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The Industrial Internet of Things (IIoT)

Flexibility, Efficiency, Visibility & Safety in the 4th Industrial Revolution

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WHAT ARE YOUR GOALS?

- Reduction of Manufacturing Costs
- Higher Machine Availability
- OEE
- Improved Asset Utilization
- Traceability of products & parts
- Improve Supply Chain
- Easily integrate new technology
- Improve product quality
- Reduce Scrap rates
- Reduce die crashes
- Reduce unplanned downtime

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ARE YOU TALKING ABOUT THESE THINGS?

- Predictive Maintenance
- Parameterization
- Model / Recipe Changes
- Format Changes
- Quality Assurance
- Condition Monitoring
- Quick Die Change
- Die Protection
- Simplify Troubleshooting
- Traceability
- Energy Management
- Security / IT
- Location Management
- Asset Management
- Analytics / Big Data
- Press Setup
- Part Bin / Cart Tracking
- Poka-Yoke / Error-Proofing

THAT'S INDUSTRY 4.0

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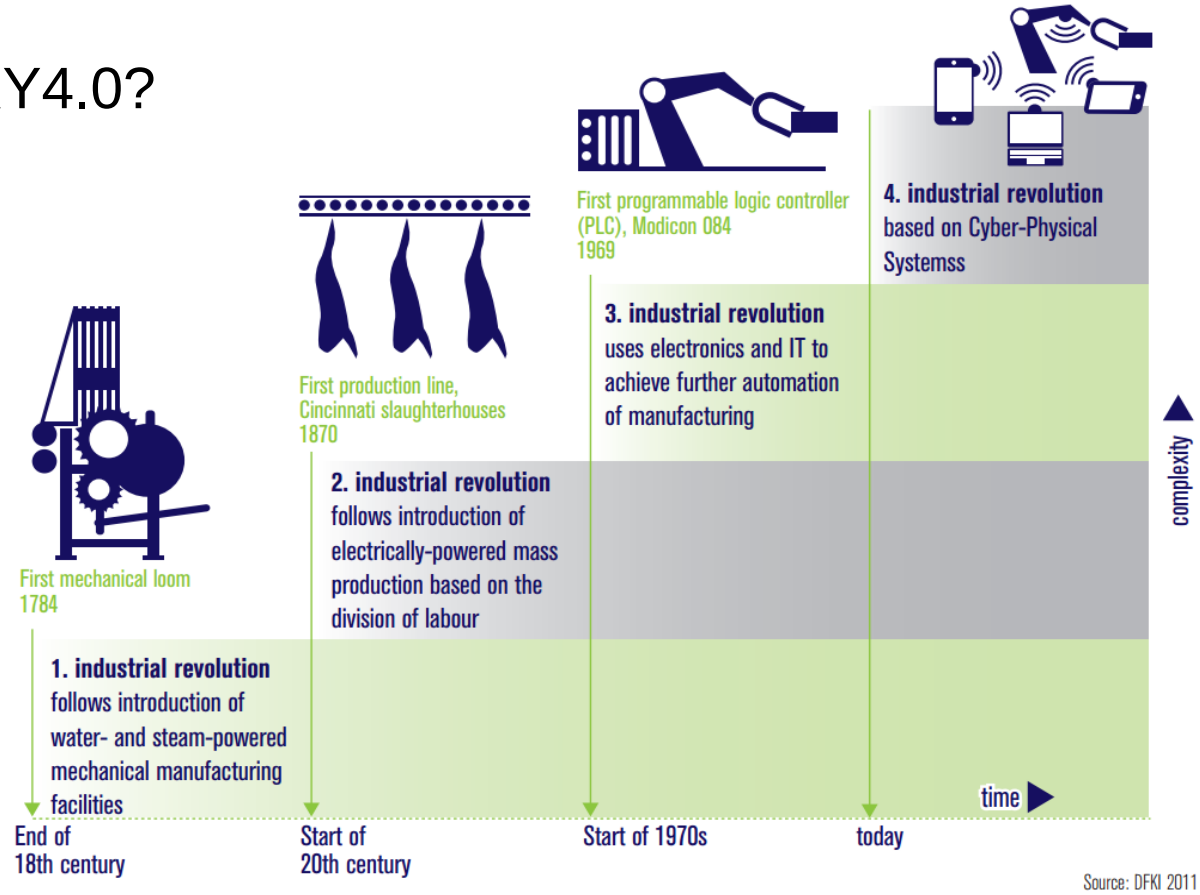
WHAT IS INDUSTRY4.0?

Motivations:

1. Flexible Manufacturing
2. Efficient Production
3. Visibility



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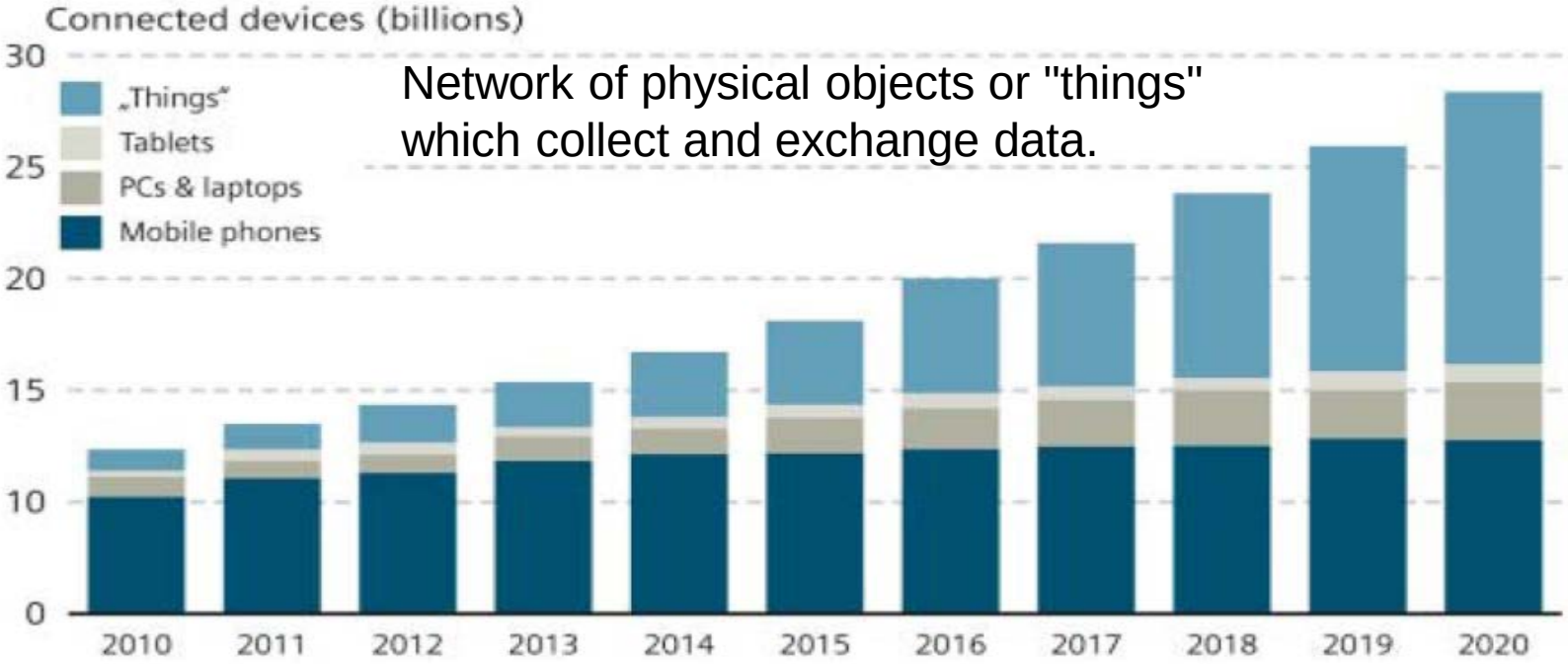
WHAT IS THE INTERNET OF THINGS (IoT)?



Network of physical objects or "things" which collect and exchange data.

Source: *Pictures of the Future, "The Internet of Things," MIT Technology Review, Business Report.*

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IoT CASE STUDY

Mass personalization

Share a **COKE**
in a Whole New Way with
Personalized Gear

CUSTOMIZE NOW

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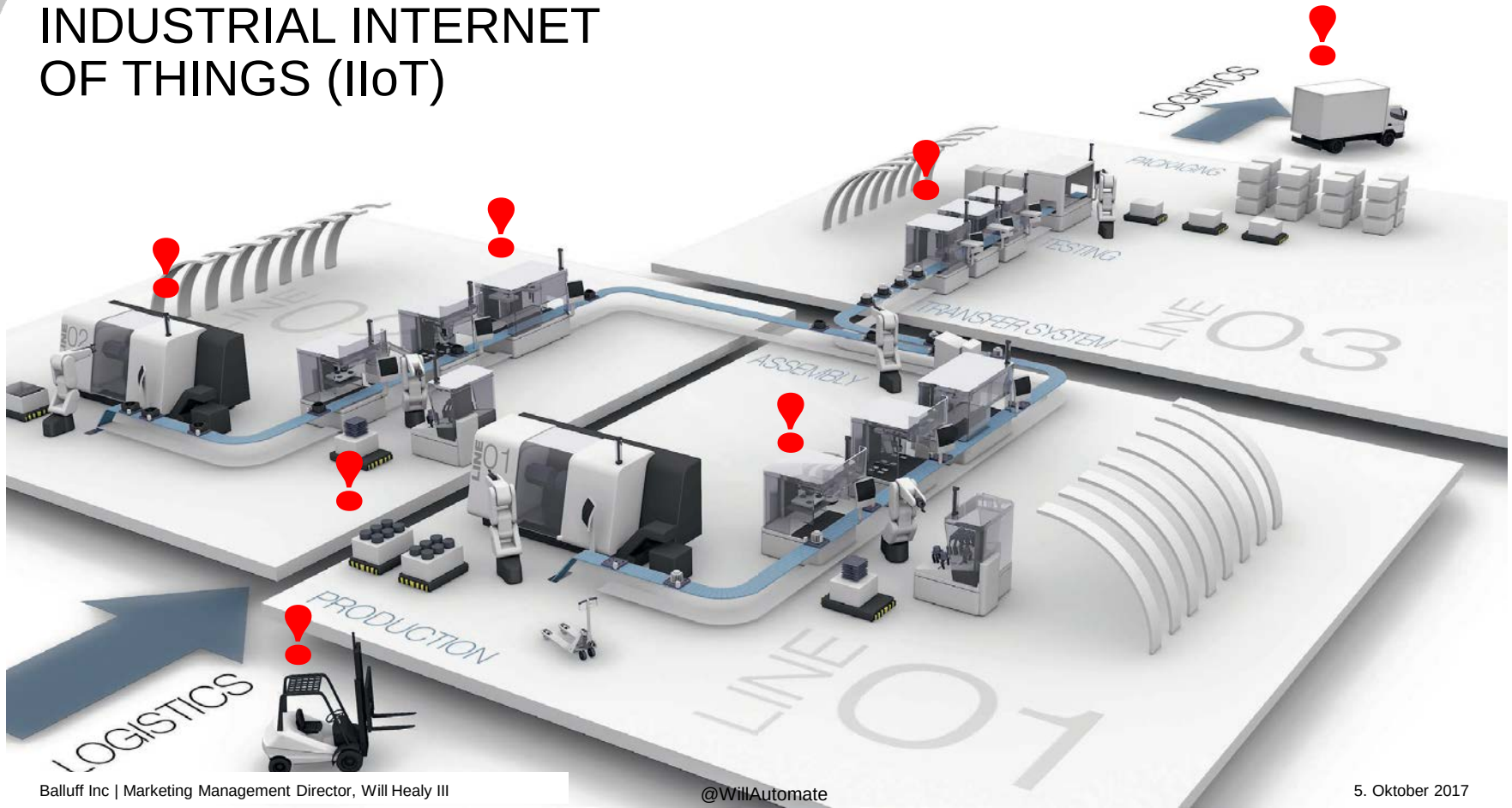
INDUSTRIAL INTERNET OF THINGS (IIoT)



BUT WHY SHOULD I PAY ATTENTION TO THIS?

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MODERNIZATION IS OVERDUE

$65 B

Automation systems reaching end-of-life

4 in 10

Manufacturers have little to no visibility into the real-time status of their manufacturing processes

50%

Manufacturers become aware of a problem only after a breakdown occurs

Sources: ARC, Morgan Stanley, Ubis

48%

Projecting a 48% reduction in unplanned downtime!

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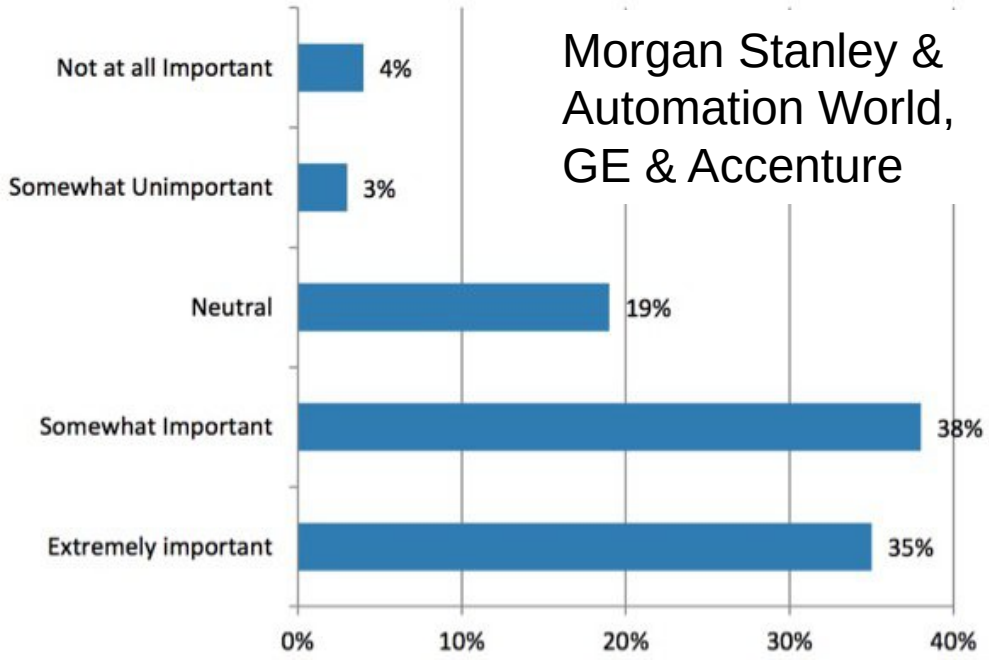
INVESTMENT IN IIoT IS HAPPENING NOW!



- Expect the automation industry to **grow at a faster pace** than GDP
- Capital budgets expected to **grow 18% for IIoT** type investments
- ***73% of companies are already investing more than 20%*** *of their overall technology budget on Big Data analytics.*

YOUR COMPETITORS ARE INVESTING IN INDUSTRY 4.0

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WHY ARE MANUFACTURERS INVESTING?

1. Reduce costs
2. Optimize asset utilization
3. Improve worker productivity

4. Create new business models/new revenue streams
5. Enhance customer experience
6. Enhance worker safety
7. Improve sustainability


Smartindustry
INITIATIVE REPORT

Digital Transformation:
The 2016 State of Initiative Report

Early adopters across manufacturing, processing and other industrial verticals move to harness the Industrial Internet of Things (IIoT).

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METAL STAMPERS & #2 ASSET UTILIZATION

- Where is it?
- Use Data?
- Repair Data?
- Setup Data?
- Last Operator?
- Maintained by?
- Predicted Maintenance Date?
- Recipe Data?

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Maintenance on the Shop Floor

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MAINTENANCE ON THE SHOP FLOOR

IIoT Enables Predictive Maintenance of Assets

Preventative Maintenance

- Timing based on age or use.
- 82% random failure pattern.

Predictive Maintenance

- Employs condition monitoring and analytics to predict failure.
- Benefits:
  - Improved Uptime
  - Asset Longevity
  - Maintenance Cost Control
  - Safety

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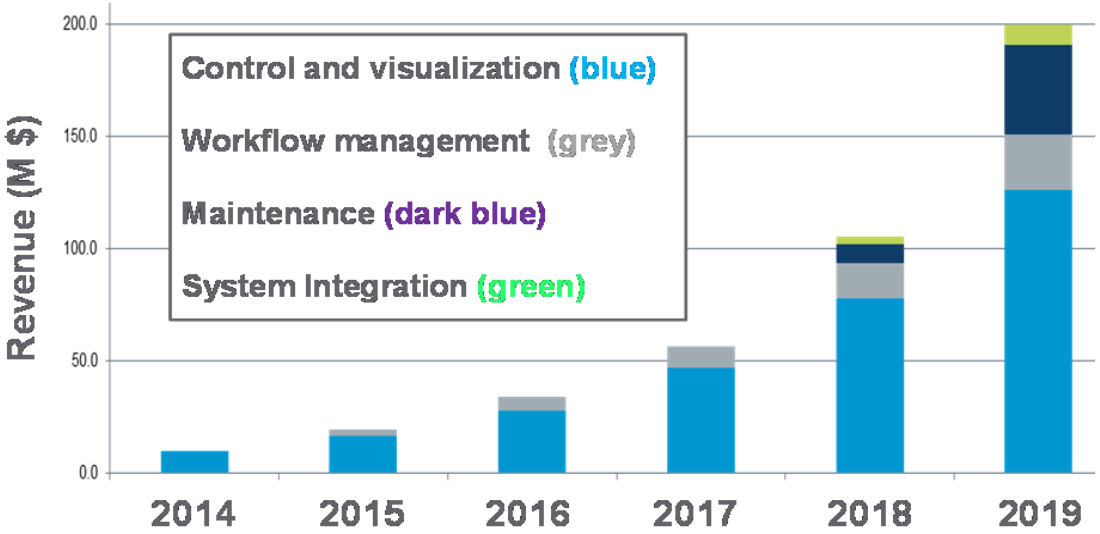
THE USE OF MOBILE DEVICES IN INDUSTRIAL APPLICATIONS

Global market projections for industrial mobile applications (courtesy of IHS)



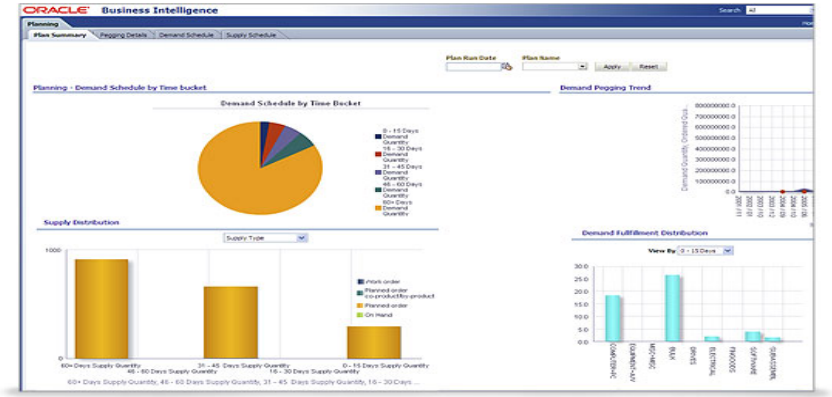
4x today!

SMART Machines: What they are and how they contribute to the future of the industry - by Dr. Rainer Beudert,

MAINTENANCE ON THE SHOP FLOOR

Diagnostics in the Cloud or Local Server

- Using Historians and Data Logging
- Visible globally across the organization in real time.
- Laser focused information into individual operations
- Share metrics of success and/or failures.



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MAINTENANCE ON THE SHOP FLOOR

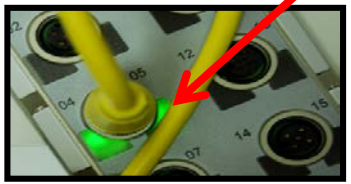
Diagnostics AT Devices

- Communicate clearly with maintenance
- Identify specific location of failure or issue
- Know the problem easily

Ethernet
Controller
Power

Info
Display

Green = Signal
Red = Short



MAINTENANCE ON THE SHOP FLOOR

ABB's IoT Enabled Low Voltage Motors

- accurately measures parameters like temperature or vibrations and sends the data via smartphone to a cloud-based secure server
- Software from ABB analyzes the data and recommends predictive maintenance measures.
- reduce unplanned downtime by up to 70%, extend motor lifetime by up to 30% and improve the energy efficiency by up to 10% - a measurable added value amortized within less than a year.

MAINTENANCE ON THE SHOP FLOOR

Predictive Maintenance of a Power Supply

- Load & stress diagnostics
- Temperature of components monitored
- Lifetime Remaining Calculated
- Reporting via LED & IO-Link
- Historian used to track trends

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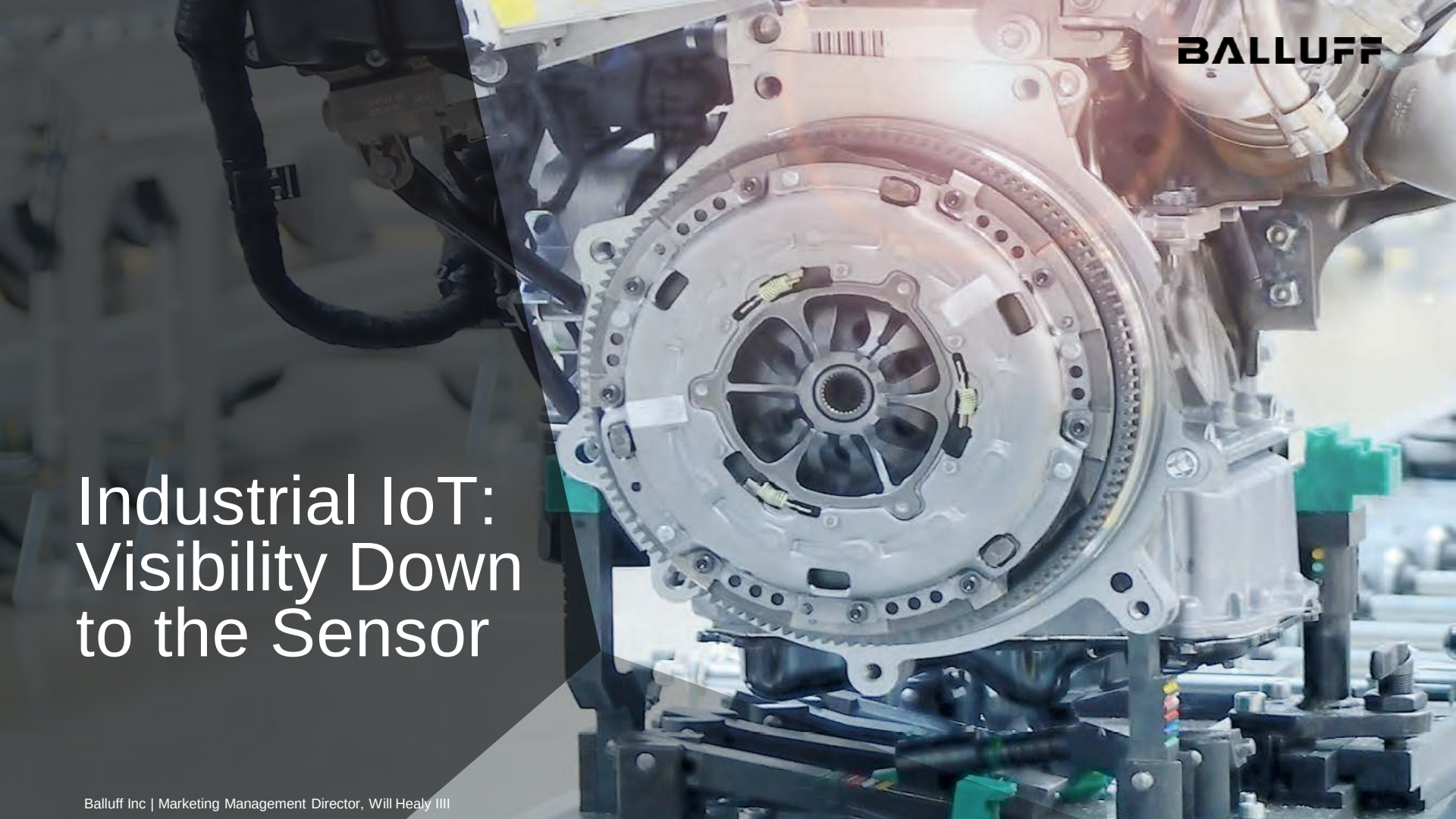
FORTUNE MAGAZINE - GM IS USING THE CLOUD TO CONNECT ITS FACTORY ROBOTS

- *“The robot calls in and says, ‘I’ve got an issue in one of my motors in one of my joints,’ ” says Scott Whybrew, who directs global manufacturing engineering at GM. “Or it may say it’s about to get sick in a few seconds.”*
- *The system ingests data flowing to and from robots as well as external devices, … It sends that information to a cloud network set up by Cisco. There, Fanuc runs algorithms tailored to the factory robots. The result? Insights that plant managers … can tap to avoid mishaps.*



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Industrial IoT: Visibility Down to the Sensor

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INDUSTRIAL IoT: VISIBILITY INSIDE THE TOOL

- What goes in must come out!
- Die Protection sensors are a must
- Automate Setup & Change Verification
- Safety & Die Protection need Control
- ROI on an entire Die Protection Program is typically only 1 crash.

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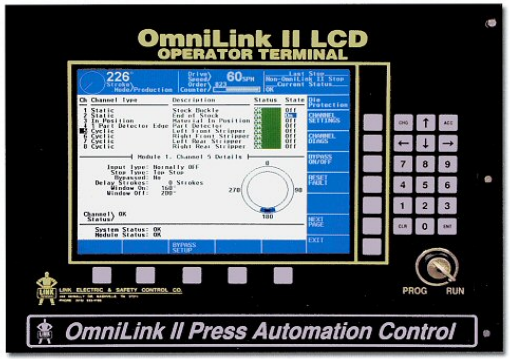
PRESS CONTROLLERS

Wintriss
Press
Controller



Link
Systems
Press
Controller

Wintriss Die Interface

Link Systems
Die Interface

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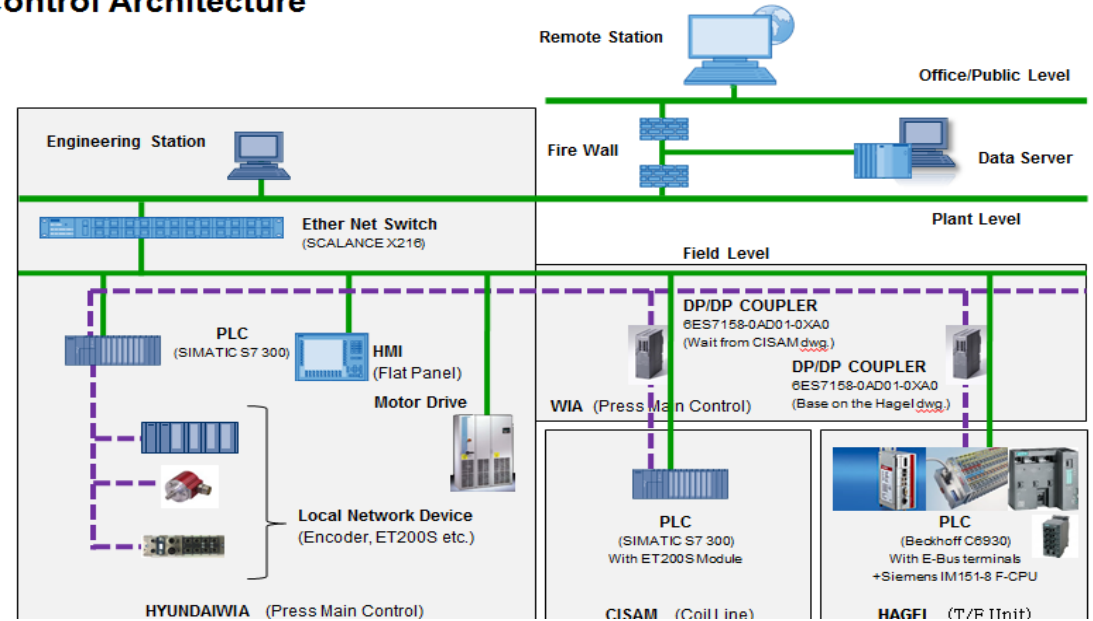
AUTOMATION CONTROLLERS

Control Architecture



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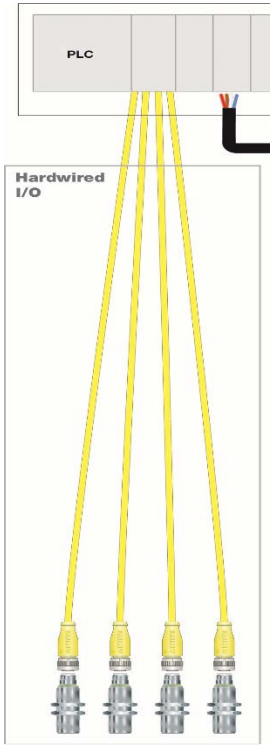
THE EVOLUTION OF I/O – HARDWIRED POINT-TO-POINT

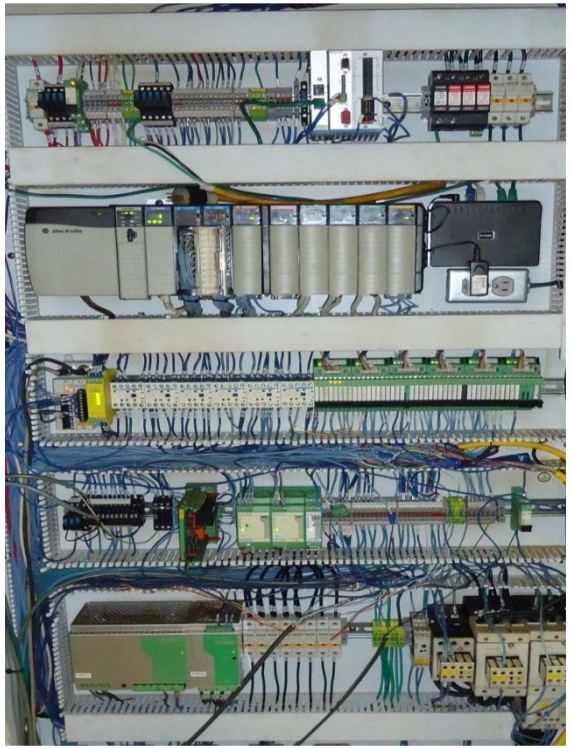
Disadvantages

- Difficult to repair
- Hard to diagnose
- High Cable Mgmt

Advantages

- Low piece cost
- Basic service skills





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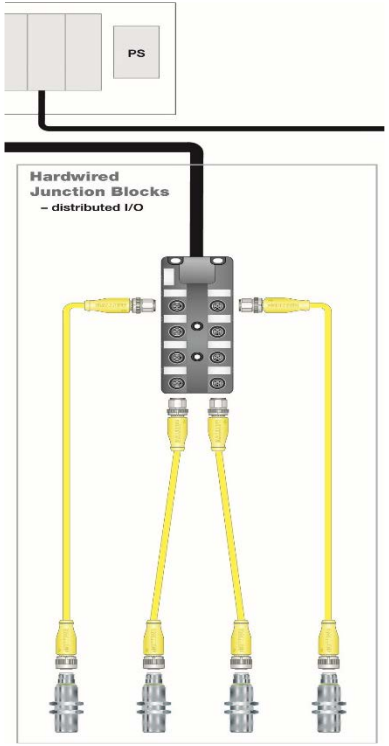
THE EVOLUTION OF I/O – JUNCTION BLOCKS

Disadvantages

- Hard to diagnose
- Long downtimes

Advantages

- Easier to repair
- Basic service skills



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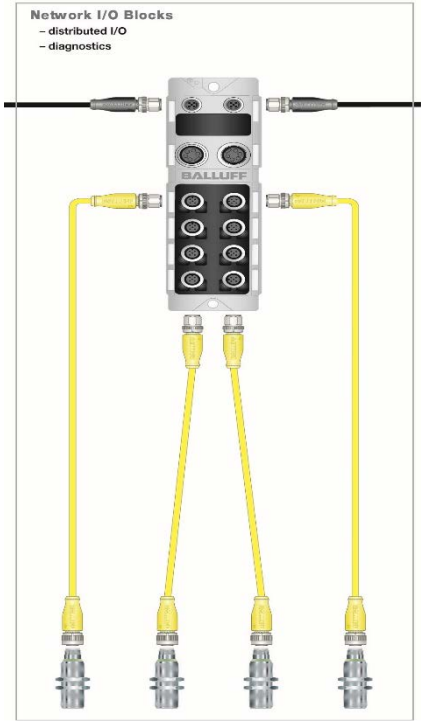
THE EVOLUTION OF I/O – MACHINE MOUNT I/O BLOCKS

Disadvantages

- Higher piece cost
- Network skills

Advantages

- Fast diagnosis
- Fast repair
- Low Cable Mgmt



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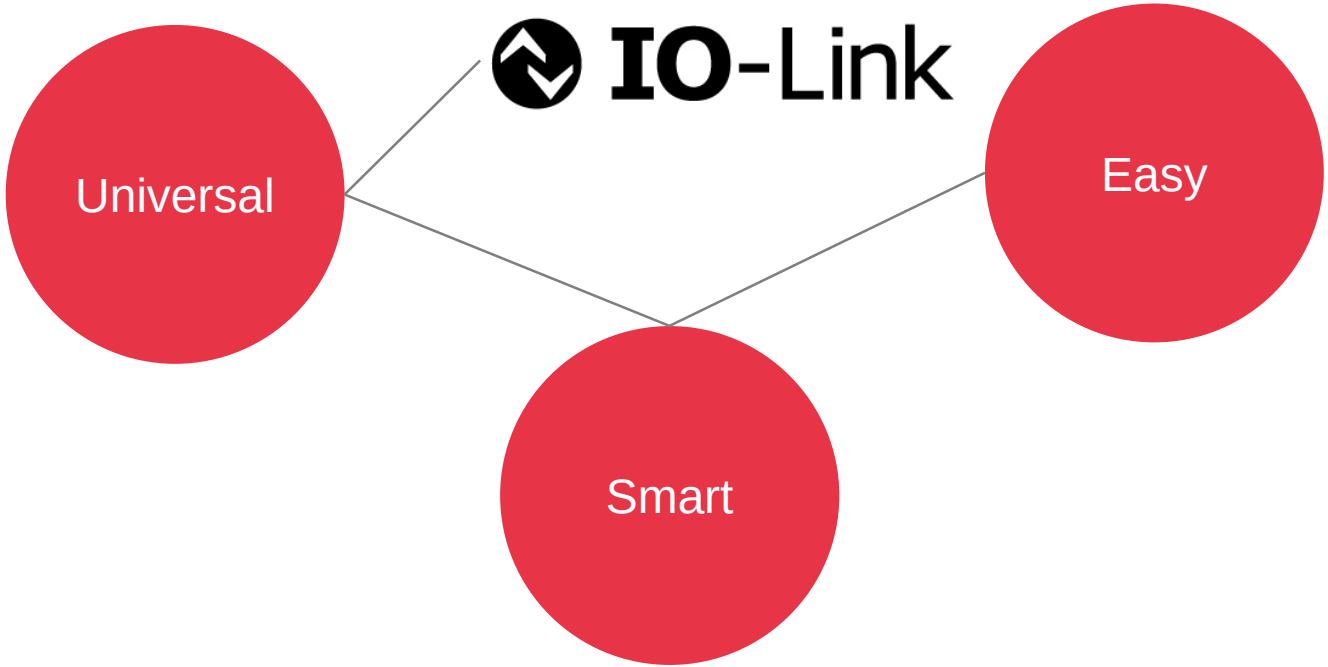
VISIBILITY DOWN TO THE SENSOR

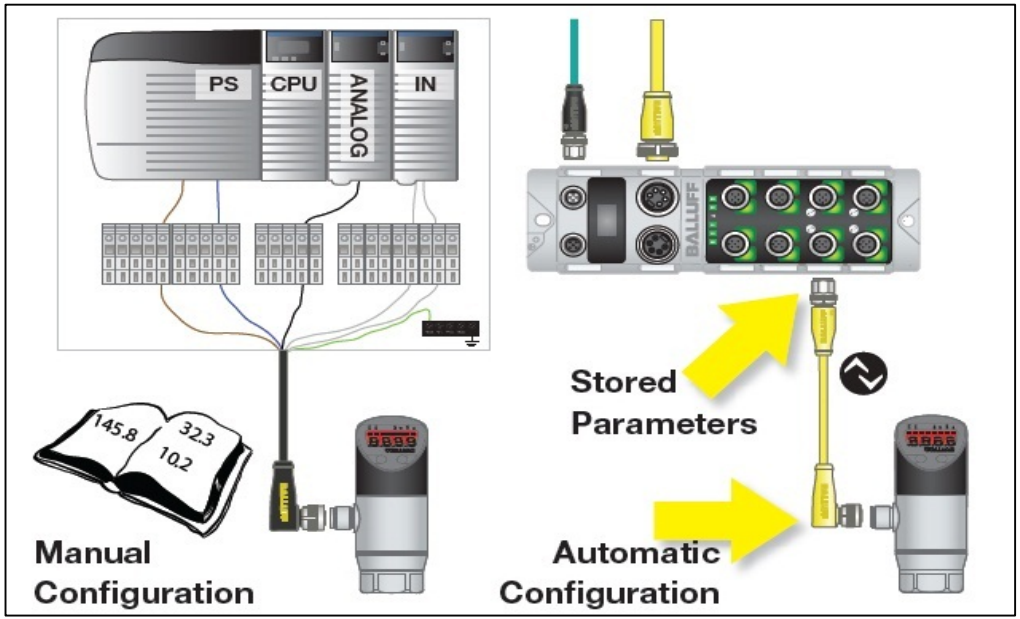
Does it make sense to have every sensor with an Ethernet connection?

Think IO-Link

VISIBILITY DOWN TO THE SENSOR



VISIBILITY DOWN TO THE SENSOR



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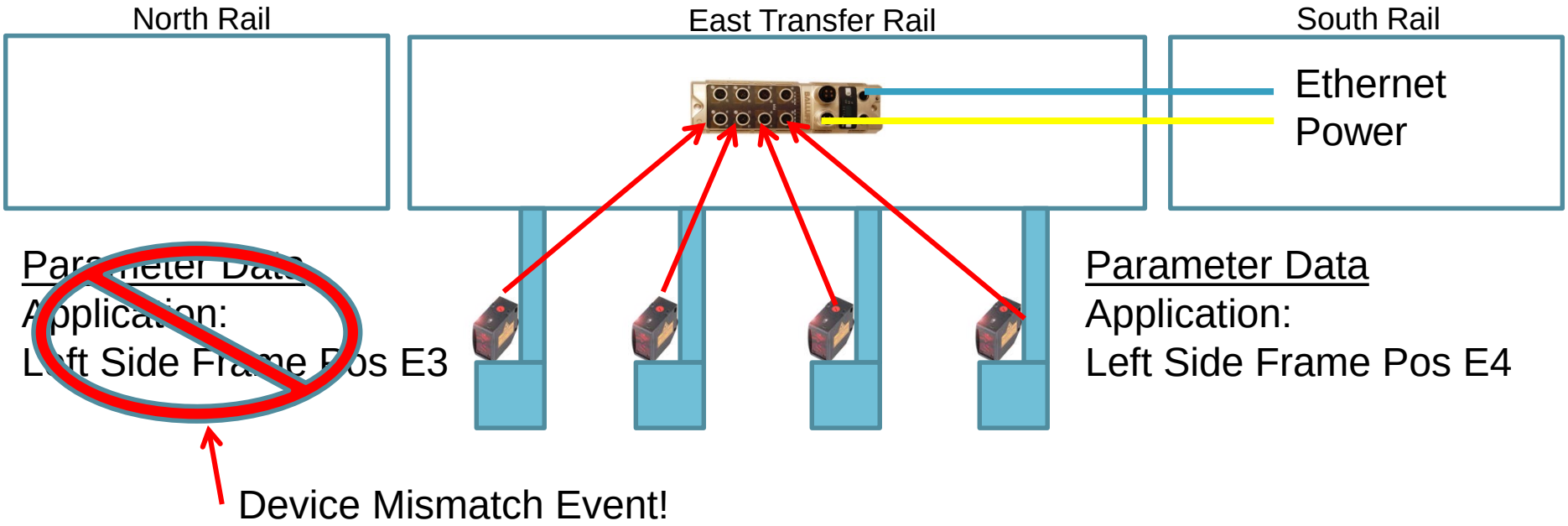
IO-LINK SMART SENSORS FOR FINGER ID IN A TRANSFER RAIL SYSTEM



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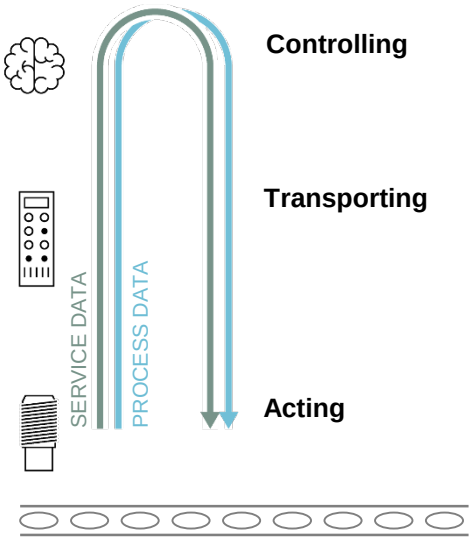
VISIBILITY DOWN TO THE SENSOR

Capture vs Control – Analytics Driven Decisions!

Logic Process
Interpretation of the supplied data

Transporting
Various systems transport the data and make it available

Creating
Capturing the actual process environment



Controlling

Transporting

Acting

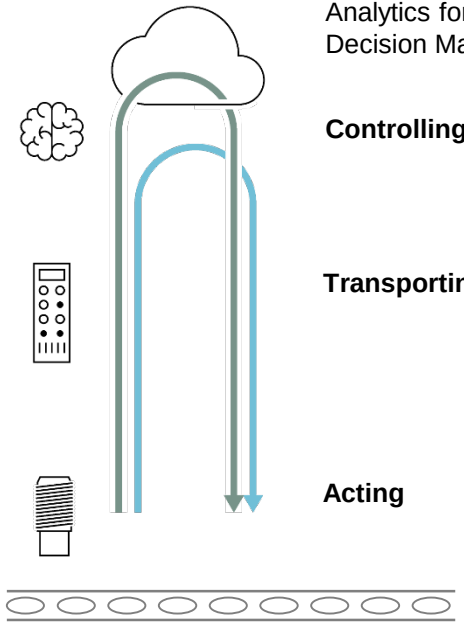
Capture

Cloud / Big Data
Analytics for Data Driven Decision Making

Logic Process

Transporting

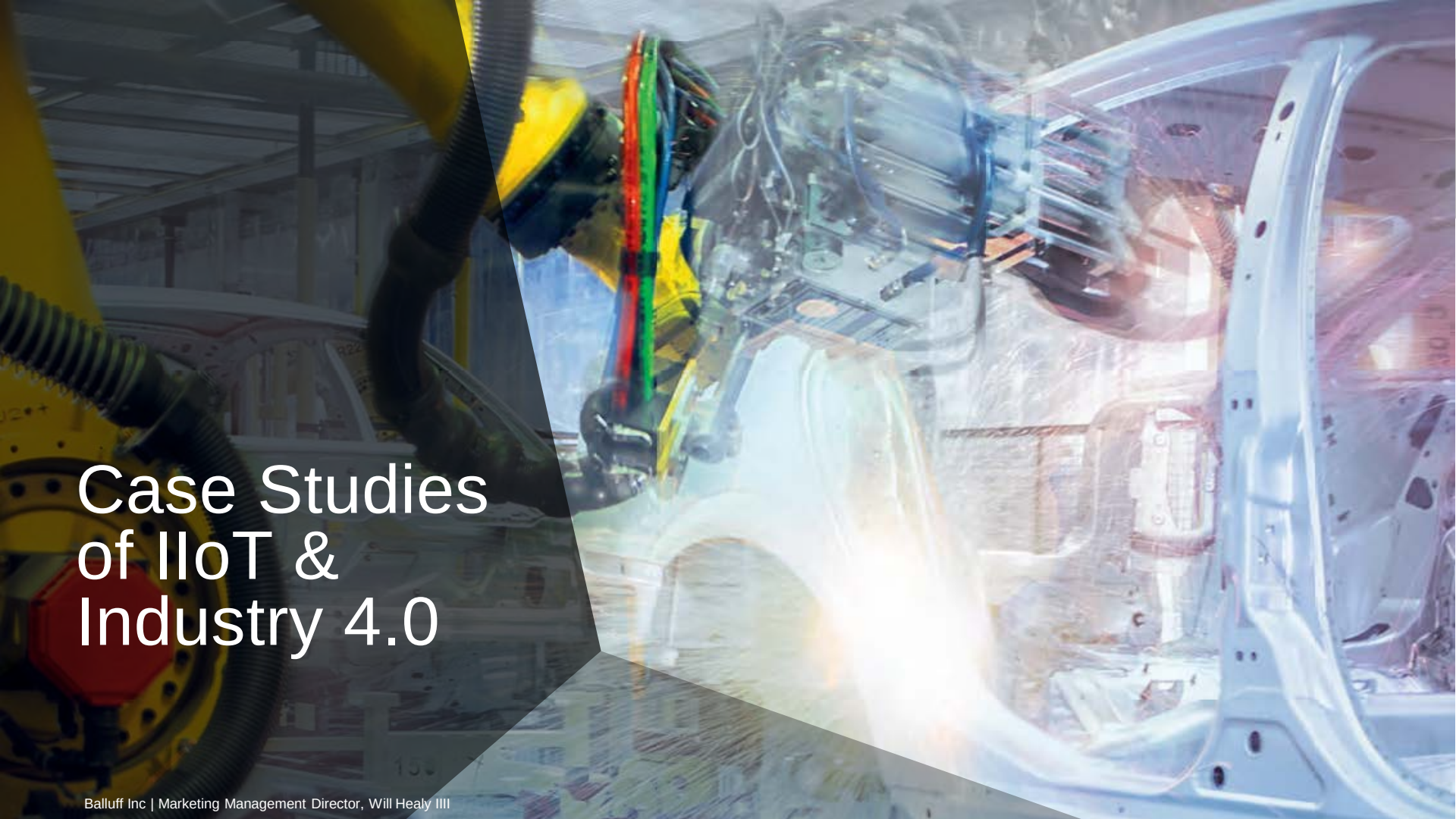
Creating



Controlling

Transporting

Acting



Case Studies of IIoT & Industry 4.0

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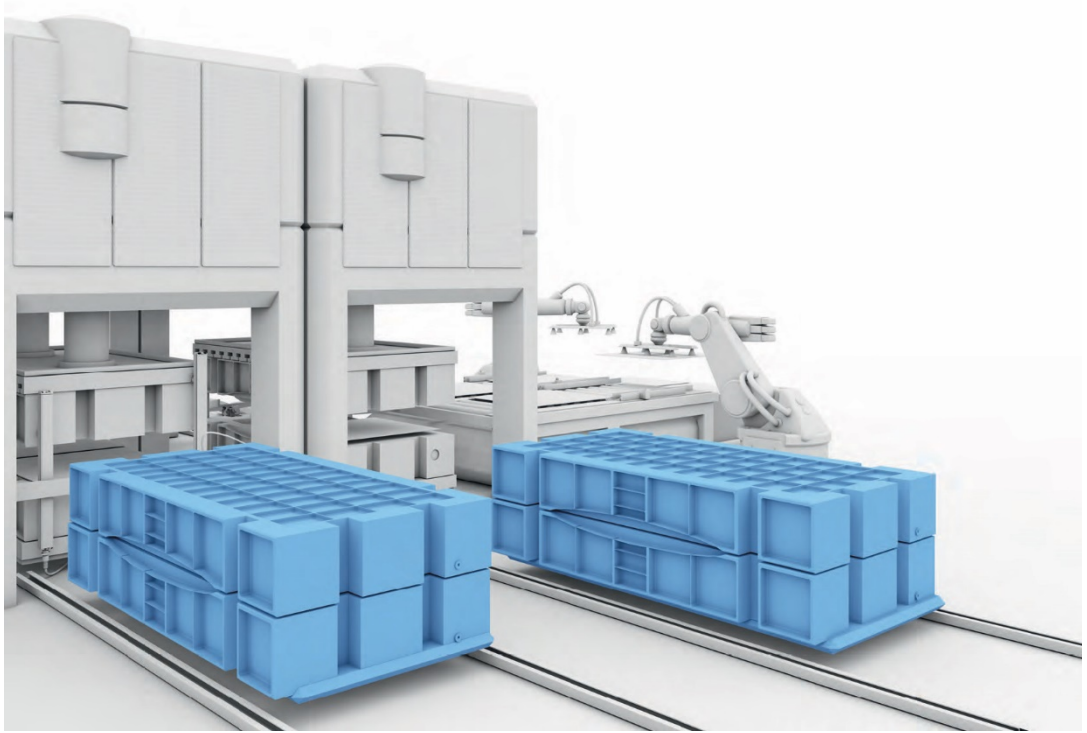
CASE STUDIES OF IIOT & INDUSTRY 4.0

Motivations

- Flexible Manufacturing
  - Lot Size 1
  - Quick Die Change
  - Automated Press Setup
- Efficient Production
  - Die Protection
  - Poka-Yoke / Lean
  - Traceability / Error Proofing
- Visibility
  - Operator / Supervisor
  - Corporate / Plant



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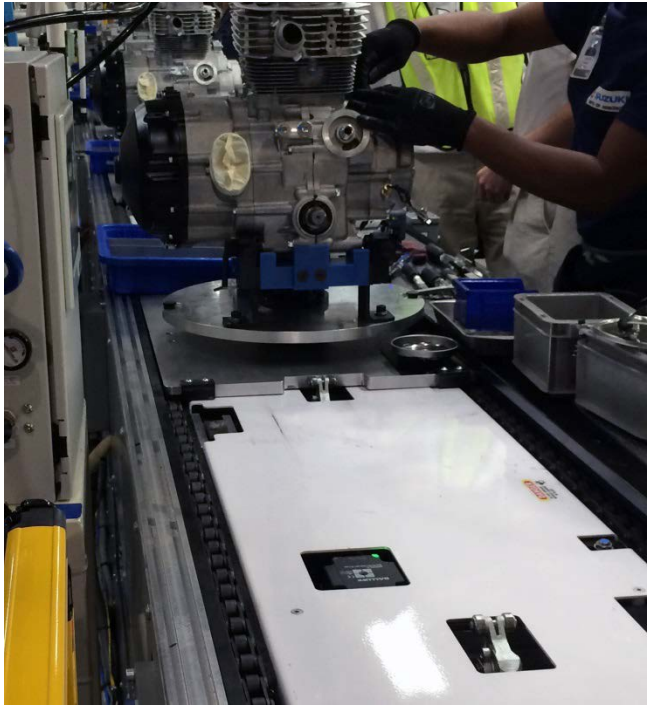
CASE STUDY: FLEXIBLE MANUFACTURING PALLETIZED ASSEMBLY

Equipment from Multiple Facilities

- Powertrain Assembly Conveyor
  - Mitsubishi Control
  - CC-Link Network
- Powertrain Assembly Kanban
  - Allen Bradley Control
  - EtherNet/IP Network
- Pressure to consolidate spares
- IO-Link allowed similar parts to be used on both systems!



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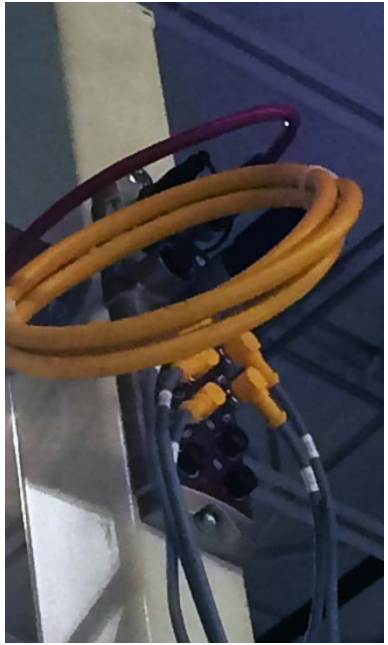
CASE STUDY: FLEXIBLE MANUFACTURING PALLETIZED ASSEMBLY

Powertrain Assembly Conveyor

- Traceability with RFID
- Sensor & pushbutton I/O
- 96 variants on one line
- CC-Link Masters
  - BIS M IO-Link RFID
  - BNI IO-Link I/O Hubs



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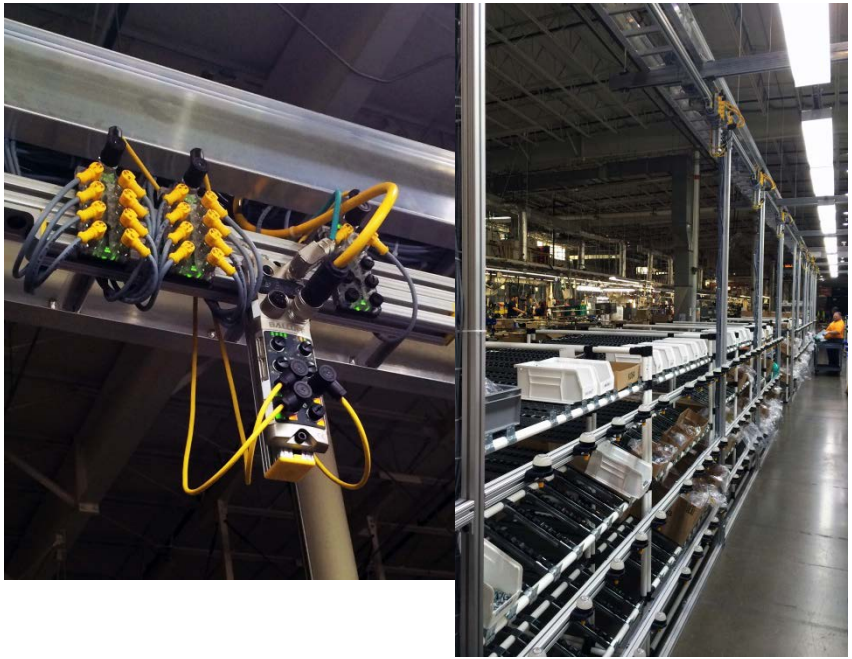
CASE STUDY: FLEXIBLE MANUFACTURING PALLETIZED ASSEMBLY

Powertrain Assembly Kanban

- Simplified Pick-To-Light wiring turned terminations into connections
- Simplified support /repair /replacement
- Simplified programming with AOIs
- EtherNet/IP Masters
    - BNI IO-Link I/O Hubs



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CASE STUDY: EFFICIENT PRODUCTION DIE IDENTIFICATION

Manufacturer Problem

- Die crashes / lock-up
- Costs the company
  - $80k per occurrence
  - 3-4 times per year
  - plus torch work to cut out die sections.
- Completely human error
- Commonly wrong shut height or wrong recipe selected.

CASE STUDY: EFFICIENT PRODUCTION DIE IDENTIFICATION

Application Solution

- UHF Long Range RFID System
- Site Survey & Project Reviews
- Software integrator required
- Eliminate human error & paper documents

Benefits…

- Eliminates damage to dies and press.
- Substantially reduces downtime.

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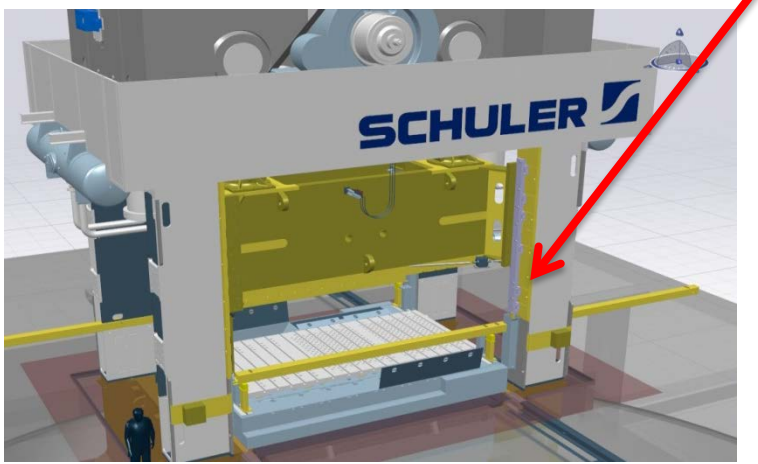
CASE STUDY: EFFICIENT PRODUCTION DIE IDENTIFICATION

UHF Antenna can be mounted on one of the columns of the press

Application Installation



Balluff RFID Tag Mounted on Die

Customized mounting location and guard to suit the customers application.

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CASE STUDY: EFFICIENT PRODUCTION DIE IDENTIFICATION

Software / Controller Integration Required

Ethernet processor with single reader/head

Handheld for tool room read/write capabilities

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CASE STUDY: EFFICIENT PRODUCTION DIE IDENTIFICATION

Manufacturer Feedback

- Implemented in Winter of 2011
- ZERO Press crashes since installed!
- Several instances where engineer was called because “Press failed to operate”,
- Turns out that the system did its job as there was a mismatch between die and recipe that would have resulted in a crash.
- After 2 years of continuous service no RFID components have required replacement.
- Communication times for RFID tag reading is extremely fast. As low as 10 millisecond response time in many cases.
- Earlier attempt to solve this with a commercial grade RFID system
    - resulted in 3 months of programming effort that never functioned satisfactorily.
    - Robustness of hardware in environment was also suspect.

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CASE STUDY: EFFICIENT PRODUCTION DIE IDENTIFICATION

Manufacturer ROI

- $240,000 to $320,000 per year
- Less $15,000 RFID Material Cost
- Less approximate $35,000 Integration
- Services Costs = Net Savings of $190,000 to $270,000 per year.

CASE STUDY #5
STAMPING, WELDING & ASSEMBLY

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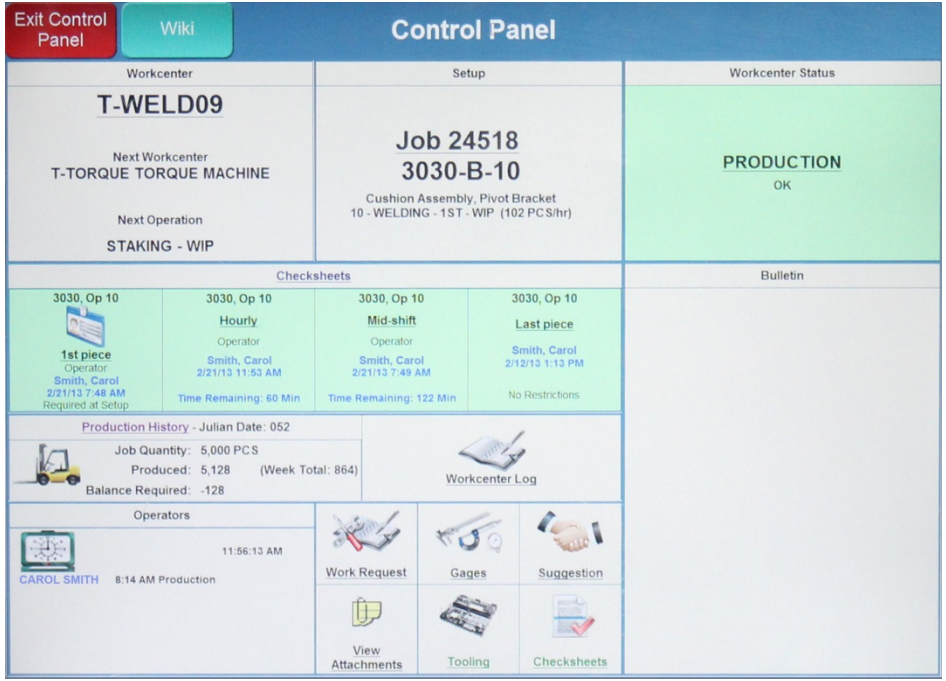
CASE STUDY #5
STAMPING, WELDING & ASSEMBLY

Smart Factory, IIoT & Industry 4.0

- Management, Maintenance, Engineering & Operator Visibility
- What Job is running? Setup next?
- Production status
- Operator and quantity
- Job / Quota / Week / Balance
- Workcenter Log
- Preventative Maintenance
- Tooling Asset Management
- Lean & Process Improvements



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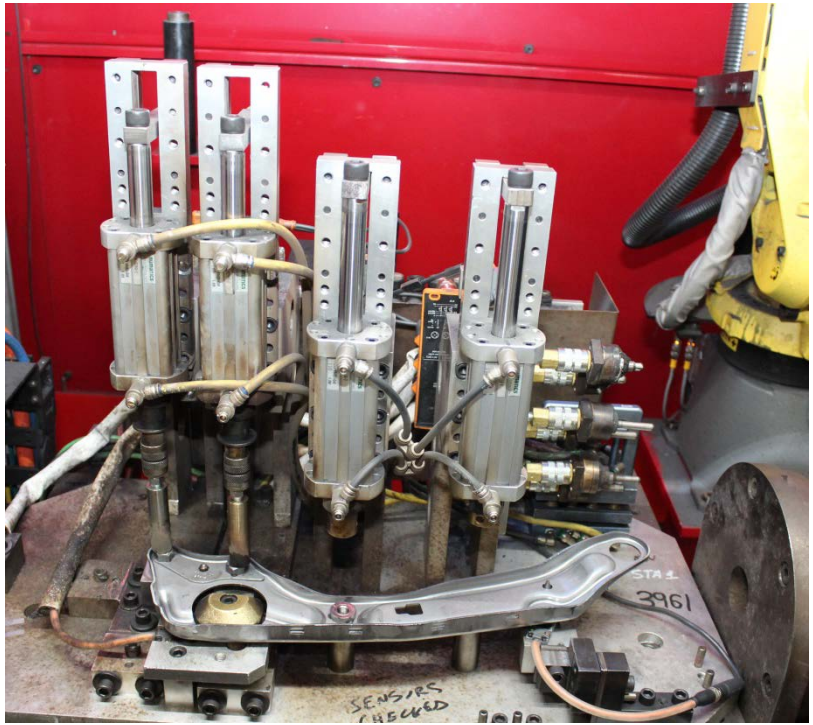
CASE STUDY #5
STAMPING, WELDING & ASSEMBLY

Nut Welder Poka-Yoke

- Quality Issue with Nut Presence
- Industry 4.0 Established in Plant
- Changeable fixtures
- IO-Link measurement sensor
- Integrated Poka-yoke in 20min



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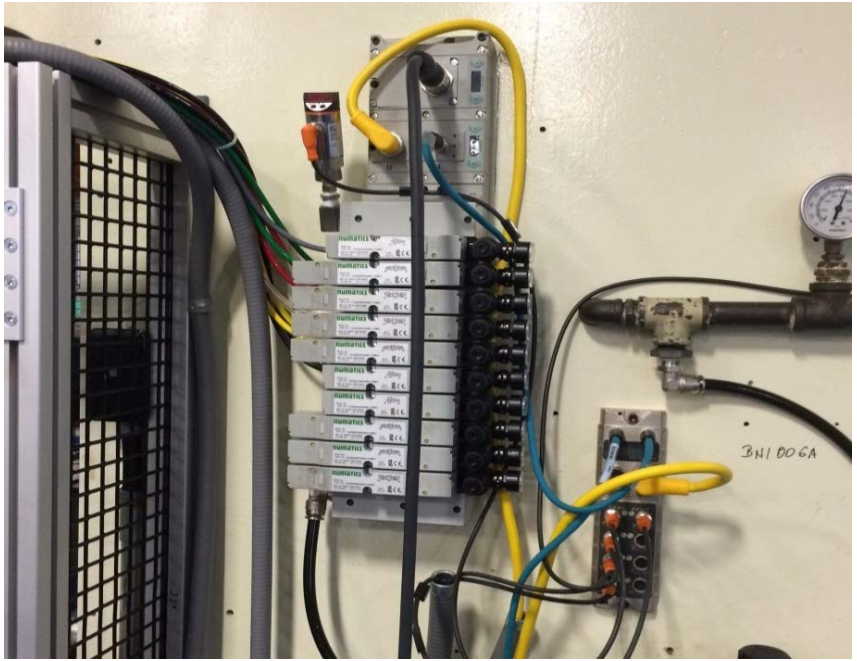
CASE STUDY #5
STAMPING, WELDING & ASSEMBLY

IO-Link Enabling Smart Industry

- Multiple Vendor Solution
- EtherNet/IP Masters
- I/O Sensor Hubs
- Smartlights
- Pressure Sensors
- Temperature Probes
- Analog Adapter for Flow Sensor
- Linear Transducers
- Non-Contact Coupler
- Variable Regulator



Safety in the 4th Industrial Revolution

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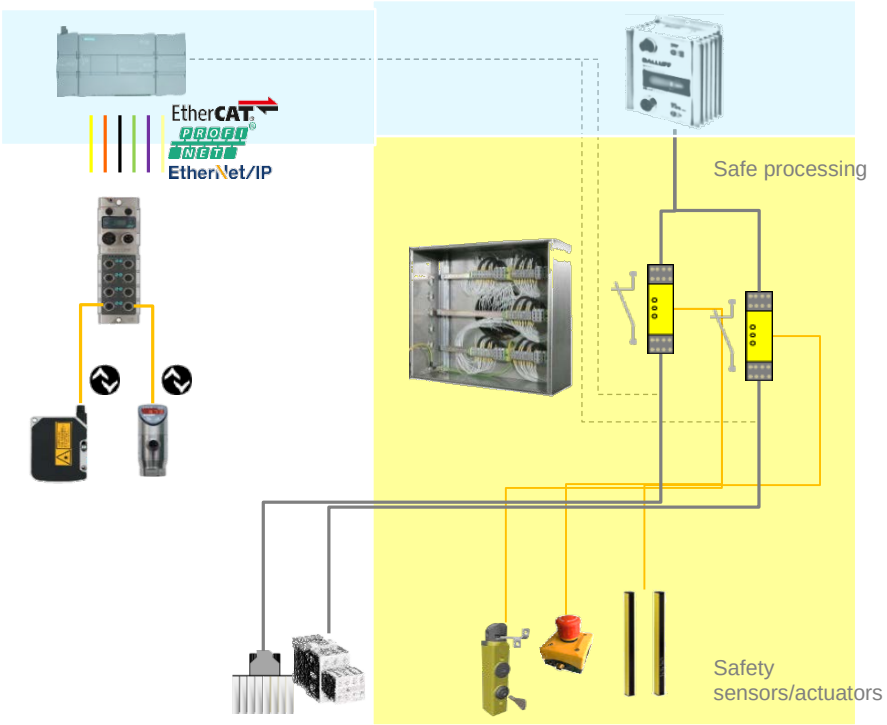
EVOLUTION OF SAFETY ARCHITECTURES

Hardwired Safety Architectures

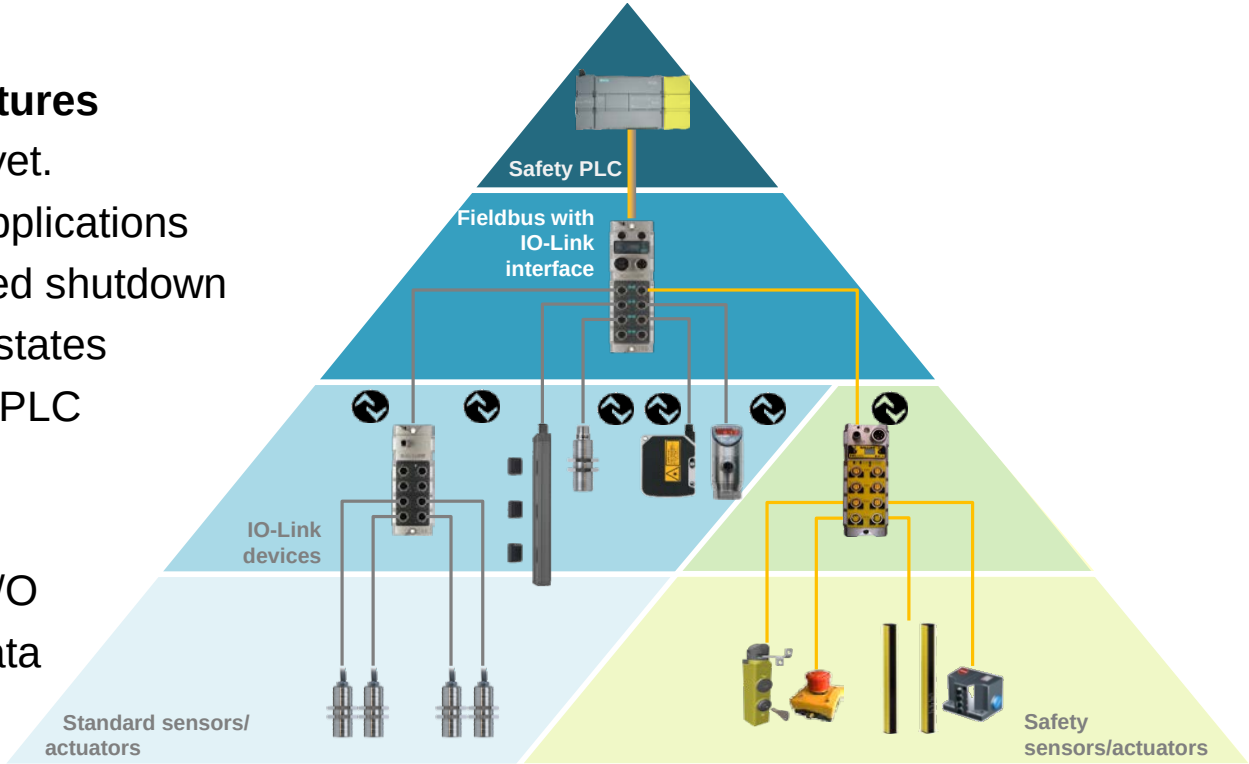
- Most common in industry right now
- "Add-on Safety"
- Signal to PLC to stop but no control.
- No managed shutdown
  - can damage automation
  - unknown shutdown states
- Basic light curtains, estops, door switches
- Dominated by safety relays



EVOLUTION OF SAFETY ARCHITECTURES

Controlled Safety Architectures

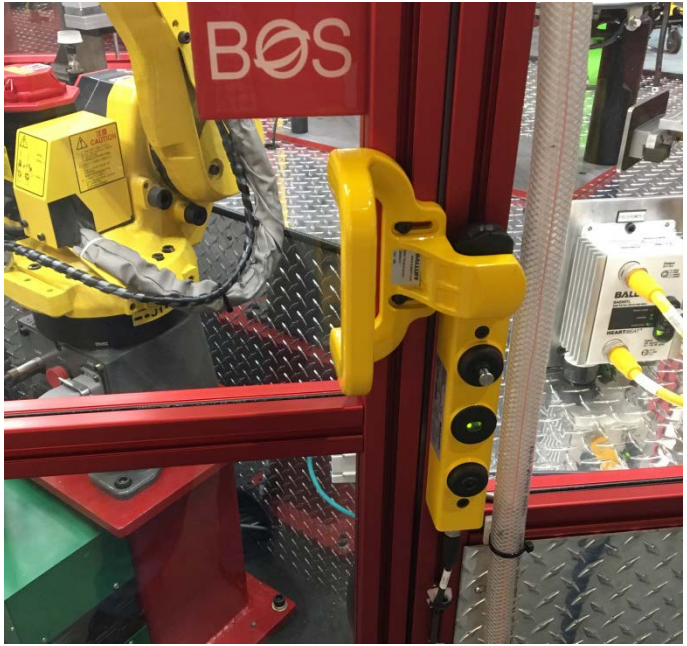
- Most users are not here yet.
- Really are Industry 3.5 Applications
- Typically provide controlled shutdown
- Known device shutdown states
- Safety & Motion enabled PLC
- Remote I/O
    - Cabinet Slice I/O
    - Machine Mount I/O
- Event Data & Process Data
- Status Parameters



SAFETY & IIOT

Downtime & Incident Analytics

- Smart Devices Report Data
  - Device Events
  - Process Data
  - Status Parameters
- Downtime from device switching
  - "Why door 6 vs doors 1&5?"
  - "How often are safety devices being switched?"
  - "Why are they being switched?"



PREDICTIVE PRESENCE

Anticipatory control of the Workcell

- flow of daily work
- shift changes
- known violators

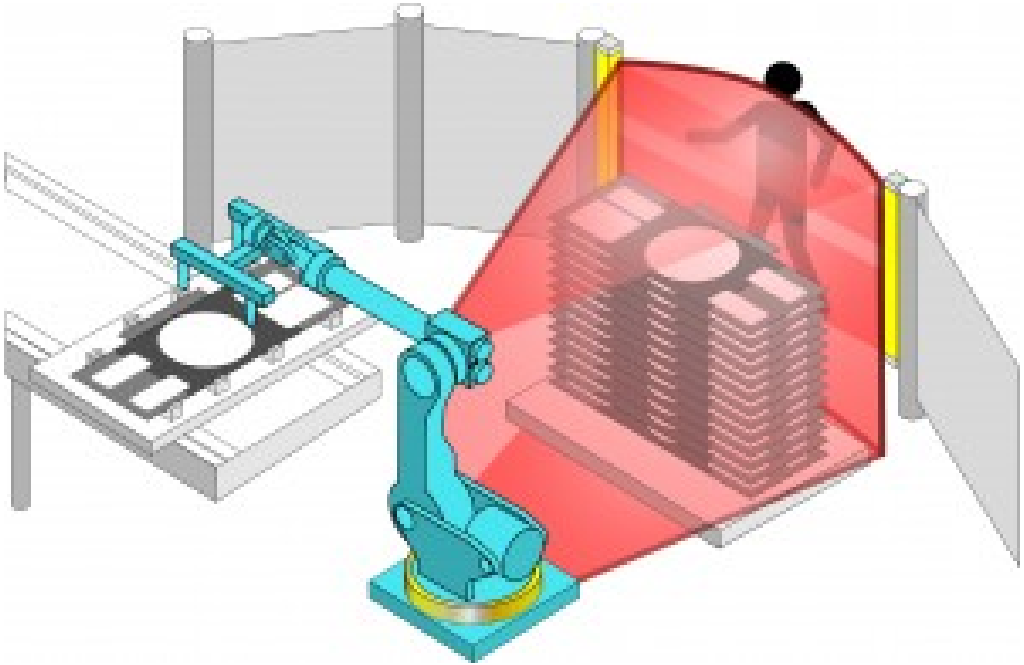
- adapt to operator habits

- preemptively slow down work in the area to not cause a hard shutdown

HUMAN / MACHINE COLLABORATION

6Axis Robots

- Most have software safety
- Zone limited control
- Improved human access to the machine
- Improved robot utilization



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HUMAN / MACHINE COLLABORATION

Collaborative Robots

- Increased Human & Robot Efficiency
  - Human idle reduced 85%!
- Applicable to Small to Midsized Mfgr
- Increased ROI (<1yr)
- Greater Flexibility in the Human Environment
- Safely Handle Complex & Dangerous Tasks (prevent unwanted motion)
- Simpler, more effective, less expensive safety

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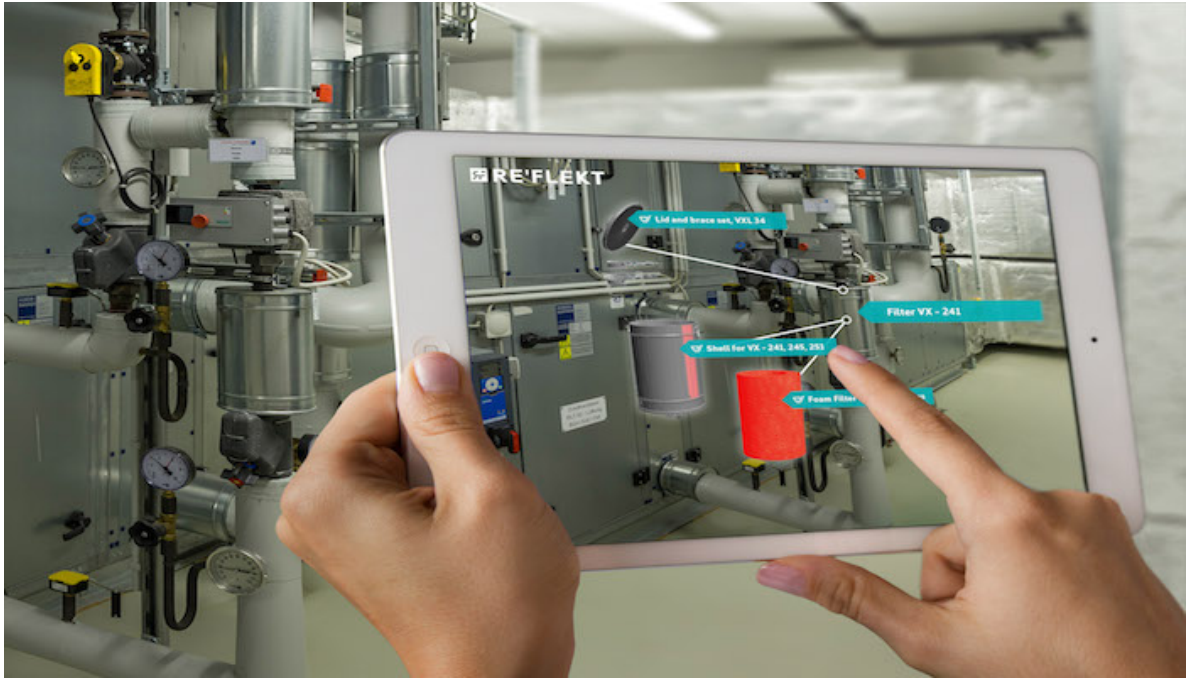
NEW TECHNOLOGY AWARENESS

More Mobile Devices

- Collaborative
- Better maintenance
- Better visualization
- Safety with a mobile device is not a new topic.



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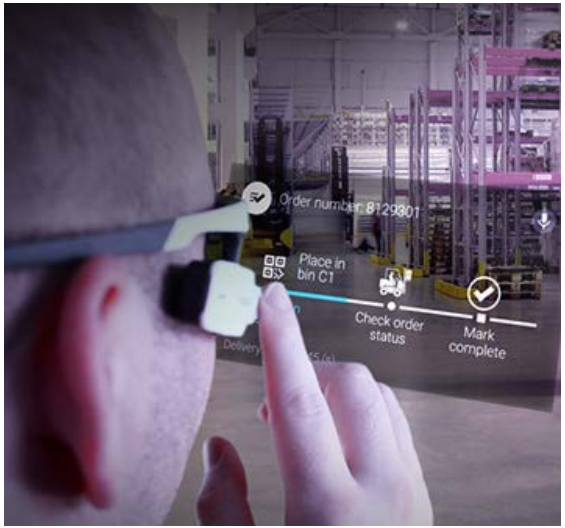
NEW TECHNOLOGY AWARENESS

Virtual Reality & Augumented Reality (VR & AR)

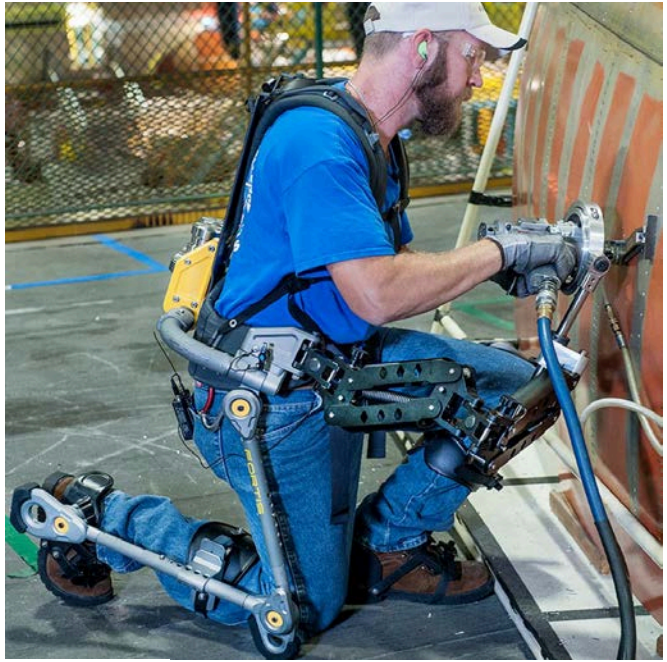
- Collaborative
- Remote maintenance
- Better visualization
- Distracted walking?
- Distracted working?



NEW TECHNOLOGY AWARENESS

Exoskeletons

- Assisted lifting, positioning, moving
- Machine & Man are one collaborative unit.
- Machine/Man Safety is going to get more complicated.
- Operators & Bystander Safety.



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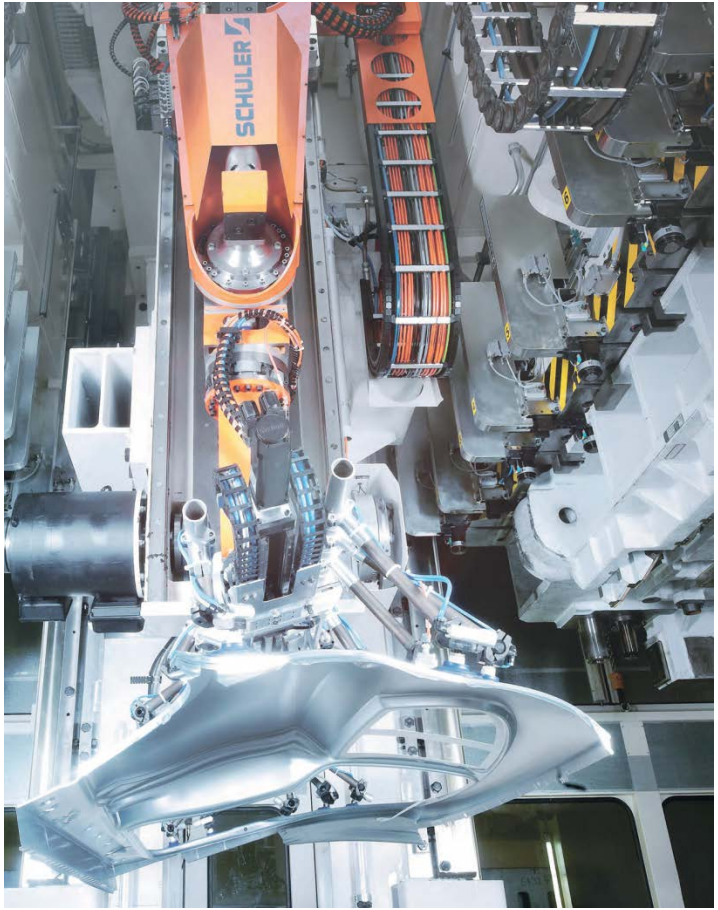
SAFETY IN THE 4TH INDUSTRIAL REVOLUTION

Recommendations for the Press Shop

- Create a Manufacturing Automation Safety Strategy & Program
- Start with Basics like:
  - Light curtains on presses
  - Press control for controlled shutdowns
  - Die Protection Program
- Have a strategy for addressing new technologies brought into the plant



Industry 4.0 – What do I do Now?

Balluff Inc | Marketing Management Director, Will Healy IIII

BULLDOZE THE FACTORY!

INDUSTRY 4.0 – WHAT DO I DO NOW?

Build a Team

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FIRST BUILD A TEAM!

Who needs what data?

- Interviews
  - Plant Mgr, Line Mgr, Engineers, Production Mgr, Quality Mgr, Operators, Maintenance, IT
- Questions to ask
  - What do you want to know?
  - What information would make you more productive?
  - What don't you need to know?

Build a strategy & action plan

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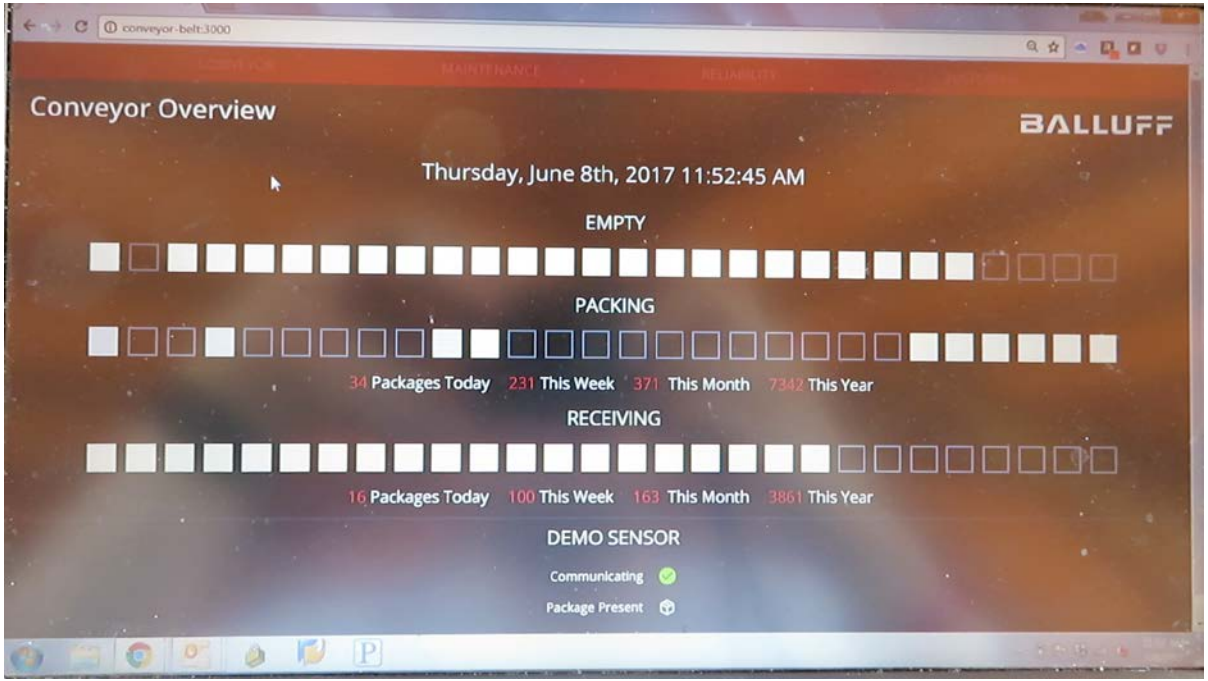
INDUSTRY 4.0 – WHAT DO I DO NOW?

DAILY ACTION

- What data do we have?
- What are we trying to accomplish?
- Specify what you want.
- Order the right thing, not the cheapest.
- What data do we need?

RESULTS & VISIBILITY



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IIoT & Industry4.0

innovating automation

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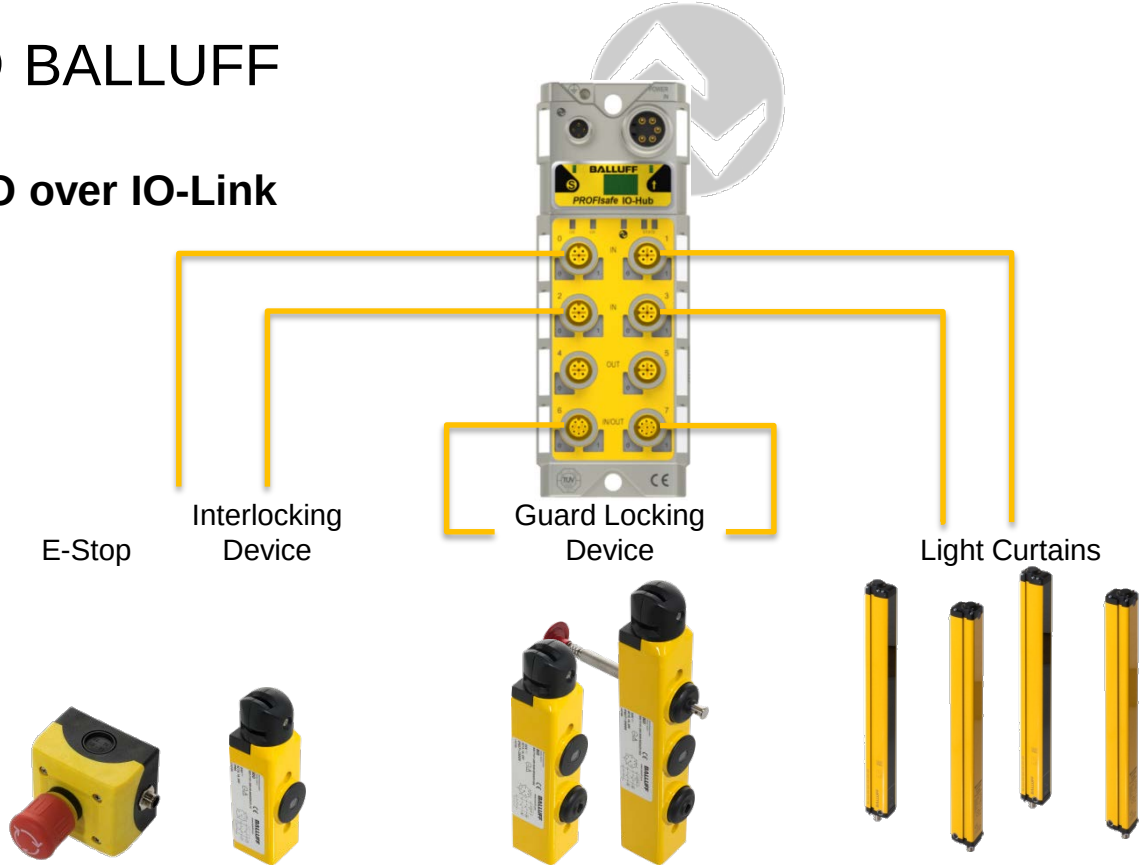
SAFETY @ BALLUFF

PROFISAFE I/O over IO-Link



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BALLUFF - INNOVATING AUTOMATION

BALLUFF TECHNOLOGIES

ENABLE & SCALE

INDUSTRY 4.0 & IIoT IMPLEMENTATIONS

BY GENERATING DATA AT THE LEVELS OF AUTOMATION CLOSEST TO PRODUCTION.

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BALLUFF - INNOVATING AUTOMATION

60+ Countries. Sensors & Accessories. Industrial RFID & Networking. Training & Services.

BALLUFF - INNOVATING AUTOMATION

- Strong North American Support
- 3 Stocking Locations
- Regional Sales Offices
- Local Area Sales Managers
- Regional Technical Application Support
- Local Automation Distribution Partners

THANK YOU FOR YOUR ATTENTION!

If there are any questions, please feel free to contact me.

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