Rockwell Automation

Motion and Mechatronics Update

Rob Votin • Mechatronics Technology Consultant

expanding **human possibility**®

Agenda

1 Kinetix Motion Portfolio

2 Armor Kinetix

3 Independent Cart Technology

4 Unified Robotics

5 OTTO - AMR

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Kinetix Motion Portfolio

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Positioning within the Kinetix Portfolio

Core Features of the Kinetix Families

Standalone Machines

Kinetix 5100 Core Features

- EtherNet/IP standalone drive
- Standalone / simple machines
- Low axes count
- Indexing drive
- Hardwired safety
- KNX5100C configuration tool

Small to Medium Machines

Kinetix 5300 Core Features

- Entry-level integrated motion drive
- Simple to medium machines
- Low axes count
- Hardwired safety
- Load observer

Medium machines

Kinetix 5500 Core Features

- Mid-range integrated motion drive
- Medium machines
- Low axes count
- DC bus sharing
- Single-axis modules
- Hardwired and network safety
- Load Observer

Large Machines

Kinetix 5700 Core Features

- Multi-axis integrated motion drive
- Large machines
- High axes count, up to 180HP
- **Diode / active front end** power source
- Single- and dual-axis modules
- Hardwired and network safety
- Advanced safety features
- Load Observer

Modernization Strategy

Kinetix 300

- Stand-Alone drive
- PTO; Indexer; EtherNet/IP
- Single Ethernet port

Ultra 3000

- Stand-Alone drive
- PTO; Indexer; Host Commands
- Optional Sercos & DeviceNet

Kinetix 350

- Integrated Motion drive
- Single Ethernet port

Kinetix 5100

- Stand-Alone drive
- Wider Power Range
- Auxiliary Feedback port
- Dual Ethernet (DLR) ports as standard

Kinetix 5300

- Integrated Motion drive
- Wider Power Range
- Auxiliary Feedback port
- Dual Ethernet (DLR) ports as standard

Kinetix 5500

- Integrated Motion drive
- Dual Ethernet (DLR) ports as standard
- Network Safety over EtherNet/IP

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Kinetix Motors

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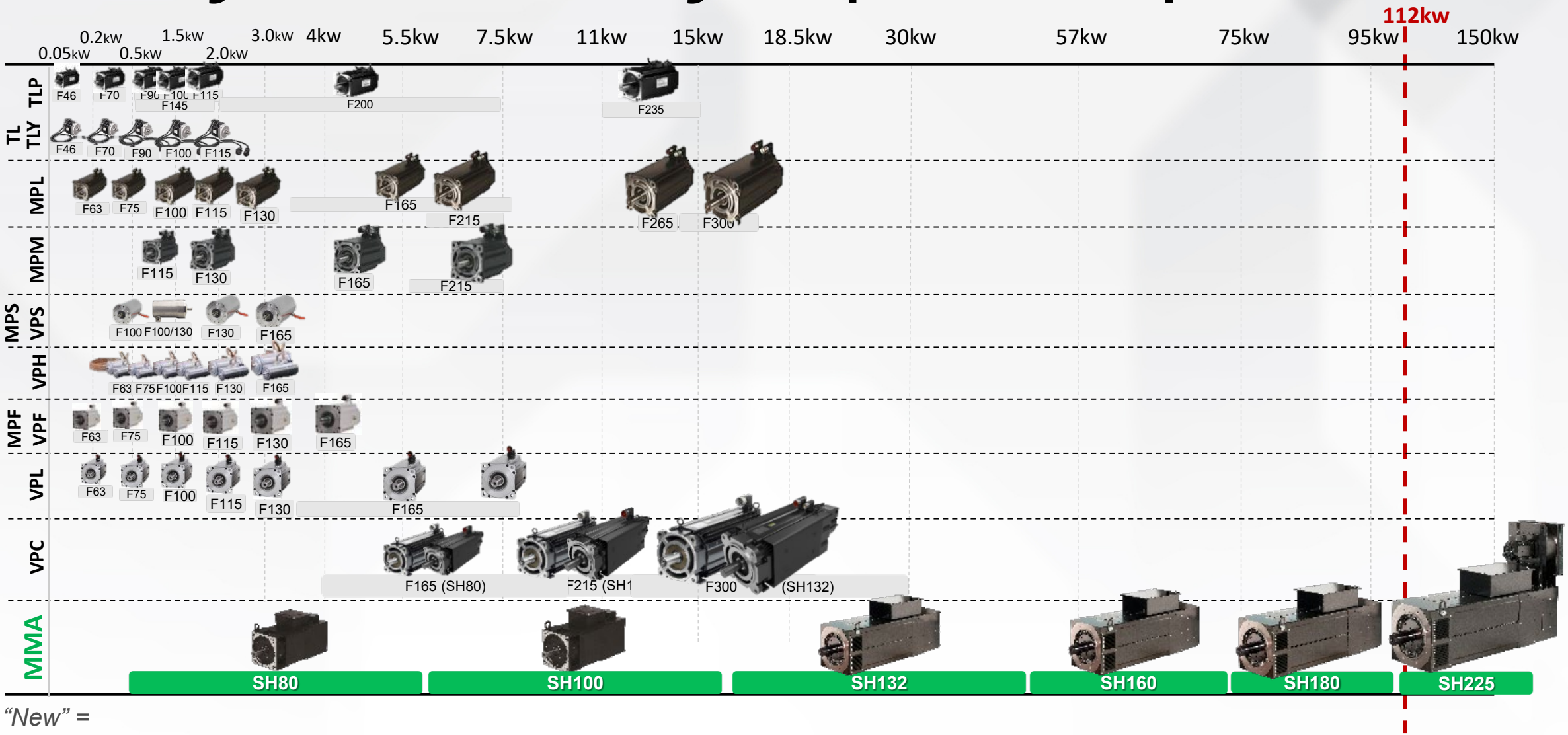
Positioning: medium inertia, high-torque, constant power



"New" = since 2019

Kinetix MMA Asynchronous Main Motors

Expanding the Kinetix rotary motors portfolio

Key Points

- Best-in-class power by frame size
- Migration path for Kinetix HPK motors
- Rockwell Automation solution where CM203 / third-party used
- True medium-inertia main motor
- Highly configurable features
- Special industry model options

Target Applications

- Converting
- Wind/unwind/rewind
- Sheeters
- Flying knife
- Material handling
- Tire building
- Metal forming

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On- Machine

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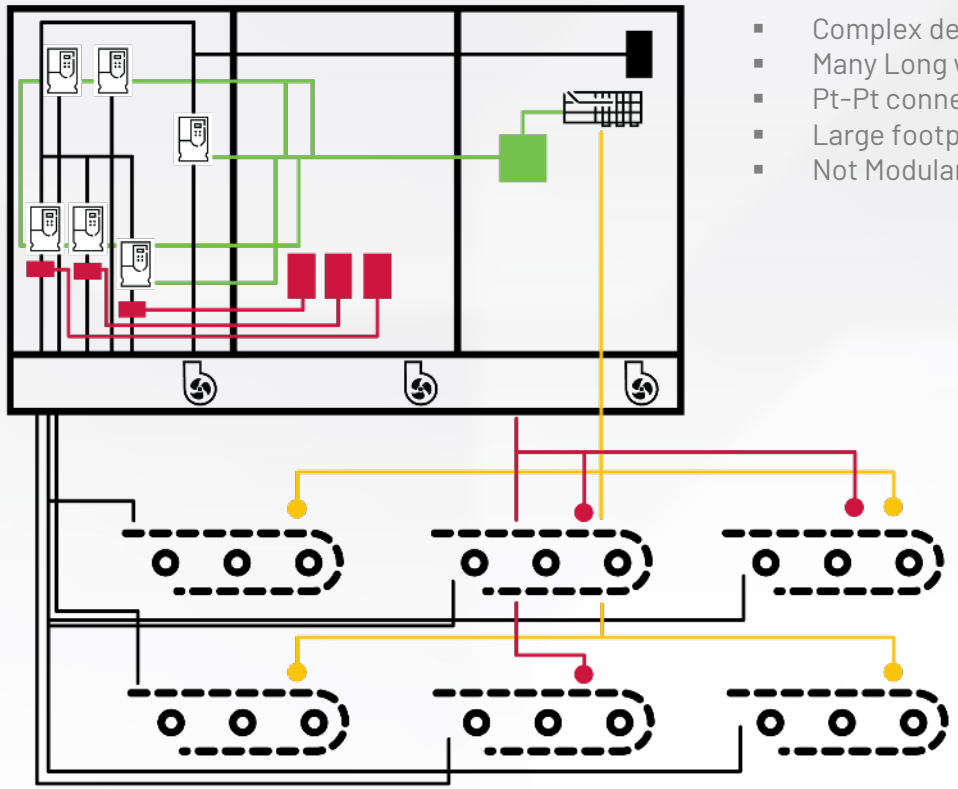
What is decentralized design?

Centralized design

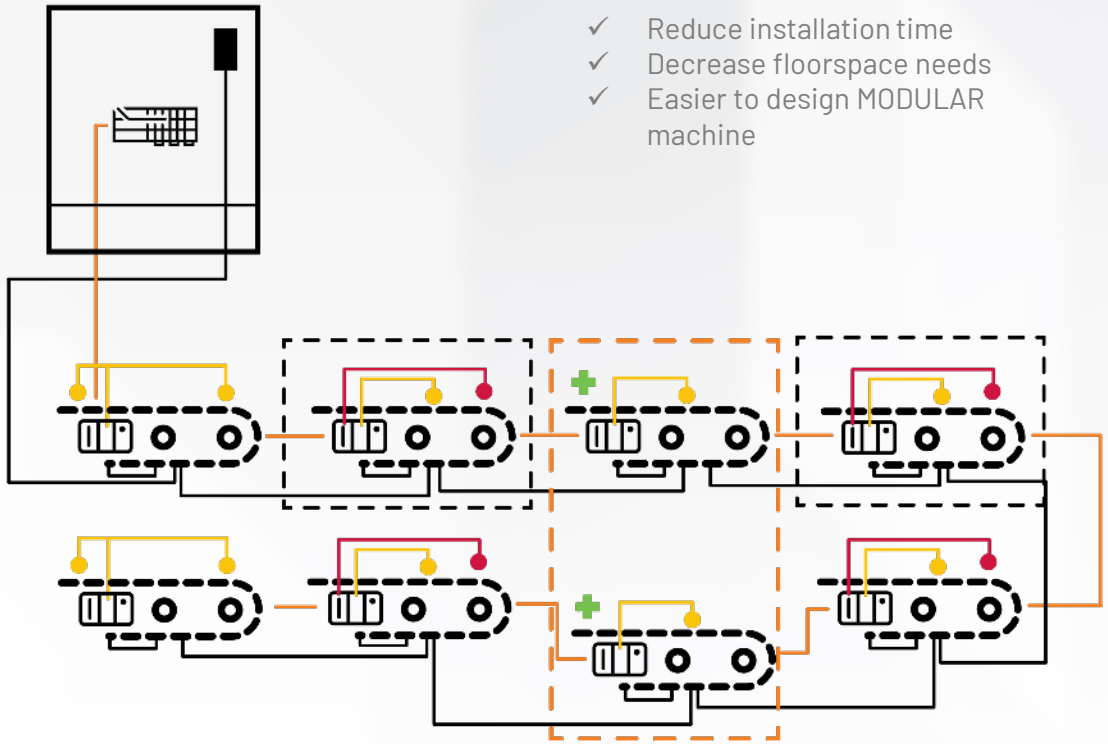


- Complex design
- Many Long wires
- Pt-Pt connections
- Large footprint
- Not Modular

Higher installation costs and more time

Improved

Decentralized design



- ✓ Reduce installation time
- ✓ Decrease floorspace needs
- ✓ Easier to design MODULAR machine

Decreased installation costs and less time

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Configurations

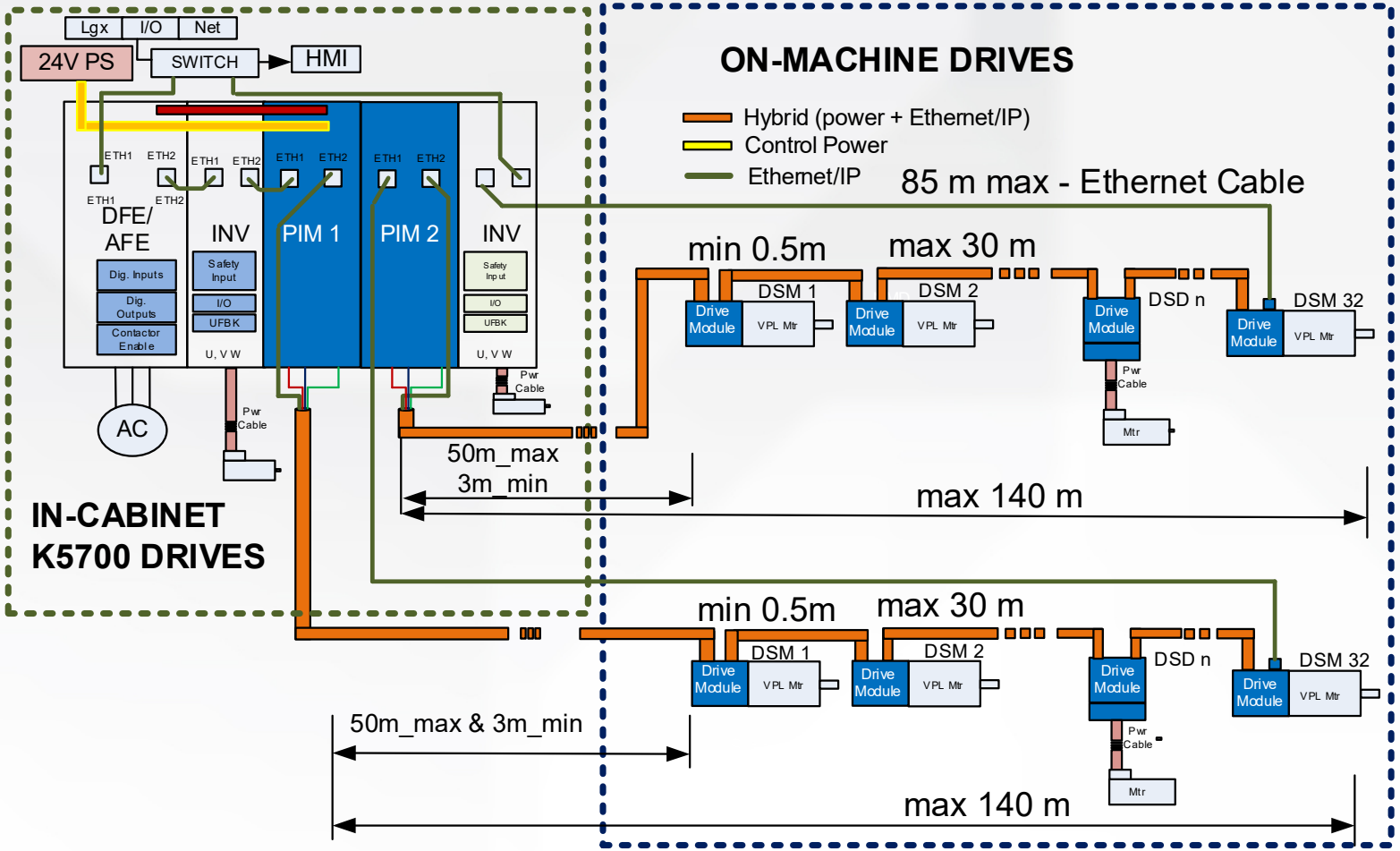
ArmorKinetix® Distributed Servo Drives (DSD)

- Servo drive mounted separately from motor
- Extension of Kinetix® 5700 family
- Flexible pairing with Kinetix® VP-family, Kinetix® MP-family, linear solutions and induction motors

ArmorKinetix® Distributed Servo and Motor (DSM)

- Servo drive and integrated motor
- Extension of Kinetix® 5700 family
- Integrated Kinetix® VPL motor

System design



- (K5700) – power supply
- Hybrid cable - integrated power and communication
- Daisy chained architecture
- Support up to 24 axes per PIM
- Multiple PIMs can be used - if more than 24 axes is needed
- Up to 140m total cable length per PIM
- Up to 30m DSM / DSD to DSM / DSD cable length
- Up to 50m PIM to DSM cable length
- 200 / 400V Class Support
- Up to 4m DSD motor power / feedback cables

Technology differentiators

Extension of Kinetix® 5700

- Load Observer / Adaptive tuning
- Virtual torque sensing
- Bus derived power supply capability

Advanced Sensing and Analytics

- Vibration monitoring
- Thermal sensing
- Peak vibration sensing

Extensive application base

- Wide power range
- Support for multiple motor types

Safety & security

- Advanced **integrated safety** SIL 3 (DSD) & SIL 2 (DSM)
- CIP Security

Holistic design

- Compact footprint
- Standard experience with On-Machine™ devices
- Kinetix® cables tested & validated

Distributed Servo and Motor (DSM) features summary

Kinetix® VPL motor based

- Four frames: 75mm, 100mm, 115mm, **130mm**
- Matches motors up to 5.5kW
- Cont. stall torque: 1-13.4 Nm
- Peak stall torque: 2-**34.6 Nm**
- Holding brake option

Innovative design

- 200 / 400V class product
- Common power structure
- Bus Derived Power Supply
- Integrated vibration sensing
- DLR capable
- IP66 rated, IP67 pending

Modern communication features

- Three connections
  - Two hybrid, PWR/COMs
  - One I/O connector with four configurable inputs
- Scalable network safety
- Standard encoder or **Safety SIL 2 encoder**
- 1 Gbit Capable

System-centric design

- Common design standards for On-Machine™ portfolio products
- Consistent connectors, LEDs, etc.
- Consistent user experience

Distributed Servo Drive (DSD) features summary

Wide motor support

- **VPx** family 63mm to 130mm frames
- **MPx** family motors w/ Hiperface sin/cos feedback only, 100mm to 130mm frames
- **Induction motors** with open loop, incremental TTL, and generic SIN/COS
- Linear motors

Innovative design

- **Up to 5.5kW (8A rms)**
- 300% Overload (1s ON and 9s OFF)
- 200 / 400V class product
- Extension of Kinetix® 5700 platform
- Common power structure
- Integrated vibration sensing
- DLR capable
- IP66 rated, IP67 pending

Modern communication features

- 4 or 5 Connections
  - Hybrid & I/O (like DSM), 74mm min bend radius
  - One motor feedback
  - One auxiliary feedback
- Four configurable inputs
- Scalable network safety
- 1 Gbit capable
- Advanced safety up to SIL 3

System-centric design

- Common design standards for On-Machine™ portfolio products
- Consistent connectors, LEDs, etc.
- Consistent user experience

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ICT Overview

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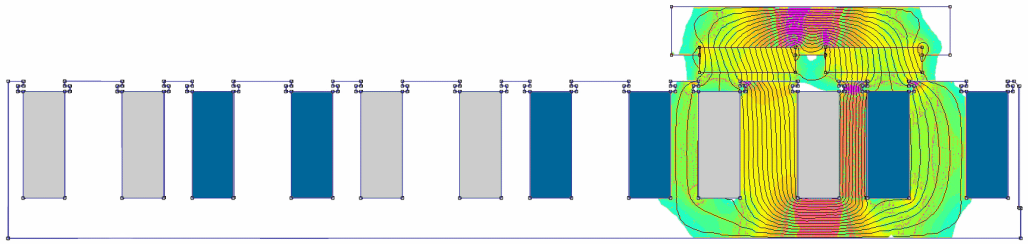
Independent Cart Technology

How does it work?

- Motor coils are stationary
  - No flexing cable wear or need for slip rings
  - Reduces wear items and maintenance
- Magnets on each cart are driven by independently energized coils
  - Intelligence is within the motor
  - Carts are moved passively via closed loop servo control
- Integrated sensors within the motor reference cart magnets to calculate position



Independent Cart Technology Benefits

Smart flexible manufacturing with the next generation machine

Higher Throughput

- Fewer moving parts **reduces maintenance** frequency and time
  - Predictable maintenance and **reduced downtime**
- Higher accelerations and speeds
- Reduce in-feed complexity
  - **Handle any spacing/timing** variation on the fly

Unlimited Flexibility

- **Independent control** over each vehicle/product
- Inherent **track & trace** with precise software-based control
- Programmatic **fast changeover**
  - Multiple 'recipes' at the touch of a button without shutdown
- Mix continuous and intermittent processes on-the-fly

Differentiated Machine Design

- Ability to **combine processes**
  - Multiple machines become one!
- **Smaller machine and line footprints**
- Modular design makes it easy to scale to different product lines
- Easy to incorporate functions to interact with the ICT products (e.g. robotics)

ICT System Animation

Independent Cart Technology Portfolio

Delivering revolutionary performance, efficiency and control across your applications

MagneMover® Lite™

Intelligent conveyor systems for light payloads (<10kg)

QuickStick®

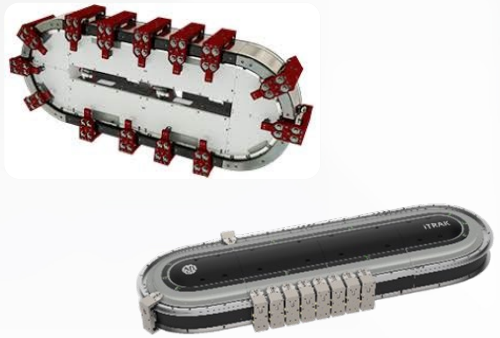
Intelligent conveyor systems for medium and heavy payloads

- **QuickStick® 150**
- QuickStick® HT

iTRAK®

High speed, high precision in-machine chassis systems

- iTRAK® 5730
- iTRAK® 5750
- [Medium Frame]



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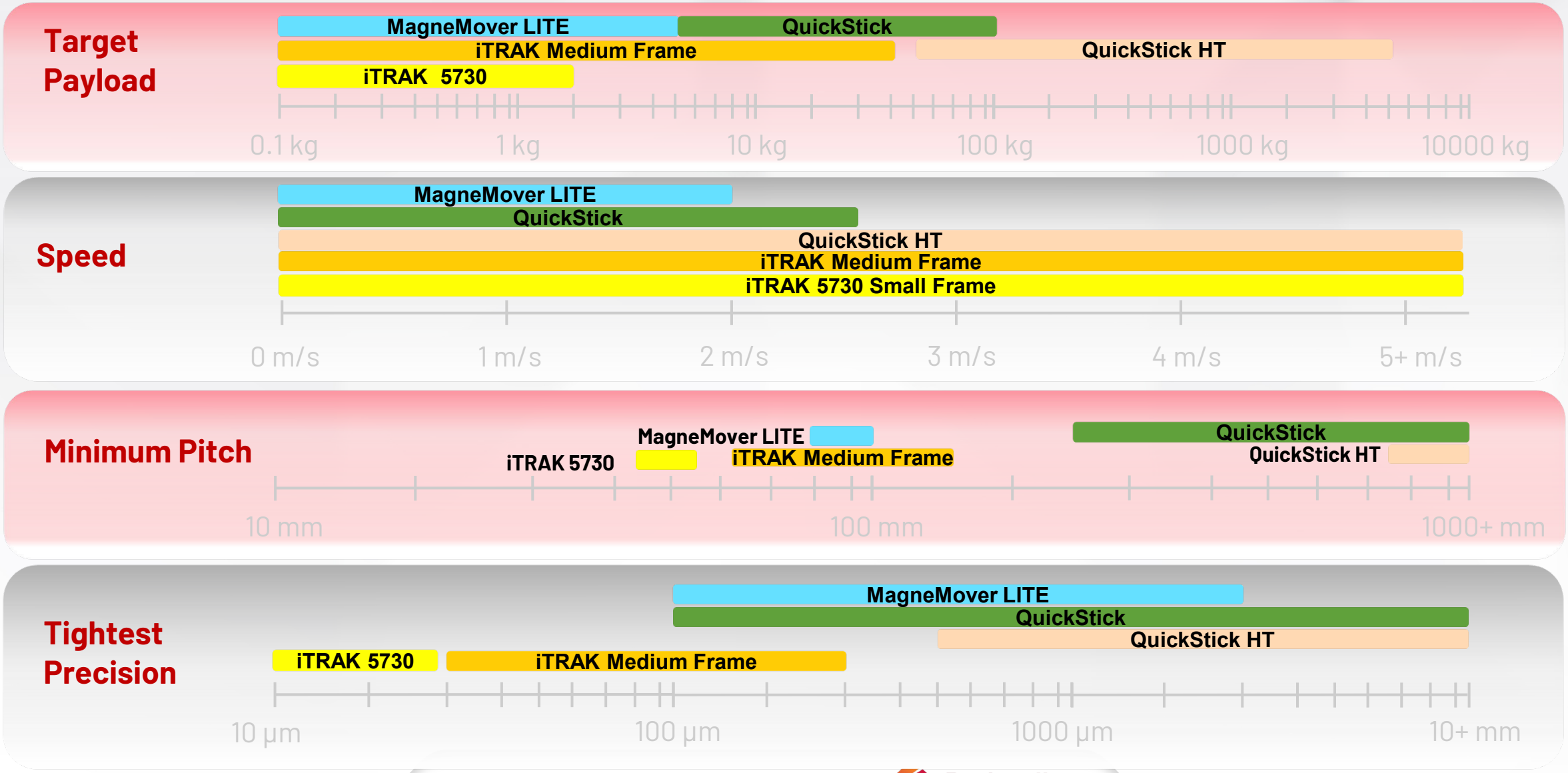
Which Product to Apply?



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MagneMover Lite

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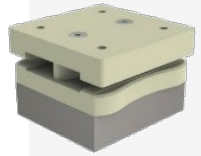
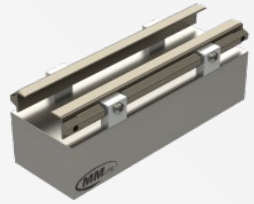
MagneMover® LITE Overview

- Air-core motor design
  - No attractive force between magnet & stator
  - Enables simple sliding cart
- Integrated drive
- Integrated guidance (rails) & cart
- Free standing or machine mount capable

Primary System Components:

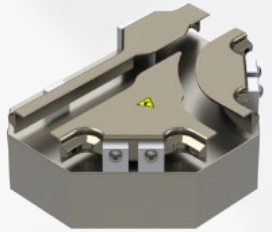


Cart

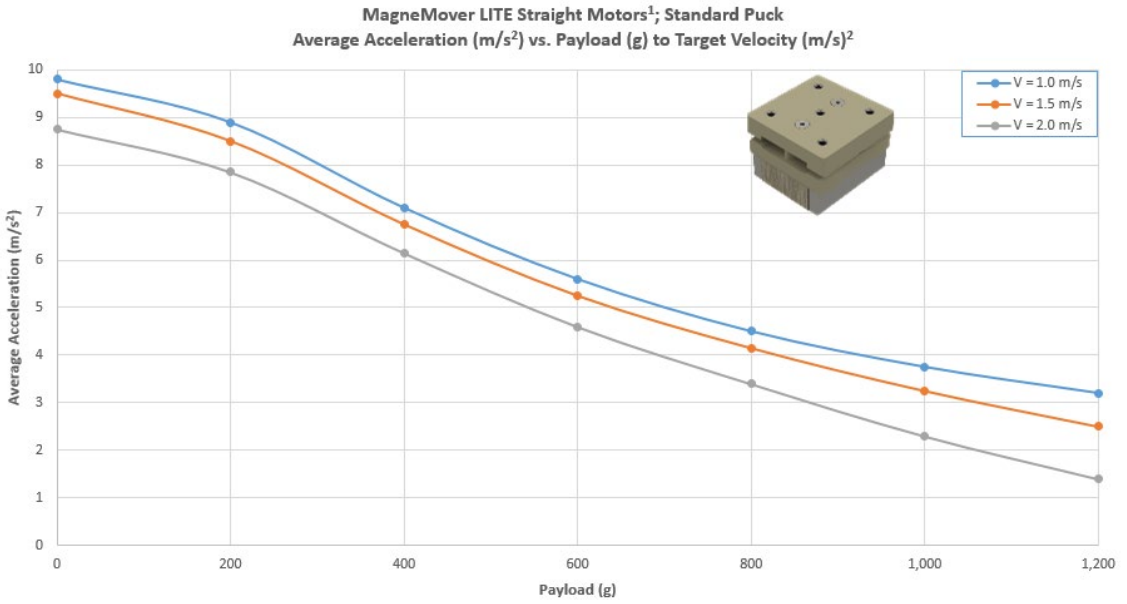


Straight
(1M & 250mm)

Curve



Switch
(L & R)



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QuickStick/HT

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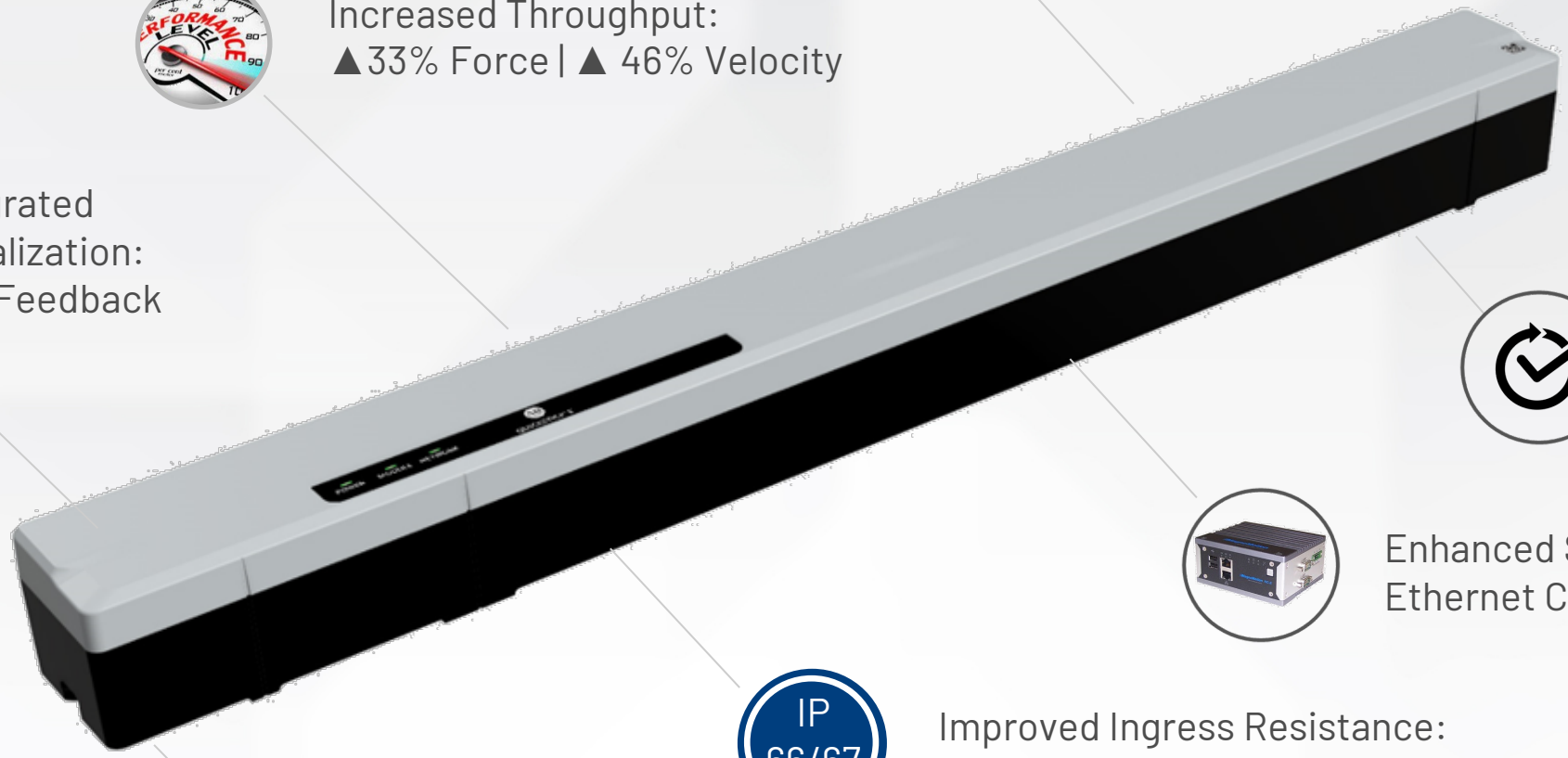
QuickStick® 150 key features

Higher Precision:
± 50µm repeatability

Increased Throughput:
▲33% Force | ▲ 46% Velocity

Integrated
Visualization:
LED Feedback



Ease of installation:
Integrated power bus

Enhanced Scalability:
Ethernet Communication

IP
66/67

Improved Ingress Resistance:
IP66/67

Zero Move Startup

iTRAK Portfolio

iTRAK® solution portfolio

iTRAK® 5730 Intelligent Track System

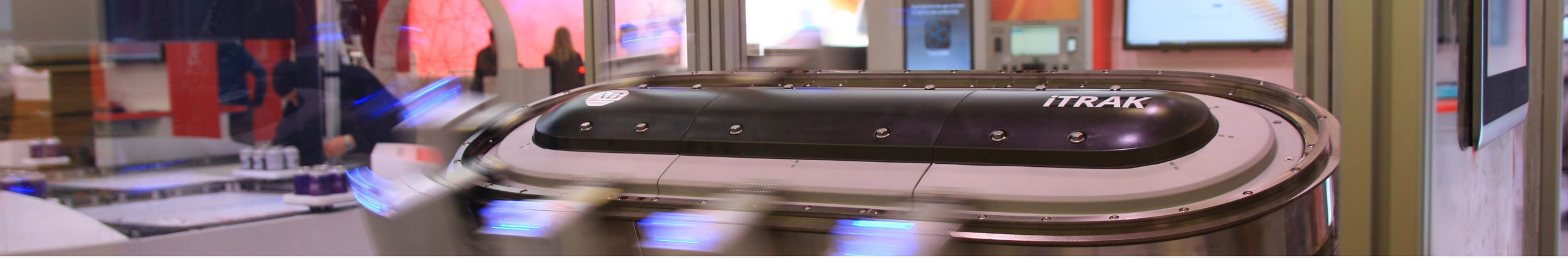
- Optimized for lighter payloads (4kg)
- Small footprint
- 50mm mover pitch
- 36N continuous force, 100N peak force

iTRAK® 5750 Intelligent Track System

- Optimized for higher payloads
- Oval & rectangular shape
- Scalable motor modules & movers

iTRAK® Engineered to Order Systems

- Large radius curve options
- Liquid cooled motor modules
- Heavy payload movers
- Full customization available



iTRAK 5730 Small Frame

Small Footprint Applications

- **True 50mm Mover Pitch**
- Lower Payloads
- Oval Shape
- Stainless Steel Rail Design

Safety Integration

- **CIP Safety**
- STO & SS1, SIL 3, PLe
- **Safety Zones on the Track**

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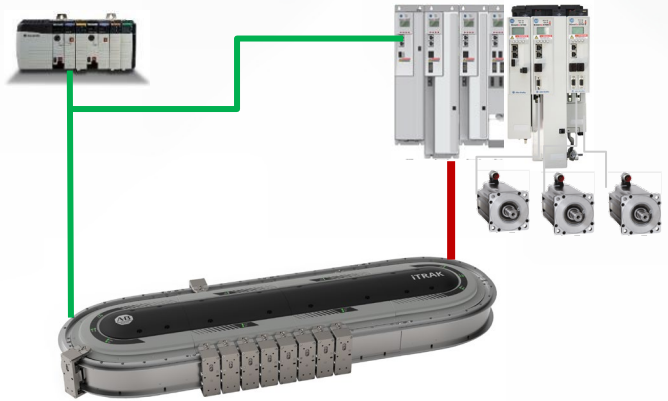
iTRAK
STO & SS1

CONSISTENT USER EXPERIENCE

iTRAK 5730 – it IS KINETIX

- Communication over the network:
  - Integrated Motion
  - Integrated Safety

- Share DC Bus of Power Supply with other Motion axes



- Benefits of Kinetix
  - Servo Loops
  - Firmware
  - Diagnostics

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iTRAK® 5750 Intelligent Track System technology differentiators

Exceptional performance

- Move **higher payloads** more dynamically
- **Speeds up to 5m/s and repeatability of 30um**
- **TriMax bearing** and rail system provide extended performance

Fully integrated motion

- Seamless extension to the Kinetix® 5700 platform
- **Application Code Manager and machine builder libraries**
- Diagnostics inherent to the Studio 5000® environment
- Standardized independent cart technology experience

Safety features

- **Network implementation of Safe Torque Off at SIL 3**
- **Network implementation of Safe Stop 1**
- **Safe zone capabilities**
- CIP Safety and CIP Security

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Independent Cart Technology Libraries

Engineering Practices

Modular code generation

Station and zone instantiation

Hardware configuration

Life Cycle Management

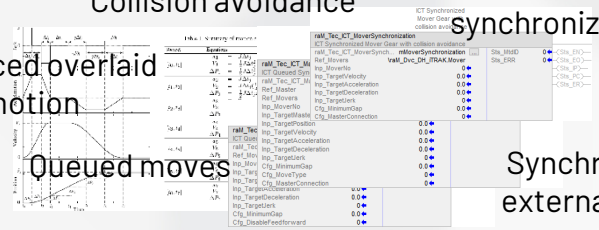
Application Code Manager library management

Code reuse

Collision avoidance

Mover to mover synchronization

Advanced overlaid motion



Queued moves

Synchronization external masters

Advanced motion

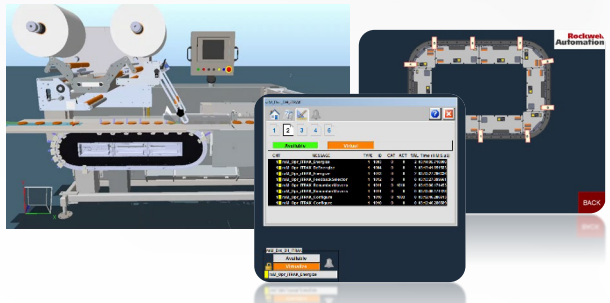
Easy to leverage device handler – *persistent status!*

ICT Libraries

Available on PCDC

Emulate3D Simulation

Visualization

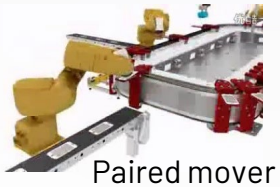


HMI Animation

HMI Faceplates

Out of the box stations and zones

External motion zones



Assembly stations

Paired mover zones

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Unified Robotics Control

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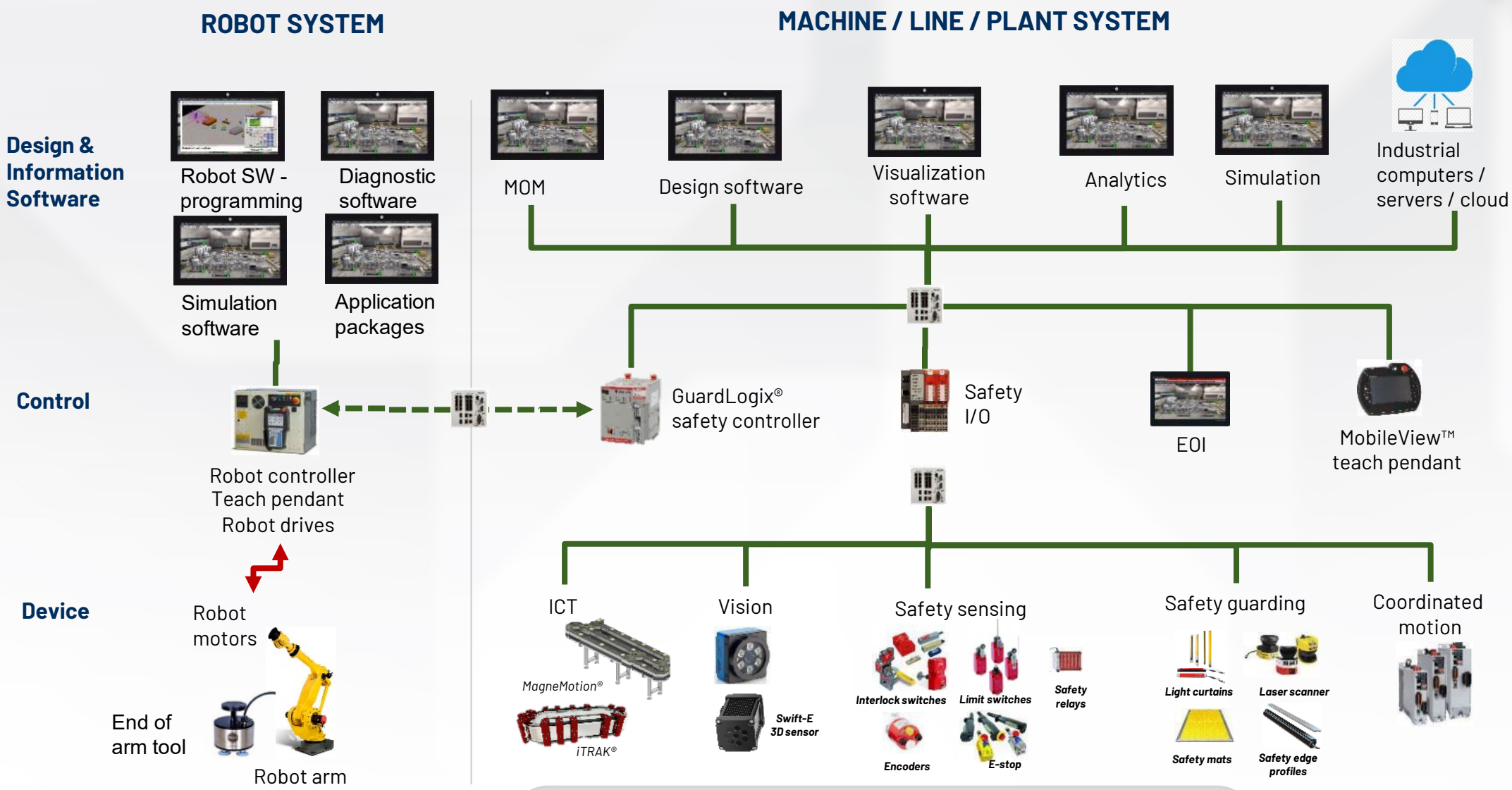
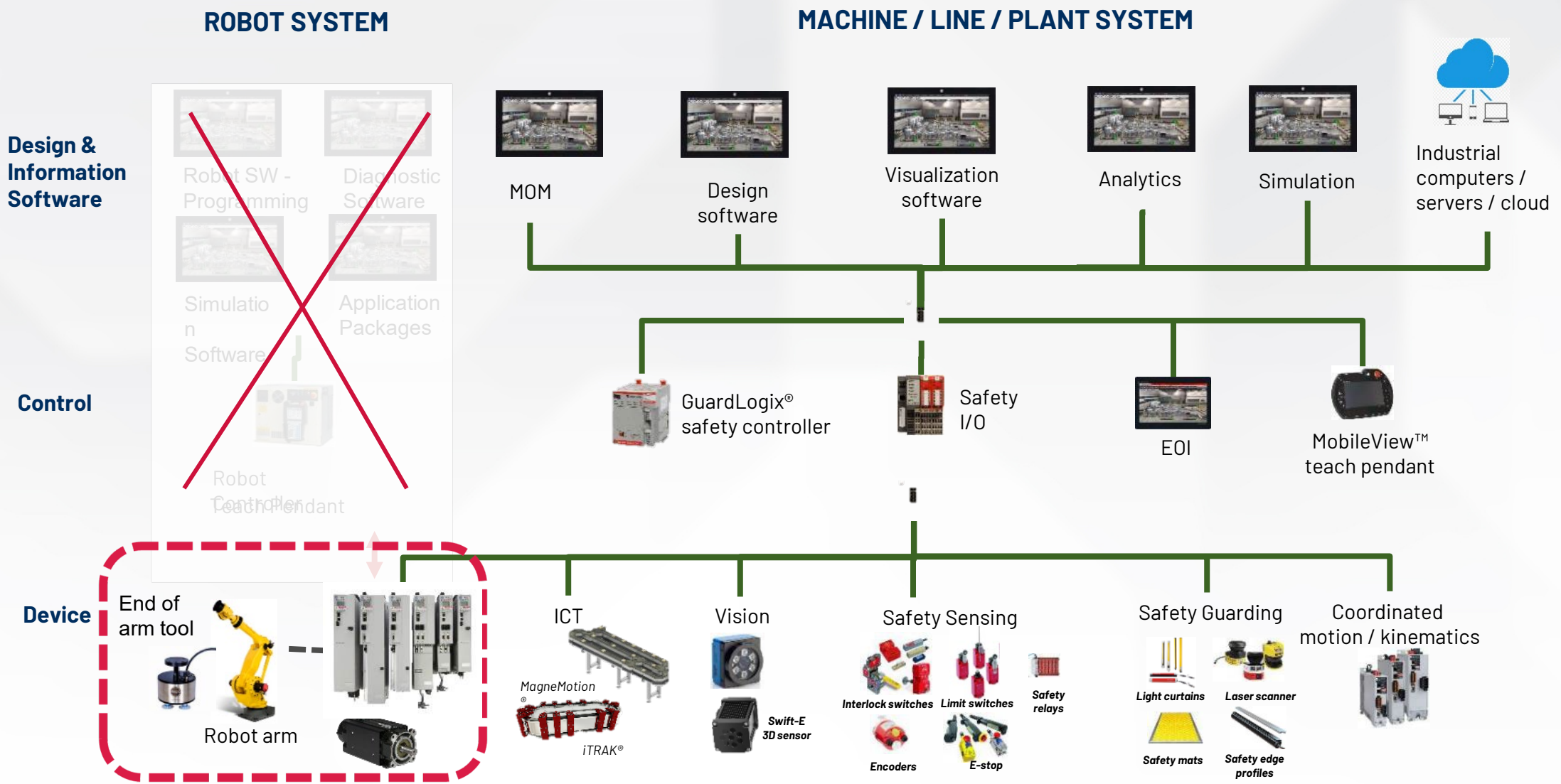
EtherNet/IP connected robot control



Unified robot control



Unified Robot Control Partners

COMAU

Founded in 1973, based in Turin, Italy.

- **EtherNet/IP connected -** Articulated, SCARA, and Collaborative robot models.
- **Unified Control** - Articulated and SCARA robot models

DENSO

Manufacturing robots since 1967, headquartered in Kariya, Japan

- **EtherNet/IP connected -** Articulated, SCARA, and Collaborative robot models.
- **Unified Control** - SCARA robot models

autonox Robotics

Founded in 2002, headquarters in Willstaett, Germany

- **Unified Control** - DELTA robot models

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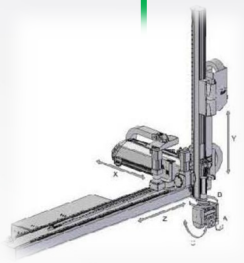
Unified Robotics Partner Roadmap

Cartesian

Kinetix® Drives*



Linear Stages

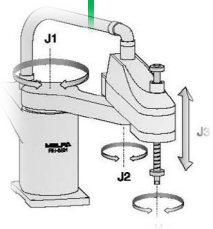
Parallel / Delta

Kinetix® Drives*

Partner
Independent / Autonox

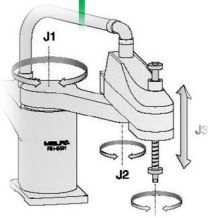
SCARA

Kinetix® 5300



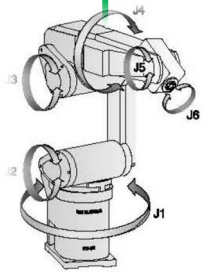
Denso

Kinetix® 5700



Articulated

Kinetix® 5700



Comau

*Kinetix 5300, 5500 and 5700 Drives

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Unified robot control – Comau

4 axis articulated dependent

PAL-180-3.1

Payload up to **180 kg**
Max H reach of **3100 mm**
Repeatability: **0.10 mm**

PAL-260-3.1

Payload up to **260 kg**
Max H reach of **3100 mm**
Repeatability: **0.10 mm**

4 axis SCARA

Rebel-S6-0.45

Payload up to **6 kg**
Max H reach of **450 mm**
Repeatability: **0.02 mm**

Rebel-S6-0.60

Payload up to **6 kg**
Max H reach of **600 mm**
Repeatability: **0.02 mm**

Rebel-S6-0.75

Payload up to **6 kg**
Max H reach of **750 mm**
Repeatability: **0.03 mm**

6 axis articulated

Racer-3-0.63

Payload up to **3 kg**
Max H reach of **630 mm**
Repeatability: **0.02 mm**

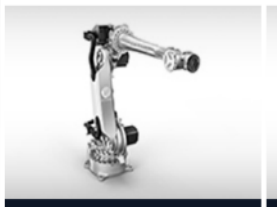
Racer-5-0.80

Payload up to **5 kg**
Max H reach of **809 mm**
Repeatability: **0.03 mm**

Racer-7-1.4

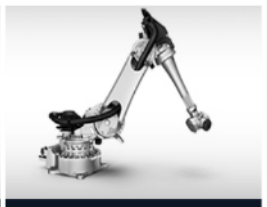
Payload up to **7 kg**
Max H reach of **1436 mm**
Repeatability: **0.05 mm**

NJ-40-2.5



Payload up to **40 kg**
Max H reach of **2503mm**
Repeatability: **0.06 mm**

NJ-60-2.2



Payload up to **60 kg**
Max H reach of **2258 mm**
Repeatability: **0.06 mm**

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autonox

- Founded in 2002, headquarters in Willstaett, Germany
- ***Unified Control*** - DELTA robot models

autonox Robotics

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OTTO Motors / ClearPath

expanding **human possibility**®

Brand clarification (previous structure)

Brand clarification (curremt structure)

RESEARCH DIVISION

INDUSTRIAL DIVISION

OTTO Material Movement Platform

Autonomous Operating System

Autonomous Mobile Robots

Unmatched Hardware Portfolio

Most Powerful Software Suite

Services and Support

OTTO MOTORS by ROCKWELL AUTOMATION

Fleet Management Software

OTTO Care & Services

Fleet Analysis Software

Rockwell Automation

Otto Motors Offering

Autonomous Mobile Robots

OTTO 100

Small and agile; perfect for human-scale loads up to 150 kg (330 lbs)

OTTO 600

Built to navigate the tightest environments with loads up to 600 kg (1,322 lb)

OTTO 1200

Built to maximize productivity in tightest space with a payload capacity of 1,200 kg (2,640 lb)

OTTO 1500

Durable for demanding applications and designed to move loads up to 1,900 kg (4,200 lbs)

OTTO Lifter

Intelligent and predictable pallet transport of loads up to 1,200 kg (2,640 lbs)