



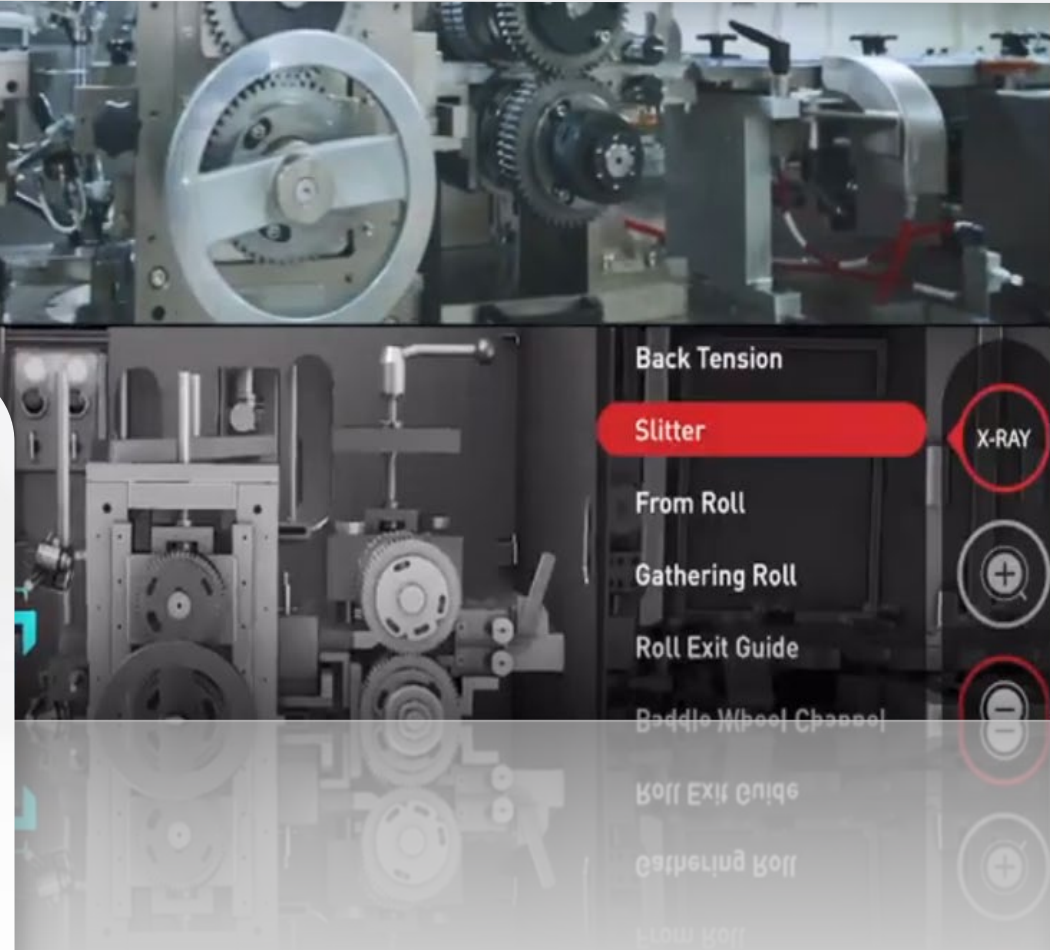
Smart Machines and Industrial Safety Solutions

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Rockwell Automation

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PUBLIC

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The Challenges
and Benefits

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Summary & Safety
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Smart Safety – The Challenges and Benefits

Smart Safety – Enabling Smarter Machines and Equipment

Challenges to Safety Operations



Worker behaviours

- Operators bypassing poorly designed safety systems
- Systems that don't account for procedural anomalies
- Standard operating procedures not being followed



Evolving workforce

- Safety implications of major workforce shift worldwide
- Older workers nearing retirement at higher risk for musculoskeletal injuries
- Younger, less experienced workers more prone to injury



Machinery downtime

- Downtime for jams, misfeeds, adjustments, changeovers and maintenance
- Minimal visibility of downtime information
- No context of downtime issues (workers interaction, machinery fault, shift patterns)
- Limited information to remedy issues



Regulatory compliance

- Compliance with industry standards can be challenging
- Documenting and reporting on approved safety systems can be challenging

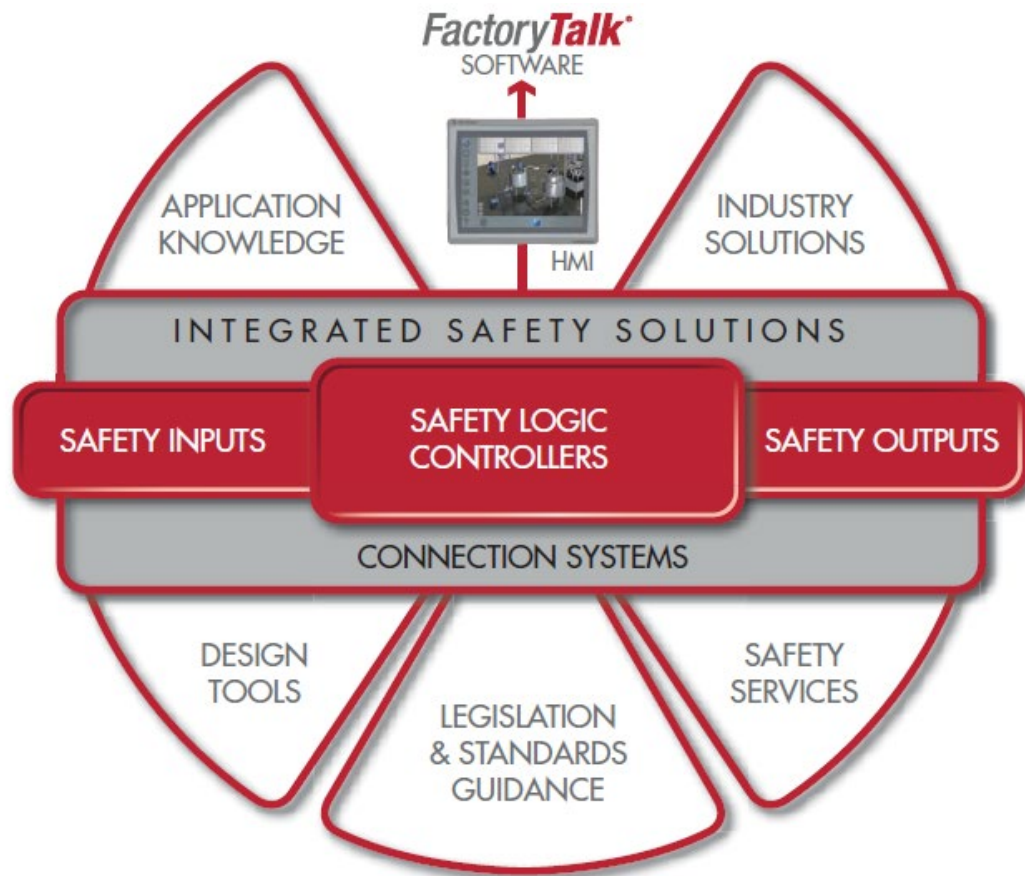


Data management

- Continuing reliance on outdated data collection and reporting methods
- Safety data often manually entered for inspections, compliance logs, incident reports, training and other processes
- Systems in which data is stored typically not connected to plant floor systems

Smart Safety – Enabling Smarter Machines and Equipment

Benefits of a Smart Safety Solution



Improve insight into worker behaviour and compliance

By incorporating safety information into EHS management systems, day to day discrepancies between policies and operating procedures can be identified



Enhance safety

Connecting people, equipment and worksites creates new opportunities to enhance worker and environmental safety, including remote access, operations visibility, worker locating and information delivery via mobile devices.



Reduce safety-related downtime

Better visibility into safety-system performance and stoppages can help determine the root cause of shutdowns. Safety and production data also can be combined to understand the frequency, duration, time and location of safety-related shutdowns.



Improve compliance

The safety data required for compliance and reporting purposes is largely collected through time-consuming, error-prone manual audits today. By integrating auditing functions into the HMI and controller, organisations can automate and speed up the auditing process, free up personnel to focus on other priorities, and reduce the likelihood of errors.

POLL QUESTION #1

Do you believe your machine's productivity is enhanced or diminished by your existing safety system?

- a) Productivity is **enhanced** by existing safety system
- b) Productivity is **diminished** by existing safety system

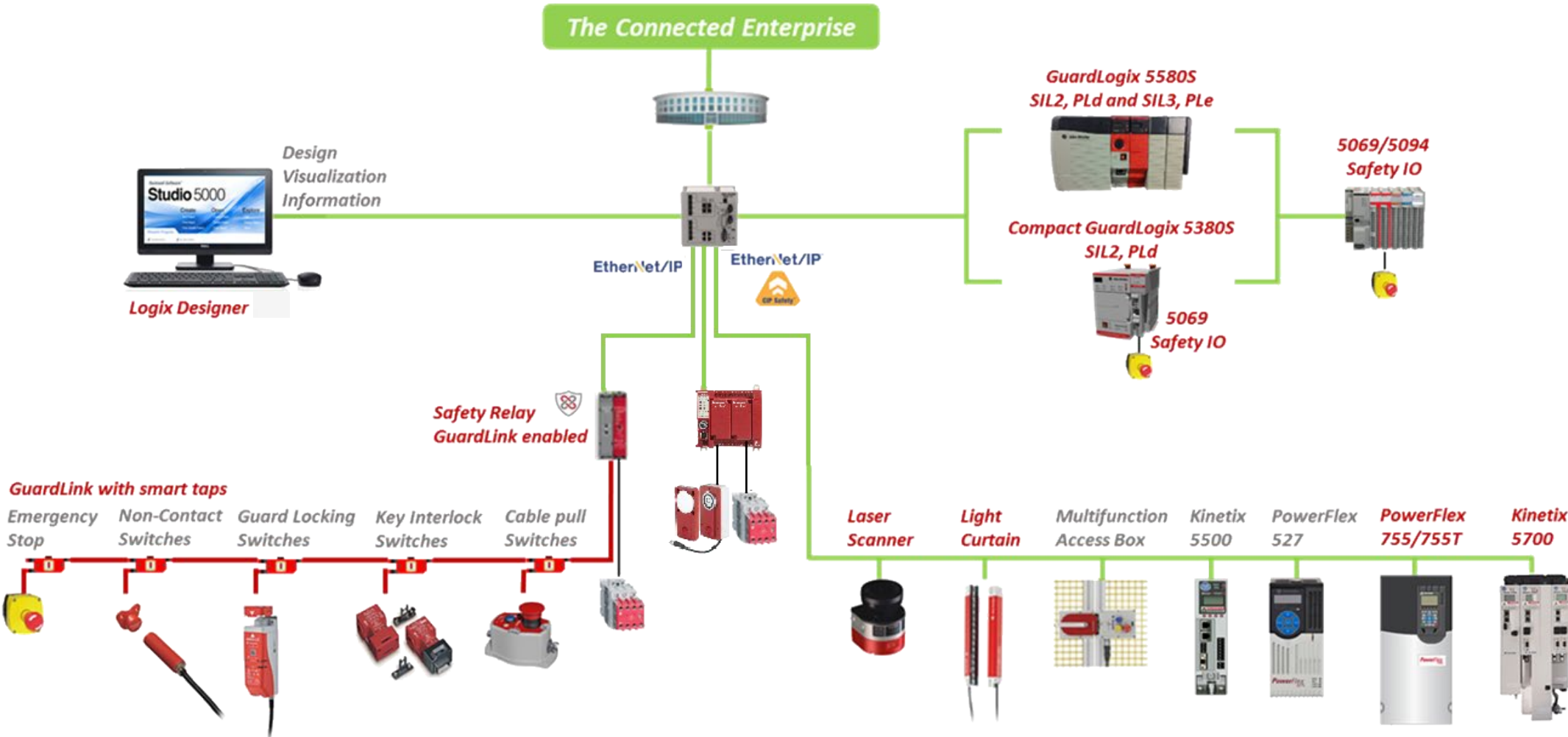


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Smart Safety and the Connected Enterprise

Smart Machine Architecture

Safety Integrated into The Connected Enterprise

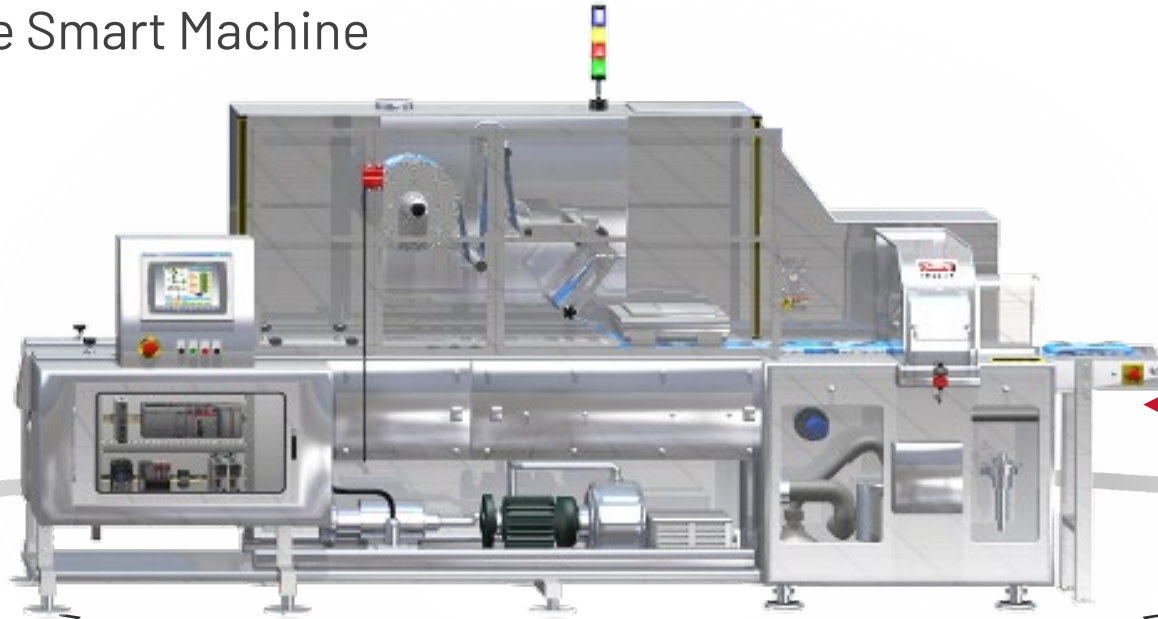


Smart Machines & Equipment

Safety Integrated into the Smart Machine

Real-time Data

Status of all Safety Devices



Information

CONTEXTUALIZATION
Light Curtain becoming misaligned

TECHNOLOGY

Knowledge

ANALYTICS
Light Curtain beam intensity status on HMI

PROCESS

Optimize

ACTION
Perform maintenance during scheduled downtime

PEOPLE

The Smart & Safe Machine

Performance

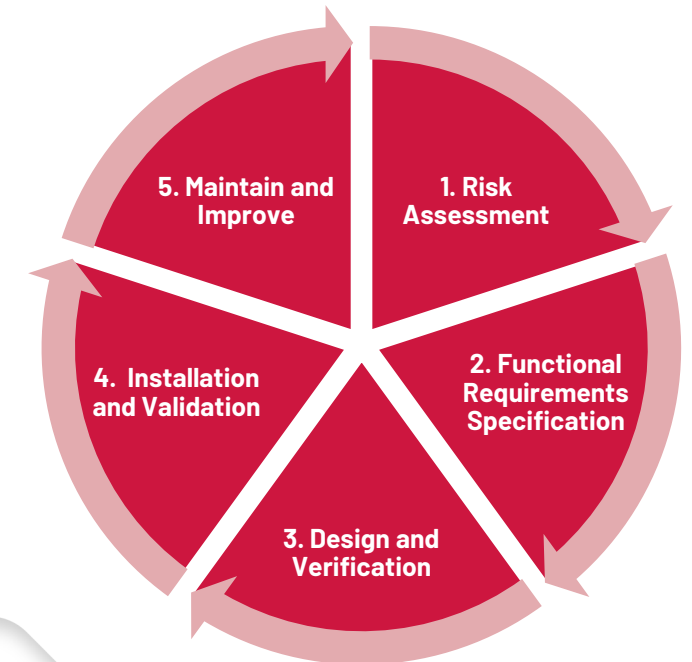
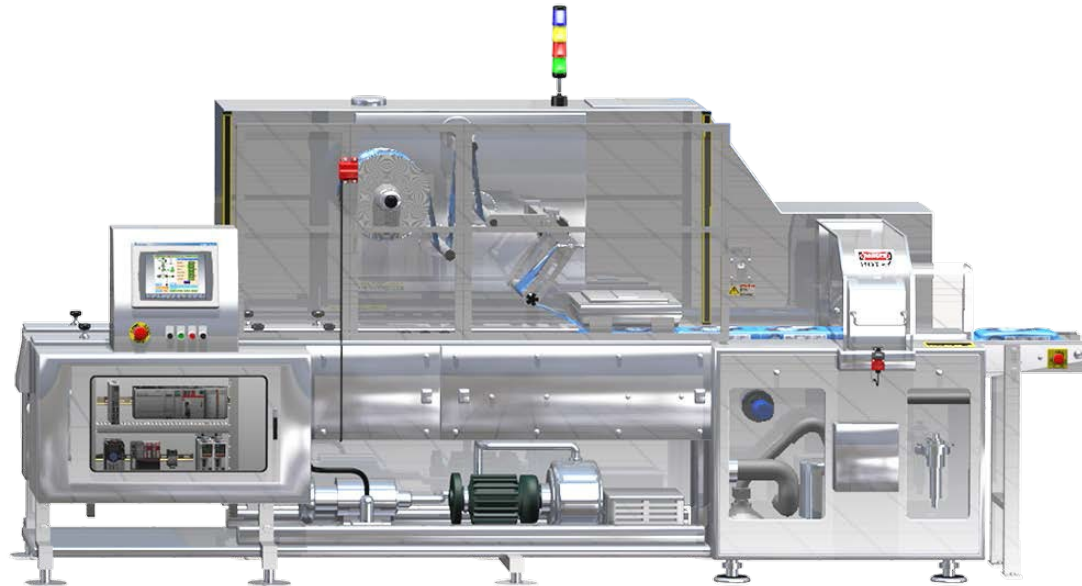
- Production Forecasting
- Downtime Tracking / Root Cause
- Diagnostics to improve MTTR
- Cycle Time Analysis
- Energy Optimization

Quality

- Inline Quality Analysis – 100%
- Quality Alerts / Limit Tracking
- Real-time SPC
- Recipe / Parameter Tracking

Safety

- Procedural Compliance
- The Safety Audit process
- Safety Program Tracking
- Safety Event tracking
- Safety System Monitoring

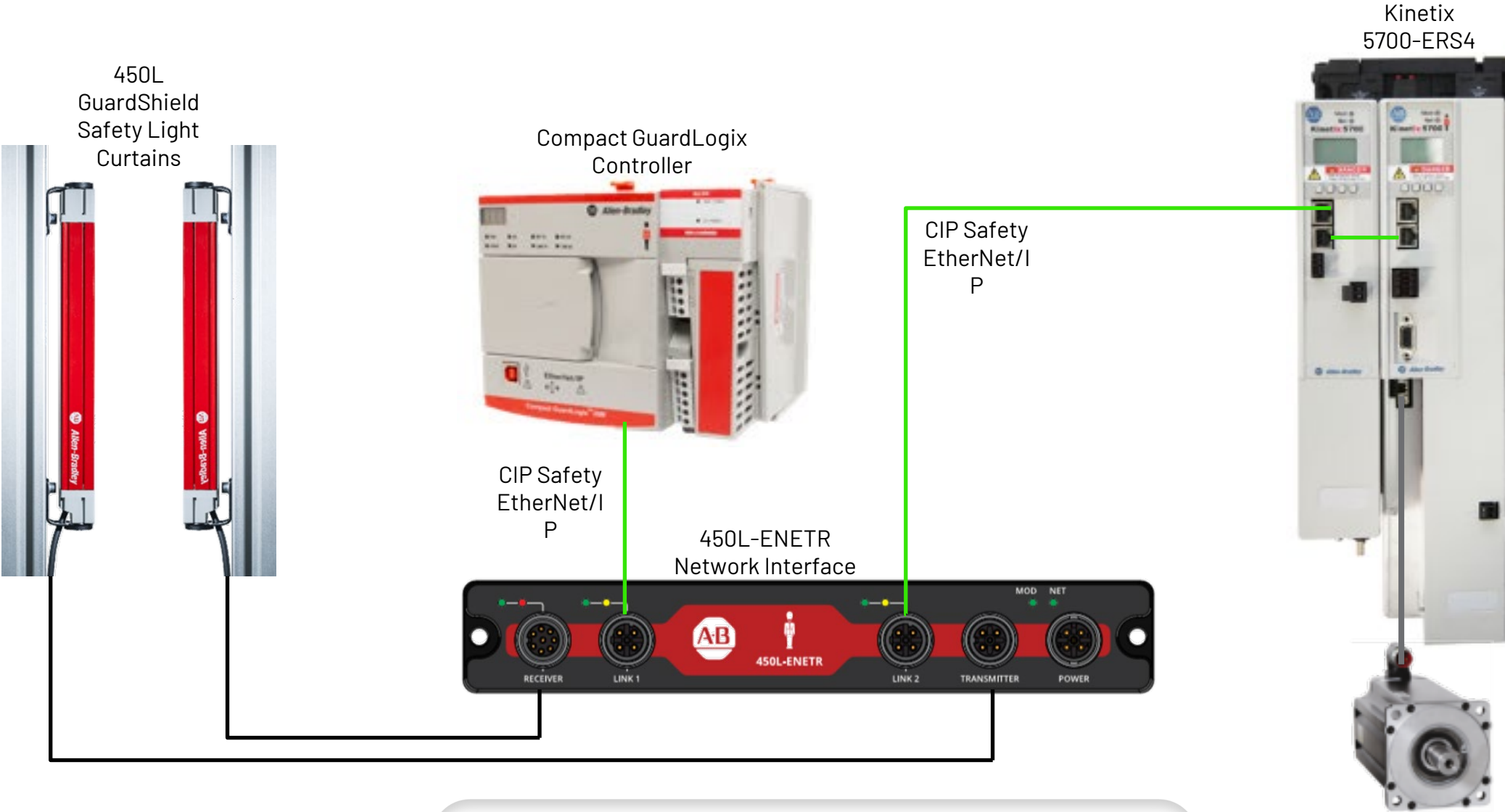




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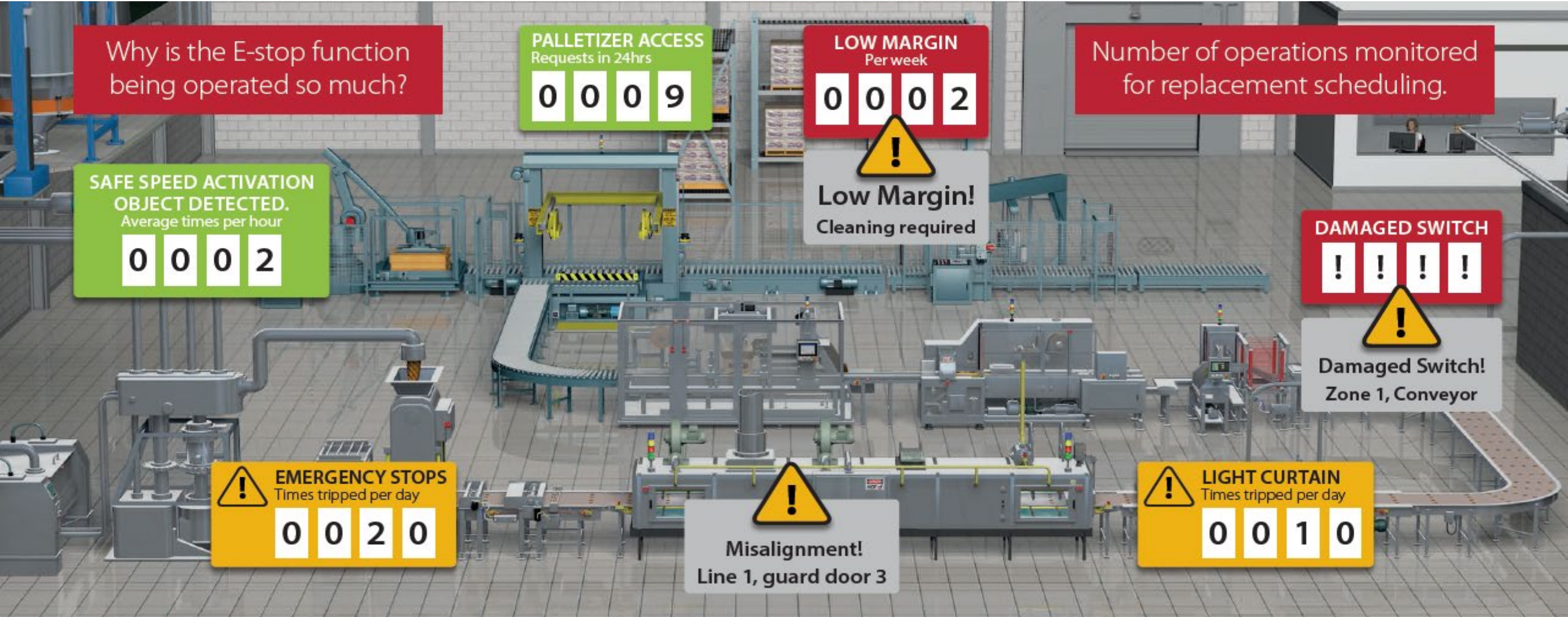
Smart Safety and Real Time
Information

450L CIP Safety Light Curtain Architecture



A Smart Machine is...Real-time Information Enabled

Smart Safety Data & Diagnostics



Smart Safety and Real Time Information

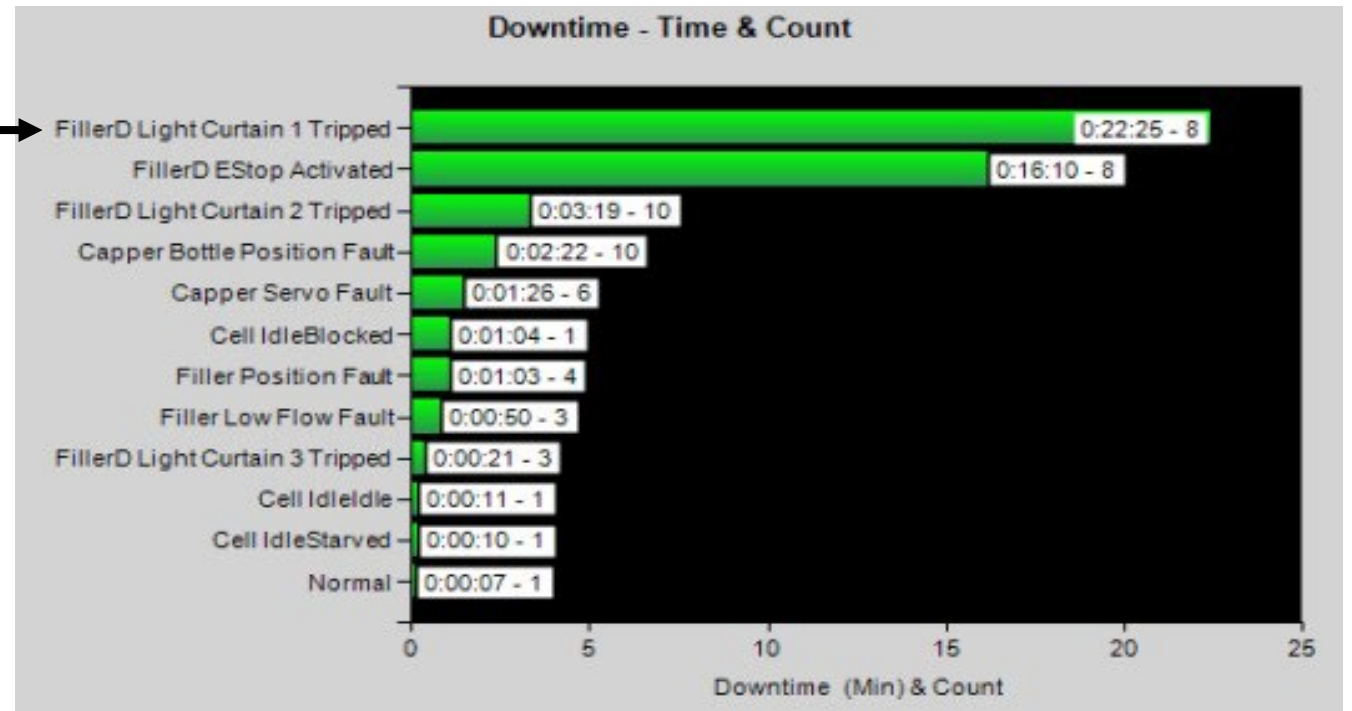
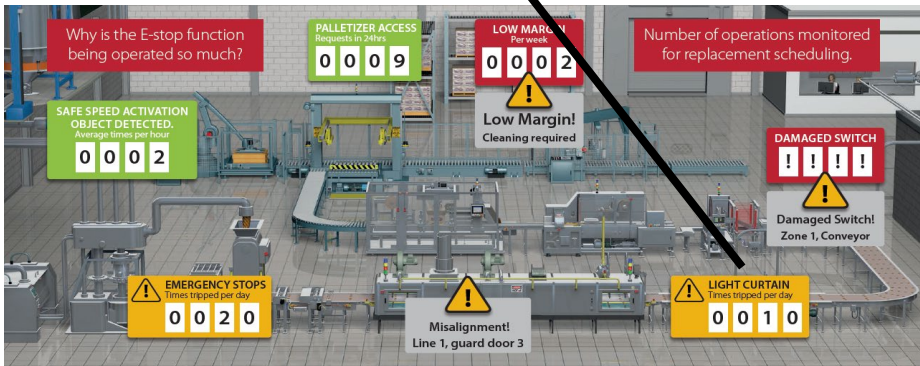
- Integration of Safety Information
- Creation of Safety Key Performance Indicators (KPI)
- Extract the Machine's Safety KPI Information in Real Time
- Establish Protocols to Monitor and Drive Actions



KPI = Key Performance Indicators

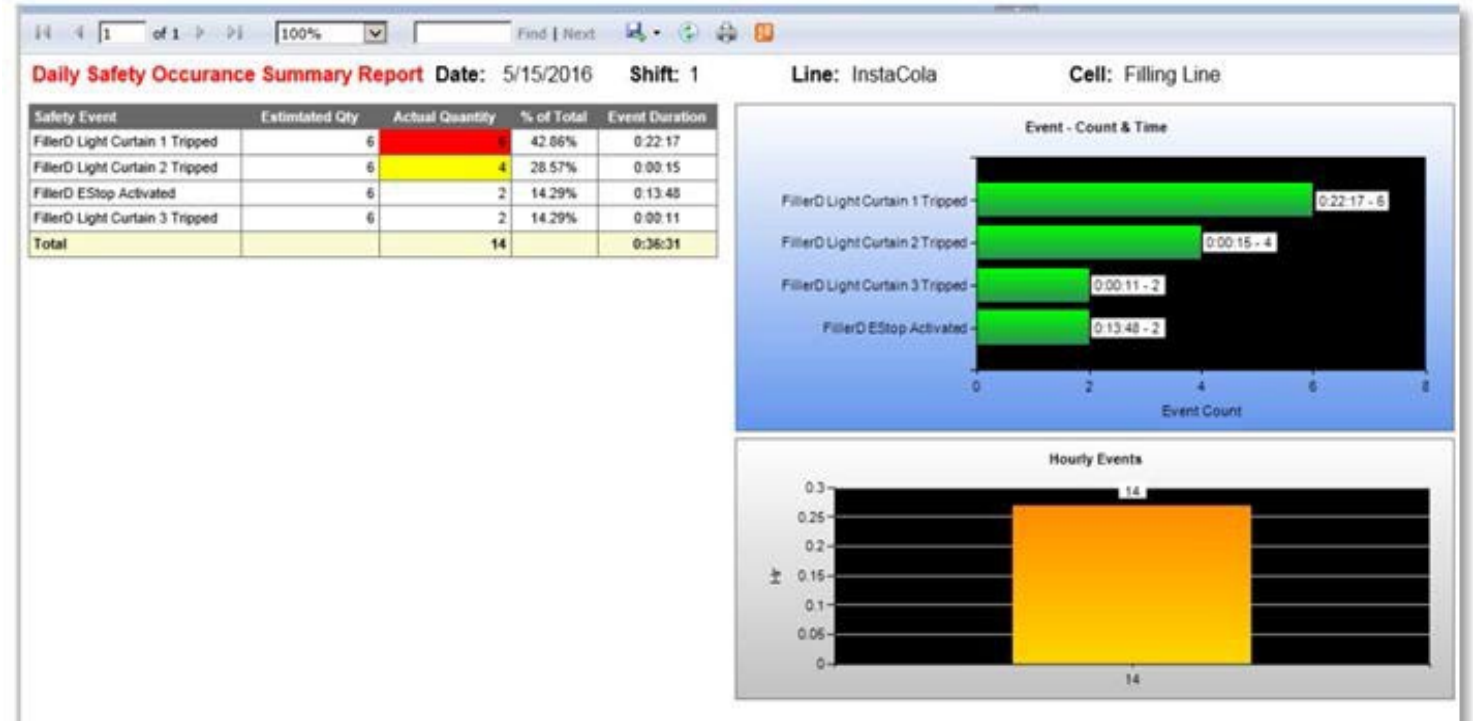
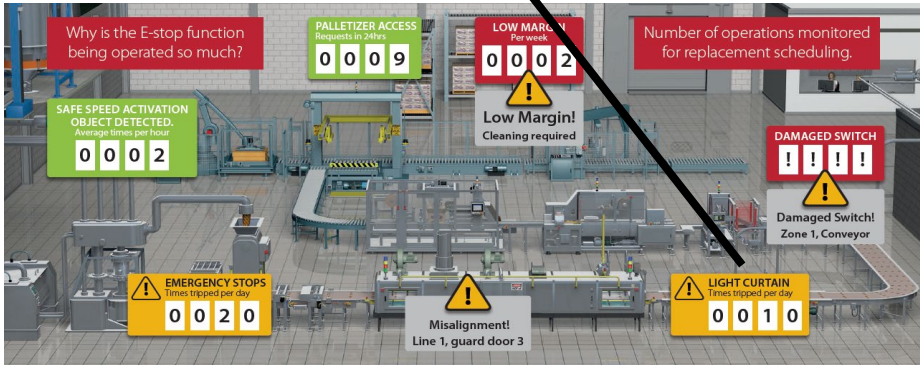
Real Time Information - Light Curtain Example

- Track higher than normal or out of range safety events.
- Monitor daily, weekly or monthly events to find trends.
- Monitor device status and performance.



Real Time Information - Light Curtain Example

- Utilize reports to help determine the root cause of safety events
- Quantify the impact of the safety events
- Plan corrective actions



POLL QUESTION #2

Do you have safety applications where people need to interact closely with the machine?

- a) Yes
- b) No



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Smart Safety and Collaborative Workspace Solutions

Smart Safety and “Collaborative Workspace” Solutions

Integrated Safety Solutions Maximize Machine Efficiency and Uptime

Safe Speed

Minor machine servicing like adjustments, feeding, cleaning & wash-downs without shutting the machine down.



Safe Direction

Cleaning & adjustments without shutting the machine down. Hazard has been removed by reversing hazard causing motion.

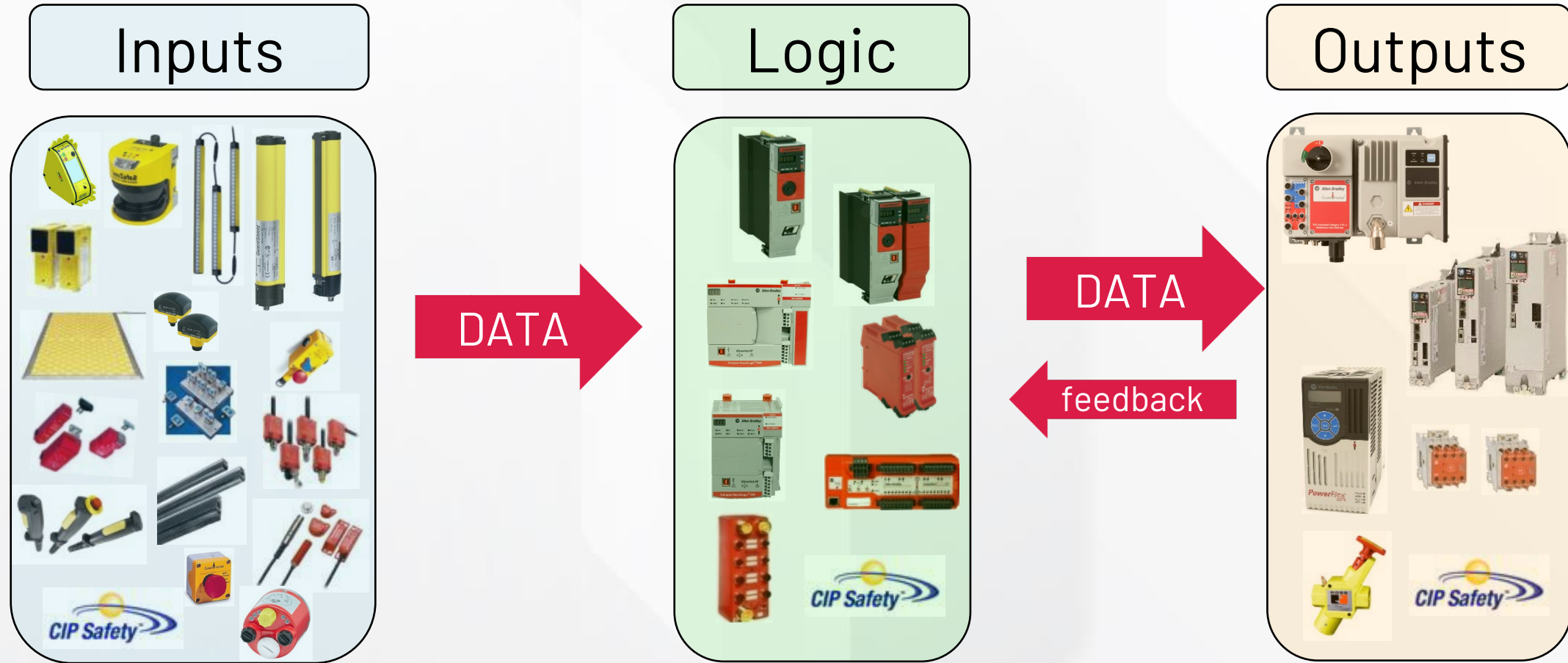


Safe Position

Allows for interaction with equipment as long as the hazard is in a safe position/location.



A Traditional Safety Function




Safety "DATA" is Discrete (bits) and often hard-wired

Information Enabled “Smart” Safety

Inputs

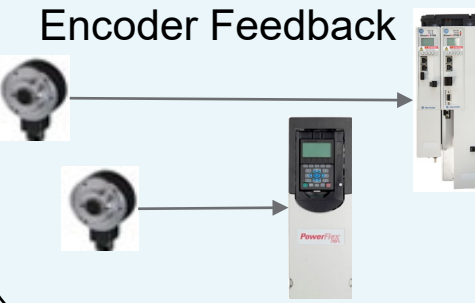


1791ES-ID2SSIR



Bulletin 843ES

Encoder Feedback



DATA

Velocity,
Position

DATA

Logic

GuardLogix




Compact GuardLogix




DATA

Safe Limited
Speed
Setpoints

Outputs



Kinetix
5700
Bulletin
2198

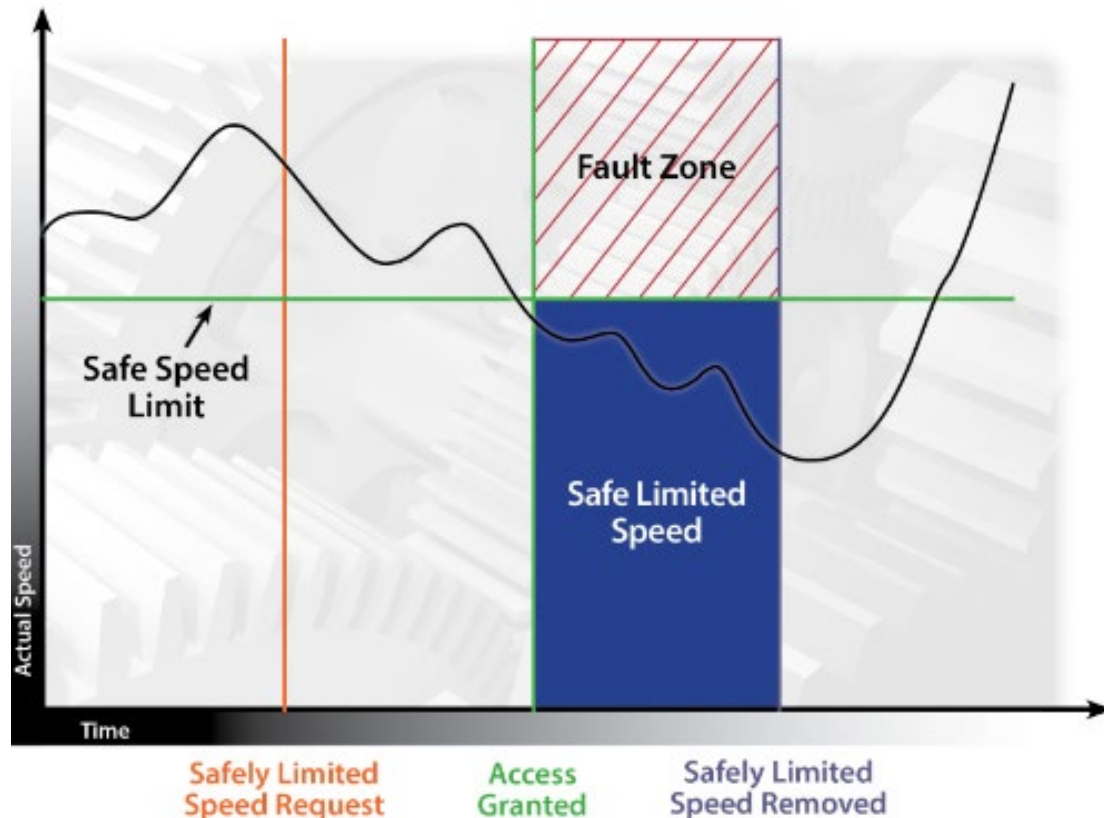


PowerFlex
755
Bulletin 26G

“Smart” Safety data includes VELOCITY and POSITION and is on Ethernet

Safely-Limited Speed (SLS)

- Monitors speed to safe speed limit
- Indicates when less than safe speed limit



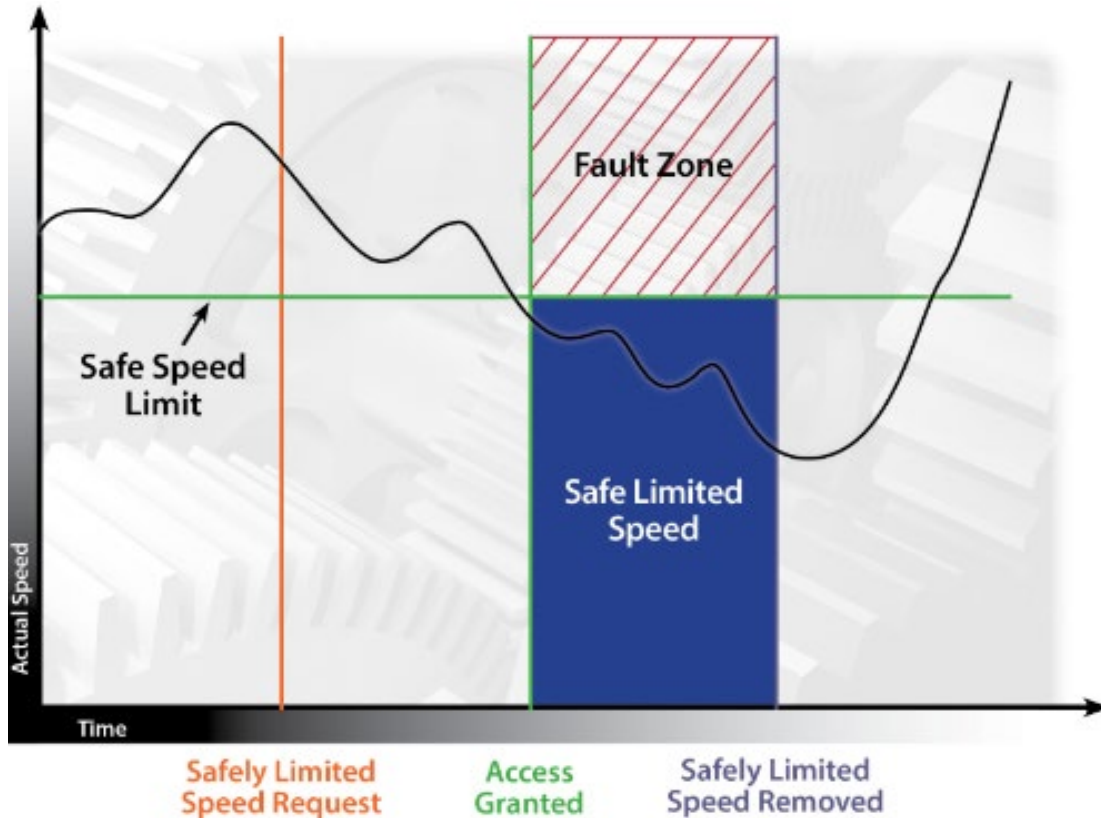
Application: machine set up / troubleshooting

- Guard door bypass: SLS and enable switch
 - Request SLS mode
 - Hold enable switch
 - Open guard door
 - Jog machine below SLS



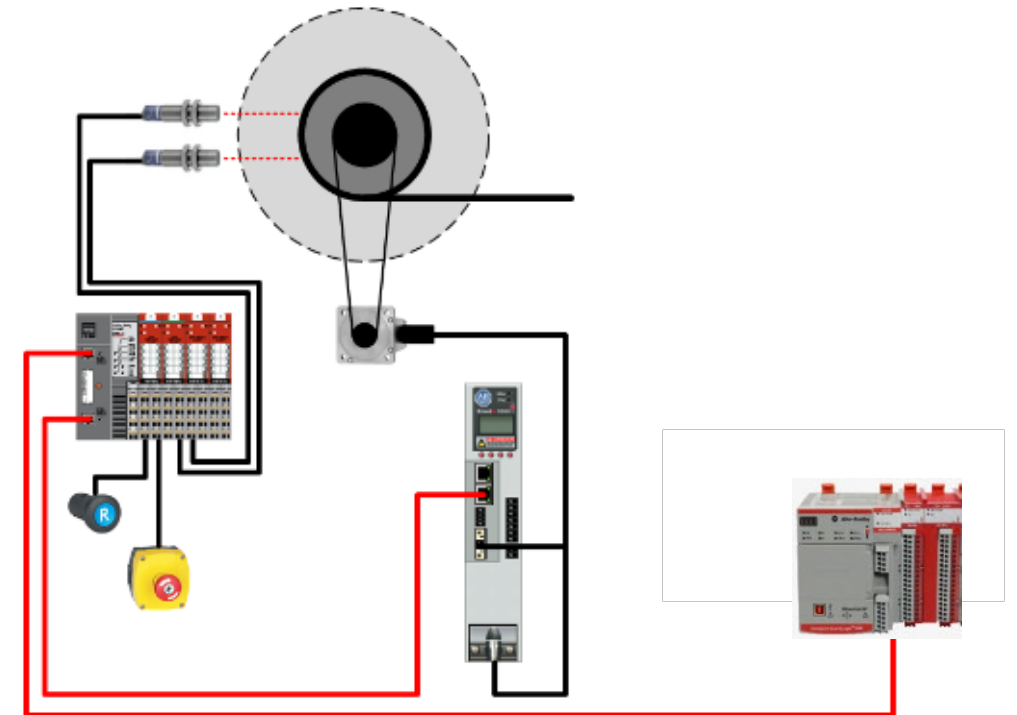
Safely-Limited Speed (SLS) – dynamic setpoint

- Monitors speed to safe speed limit
- Indicates when less than safe speed limit



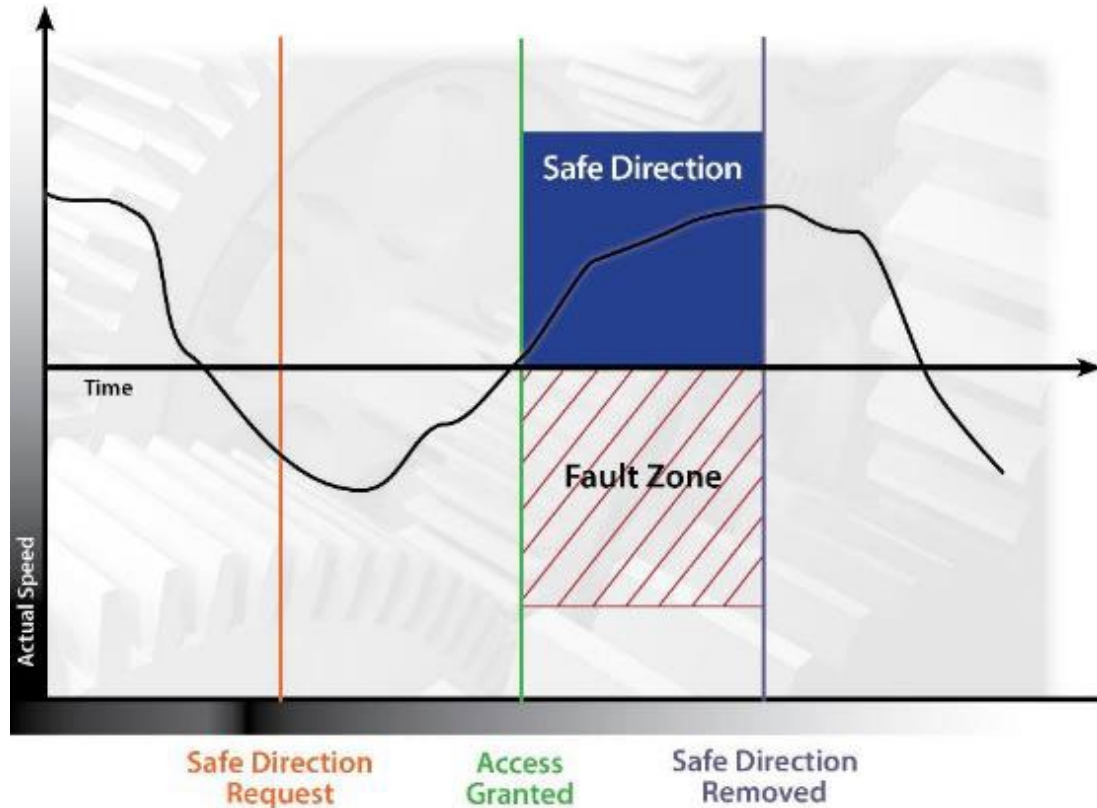
Application: threading – material unwind

- Guard door bypass: SLS & enable switch
 - Historically: fixed limited speed setpoint
 - GuardLogix® controller allows changing



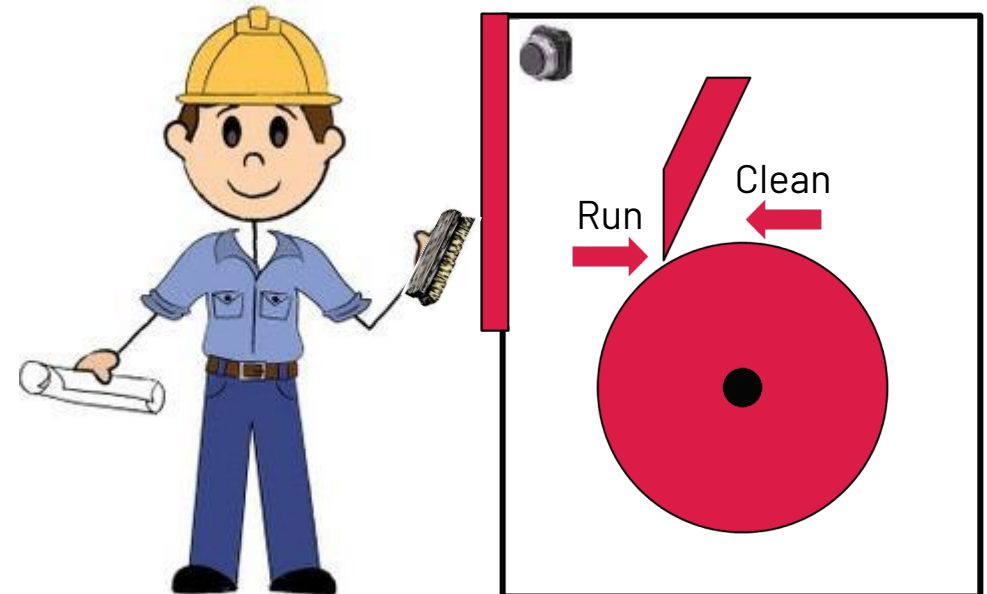
Safe Direction (SDI)

- Prevents unintended motor shaft direction
- Operation is allowed only in Safe Direction



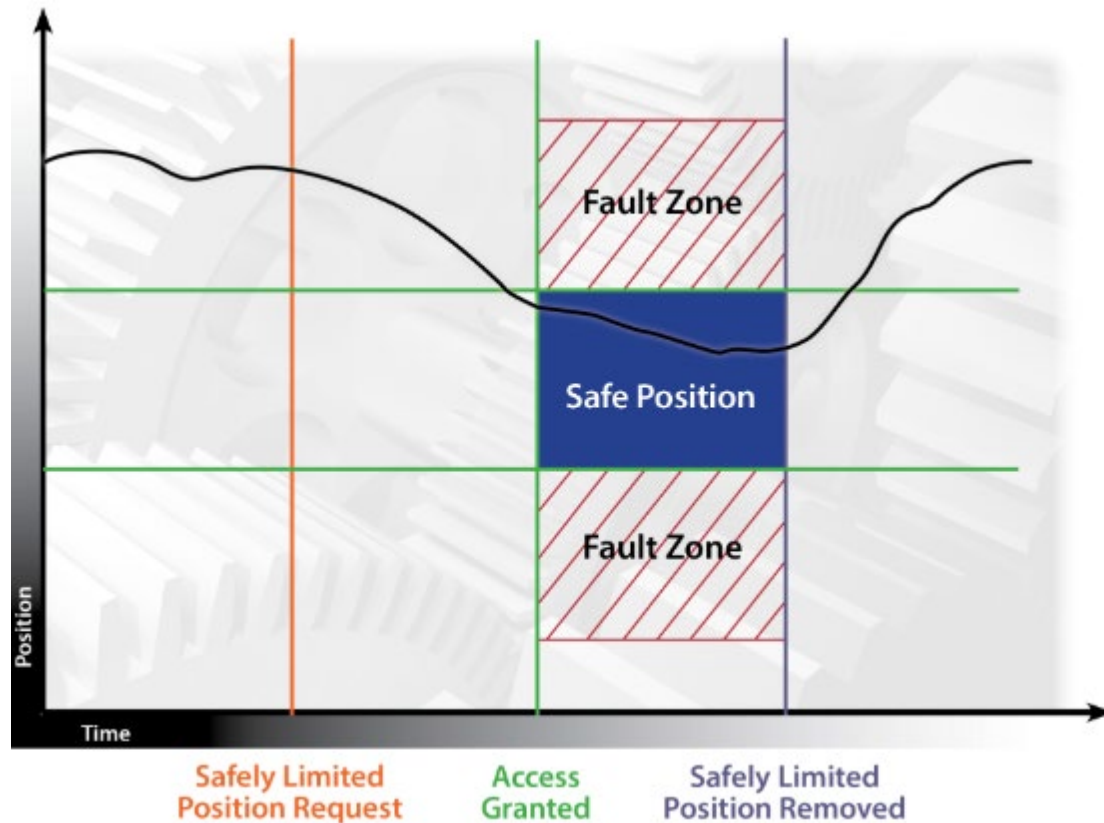
Application: machine cleaning

- Guard door bypass: Safe Direction
 - Cleaning mode selects Safe Direction
 - Safe limit speed also applied
 - Hold to run control



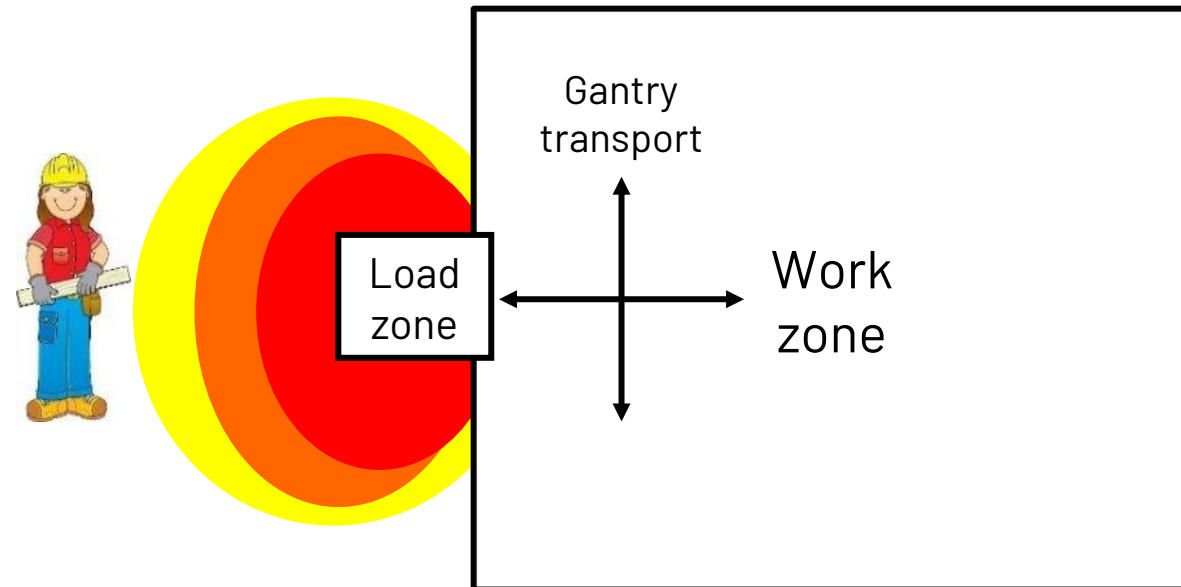
Safely-Limited Position (SLP)

- Monitors position: between two limits
- Indicates when in safe position window



Application: machine parts loading

- If gantry is in safe position, continue operation while operator loads part



Speed / Position monitoring system – SCALABLE PLd or PLe

PLd



OR



Compact GuardLogix[®]
5380-S2 controller

GuardLogix[®] 5580
controller

PLe



OR



Compact GuardLogix[®]
5380-S3 controller

GuardLogix[®] 5580 controller
with **safety partner module**

Many options for bringing in Speed/Position data



Kinetix 5700-ERS4



Kinetix® 5700
ERS4 drive



VPL motor with SIL2/PLd
safety rated encoder

OR



Kinetix® MP motor with "M" or "S"
encoder (absolute - Sin/Cos)



VPL motor with SIL2/PLd
safety rated encoder

AN
D



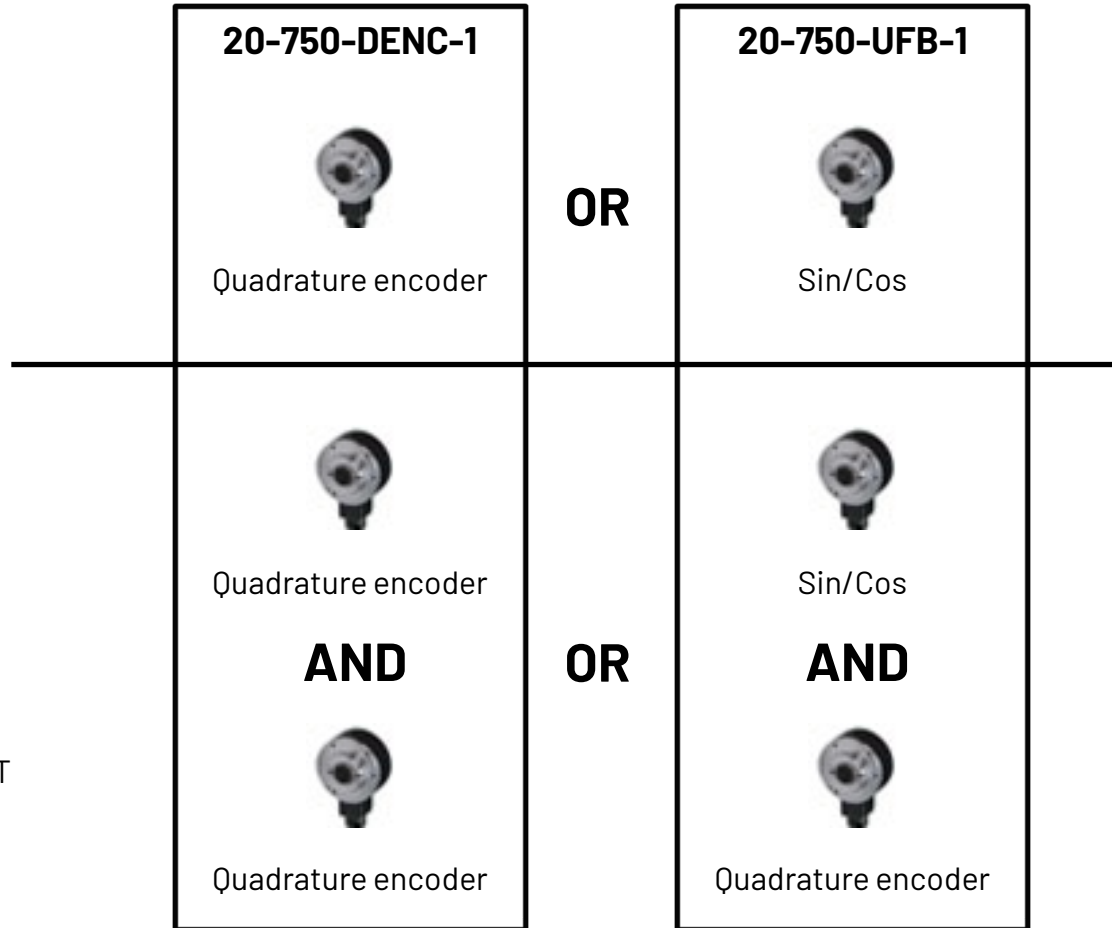
842HR Sin/Cos encoder

Speed monitoring PLe
Position monitoring PLd limited

PowerFlex 755



PowerFlex® 755 and 755T drives



1791ES Safety Interface for Encoders

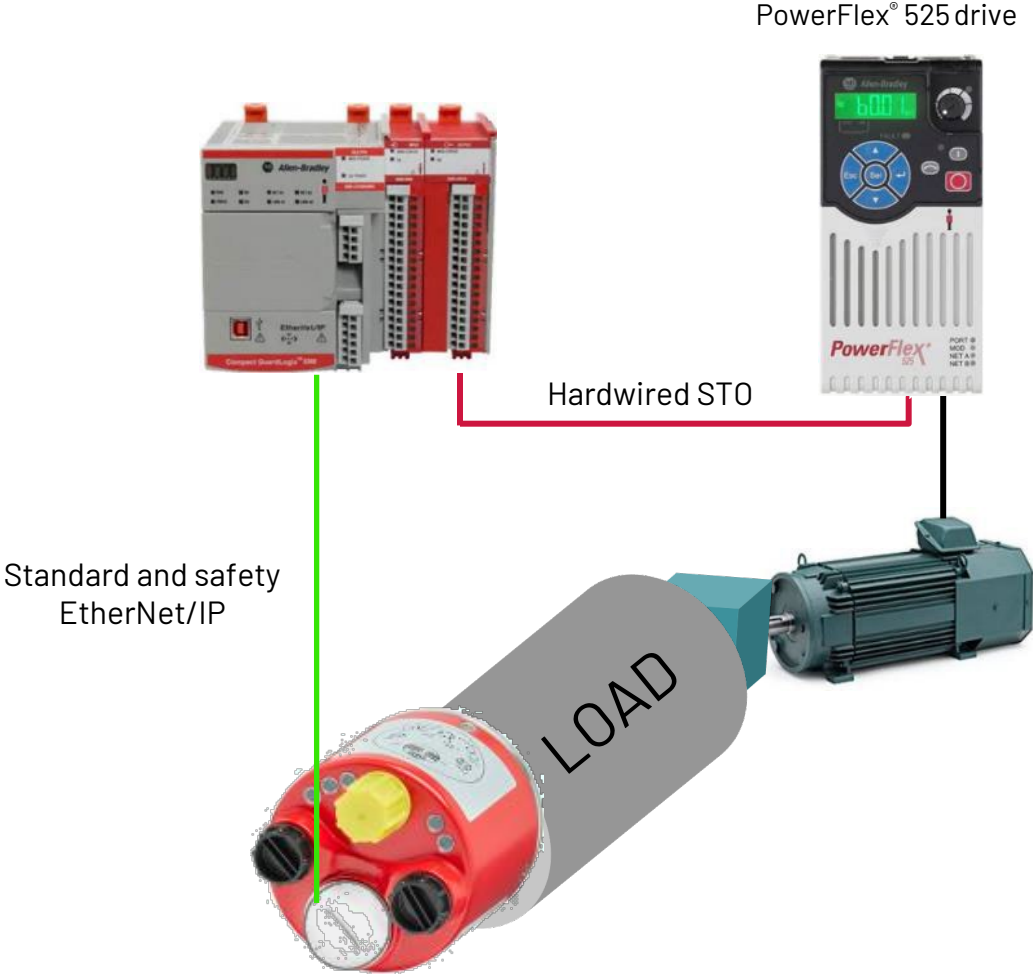


1791ES encoder interface module

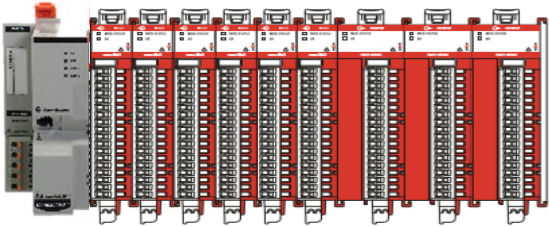
| Channel 0 | Channel 1 |
|----------------------|-----------|
| Sin/Cos or Hiperface | None |
| Sin/Cos or Hiperface | A quad B |
| | SSI |
| A quad B | A quad B |
| | SSI |
| SSI | A quad B |
| | SSI |

Speed and position control system

Now: 843ES CIP Safety encoder



New Options for Safety I/O



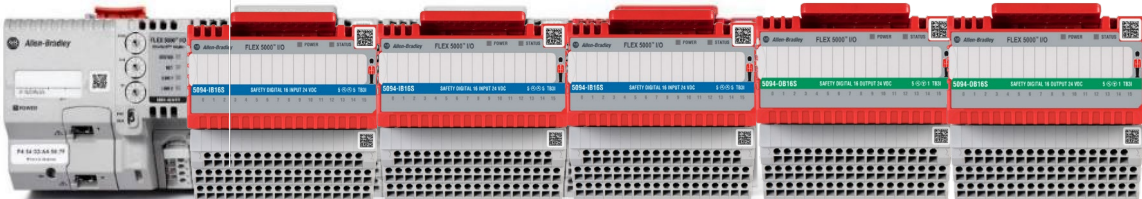
Compact 5000™ I/O



Point™ I/O



1756 ControlLogix® I/O



FLEX 5000™ I/O



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Summary & Safety Resources

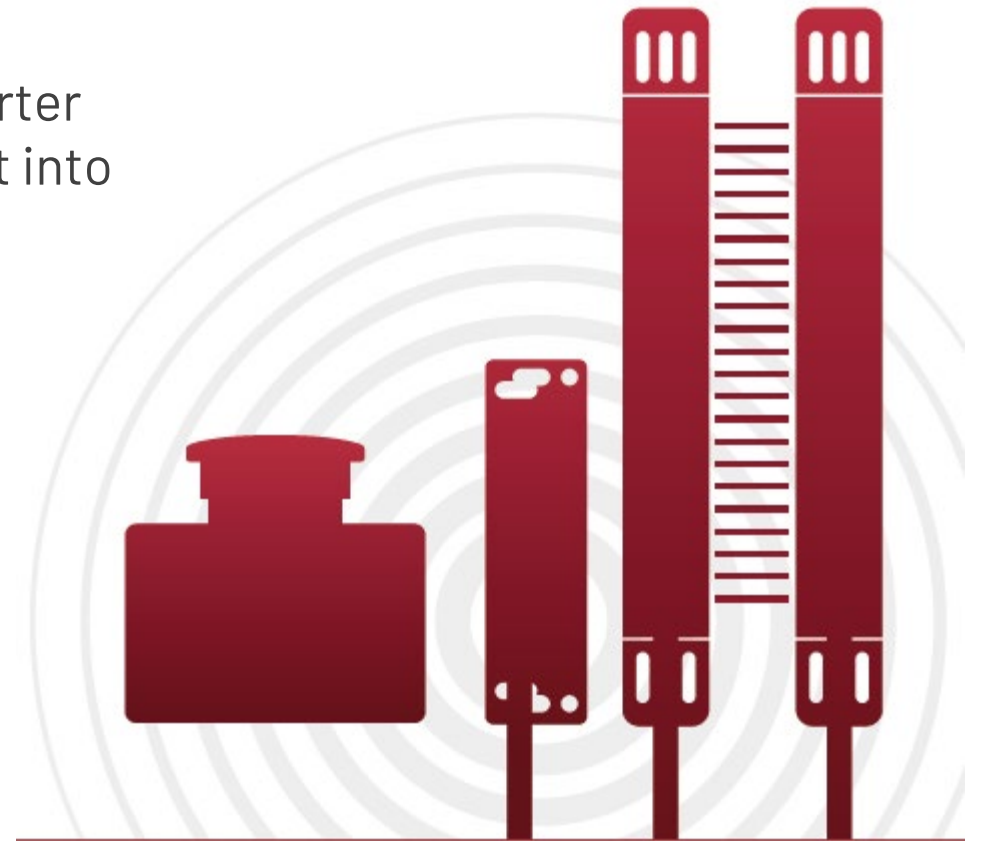
Summary

Manufacturers face many challenges when balancing machinery safety and productivity.

Machine Builders can differentiate themselves by enabling smarter machines to harness the safety system data and transforming it into meaningful information.

Benefits of integrating Smart Safety Solutions:


- Improve insight into worker behavior
- Enhance worker safety
- Reduced safety-related downtime
- Improve regulatory compliance



Summary

Whitepaper: Reimagining Safety In the Connected Enterprise (Safety-WP034)

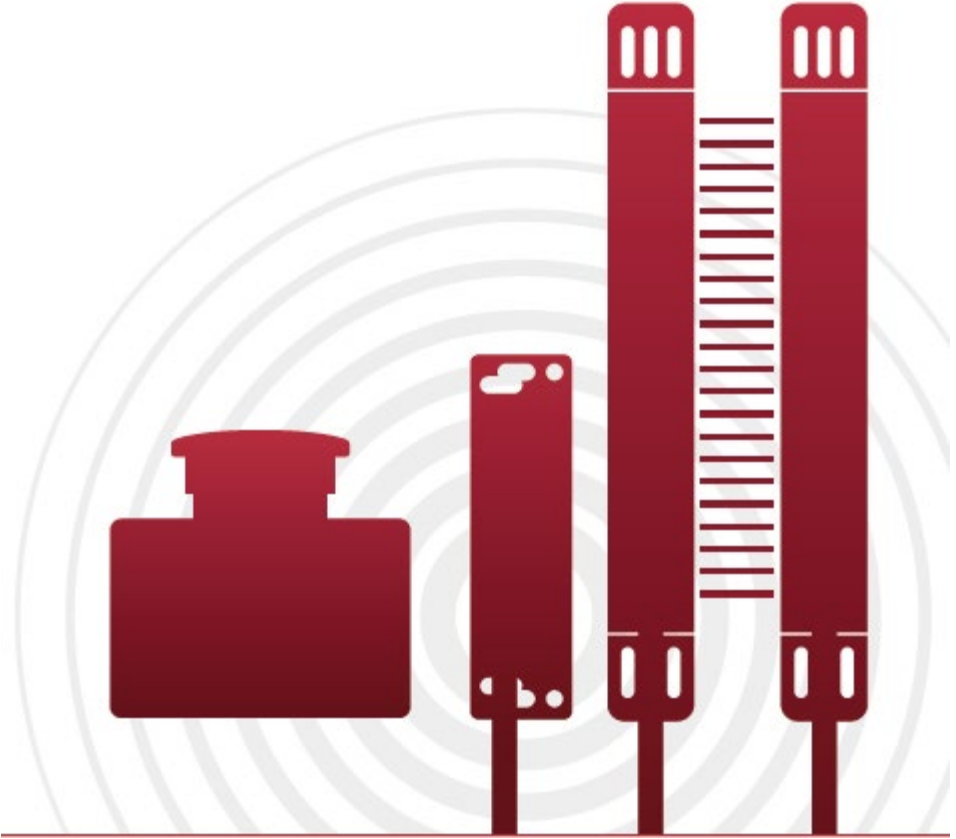
**Reimagining Safety in
The Connected Enterprise**



Harnessing the power of safety and operational data can substantially improve safety compliance and performance. The Connected Enterprise enables this, empowering safety professionals with a real-time understanding of worker behaviors, machinery compliance, causes of safety shutdowns or stoppages, and safety anomalies and trends.

**LISTEN.
THINK.
SOLVE.**

Allen-Bradley • Rockwell Software **Rockwell
Automation**



Safety Tools and Resources



Safety Reference Manual
Introduction

Kinetix 5700 Safe Monitor Functions

Catalog Numbers 2198-0006-ERS1, 2198-0012-ERS3, 2198-0020-ERS3, 2198-0022-ERS1, 2198-0027-ERS3, 2198-0046-ERS1, 2198-0130-ERS1, 2198-0140-ERS1, 2198-0006-ERS4, 2198-0012-ERS4, 2198-0020-ERS4, 2198-0022-ERS4, 2198-0027-ERS4, 2198-0046-ERS4, 2198-0130-ERS4, 2198-0140-ERS4, 2198-0006-ERS5, 2198-0012-ERS5, 2198-0020-ERS5, 2198-0022-ERS5, 2198-0027-ERS5, 2198-0046-ERS5, 2198-0130-ERS5, 2198-0140-ERS5

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This video continues on from 450L GuardShield™: Introduction to 450L CIP Safety over EtherNet/IP™

Studio 5000 Setup for 450L GuardShield CIP Safety

This how to video details the integration of Studio 5000® with 450L GuardShield safety light curtains.

Application Technique

Safety Function: Actuator Subsystems – Stop Category 0 via the PowerFlex 525 and PowerFlex 527 Drives with Safe Torque-off

Products: Guardmaster Dual-Input Safety Relay, Guardmaster Expansion Module, PowerFlex 525 Drive, PowerFlex 527 Drive

Safety Rating: Cat. 3, PL to ISO 13849-1:2008

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User Manual
Digital I/O Modules

1756 ControLogix Digital Safety I/O Modules

Catalog Numbers 1756-0B165, 1756-0B955

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Compact 5000 I/O System

Creating a more efficient, nimble and productive business

The Compact 5000® I/O system offers a wide variety of standard and safety modules with dual gigabit (GbE) embedded Ethernet ports for Device Level Ring (DLR) and Linear topologies. This flexibility allows more customization for applications demanding high performance and speed. The system expands performance capabilities within the Logix platform in a compact design, and functions as local I/O modules in a CompactLogix® 5380, Compact GuardLogix® 5380, or CompactLogix 5480 system.

Through the Compact 5000 EtherNet/IP™ adapter, it is the ideal distributed I/O solution for CompactLogix 5380, Compact GuardLogix 5380, CompactLogix 5480, ControLogix® 5380, and GuardLogix 5580 controllers.

Smart

- Embedded switch technology supports DLR and Linear topologies
- Status display provides information without software connection

Safety

- Single channel SIL 3/PL rated
- Faster safety response reaction time
- Enhanced diagnostics information

Productive

- Faster transfer rates with high-speed backplane
- Easy configuration with integrated USB port
- Solve multiple applications with support up to 31 local I/O modules

Secure

- Reduce power termination to I/O modules with integrated power supply
- Easy access to SD card and reset button and added layer of protection with access door
- Increased security with digitally signed module firmware

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843ES CIP Safety over EtherNet/IP Encoders

Improve performance and productivity with Integrated Safety

843ES CIP Safety over EtherNet/IP™ Encoders are designed for safety applications that require speed, direction, or position measuring safety functions. These encoders support the GuardLogix™ controller based safety functions, according to IEC 61800-5-2, in the Studio 5000 Logix Designer™ application. By providing auxiliary feedback directly through an EtherNet/IP network for CIP Safety, it makes it easier to achieve the desired safety integrity or performance level by reducing the number of components needed and utilizing the already available advanced drive safety instructions.

Benefits

- Added safety** - When used as part of an integrated safety system that includes a GuardLogix 5380ES controller or Compact GuardLogix 5380ES controller, the 843ES CIP Safety Encoder provides safety ratings up to and including SIL 3, CL 1 and PL a Cat. 3 (single channel Logix Designer™ application version 31 or later is required)
- Reduced design time** - The ability to integrate the safety functions over EtherNet/IP provides the opportunity to reduce hardware and installation costs. Use the position, velocity and acceleration feedback from the 843ES CIP Safety Encoder to program safety functions on the same network and controller as the standard control.
- Higher productivity** - The ability to continue production while safety monitoring for speed, direction, or position helps improve productivity and overall machine performance.
- More visibility** - The integration of the safety and standard control systems provides operators and maintenance personnel with visibility to all machine events - including safety events. This helps enable a quick response that allows the machine to return to full production faster.

Features

- Rated up to and including SIL 3 according to IEC 61800-5-2, IEC 62061, and IEC 61508-1
- Rated up to and including PL a, Cat. 3, according to ISO 13849-1
- Clamping, sprockets, and square flange options for solid shaft
- Blind hollow shaft available with rotor coupling
- Feather key solid shaft to prevent rotation
- Dual EtherNet ports with embedded EtherNet/IP switch for linear networks and Device Level Ring topologies
- IP67 installation rating
- Small form factor
- 16-bit safety resolution, 18-bit standard resolution
- 12-bit multi turn resolution

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Industries Capabilities Products Support Company Sales

Industrial Safety Solutions

Safety and Productivity Solutions

Safety Solutions Electrical Machine Management Machinery Process Services Resources System Tools

Q&A