SPCI - (29-01-2019)

Using Analytics to Create Value from Process Data

Introducing Industrial Analytical Framework

Ari Niinistö, Digital Lead, Industrial Automation

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Digitalization is Driving Cost-Reduction and OEE Improvements

AI and Analytics are Leading the Change

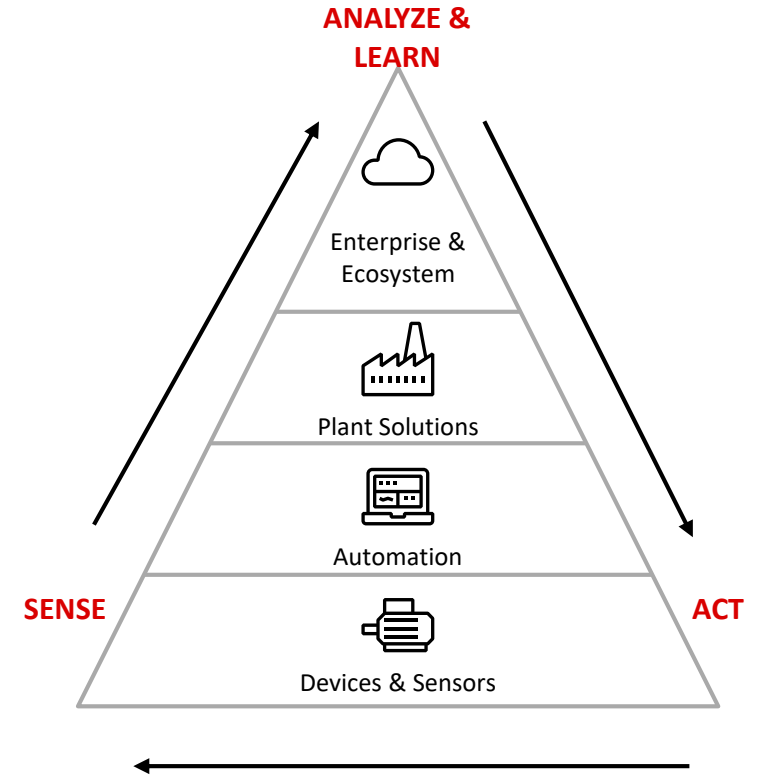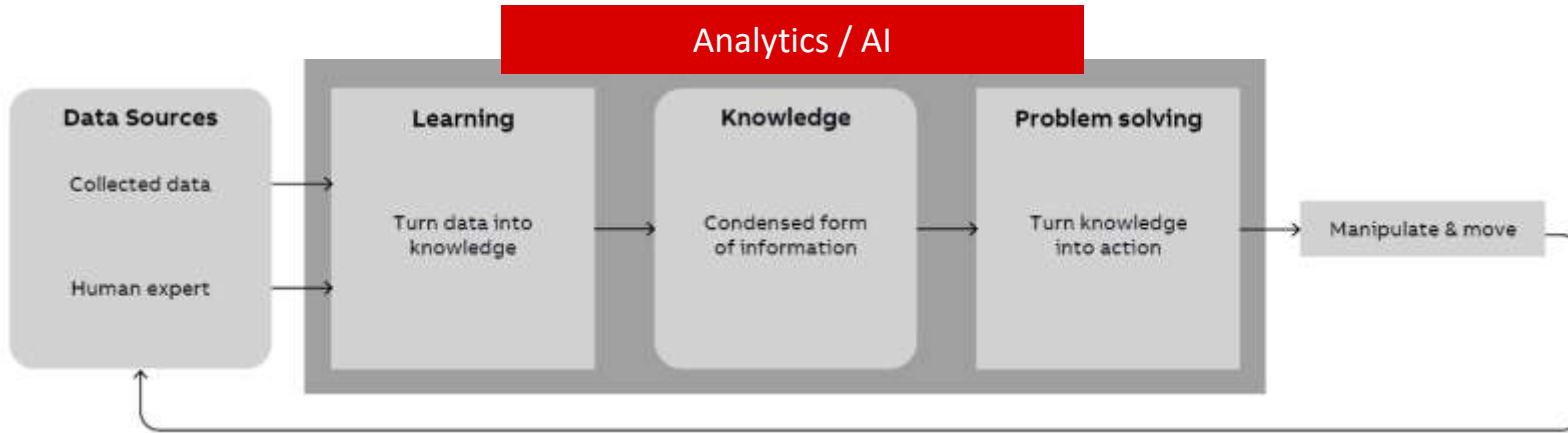|	Raw-material supply (forestry and harvesting)	Pulp production	Paper and board production		Cost-reduction on total cost base, estimate, %		OEE[2] improvement, estimate, p.p.[3]
			Paper machine	Convert-ing line	Existing technologies	Existing and future technologies	Existing technologies
AI[1] and analytics	Fiber yield, chemical consumption, and energy				~4.5	~7.0	
	Predictive maintenance				~2.0	~2.5	~2.0
	Throughput debottlenecking and quality						~3.0
Auto-mation	Logistics automation				~0.5	~1.0	
	Process automation					~0.5	
	Remote process control					~1.5	
	Remote process inspection				~1.0	~1.0	
Mobile	Digital field-force apps				~1.0	~1.0	
	Digital business-support functions				~0.5	~0.5	
	Digital performance management						
	Total opportunity[4]				~10%	~15%	~5 p.p.

[1]Artificial intelligence.
[2]Overall equipment effectiveness.
[3]Percentage points.
[4]Not including purchasing, marketing and sales.

Industrial Analytics – Key Components

From Data to Action

ANALYZE & LEARN

Data Sources
- Collected data
- Human expert

Analytics / AI

Learning
Turn data into knowledge

Knowledge
Condensed form of information

Problem solving
Turn knowledge into action

Manipulate & move

Enterprise & Ecosystem

Plant Solutions

Automation

Devices & Sensors

SENSE

ACT

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Industrial Internet Consortium

Analytics Framework

INDUSTRIAL INTERNET OF THINGS ANALYTICS FRAMEWORK

We are pleased to announce the Industrial Internet of Things Analytics Framework (Industrial IoT Analytics Framework) for system architects, technology leaders and business leaders looking to successfully deploy industrial analytics systems.

Advanced analytics is at the core of the Industrial Internet of Things (IIoT). When analytics are applied to machine and process data, they help optimize decision-making and enable intelligent operations. These new insights and intelligence can be applied across any level of any industry if the appropriate data can be collected and analytics are applied correctly. If data is the new oil, data analytics is the new engine that propels the IIoT transformation.

Agenda

Industrial Analytics

Business Viewpoint

Usage Viewpoint

Functional Viewpoint

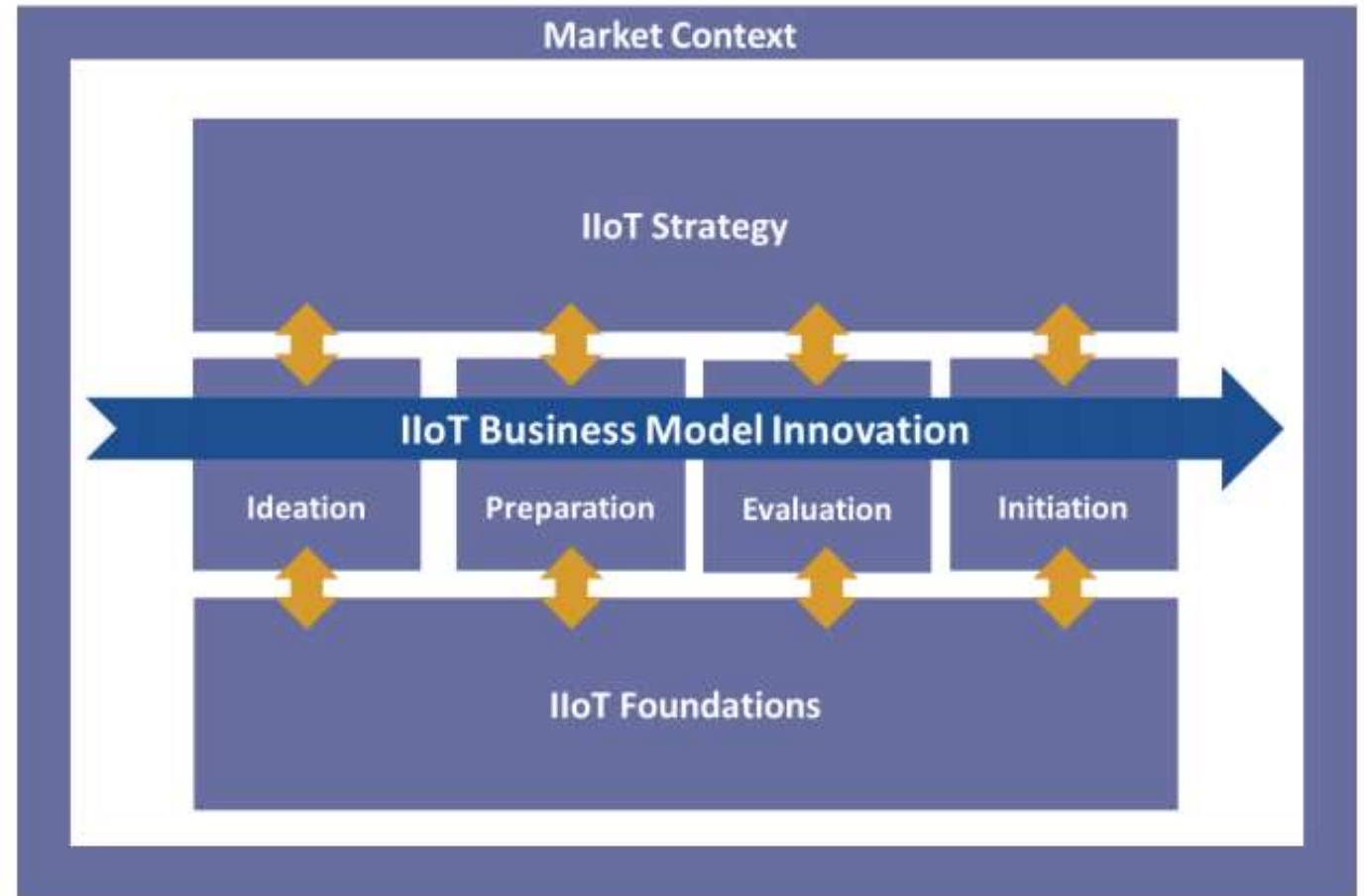Implementation Viewpoint

Crosscutting Concerns

Conclusions

"Analytics Framework", Industrial Internet Consortium (2017).

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Creating Business Value

Who: Business and operations stakeholders

What: Increase throughput and quality, reduce expenses and inventory

Why: Generate higher margins and competitive advantage to create business value

How: Identify performance bottlenecks and cost reduction opportunities in overall operations continuously and apply data analytics to remove them one-by-one

"Business Strategy and Innovation Framework", Industrial Internet Consortium, (2016).

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Papermaking Process

Analytics must be tied to Industrial Domain
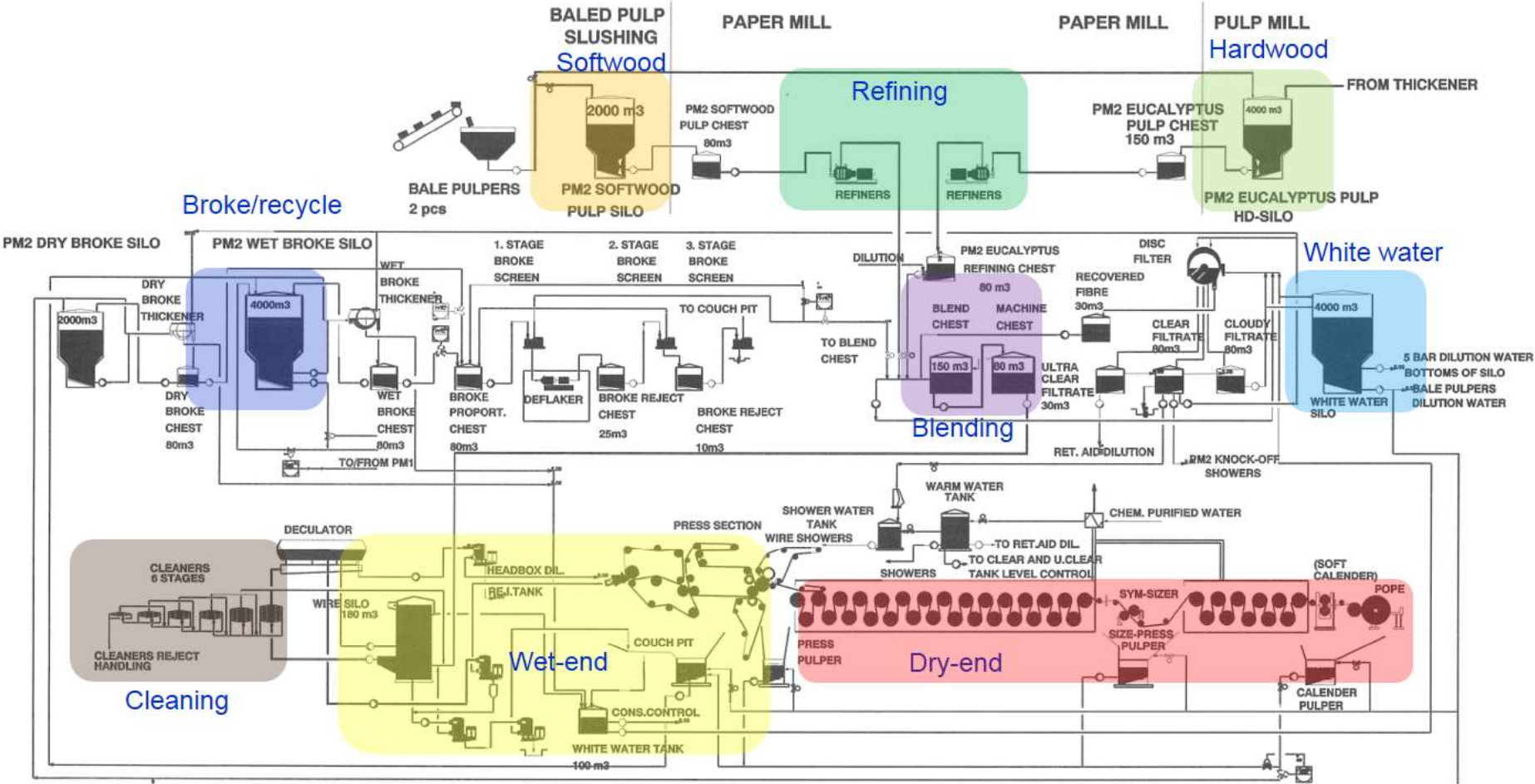
Analytics Framework

Usage Viewpoint

Descriptive Analytics

Gain insight from historical or current data streams for status and usage monitoring, reporting, anomaly detection and diagnosis.

Predictive Analytics

Identify expected behaviors or outcomes based on predictive modeling using statistical and machine-learning techniques, e.g. capacity demand and usage prediction, material and energy consumption prediction, and component and system wear and fault predictions

Prescriptive Analytics

Uses the results from predictive analytics as guidance to recommend operating changes to optimize processes and to avoid failures and the associated downtime.

Analytics results are either used to support human decision or applied automatically to the machines and systems.

"Analytics Framework", Industrial Internet Consortium (2017).

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Analytics Architecture
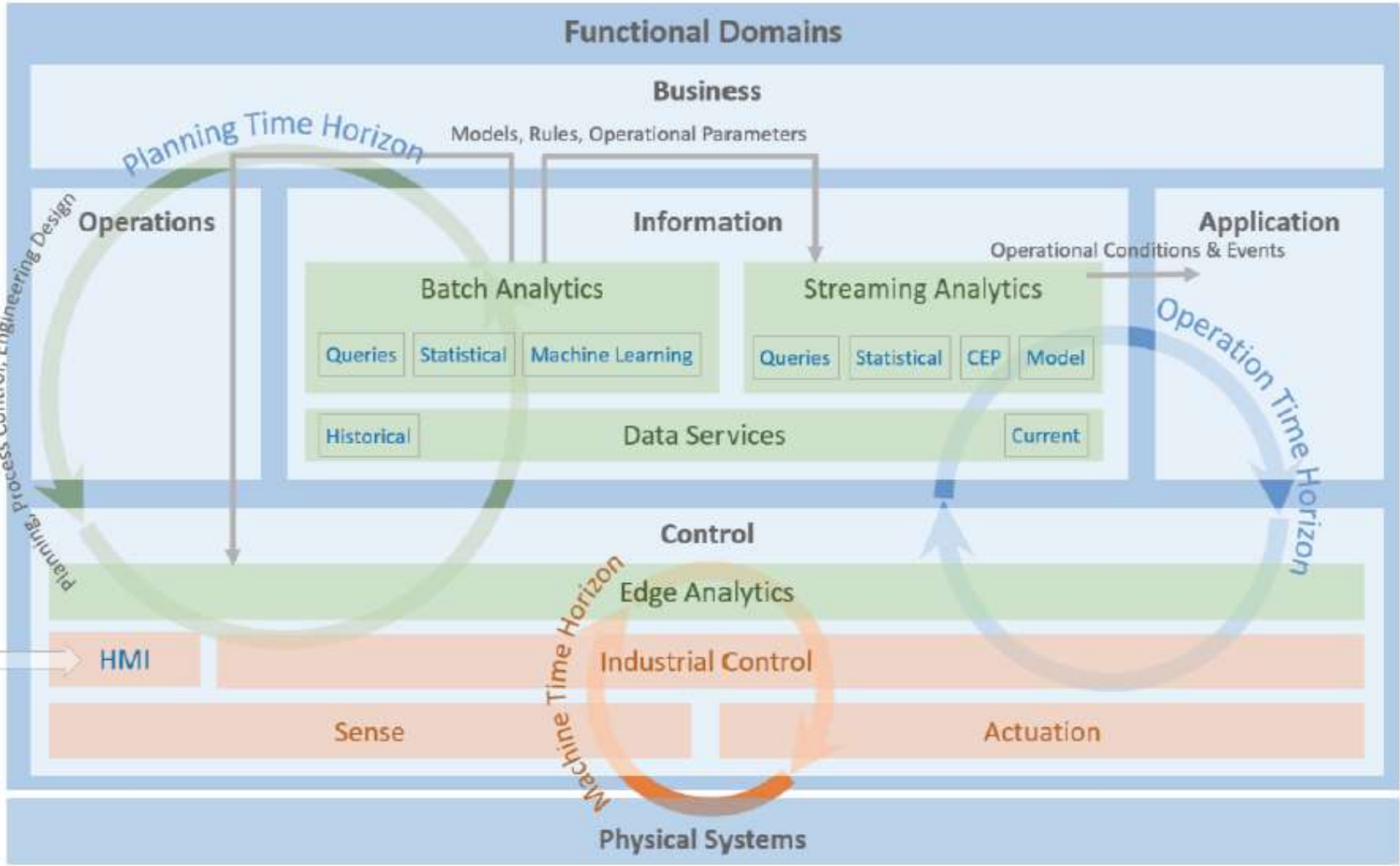
"Analytics Framework", Industrial Internet Consortium (2017).

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Industrial Analytics

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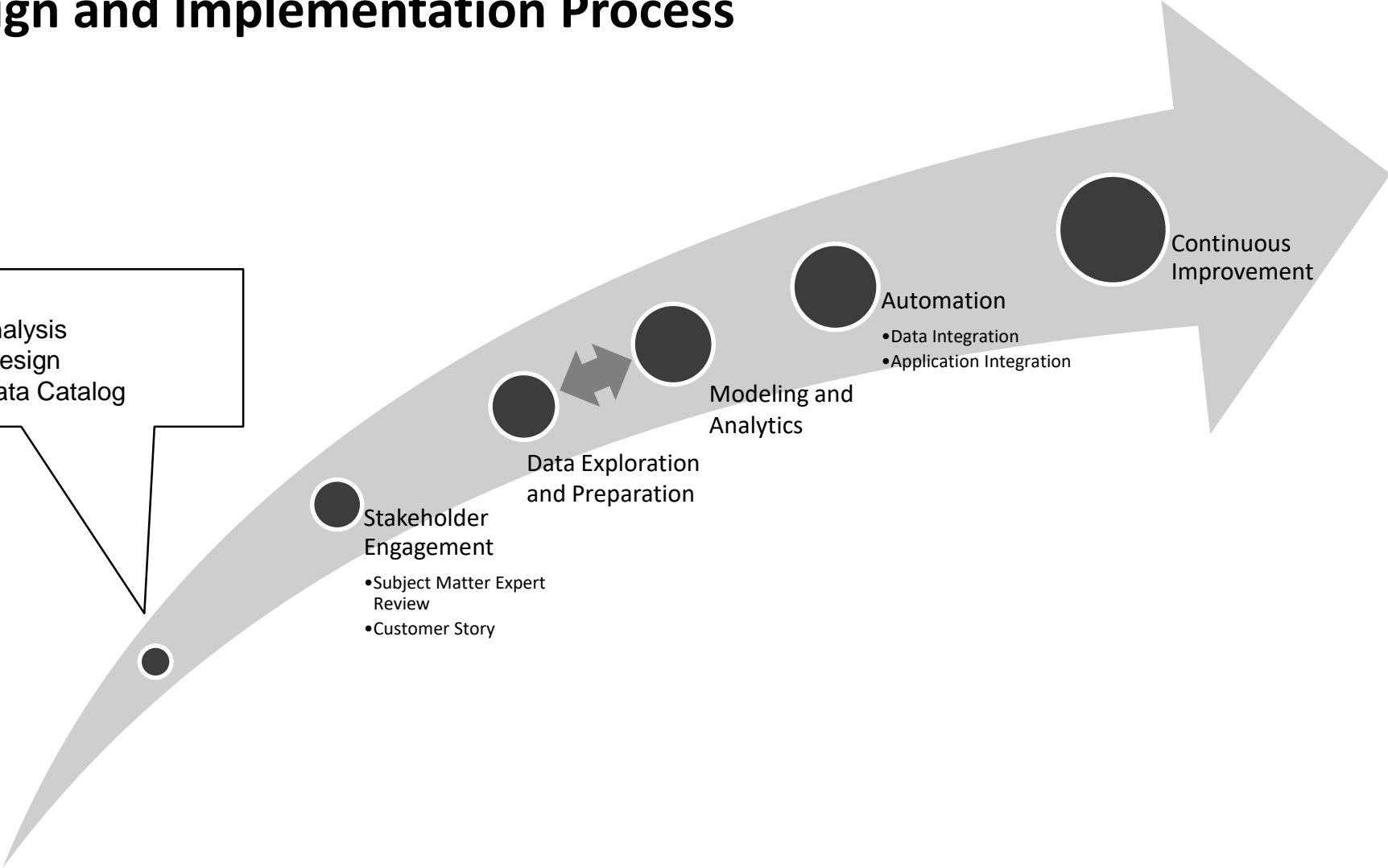**Implementation Viewpoint**

Crosscutting Concerns

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"Analytics Framework", Industrial Internet Consortium (2017).

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Analytics Design and Implementation Process

Continuous Improvement

Automation
- Data Integration
- Application Integration

Modeling and Analytics

Data Exploration and Preparation

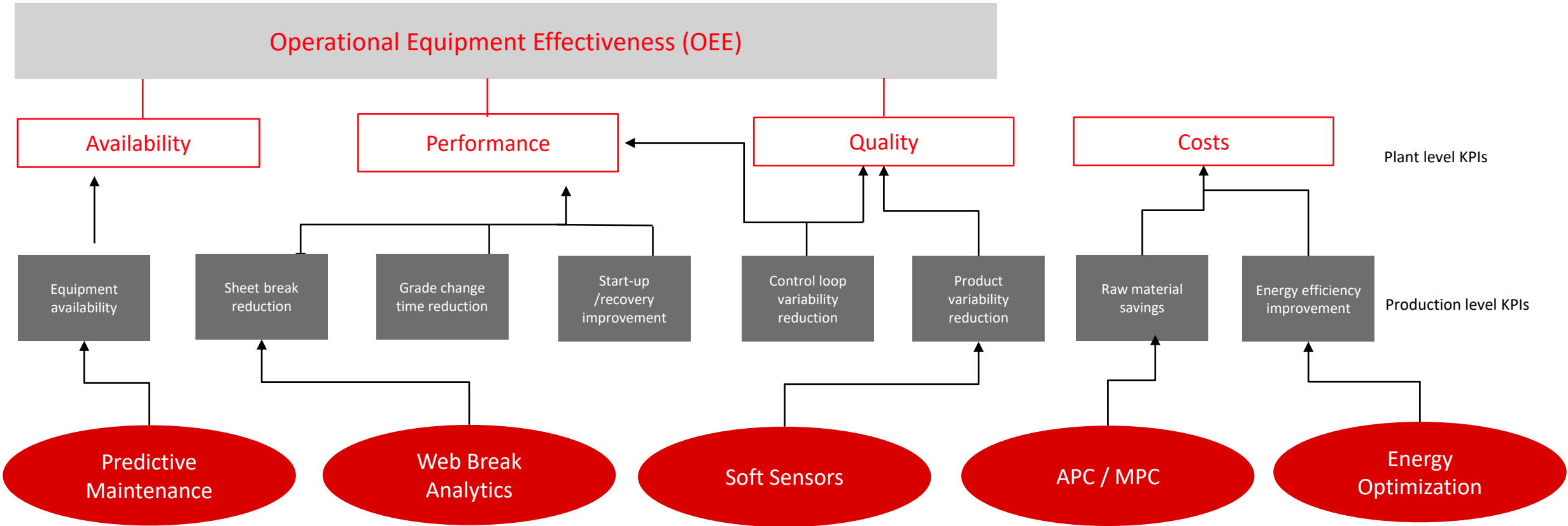**Stakeholder Engagement**
- Subject Matter Expert Review
- Customer Story

Business Case
- Customer Profile Analysis
- Value Proposition Design
- Environment and Data Catalog

ABB
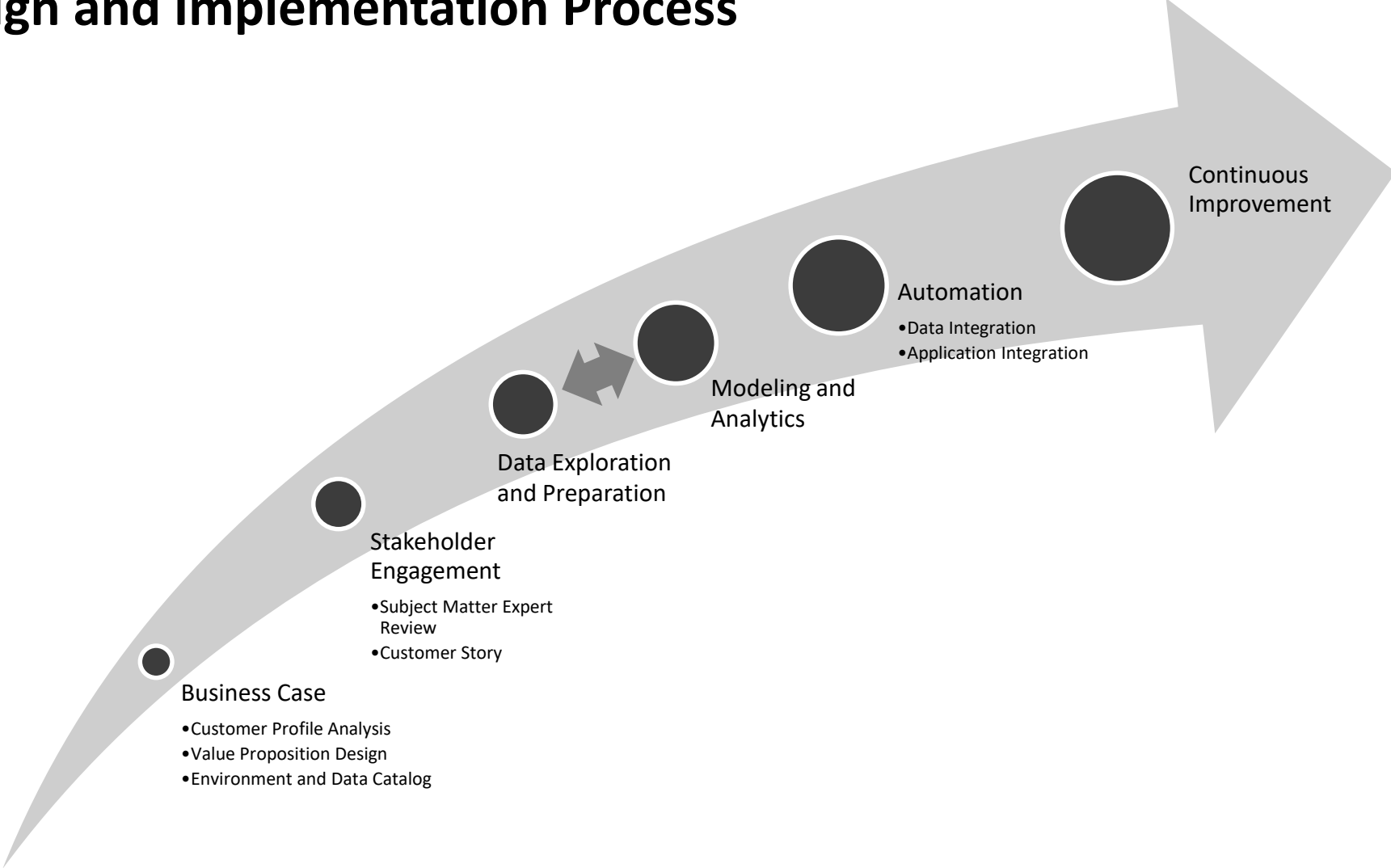
Analytics Design and Implementation Process

Business Case

Business Case
- Customer Profile Analysis
- Value Proposition Design
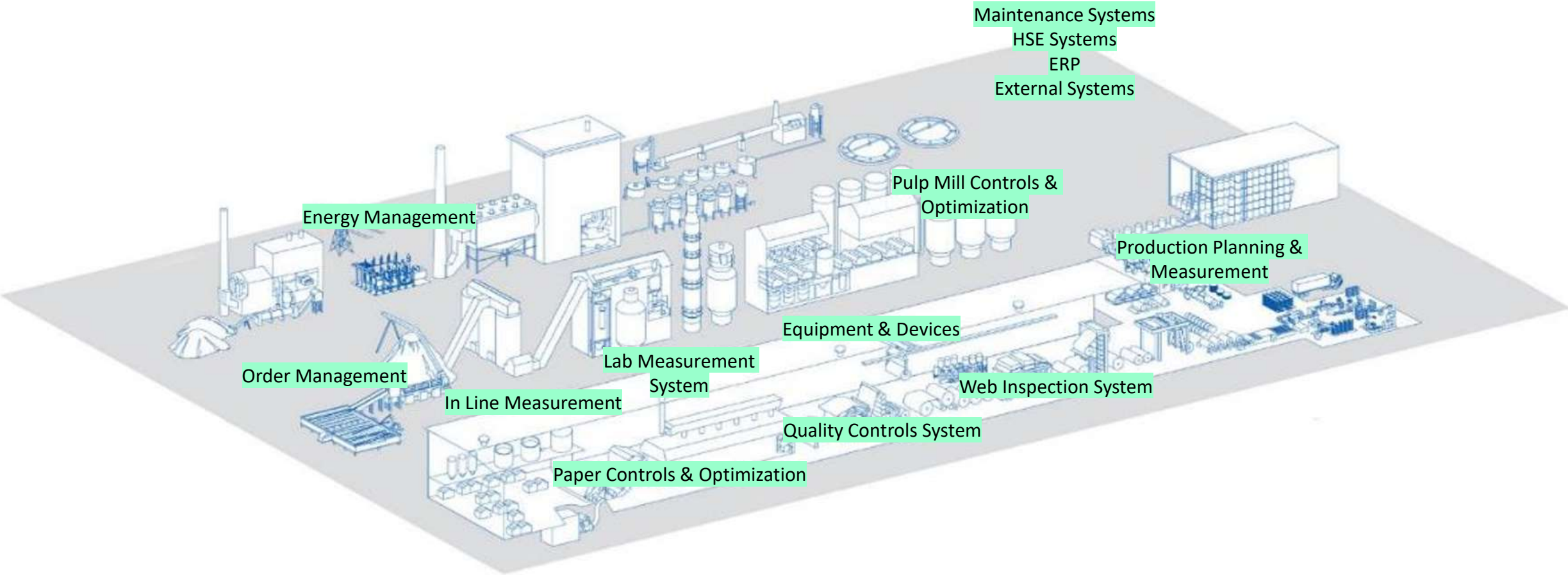- Environment and Data Catalog

Stakeholder Engagement
- Subject Matter Expert Review
- Customer Story

Data Exploration and Preparation

Modeling and Analytics

Automation
- Data Integration
- Application Integration

Continuous Improvement

Target Key KPIs with the Analytics

Measure and Sustain the Benefits

Operational Equipment Effectiveness (OEE)

Availability   Performance   Quality   Costs   Plant level KPIs

Equipment availability | Sheet break reduction | Grade change time reduction | Start-up /recovery improvement | Control loop variability reduction | Product variability reduction | Raw material savings | Energy efficiency improvement   Production level KPIs

Predictive Maintenance   Web Break Analytics   Soft Sensors   APC / MPC   Energy Optimization

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Pulp and Paper Plant

Data sources and systems

Maintenance Systems
HSE Systems
ERP
External Systems

Pulp Mill Controls & Optimization

Energy Management

Production Planning & Measurement

Equipment & Devices

Order Management

Lab Measurement System

In Line Measurement

Web Inspection System
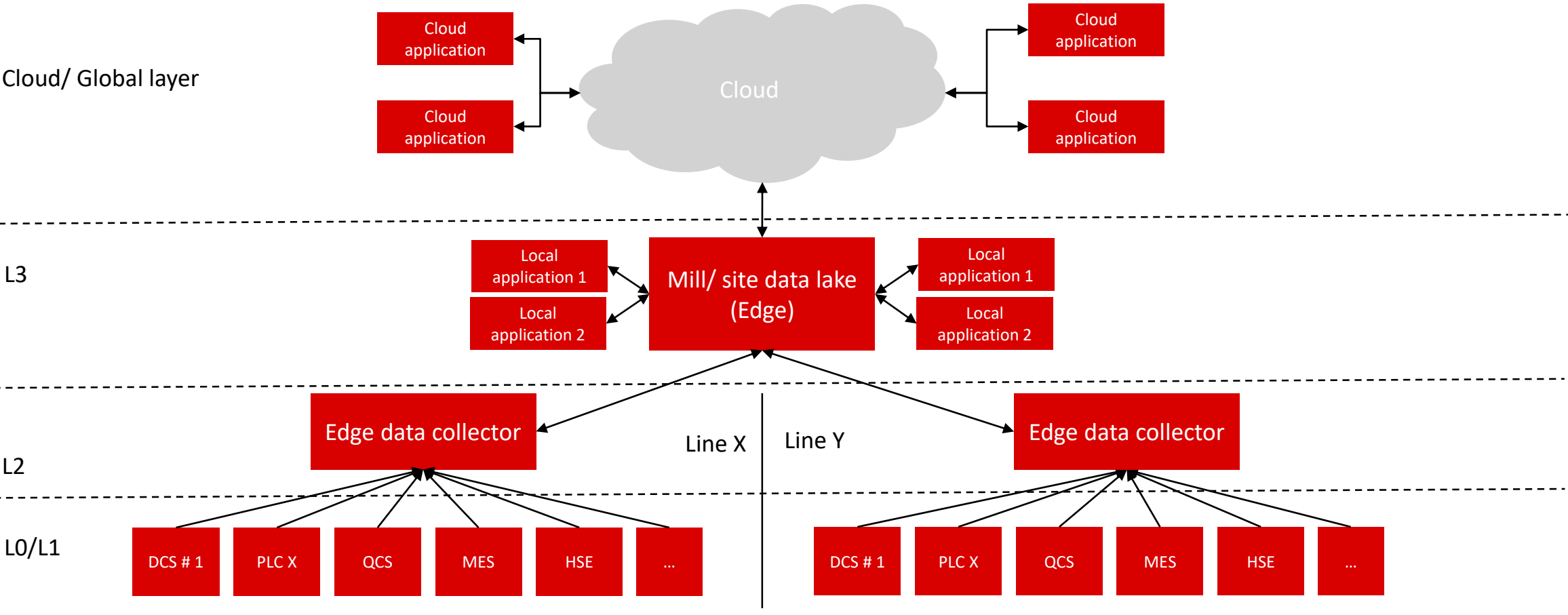
Quality Controls System

Paper Controls & Optimization

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Data Sources and Systems

Typical production data collection landscape
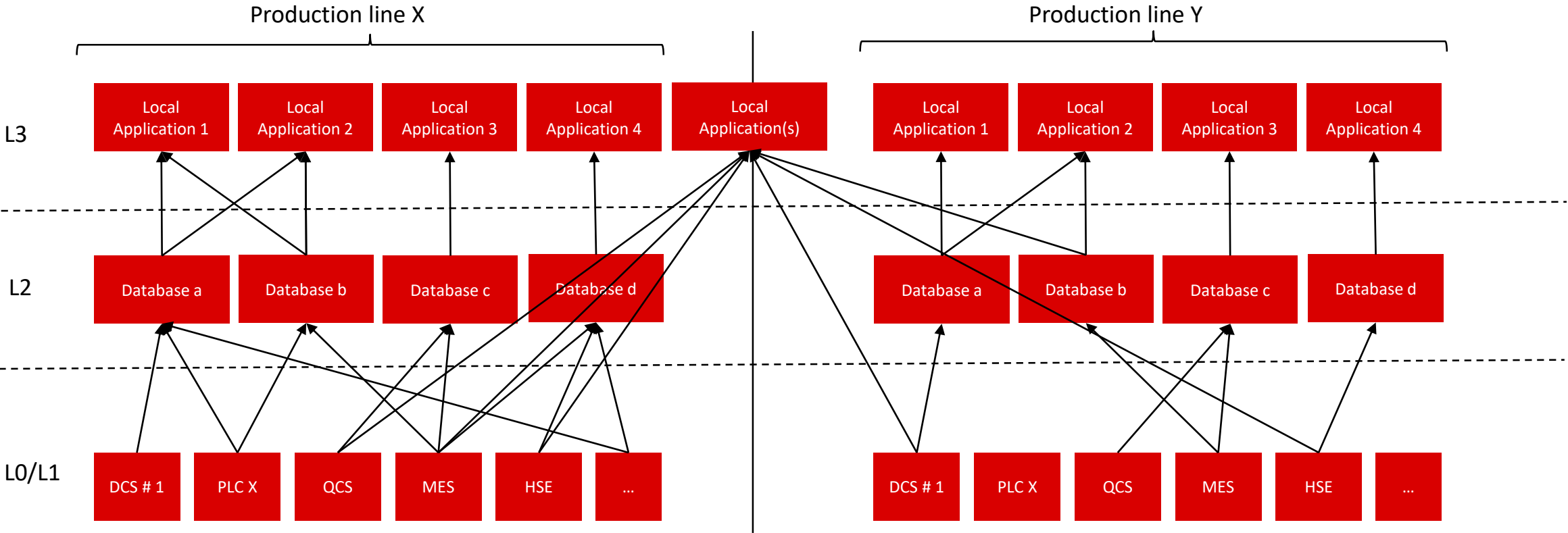
Data Sources and Systems

Managed and Structured Architecture

Cloud/ Global layer

Cloud application

Cloud application

Cloud

Cloud application

Cloud application

L3

Local application 1

Local application 2

Mill/ site data lake (Edge)

Local application 1

Local application 2

L2

Edge data collector

Line X | Line Y

Edge data collector

L0/L1

DCS # 1 | PLC X | QCS | MES | HSE | ...

DCS # 1 | PLC X | QCS | MES | HSE | ...
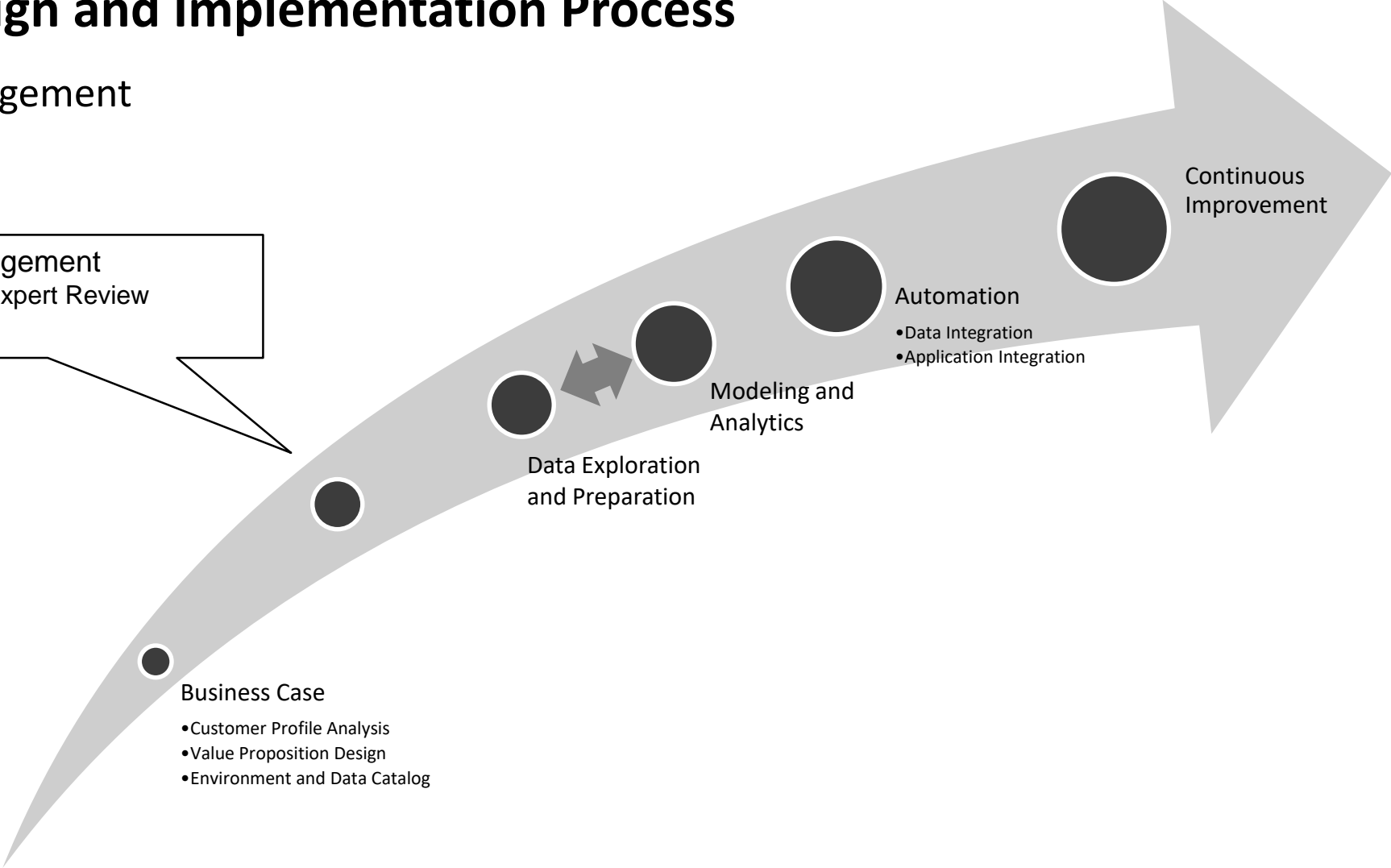
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Analytics Design and Implementation Process

Stakeholder Engagement

Stakeholder Engagement
- Subject Matter Expert Review
- Customer Story

Continuous Improvement

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Value & Design Workshops Help to Define Right Analytical Solutions

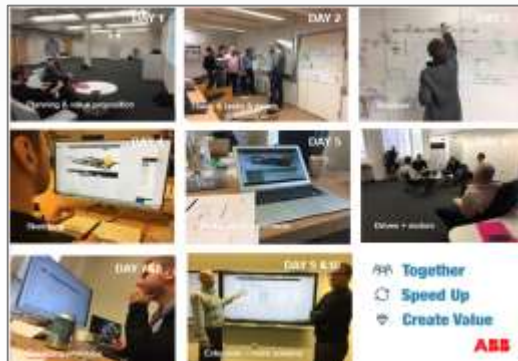| Content of value workshop		Design and define MVP	Start Project

Step 1. Define challenge and engage stakeholders

- Invite different roles
- Define objectives and value proposition
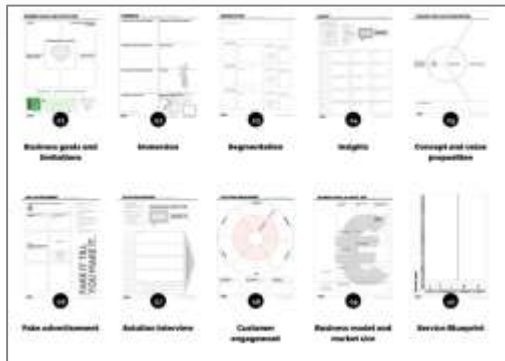
Step 2. Define solution to the issue

- Draft solution with users and SME
- Define data sources and architecture
- Quantify the estimated business value

Step 3. Create design mock-up and use off-line analytics to show fast results

- Create design mock-up to discuss and modify
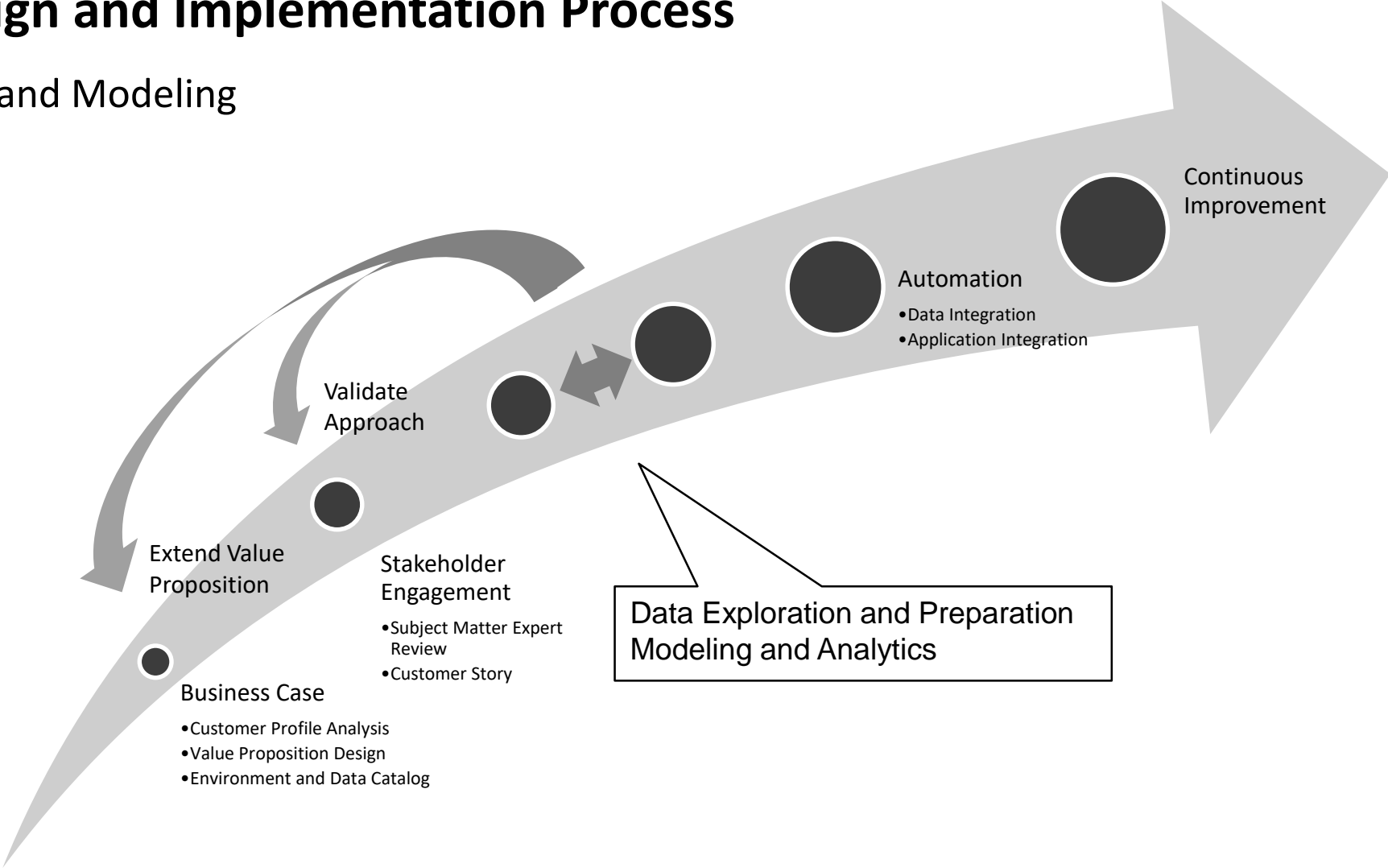- Define MVP (minimum viable product)

Step 4. Validate value & start project

- Validate the MVP together with the stakeholders and make last modifications
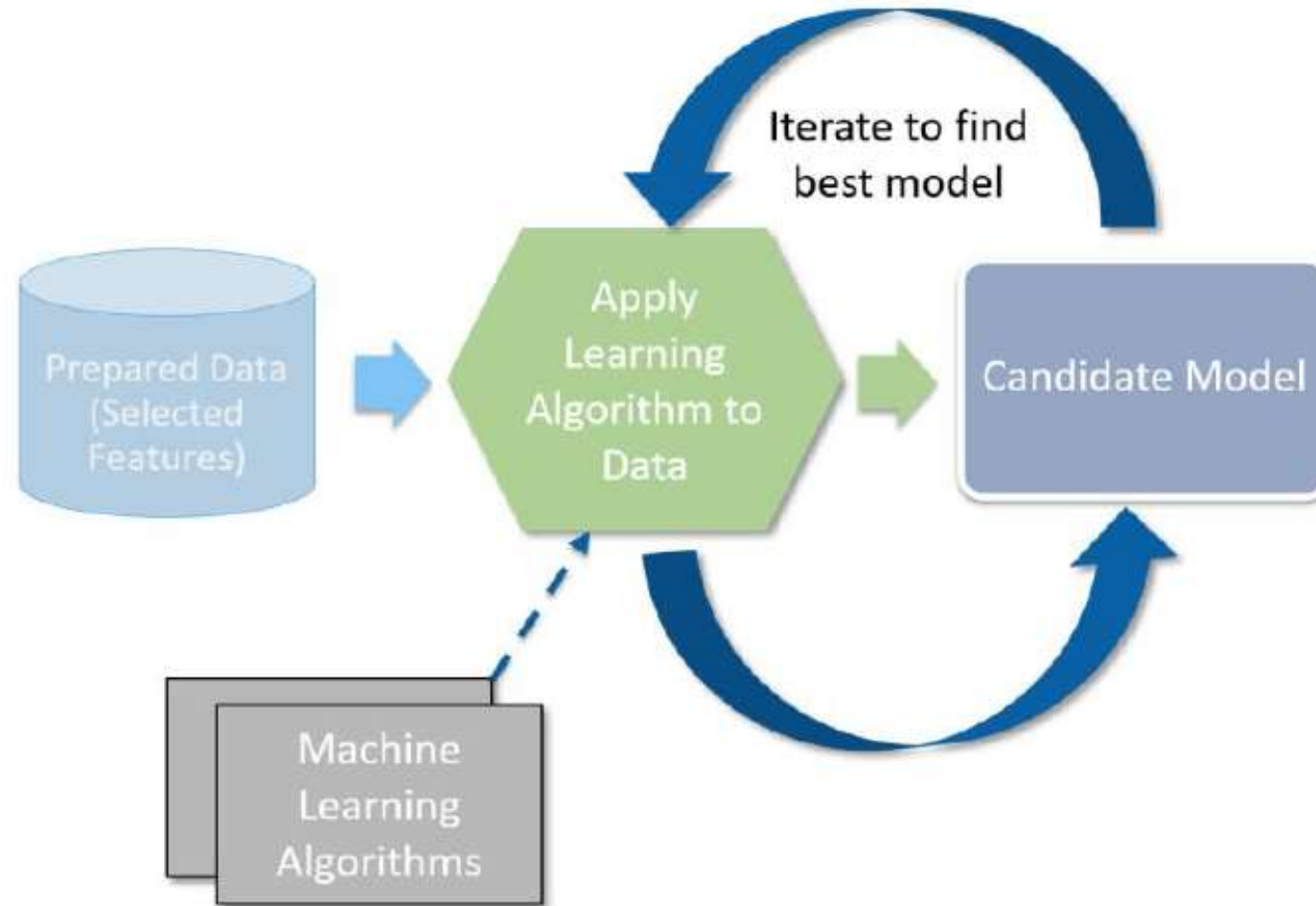- Start a project with agile project framework

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Analytics Design and Implementation Process

Data Exploration and Modeling

Continuous
Improvement

Automation
- Data Integration
- Application Integration

Validate
Approach

Extend Value
Proposition

Stakeholder
Engagement
- Subject Matter Expert
  Review
- Customer Story

Data Exploration and Preparation
Modeling and Analytics

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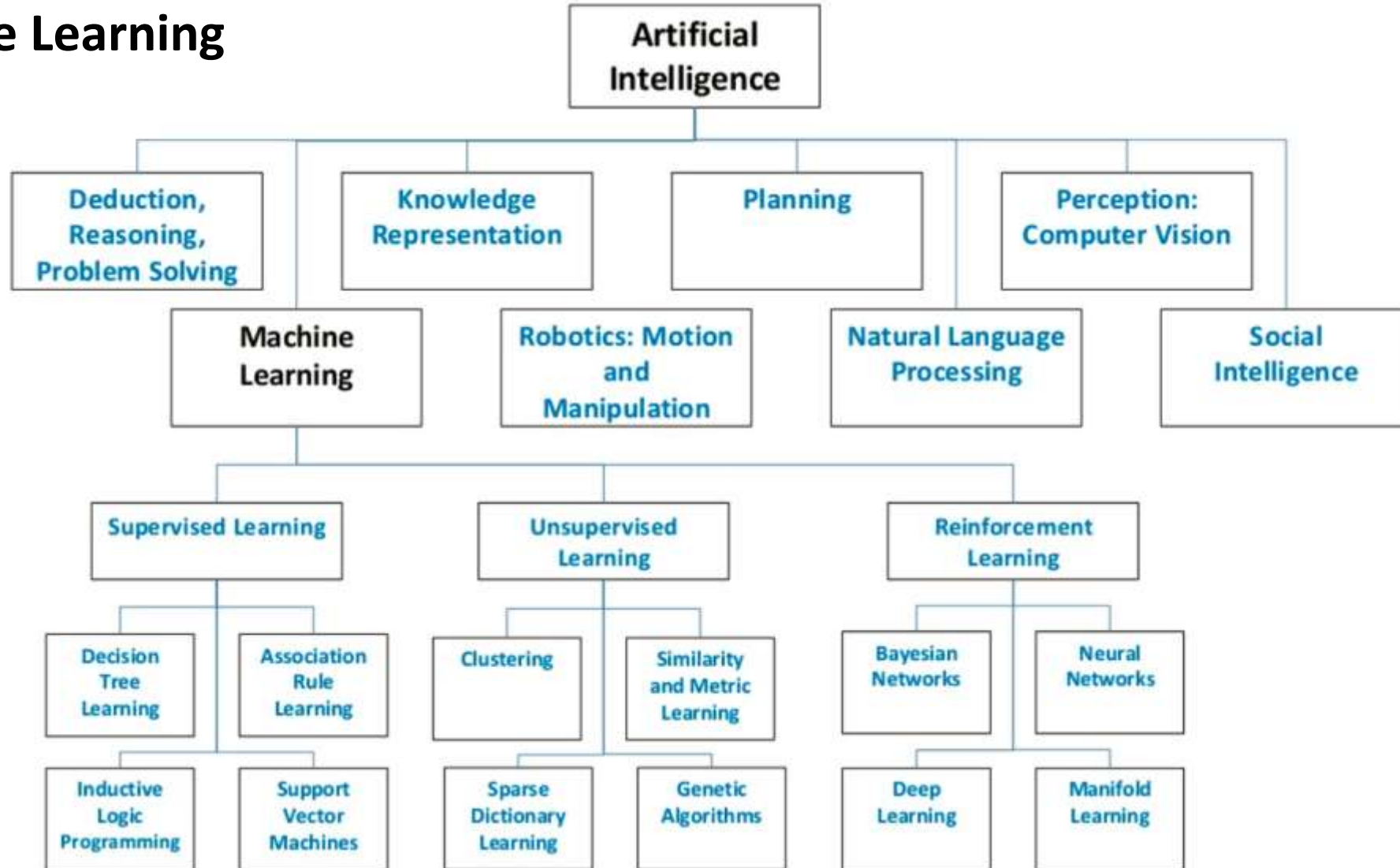- Environment and Data Catalog

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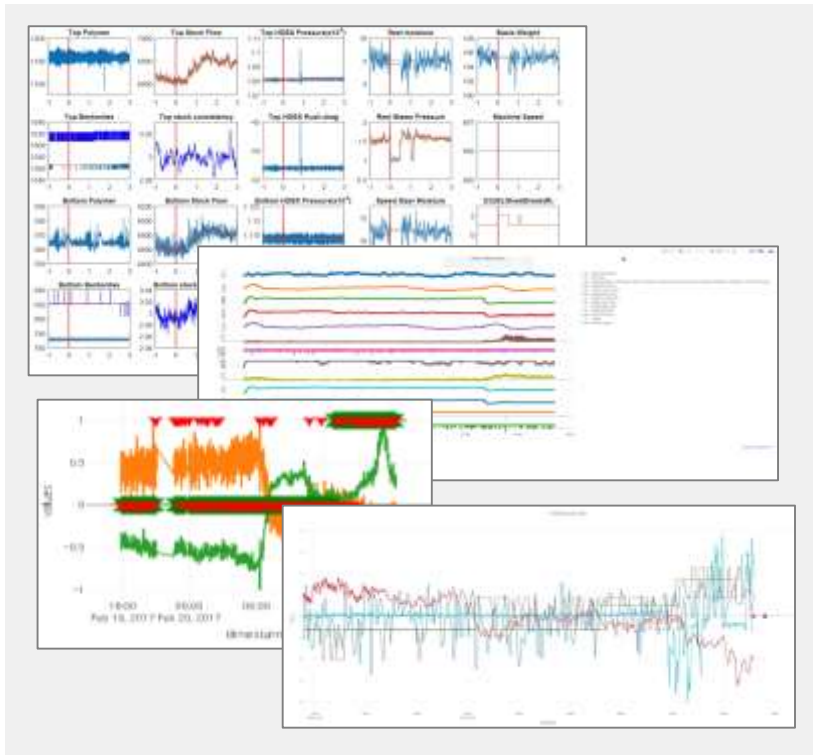# Data-driven Model Building Process

AI / Machine Learning

Algorithms

Web Break Analytics - Description, Prediction & Prevention

- **Data sources.** Drives, QCS, WIS, Quality, Mechanical, Automation, Soft sensors…
- **Other dimensions.** Paper grade / grade change, hour of day, operator at work, break location, raw materials, maintenance logs…

Outputs

User Interface

Web Break Analytics

Real Time Web Break Prediction

Time to Web Break

Web Break Characterization
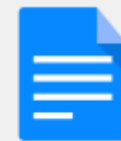
Web Break Prescriptive Analysis

Machine Learning Models
- Anomaly Detection
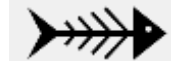- Predictive Models
- Root cause characterization
- Rule Generation

Operator Feedback loop

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Analytics Design and Implementation Process

Automation

Continuous
Improvement

Modeling and
Analytics

Data Exploration
and Preparation

Automation
- Data Integration
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Stakeholder
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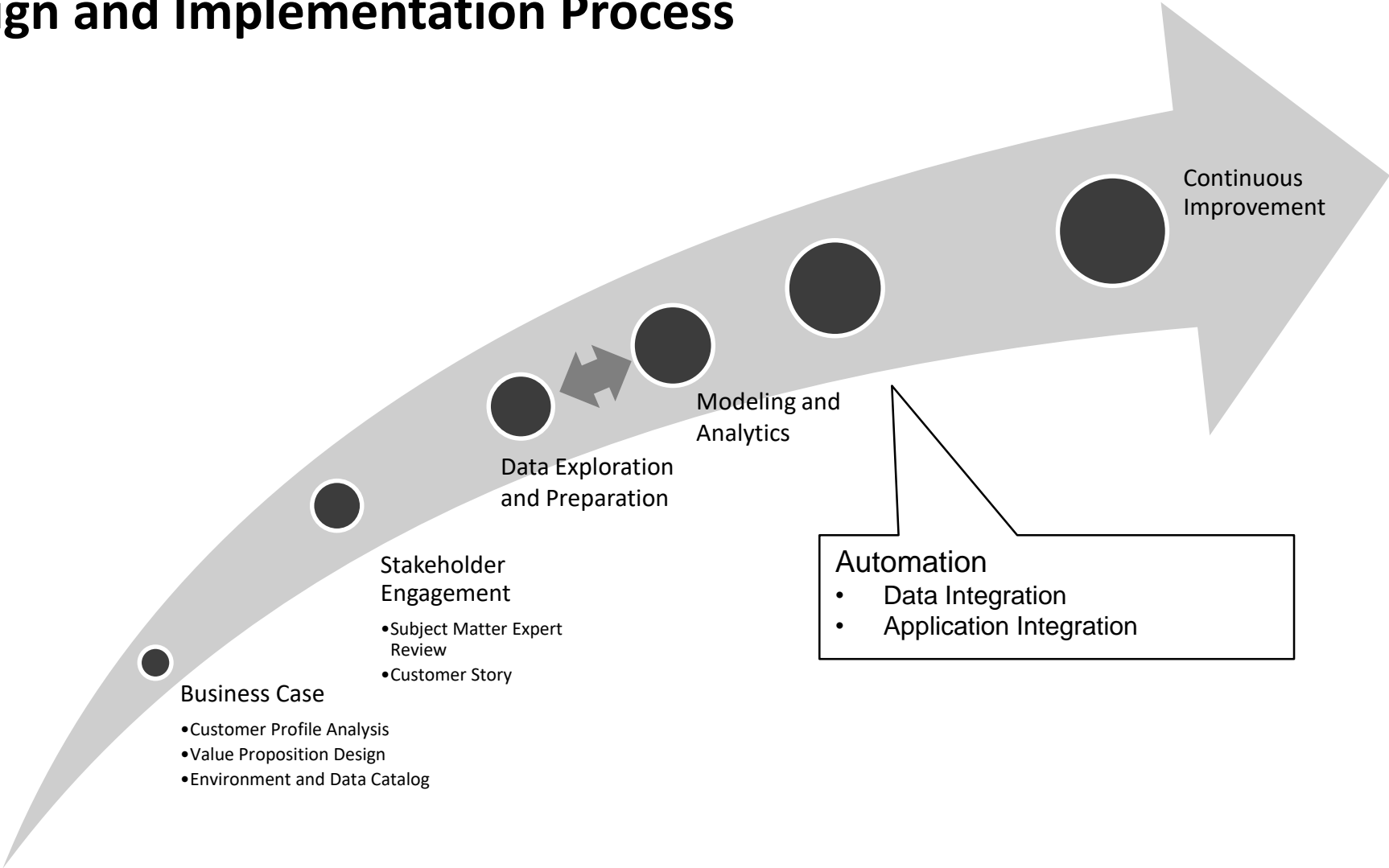
Response Time Horizon vs Deployment Options

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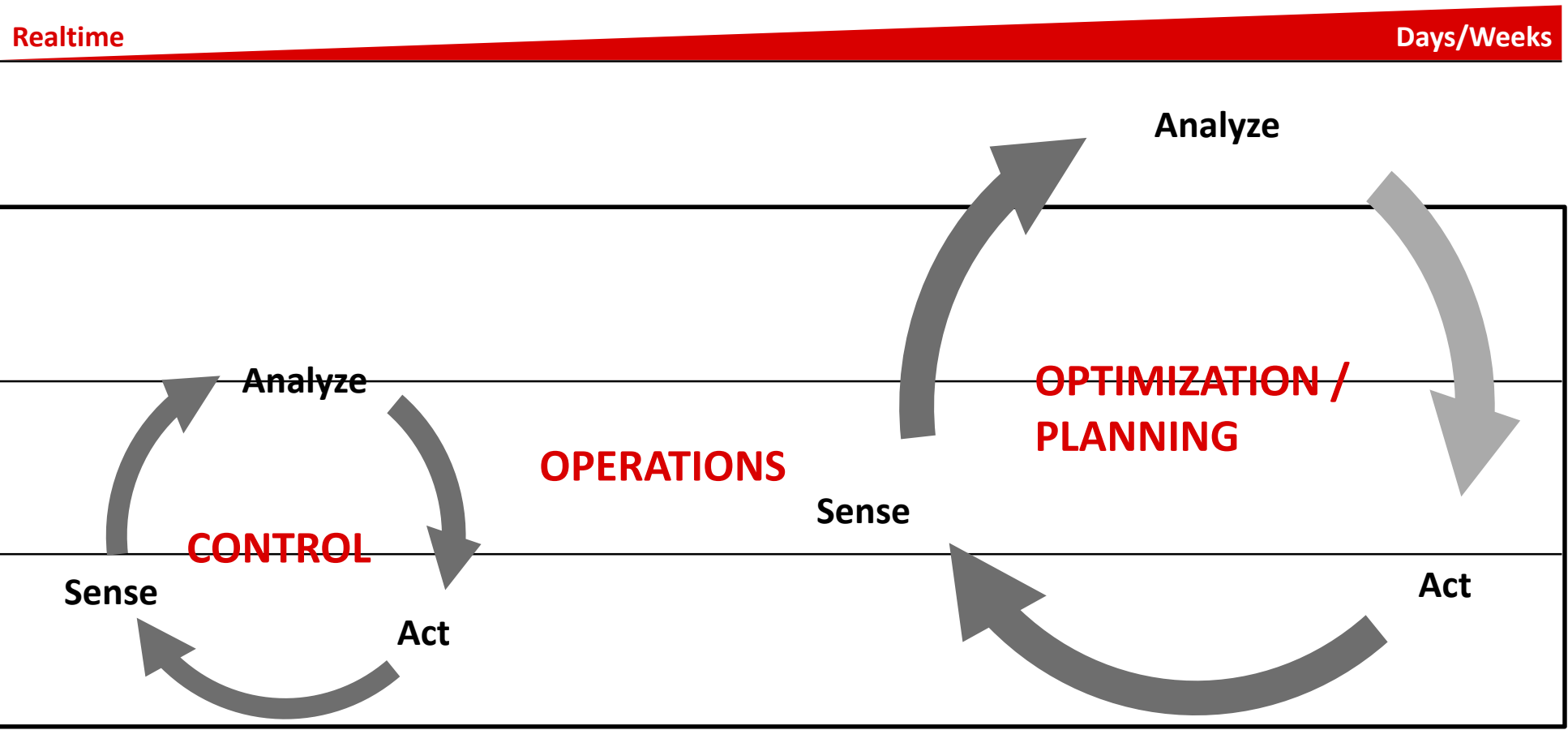
Analytics Deployment Considerations

Evaluation Criteria	Analytics Location		
	Plant	Enterprise	Cloud
Analysis Scope			
Single Site	✓	✓	✓
Multi-Site		✓	✓
Multi-Customer			✓
Time Horizon			
Control Loop	✓		
Human Decision	✓	✓	✓
Planning Horizon	✓	✓	✓
...			

Other criteria: Network reliability, Bandwidth, Scalability, Information security, Accessibility etc

"Analytics Framework", Industrial Internet Consortium (2017).
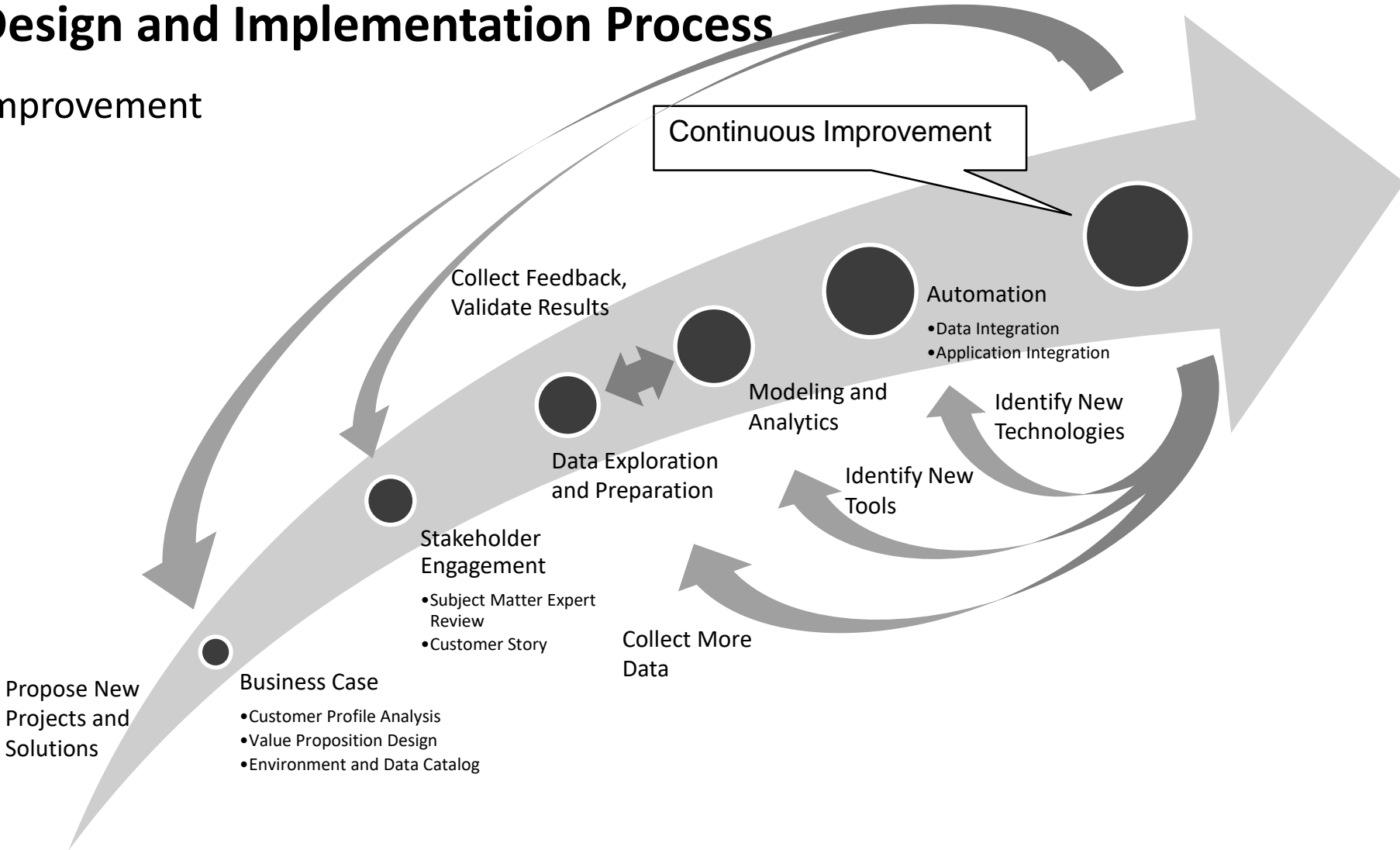
Analytics Design and Implementation Process

Continuous Improvement

Continuous Improvement

Collect Feedback,
Validate Results

Automation
- Data Integration
- Application Integration

Modeling and
Analytics

Identify New
Technologies

Data Exploration
and Preparation

Identify New
Tools

Stakeholder
Engagement
- Subject Matter Expert
  Review
- Customer Story

Collect More
Data

Propose New
Projects and
Solutions

Business Case
- Customer Profile Analysis
- Value Proposition Design
- Environment and Data Catalog

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"Analytics Framework", Industrial Internet Consortium (2017).

System Characteristics Related to Analytics

Crosscutting Concerns

Safety

Design industrial analytics processes and computations to prevent unintended operation and independently validate that the resulting actions do not harm life or property.

Security

Provide defense in depth so that if a malicious or un-intended action compromises one security or accountability measure then another measure still guards the assets.

Data Management

Common across tiers and accessible using a federated information model that supports search, classification and markup to enable rapid industrial analytics application development. Data ownership rights need careful considerations.

Connectivity

Distributed architecture requires connectivity between components, not only between collocated processes but also across wide-area and global networks.

"Analytics Framework", Industrial Internet Consortium (2017).

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Creating Value from Data with Industrial Analytics
Much more than just technical algorithms and AI

Data is an asset
Invest and manage your asset

Remove silos
Data, organizational, people

Mindset
Thinking, attitudes, habits, co-operation,

Processes
Lean, Agile, cross site teams, value chains, business processes

Competence
Competence development, technologies, algorithms

Partnering
Partnerships, co-creation, ecosystems

Safe & Secure
Physical Security, Access management, data and network security,

Value from Data
Data driven decision making and management

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