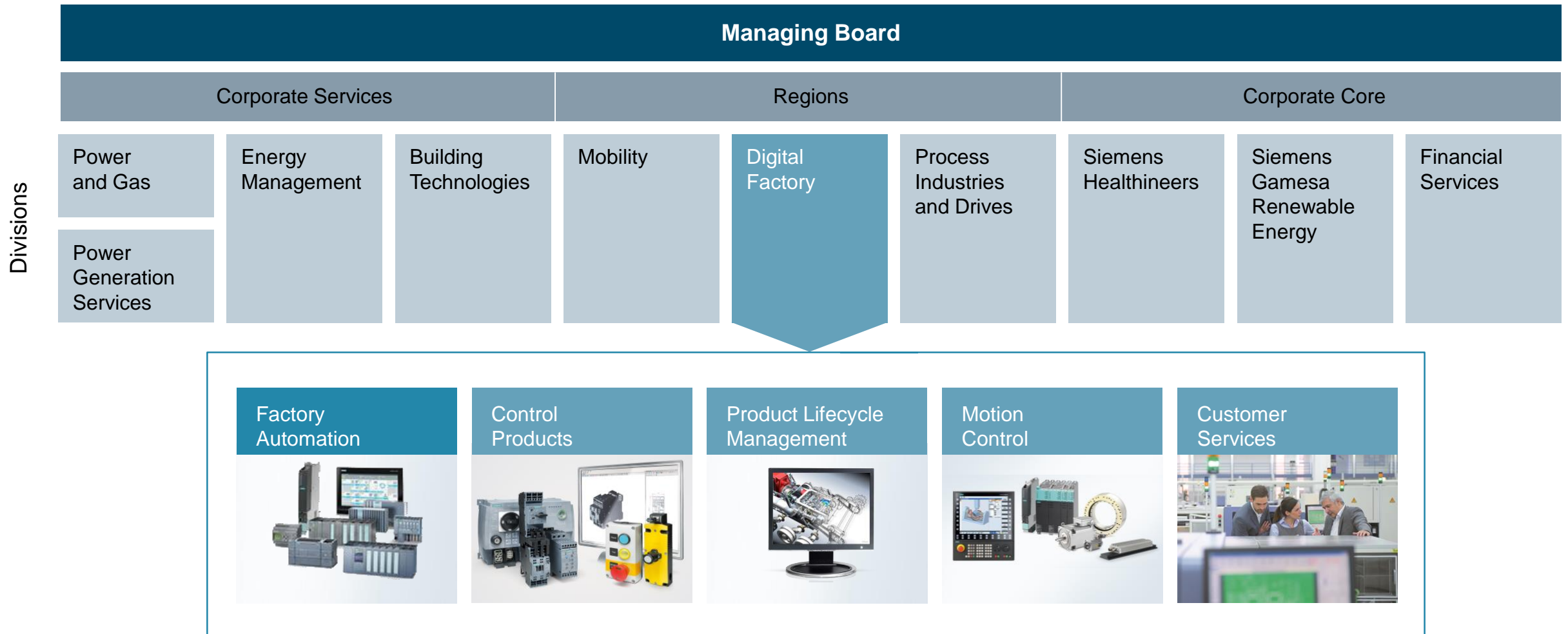


Predictive Quality in Electronics Manufacturing



Siemens corporate structure



Excellence in manufacturing – For our customers



Our Mission

”Be the Role Model for Excellence in Manufacturing to provide proven Value Add for our Customers and Business Unit, based on the methods of Digital Enterprise and Lean Industrial Engineering”

Shape the Digital Future. Together.

Dr. Gunter Beitinger, Vice President Manufacturing



Evaluate new Business models



Shorten time to market



Increase Flexibility



Improve Quality



Boost Efficiency



Increase Security

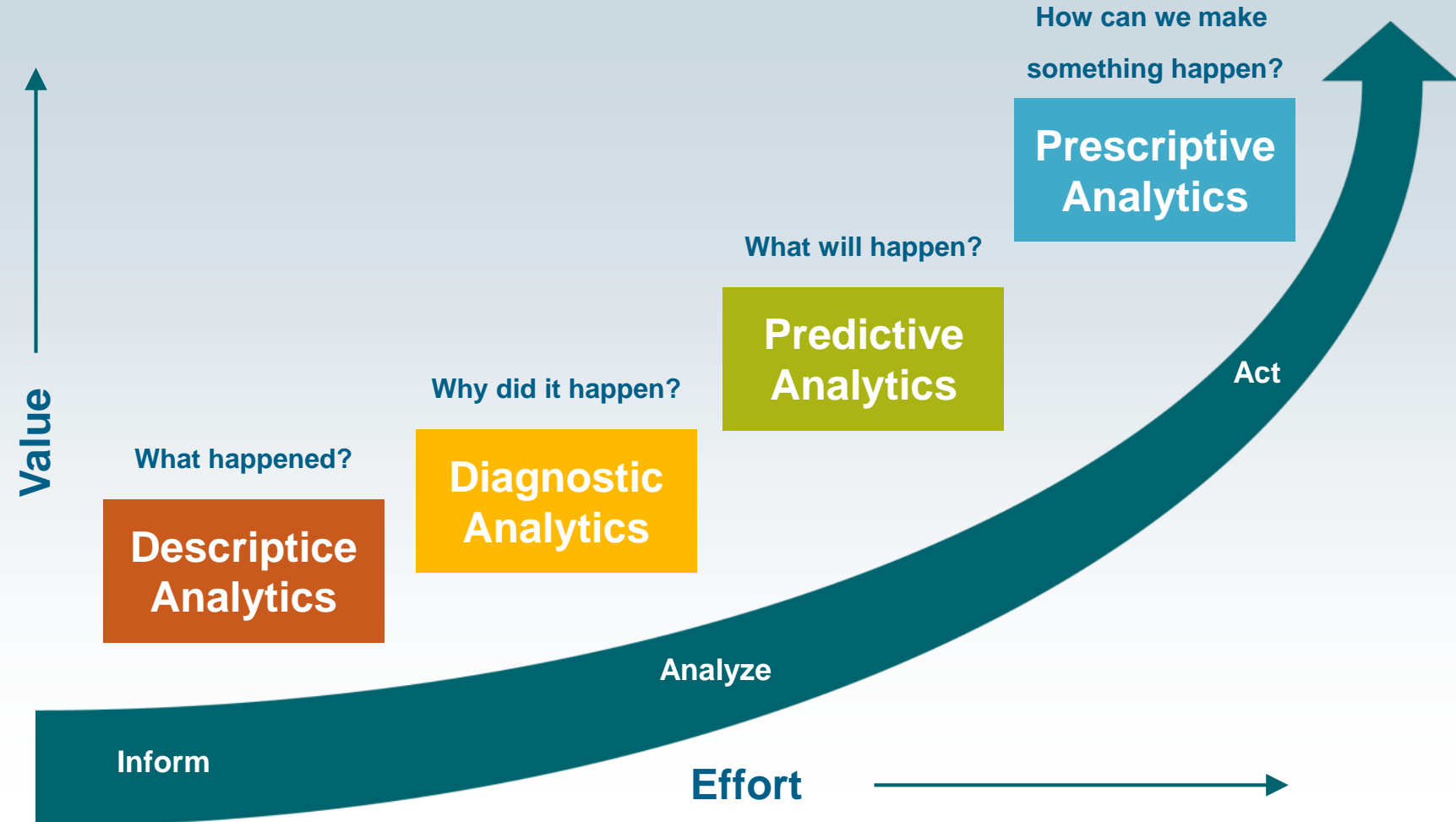
Our Locations



Advanced data analytics as a key enabler to optimize our processes

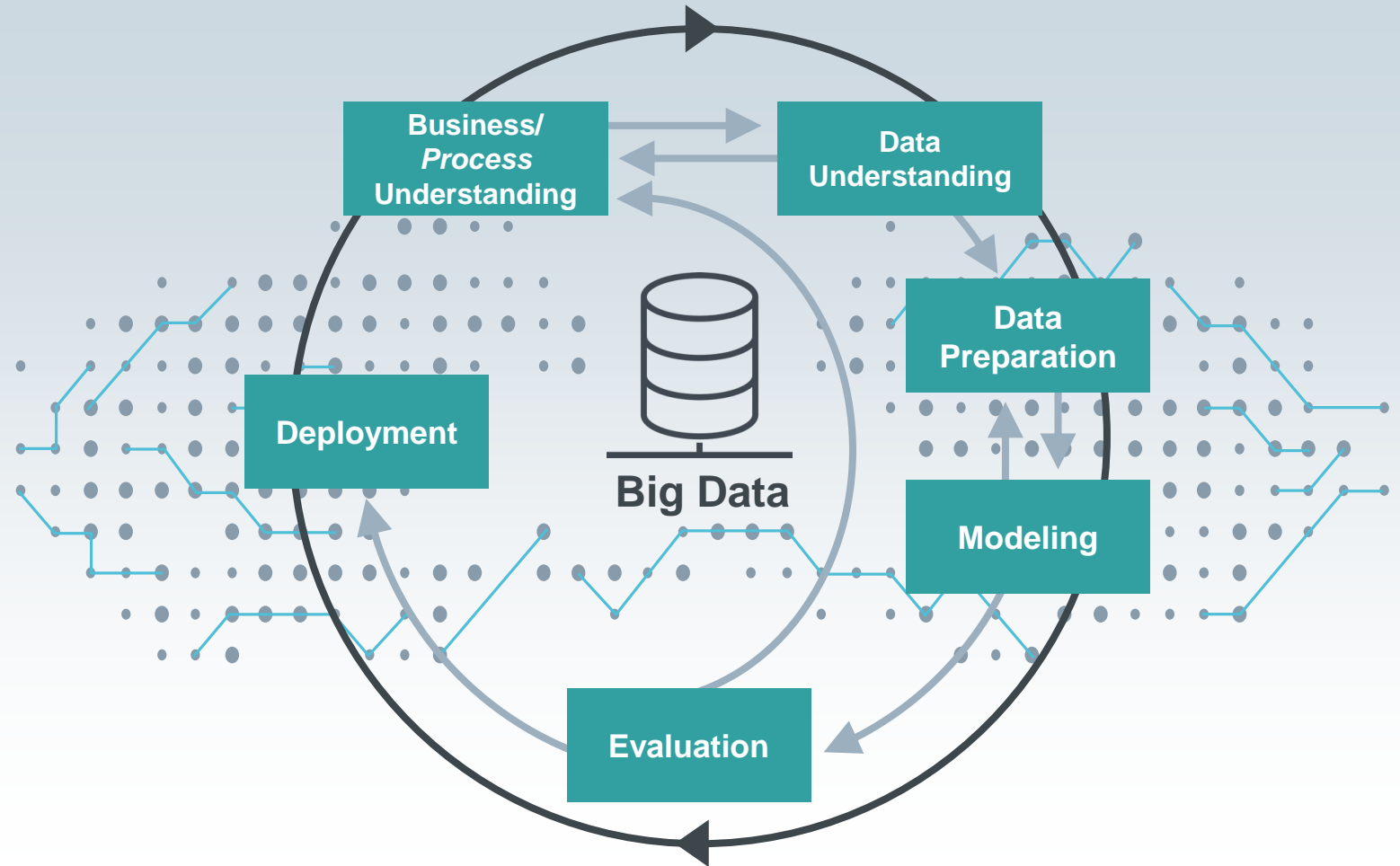
„Predictive Analytics uses Big Data to analyze past patterns and predict the future“

Gartner



CRISP-DM¹ as the preferred approach for our advanced data analytics projects

To get the best results make sure to include process domain know-how!

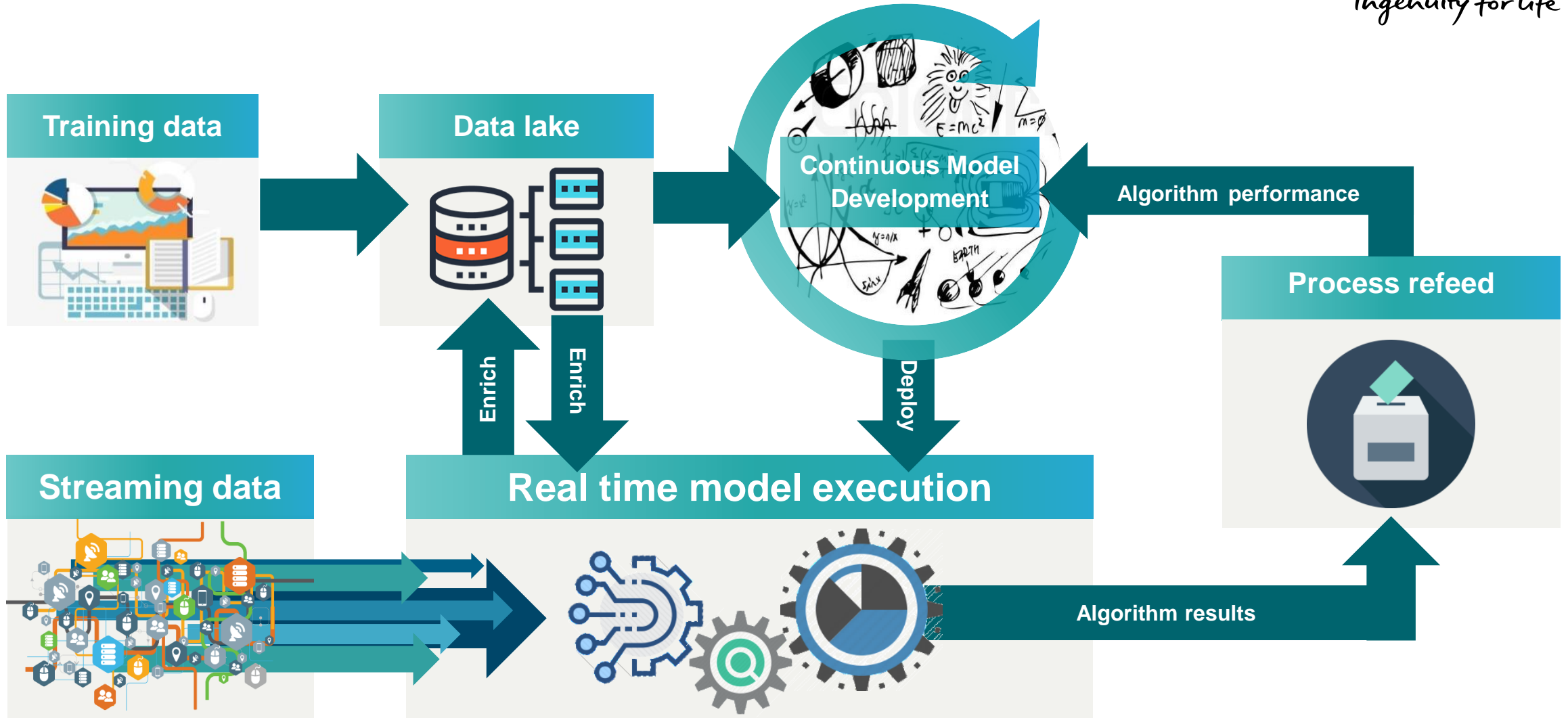


¹ **CRISP-DM: Cross Industry Standard Process for Data Mining**


**„Predictive Analytics
requires both domain
and scientific know
how!“**



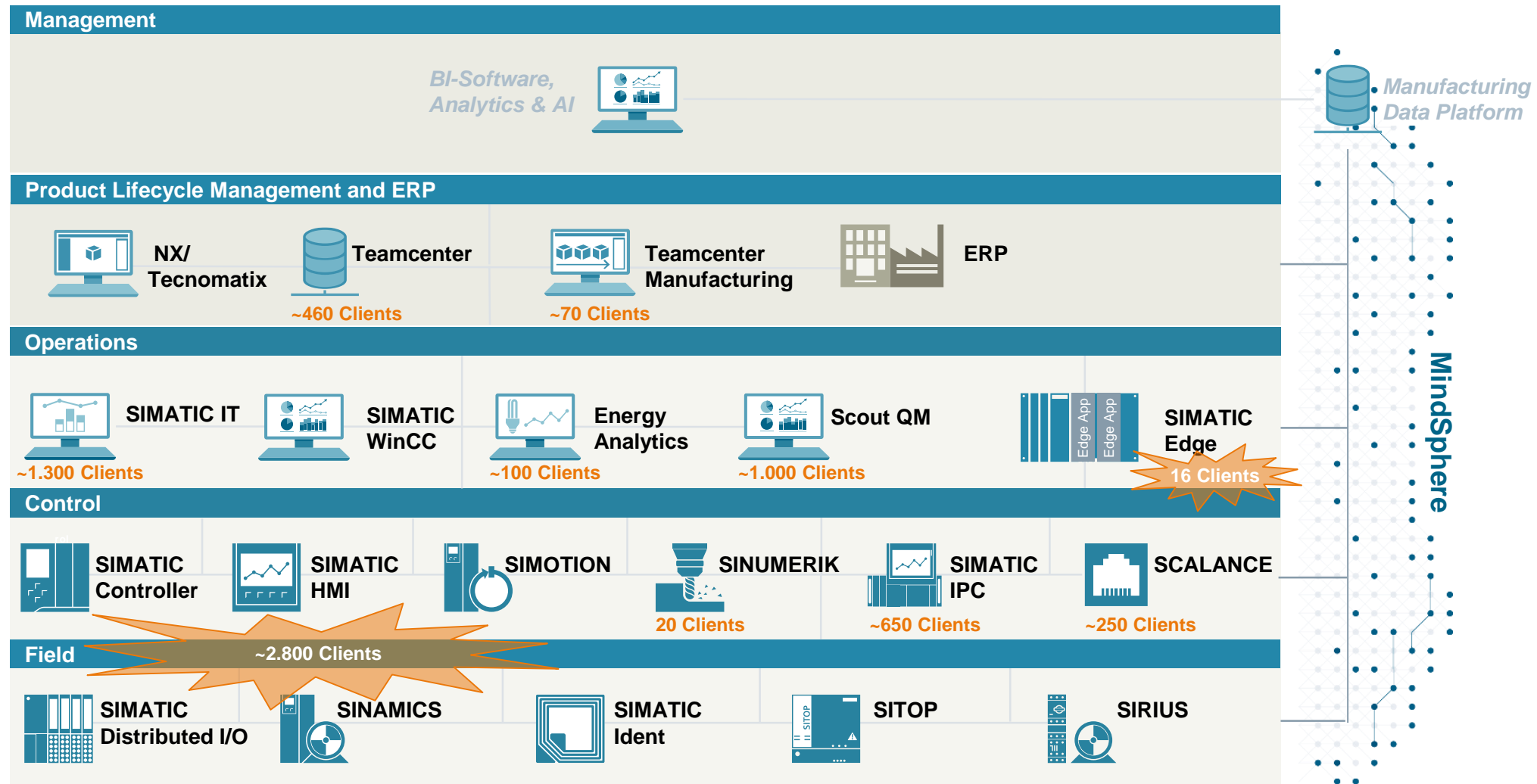
A digital factory needs an analytics eco system



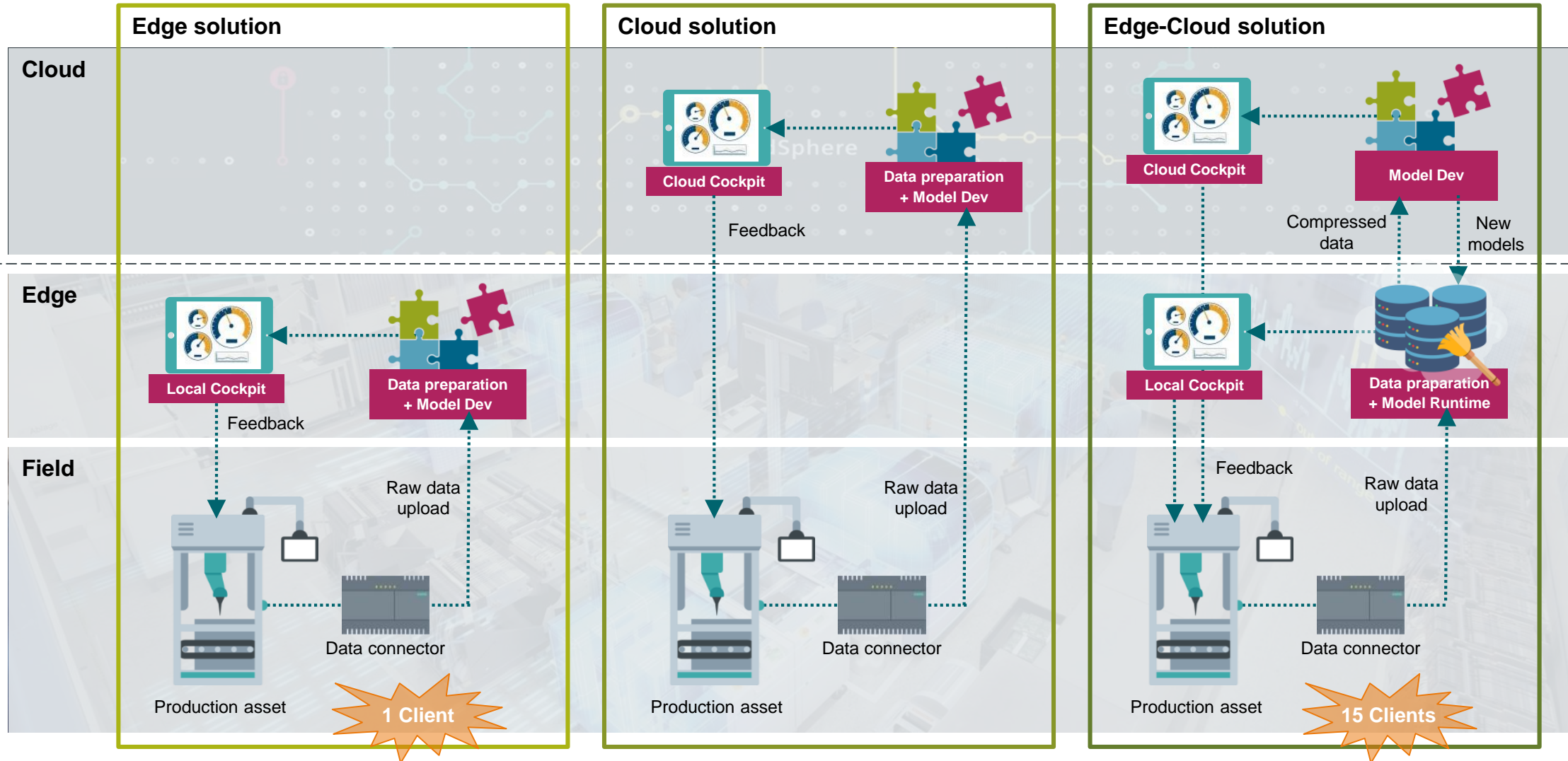
„One of the biggest challenges is to build up an analytics ecosystem!“



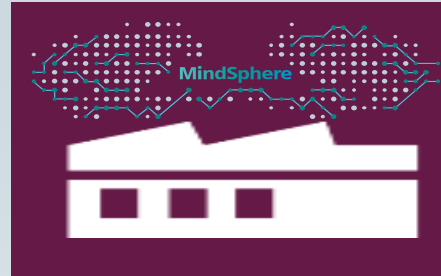
Actual EWA IT-architecture already covers a large portion of desired Lean Digital Factory blueprint



An edge-based system combines the benefits of a pure local and pure cloud solution



Hot topics for advanced data analytics in manufacturing environment



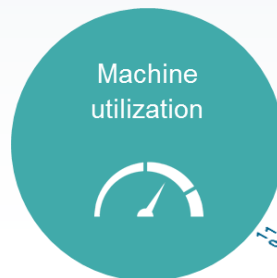
Manufacturing

“How to improve quality level while reducing test effort?”



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“How to achieve one-piece-flow while maximizing utilization?”



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“How to increase uptime while minimizing maintenance costs?”



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“How to stabilize processes while lowering control effort?”



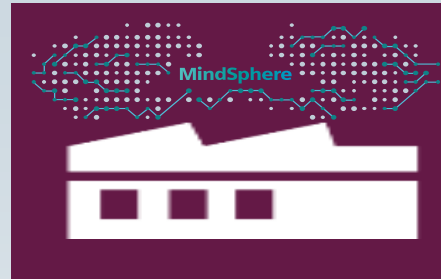
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“How to improve collaboration while reducing communication?”



1000011
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Three use cases for advanced data analytics in manufacturing



Manufacturing

“How to improve our quality level while reducing our test effort?”

Quality Improvement



“How to achieve one-piece-flow while increasing machine utilization?”

Machine utilization



“How to increase machine uptime while reducing maintenance costs?”

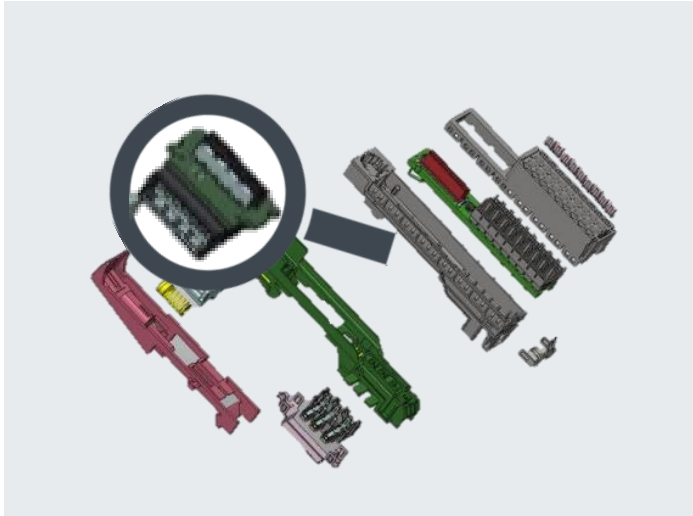
Predictive Maintenance



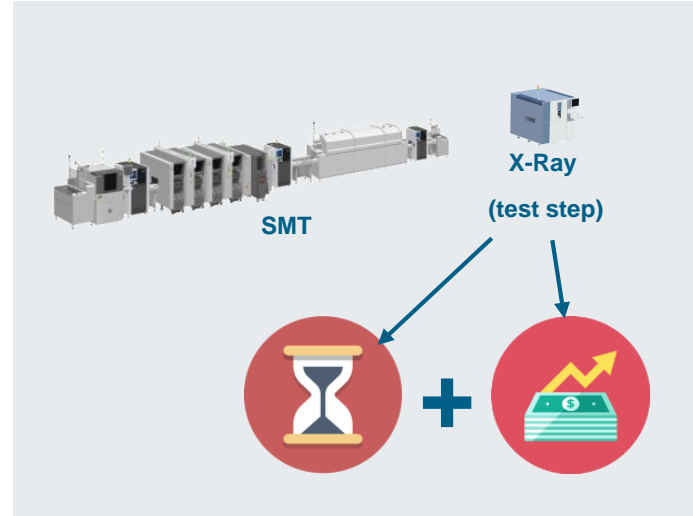
Advanced data analytics reduces test effort significantly



SIEMENS
Ingenuity for life

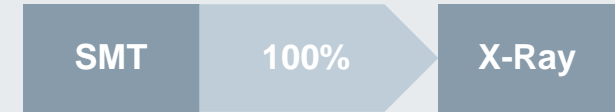


Objective: Connector PCB¹ of a distributed I/O



Problem: X-Ray test is a time and cost intensive work step

Today:



Future:



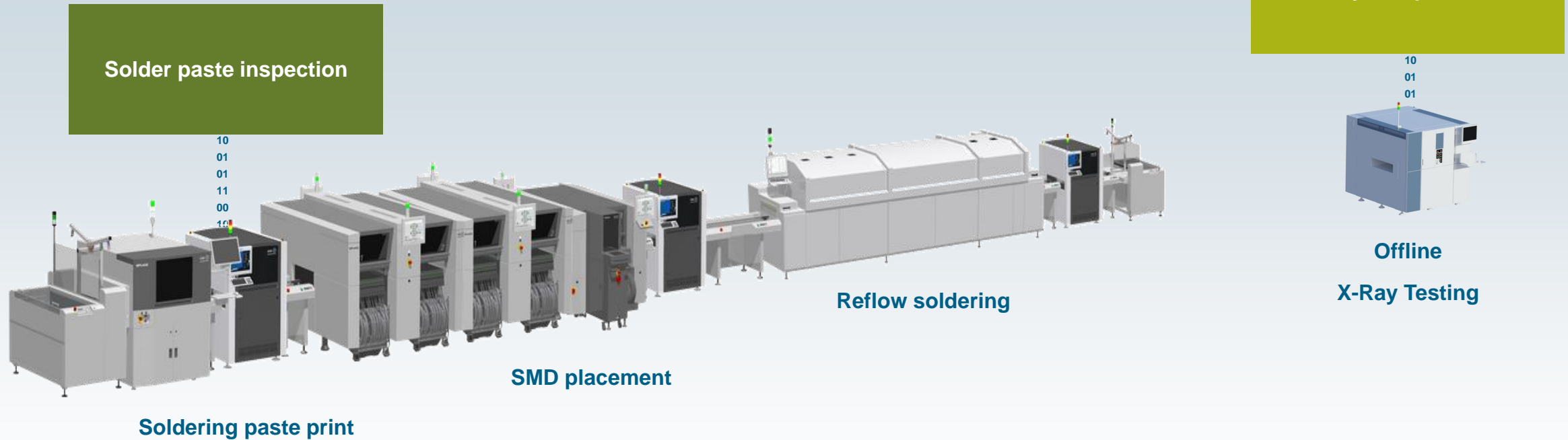
Target: Evaluate quality prediction model to reduce X-Ray test effort

¹ **PCB**: Printed Circuit Board

Inspection data and X-Ray test data are used to create a prediction model for product quality



SIEMENS
Ingenuity for life



Model inputs: 52Mio datasets with very high Process Quality of 7dpm¹
Model requirements: Optimize test slip (Bad products are labeled as good)

¹ dpm: Defects per million

X-Ray testing effort can be reduced from 100% to at least 70%



Next steps

- Further data model validation
- Adapt algorithm to new product
- Implement automatic data collection and prediction model

| Slip-optimized model | | True result | |
|----------------------|--------|-------------|----------|
| | | n.i.O. | i.O. |
| Prediction | n.i.O. | 135 | 18373464 |
| | i.O. | 0 | 8378038 |
| Class Recall | | 1.0 | 31,32% |

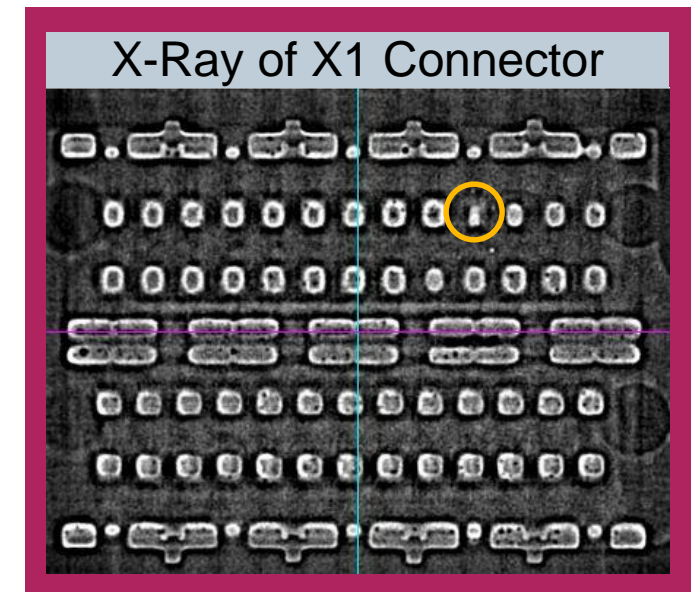
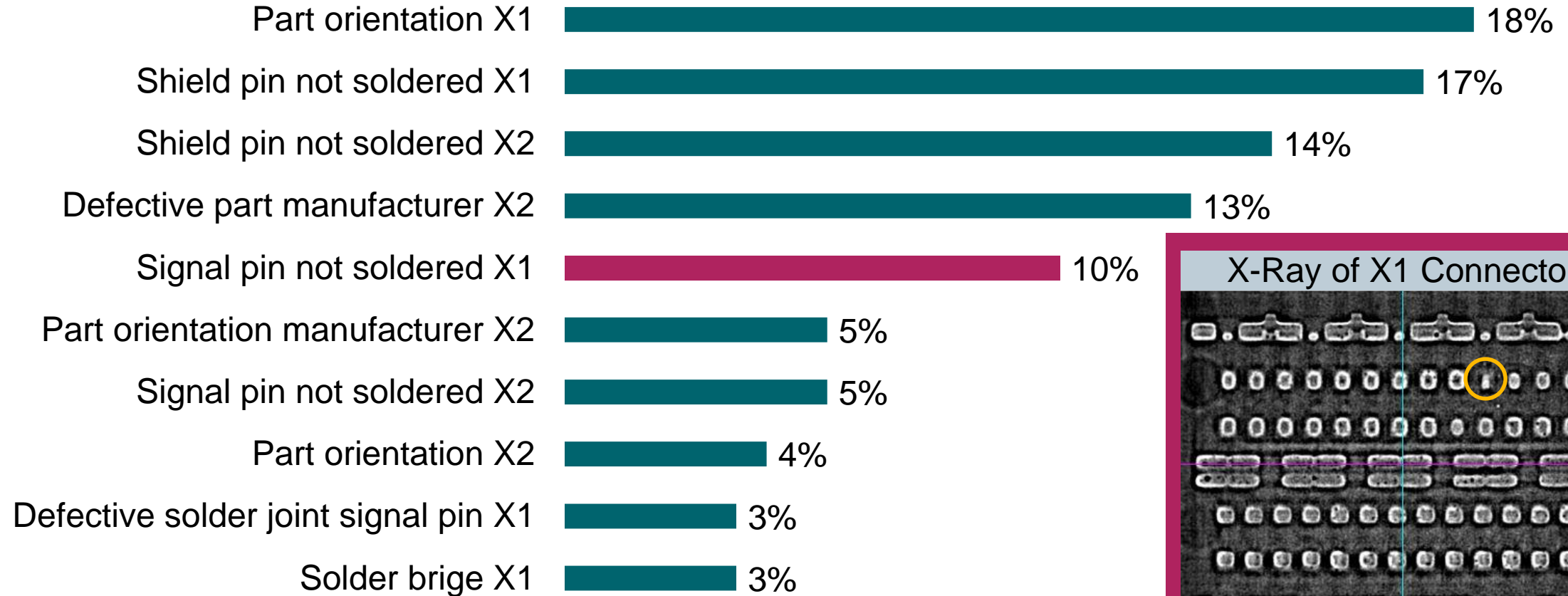
Slip

less x-Ray tests needed!

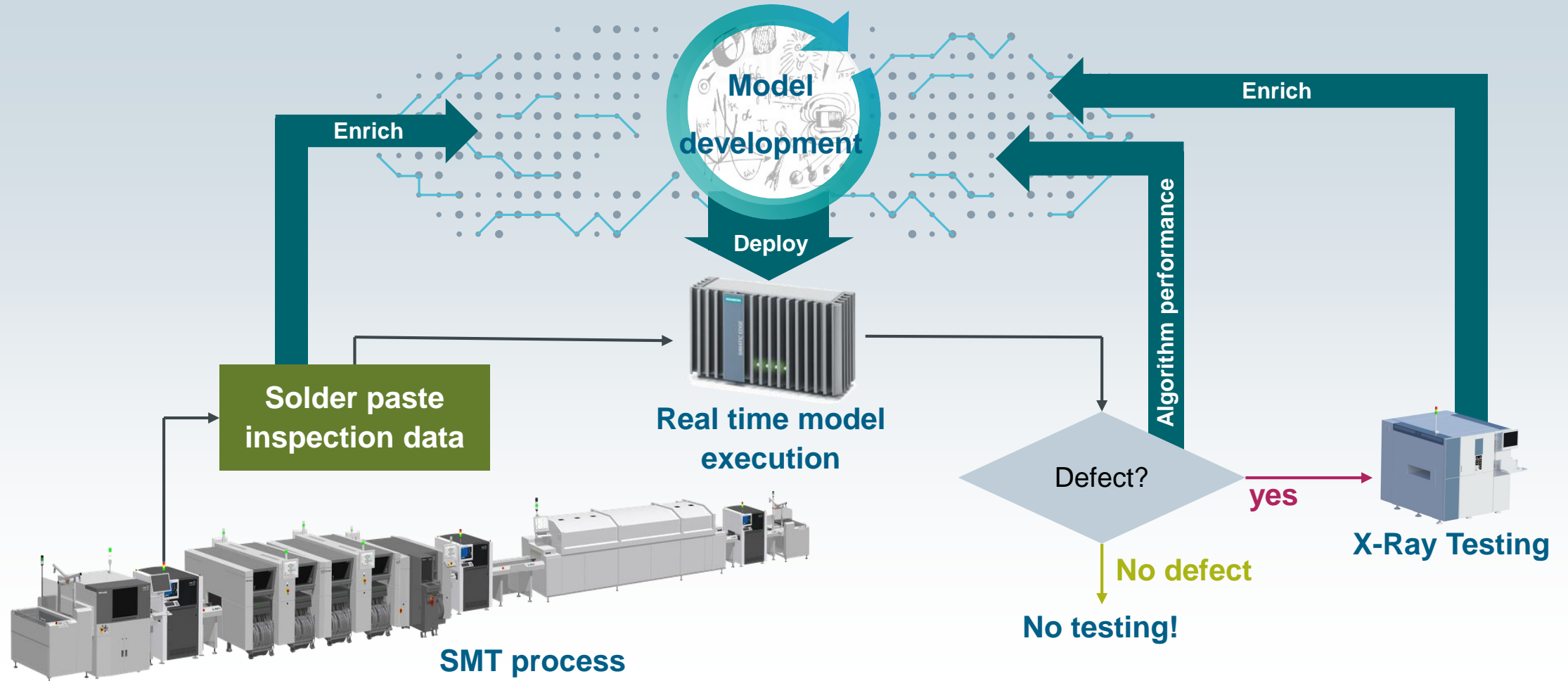
Target: Minimize slip

Current best data analytic process:
Gradient Boosted Trees + MetaCost (0 / 10 / 100 / 0)
+ Undersampling mit 1.000 i.O. w/o shielding pins

Most common error types in base unit production detected by X-Ray testing



The X-Ray system setup according to our analytics eco-system

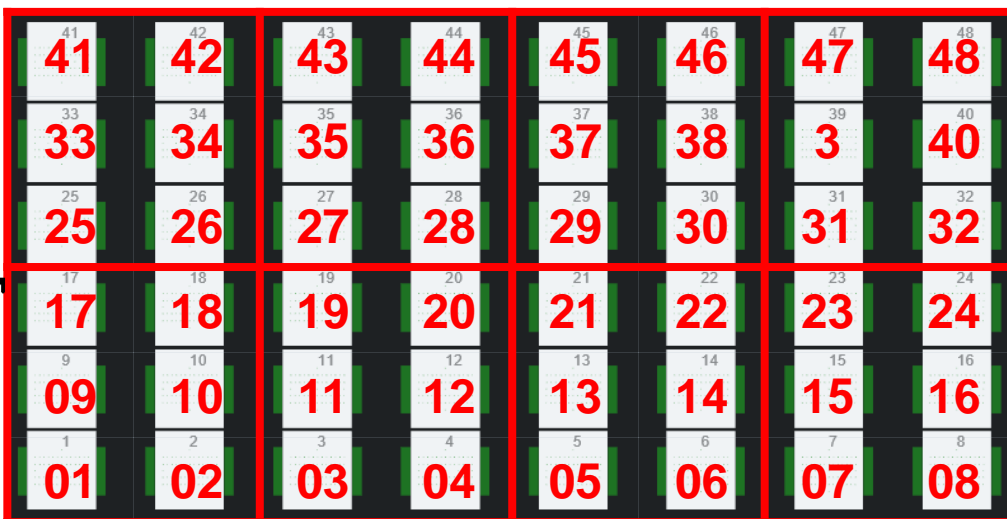


The panel for SMT production consists of 48 boards and is double-sided assembled



Bottom – connector X2

- 48 Boards per panel
- 52 Pins per board_X2
- 2496 Pins per panel_X2
- 8 Field of views



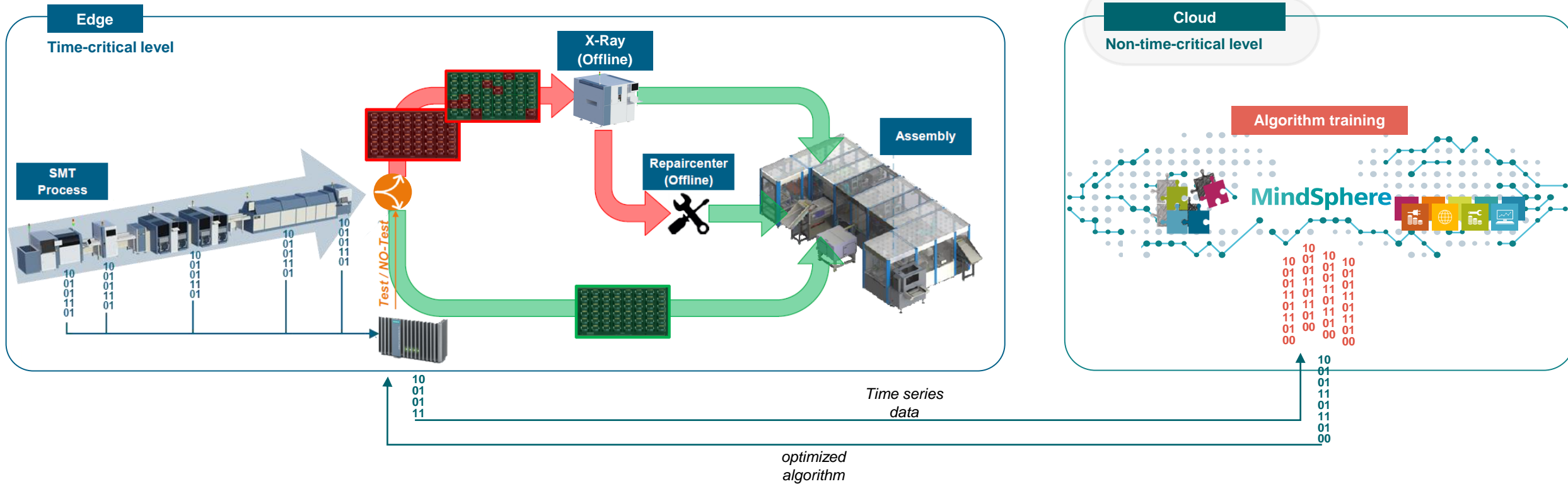
Top – connector X1

- 48 Boards per panel
- 79 Pins per board_X1
- 3792 Pins per panel_X1
- 8 Field of views

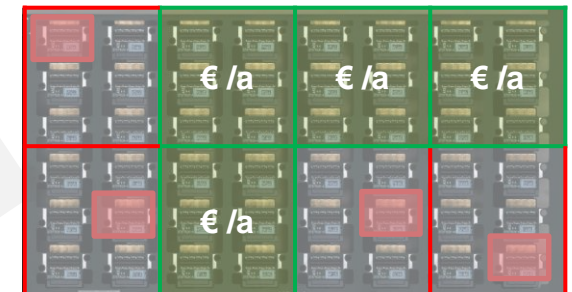
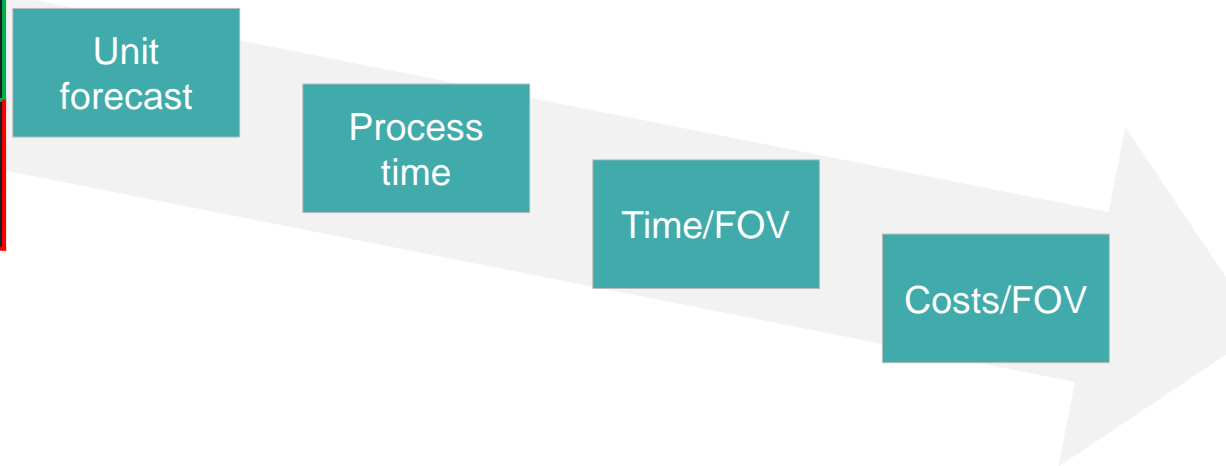
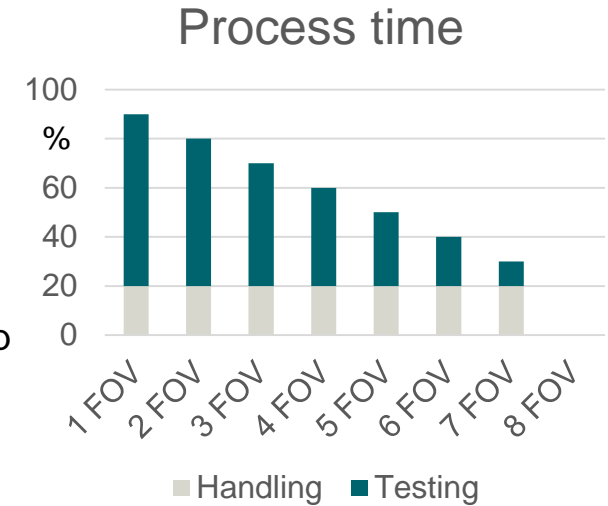
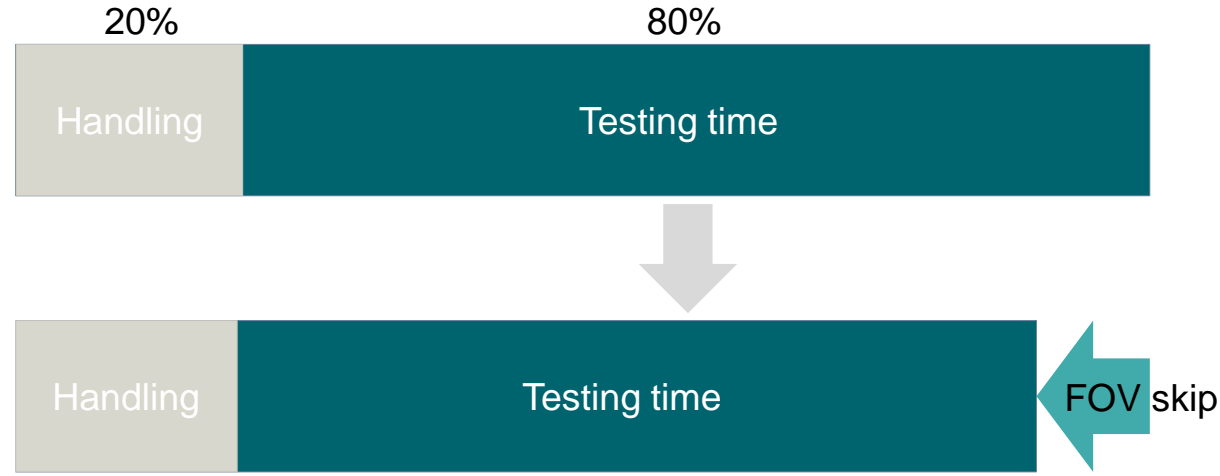
Alternative routing of the printed circuit board depending on the label of the algorithm



- Scenario 1) All boards of the panel are predicted as good quality
- Scenario 2) All boards of the panel are predicted as poor quality
- Scenario 3) Some boards of the panel are predicted as good / poor quality



Dynamic X-Ray testing enables additional productivity



AI minimizes
necessary X-RAY
tests by currently 30%

Target for the future is

100%

While maintaining the
high Quality rate of

100%

Resulting in reduced
capital invest for
further X-RAY
machines of

500k€

// TIA Portal Openness

devices Where(device -> device.Subtype)
Select(device -> device.DeviceItems)
(deviceItems -> device)
(From: Target: 0)



Thank you for your attention