INC
INVENTION
CENTER

How to establish a "Print 4.0" implementation plan

Patrick Kabasci & Dr. Andreas Kraushaar

Before we start…

? !

Please ask your questions at any time in the Questions and Answers function.
A moderator collects your questions, which will be answered in a 20-30 minute Q&A session at the end of the seminar.

Welcome – About us

Patrick Kabasci

Director Operations Hong Kong

INC Invention Center at RWTH Aachen Campus

Dr. Andreas Kraushaar

Head of Department Prepress

Fogra Research Institute for Media Technologies

Technology trends

Idea to Industy

Time to market

Disruptive Strategies

Innovation culture

OEM to ODM

Agile Development

»We create world class innovators«

Market trends

New business models

Market launch

Digitalization

Decision making

Roadmapping

Portfolio Management

A clear strategy and mastered process to success

e.GO Mover

e.GO

STREETSCOOTER

UNLIMITED X

REHAU
Unlimited Polymer Solutions

e.SAT

Aachen's Contribution to Industrie 4.0

>> **Your entrance card to 'Engineering Valley' at RWTH campus**

Research: Fraunhofer IPT and WZL

Opinion leaders since the beginning and current internationally renowned strong expertise
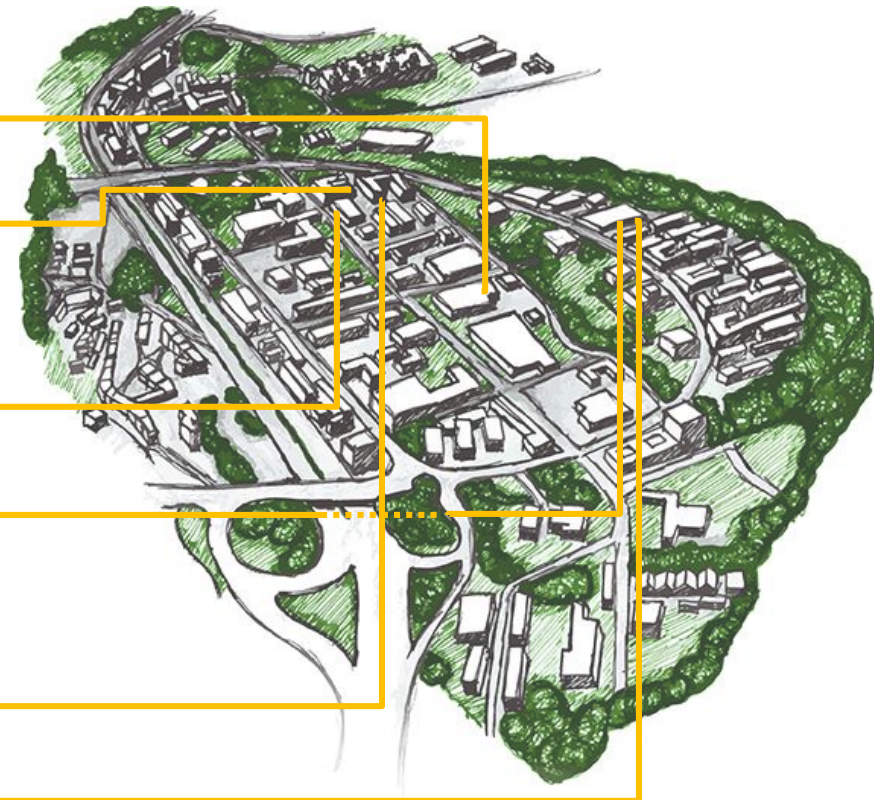
Fraunhofer IPT

WZL | RWTH AACHEN UNIVERSITY

Industry support: KEX and I4.0MC

Cutting-edge research interpreted and condensed to meet industry needs

KEX. Knowledge Exchange®

INDUSTRIE 4.0 MATURITY CENTER

Application: e.GO

Examples of Industrie 4.0 in real production – from prototyping to electric car production in series

e.GO

DEMOFABRIK AACHEN

What we do

Community

Interact with our community of leading innovators and researchers to find valuable collaboration opportunities

Advisory

Get support from the concept to the implementation phase to make your innovations faster and more successful

Implementation

Get access to top technology, market & innovation experts and find out about relevant trends & developments ahead of time

Trainings

Build up the skills in your employee base to become a world-class innovator for your products, production and services

Your partner for innovation in Hong Kong

Our focus areas in Hong Kong are:

INDUSTRIE 4.0	TECHNOLOGY	INNOVATION
Helping companies to Industrie 4.0 in the Greater Bay Area	Bringing top-edge German technology expertise and engineering in Industrie 4.0 and Data Analytics to your projects	Program to transform traditional OEM manufacturers to OBM companies

Together with HKPC, our Hong Kong office will support you from the starting point to becoming a world-class innovator

Services:

- Trainings
- Strategy definition
- Assessments
- Coaching and advisory
- Finding relevant experts
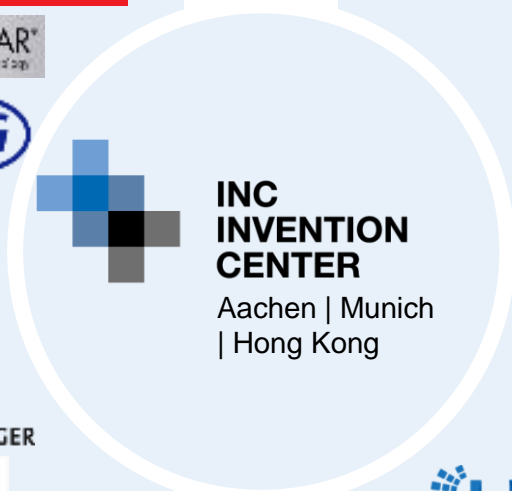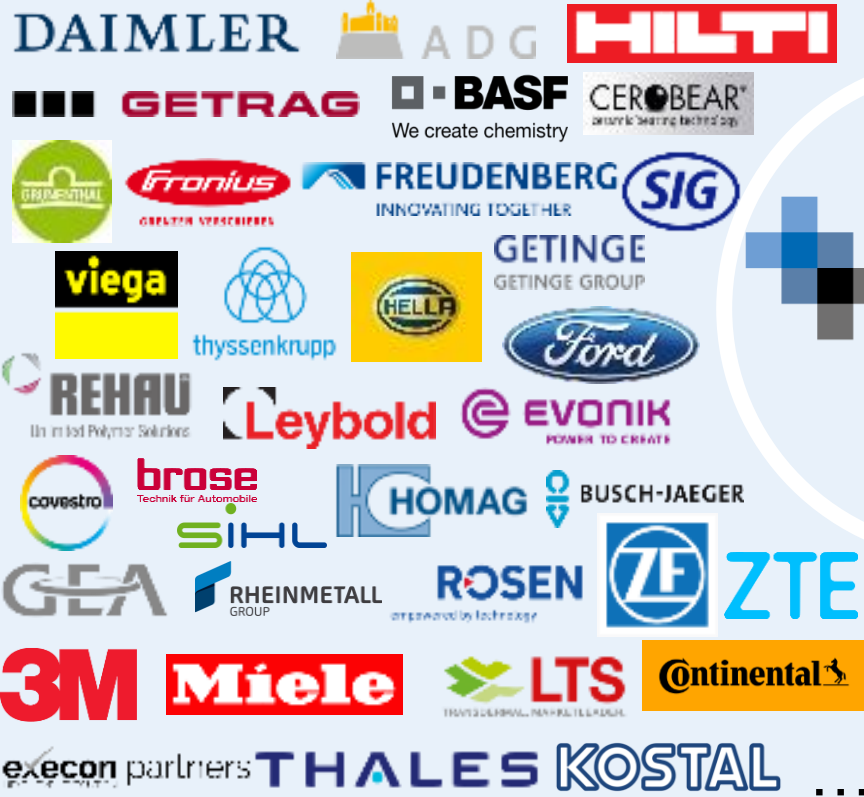- Joint development of prototypes

Topics:

- Industry 4.0
- Product and service innovation
- Data Analytics

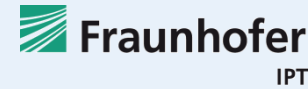# The Invention Center network enables Big Innovations to happen

World-leading innovators as corporate members interested in joint development of the solutions of tomorrow

DAIMLER · ADG · HILTI · GETRAG · BASF (We create chemistry) · CEROBEAR (ceramic bearing technology) · Fronius · FREUDENBERG (INNOVATING TOGETHER) · SIG · viega · thyssenkrupp · HELLA · GETINGE (GETINGE GROUP) · Ford · REHAU (Unlimited Polymer Solutions) · Leybold · EVONIK (POWER TO CREATE) · covestro · brose (Technik für Automobile) · SIHL · HOMAG · BUSCH-JAEGER · GEA · RHEINMETALL GROUP · ROSEN (empowered by technology) · ZF · ZTE · 3M · Miele · LTS · Continental · execon partners · THALES · KOSTAL · …

INC INVENTION CENTER

Aachen | Munich | Hong Kong

...

Fraunhofer IPT — 80 Fraunhofer institutes in Germany and all leading innovation hubs (USA, Scandinavia, Asia, …)

TIME Research Area Technology, Innovation, Marketing, Entrepreneurship · RWTH AACHEN UNIVERSITY · WZL · RWTH AACHEN UNIVERSITY · RWTH AACHEN CAMPUS — Over 200 institutes at a leading technical university in Germany

KEX. Knowledge Exchange — Leading solution providers in Industry 4.0, Additive manufacturing, Data analytics and future mobility

hkpc — Local partners for implementing innovation, Industry 4.0 and Advanced Manufacturing

Leading research partners provide expertise and access to a worldwide network of knowledge

Local understanding and Global expertise -
We are looking forward to cooperate with you
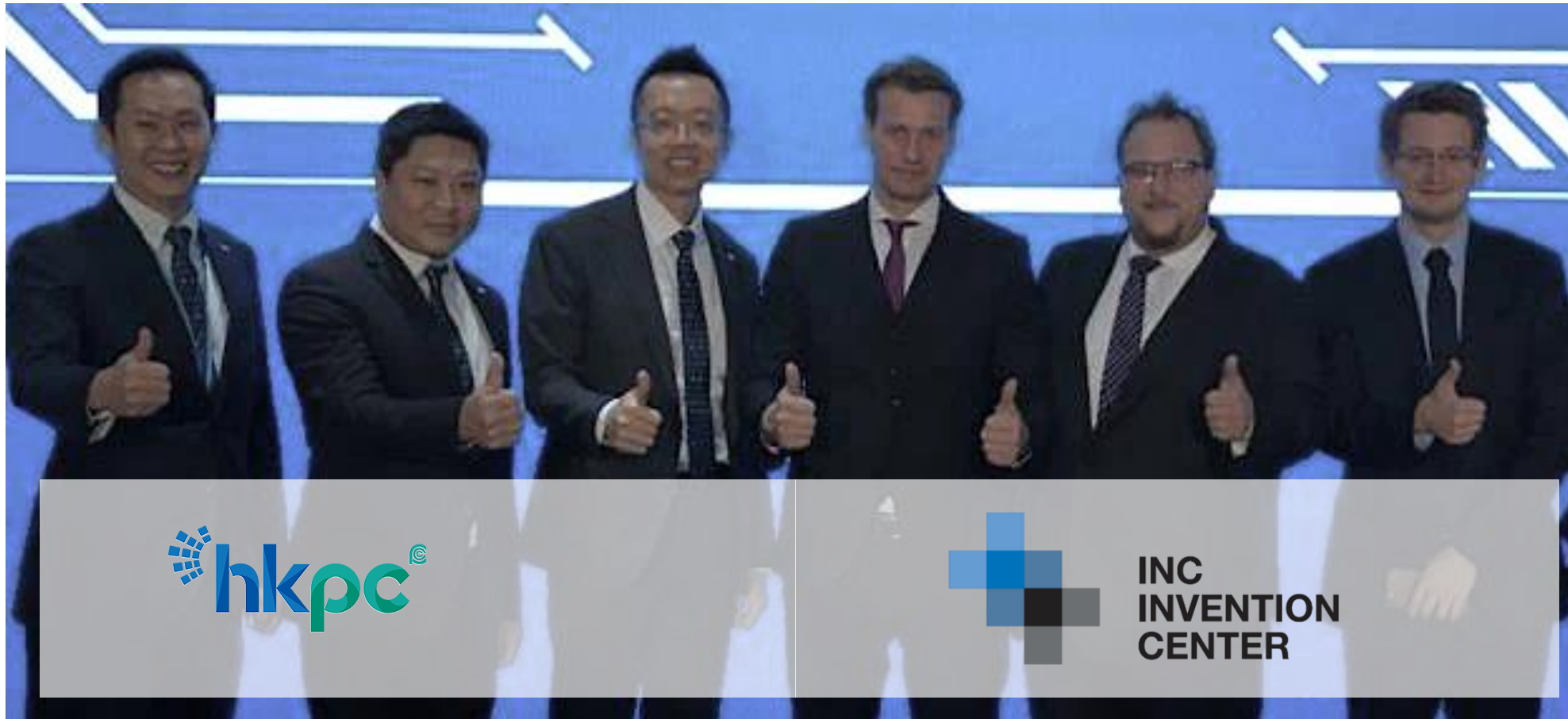
Want to know more about INC Invention center

» ## Visit our Website:

www.invention-center.hk

» ## Write us an e-Mail:

info.asiapacific@invention-center.de

Berlin, Germany

Paris, France

Self organizing systems – industry 4.0

Berlin, Germany

Paris, France

Industry 4.0

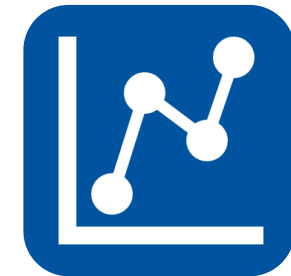Industry 4.0 is <u>not just</u> automation

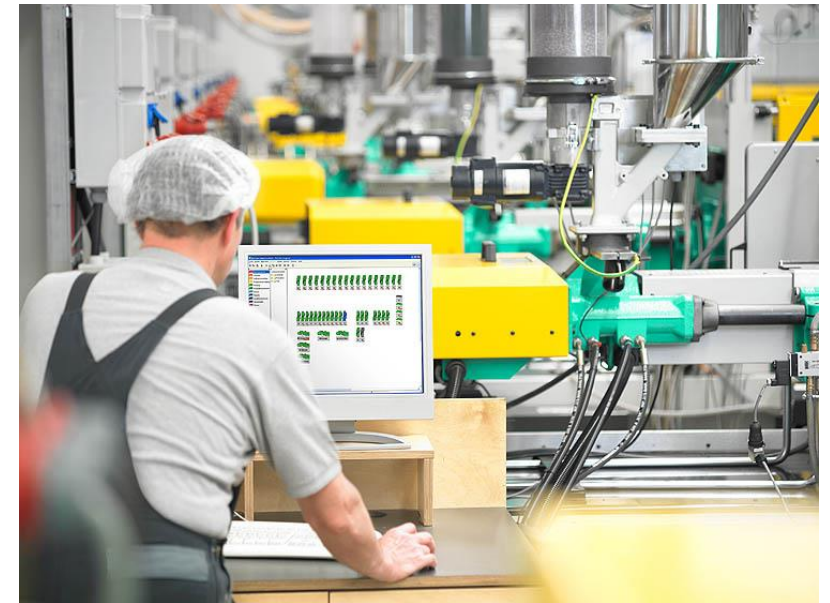# Think about smart devices…

Sensors & Input

Output & HMI

Connectivity

Data Analytics

…and this Intelligence
Is now brought to the whole value chain

Industrial Internet

Cyber-Physical Systems

Smart Services

Internet of Services

Smart Production

Internet of Things

Industry 4.0

Factories of

Digitalization the Future

Smart Cities

Smart Products

Smart Manufacturing

Smart Factory

Smart Home

Definition of Industry 4.0

Platform Industry 4.0

„The Term Industry 4.0 stands for the fourth industrial revolution. Best understood as **a new level of organization and control** over the **entire value chain of the life cycle of products**, it is geared towards increasingly individualized customer requirements. (…) The basis for the fourth industrial revolution is the **availability of all relevant information** in real time by connecting all instances involved in the value chain. The ability to derive the optimal value-added flow at any time from the data is also vital. The connection of people, things and systems **creates dynamic, self-organizing, real-time optimized value-added connections** within and across companies. (…)"
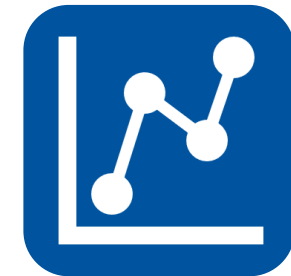
Is it the technology?

Sensors & Input

Output & HMI

Connectivity

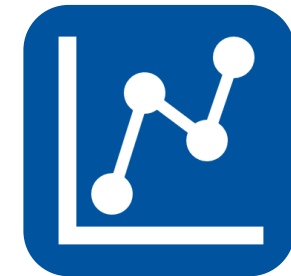Data Analytics

Is the technology enough?

Sensors & Input

Connectivity

Output & HMI

Data Analytics

Start with the Value!

Smart Navigator

Driving the digital transformation of the printing industry

Connectivity

Data Analytics

Sensors & Input

Smart Processes

Smart Supply Chain

Output & HMI

Smart Products & Services

New Digital Business Models

Smart Production

Mindset and Culture

Uniqueness

Application

Enablers

Strategy and Organization

Value

Growth & Revenue

Productivity & Efficiency
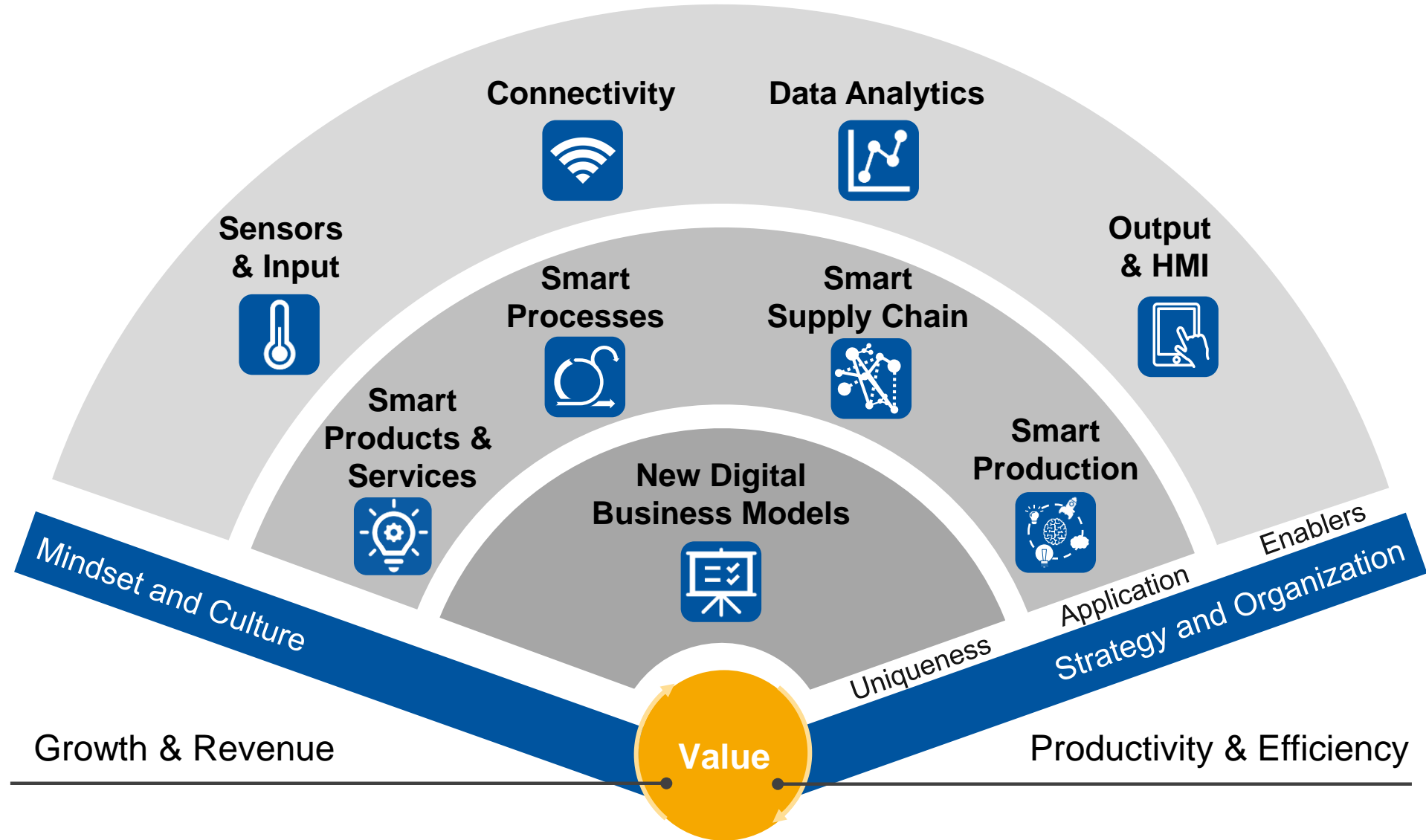
Current Market trends influencing the Printing Industry

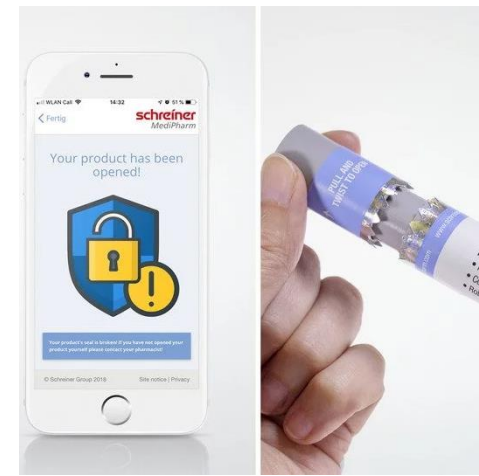**Mass customization**

Seamless media switch

Augmented product experience

Packaging as product experience

Documentation and compliance

Smart Navigator for Print 4.0

Driving the digital transformation of the printing industry
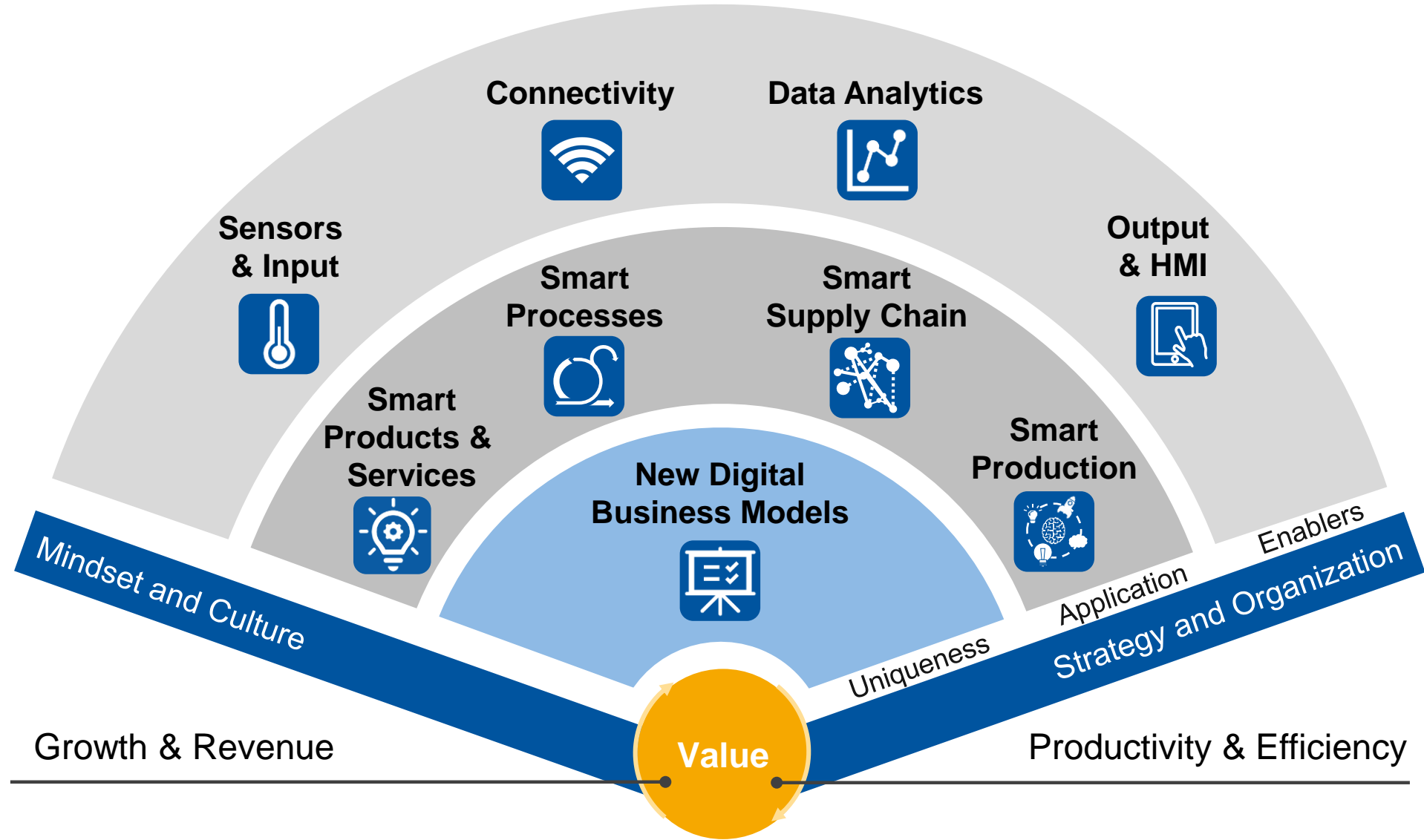
New Digital Business Models

» While publishers are positioning themselves as content providers, print service providers are increasingly offering Infrastructure-as-a-Service services (secure data management in the cloud). The combination of content and data enables the development of additional services in the form of user or advertising apps.

The way to Print 4.0 for your company

What does your company need on the way to new business models?

- Develop a clear understanding of the value brought to customers with the new services

- Develop competences in the technologies needed

- Build up required infrastructure

- Engrain the new services into your sales and marketing operations

The way to Print 4.0 for your company

How do you have to proceed to develop new business models?

- Start small – pilot with interested customers and start internal projects

- Optimized processes first – sometimes existing infrastructure works well once processes are systemized and digitalized

- Consider the impact on company culture and organization

- Transform along the HK i4.0 Maturity model – start by digitalizing, inside-out from production, to the higher levels of disruptive business models

Smart Navigator

Driving the digital transformation of the printing industry

Connectivity

Data Analytics

Sensors & Input

Output & HMI

Smart Processes

Smart Supply Chain

Smart Products & Services

Smart Production

New Digital Business Models

Mindset and Culture

Strategy and Organization

Uniqueness

Application

Enablers

Growth & Revenue

Productivity & Efficiency

Value
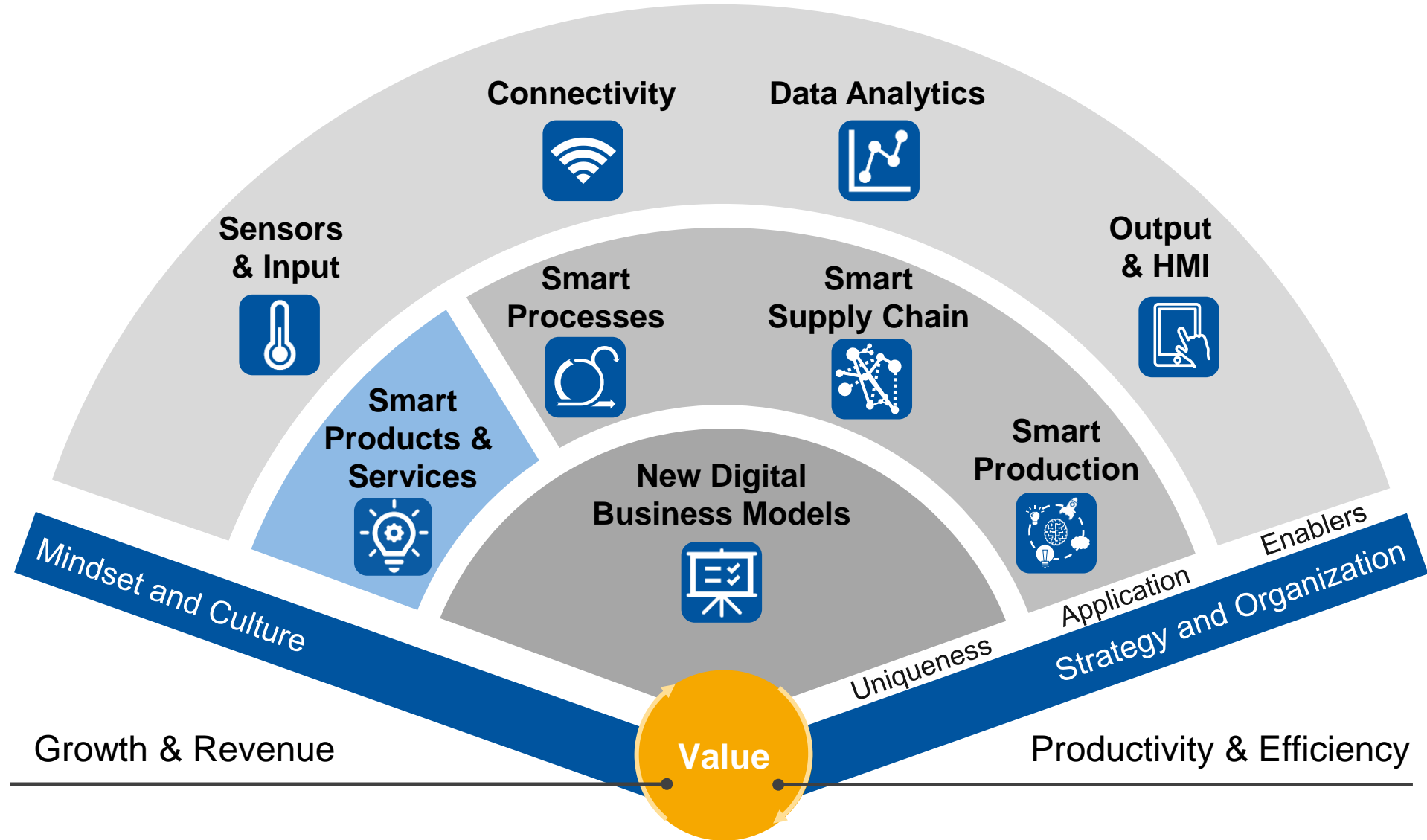
Smart Products & Services

» Johnnie Walker uses thin electronic sensors that transmit when the bottle has been opened or where in the distribution chain it is currently located. In addition, the bottle can upload promotional offers while the bottle is still in the store. But as soon as the sensor indicates that the bottle has been opened, the information is exchanged with cocktail recipes.

The way to Print 4.0 for your company

What does your company need on the way to smart products and services?

- Obviously you need the machines and processes to apply smart ink and/or integrate printed or roll-to-roll circuitry

- But also the way you get data will be impacted, and smaller customers will first need to get to know the new possibilities
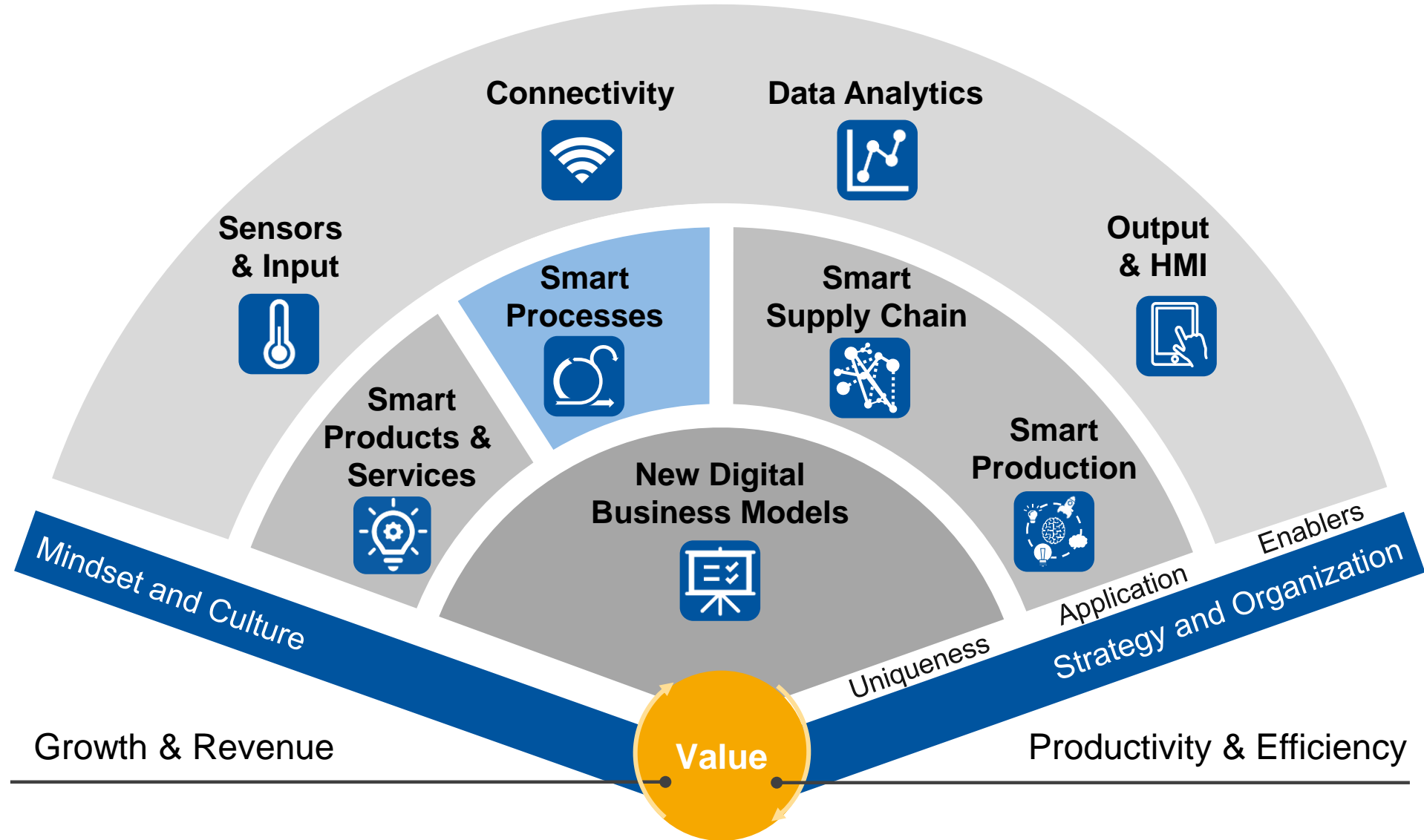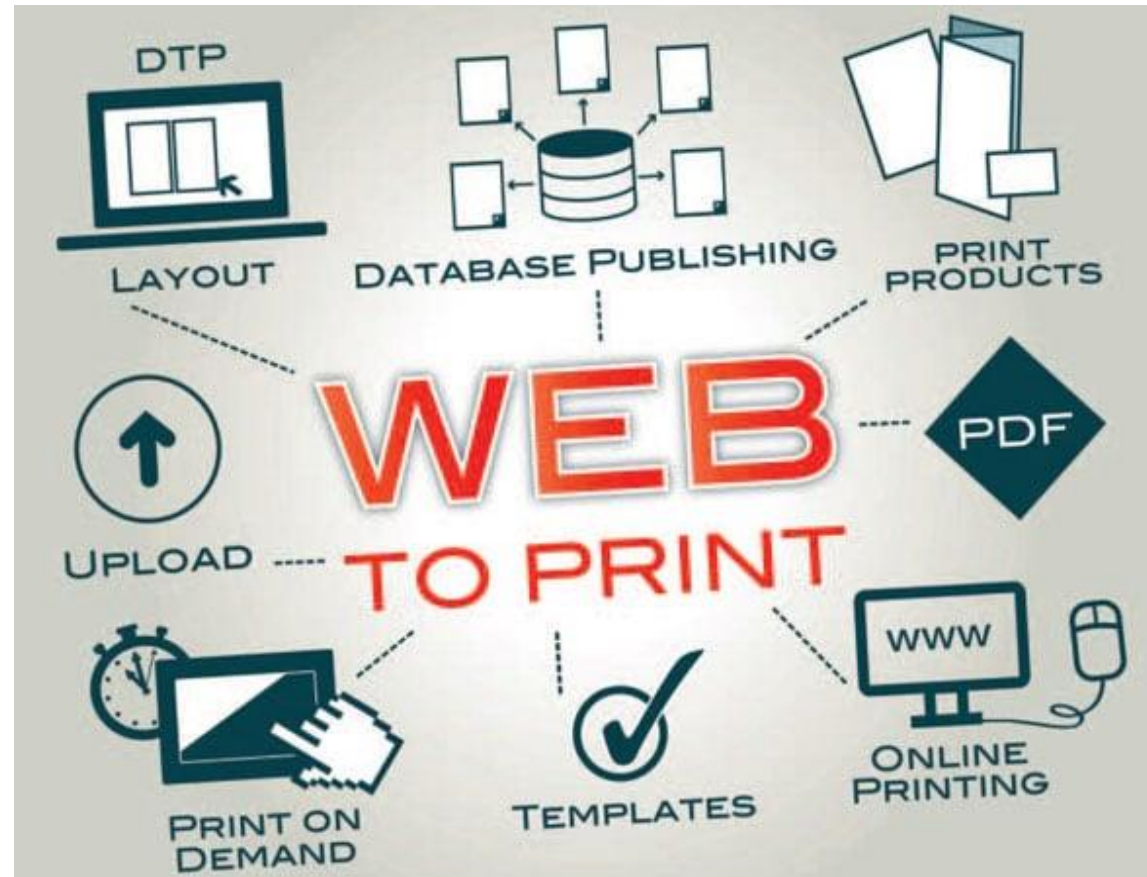
The way to Print 4.0 for your company

How do you have to proceed to develop smart products and services?

- Conduct market tests with your customers as to what additional functions they really need

- Pilot small – if possible with a demonstration machine or having the machine vendor provide prototypes which you finish in your operations

- Once the capabilities are in place: also put in place needed infrastructure – if your print products can link the user up to a website, but your small customer does not have the infrastructure, you can provide it for them to make additional revenue

Smart Navigator for Print 4.0

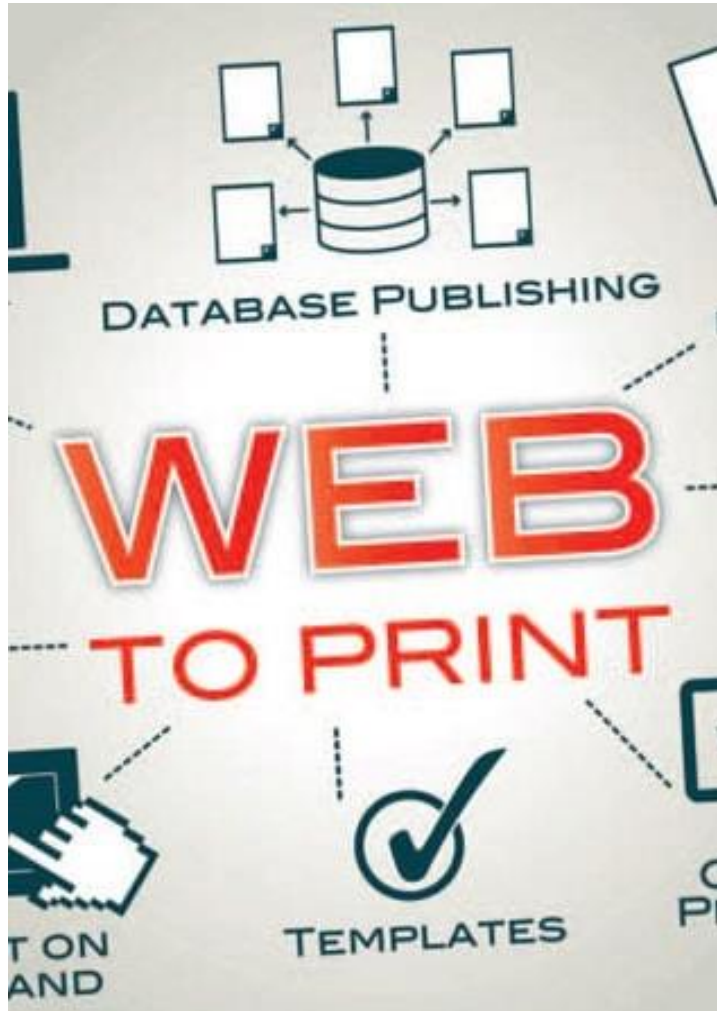Driving the digital transformation of the printing industry

Smart Processes

> Web-to-print platforms offer an intuitive user interface for the creation of individual print products and are therefore relevant for both large industrial customers and private individuals.

The way to Print 4.0 for your company

What does your company need on the way to smart processes?

- End-to-end integrated IT systems

- A clear culture of valuing proper data entry

- Connected machines and warehouses to make use of the automated processes

The way to Print 4.0 for your company
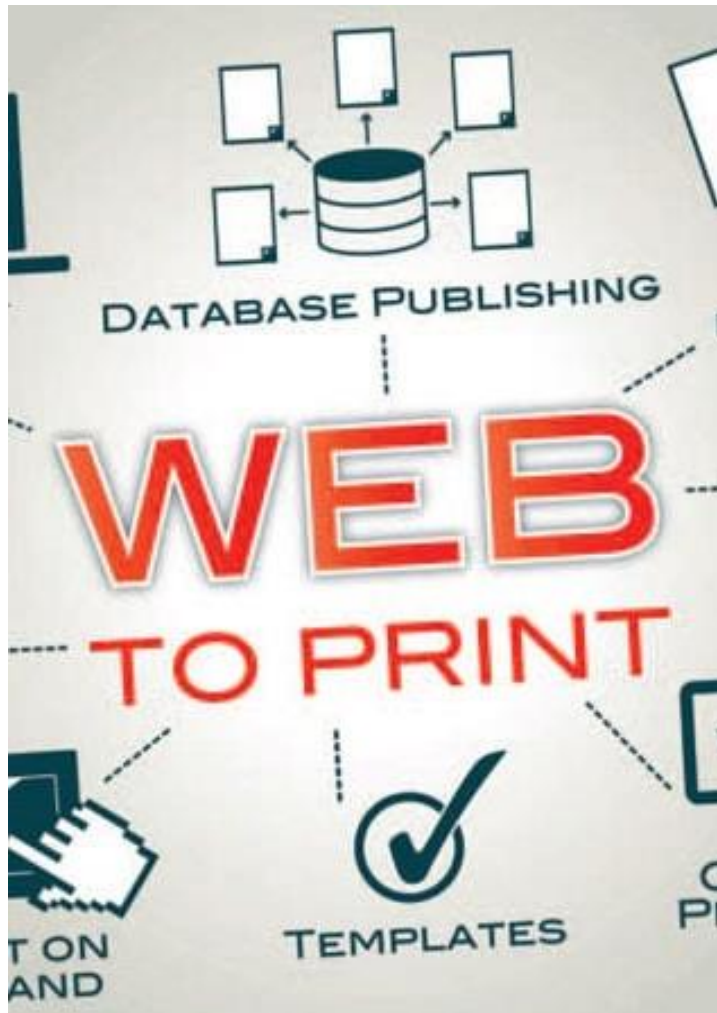
How do you have to proceed to develop smart processes?

- Start by systemizing internal processes end-to-end

- Then pilot with a few key products or customers

- Think of the needed marketing capabilities

Smart Navigator for Print 4.0

Driving the digital transformation of the printing industry
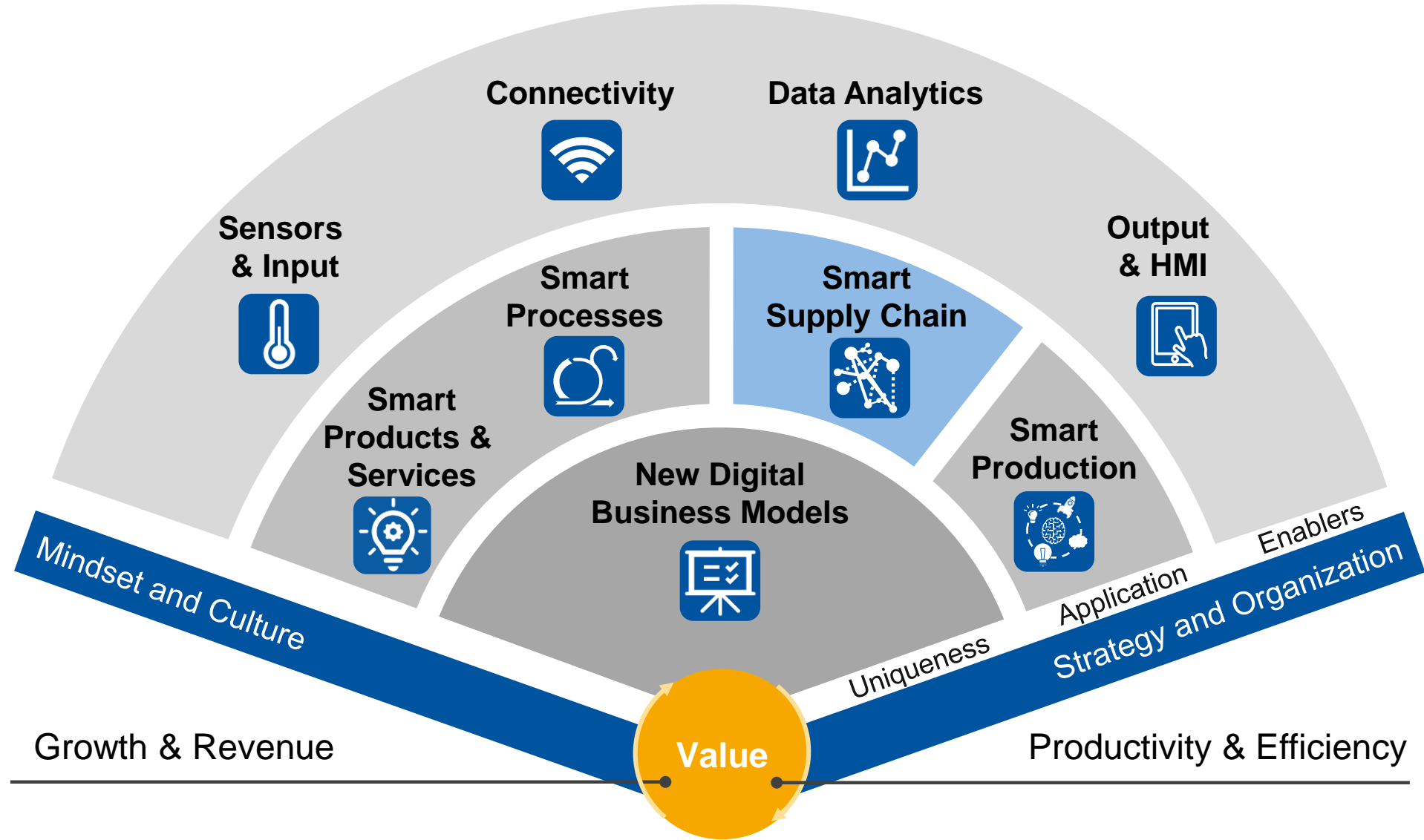
Smart Supply Chain
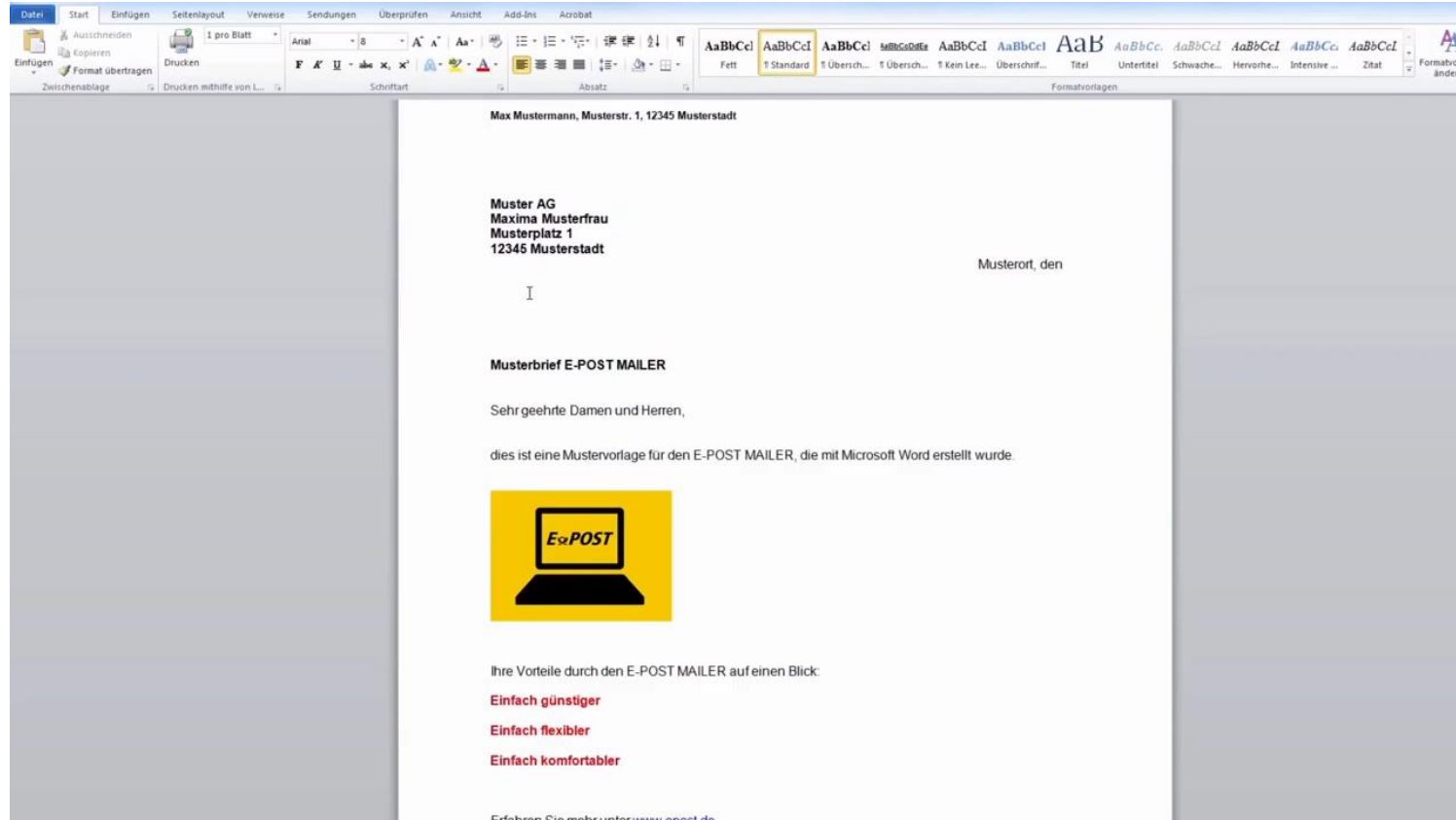
The e-letter is a web-based hybrid mail service for the secure and binding digital transmission of written communication.

The way to Print 4.0 for your company

What does your company need on the way to a smart supply chain?

- Seamless IT integration with suppliers, logistics partners and customers

- Clear contracts stating who does what automatically on IT notice

- Proper infrastructure for handling the underlying processes (see web to print)

The way to Print 4.0 for your company

How do you have to proceed to develop a smart supply chain?

- Who are your ecosystem partners? Whom do you need to involve for the solution to succeed? Formulate a clear business model jointly

- Develop the IT capabilities for seamless information exchange

- Make sure there are no hindering points to the customers (such as having to switch a service they are already using!)

Smart Navigator for Print 4.0

Driving the digital transformation of the printing industry

Connectivity

Data Analytics

Sensors & Input

Smart Processes

Smart Supply Chain

Output & HMI

Smart Products & Services

New Digital Business Models

Smart Production

Mindset and Culture

Uniqueness

Application

Enablers

Strategy and Organization

Growth & Revenue

Value

Productivity & Efficiency
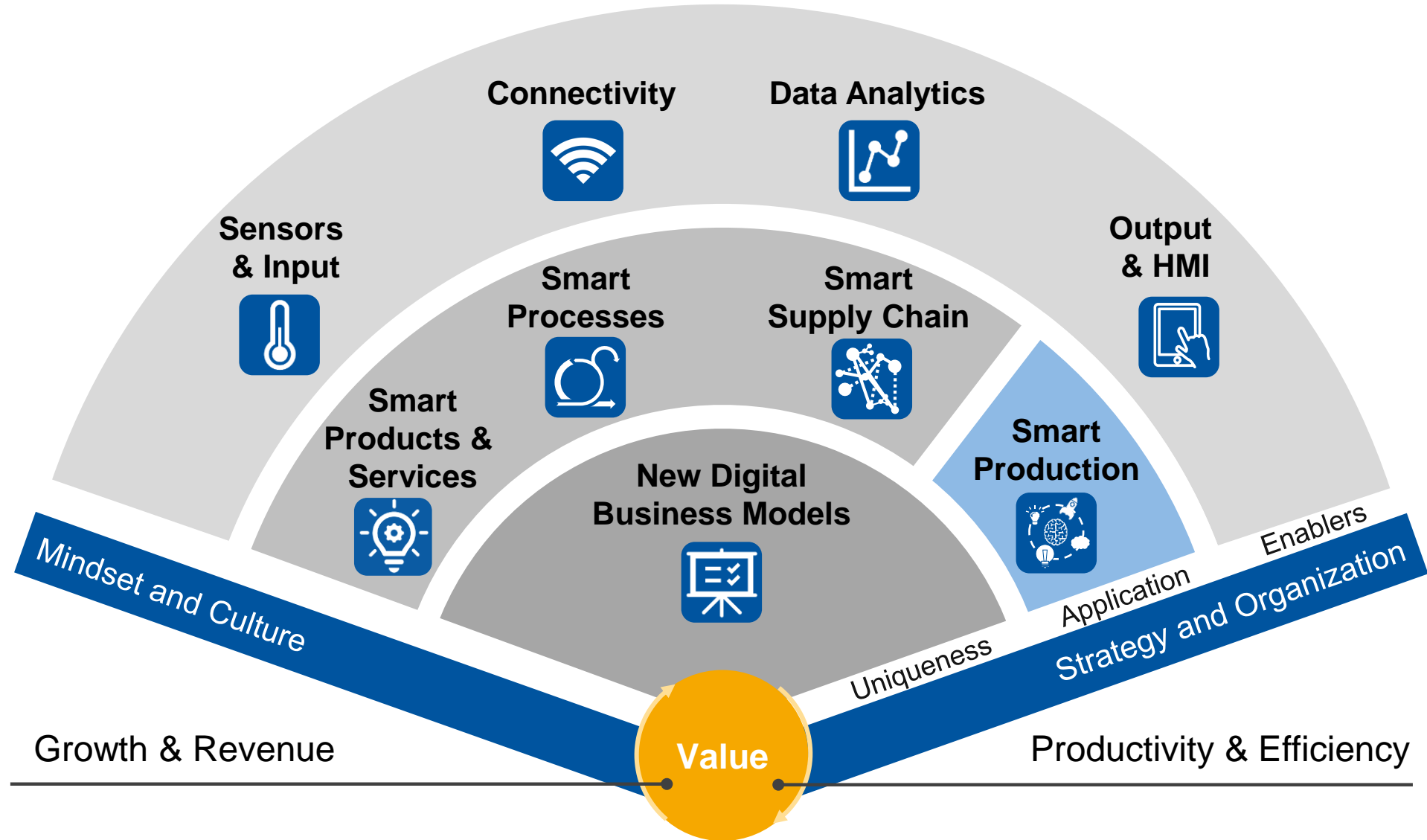
Smart Production

A CoBo-Stack can move nine tons of paper and more per shift.

The way to Print 4.0 for your company

What does your company need on the way to a smart production?

- Transparency as to what goes on at the shopfloor

- Tracking and tracing of goods and materials

- Connected machines to access status

The way to Print 4.0 for your company

How do you have to proceed to develop a smart production?

- Start with individual pilots, roll out after they have been perfected at one line

- Not everything has to be fully automated to create value. Go along the maturity levels
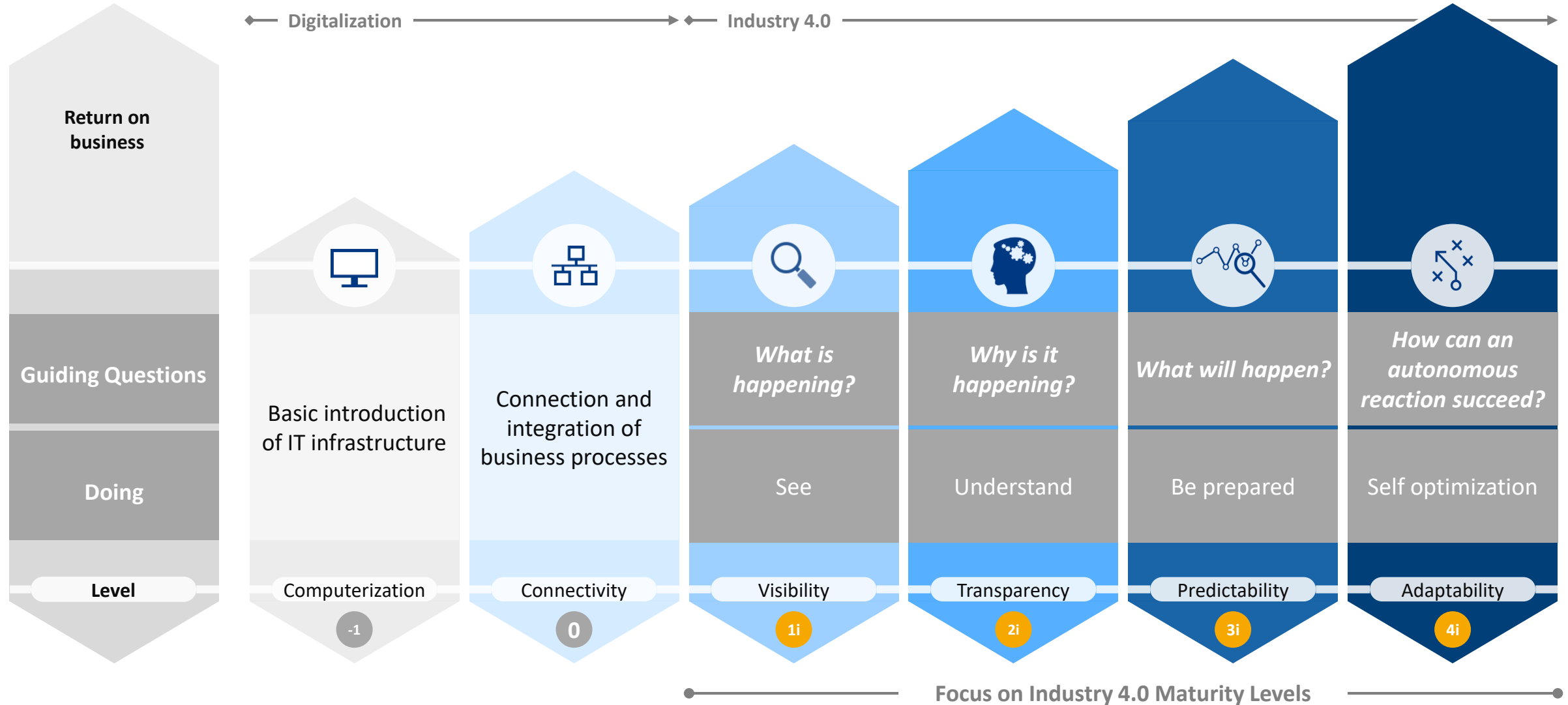
Industry 4.0 – What could go wrong?

Good infrastructure is important to realize the benefits of advanced technology – also in Industry 4.0

???

Industry 4.0 Maturity Index

Digitalization → Industry 4.0

	Computerization	Connectivity	Visibility	Transparency	Predictability	Adaptability
Return on business						
Guiding Questions			*What is happening?*	*Why is it happening?*	*What will happen?*	*How can an autonomous reaction succeed?*
	Basic introduction of IT infrastructure	Connection and integration of business processes				
Doing			See	Understand	Be prepared	Self optimization
Level	Computerization	Connectivity	Visibility	Transparency	Predictability	Adaptability
	-1	0	1i	2i	3i	4i

Focus on Industry 4.0 Maturity Levels

DIGITALIZATION

How to perform a transformation towards Industry 4.0?

INDUSTRY 4.0

Industry 4.0 Maturity Index
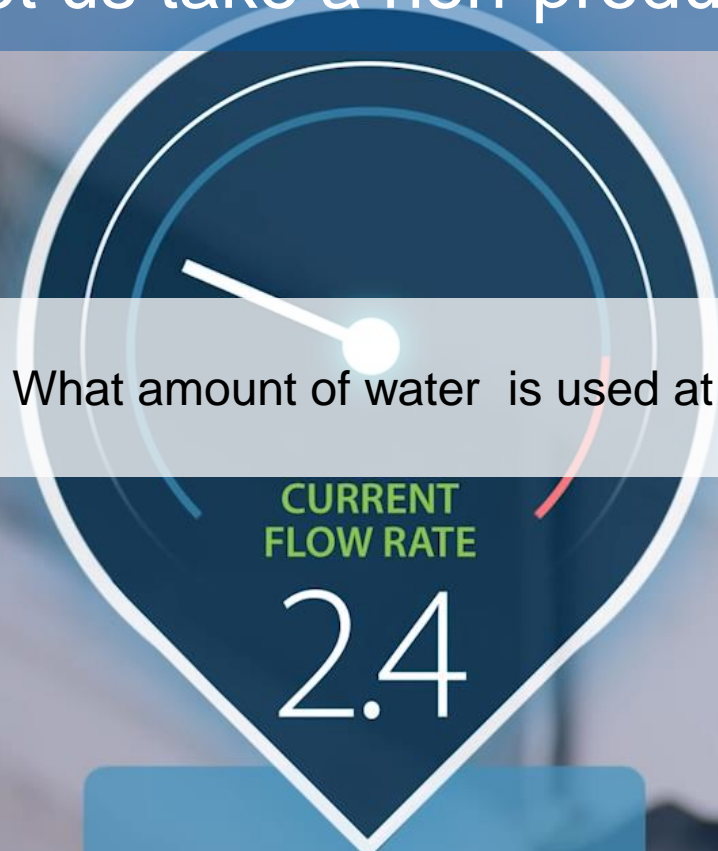
What is happening?

Visibility	Transparency	Predictability	Adaptability
1i	2i	3i	4i
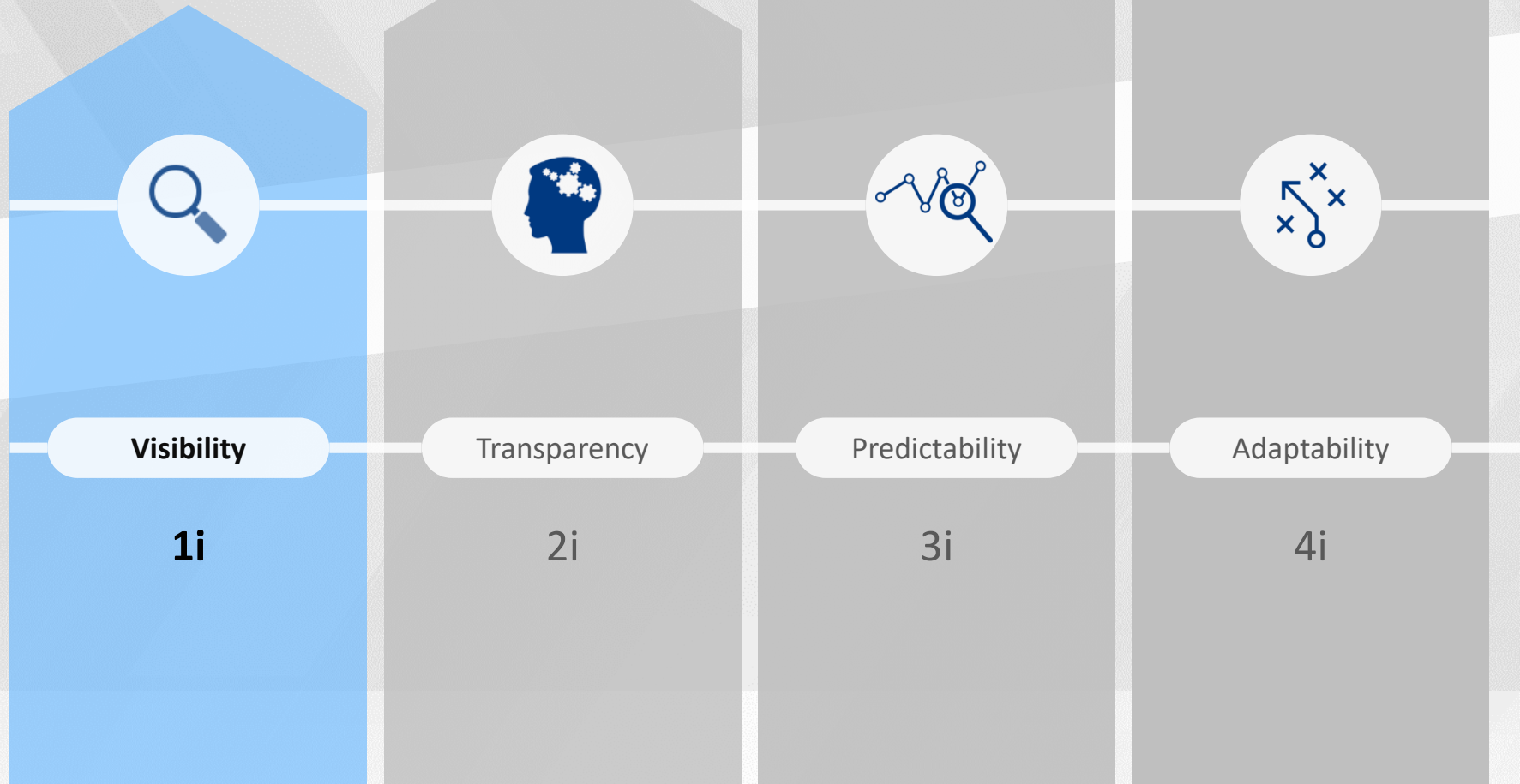
Level 1i: Visibility – What is happening?
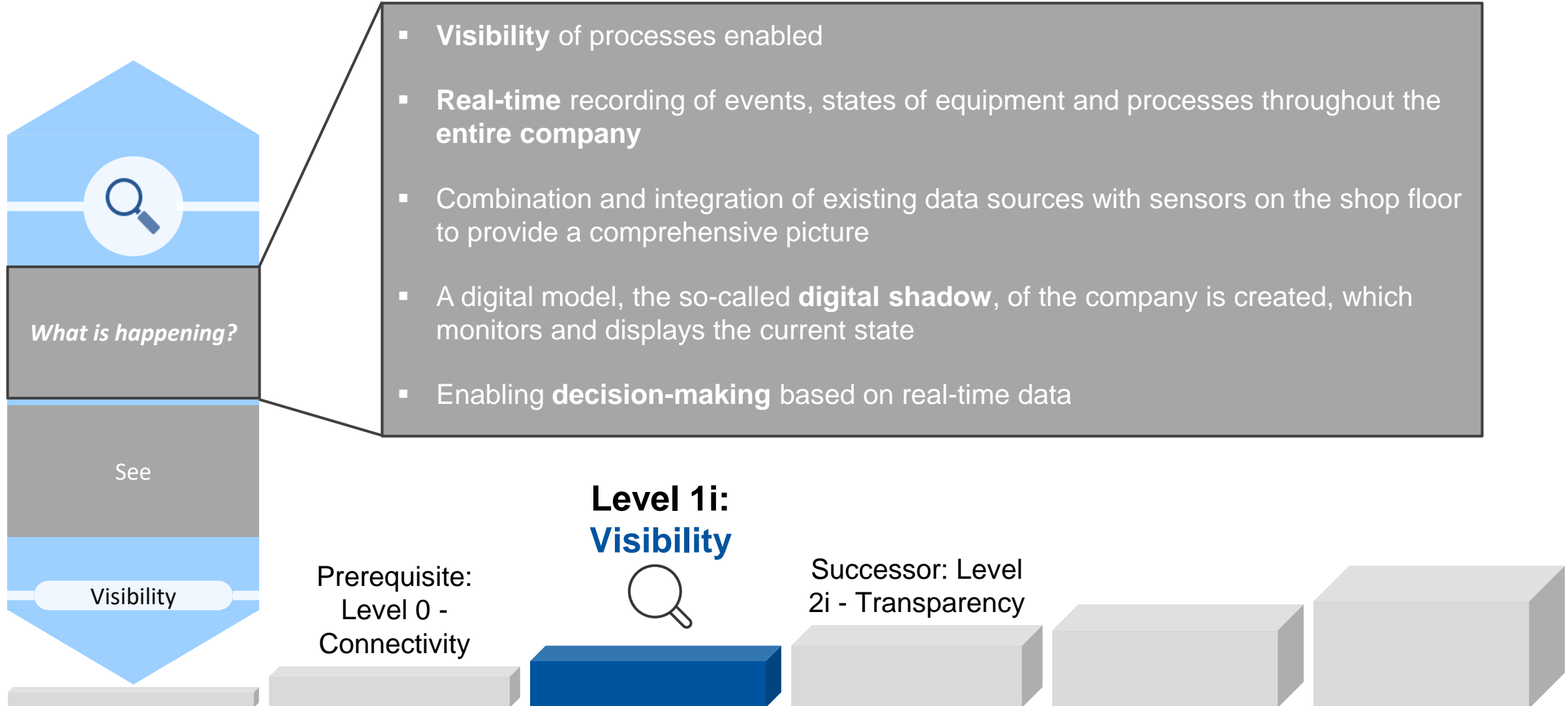
- **Visibility** of processes enabled

- **Real-time** recording of events, states of equipment and processes throughout the **entire company**

- Combination and integration of existing data sources with sensors on the shop floor to provide a comprehensive picture

- A digital model, the so-called **digital shadow**, of the company is created, which monitors and displays the current state

- Enabling **decision-making** based on real-time data

What is happening?

See

Visibility

Level 1i:
Visibility

Prerequisite: Level 0 - Connectivity

Successor: Level 2i - Transparency
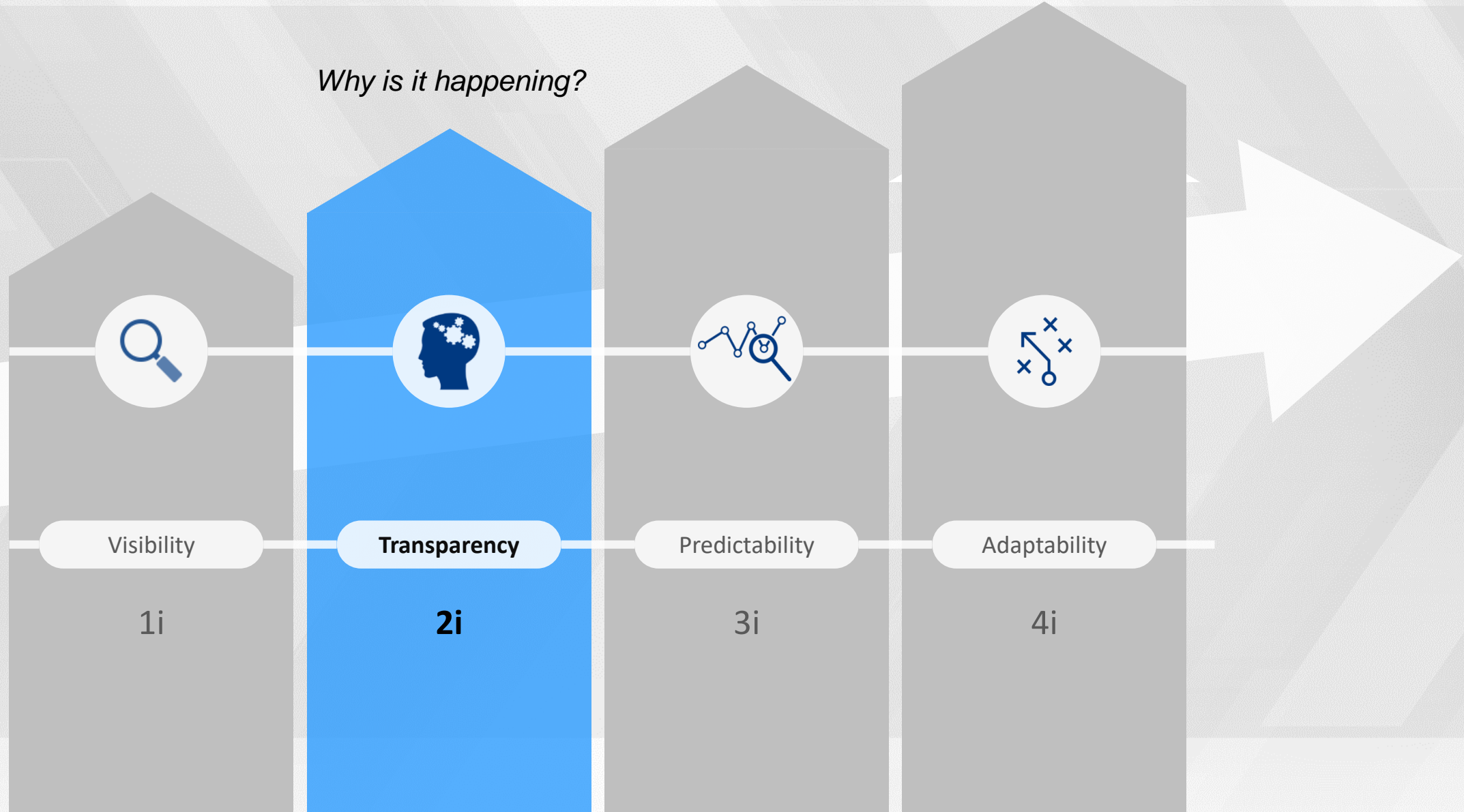
Level 2i: Transparency – Why is it happening?

Why is it happening?

Understand

Transparency

- Processes throughout the company are made **transparent,** meaning that data is easily accessible to relevant stakeholders in a timely manner

- Understand **why** something is happening and generate knowledge by means of **root cause analysis**

- Application of engineering knowledge to **identify and interpret dependencies** in the company's digital shadow

- **Data analytics applications** such as machine learning and pattern recognition are deployed

- Data about interactions is used, for instance, to carry out **condition monitoring** of machinery equipment

Level 2i:
Transparency

Prerequisite:
Level 1i - Visibility

Successor: Level
3i - Predictability

Level 2i

Why am I using so much water right now?

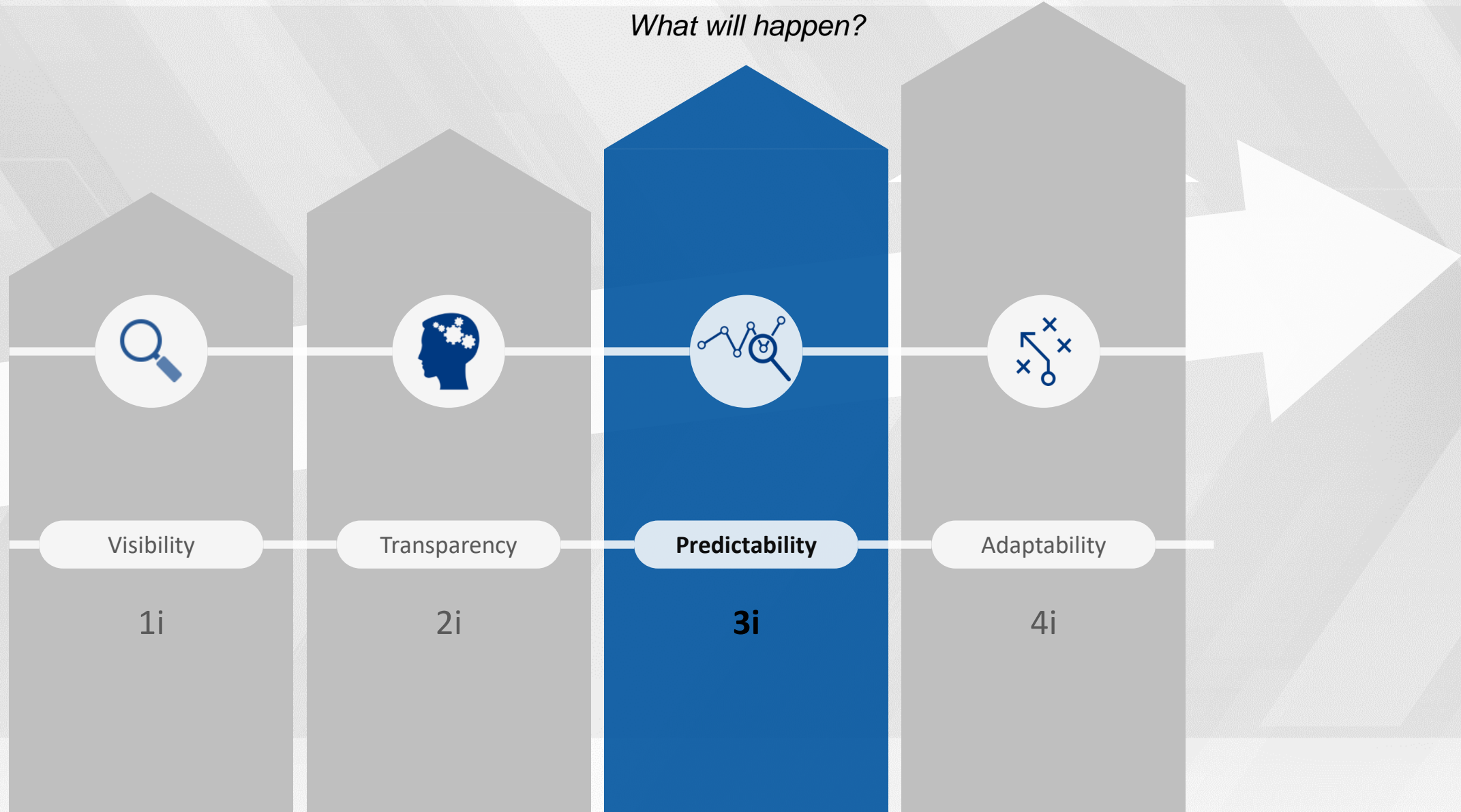Aggregation and contextualization of data in order to provide information and recognize correlations
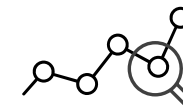
Industry 4.0 Maturity Index

What will happen?

Visibility	Transparency	**Predictability**	Adaptability
1i	2i	**3i**	4i

Level 3i: Predictability – What will happen?

- **Projection** of the digital shadow **into the future**, depiction of a variety of scenarios and selection of the most likely one

- Implementation of **appropriate measures based on predictions** to reduce the number of unexpected events and enable a robust business operation

- Anticipation of future events extends lead times to react to events, while counter measures still have to be carried out manually

- Quality of predictions is heavily dependent on a properly constructed **digital shadow** as well as **knowledge** of relevant interactions from levels 3 and 4

What will happen?

Be prepared

Predictability

Prerequisite: Level
2i - Transparency

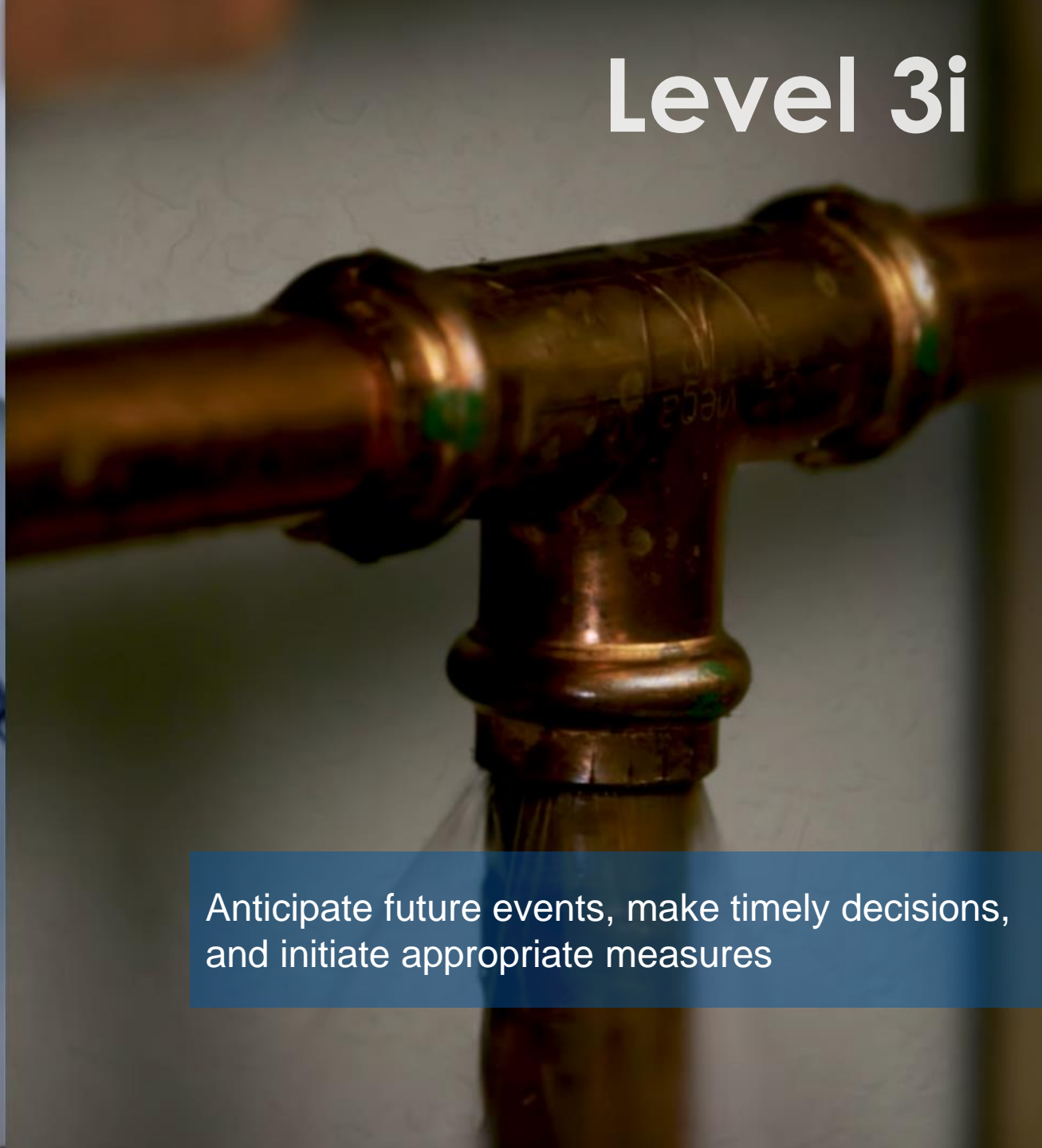**Level 3i:
Predictability**

Successor: Level
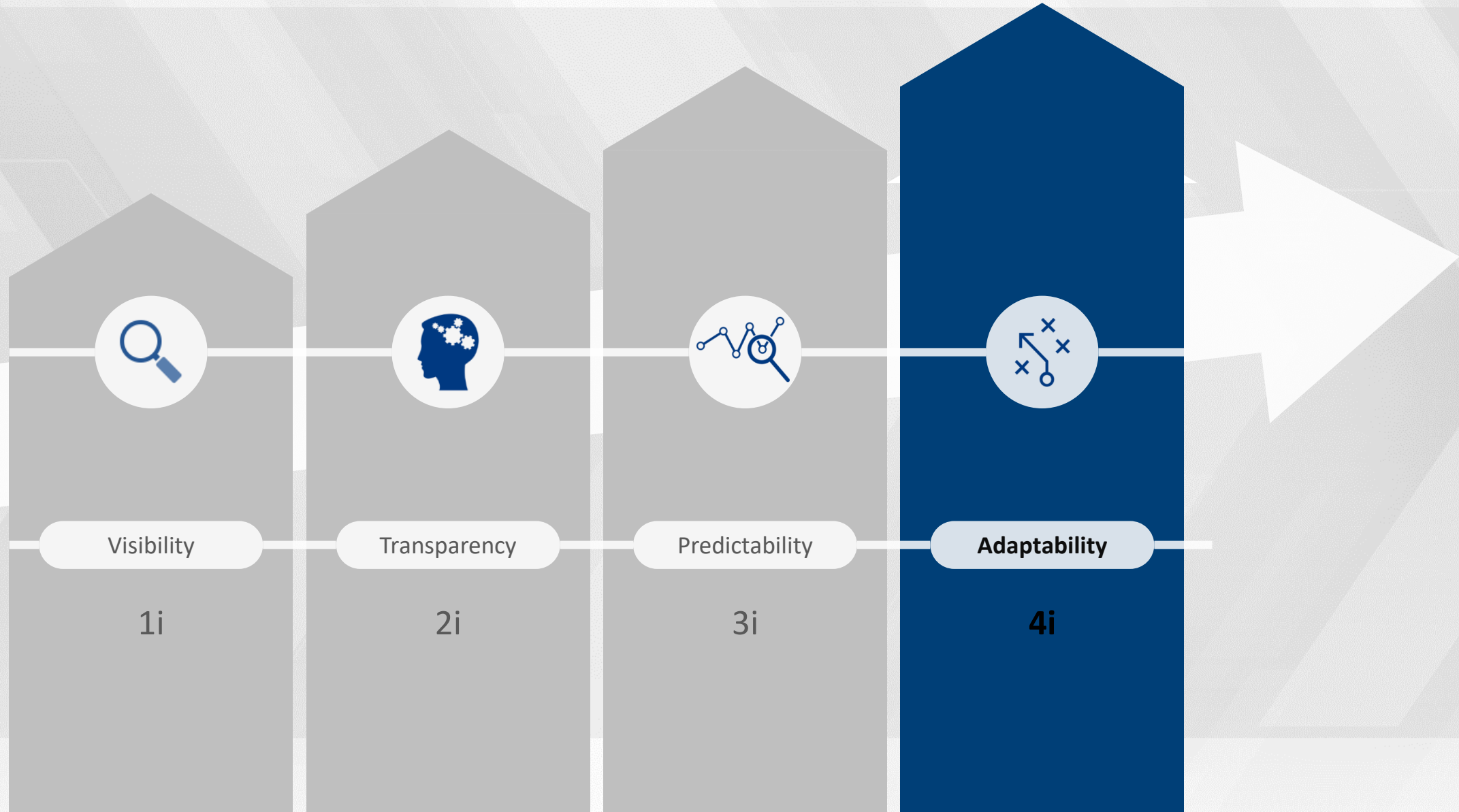4i - Adaptability

Level 3i

When will the next leakage occur?

Saturday

16

Anticipate future events, make timely decisions, and initiate appropriate measures
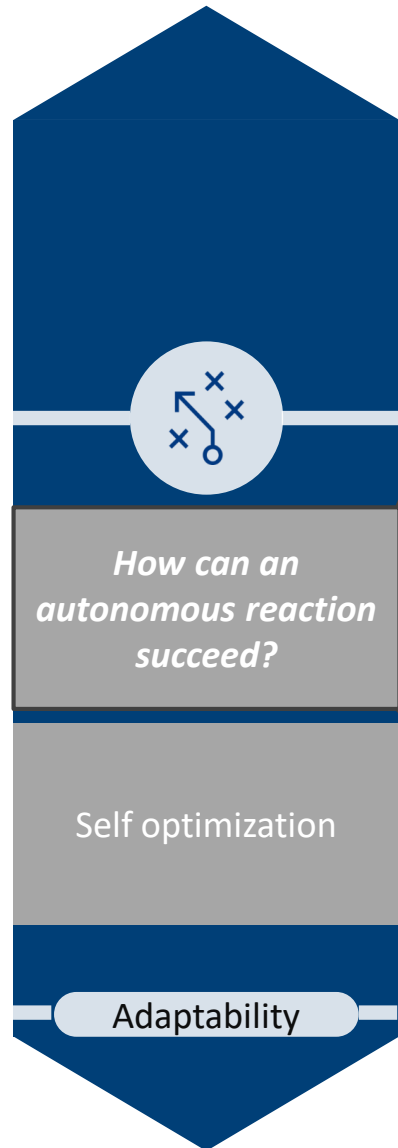
# Level 6: Adaptability – How can an autonomous reaction succeed?

How can an autonomous reaction succeed?

Self optimization

Adaptability

- Certain decisions are delegated to **IT systems** to react to a changing business environment as quickly as possible

- **Forecasting capability** builds the fundament for automated actions and self-optimization

- Individual processes are automated, based on **complexity**, **cost-benefit ratio** and a careful **risk evaluation** of automation

- Utilization of data from the digital shadow to autonomously make the **best** possible decisions in the **shortest** possible time

- Big data techniques such as Machine Learning and Optimization to make **intelligent decisions** based on data and **improve process performance**

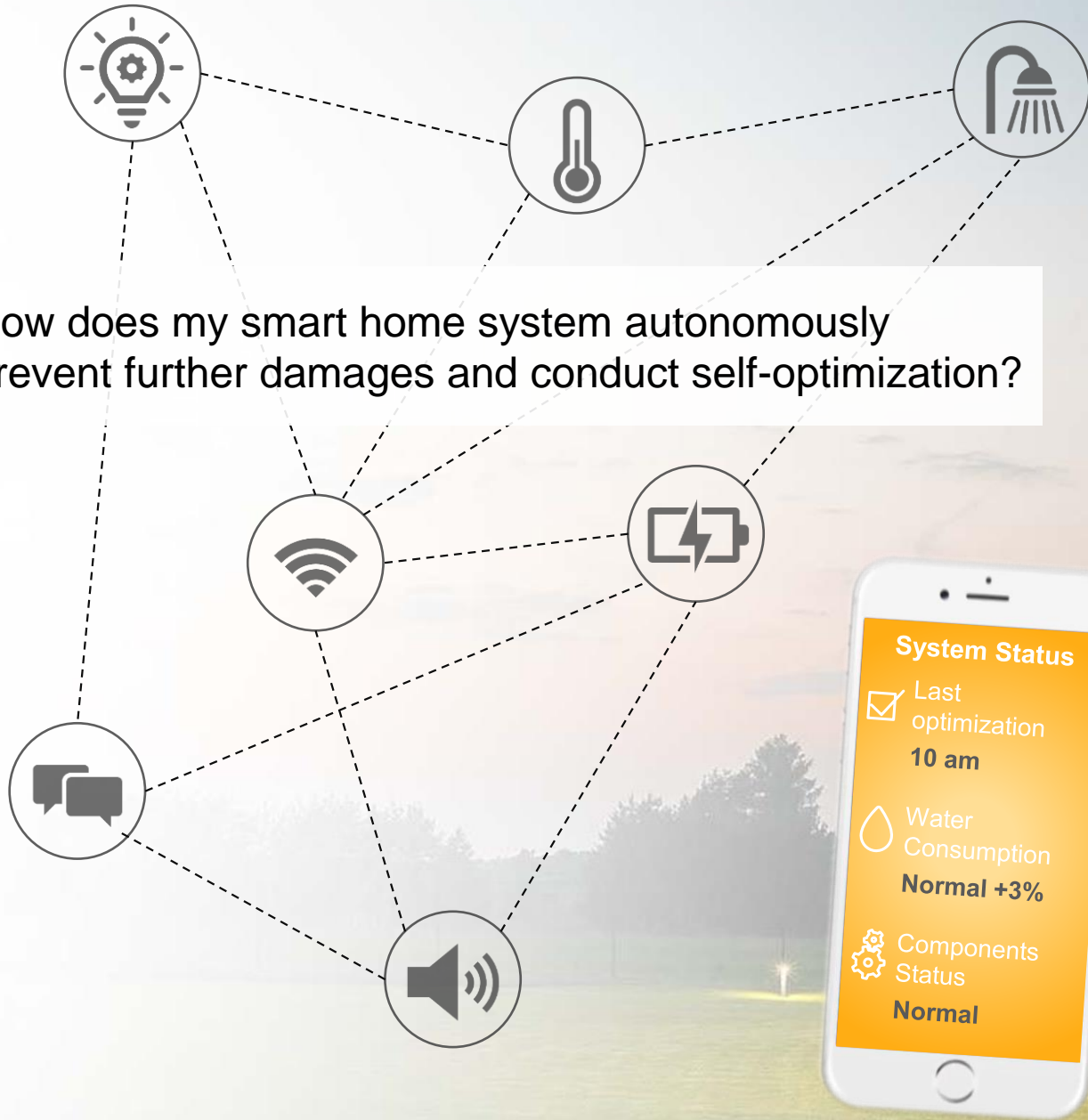- Implementation of corresponding measures **without human assistance**
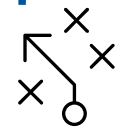
Prerequisite: Level 3i - Predictability

Level 4i: Adaptability

Level 4i

How does my smart home system autonomously prevent further damages and conduct self-optimization?

System Status

☑ Last optimization

10 am

💧 Water Consumption

Normal +3%

⚙ Components Status

Normal

A variety of domestic appliances embedded in a comprehensive smart home system that adapts to human behavior based on data and autonomously acts during events to improve efficiency or prevent damage.
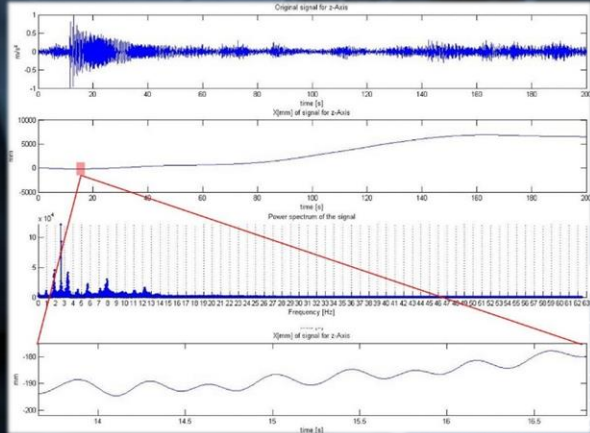
Smart Home

Industry 4.0

Level 1i

Visualization - What is happening?

Level 2i

Condition Monitoring – Why is it happening?

Level 3i

Prediction - What will happen?

Level 4i

How can an autonomous reaction succeed?
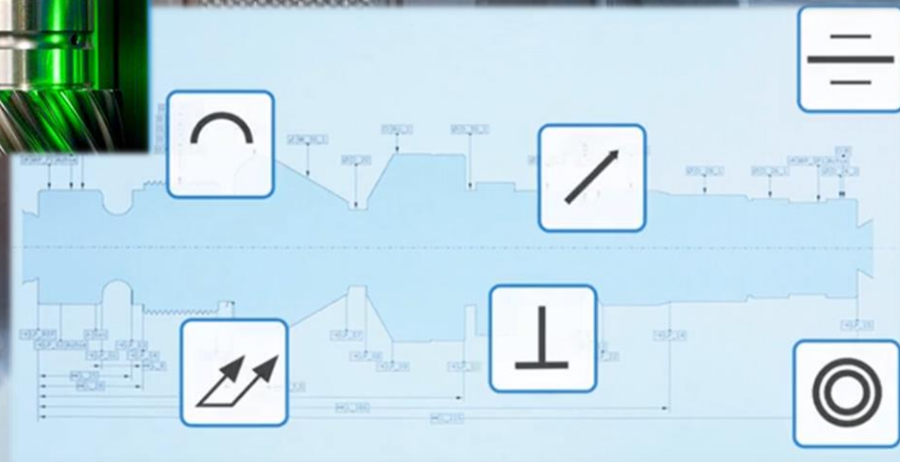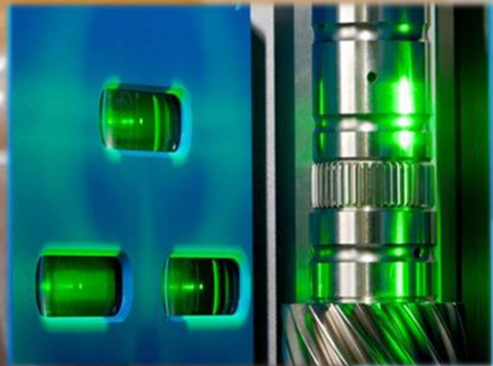
For achieving value from an introduction of Industry 4.0, it is important to consider technology, but also culture and organization as part of the Industry 4.0 Infrastructure
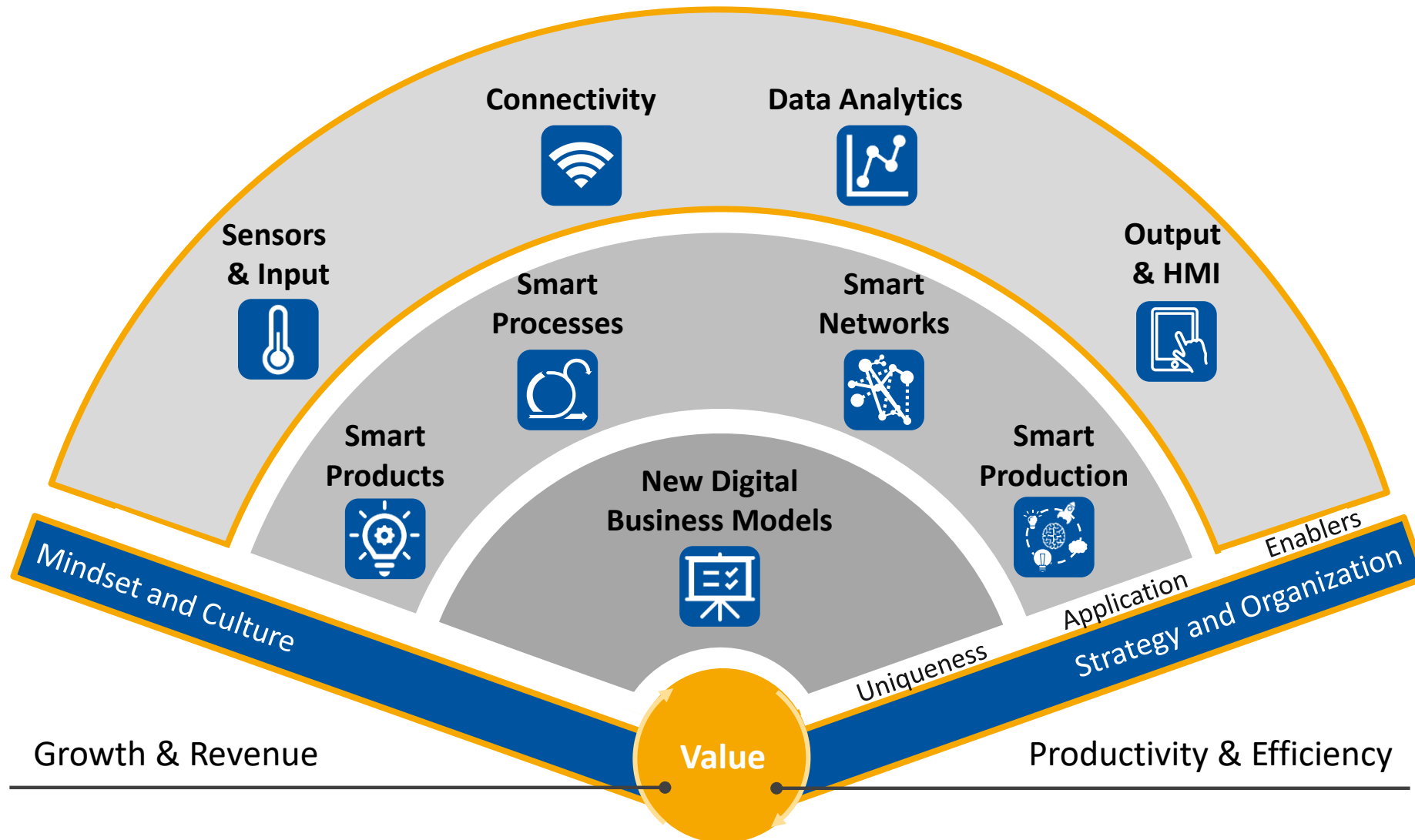
Value is created by equally investing in the four structural dimensions resources, information systems, organizational structure and culture
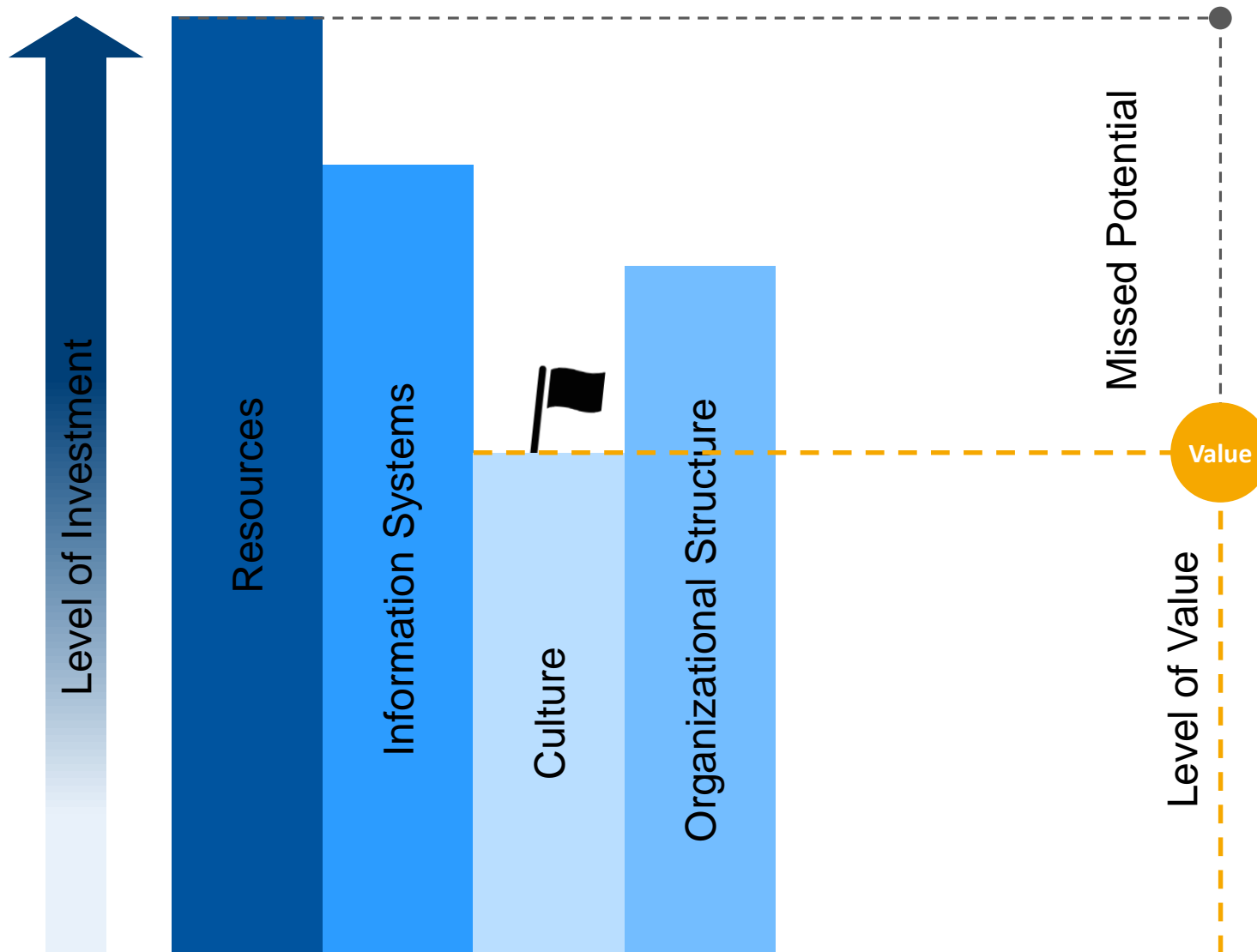
Primary Target

Create a balance between all four dimensions.

Example for unbalanced investment – If employees do not react to performance metrics displayed on a dashboard, no value is created
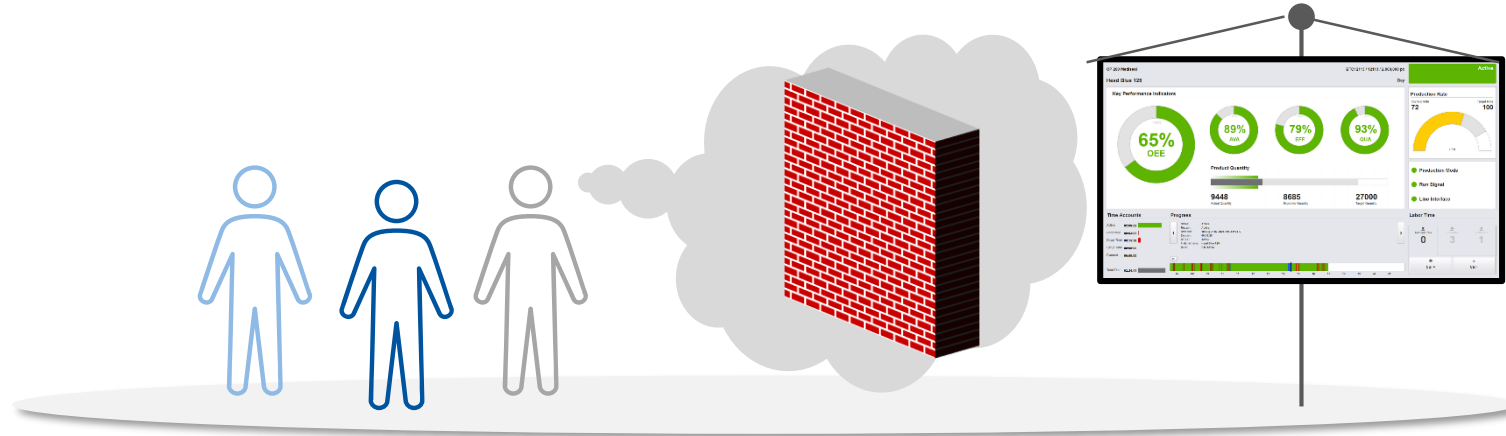
✓ Data preparation and visualization (e.g. digital KPIs on dashboards)

✗ Lean corporate culture, willingness to improve, using provided information

➢ If investments in digital tools and sensors are not backed up by a structured organization and promoting the right culture, they will often not be used, wasting any potential generated value

Example for unbalanced investment - Data visualization on dashboards is not reliable, if tracking sensors are not continuously deployed throughout the process chain
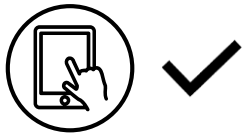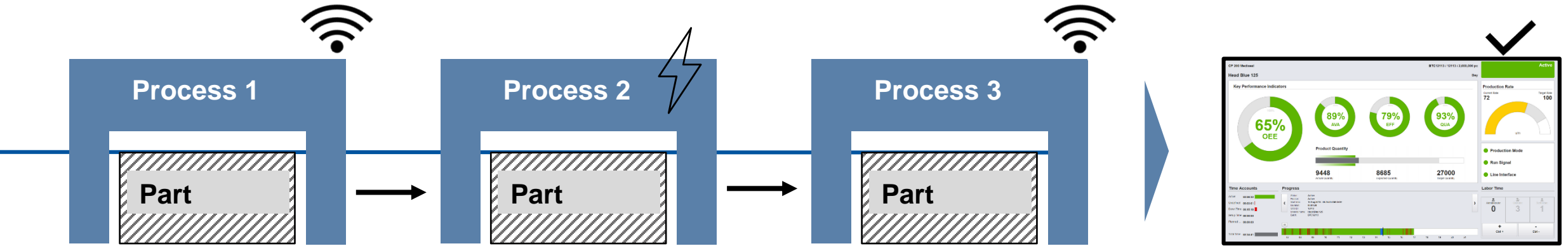
Data preparation and visualization (e.g. digital KPIs on dashboards)

Sensor technologies in each process step

➢ Digital KPIs can be used to support decision making. These digital KPIs can be visually tracked, analyzed and displayed with information management tools such as dashboards. Nevertheless, the application of these dashboards only makes sense, if the whole process chain is equipped with sensor technologies that constantly generate a reliable data basis without gaps

➢ If the data is incomplete, no traceability throughout the whole process is possible

Start from the Value! – The way to Industry 4.0 transformation

Value

Objectives

Strategy

Start the Transformation Process

Definition of value
What kind of value do I want to generate?

Determination of objectives
What are my desired future outcomes?

Formulation of a strategy
How do I reach my objectives?

Create a digital vision, define digital objectives, build competencies in technology fields, and link them in a digital strategy

Digital Vision

Digital Objectives

Digital Strategy

Technology of the single technology fields

TF1 TF2 TF3 TF4 TF5 TF6 TF7 ...
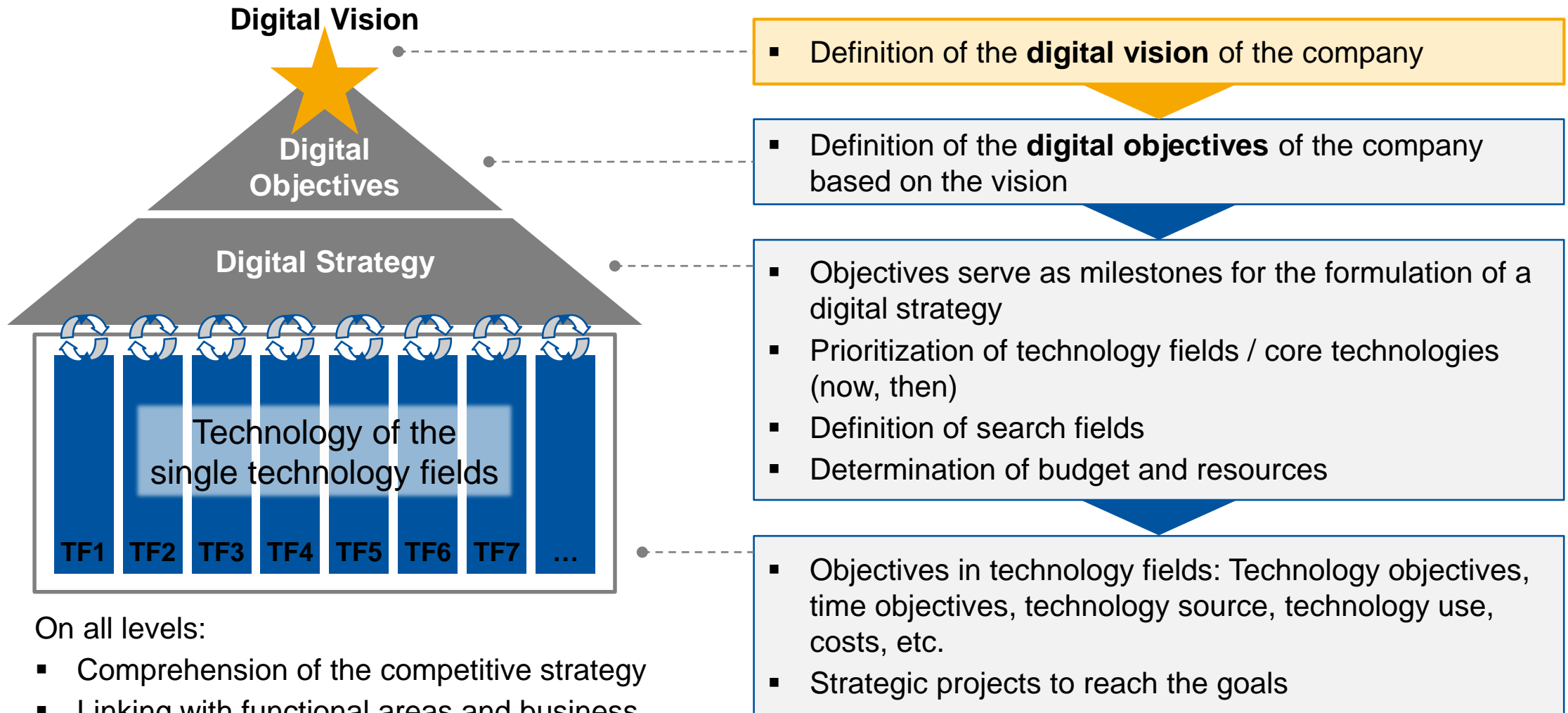
On all levels:
- Comprehension of the competitive strategy
- Linking with functional areas and business strategies

- Definition of the **digital vision** of the company

- Definition of the **digital objectives** of the company based on the vision

- Objectives serve as milestones for the formulation of a digital strategy
- Prioritization of technology fields / core technologies (now, then)
- Definition of search fields
- Determination of budget and resources

- Objectives in technology fields: Technology objectives, time objectives, technology source, technology use, costs, etc.
- Strategic projects to reach the goals

How to match a top-down strategy with pilot projects

Value

Strategically defined goals and initiatives

Goals and targets of the company

Application lighthouses – Improvement initiatives

Maturity pilot projects

Technology platforms – Pilot projects
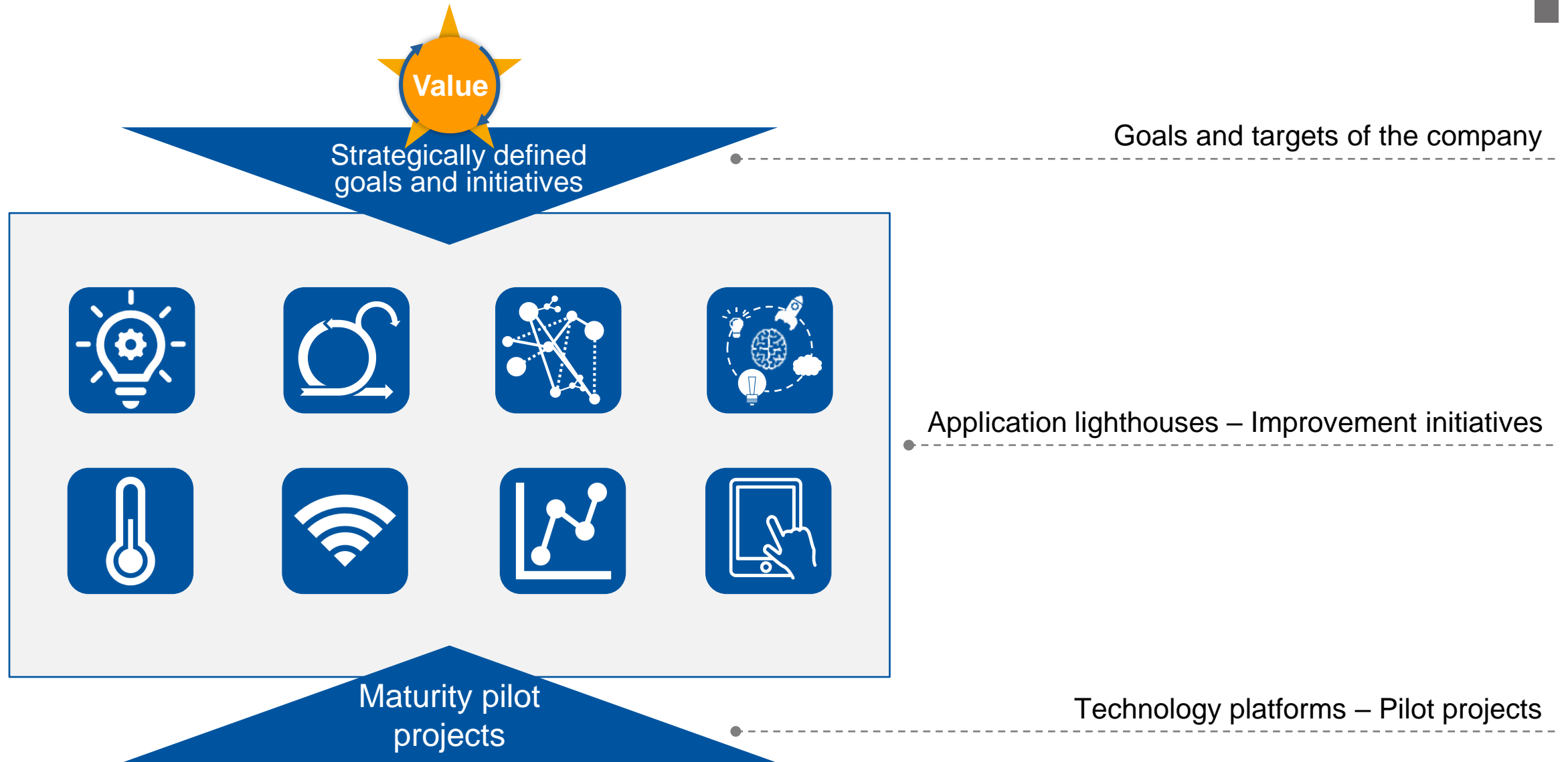
Gap Analysis: Capability evaluation

Capabilities include

Resources

decentralized (pre-)processing of sensor data

automated data acquisition via sensors

task-oriented interface design

efficient communication

digital competencies

Information Systems

horizontal and vertical integration

application-specific user interfaces

contextualized data delivery

resilient IT infrastructure

data analysis

Exemplary evaluation

Organizational Structure

agile management

flexible communities

motivating incentive systems

focus on customer benefits

management of decision rights

Culture

open communication

openness to innovation

continuous professional development

data-based learning and decision-making

confidence in processes and information systems

● Maturity level complies with objective   ● Current maturity differs from objective   ◨ Field of action

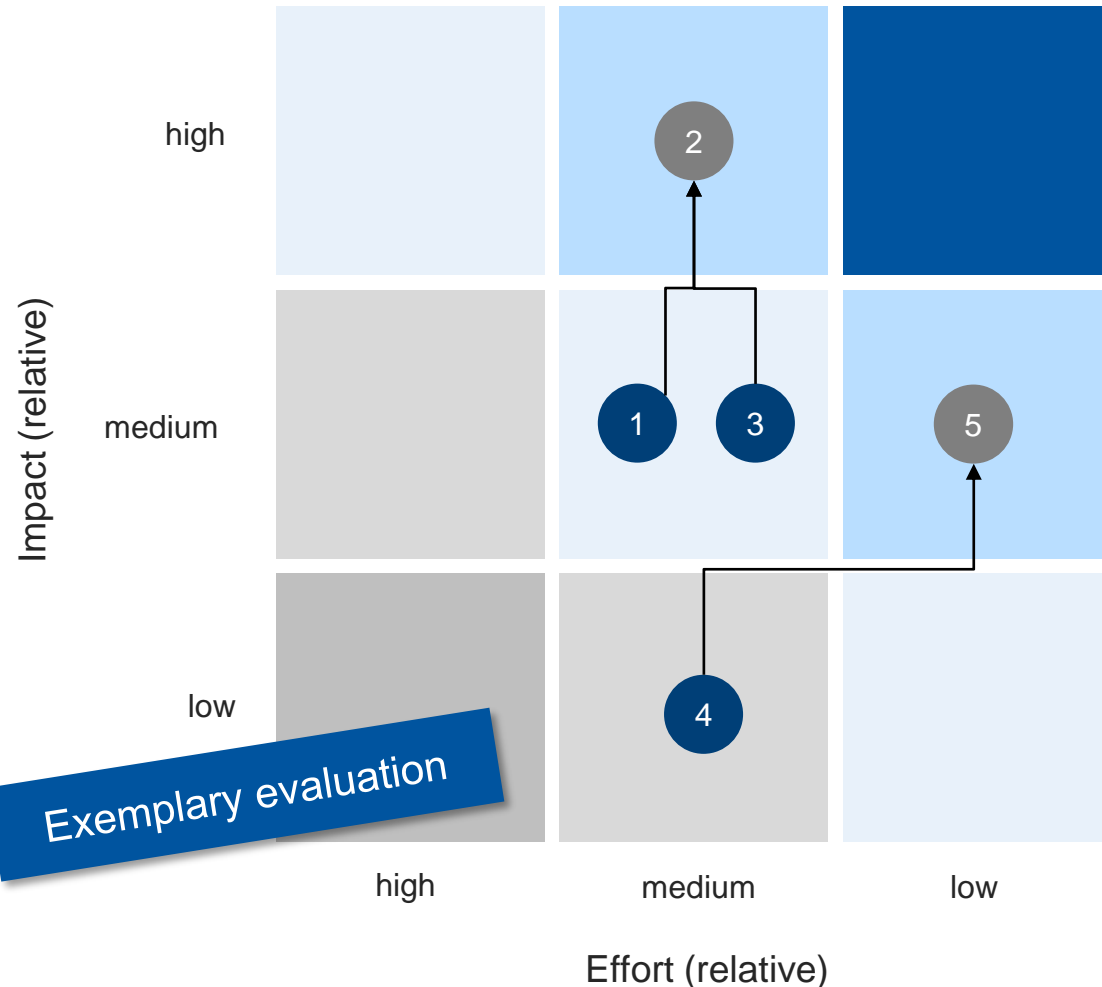# Projects can be grouped by effort and impact to find quick wins, however in many cases infrastructure measures (with little impact by themselves) are needed to enable multiple higher-impact measures

Impact (relative) — high / medium / low

Effort (relative) — high / medium / low

Exemplary evaluation

1. ▪ Elimination of paper-based workflows
2. ▪ Process analytics to stabilize order flow within workshop production
3. ▪ Introduction of MES system
4. ▪ End-to-end real time communication
5. ▪ …

Legend:

● Initiatives which can immediately be started

● Initiatives with prerequisites

The Industry 4.0 roadmap – goals, processes, capabilities

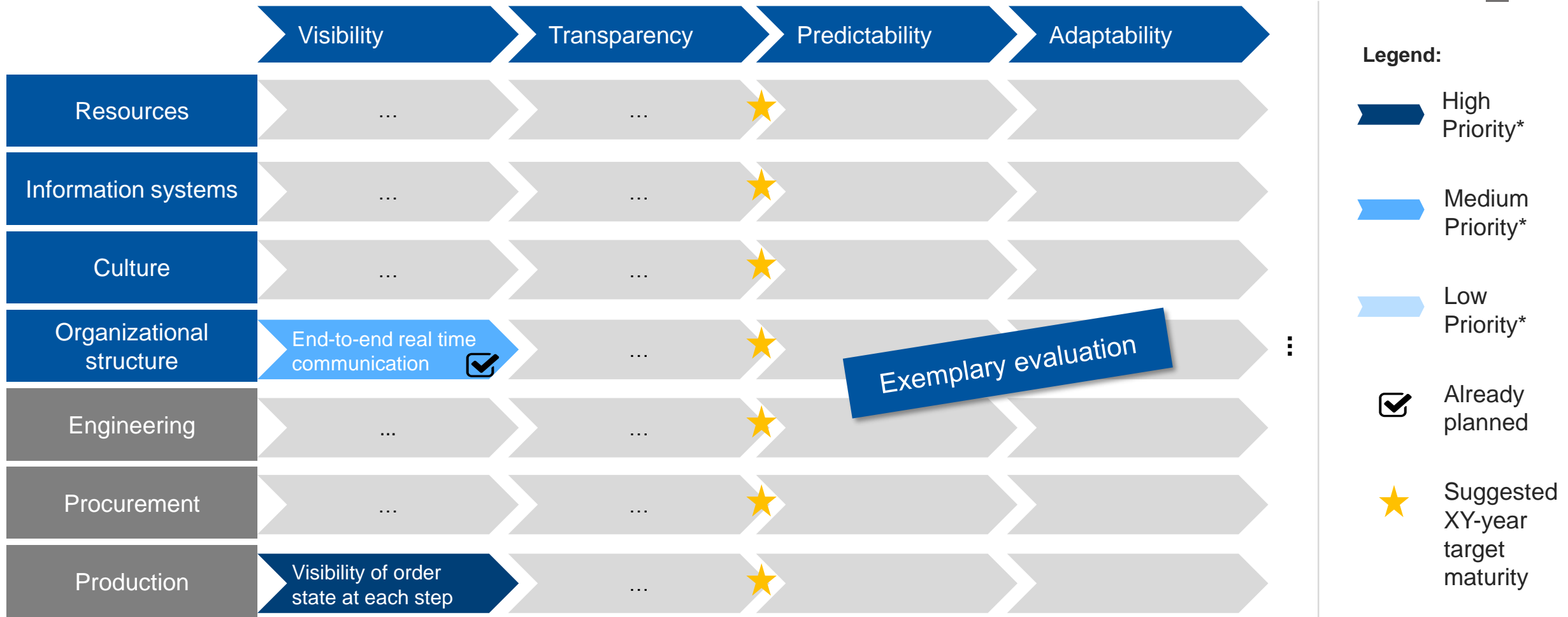|	Visibility	Transparency	Predictability	Adaptability
Resources	...	...	⭐	
Information systems	...	...	⭐	
Culture	...	...	⭐	
Organizational structure	End-to-end real time communication ☑	...	⭐	
Engineering	...	...	⭐	
Procurement	...	...	⭐	
Production	Visibility of order state at each step	...	⭐	

Exemplary evaluation

...

Legend:

▬	High Priority*
▬	Medium Priority*
▬	Low Priority*
☑	Already planned
⭐	Suggested XY-year target maturity

*Qualitative evaluation

Selected initiatives are ranked into an Industry 4.0 roadmap according to their respective maturity level and furthermore prioritized from low to high priority using a dedicated color code.

The way to Print 4.0

1 What do we **want**?

Jobs to be done and Strategy

2 What do we **have now**?

Assessment

3 How do we get there **step by step**?

Roadmap and pilot projects

4 How do we **scale**?

Transformation organization, business plan, infrastructure
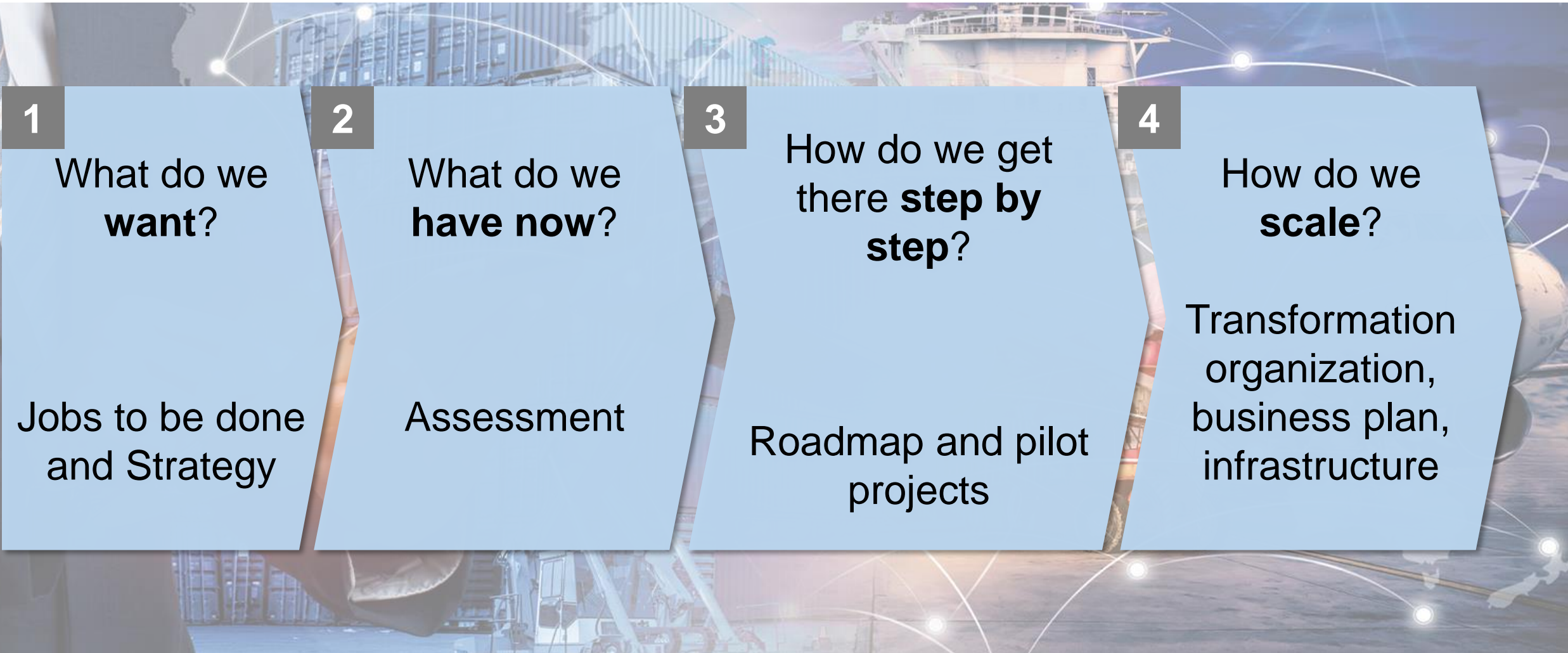
Joint project support for assessment, roadmapping and implementation

i4.0 Assessment and strategy development

Roadmap and pilot project development

Advisory

Recognition

Projects jointly conducted by INC Invention Center and HKPC, with quality control and endorsement by Fraunhofer IPT

Your contact

Patrick Kabasci

Director Operations Hong Kong

INC Invention Center

Campus-Boulevard 30 | 52074 Aachen | Germany

+49 151 5444 8619

Patrick.Kabasci@invention-center.de

Dr. Andreas Kraushaar

Head of Department Prepress

Fogra Research Institute for Media Technologies

Einsteinring 1a | 85609 Aschheim near Munich | Germany

+49 89 431 82 335

kraushaar@fogra.org

How to establish a "Print 4.0" implementation plan

Patrick Kabasci & Dr. Andreas Kraushaar