DIGITAL FACTORY

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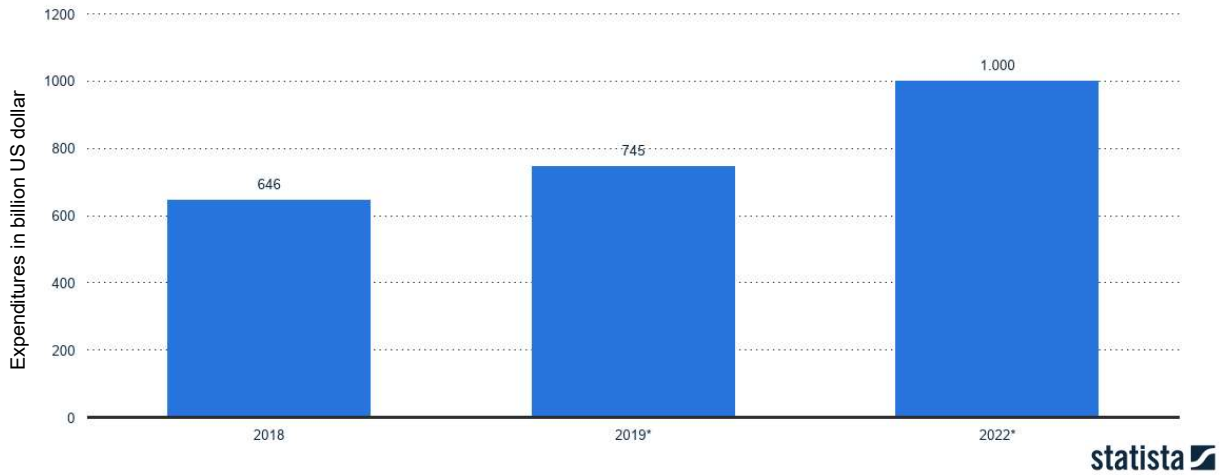
DIGITAL FACTORY NOW

The Power and Potential of Digitalization

Potential

Forecast for expenditure on the Internet of Things (IoT) worldwide in the years 2018 to 2022 (in billion US dollar)



Countries all over the world are investing into digitalization

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Source: Statista: ID537226 (https://de.statista.com/)

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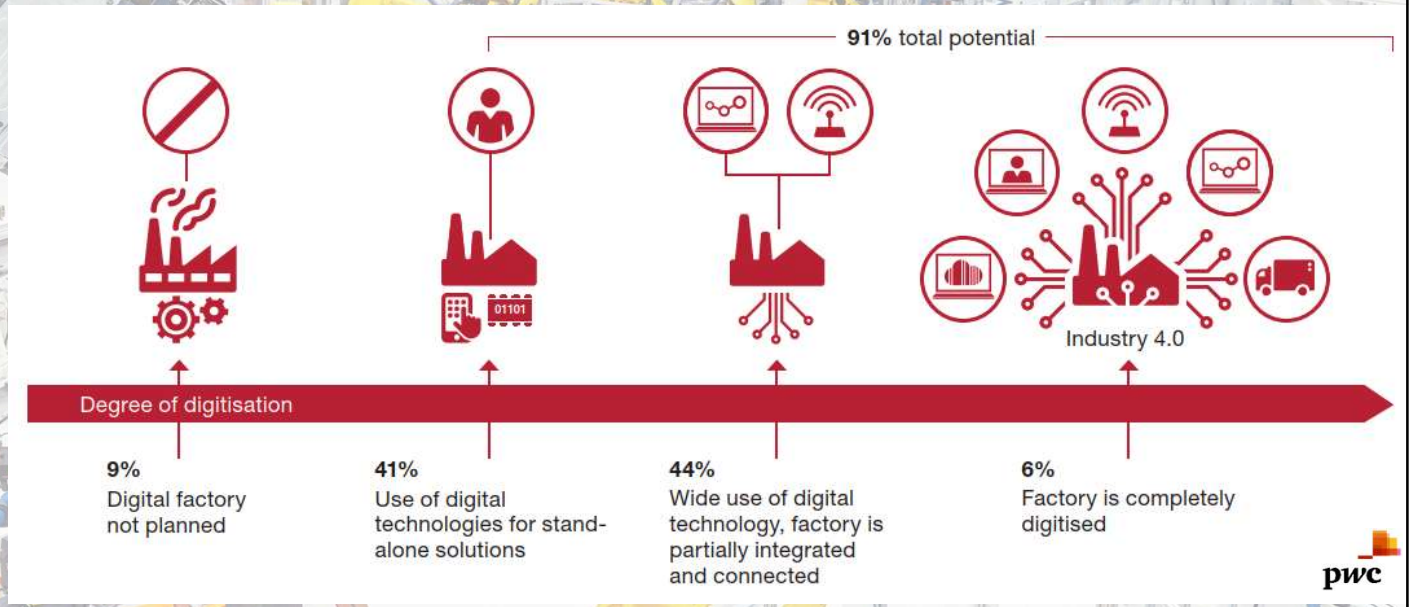
Potential



9 out of 10 companies are investing in Digital Factories

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Source: pwc: Digital factories 2020 - Shaping the future of manufacturing: (https://www.pwc.com/gx/en/industries/industrial-manufacturing/publications/digital-factories-2020.html)

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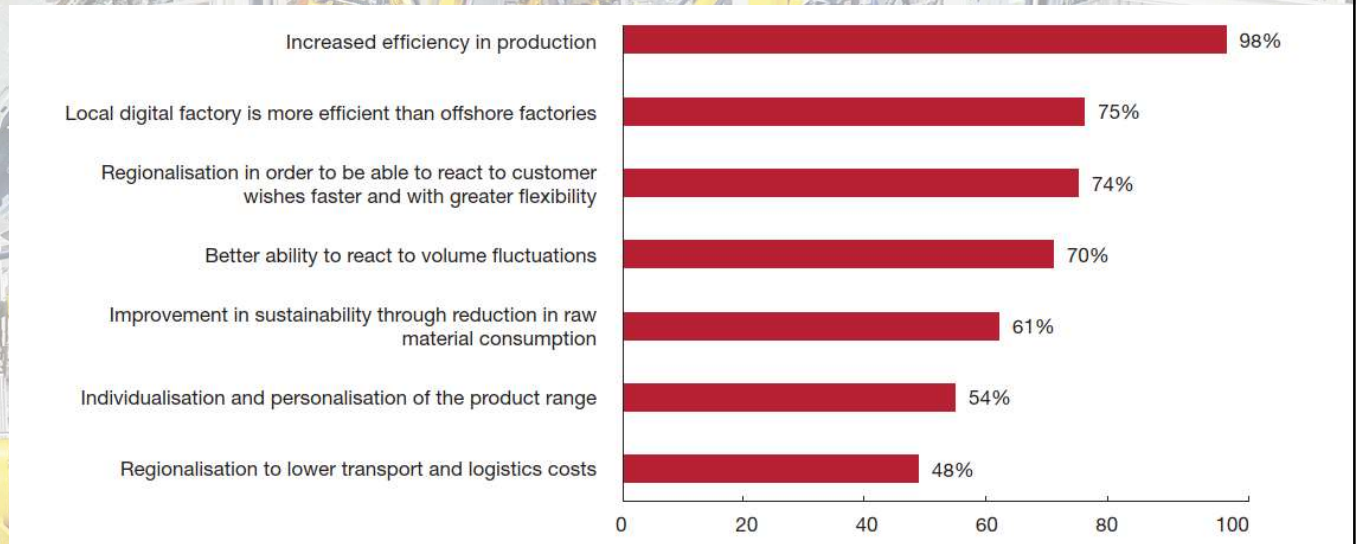
Why invest in Digital Factories?



Q: What are your significant reasons for setting up or expanding digital factories?
Base: Respondents planning to set up or expand digital factories

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Efficiency and customer centricity are top reasons for expanding Digital Factories

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Source: pwc: Digital factories 2020 - Shaping the future of manufacturing: (https://www.pwc.com/gx/en/industries/industrial-manufacturing/publications/digital-factories-2020.html)

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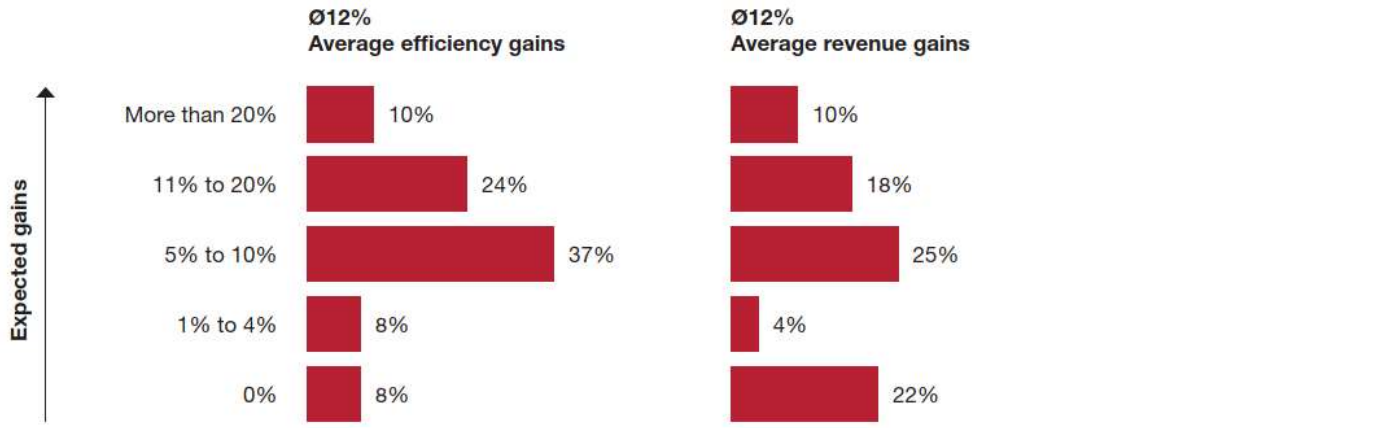
Why invest in Digital Factories?



Q: An efficiency gain by how many percent in comparison to now do you expect for your company over the next five years from digital factories? A revenues gain by how many percent in comparison to now do you expect for your company over the next five years from digital factories?

Base: Respondents whose companies have or are planning a digital factory or the use of at least one digital concept

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Respondents expect both efficiency and revenue gains of 12% on average over the next 5 years

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Source: pwc: Digital factories 2020 - Shaping the future of manufacturing: (https://www.pwc.com/gx/en/industries/industrial-manufacturing/publications/digital-factories-2020.html)

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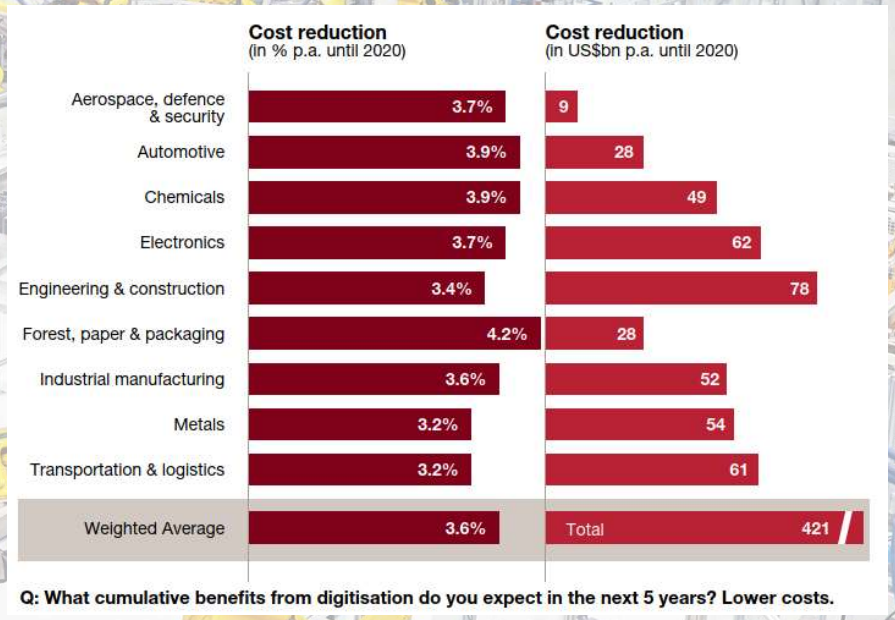

pwc

Companies in every industry sector expect significant cost reductions

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Source: pwc: Industry 4.0 - Building the digital enterprise (https://www.pwc.com/gx/en/industries/industries-4.0/landing-page/industry-4.0-building-your-digital-enterprise-april-2016.pdf)

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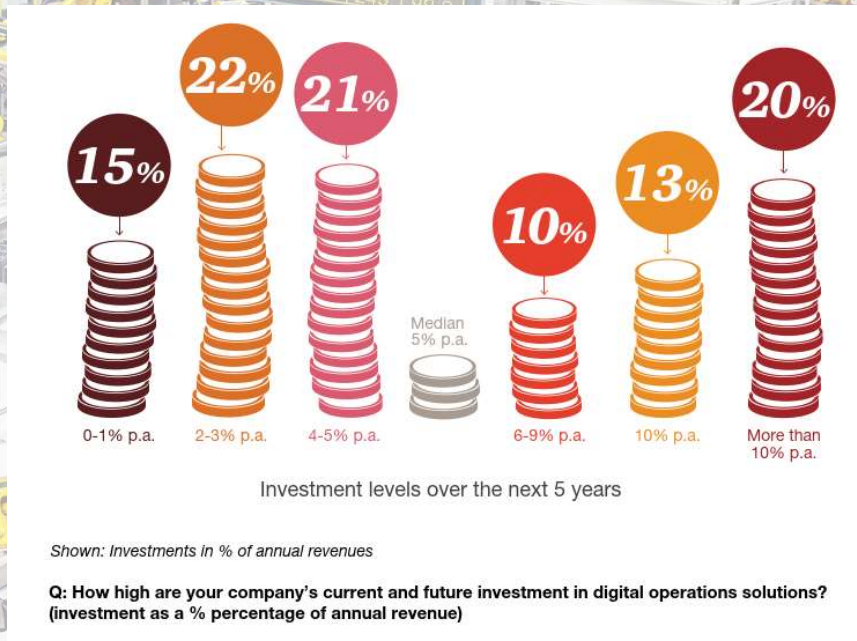
Why invest in Digital Factories?



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Companies that do not strategically invest will lose competitive advantage

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Source: pwc: Industry 4.0 - Building the digital enterprise (https://www.pwc.com/gx/en/industries/industries-4.0/landing-page/industry-4.0-building-your-digital-enterprise-april-2016.pdf)

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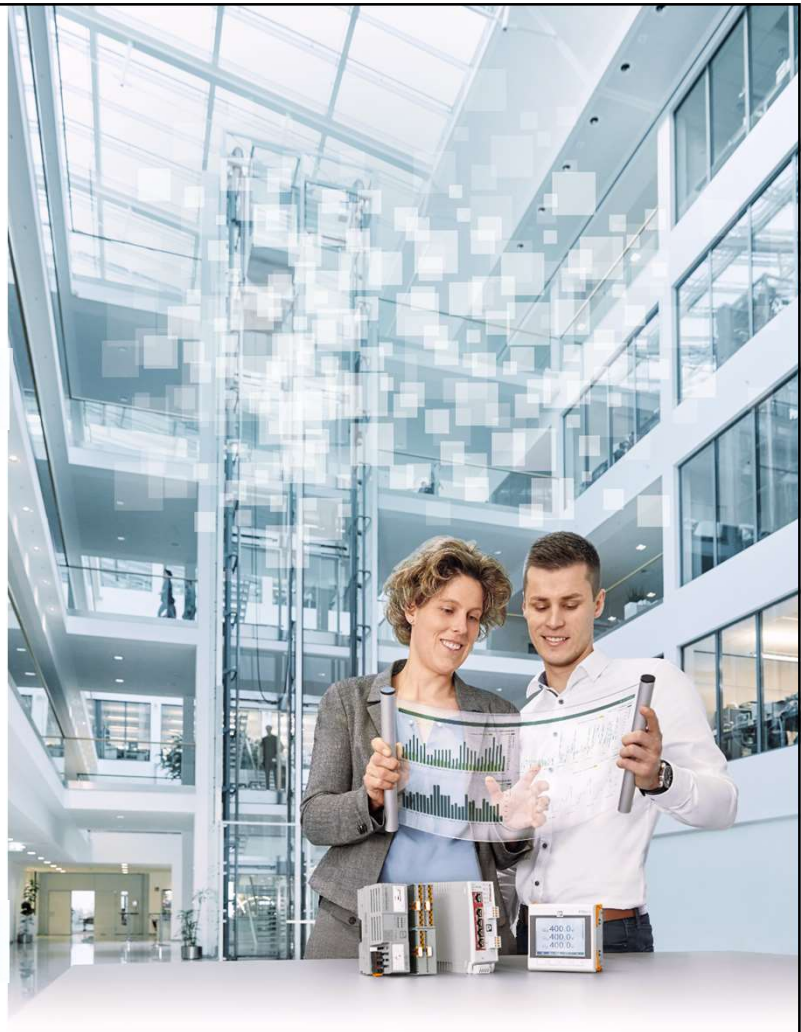
Digitalization and mankind

Digitalization does not replace people

Digitalization creates new jobs



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From a Factory to a Digital Factory

Digitalization changes our world

Flexible consumption

New, data centric business models

Mass customization

Economic production with batch size one

Smart devices / IoT

Networked systems as a basis

Knowledge sharing

Lack of skilled workers and efficient development processes

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Goals of Digital Factory

1. **Optimized production**
2. **Reduced costs**
3. **Idea-to-cash**

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Digital Factory | From a factory to a Digital Factory

Customer requirements and benefits

Enable new ideas

The Digital Factory transfers data into information. This information will be used to optimize processes and reduce costs.

- New business models
- Idea-to-cash

Flexible infrastructure

Our solutions are scalable to respond quickly to growth potentials. Independent on the factory and production size and amount of data – we are able to adapt a solution to every industry.

- Optimized production
- Update capability

Proof-of-concept

Everything was proven in our own production facility. From concept to maintenance, we provide finished and tested use cases.

- Reduced engineering costs
- Benefit from experience

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Challenges

- Extract relevant information from a huge amount of data automatically
- Get more information output with lower investment
- Reduced engineering costs by increasing automation and communication

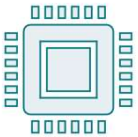
Technological aspects (technology push)

Industrial revolution

1.	Mechanical production	18th century
2.	Mass production	1870
3.	Automation of production	1969
4.	IIoT	Currently

- Steam machine
- Simplify and accelerate hard work

- Sequential work flow
- Increased production rate



- From relay to PLC
- Flexible control adaptions

- **Every device is connected**
- **Big data**

Illustration according to:
G. Reinhart, Handbuch Industrie 4.0, S.XXXI

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Changes through Digital Transformation

BEFORE INTERNET

- Clipboard
- Stack lights
- Memos
- Meeting
- Scheduler board
- Push buttons
- Phone calls
- Bells
- Daily reports

DIGITAL TRANSFORMATION

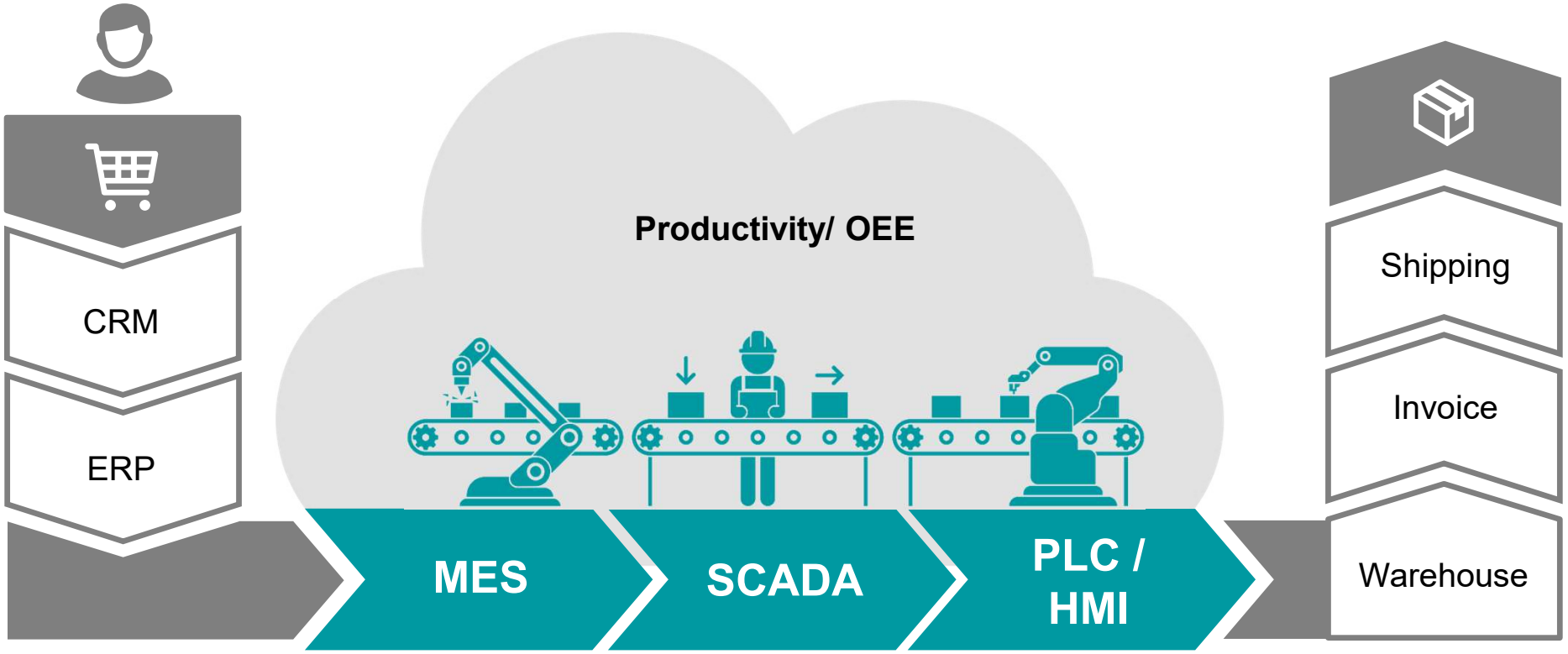
Process information available and accessible from everywhere
– No PAPER –

How to do the move to a Digital Factory?

WITH INTERNET

- E-mail/ SMS
- Andon board/ notification
- Digital comments (MES)
- Webpage (machine)
- Teams/ Zoom (Flow)
- Digital/ realtime
- Control room/ MES/ SCADA
- Video messaging
- Realtime opportunities

Why do many digitalization strategies fail?



OEE = Overall equipment effectiveness

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How to calculate OEE (overall equipment effectiveness)

1. Locate source of inefficiencies
2. Quantify the degree of inefficiency

OEE combines three factors:

Availability (**A**)	100% machine is available at scheduled time
Performance (**P**)	100% performance at max. speed
Quality (**Q**)	100% of all parts are OK

$$OEE = A * P * Q$$

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The six big losses of OEE

A. Planned output

B. Gross output

C. Net output

D. Valuable output

5. Start up scrap
6. Scrap

3. Idling
4. Reduced speed

1. Breakdowns
2. Set-ups & changeover

$$\underbrace{\frac{Gross\ output}{Planned\ output}}_{\downarrow\ Availability\ rate\ \boldsymbol{A}} * \underbrace{\frac{Net\ output}{Gross\ output}}_{\downarrow\ Performance\ rate\ \boldsymbol{P}} * \underbrace{\frac{Valuable\ output}{Net\ output}}_{\downarrow\ Quality\ rate\ \boldsymbol{Q}} = \boldsymbol{OEE}$$

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How to move to a Digital Factory?

Digital Transformation

- Digitization of business
  - No paper
  - Unified data
- Gather information with actual data
- Use of digitalization **to inform and guide** people

Industry 4.0

- 4th industrial revolution
  - Network/ technology
  - Standards/ protocols
- Smart production principles
  - Connection of all machines and systems
  - Open architecture

Digital Factory

- The result of Digital Transformation and Industry 4.0
- Information from each producer to each consumer
- Available data anytime, everywhere
- Translation of data into information

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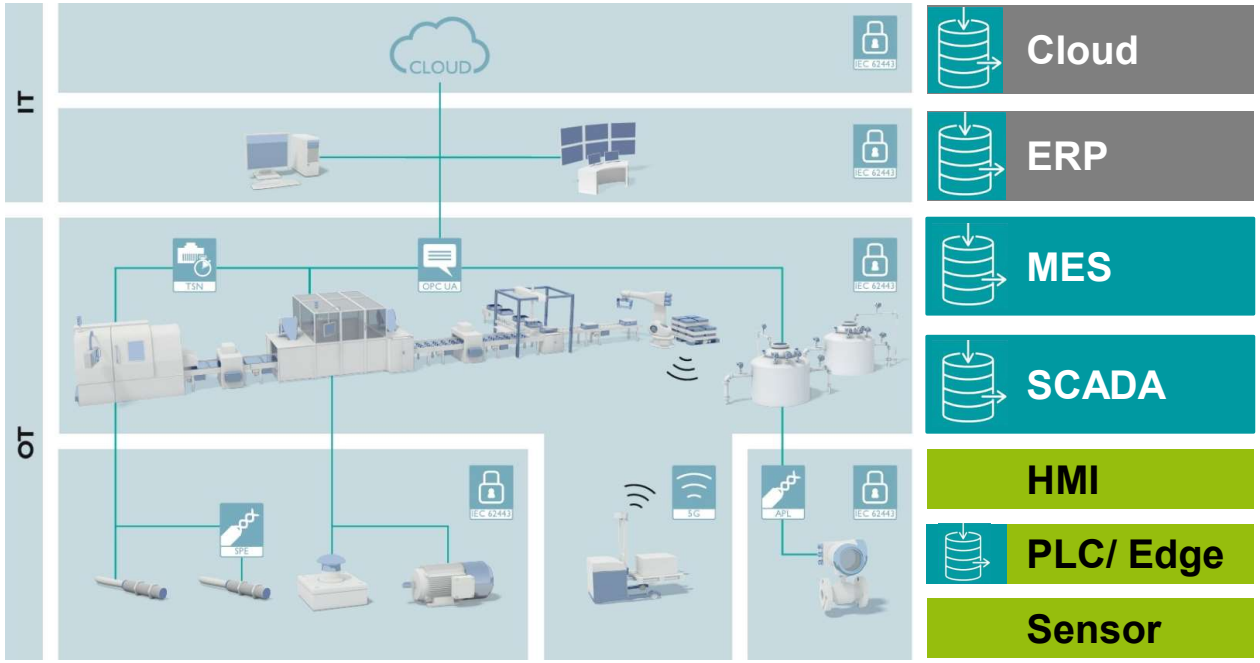
Why does the current architecture prevent innovation?



Cloud

ERP

MES

SCADA

HMI

PLC/ Edge

Sensor

Solut ntered

- No normalization
- No abstraction
- No standard
- Only high-value projects
- Data silos

Show stopper for optimization projects !

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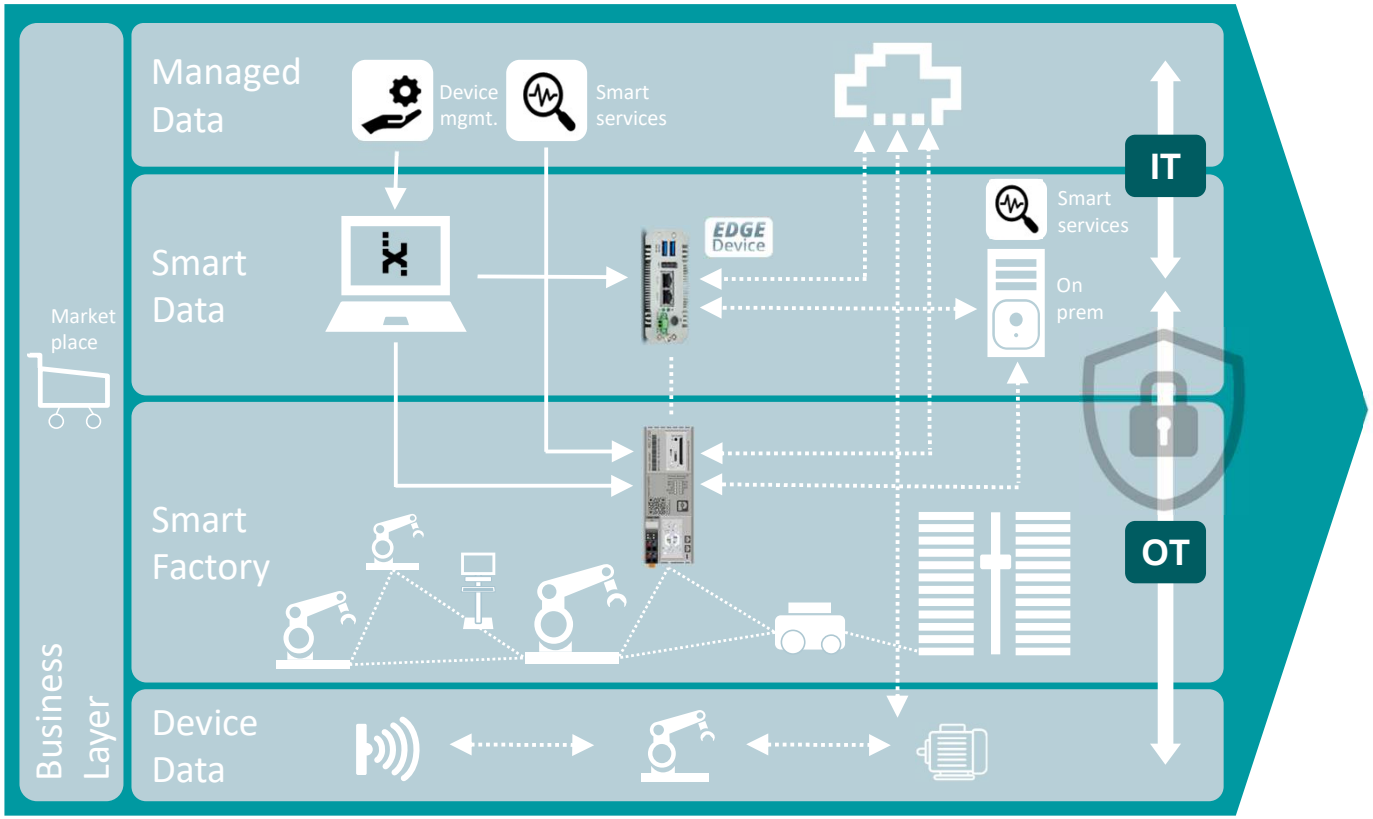
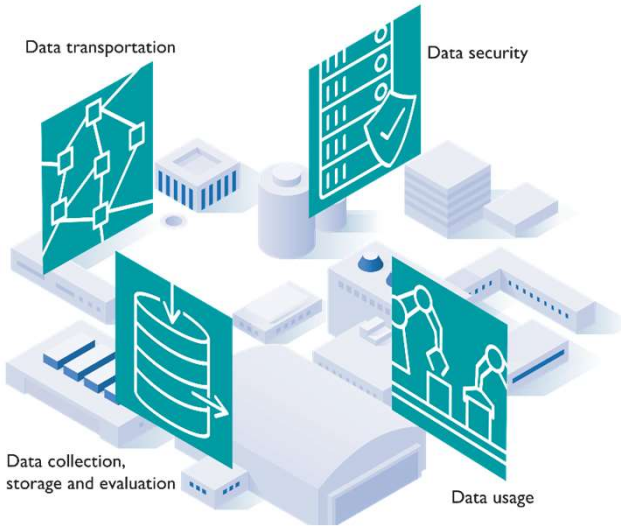
Digital Factory | From a factory to a Digital Factory

Create a solution to enable factory optimization





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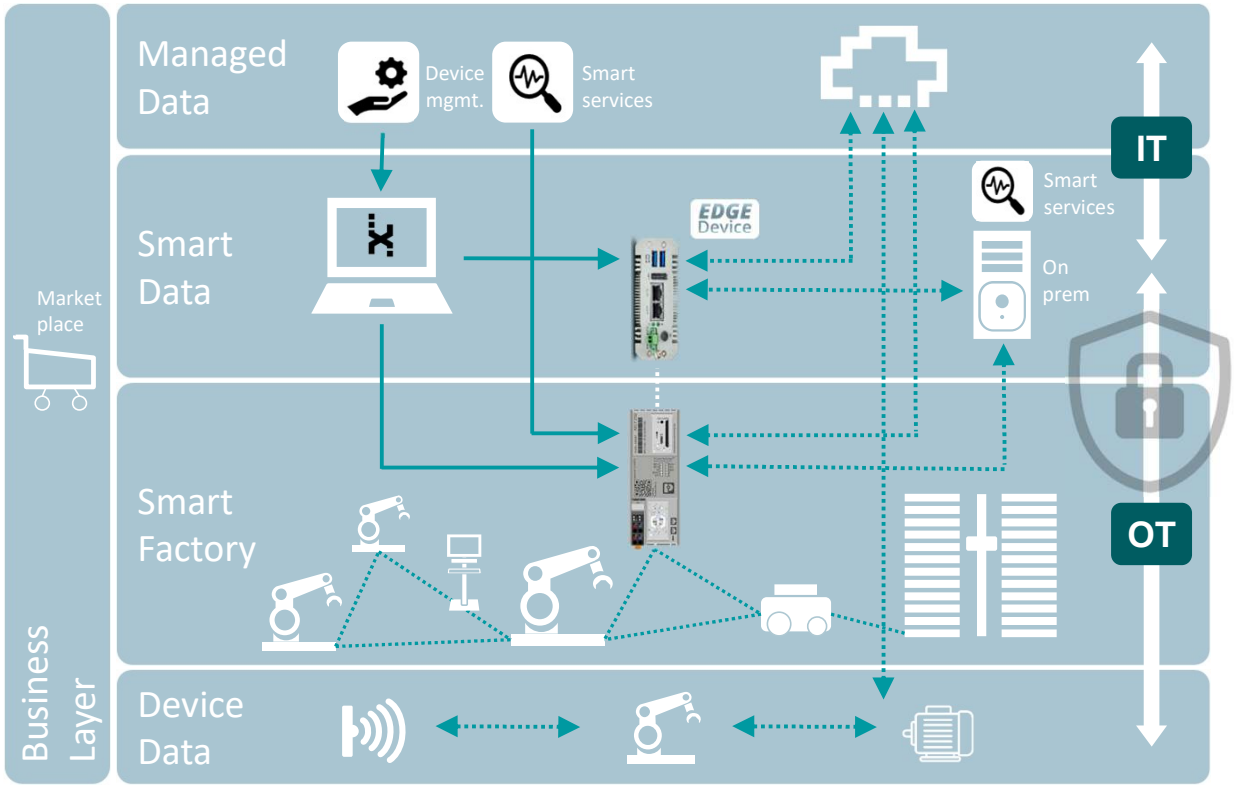
Digital Factory | From a factory to a Digital Factory

Application-oriented customer approach



Data transportation

- Network structuring and management
- Ensure data quality and bandwidth
- Select the ideal digital infrastructure

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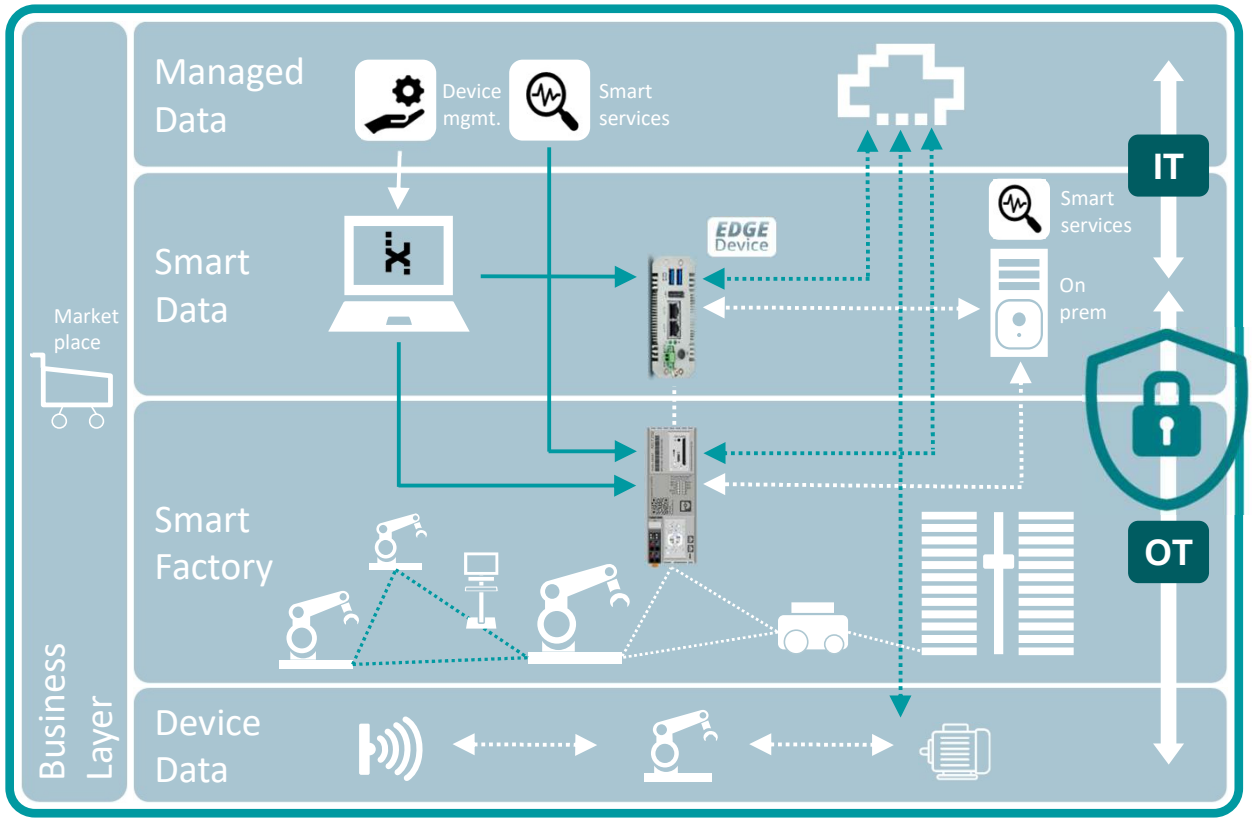
Digital Factory | From a factory to a Digital Factory

Application-oriented customer approach



Data security

- Protect the factory against hacker attacks
- Ensure a state-of-the-art protection
- Worldwide support

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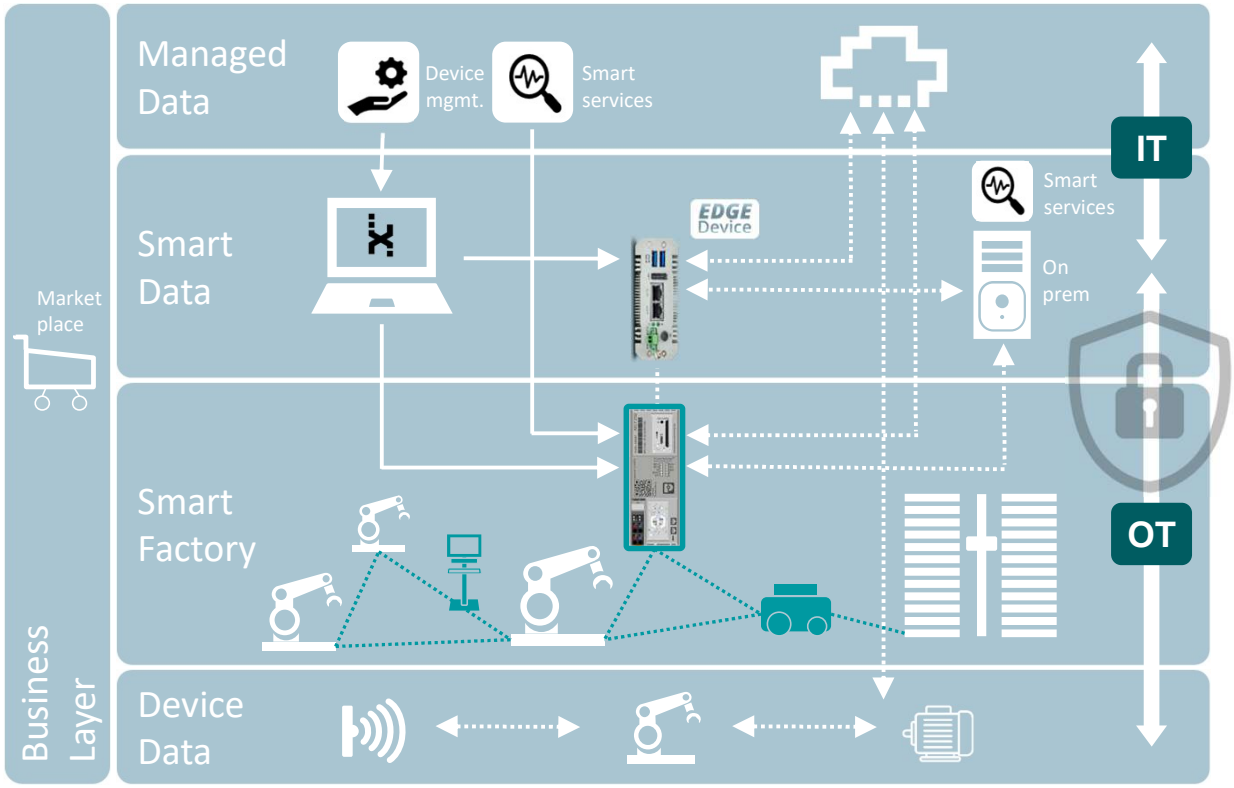
Digital Factory | From a factory to a Digital Factory

Application-oriented customer approach



Data usage

- Smart production
- Horizontal and vertical integration – easy and fast
- Ensure openness to other systems

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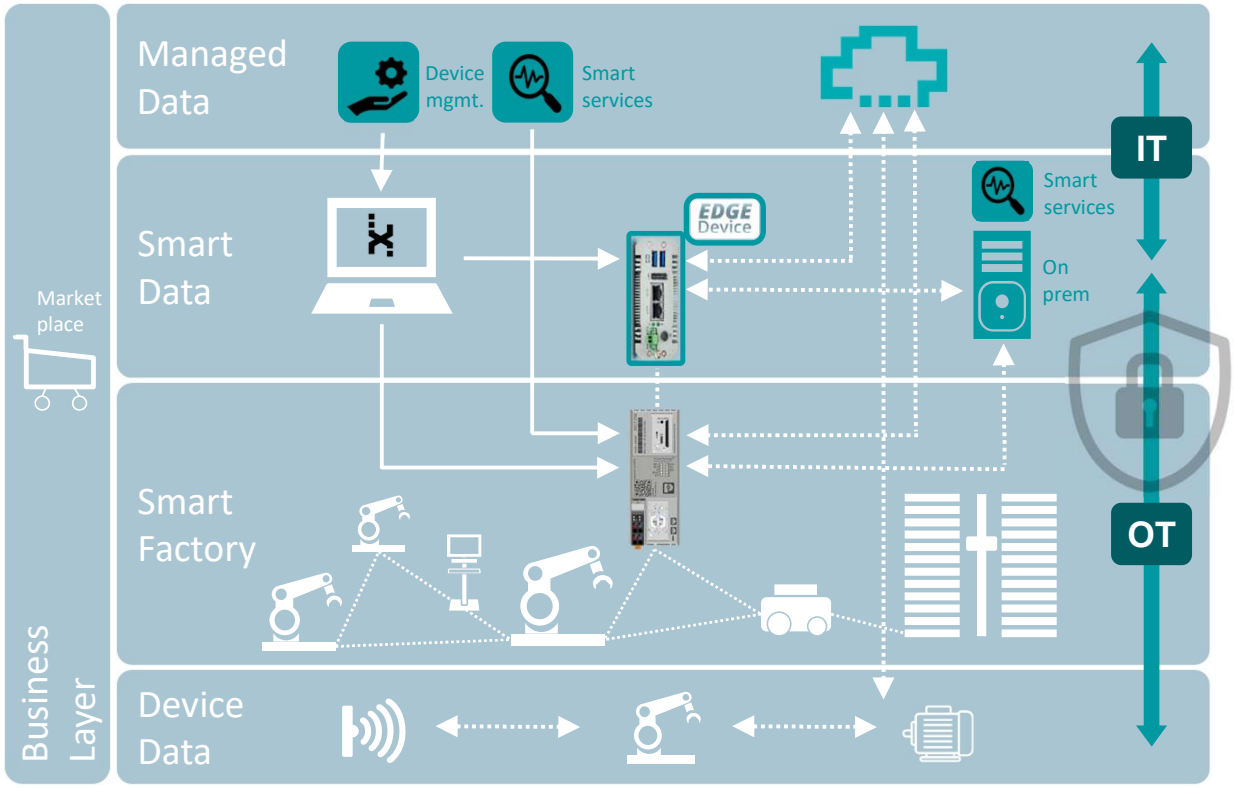
Application-oriented customer approach



Data collection, storage and evaluation

- Data acquisition with full connection from OT to IT
- Ensure normalized data
- Transform data into information

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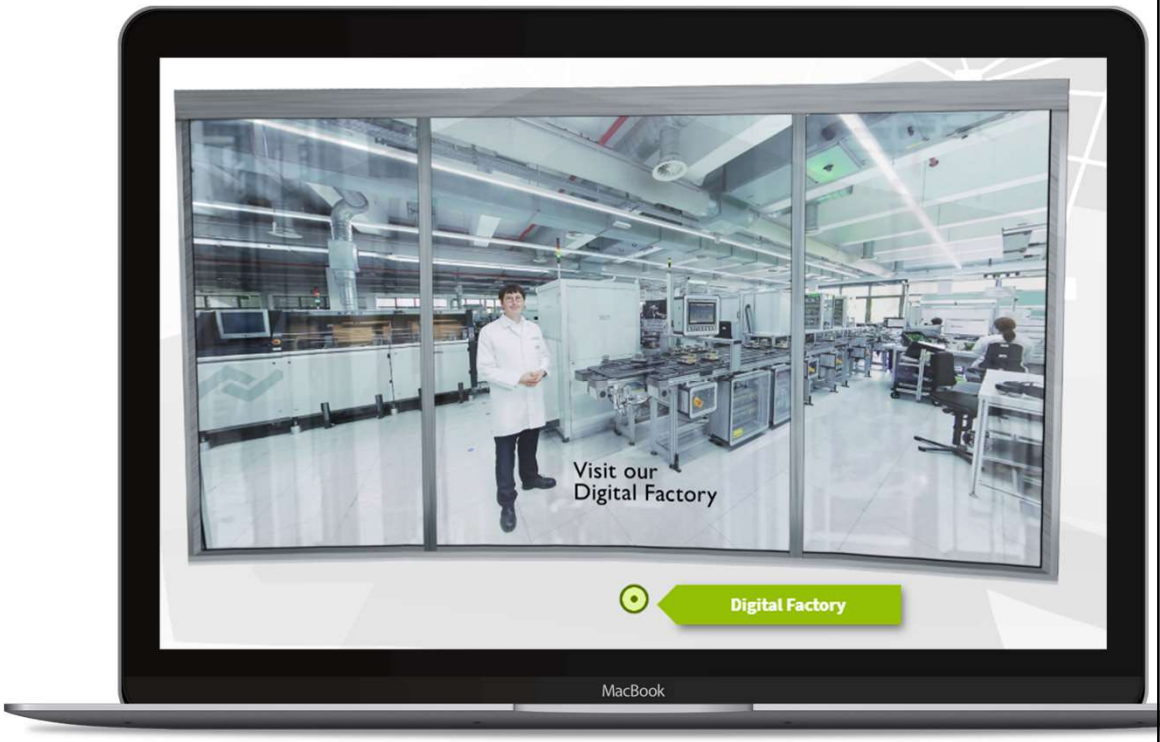
Proof-of-concept in our own Factory in Bad Pyrmont



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Our Uses Cases for your Productivity Increase

Segments of Digital Factory

Data transportation

Network structuring and management

Data collection, storage and evaluation

Data conversion into information

Data security

Investment protection against unwanted access

Data usage

Simple horizontal and vertical integration

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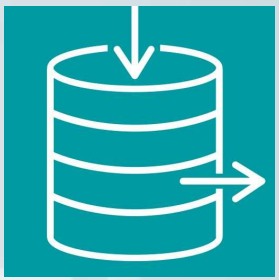

Data Collection, Storage, Evaluation

Digital Factory

Data collection, storage and evaluation

- Full connection from OT to IT
- Normalized data
- Reduced engineering costs

Data collection

OT meets IT

Anomaly detection

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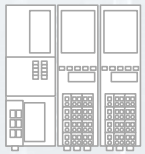
Digital Factory | Data collection, storage and evaluation

Data conversion into beneficial information

collect



- PLCnext, Edge
- EMPro
- Isolators, Smart Elements
- …

Different data sources

store

MQTT.ORG

Microsoft SQL Server

PROFICLOUD

influxdb

Actual or historic data bases

evaluate

alteryx

SIGA OT Solutions

PHOENIX CONTACT Smart Business GmbH

Data to information with data analytics partner

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Requirements translated into GDAs

Optimization requires a good data base

1. Data collection
    1. Open to OT and IT protocols
    2. Possible adjustment to specific data sources
    3. Normalization of data
2. Data storage
    1. Scalable – PLC, on premise (DB), cloud
    2. Realtime and historic
3. Data evaluation
    - Idea-to-cash
    - Optimizations (e.g. reducing downtimes)

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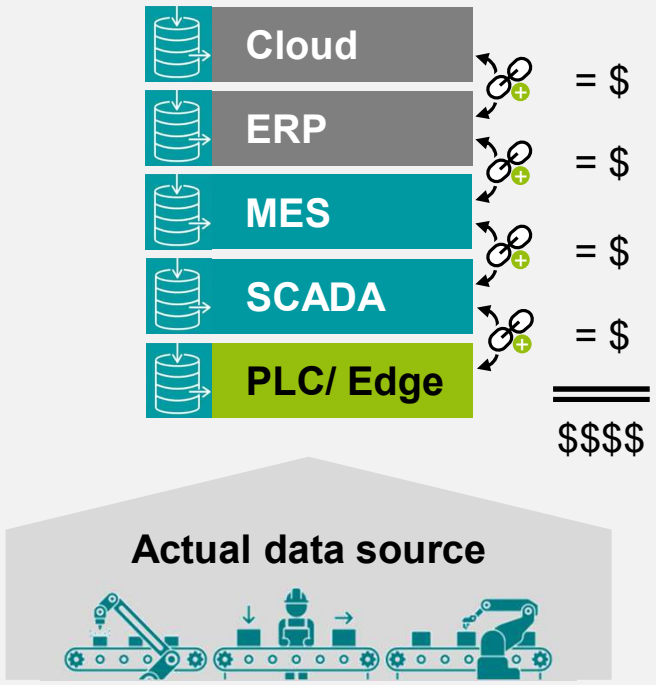
Current costs of data collection



Challenges:

- Data silos are structured in different layers
- External interfaces are needed to communicate between the layers
- Every interface creates costs
- Disadvantages:
  - Expensive
  - Inflexible
  - No standard

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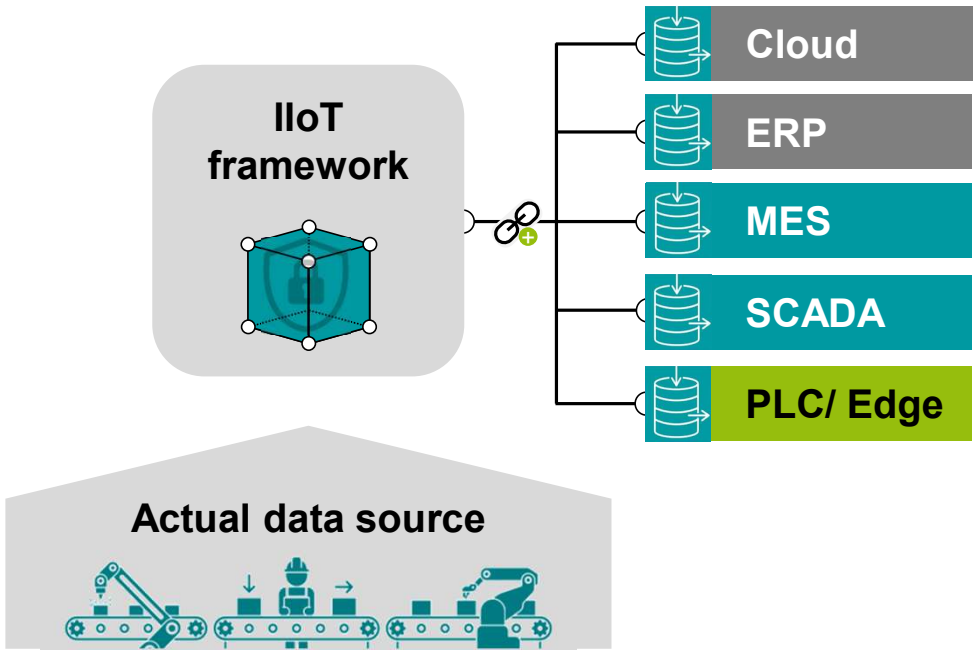
The IIoT framework connects all layers



Solution:

- All layers are connected from ERP to PLC
- Actual data on every layer
- Security is considered

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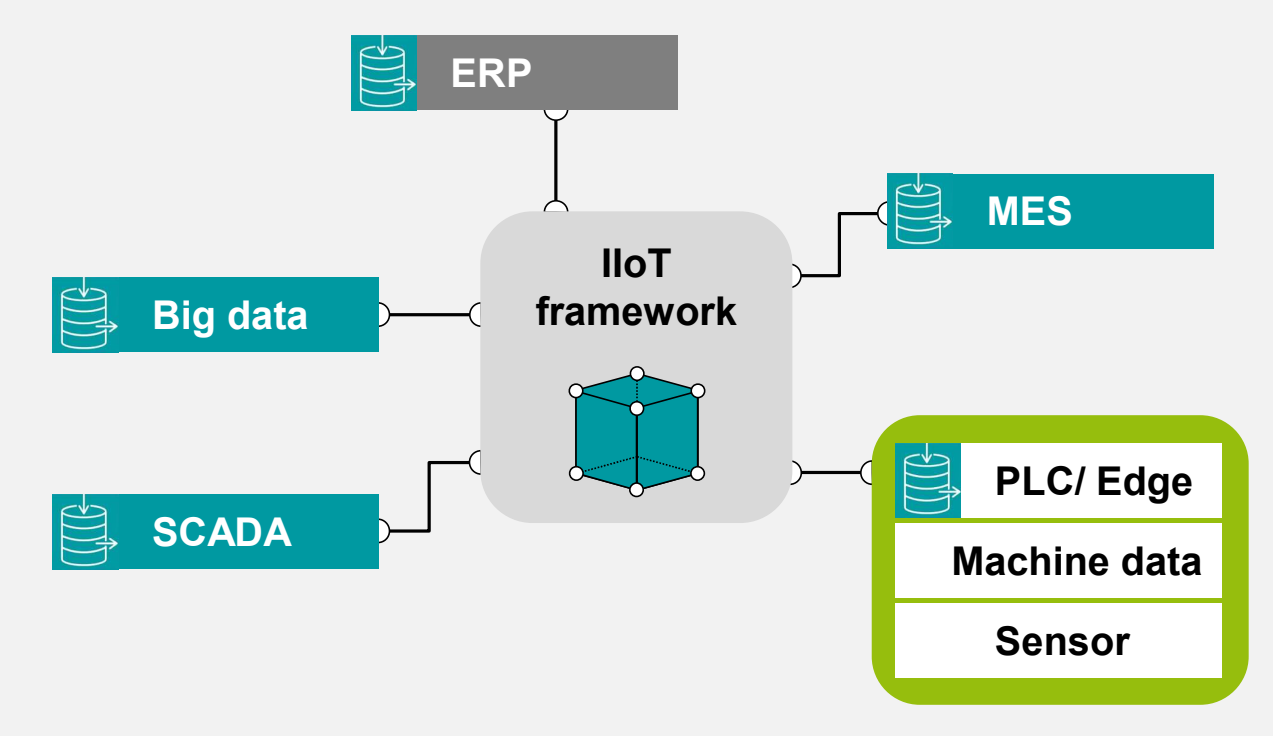
Digital Factory | Data collection, storage and evaluation

One language for all systems



- Normalization
- Abstraction (name space)
- Standard
- No data gaps
- Scalable
- No data silos
- Idea-to-cash: small projects can be implemented quickly

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Data storage: different data bases are needed

- Fast storing
- Fast reaction
- Adjustment of processes with the help of realtime data

- Actual data from everywhere
- Decisions are based on truth of data
- Used for visualization MQTT Broker

- Big amount of data
- Saved as historic data
- Base for AI services
  - Machine learning
  - Anomaly detection

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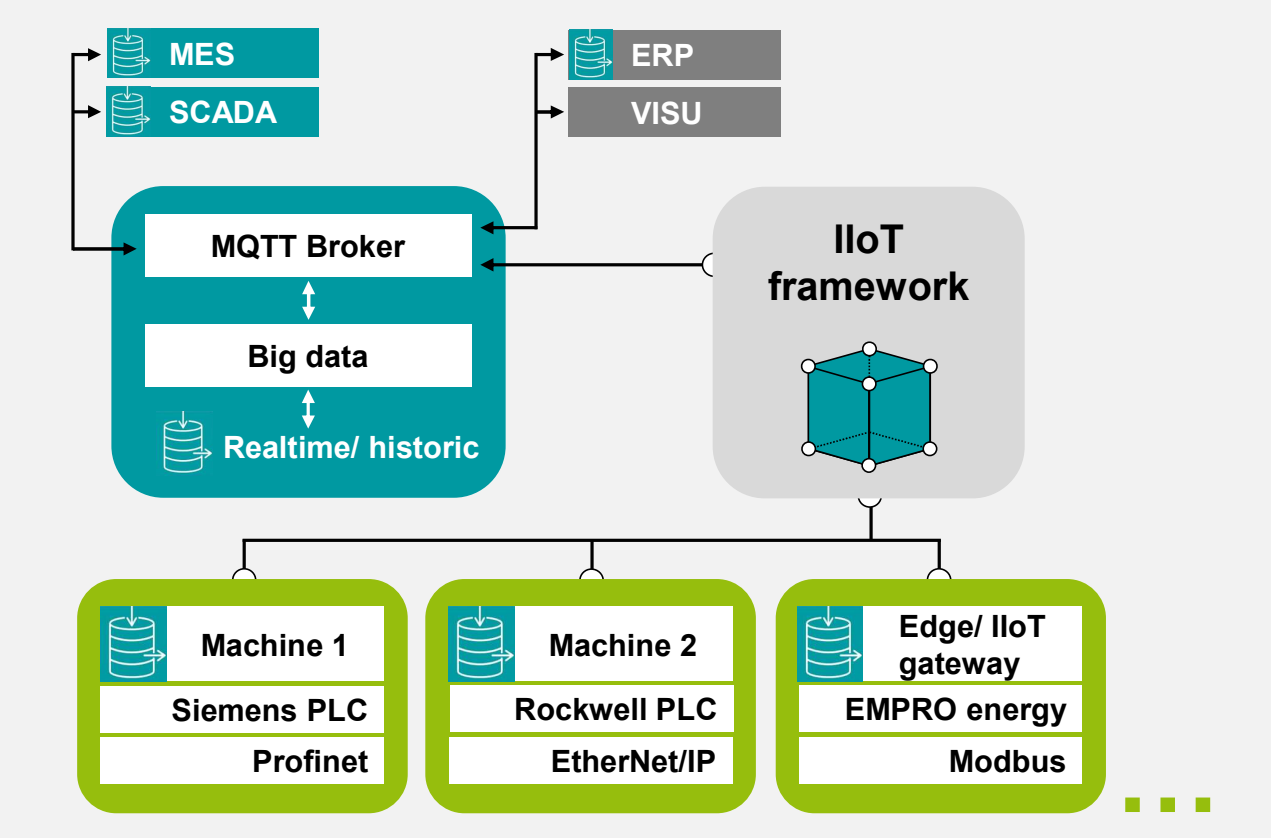
Possible IIoT solution



- Normalization and connectivity as a standard
- Scalable
- Open framework

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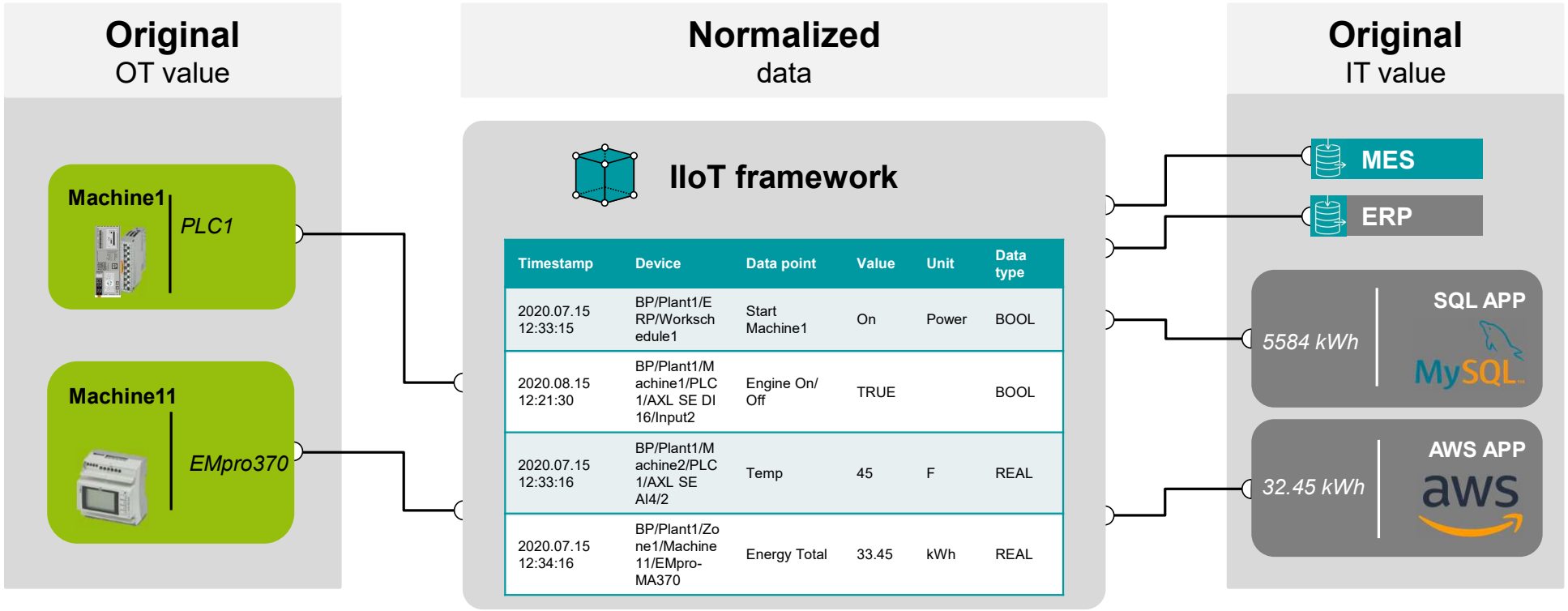
Digital Factory | Data collection, storage and evaluation

OT meets IT thanks to normalization of data



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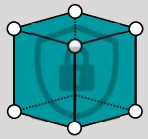
Digital Factory | Data collection, storage and evaluation

IIoT framework from Phoenix Contact is the solution

- ✓ **Collect and standardize** your industrial data in one solution abstraction (name space)
- ✓ **Deliver** data more efficiently – timestamped and on data change
- ✓ **Less effort** to implement custom scripts and middleware – easy-to-scale

IIoT framework



- ✓ **Reduced time** required preparing data for analysis – normalized and easy-to-read
- ✓ **Ensuring** system-wide security – device and patch management and certification updates
- ✓ **Less time spent** on integration and maintaining system integrations

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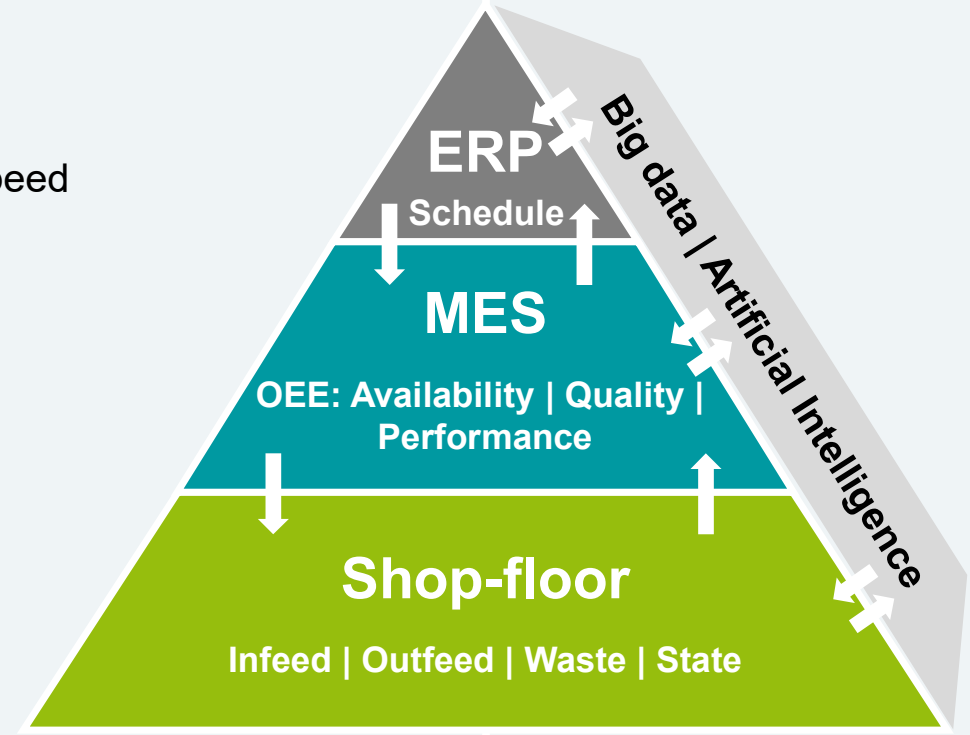
Digital Factory | Data collection, storage and evaluation

Change of workflow

- Not enough output
- Accelerate machine speed
- Better OEE ?
- More waste
- Increased costs



- Not enough output
- Recommendations for optimal parameters
- Better OEE
- Higher quality
- Cost savings

Before digitalization

With digitalization

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Summary

Our value proposition for your Digital Factory

In order to meet today's digitalization requirements and profitably realize opportunities, our solutions offer you the following added values:

- Scalable – individually tailored your requirements
- Tested and validated – in our own production
- Ready-to-use – benefit from the Digital Transformation today

With goal-oriented consulting, we find together the right solution for your Digital Factory. Let's tackle the challenges of digitalization together and seize the opportunities.

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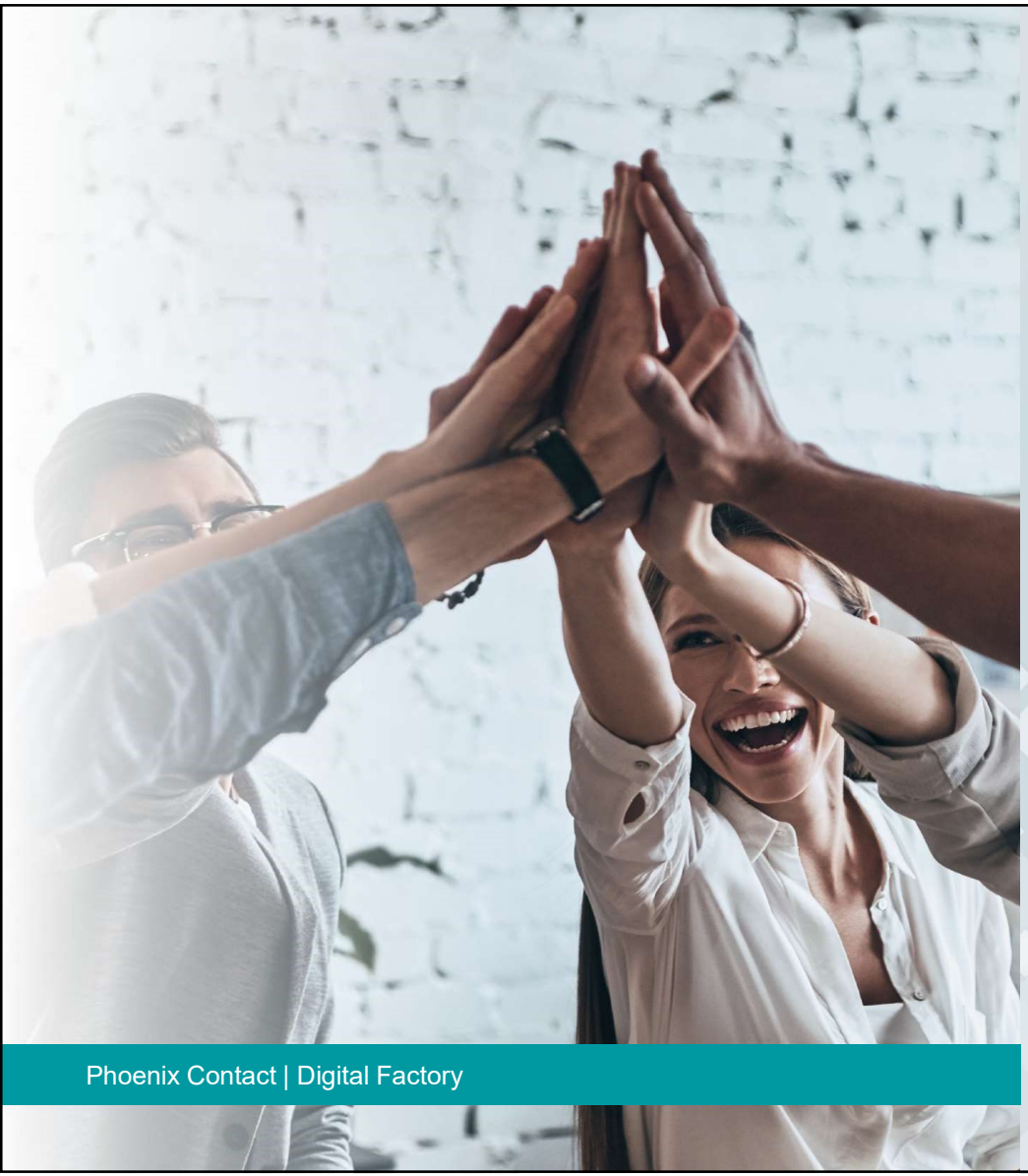

Phoenix Contact | Digital Factory

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