Data4AI in Manufacturing: Scenarios and Opportunities

European Commission

BDV BIG DATA VALUE ASSOCIATION

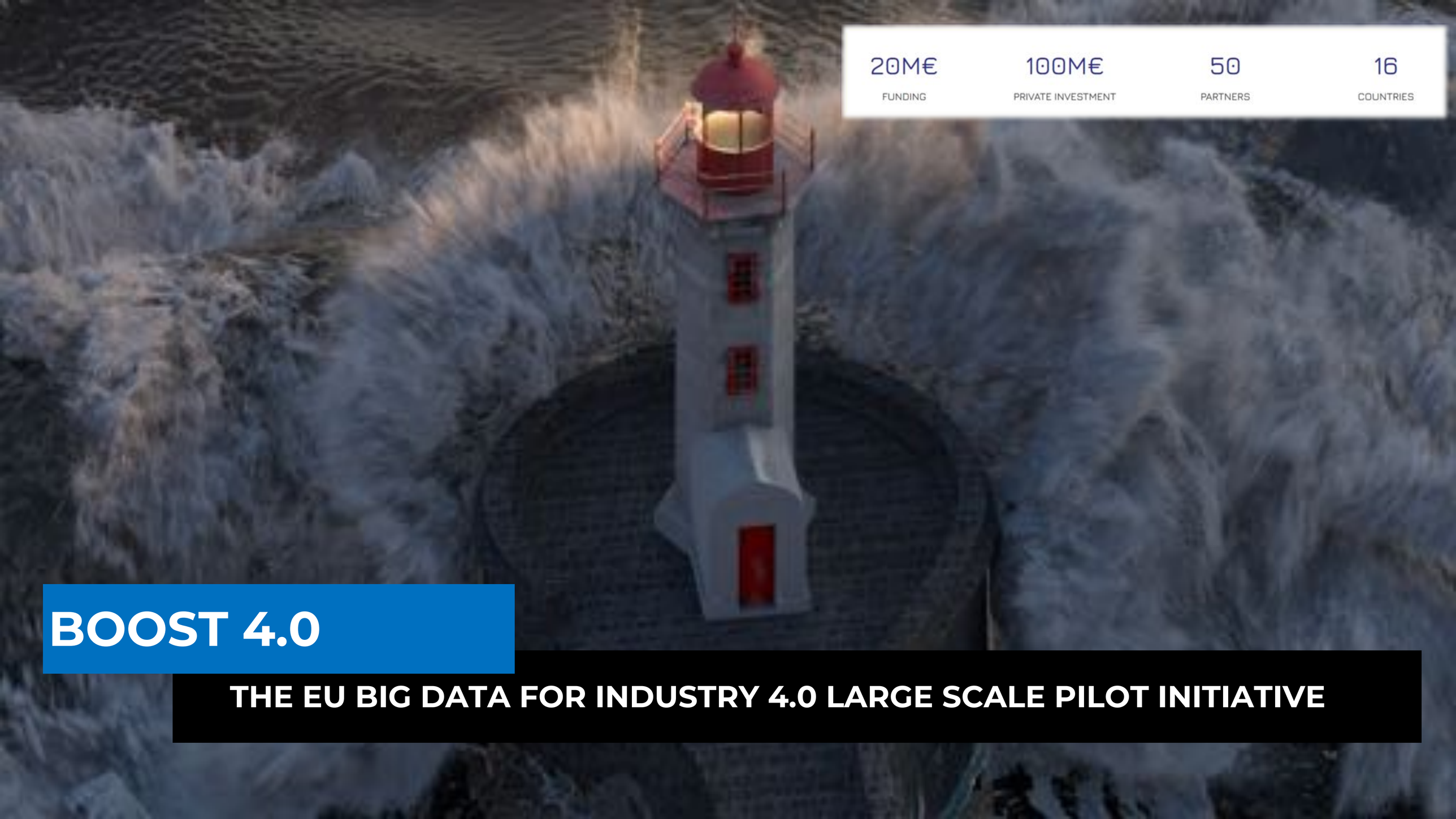
EFFRA EUROPEAN FACTORIES OF THE FUTURE RESEARCH ASSOCIATION

FoF Factories of the Future Public Private Partnership

I4MS

INTERNATIONAL DATA SPACES ASSOCIATION

Boost 4.0 BIG DATA FOR FACTORIES



BOOST 4.0

THE EU BIG DATA FOR INDUSTRY 4.0 LARGE SCALE PILOT INITIATIVE

Coordination

Scientific Management & Digital Transformation

Big Data Infrastructure

Factory 4.0 Big Data Expertise

Big Data Tools & Smart Machines

Lighthouse Factories 4.0

Replication Factories 4.0

Open Communities

Certification & Standards

QU4LITY

THE EU AI DIGITAL MANUFACTURING PLATFORM FOR ZERO DEFECT

Coordination

Atos

Technical Management & Digital Transformation

ENGINEERING

innovalia ASSOCIATION

Open Digital Manufacturing Platforms & Digital Infrastructures

TTTech Ensuring Reliable Networks

Telefónica

ATB Institut für angewandte Systemtechnik Bremen GmbH

Technology Transfer System

Synesis sustainable automation

INTERNATIONAL DATA SPACES ASSOCIATION

Technische Universität Braunschweig

AIT CENTER OF EXCELLENCE FOR RESEARCH AND EDUCATION

UNPARÁLLEL

SIEMENS

NXT CONTROL

Schneider Electric

VISUAL COMPONENTS

ATLANTIS ENGINEERING

PACE

SQS

ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE

technische universität dortmund

ZDM Manufacturing Equipment

+GF+

ghi SMART FURNACES

FAGOR ARRASATE

PRIMA INDUSTRIE

DANOBAT

ASTI

UNIMETRIK METROLOGY AND CALIBRATION

Smart Connected Pilot Factories 4.0

Whirlpool CORPORATION

PHILIPS

AIRBUS

KOLEKTOR

RIA STONE

Continental

SIEMENS

thyssenkrupp

MONDRAGON HUMANITY AT WORK Finance Industry Distribution Knowledge

Industry 4.0 Experimental Facilities & Digital Innovation Hubs (DIH)

eit Digital

Jožef Stefan Institute Ljubljana, Slovenia

POLITECNICO MILANO 1863

aic AUTOMOTIVE INTELLIGENCE CENTER

INTELLIMECH CONSORZIO PER LA MECCATRONICA

cea

Fraunhofer

TNO innovation for life

VTT

DATA ECONOMY

INDUSTRY 4.0

Big Data Impact on Factories

15% GDP

Manufacturing contribution

$600 billion

Value for Industry

1.25 T€

Gross Value added by Big Data

Big Data Impact on Factories

605 BEUR

Value loss from digital transformation failure

50%

Machine-time downtime

20%

Production efficiency improvement

DATA SHARING

BARRIERS FOR INDUSTRIAL B2B DATA SHARING

99%

Manufacturing Data Value is Lost

Industry 4.0 Big Data Fears

- 57% worry about **revealing** valuable data and **business secrets.**
- 59% fear the **loss of control** over their data.
- 55% feel **inconsistent processes** and systems as a (very) big obstacle.
- 32% fear that **platforms** do not reach the **critical mass**, so that data exchange will be interesting.

SCENARIOS

BOOST 4.0 DATA VALUE CHAINS

40%

By 2020, 40% of All Digital Transformation Initiatives, and 100% of All Effective IoT Efforts, Will Be Supported by Cognitive/AI Capabilities

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IDC
ANALYZE THE FUTURE

AI for Factories 4.0: Autonomous Factories

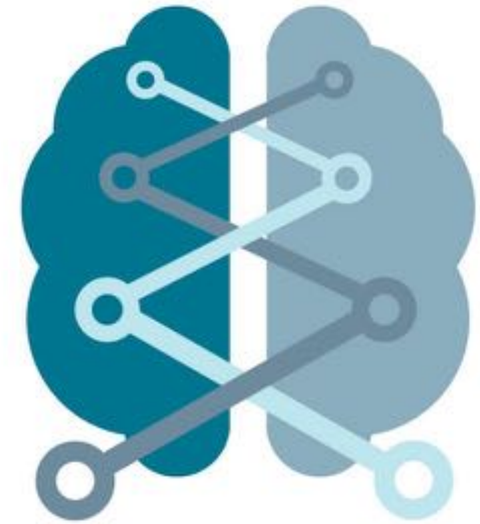
Smart Factory

Digital Factory

Autonomous Factory

AI for Factories 4.0: Autonomous Factories

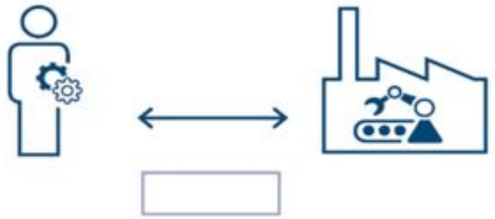
AUTONOMOUS =



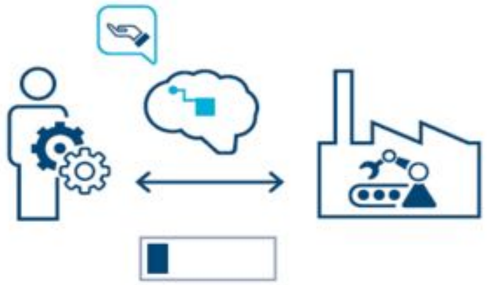
AI

4

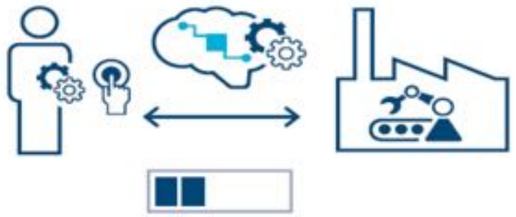
AI for Factories 4.0: Autonomous Factories



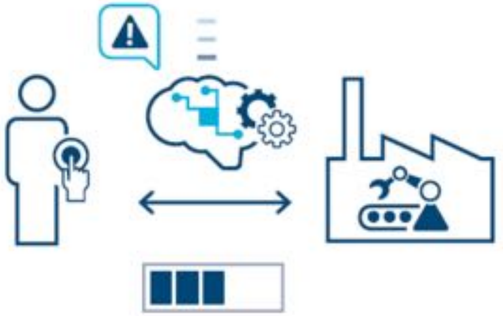
Autonomy Level 0
No autonomy, human beings have full control without any assistance.



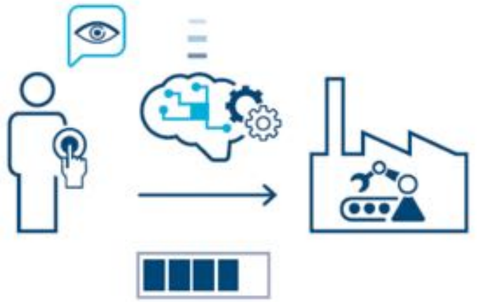
Autonomy Level 1
Assistance with respect to select functions, human beings have full responsibility and make all decisions.



Autonomy Level 2
Partial autonomy in clearly defined areas, human beings have full responsibility and define (some) goals.

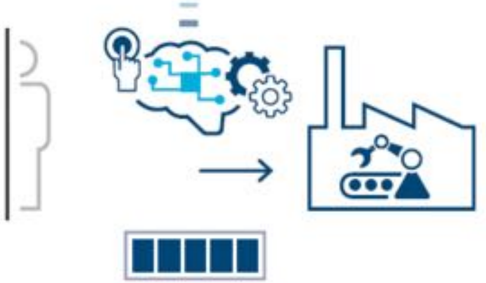


Autonomy Level 3
Delimited autonomy in larger sub-areas, system warns if problems occur, human beings confirm solutions recommended by the system or function at a fall-back level.



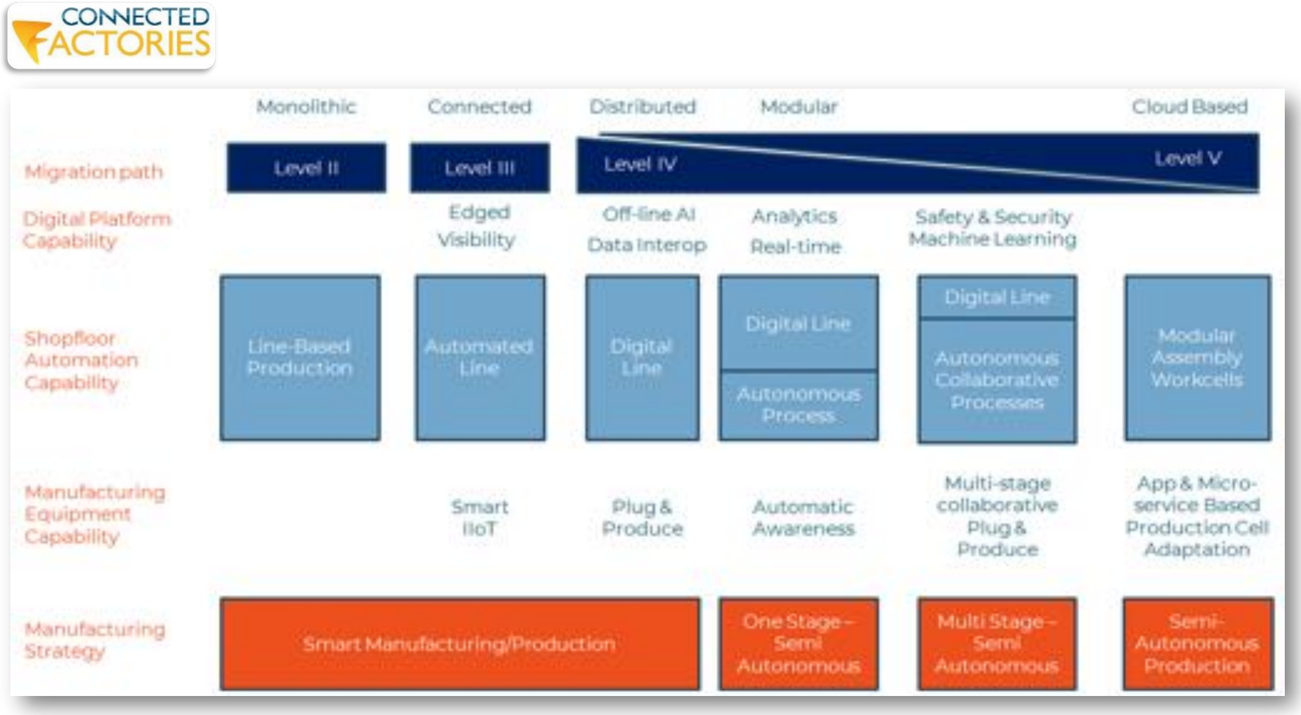
Autonomy Level 4
System functions autonomously and adaptively within defined system boundaries, human beings can supervise or intervene in emergency situations.

Production Level 4



Autonomy Level 5
Autonomous operations in all areas, including in cooperation and in fluctuating system boundaries, human beings need not be present.

AI for Factories 4.0



AI for manufacturing will pave the way to the synergetic and dynamic collaboration between humans, machines and robots in autonomous factories for efficient mass customization, flexible mass production, logistics & assembly, smart & safe modular production and collaborative & reconfigurable robotic systems.

Boost 4.0 EIDS Data Value Network Scenarios

All products
One manufacturer

Interoperability across **vertical** services, data sources & **platforms**

All machines
One production line

Interoperability across **digital twins** & administration shells

All data sources
One business activity

Interoperability across open & industrial **data assets**

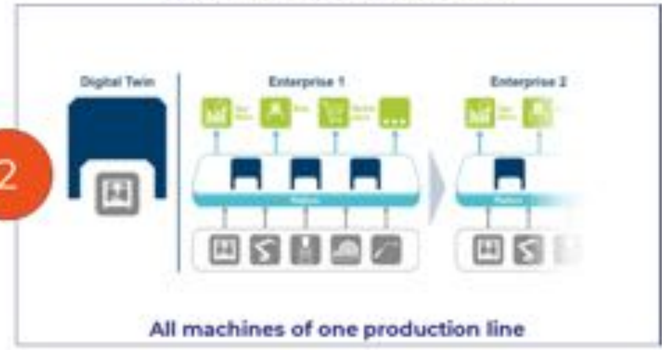
All suppliers & consumers
One product

Interoperability across data silos in the **product lifecycle**.

1

All products of one manufacturer

2



All machines of one production line

3

All data sources for one business activity

4

All suppliers and consumers of one product type

OPPORTUNITIES

ENHANCED MANUFACTURING PROCESSES

Factories 4.0 – Industrial manufacturing processes

Plug & Produce
Modular Assembly Cells

Flexible operations

Mass customisation

Autonomous
Transportation & Logistics

Components move

Products move

Machines move

Factories 4.0 – Industrial manufacturing processes

Safe human-robot collaboration

Human-robots-machines come together as needed for mission-oriented tasks

Digital twin – Real factory synchronised operations

Real-time digital and physical actuation

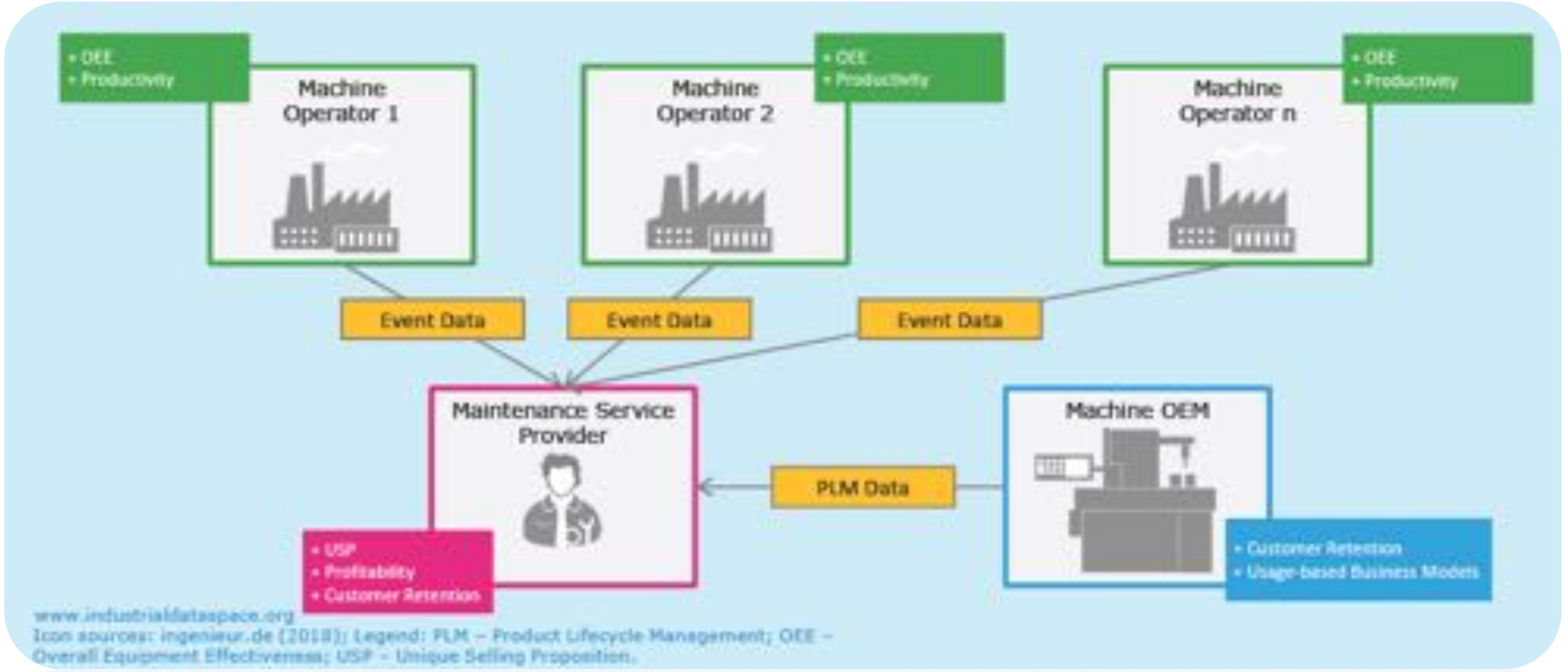
Continuous Production Planning Adaptation for Zero Defect Manufacturing

Human in the loop - Augmented Virtual Decision Support

OPPORTUNITIES

OPENNESS & COLLABORATION

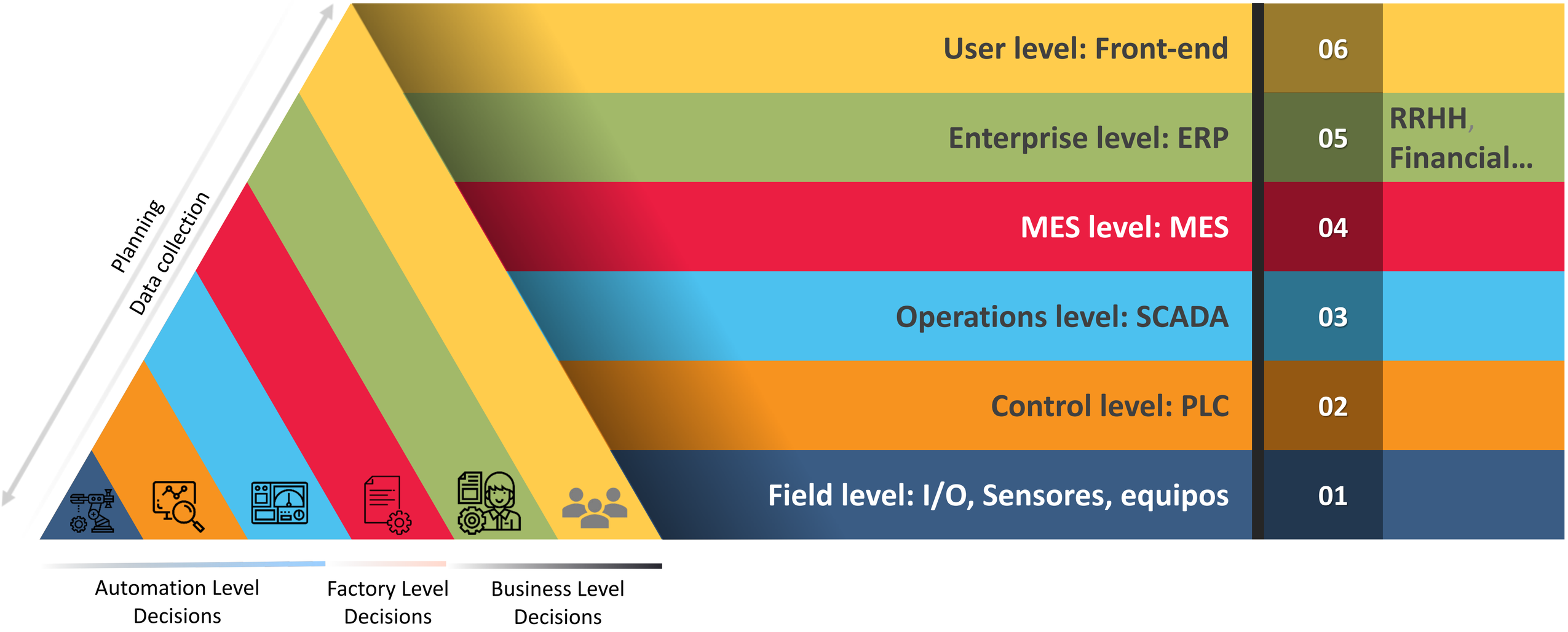
Autonomous Factories 4.0 Transformation: Collaborative Cognitive Manufacturing Processes



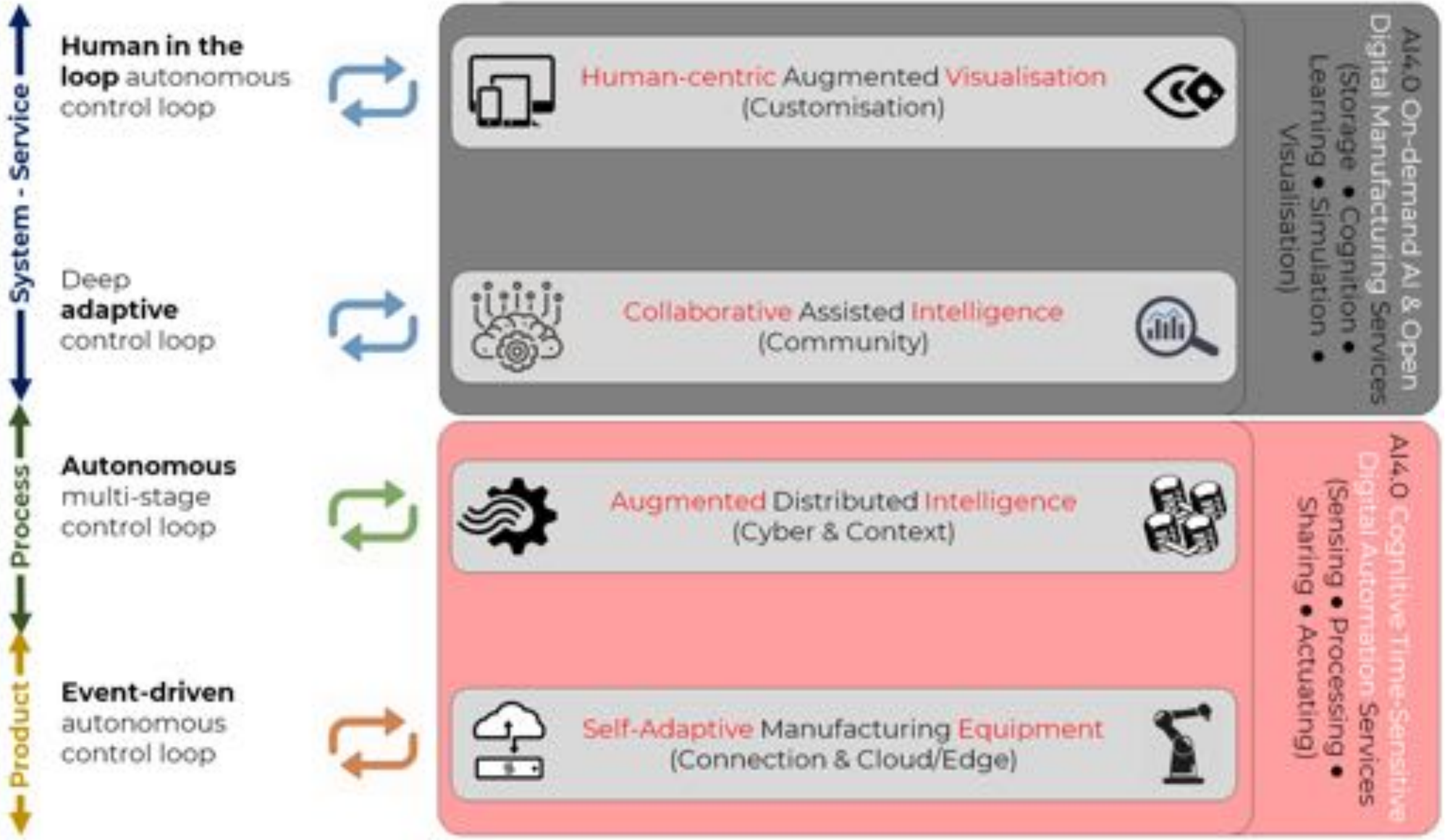
OPPORTUNITIES

DECISION WORKFLOWS

Autonomous Factories 4.0 Transformation: Decision & Control Workflows



Autonomous Factory Decision & Control Loops



Autonomous Factory Decision & Control Loops

IIoT data streams

Classical control loop

Actuation

Feed-back control loop

(Deep Edge) Control

Industrial Big Data Space

Simulation-based prognosis

Actionable Edge AI

QUALITY

Selected data streams

(Federated edge) machine learning loop

Cross-context learning

Feed-forward control loop

After-sales Service

Production/ Workplace

Engineering / Planning

Autonomous Factory Decision & Control Loops

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1

Improve quality
of decisions

2

Reduce time
to decision

3

Make things happen
as plan/predicted

QUALITY

Thanks!

Any questions?

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