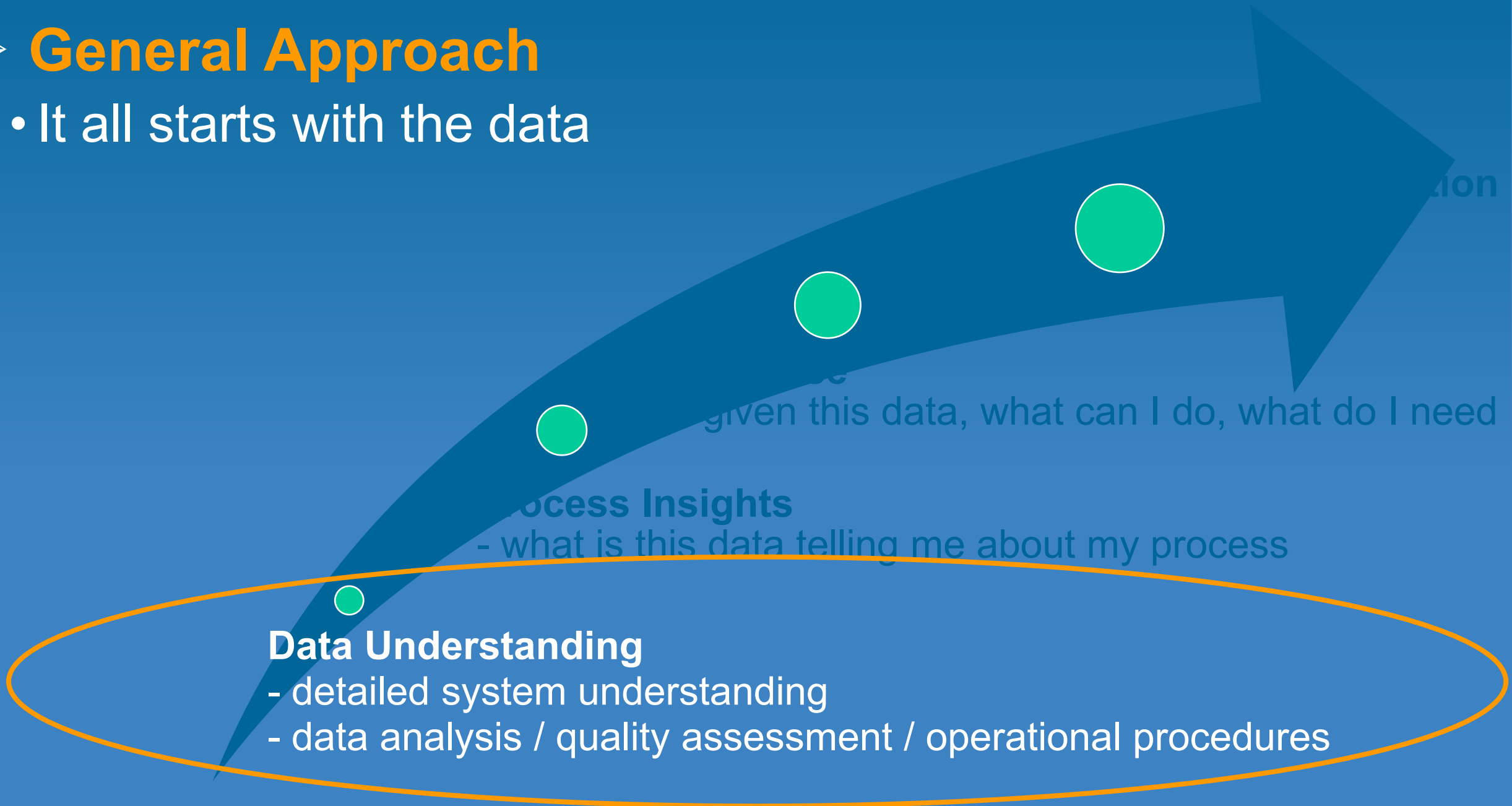
- Realise benefits each step



Towards a Digital Solution

➢ General Approach

- It all starts with the data



PrecisionNow Digital Solution → *Why?*

- **Numerous Unrealised Benefits**
  - Process insights; Risk assessments
  - Day-to-day operations; Future operations; Situational awareness
- **Effort**
  - Already collecting the data
  - Can be automated

*Precision**Now*** Data Analytics → *How?*

➢ Manage Entire Data Life-Cycle

- Design, → What data and why is it needed?
- Commissioning, Collection, → Resource allocation, departments?
- Maintaining, Repairing, → Data quality be assured?
- Modifying, Replacing → Criteria for replacement?

PrecisionNow Data Analytics → *Digital Solution*

➢Digital Design

- Problem identification
- Solution design

➢Data-Derived Outcome

- Data-driven KPIs
- Process insights
- Operational parameters

➢Data Evaluation

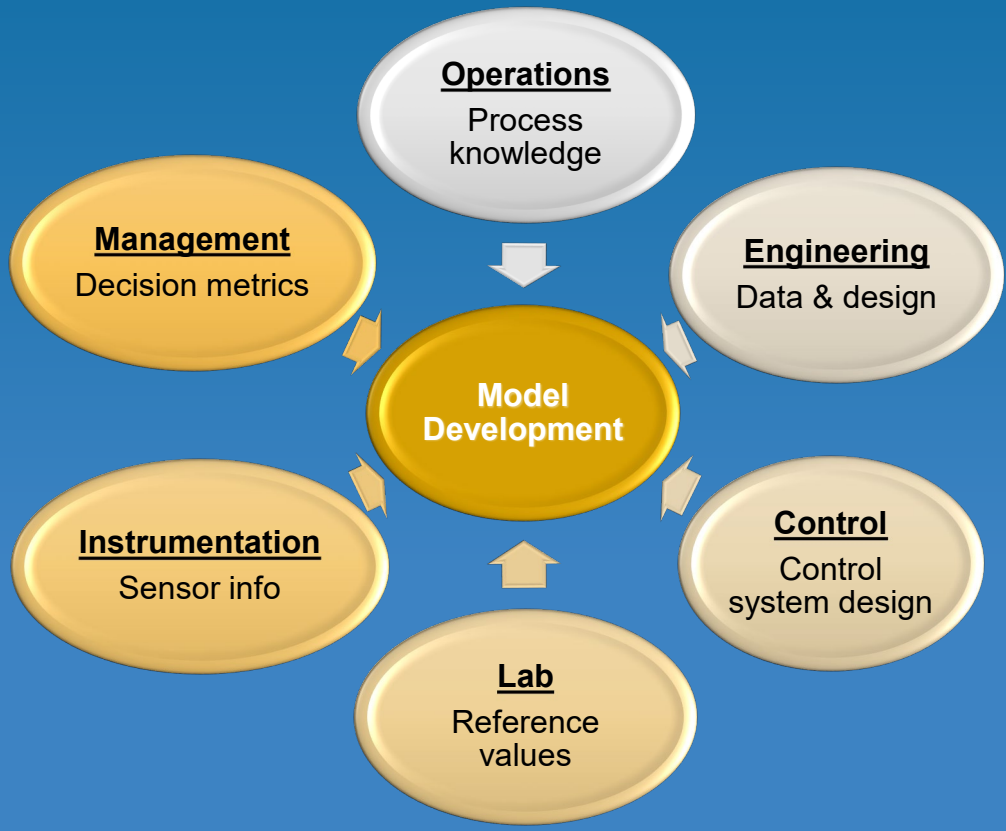
- Data quality assessment
- Maintenance / quality alerts

PrecisionNow Data Analytics → *Digital Solution*

Problem & Design → Collection

➢Digital Design

- Model is knowledge repository
- Identification of unknown relationships
- Identification of critical data gaps
- Determination of process indicators



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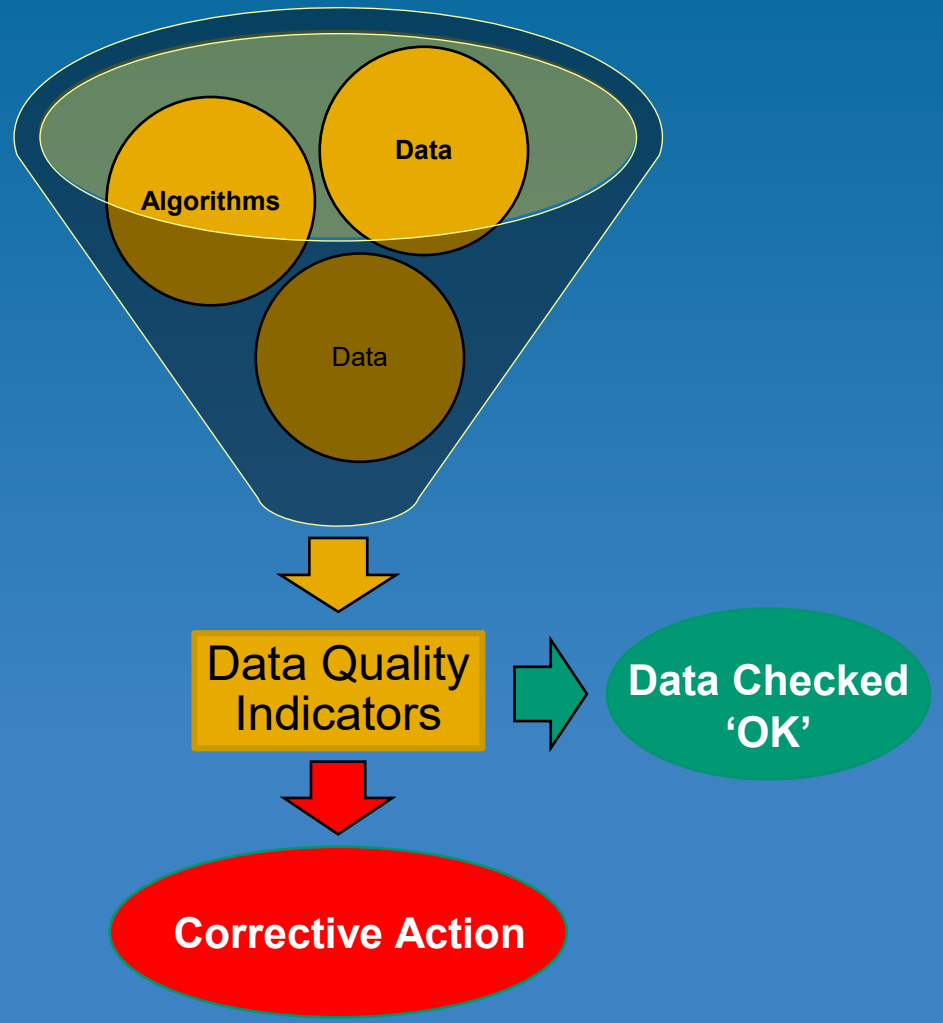
Data Evaluation



➢Real-Time Evaluation

- Real-time quality indicators
- Immediate feedback

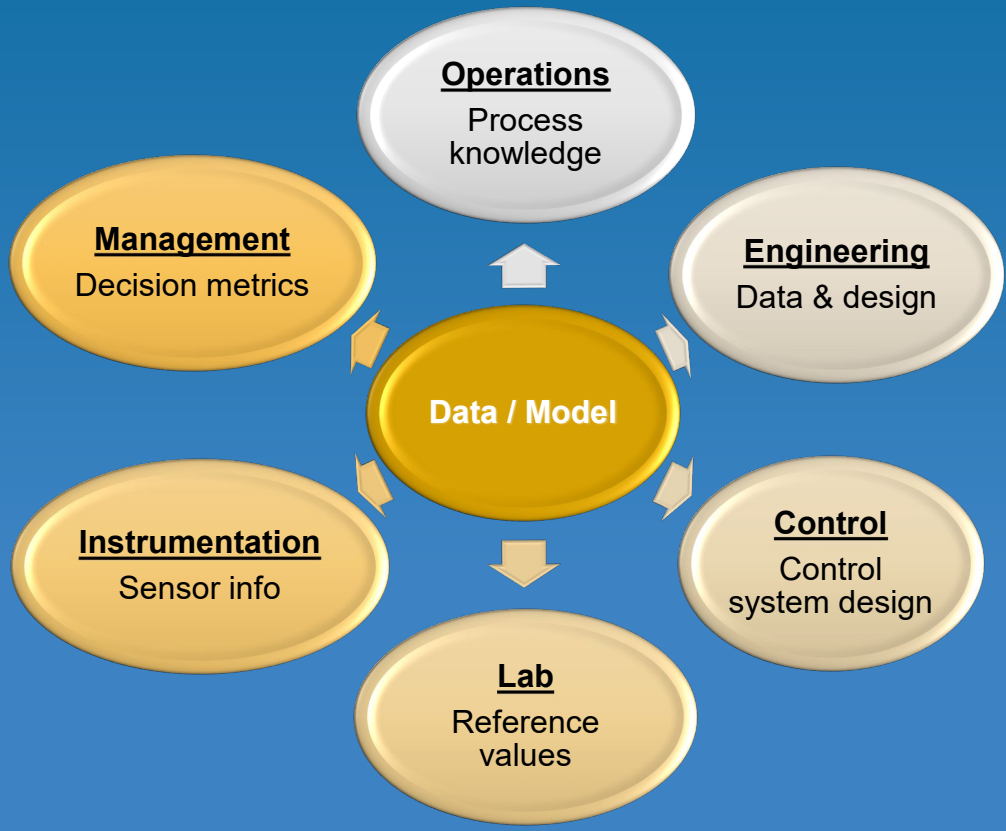
PrecisionNow Data Analytics → *Digital Solution*

➢Data Quality Solution

- Automated, goal-oriented
- Ease-of-Use data algorithms
- Standardised approaches
- Verifiable QA/QC

PrecisionNow Data Analytics → *Digital Solution*

High Quality Data → KPIs / Actionable Outcome

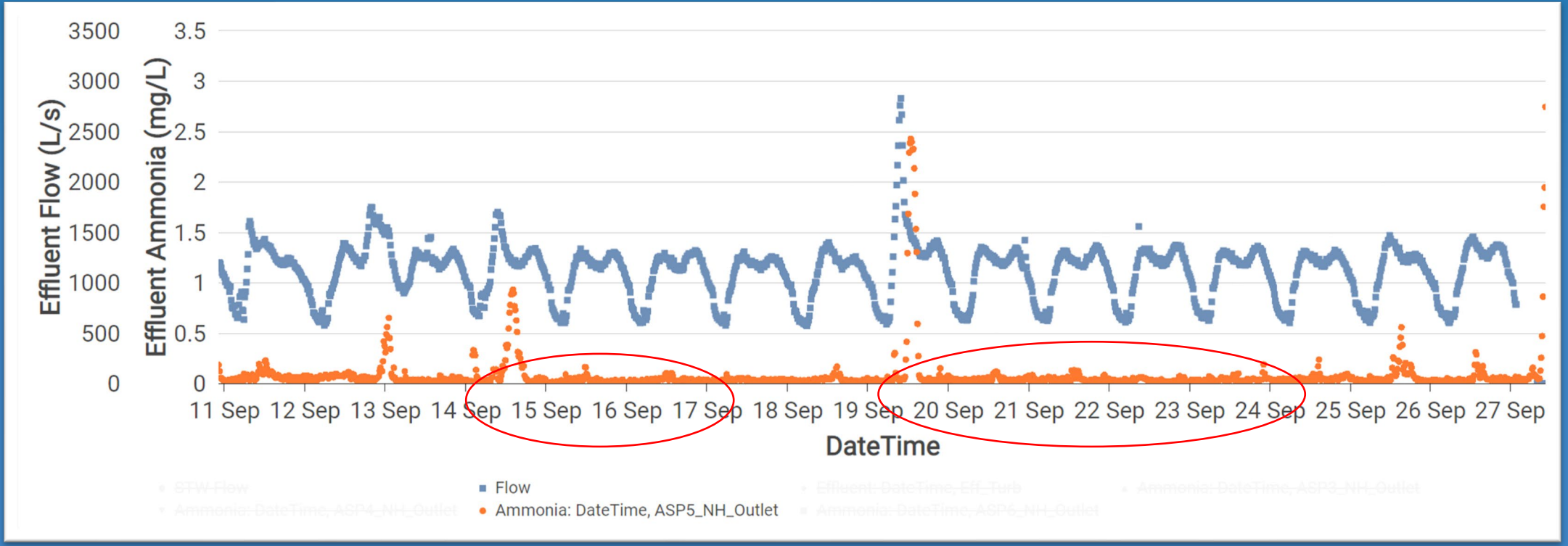


➢Data-Derived Outcomes

- Real-time process KPIs
- Digital twin output
- Operational parameters
- Risk assessment
- Situational awareness

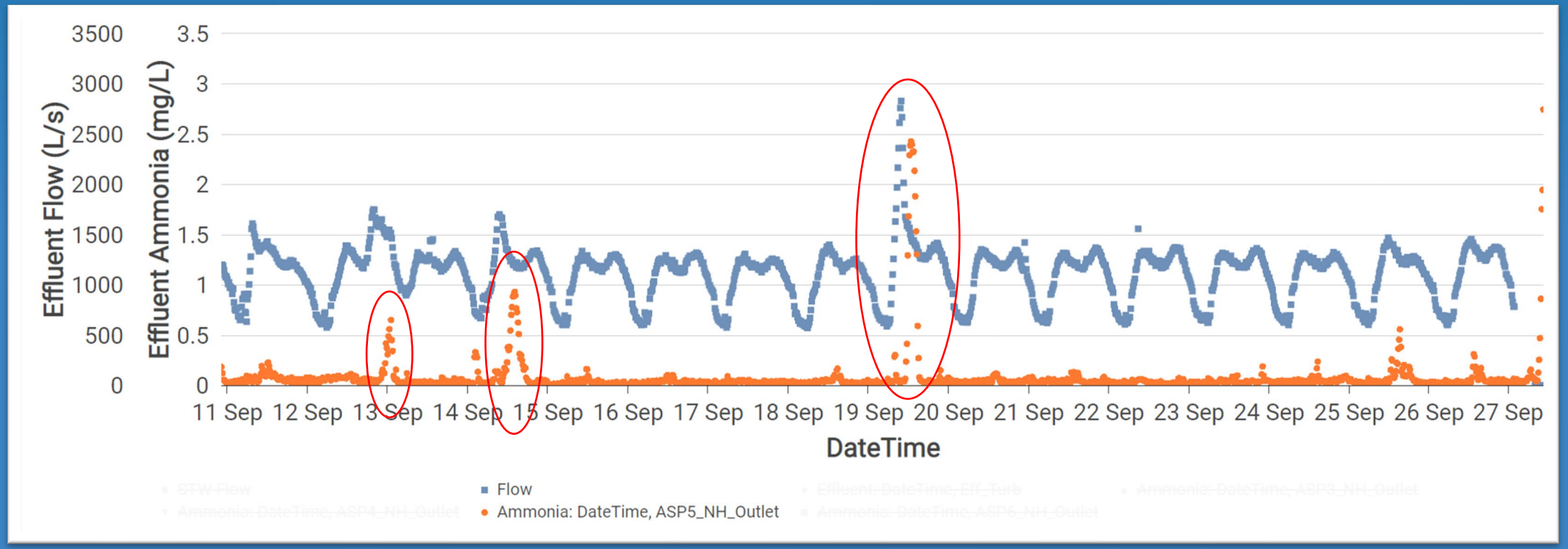
Problem Identification

- How to model variable dry weather ASP behaviour …



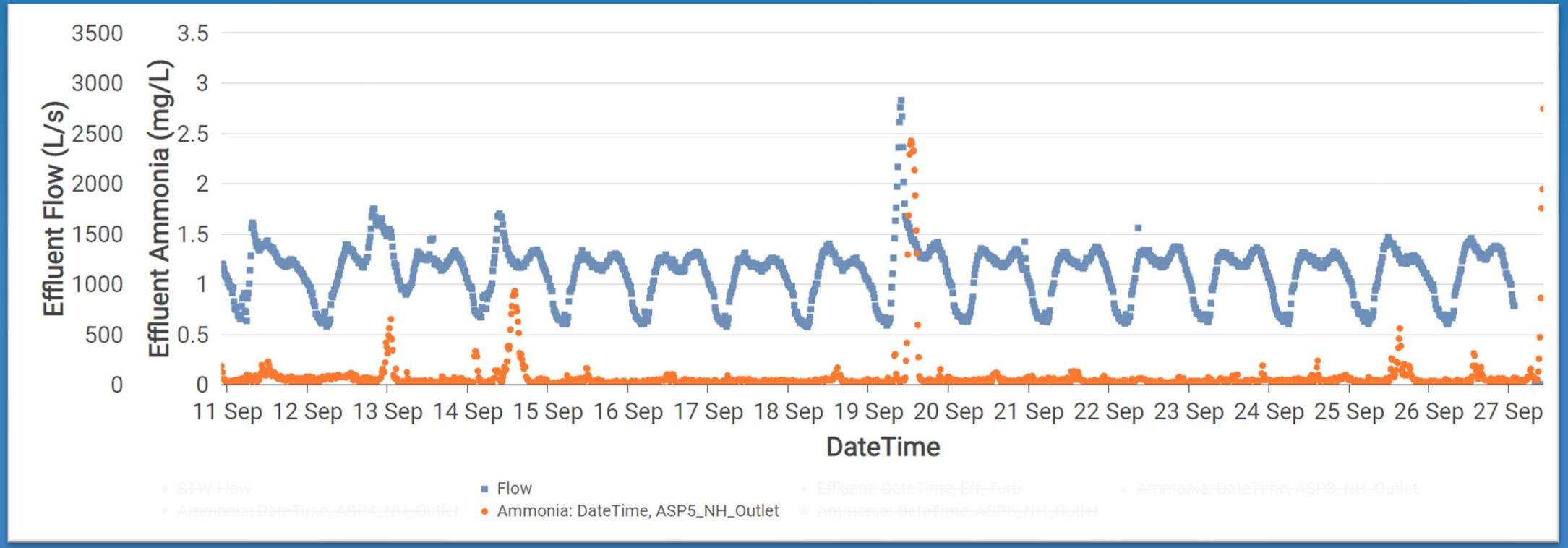
Problem Identification

- How to model variable dry weather ASP behaviour …
- How to predict first flush events …



Problem Identification

- How to model variable dry weather ASP behaviour …
- How to predict first flush events …
- How to explain notion of variable influent characterisation …



Thought Process

- Why would sewage composition vary significantly day-to-day
  - Do people change?
  - Does industry change?

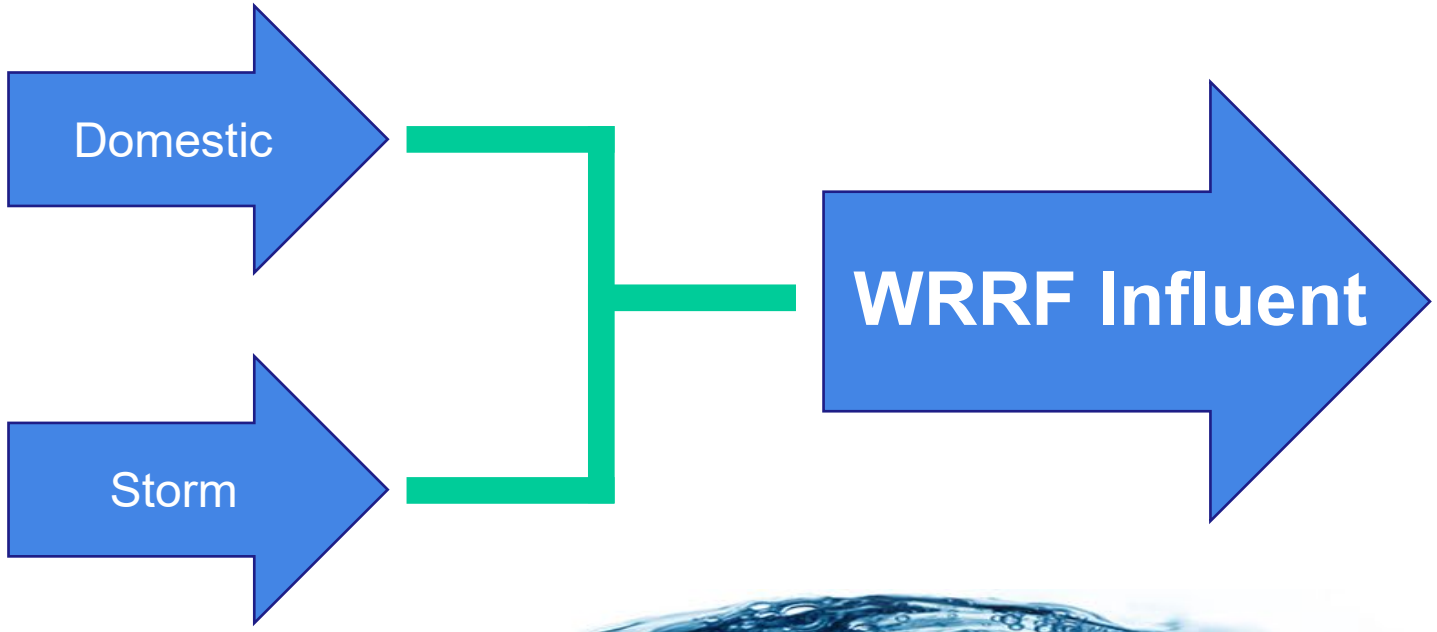
Thought Process

For > 30 yrs …

- Domestic sewage fixed
- Storm inputs as separate entity

  - Defined Diurnal Flow
  - Fixed Characterisation

  - Variable Flow
  - Defined Characterisation



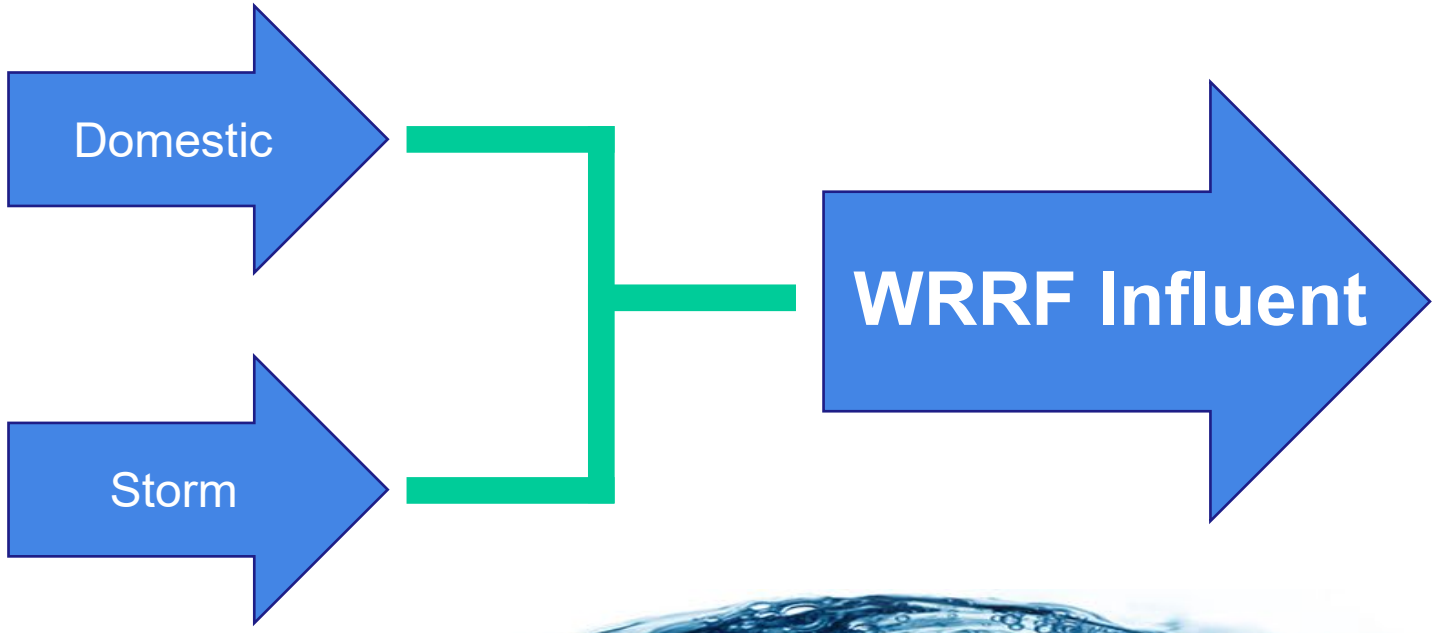
Thought Process

Worked …

- General process/control behaviour
- Predicted a variable influent

  - Defined Diurnal Flow
  - Fixed Characterisation

  - Variable Flow
  - Defined Characterisation



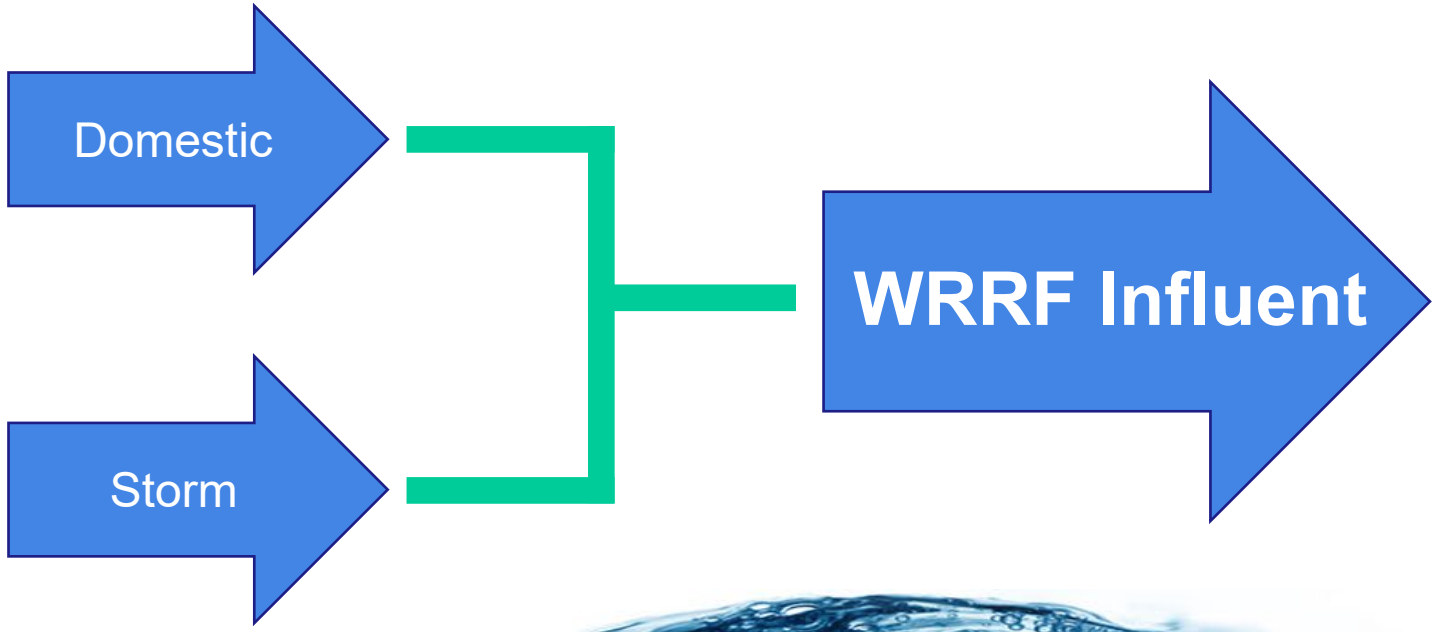
Thought Process

Worked … But NOT this time

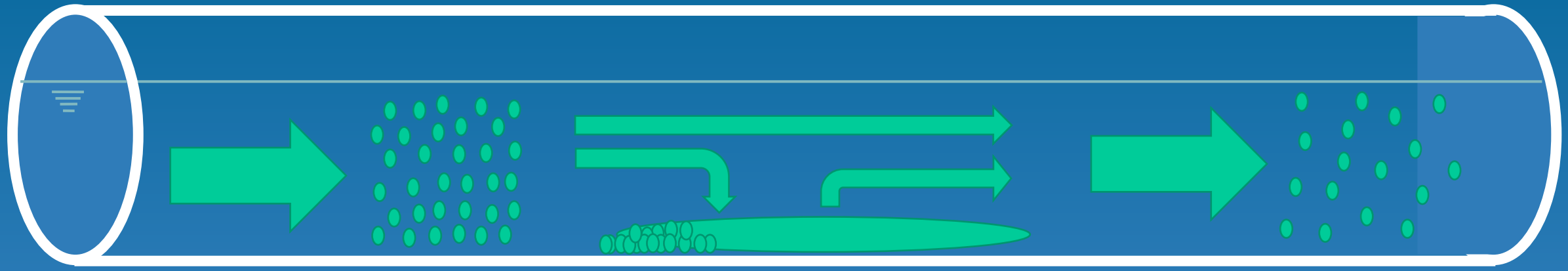
- General process/control behaviour
- Predicted a variable influent

  - Defined Diurnal Flow
  - Fixed Characterisation

  - Variable Flow
  - Defined Characterisation



Model Development



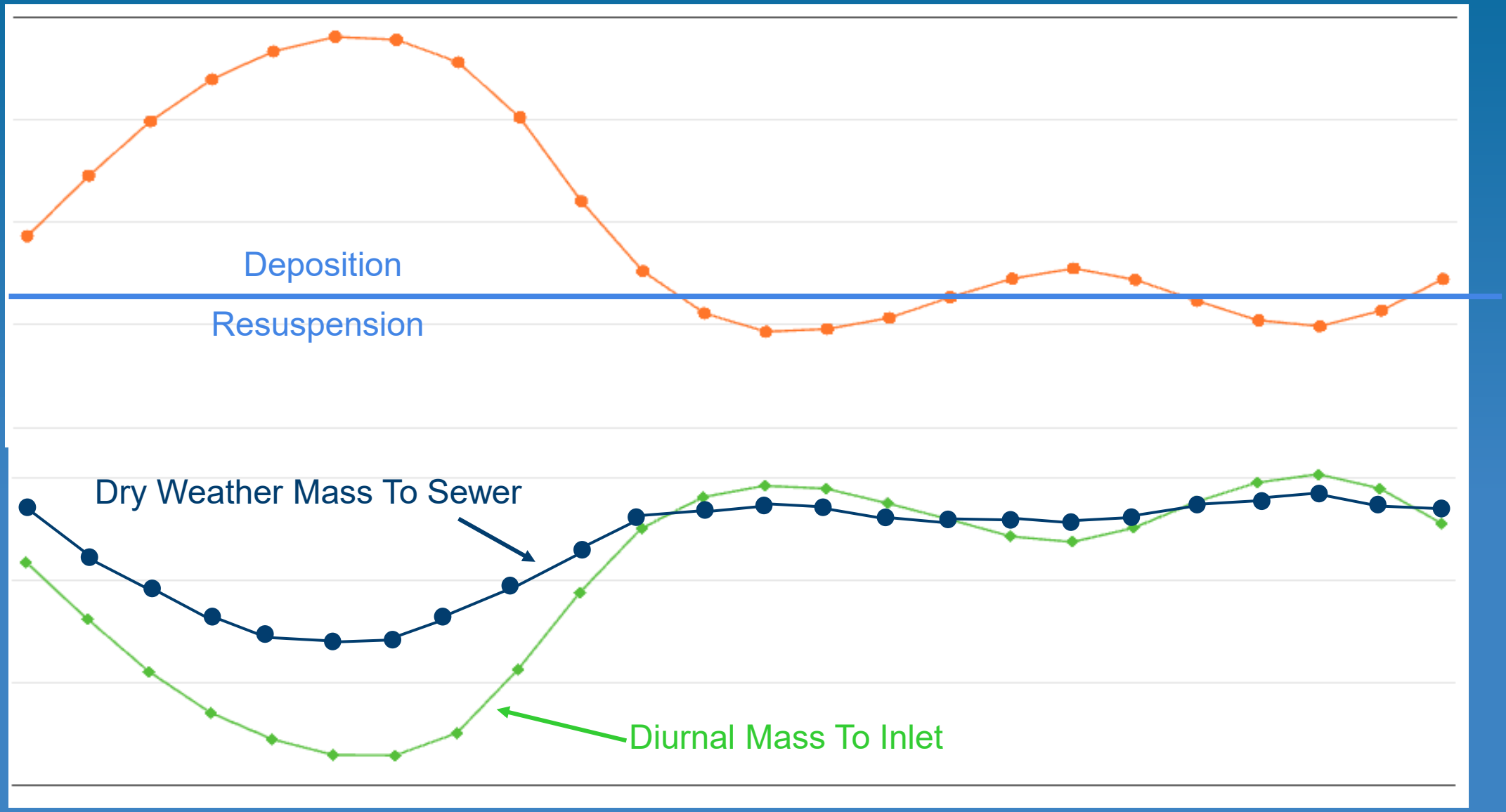
What If …

Deposition & *Resuspension* function of flow & sewer state

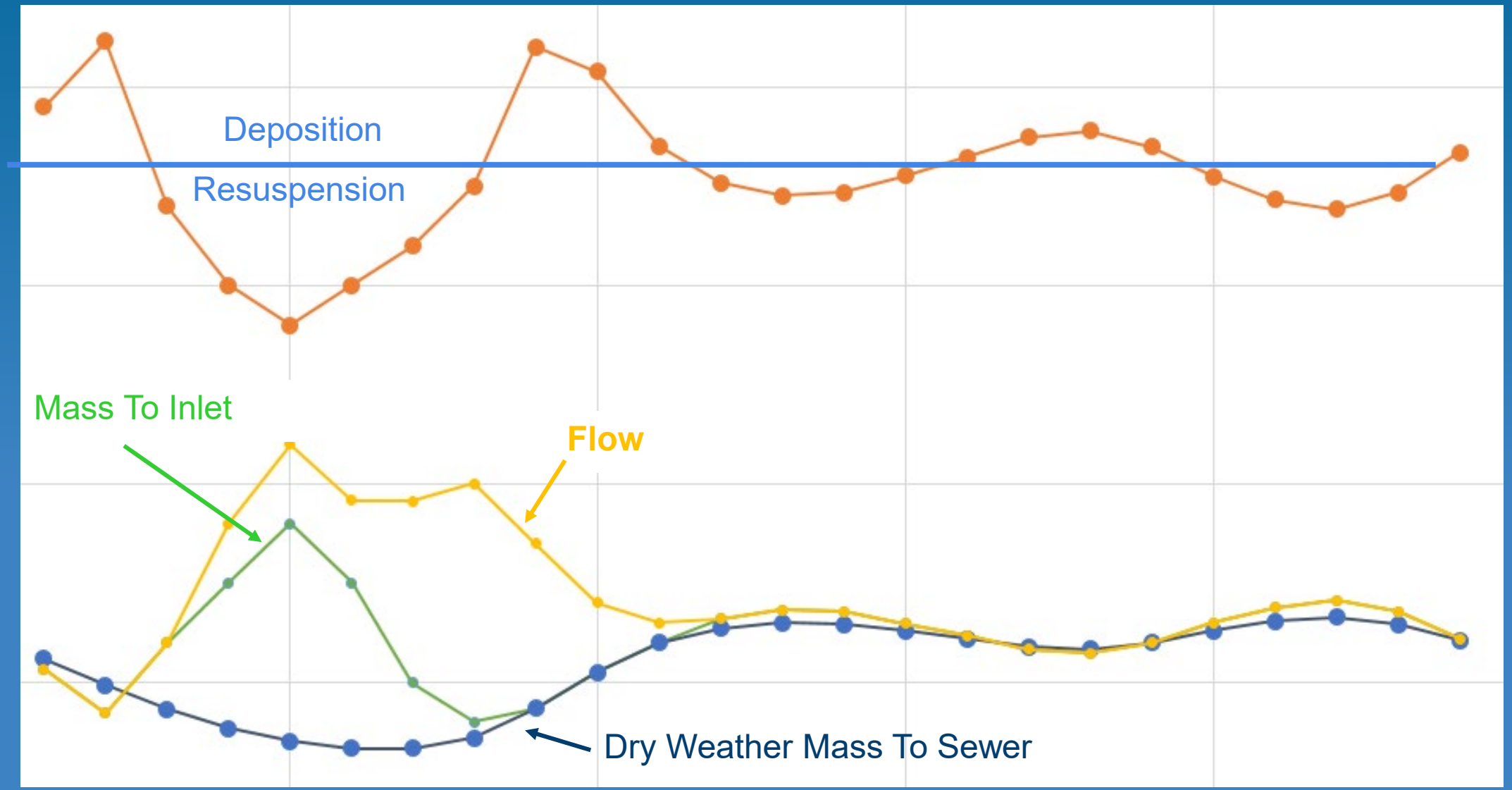
- Variations in daily diurnal wastewater strength
- Impact of high(er) flow events also possible

Model Development

Model Development – Typical Dry Day



Model Development – Wet Weather Event

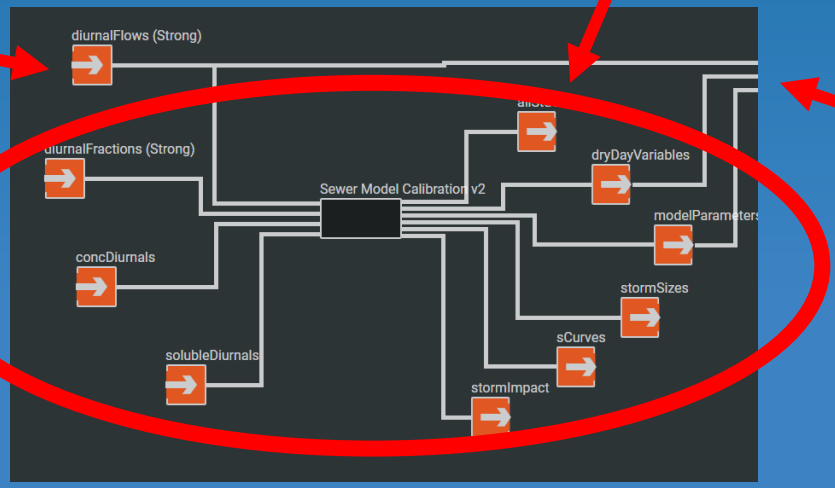


Model Development & Calibration

- Historical Data (off-line)

Historical Influent Flows

Data Model Calibration



Data Model Parameters

Data Model

Calibrated with Historical Data

PrecisionNow

dDockDT

A PRIMODAL SYSTEMS DIGITAL TWIN TECHNOLOGY

Data Quality Assessment

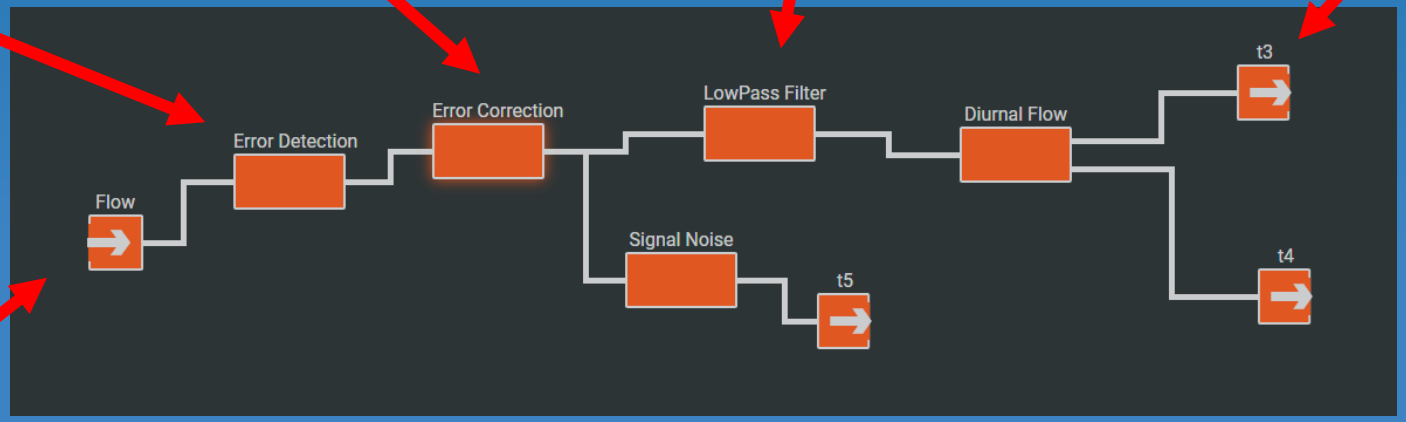
- Real-Time Evaluation (on-line)

Error Detection

Error Correction

Smoothing

Real-Time High Quality Model Input



Real-Time Data Acquisition

PrecisionNow

dDockDT

A PRIMODAL SYSTEMS DIGITAL TWIN TECHNOLOGY

Real-Time Operation

- Real-Time Prediction (on-line)

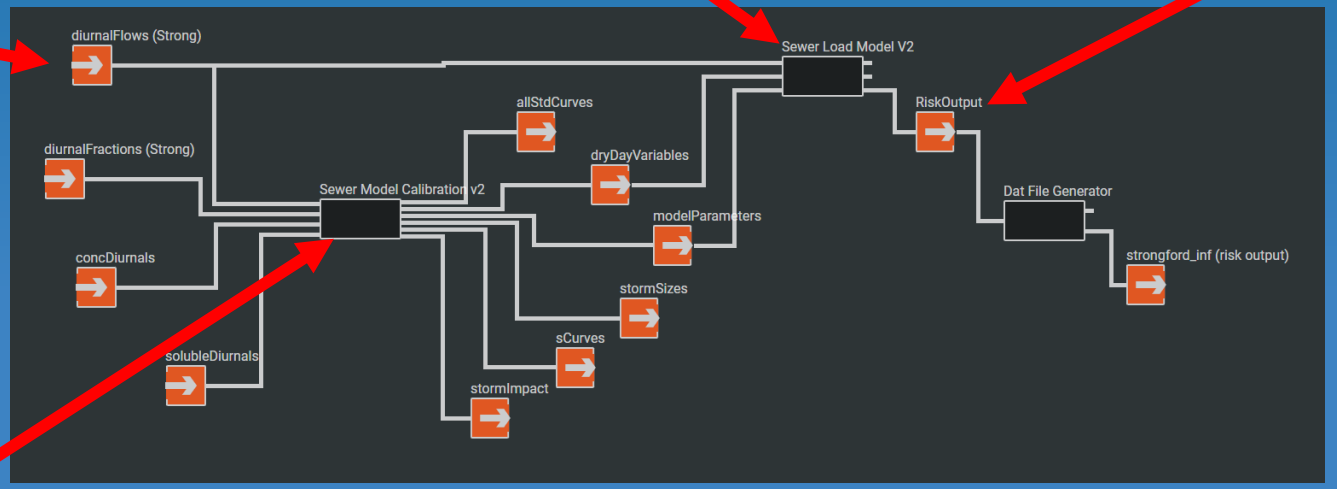
Real-Time High Quality Model Input

Influent Flow

Data Model

Continuously Running Influent Soft-Sensor

Real-Time Performance Output



Data Model

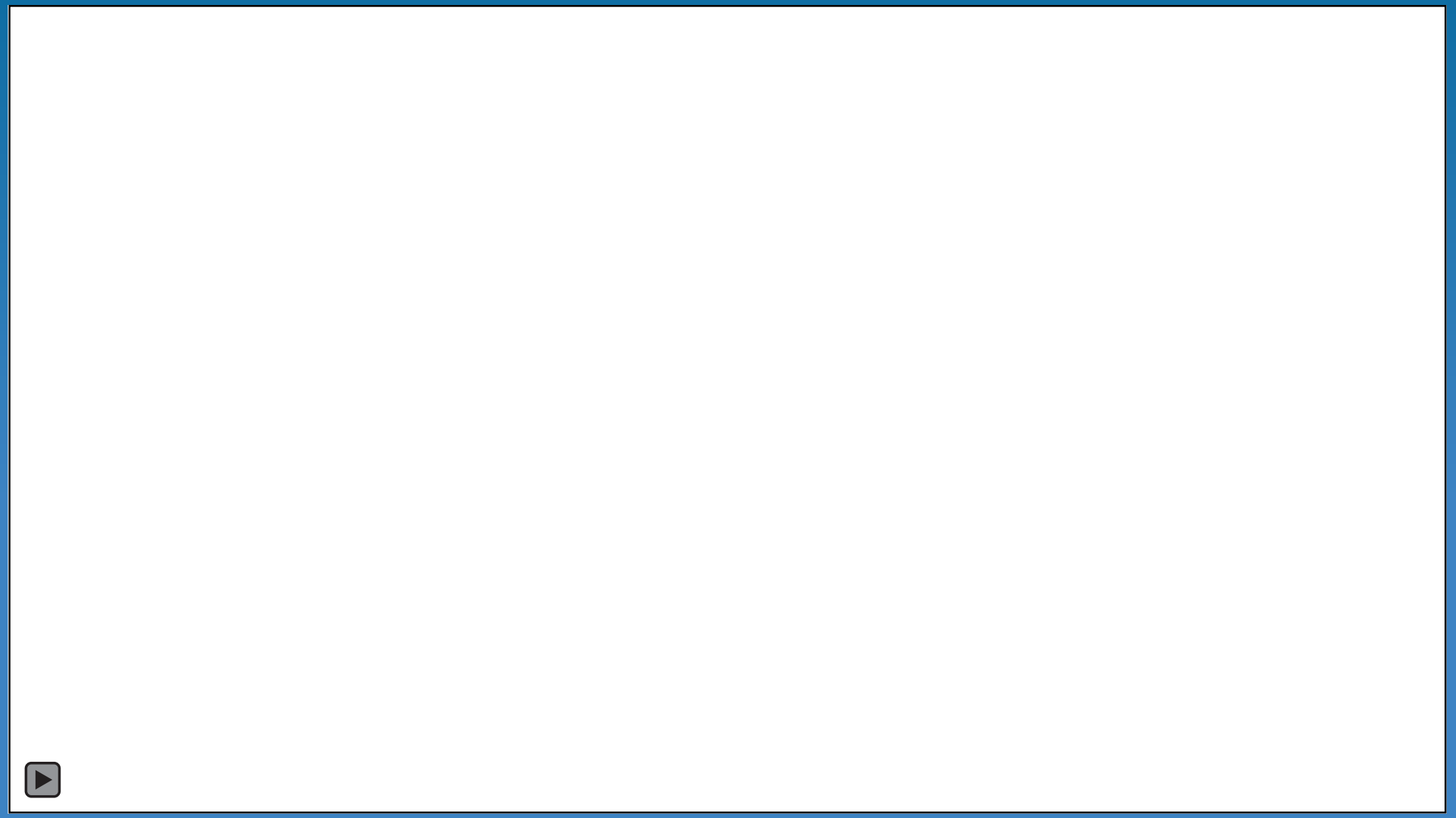
Calibrated with Historical Data

PrecisionNow

dDockDT

A PRIMODAL SYSTEMS DIGITAL TWIN TECHNOLOGY

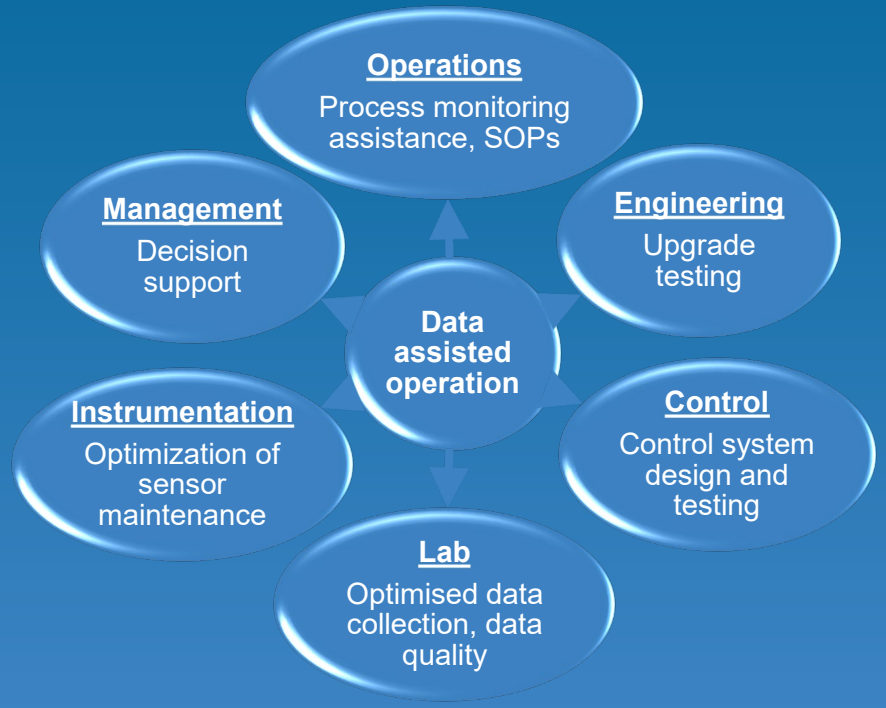
Case Study → Real-Time Risk Assessment



Conclusion

➢ Successful Implementation

- Easy to Use/Understand
- Usable by <u>all</u> disciplines
- Incentives for <u>all</u> disciplines
- Data quality *is essential*
- Consolidates data usage / outputs
- Develops new data-driven operational outcomes into existing SOPs and operator work schedules

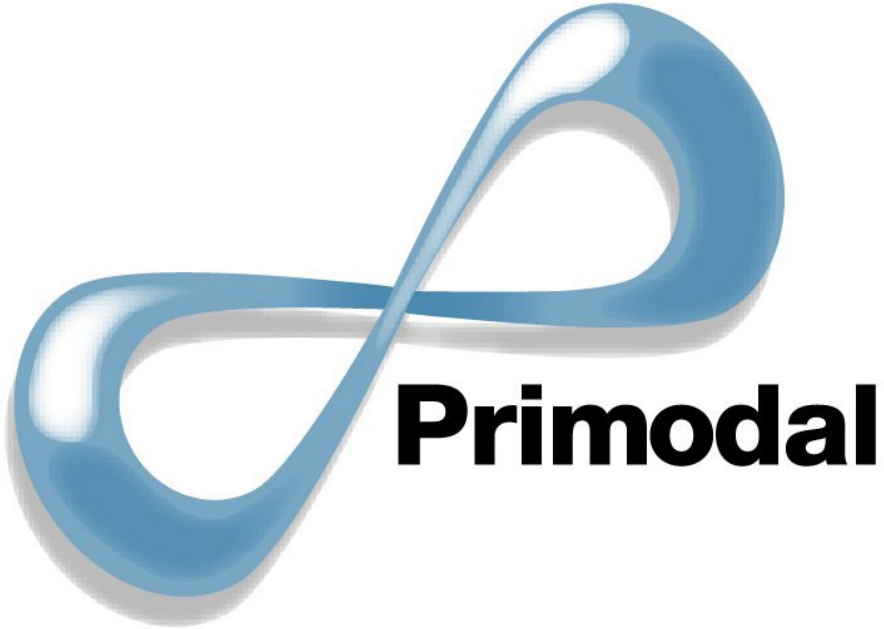


Conclusion

- Digital Solutions Need Prior and Post Model Data Analysis
  - Quality assessment *prior* to the application / model
  - *Post* model output analysis for real-time operational efficiency

- Precision***Now***
  - User-Configurable DT technology
  - Real-time data analysis & preparation
  - Data scheduling to/from the model
  - Multiple model capabilities (simple, ML, mechanistic, …)

Thank-you !



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PrecisionNow Digital Solution → *Why?*

- Goal (irrespective of data user)
  - Improved data quality
  - Practical process understanding & improved operation
  - Better decision-making

PrecisionNow Data Analytics → *Digital Solution?*

- Treat Process Data as an Asset
  - Systematic approach to its maintenance
  - Realise the value contained within
  - Develop, maintain, and update
  - Maximise the economic and capital value

PrecisionNow Data Analytics → *Digital Solution*

➢Data Quality Solution

- Automated, goal-oriented
- Ease-of-Use data algorithms
- Standardised approaches
- Integrated model (data, process) analysis
- Verifiable QA/QC

Towards a Digital Twin

➢ How?

- Staged approach
- Realising benefits each step