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Erich Eichinger
Lead Architect

Valentin Zickner
Solution Architect

React intelligently:
How to supervise processes with production data

Vom Sensor zum Workflow und zurück:
Wie die Kombination von Prozessautomatisierung und IIoT neue Möglichkeiten für die Industrie 4.0 eröffnet

13th July 2023

1. Introduction

2. Potential and Use Cases

3. Factory Model Demo

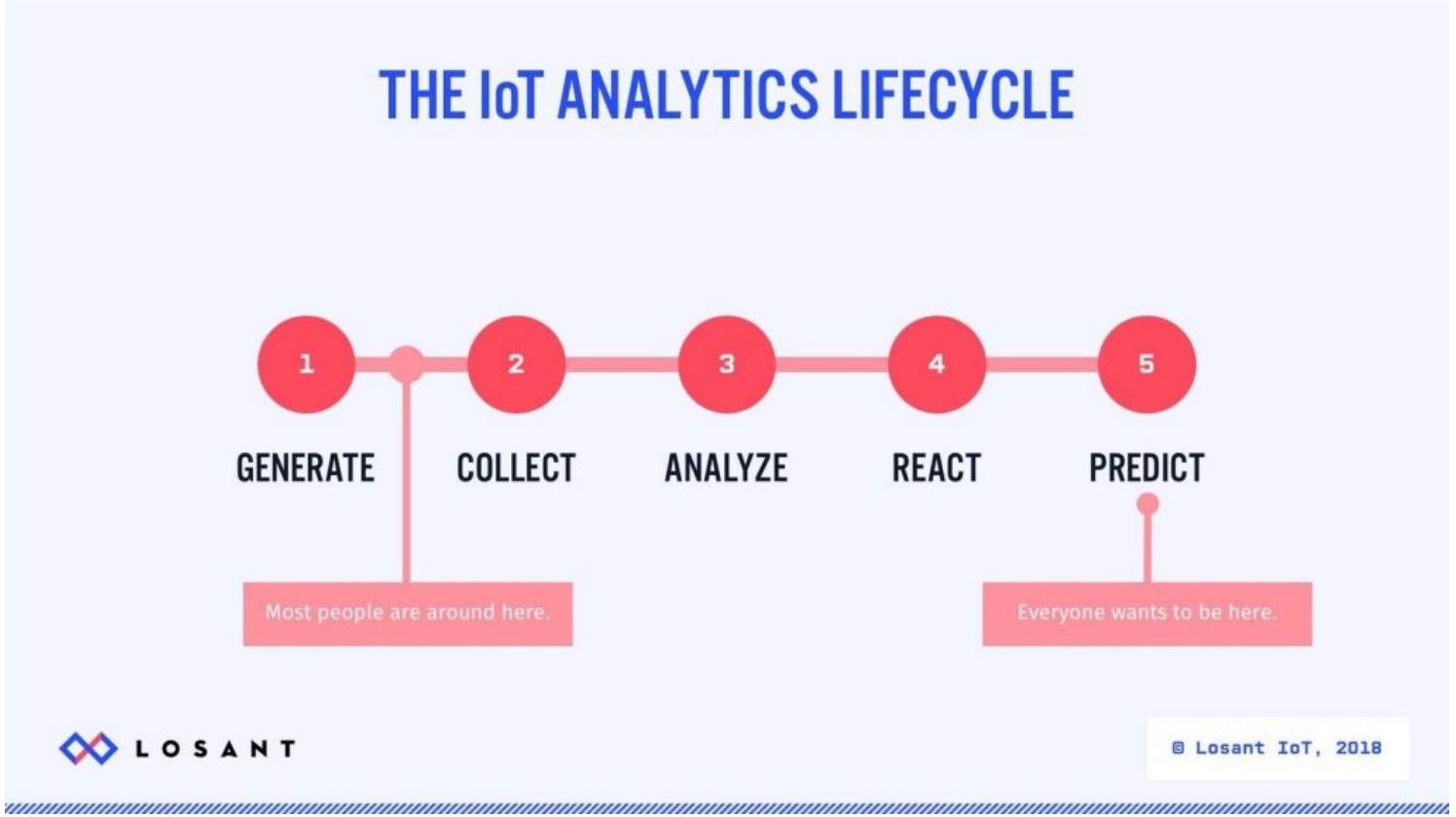
4. Architecture Blueprint

5. Questions and Answers

Typical Industry Challenges

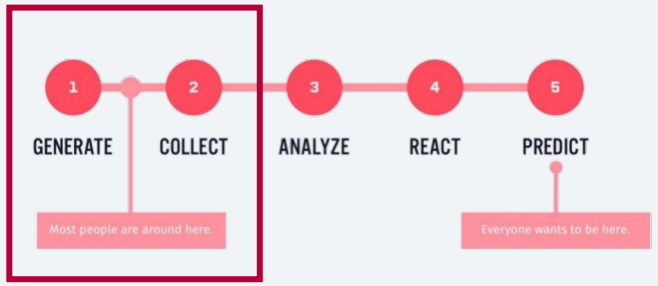
- **Missing or wrong documentation**
- **Missing location information**
- **Delayed Approvals**
- **Deviation Management**
  Triggers Downstream Processes, e.g. Scrapping and Root Cause Analysis
- **Missing Historical Information**
  RCA requires seamless documentation and data about all activities
- **Process Compliance**
- **Gap between Digital and Offline Activities**
  Manual Tasks Decrease Productivity, are Error-Prone and Increase Employee Turnover

(Industrial) IoT Data Processing Lifecycle



https://www.iottechexpo.com/2018/11/iot/the-iot-analytics-lifecycle-from-generating-data-to-predicting-the-future-losant/

Generate and Collect



GOAL

Collect Data and Events from Heterogenous Sources

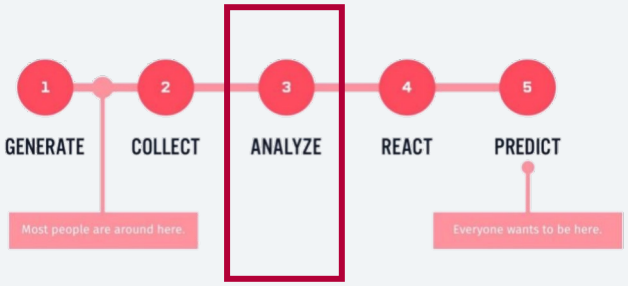
- Hardware (Sensors, Network)
- Connectors/Adapters
- In IoT: small, but many and frequent messages

TOOLS

Transport and Store Events

- Data transport/shipping pipeline
- Clean, annotate and store data
- Kafka proven technology for reliable data shipping
- Rich ingress & egress connector ecosystem (e.g. PLC4X for IIoT)

Analyze



GOAL

Batch vs. Realtime

- Batch: Offline analysis of large chunks of data
- Realtime: On-the-fly analysis of event streams ("Streaming")

Enrich and Aggregate Event Data

- Combine data with other Sources
- Generate new events from event stream

TOOLS

Technologies

- KSQL/KStream
- Apache Flink
- Apache Storm

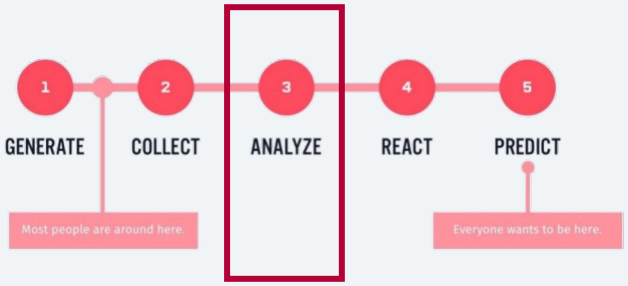
Flink

APACHE STORM™

ksqlDB

POTENTIAL AND USE CASES

Increase Transparency



USE CASES

Monitoring of Individual Machines and their Components

- Visualise and analyse sensor & configuration data

Control Machine

- Control actuators and execute configuration changes from BPM and have them automatically documented

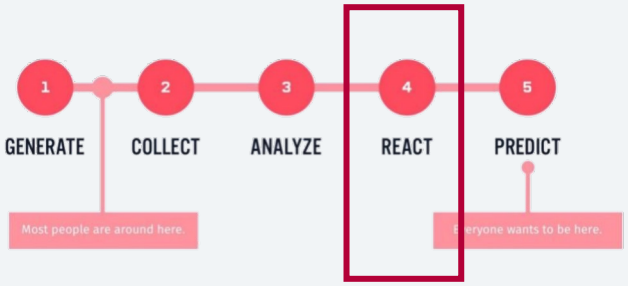
Alerting

- Monitor business rules (maintenance intervals and thresholds etc.) and raise alerts/automatically plan maintenance tasks
- Automate quality checks, e.g. integrate with ML systems

QA Auditing

- Manual/automated quality gates automatically integrated into documentation

React



GOAL

Generate Response for Analysis Outcomes

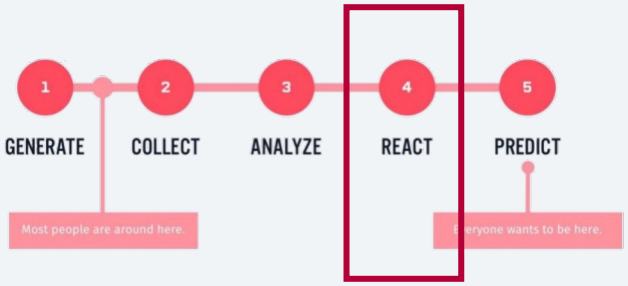
- Reports to gain insights and transparency
- Automatically evaluate business rules
- Automated response actions
- Depends on realtime requirements, e.g. brain vs. spine

TOOLS

Brain: Case & Process Management with Flowable

- Integrate machine processes and human interaction
- Respond to events
- Trigger process transitions
- Evaluate business rules
- Send messages
- Integrate with CRM, ERP, MES, Space (QA) etc.

Respond



USE CASES

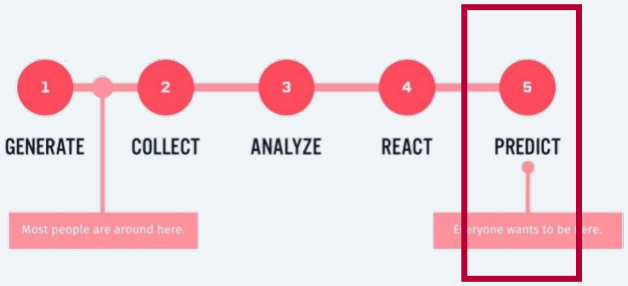
Orchestration of Production Line Processes

- Control potentially very complex production processes and plans

Production Plan Change Requests

- Mix of machine and human processes
- BPM enables fully digital integration
- Execute plan changes automatically

Predict



GOAL

Simple Rules and Recipes

- Example: If running > 2000h ➔ Change oil

Use Machine Learning Models to React Preemptively

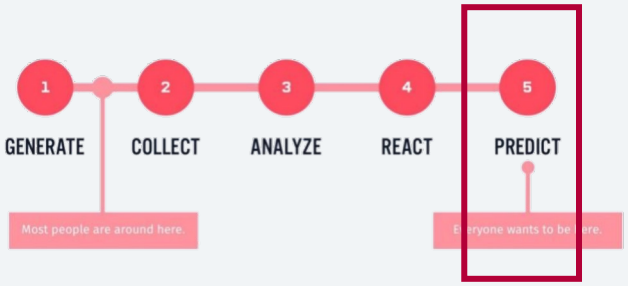
- Holy Grail: Predictive Maintenance

TOOLS

Prediction Alone is not Enough

- (Re-)Action requires integration of ERP and MES (schedule maintenance teams, order required parts etc.)
- Requires careful cost/benefit analysis

Predict - Usecases



USE CASES

Predictive Maintenance

- Predict parts failure

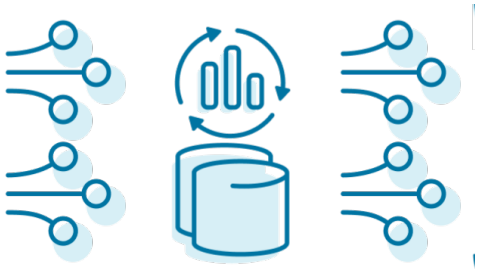
Predictive Recipe-Management

- Learn optimal machine parameters

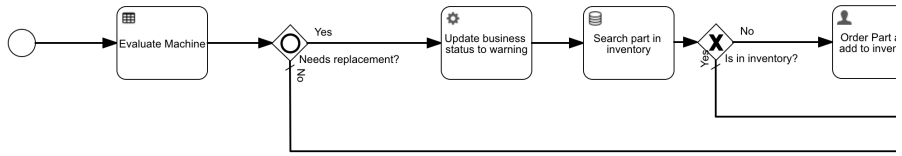
Predictive Resource Planning

- When/where/how many parts are needed

More than the Sum of its Parts



Data Streaming



Business Process Modelling, Reacting to Events & Integrating Machine Processes with Human Interaction

More than the Sum of its Parts

Benefits

- **Eliminate Offline Gaps** between Manufacturing, Operations and Customer Processes
- **Full Integration** of Machine Processes with Human Interaction
  - e.g. handling customer orders via Whatsapp
- **Standardization** of Process Modelling in CMMN/BPMN
  - Monitoring, Change/Order Processes, Production Plans
- **Process-Knowledge is captured in "Executable Models" → "living processes"**
  - Domain-Experts over Tooling-Experts
  - Digital Process Versioning

Innovate

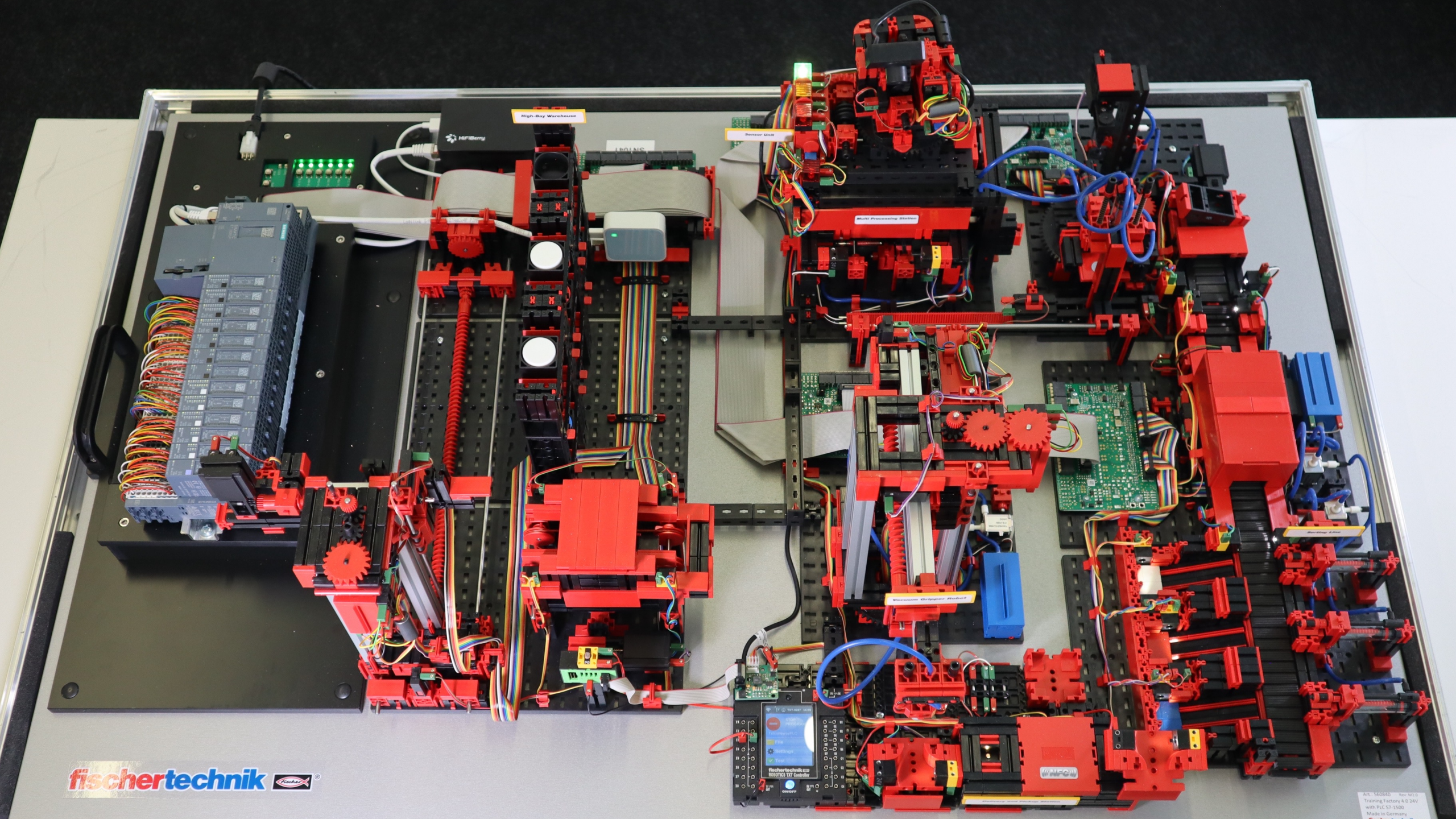
End-to-End Automation from Order to Production

- Customer orders product, fills in specification, order undergoes approval steps etc.
- Specification is automatically transmitted into planning/production systems

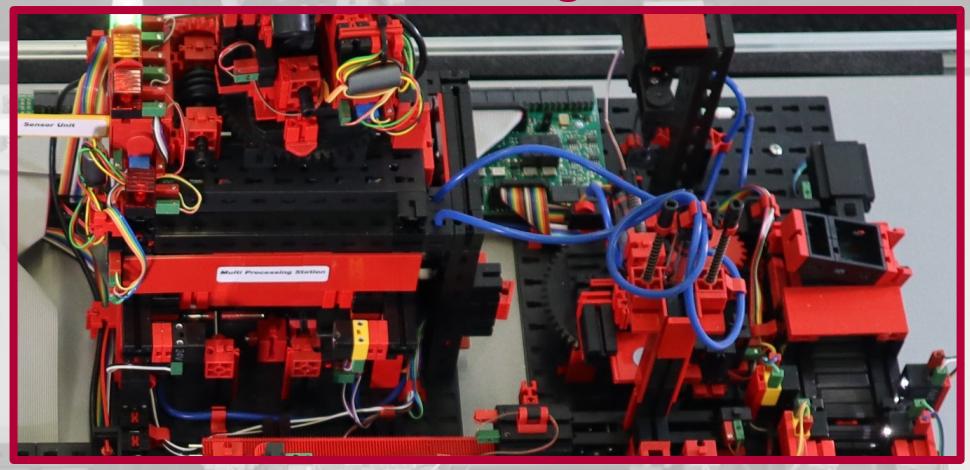
Omni-Channel Integration through Flowable

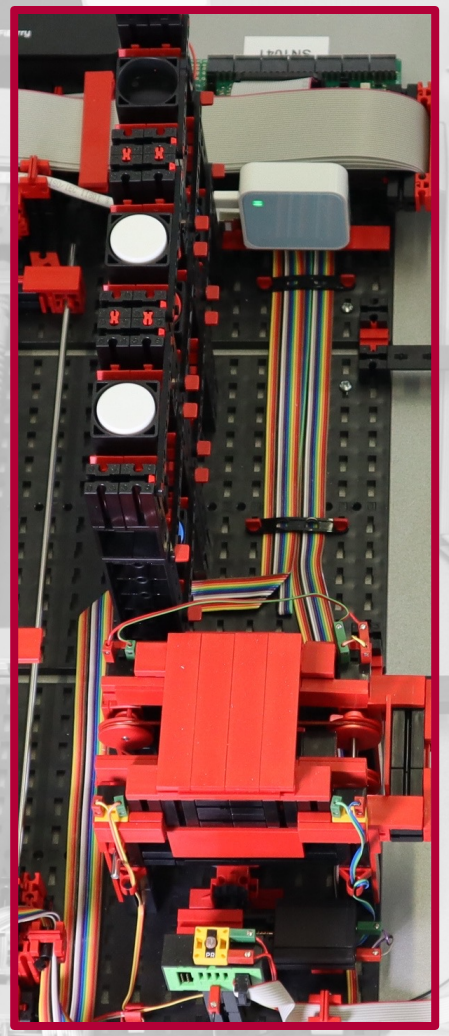
- WhatsApp for Maintenance Staff integrated with ERP
- ....

Factory Flow

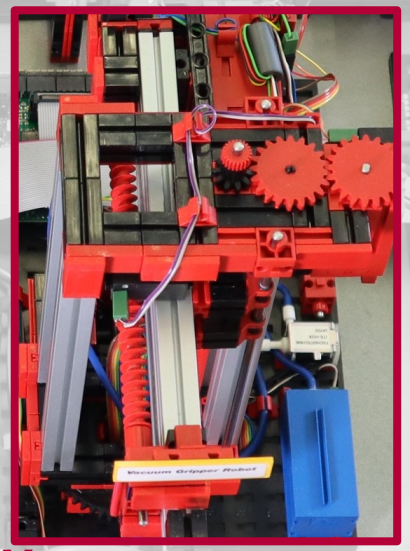

High-Bay Warehouse
HiFiBerry
Sensor Unit
Multi Processing Station
Vacuum Gripper Robot
Sorting Line
fischertechnik
ROBOTICS TXT Controller
Art. 560840
Training Factory 4.0 24V
with PLC S7-1500
Made in Germany

Multi-Processing Station

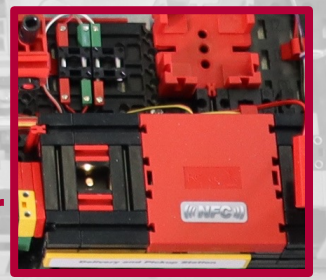




High Bay Warehouse

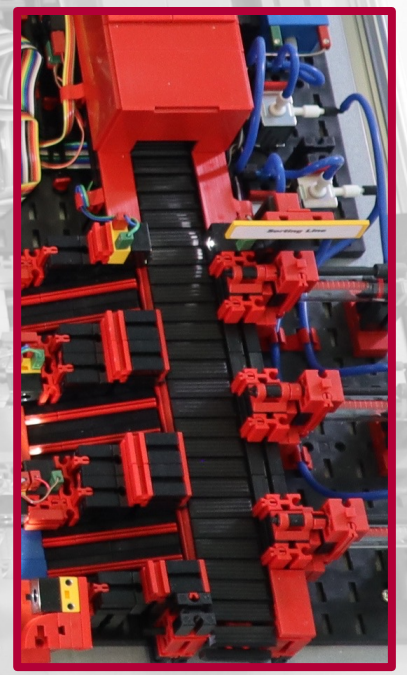


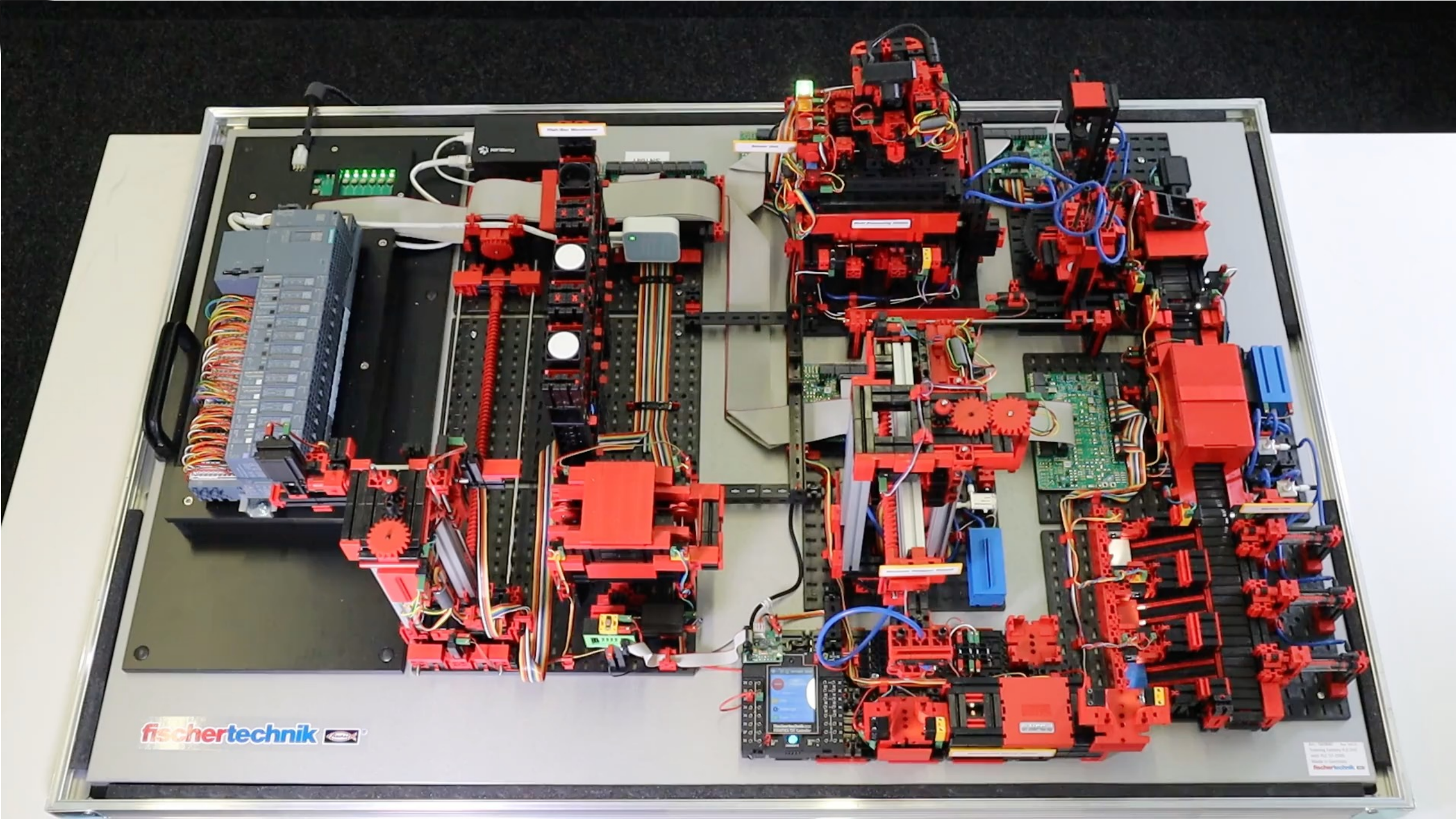
Vacuum Gripper



NFC Reader & Output

Sorting Line




fischertechnik

Demo
Use Cases

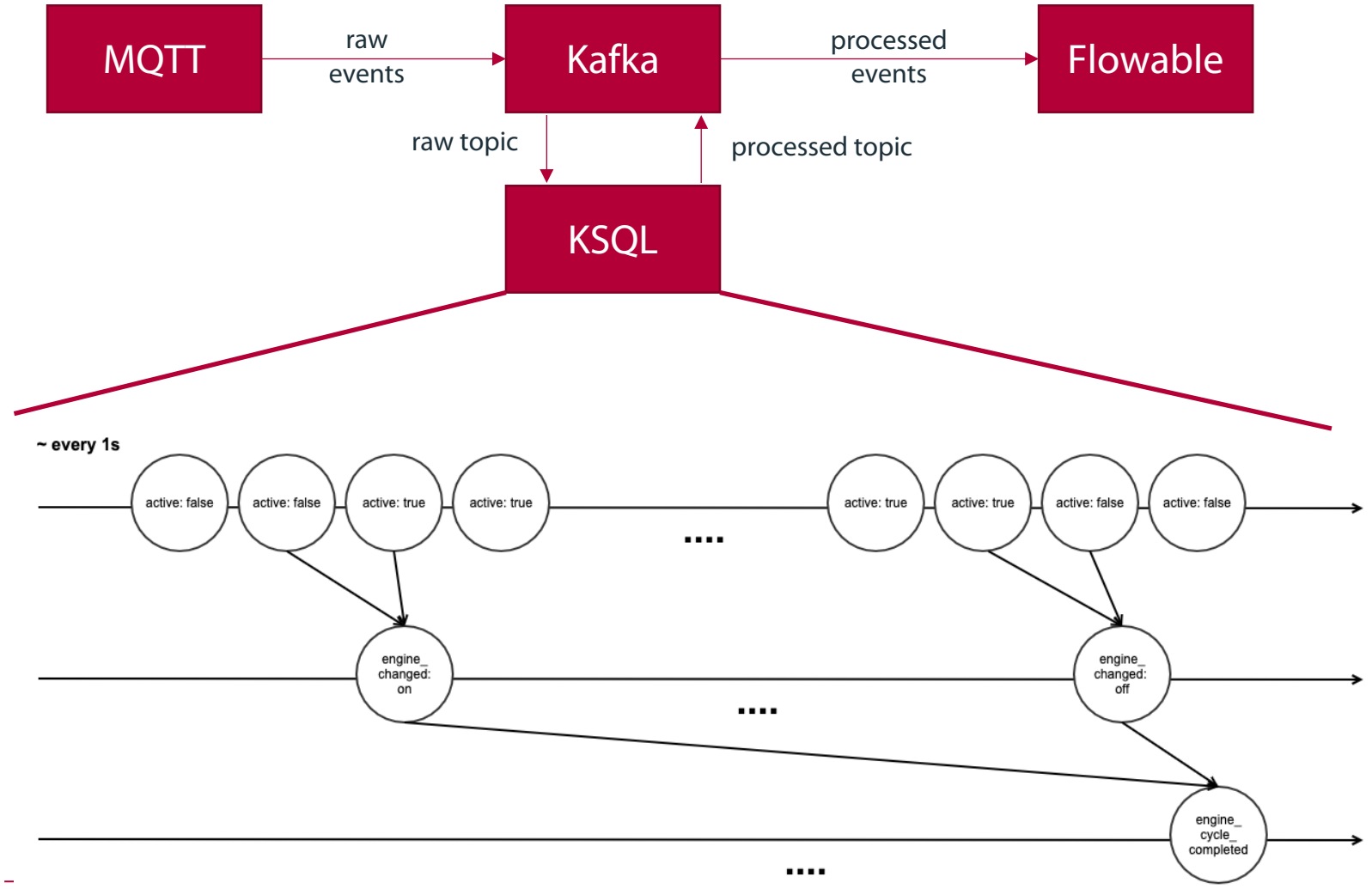
React to Machine Events

- Automatically Detect Machines
- Keep Track of Machine Activity -> Total Running Time
- Raise Alert When Machine Requires Maintenance
  - Create Maintenance Task if [total running time] > x
  - Require Replacement if [nr of power cycles] > x

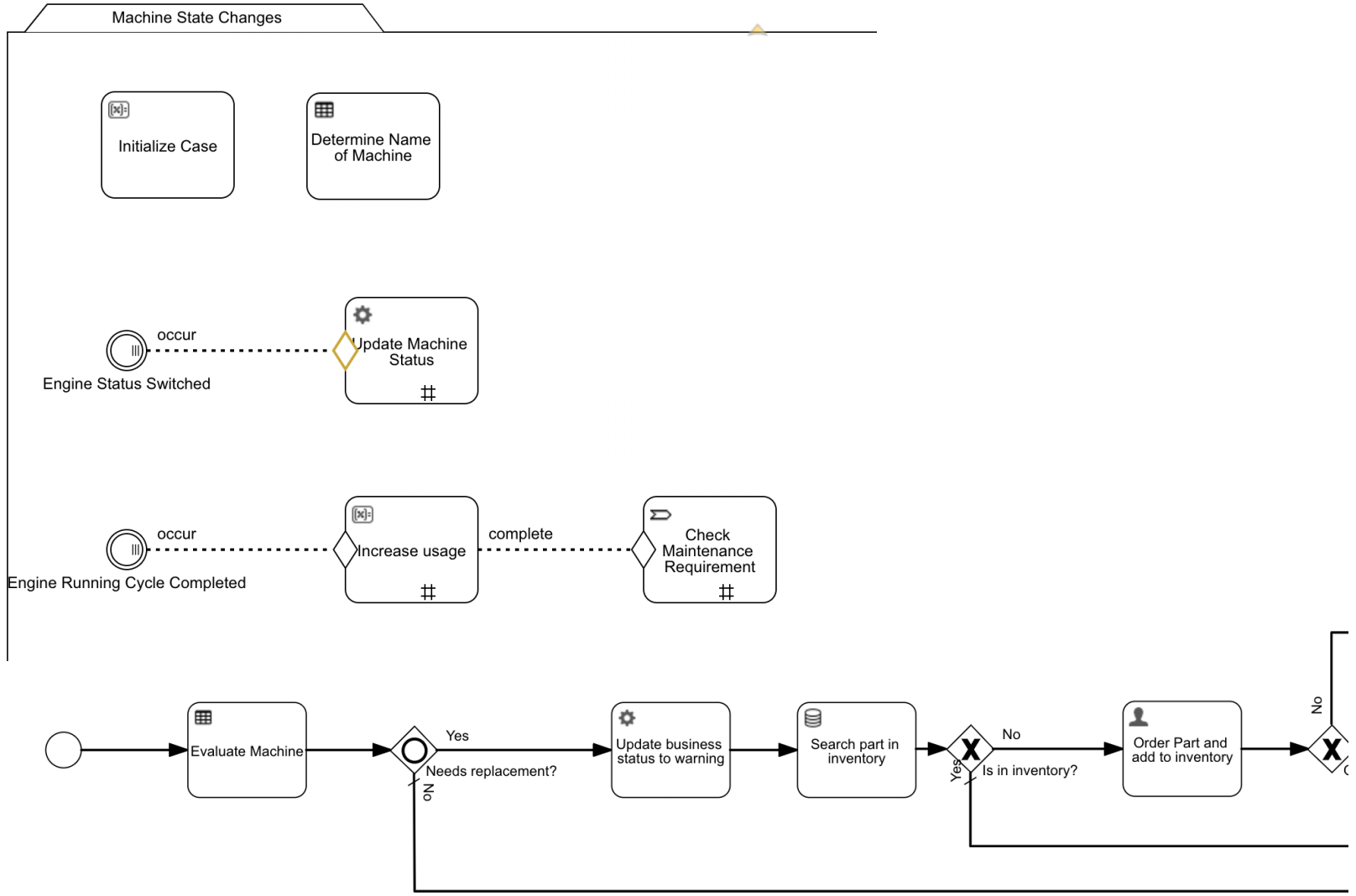
Control Machines

- Place Order Via User Interaction

Event Flow & Preprocessing in Kafka & KSQL

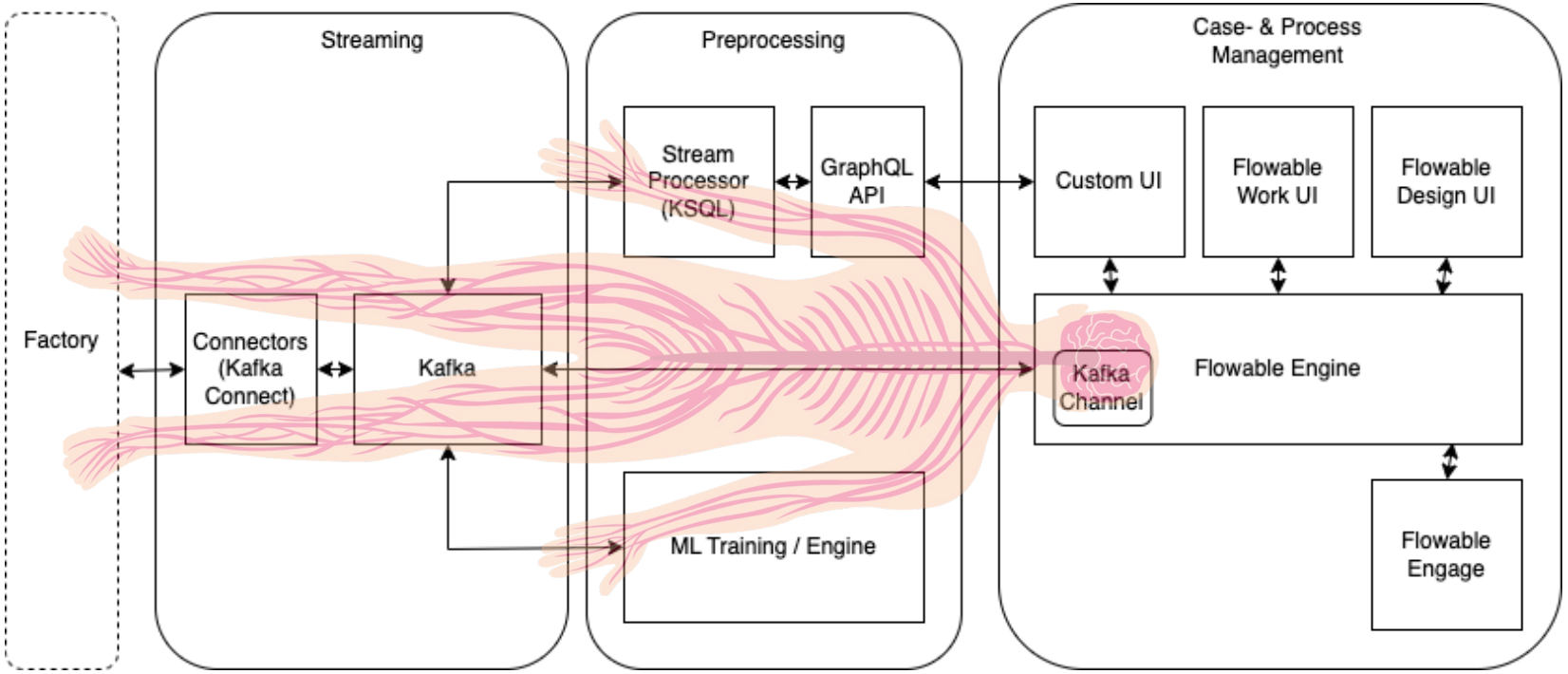


Processes modelled in Flowable




Flowable

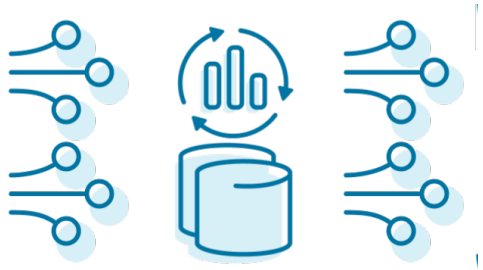
Architecture Blueprint - Overview



Architecture Blueprint – Components

- **Event Streaming Hub**
  - Kafka
  - Kafka Connect + PLC4x
- **Complex Event Preprocessor & Analytics**
  - KSQL / Apache Flink / ...
  - (custom/bespoke) event processor for complex tasks or integrate custom processor components (e.g. KStream)
  - ML Service (Training + Prediction)
- **Case- & Process-Management**
  - can be modelled by business modelling experts
- **Frontend**
  - for providing transient runtime information

More than the Sum of its Parts



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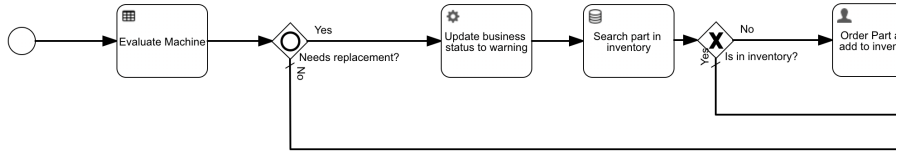

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More than the Sum of its Parts

Get in Touch & Try it out!

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Flowable
Intelligent Business Automation

CONFLUENT
Data in Motion

Erich Eichinger
Lead Architect

erich.eichinger@mimacom.com

www.linkedin.com/in/ericheichinger

Valentin Zlckner
Solution Architect

valentin.zickner@flowable.com

www.linkedin.com/in/zickner

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