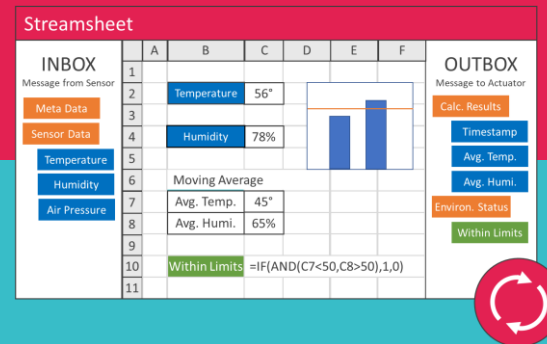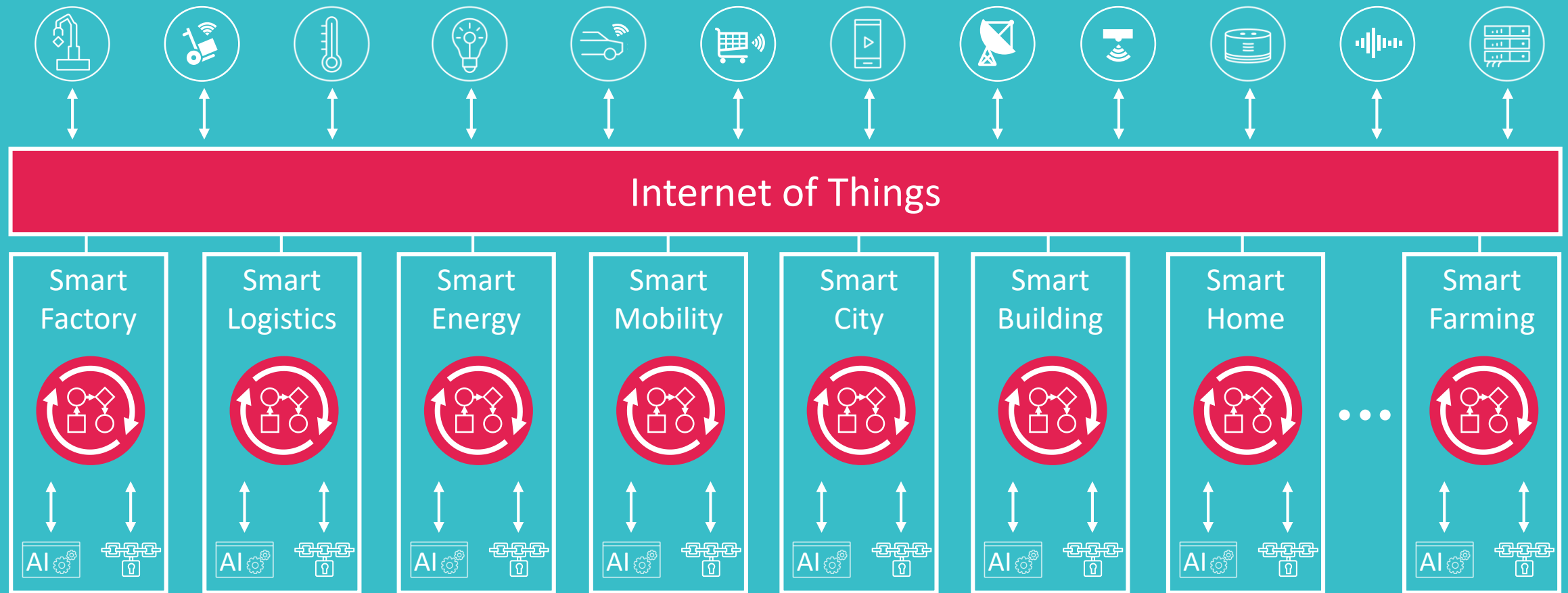# Streamsheets

Server-based IoT-Spreadsheets

→ Empower the Non-Programmer to build smart IoT Processes and Data Flows

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In tomorrow's smart and connected world, **billions** of processes & data flows must be **programmed** to connect and create value in IoT, AI and Blockchains.

Internet of Things

| Smart Factory | Smart Logistics | Smart Energy | Smart Mobility | Smart City | Smart Building | Smart Home | Smart Farming |

AI-System · Distributed Ledger

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Problem: Today, all IoT platform and data flow modelling tools require coding to some extend. However, business users (who know the processes) are usually **not programmers**.

Programmers are **expensive**, briefing & feedback loops take forever and already today there is a **shortage** of programmers.
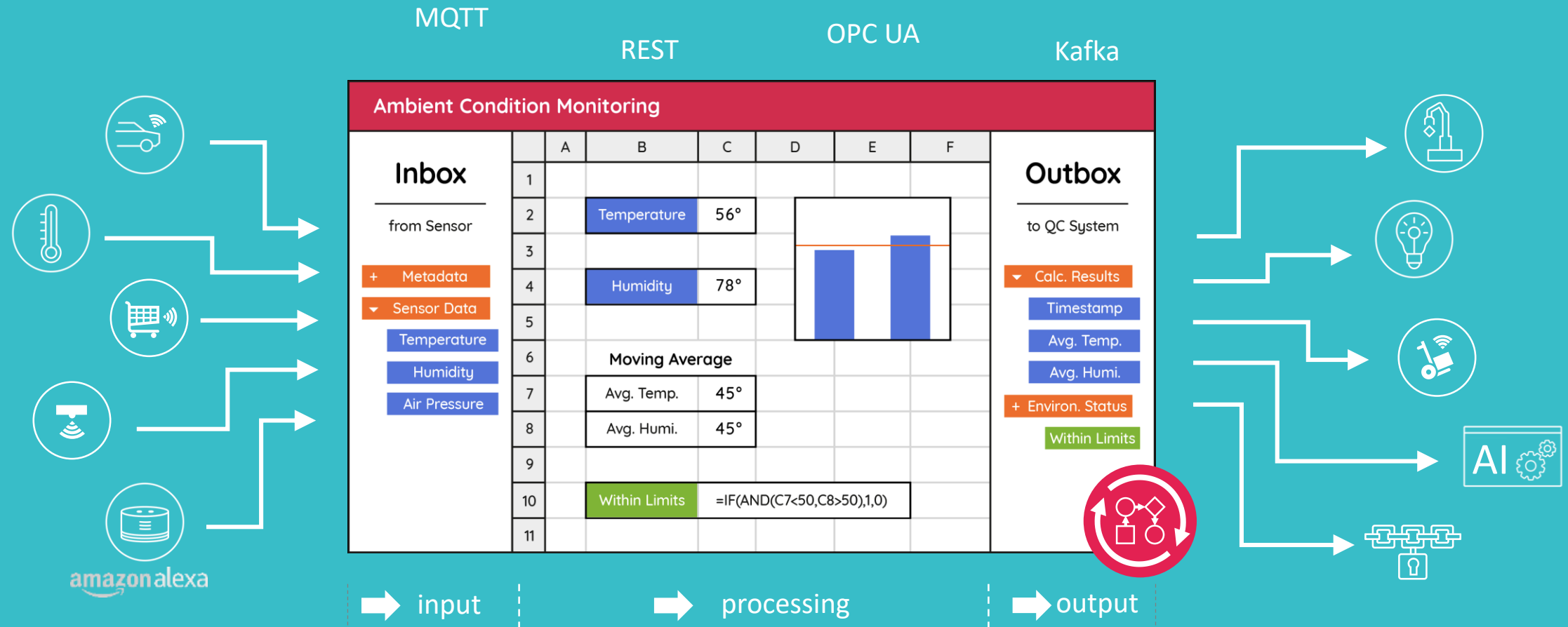
→ In the end, apps get very **expensive** and often come **too late** - **or never!** (because of lack of resources and money).

But fortunately, every business user knows Spreadsheets and knows how to enter Excel-Formulas to build logic.

Empowering the business user to build IoT processes and data flows - That's why we invented **Streamsheets**!

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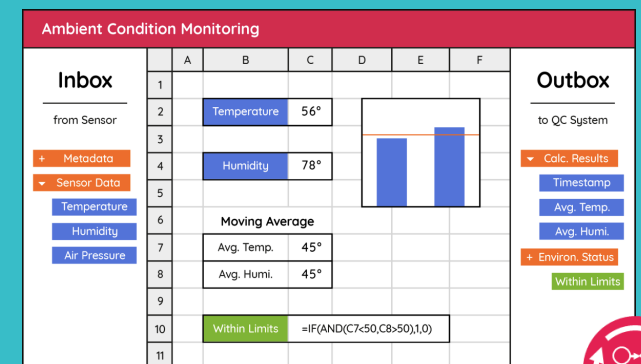
Streamsheets are **end-user**-friendly, **next-gen** spreadsheets that run on a **server**, take **high loads** of complexity, **connec**t to any app, device or streaming platform and process & forward **data streams** in **real-time**.

MQTT

REST

OPC UA

Kafka

Ambient Condition Monitoring

		A	B	C	D	E	F
Inbox	1						
from Sensor	2		Temperature	56°			
	3						
+ Metadata	4		Humidity	78°			
▼ Sensor Data	5						
Temperature	6		**Moving Average**				
Humidity	7		Avg. Temp.	45°			
Air Pressure	8		Avg. Humi.	45°			
	9						
	10		Within Limits	=IF(AND(C7<50,C8>50),1,0)			
	11						

Outbox

to QC System

▼ Calc. Results
Timestamp
Avg. Temp.
Avg. Humi.
+ Environ. Status
Within Limits

amazon alexa

➡ input   ➡ processing   ➡ output

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Basic concept of working with streamsheets
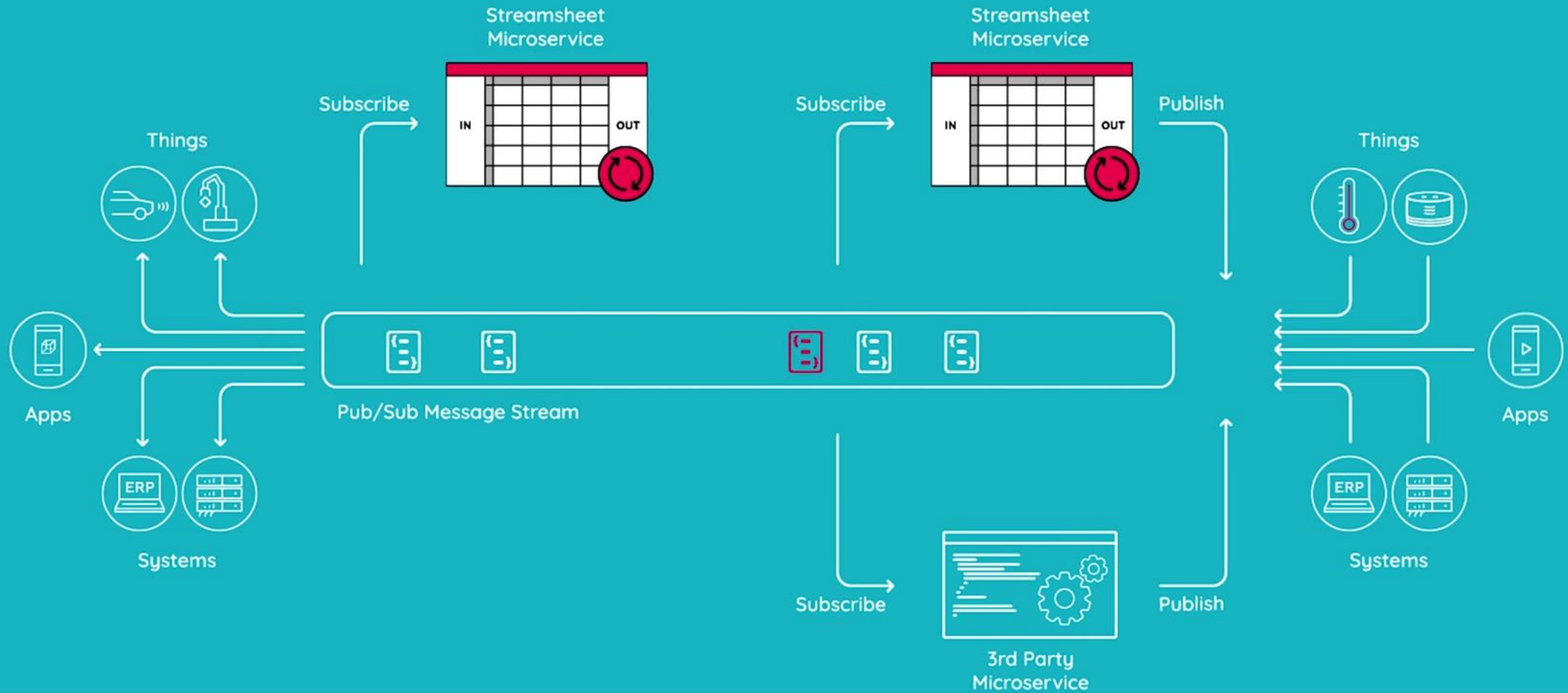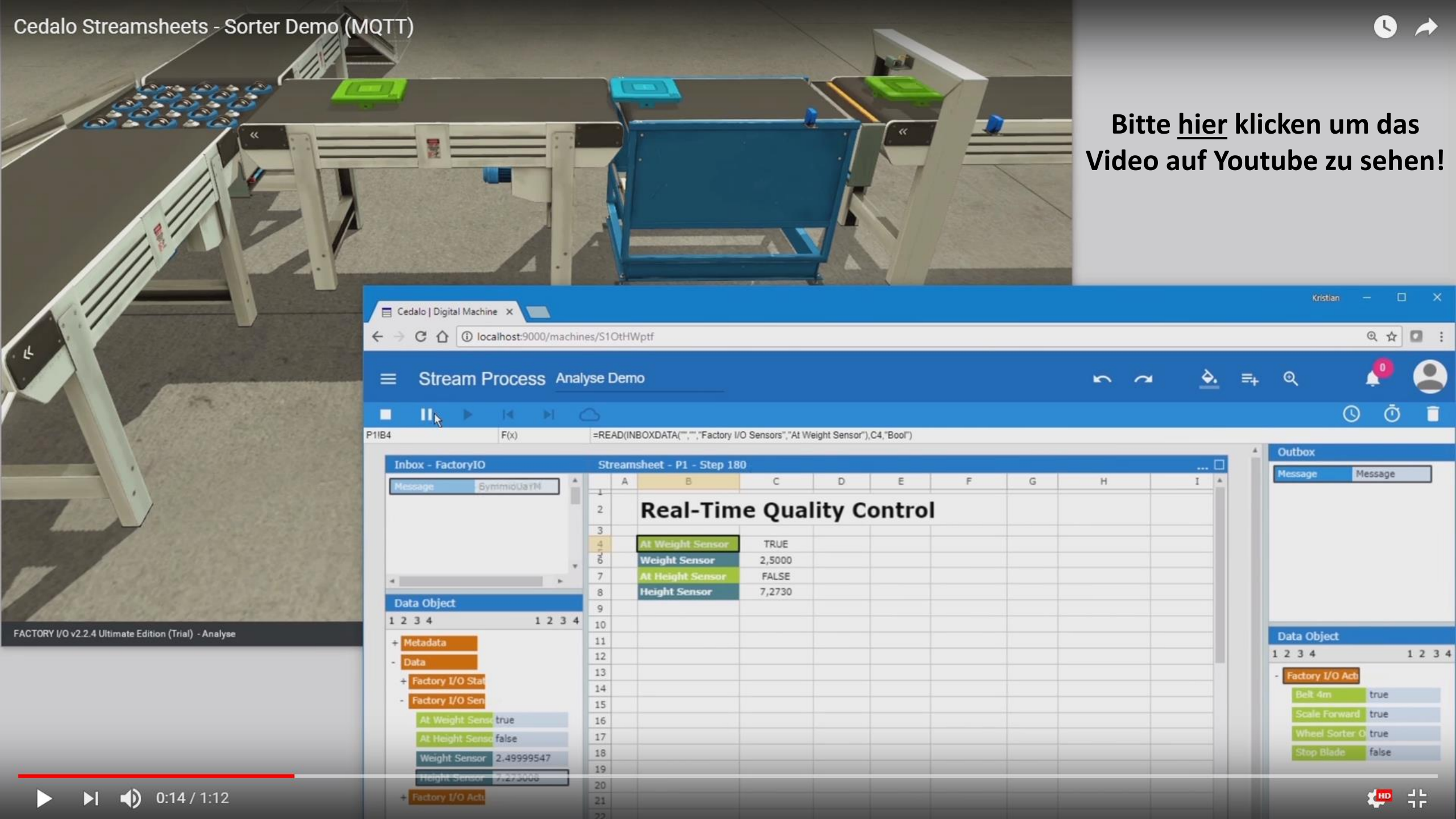
Bitte hier klicken um das Video auf Youtube zu sehen!

Cedalo Streamsheets - Sorter Demo (MQTT)

Bitte hier klicken um das Video auf Youtube zu sehen!

FACTORY I/O v2.2.4 Ultimate Edition (Trial) - Analyse

0:14 / 1:12

Kristian

Cedalo | Digital Machine

localhost:9000/machines/S1OtHWptf

Stream Process   Analyse Demo

P1!B4   F(x)   =READ(INBOXDATA("","","Factory I/O Sensors","At Weight Sensor"),C4,"Bool")

Inbox - FactoryIO   Streamsheet - P1 - Step 180   Outbox

Message   6ymmioUarM   Message   Message

Real-Time Quality Control

At Weight Sensor	TRUE	
Weight Sensor	2,5000	
At Height Sensor	FALSE	
Height Sensor	7,2730	

Data Object   Data Object

1 2 3 4   1 2 3 4   1 2 3 4   1 2 3 4

+ Metadata
- Data
  + Factory I/O Stat
  - Factory I/O Sen
    At Weight Sens   true
    At Height Sens   false
    Weight Sensor   2.49999547
    Height Sensor   7.273006
  + Factory I/O Act

- Factory I/O Act
  Belt 4m   true
  Scale Forward   true
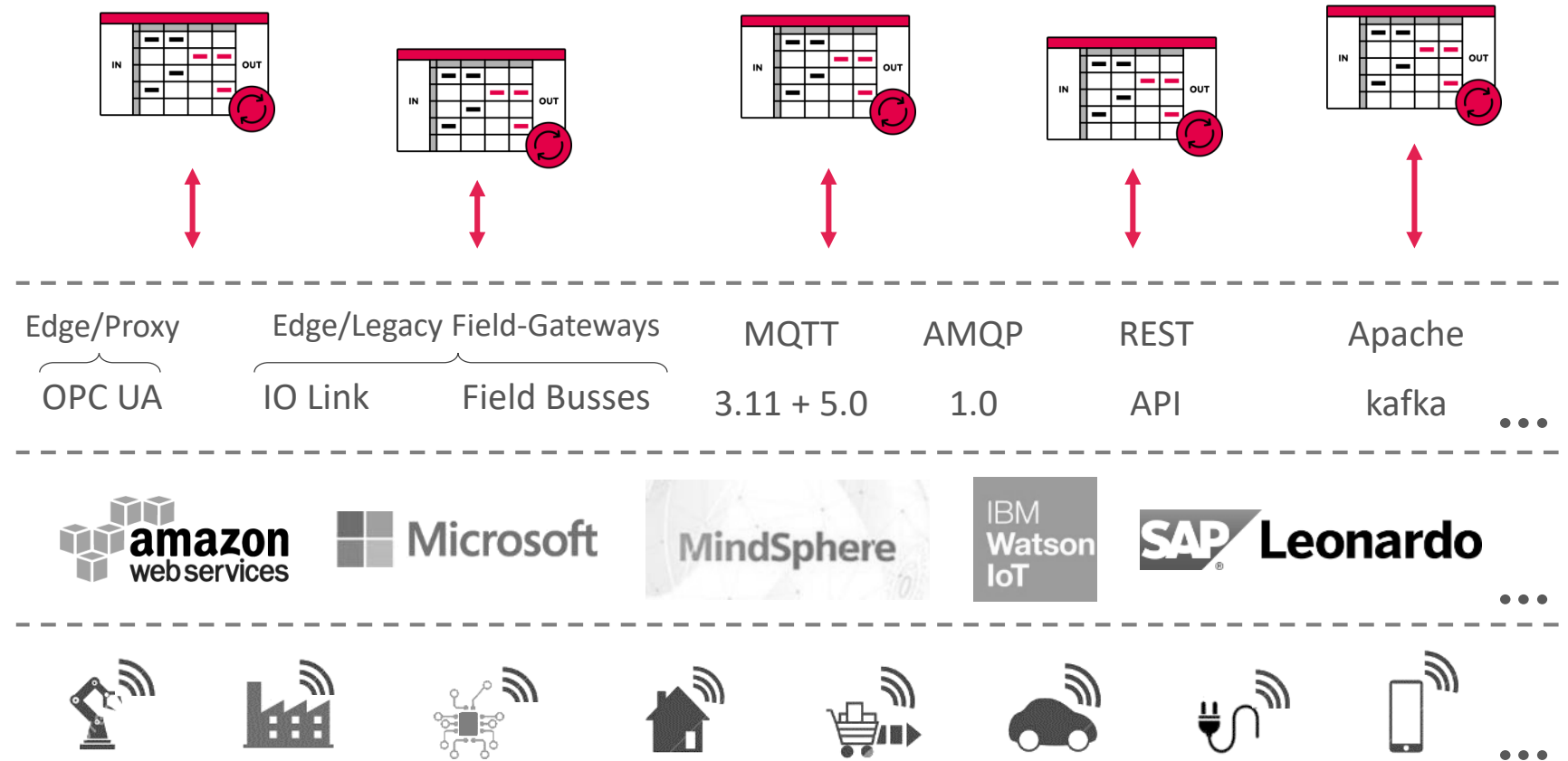 Wheel Sorter O   true
  Stop Blade   false

Streamsheets sit **on top of all major IoT platforms** and communicate via standard IoT M2M protocols.

Streamsheet Services & Apps

... work with all protocols (and legacy field-gateways)

Edge/Proxy	Edge/Legacy Field-Gateways		MQTT	AMQP	REST	Apache
OPC UA	IO Link	Field Busses	3.11 + 5.0	1.0	API	kafka

...

... support all leading Cloud- and IoT-Platforms

amazon web services   Microsoft   MindSphere   IBM Watson IoT   SAP Leonardo

...

... connect to any sensor, actuator, device or app
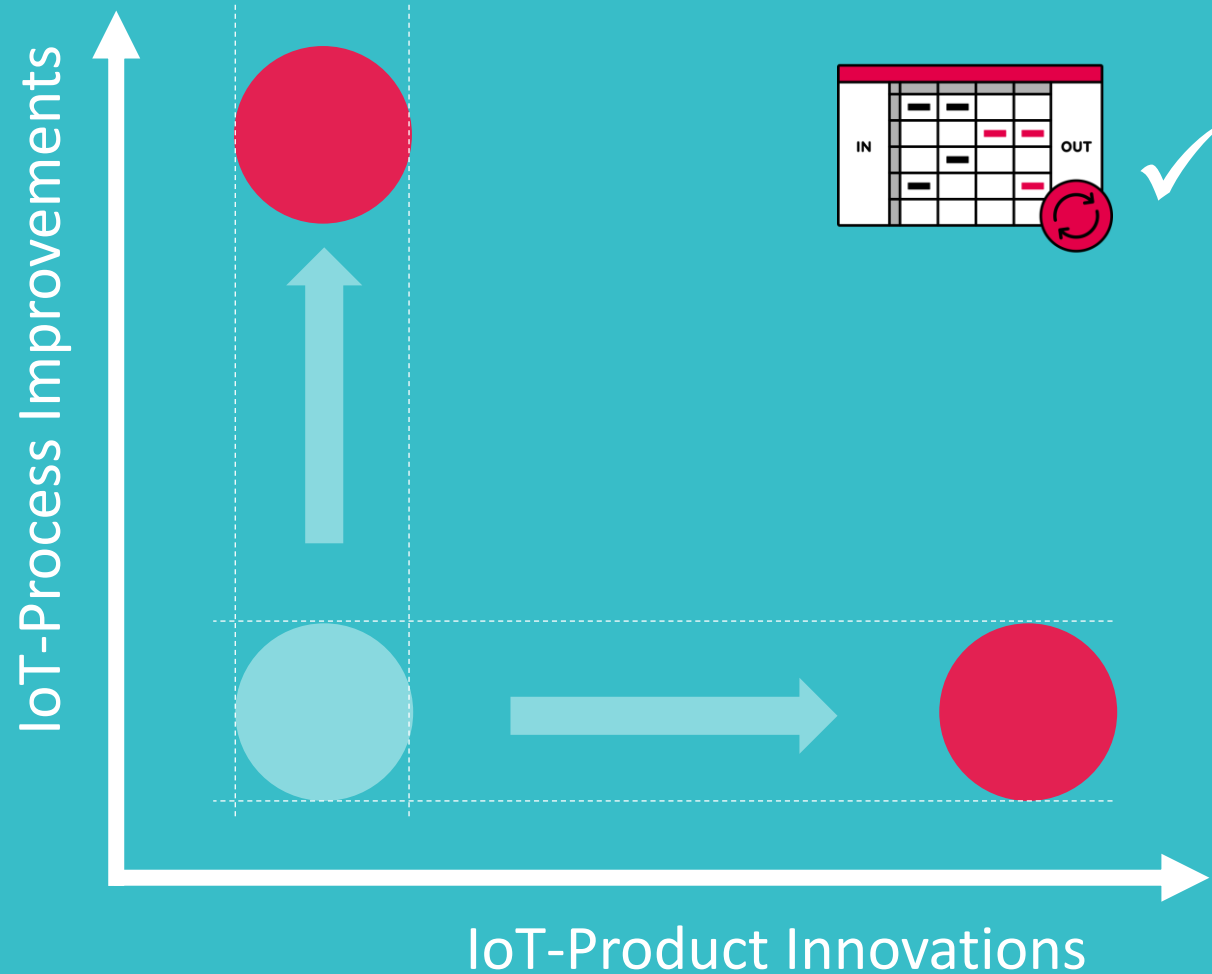
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Streamsheet Use Cases

IoT-Process Improvements

(Quality, Efficiency)

+

IoT-Product Innovations

(Features, Maintenance)

Random selection of Streamsheet Use Cases

Data flow for Product-as-a-Service

A machine supplier sells his machines on a pay-per-use basis. The supplier monitors the machine usage and maintenance-related sensors at the production site 24/7. Customer and supplier agree on a Streamsheet model which contains the individual, joint price model with all rules, metrics and corresponding price charges. Supplier uses Streamsheets to calculate usage charges and to send invoicing data automatically to an ERP system. Further, the Streamsheet acts as a real-time data feeder for an AI-based predictive maintenance system.

Brown-Field data integration

Real-time acquisition of machine data stored locally in proprietary file formats on legacy production machines. Machine specific conversion of data from legacy file formats to one centrally defined format for all machines. Machine operators use their individual and machine specific know-how to model the data conversion in Streamsheets. The Streamsheets send the data in real-time to the standardized data collection instance (e.g. Apache Kafka Stream or SQL/NOSQL-Database).

Real-Time Price Building

Based on real-time data streams (e.g. sensor data, demand predictions, stock available, competitor pricing, weather forecasts, etc.), Streamsheets with formula-based heuristics calculate the most profitable price in real-time and publish this price automatically on a minute-by-minute base to eCommerce or ERP platforms. The business know-how lies in the hands of market insiders who are usually not programmers. The model and the price building heuristics can undergo continuous changes and evolve on a weekly or even daily basis.

Point of Sale Real-Time Promotions

Proximity Beacons like Google's Eddystone or Apple's iBeacon allow to gather information on customer behavior at the Point of Sale in a retail shop. Streamsheets read and process the customer's movement while shopping. Using formula-based heuristics, the Streamsheet triggers customer specific promotions at the POS in the shop in real-time. Streamsheets allow the shop owner or retail specialist to design and experiment with the heuristics by simply editing spreadsheet formulas.
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Use Case: Predictive Maintenance / Extended Warranty

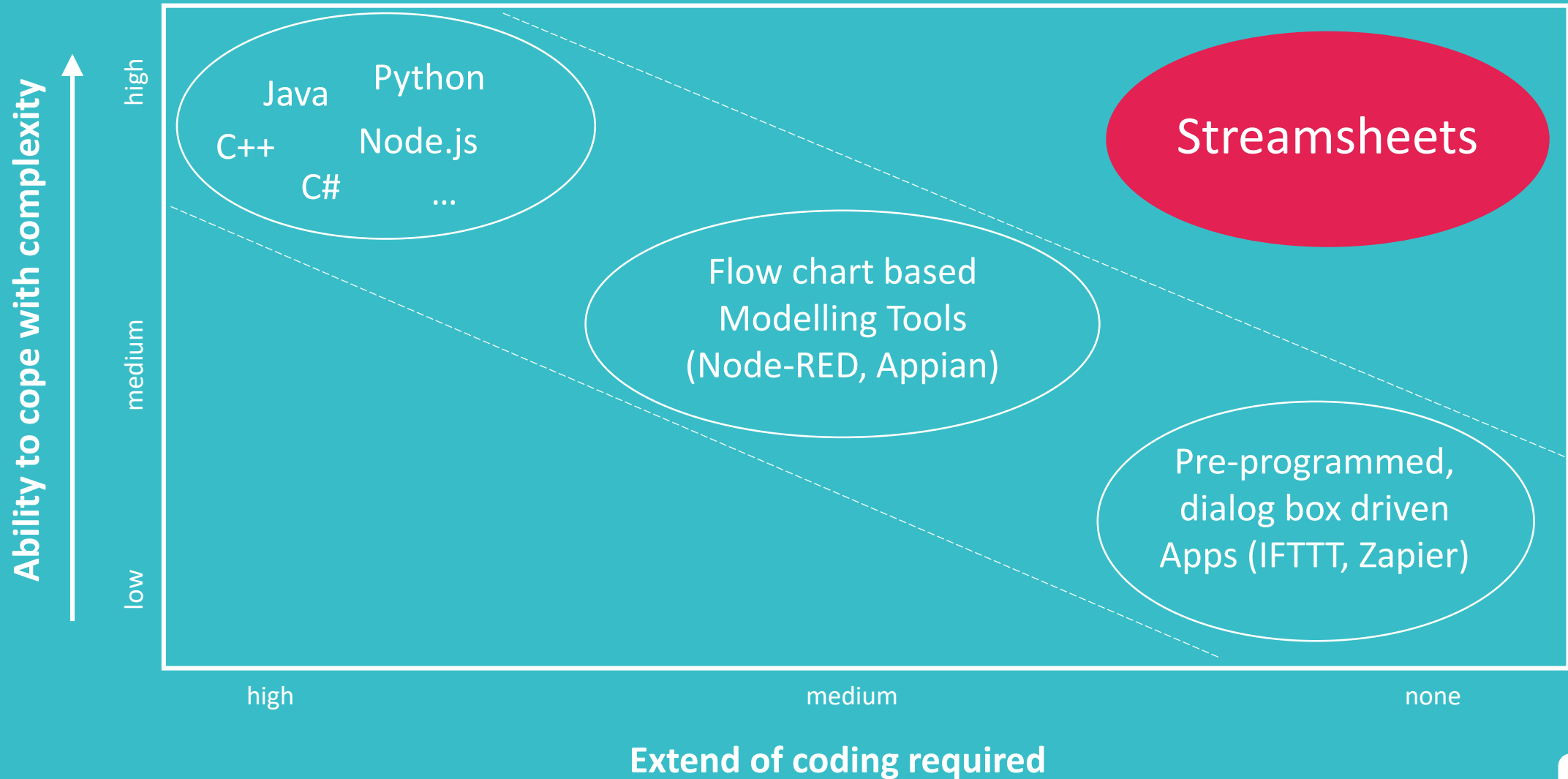Machine supplier offers extended guarantee to machine buyer if supplier is allowed to monitor machine usage and environment data at production site 24/7.

Supplier uses data to check consistency with allowed operational limitations, predicts upcoming errors or maintenance issues and, additionally, feeds an AI system to learn about the machine´s error susceptibility in normal and extreme operating conditions of real operating environments.

Supplier and customer discuss and agree on the selection, the amount and frequency of data transmitted and on the rules and parameters that are applied in their business case. Customer and supplier jointly develop the Streamsheet model. If operational conditions are outside of agreed limitations, the parameters are recorded in a distributed ledger as protection against manipulations. Streamsheets are used to detect anomalies and to prepare and transport the corresponding data to the ledger.

Production Cloud (Manufacturer)

Distributed Ledger (Consensus Mechanism)

Supplier Cloud

AI

REST

REST

3

2

IN | OUT

IN | OUT

OPC UA

4

OPC UA

MQTT

1

Shop Floor

7

IN | OUT

REST

ERP

REST

REST

AI

OPC UA

IN | OUT

5

6

1. Streamsheet to convert MQTT to OPC UA
2. Streamsheet feeds Blockchain with incidents
3. Streamsheet feeds AI System (Production Quality)
4. Streamsheet to send data to Robot PLC
5. Streamsheet to prepare Robot data for AI input
6. Streamsheet feeds AI System (Product Quality)
7. Streamsheet to send incidents to ERP system

IN | OUT — Streamsheet

Distributed Ledger

AI — AI-System

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Competitive approaches

Ability to cope with complexity

high

Java   Python

C++   Node.js

C#   ...

Streamsheets

medium

Flow chart based
Modelling Tools
(Node-RED, Appian)

low

Pre-programmed,
dialog box driven
Apps (IFTTT, Zapier)

high   medium   none

Extend of coding required

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Highlights & Advantages

- **Time savings:** No lengthy briefings → instant start and deployment
- **Cost savings:** Process owner does not need to hire a programmer
- **Little training required**: Accepted and familiar user interface
- **Interactive development**: Instant discovery of errors and logical flaws
- **Unrivaled feature velocity**: Ideal for short-term & changing requirements

save money	save time	empower people	be agile

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Huge market opportunity – Millions of trained users

Market size and growth for IoT, Industry 4.0 & Smart Technologies are very promising and certainly not a limiting factor for cedalo.

14 Billion Euro

Bitkom: Revenue from Industry 4.0 in GER in 2025

23 Billion Euro

McKinsey: Revenue from IoT in GER until 2020

80 Billion Euro

A.T. Kearney: Revenue from IoT in EU in 2025

> 500 Mio. users!

Spreadsheet users worldwide become empowered to create apps and microservices

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An efficient business model: Freemium

Free Offerings
(Website)

OEM-Sales
(Device Manufacturers)
(PaaS-Providers)

Online Sales
(Website)

Indirect Sales
(Partner Channel)

Direct Sales
(Key Customers)

Educational	++
Base Edition (Single-User)	+
OEM-Edition	+
Professional Edition	++
Enterprise Edition	+++

Revenue Types

Upfront-License
On-premise

Pay-per-Use
Cloud-Service

Support-Contracts

Online-Training

+ Basic Feature Set
++ Full Feature Set
+++ Extended Features

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