

Collaborative Robots and Industry 4.0



A Technology Leader

Mitsubishi – 144 Years of growing into a major brand covering over 40 companies

Mitsubishi Gas Chemical



Mitsubishi Electric Corporation



Mitsubishi Heavy Industries



NYK Line



**Bank of Tokyo –
Mitsubishi UFJ**



Mitsubishi Motors



Kirin Brewery

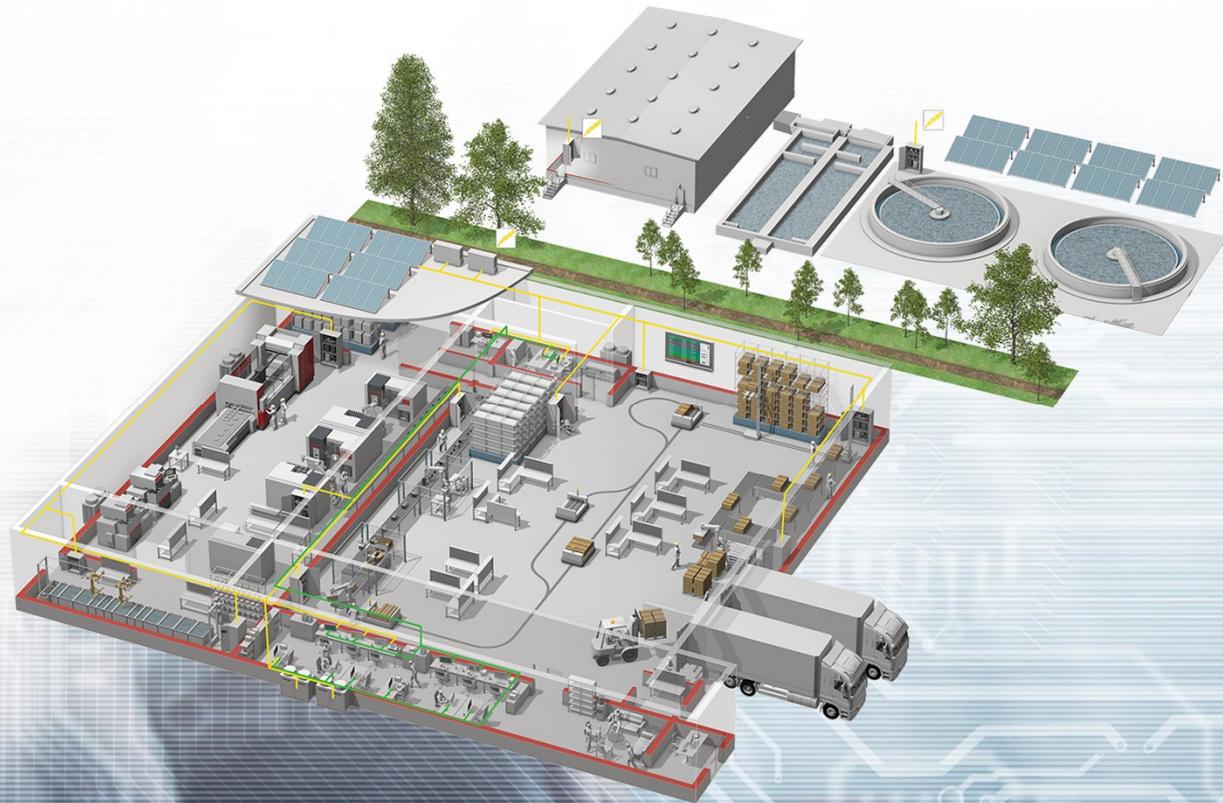


Nikon

Each Mitsubishi company is separate entity and operates independently

MITSUBISHI ELECTRIC's Factory Automation – Product portfolio

- Software
- MMI
- PLCs
- Inverter Drives
- Motion Controllers
- Servos
- Motor Starters
- Switchgear
- Robots
- CNC
- EDM
- Laser Processing



The Art of Manufacturing

e-Factory[®]

Making sense of the world

Cloud of confusion?

Statistical degrees of freedom

Cloud **Big** Analytics IIoT
data Cyber physical systems

Industrie 4.0

Stuxnet Cyber security Smart Factory

Creative economy

IoT

Industrial Internet Consortium

R

Small data

Azure

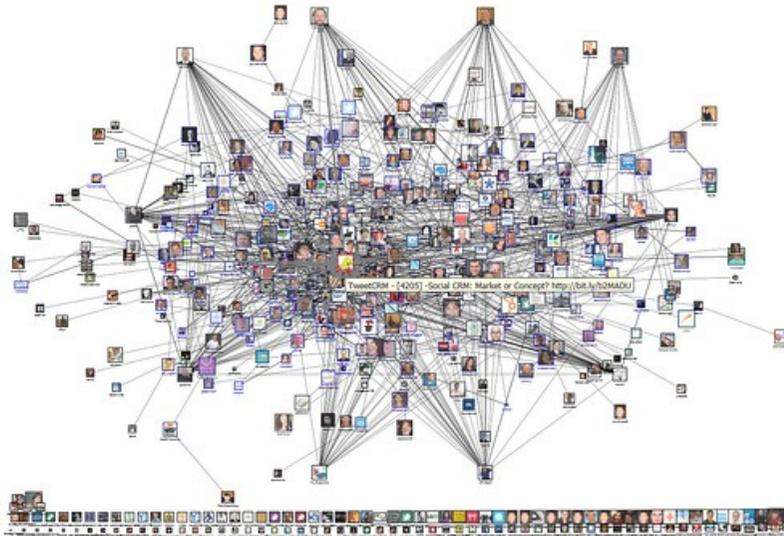
Edge processing

中国製造2025

But what does it
actually all mean?

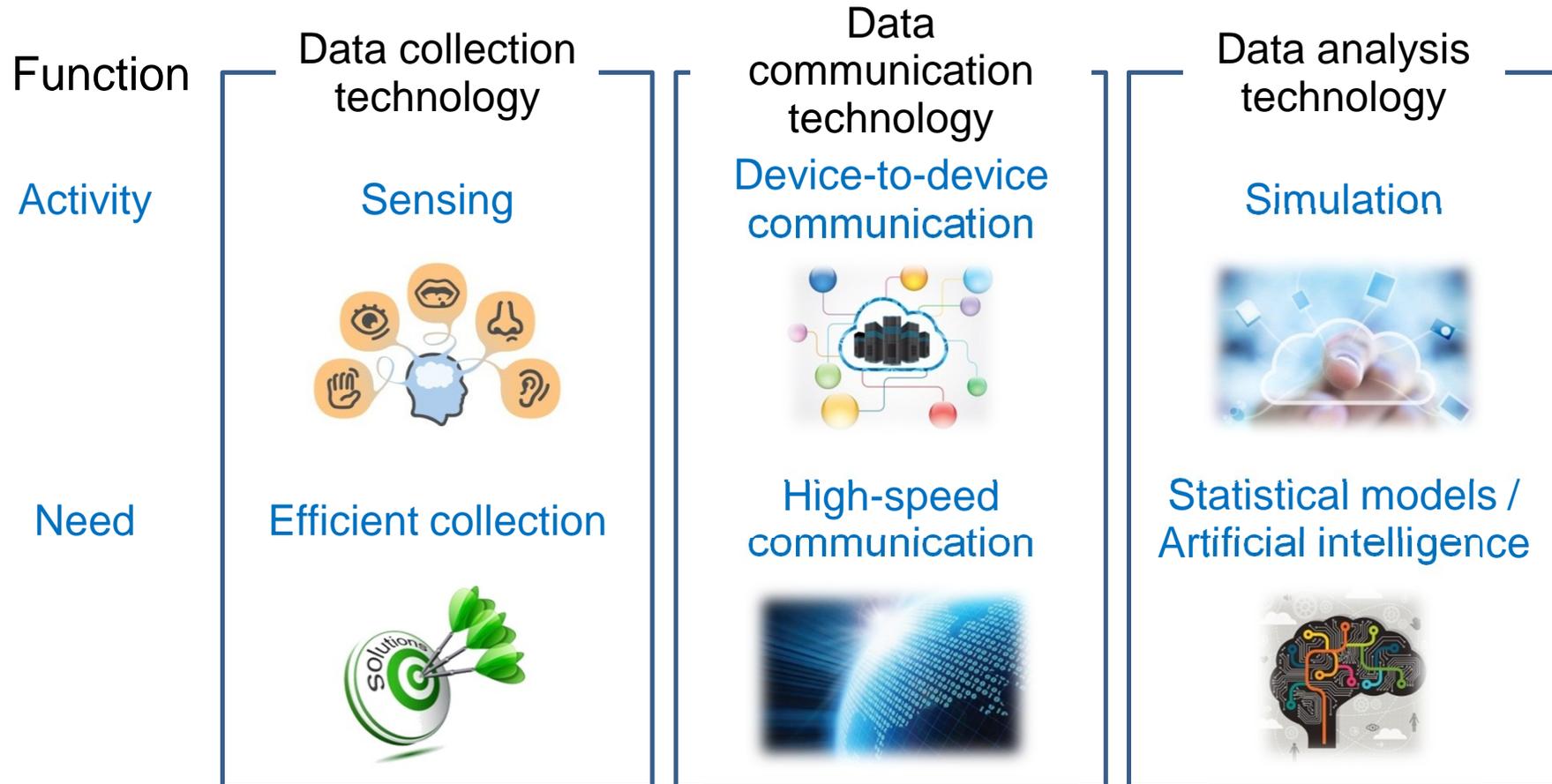
They are all related to the same thing...

A world where all parts
are interlinked and coexist



...where efficiencies,
cost reductions and
productivity increases
can be achieved through
integrated automation
and extracting hidden benefits
from existing resources

Kaizen based manufacturing; Plan, Do, Check, Act



An ICT driven world enables this process to be faster and more efficient

e-F@ctory

FA/IT integration solution

Basic Concept

e-F@ctory uses FA technologies and IT technologies **to reduce total cost** of development, production, and maintenance **and to support advanced manufacturing** (Monozukuri)

Production sites
optimized by
e-F@ctory
can

Collect production-site data in **real time**

Seamlessly link data collected through FA with the IT system

Feed back analysis results from the ICT system to production sites

FA Integration Solution

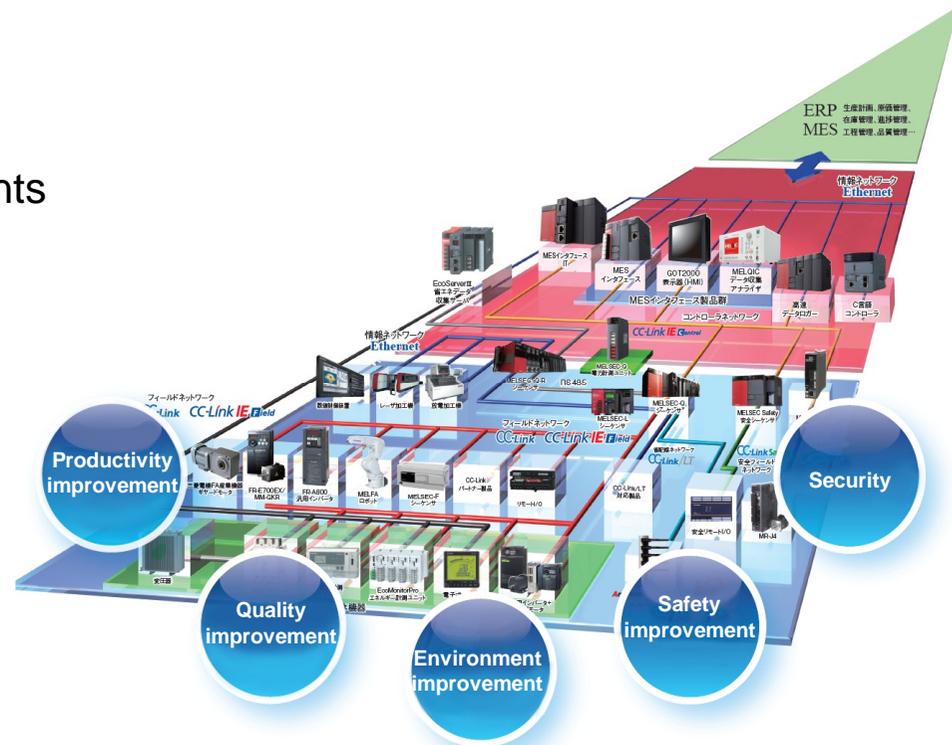
This solution improves

- Productivity • Quality • Environment
- Safety • Security

through

- Visualization with analysis • Improvements
- Increased availability at production sites

It assists companies to reduce TCO and to improve the company values.



since 2003

Alliance Partners:

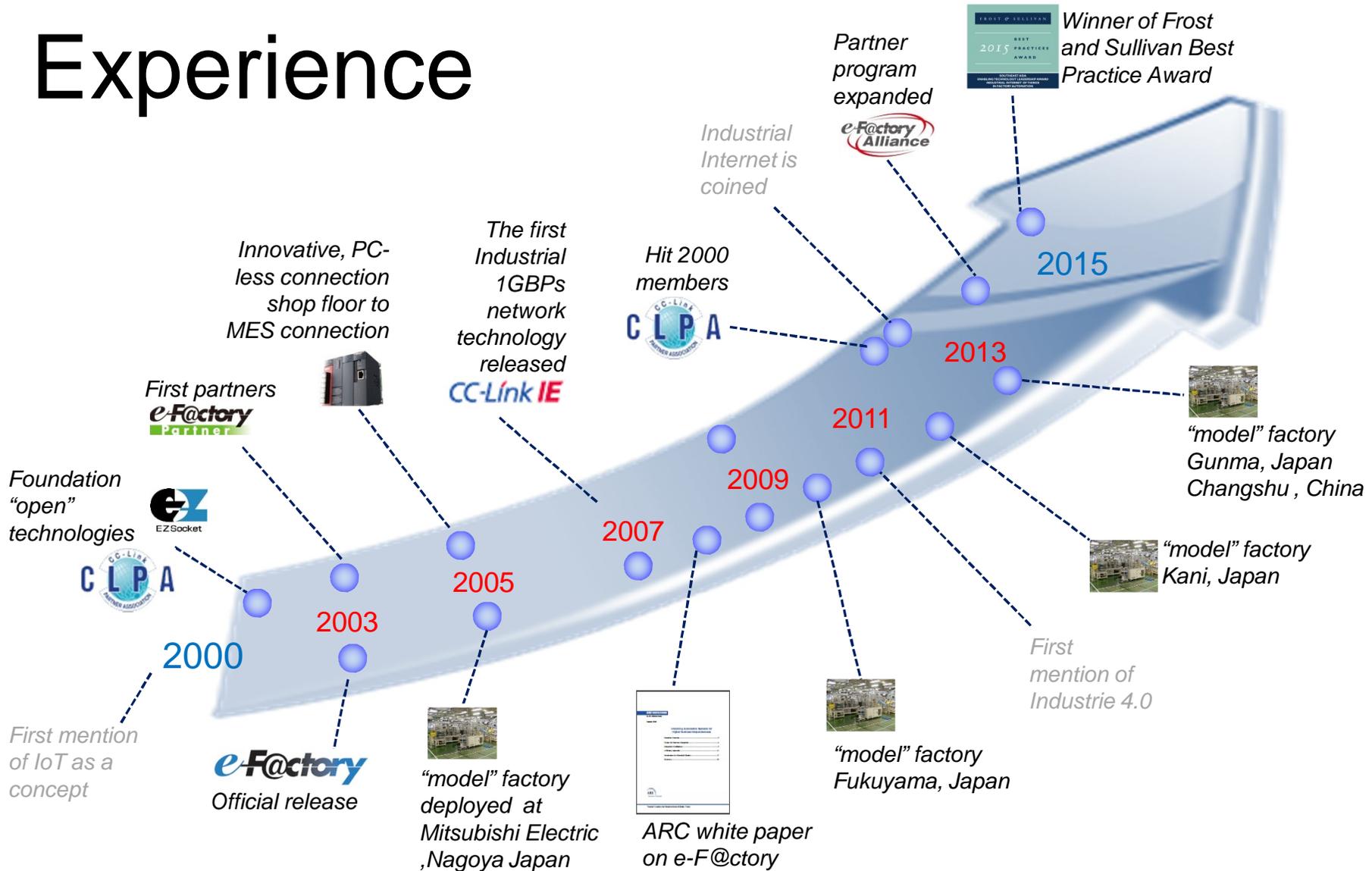
- Direct 279 companies
- Indirect 2800 companies

Installed systems:

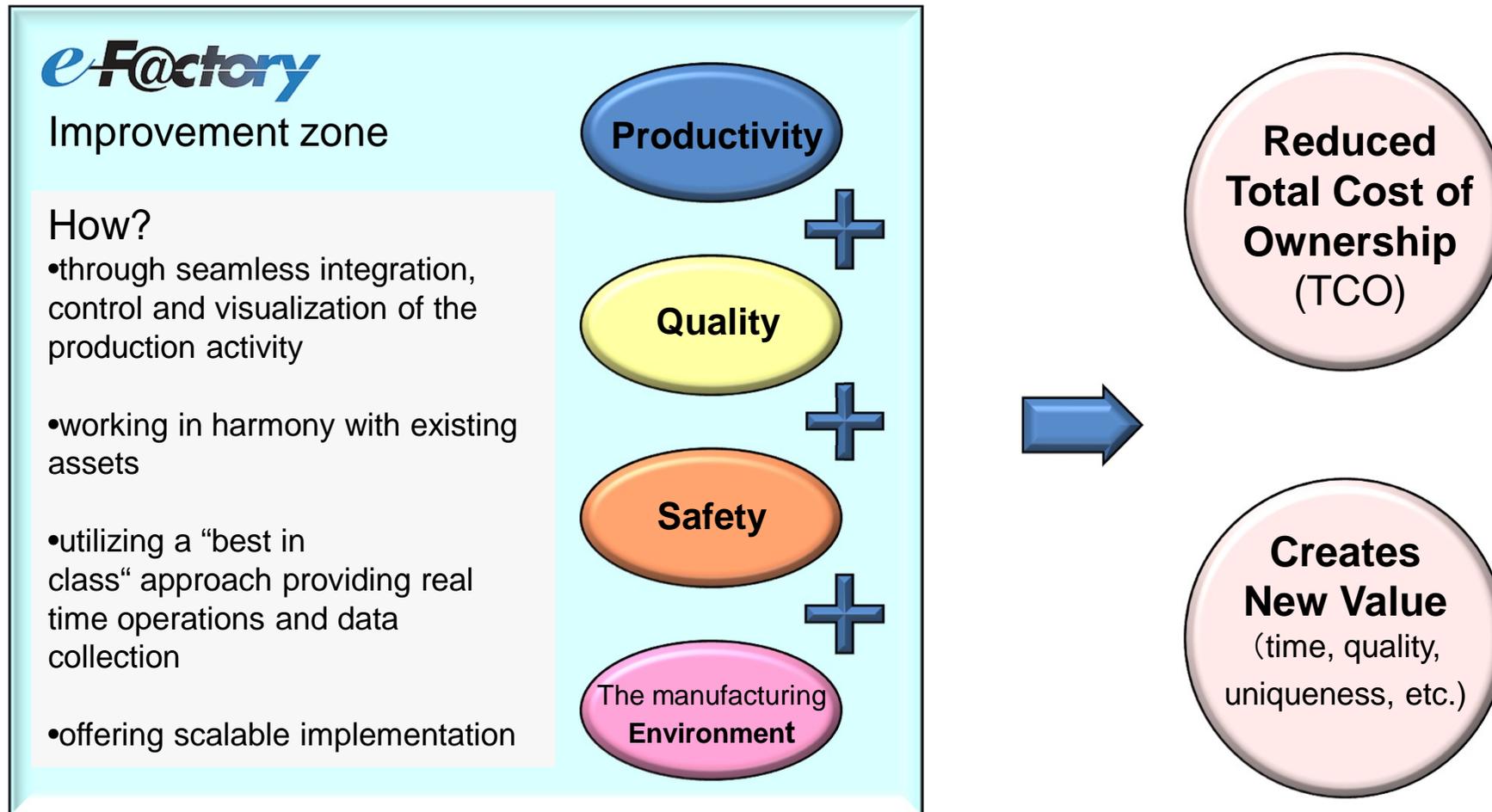
- 130 factories,
- more than 5000

Visualization with analysis and improvements

Experience



The **e-Factory** effect



Robotics in an Industry 4.0 context



Why robots are important for I 4.0 ?

- Statement from IFR :”By 2018 global sales of industrial robots will on average grow year on year by 15 percent”
- Flexible production is a main point of I4.0
 - Constant operation at high speed
 - Reduced operation costs
 - Reliable
 - robots are giving the flexibility
 - Down to single lot production
 - Simulation and automatic program creation



Robotics in manufacturing

New kind of applications and tasks can be handled by collaborative robots which have not been automated before.

Traditional industrial robots (Cooperative)

To improve the performance of the machine

Very fast and precise

Human can interact and co-operate with the robot with reduced speed/torque and limited position

Collaborative robots

Support the worker -> work like humans

Safety first

Slow and easy to use and easy to move

Human can work all the time close to the robot

Collaborative robots are more a complementary to industrial robots than a competitor of traditional industrial robots

Cooperating robots for I 4.0

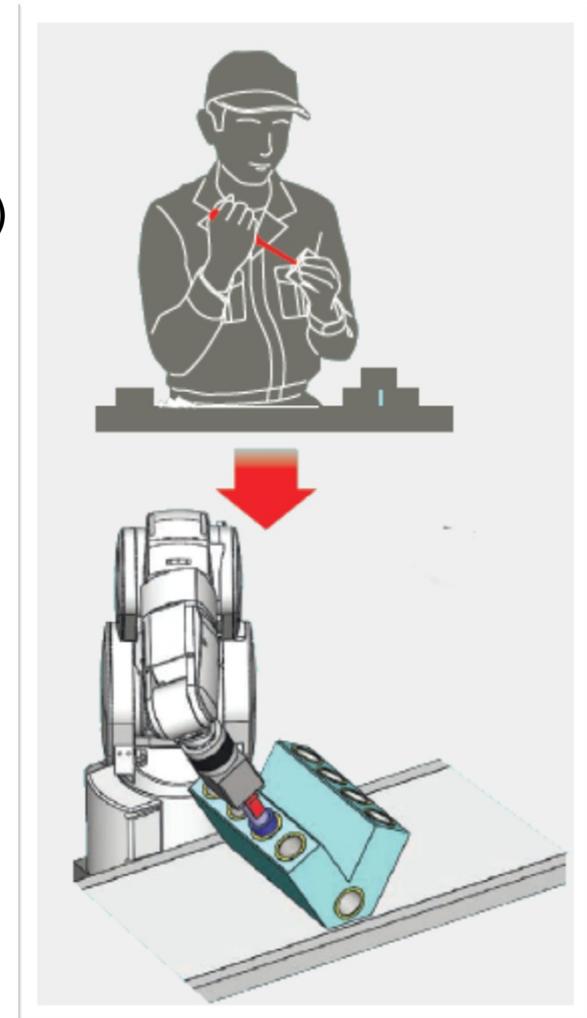
Intelligent periphery

Force sensor (control the force like human being)

Camera (to see like human being)

3D vision for bin picking

Safety (worker can interact with the robot
without stopping the robot)



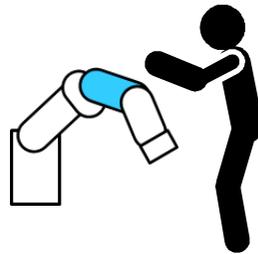
Collaborative Robots

What is next important ?

- Detecting the collision before the worker touches the robot by wireless sensors
- Easy teaching by moving the arm manually to the position
- Interactive control of robot by touching the robot arm and give commands like start, program change



Start Program



Reset Program

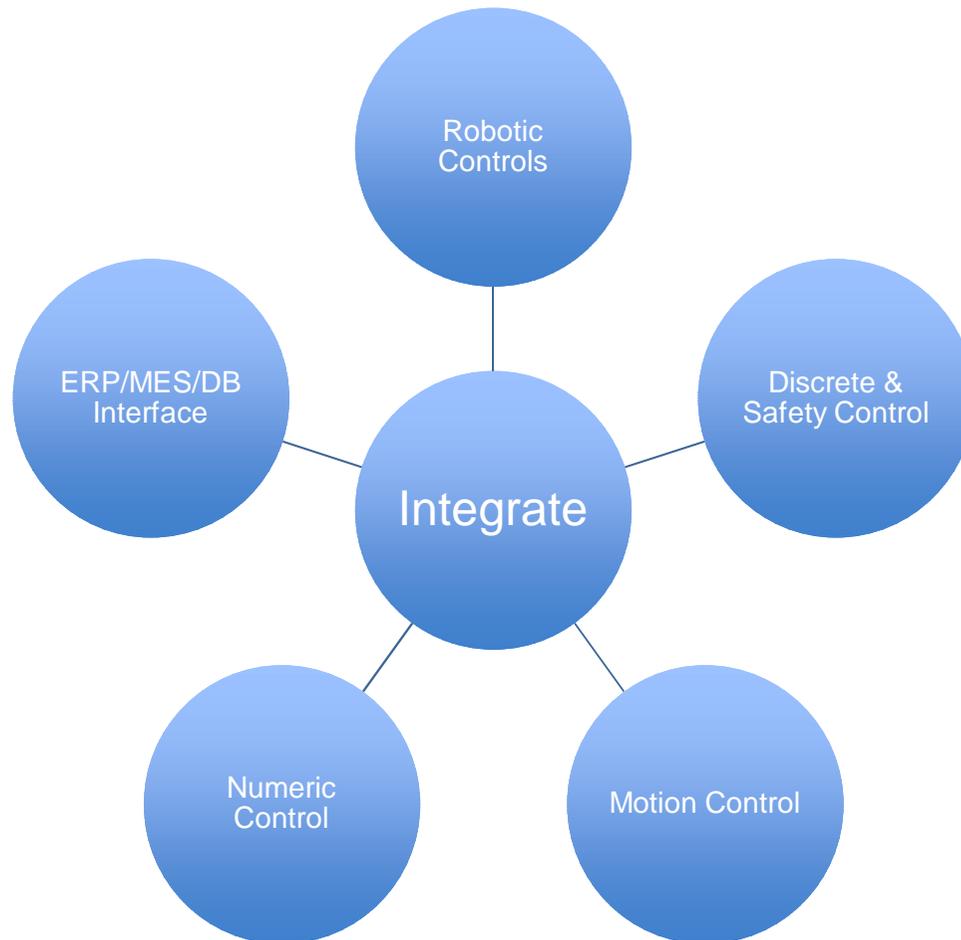


Switch operation
mode



Muting mode

Expanding beyond collaborative robots

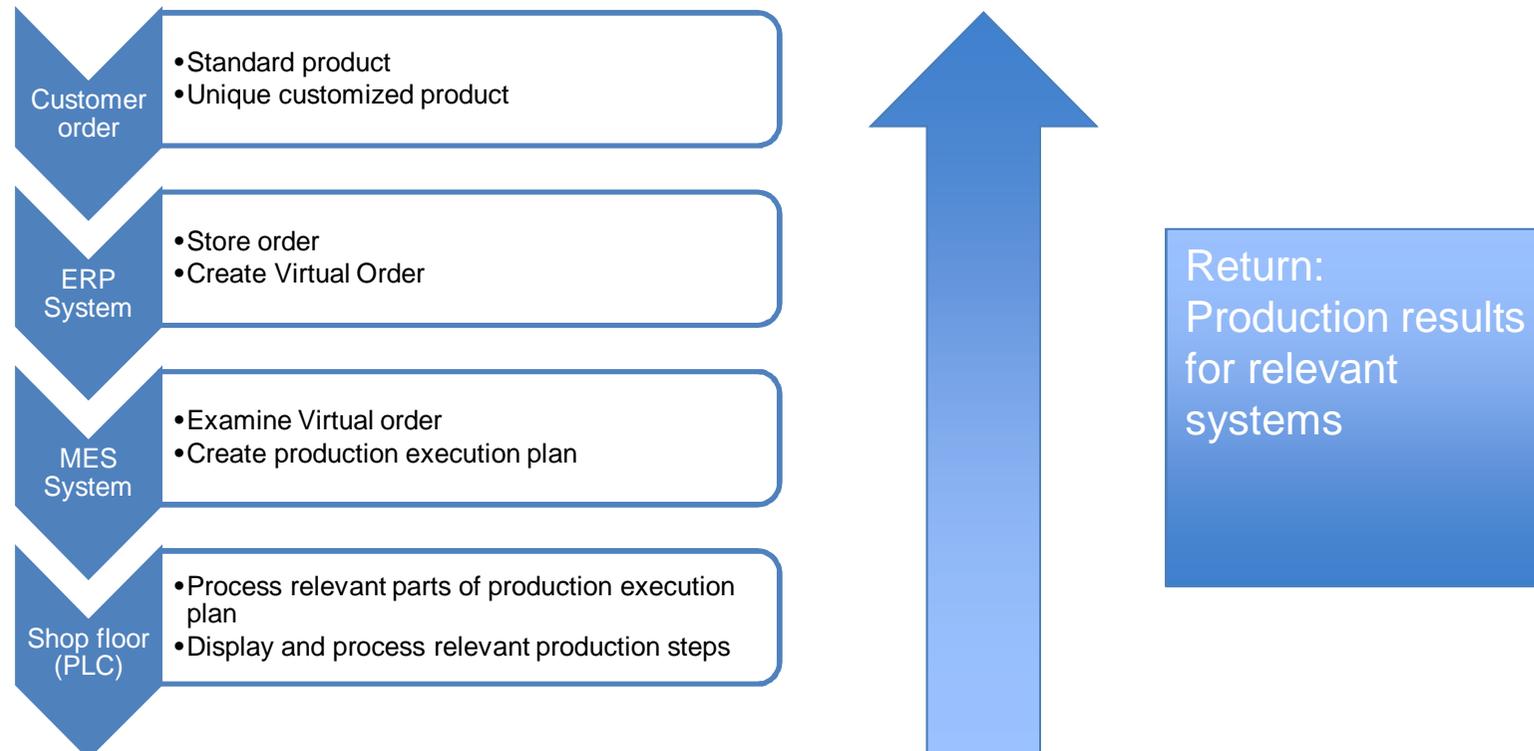


Information within a single platform is available for all disciplines

Result:

- **far lower integration cost**
- **Single interface to enterprise systems**

Possible Example



Automated and manual processes coexist in manufacturing environment.
Human for high intelligence flexibility
Automation supports the human by doing repetitive and low level intelligent tasks along the value chain

Enterprise

Shop Floor

Corporate Enterprise

Interacts with Corporate Enterprise Systems

Only 2 layer
Reducing
TCO

iQ Platform



Integrates all automation relevant aspects



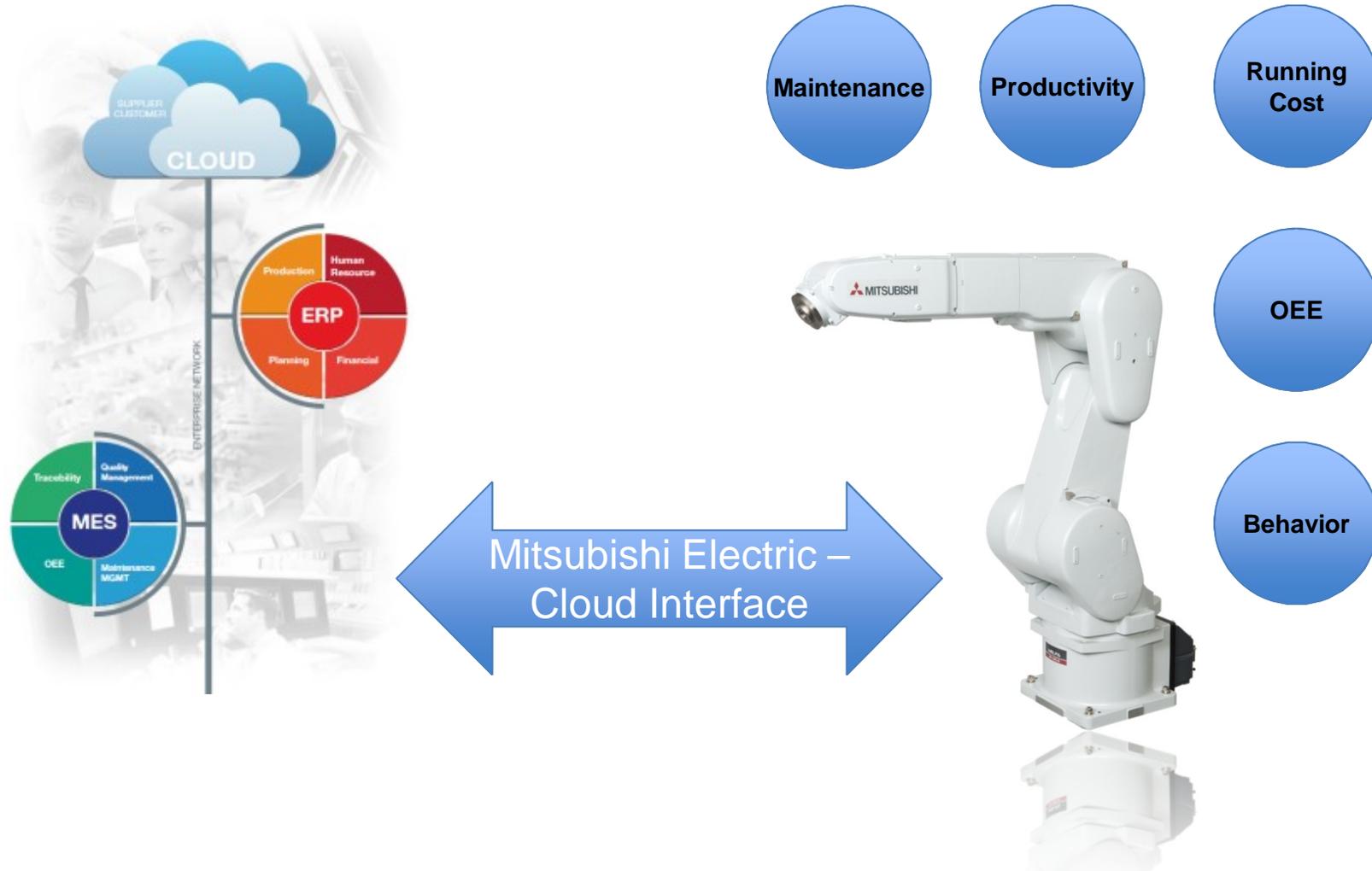
CNC

Discrete

Motion

Robotic

Cloud and Robotics



Example: Cloud and Robotics Architecture



**Cloud
(HANA SAP)**



**iQ-R
C-Controller**



iQ Platform

R12CC



- Maintenance
- Productivity
- Running Cost
- OEE
- Behavior

Thank you.

Danke.

Merci.

Grazie.

Gracias.

Teşekkürler.

شكرا

ありがとうございました。

謝謝。

спасибо

