

Technologies Transforming Industrial Operations and Production Capabilities: Process Automation and Robotisation

Industry5.0

Rakvere, 14/05/2026

 **EFESO**
MANAGEMENT CONSULTANTS

The Perfect Storm

- **A once-in-a-century transformation of the operations system**
- **From lean systems to self-optimizing value chains**
- **Unlocking the next frontier of performance improvement**
- **Operating model redesign as the critical success factor**
- **A decisive window for industrial competitiveness**



“The companies that master the art of combining innovation and operational excellence will dominate their industries.”

— Jeff Immelt, former CEO, GE ”



EFESO is the leading global pure player in operations strategy and performance improvement

We unlock the full potential of businesses through operations, delivering valuable, tangible and future-proof results



Global Footprint. Local Delivery

+1,000

Results-oriented operations **specialists** with hands-on industry experience

+1,500

Projects delivered in **>75 countries** annually

45

Nationalities in **>30 offices** worldwide

Top-Tier
Return on consulting

We bring deep expertise in both industrial sectors and private equity to achieve real results

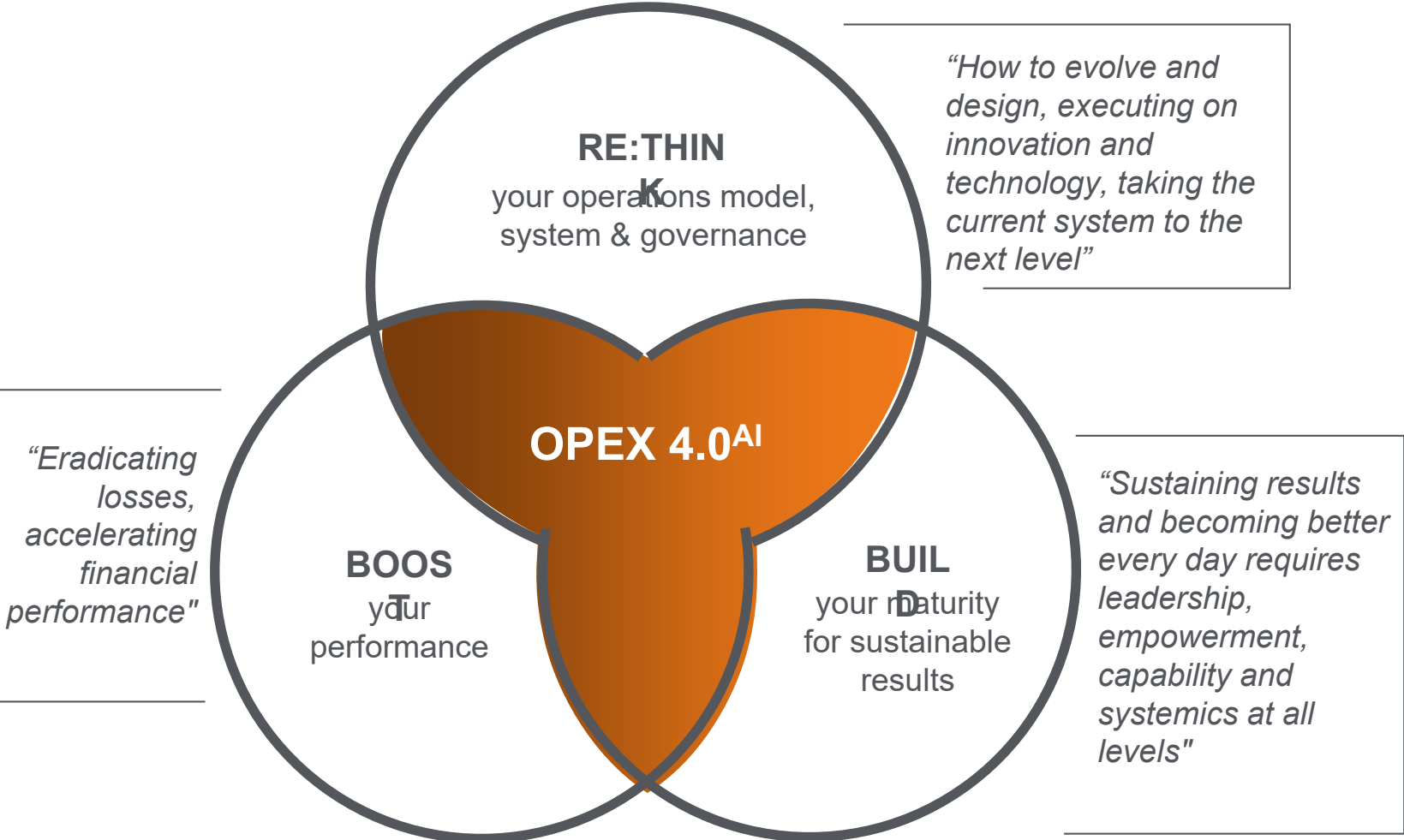
Aerospace & Defense AIRBUS EDGE LEONARDO NAVAL GROUP esa MBDA	Cosmetics L'ORÉAL CLARINS PUIG Beiersdorf ESTÉE LAUDER COMPANIES Pierre Fabre GUERLAIN PARIS	Luxury Goods FENDI HERMÈS PARIS LVMH EssilorLuxottica BUCCELLATI Milano dal 1919 Cartier	Private Equity BlackRock PAI PARTNERS AEA Platinum Equity KKR H.I.G. CAPITAL stellex ARDIAN APOLLO
Automotive & Battery RENAULT ALPINE Ferrari VW Valeo	Consumer Goods Unilever essity P&G BAT reckitt alpinestars	MedTech SureWrx OLYMPUS mi microamerics EXALTA SIEMENS	Resources Mining & Processing ArcelorMittal Novelis voestalpine Alleima FEPA VALE umicore
Building Materials BMI SAINT-GOBAIN etex	Food & Beverage PERFETTI MILKA DANONE Lindt HEINEKEN Mondelēz International HARIBO MARS Jose Cuervo	Oil & Gas, Sustainable Energy HF Sinclair SHV ENERGY orano slb TOTAL Shell	Retail ACTION Kingfisher PRIMARK MIGROS Industrie JD
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The Manufacturing Transformation (OPEX 4.0^{AI}) transformation journey involves the execution and integration of three components RE:THINK, BOOST and BUILD



The right mix of

- Innovation in execution and rethinking structures
- Boosting results and quick successes
- Building elements of an OPEX system autonomy and empowerment to ensure sustainability of results



When a robust OPEX system is supported by AI algorithms the results accelerate exponentially

Artificial Intelligence

Computer applications that mimic human behaviour

Rule Based (Old) AI

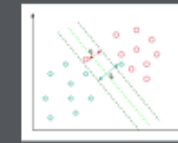
Computer applications that use human designed rules to make decisions

Machine Learning

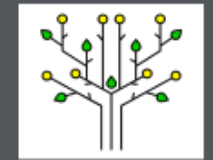
Computer applications using data to learn patterns and make associations



Reinforcement Learning



SVM



Random Forest

Deep Learning

Machine learning models using deep neural networks carrying out more sophisticated, non-linear calculations



Deep Reinforcement Learning

Trained through trial and error and using self-supervised approaches



Generative Neural Networks

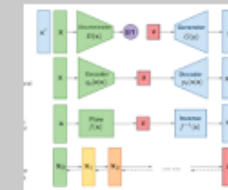
Machine learning models using deep neural networks carrying out generative tasks



Grok



ChatGPT



Image



Language

The Manufacturing Transformation journey is built up of consistently improving Value streams and processes, Human Dynamics, IT and systems architecture and Industrial AI

Industrial Artificial Intelligence

IT and systems architecture

Human dynamics

Value streams and processes

What constitutes Industrial AI

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HUMAN DYNAMICS & CHANGE MANAGEMENT
Target picture Human Dynamics

Mobilize LEADERSHIP

- Alignment of senior team
- Clarity and 'handshake' about leaders' role and contribution
- Translating higher-level goals to a level relevant for teams
- Leaders are also a target group!

Facilitate SENSE MAKING

- Availability of information and perspectives
- Role modeling interpretations supportive of projects
- Time and support for the organization to come to terms

Maintain high levels of COMMUNICATION

- Regular rhythm and special events
- Continuous information and escalation flow
- Two-way – keep listening
- Methods which reach the target groups

ENVIRONMENT AND TRACTION FOR SUCCESSFUL CHANGE

DESIGN TO SUCCEED

Top-down levers: Sense making, Dialogue, Leadership

Bottom-up levers: Involvement, Competence, Experiences

INVOLVE your target groups

- Understanding their needs and position
- Participation in shaping the changes
- News ways of working fit to their specific situation
- Decisions about implementation delegated as much as possible
- Target groups have a clear role to play / task to do

Create positive EXPERIENCES

- Prototypes and demo-versions
- Tests and pilots
- Peer-to-peer exchanges on good change practices
- Creating early successes
- Enabling target groups to claim the successes

Enable acquiring COMPETENCIES

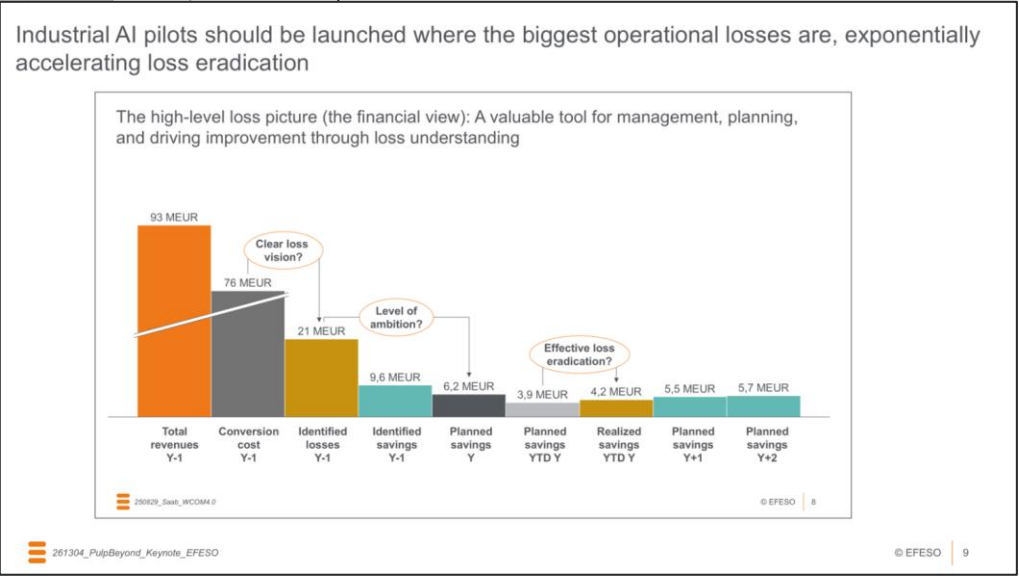
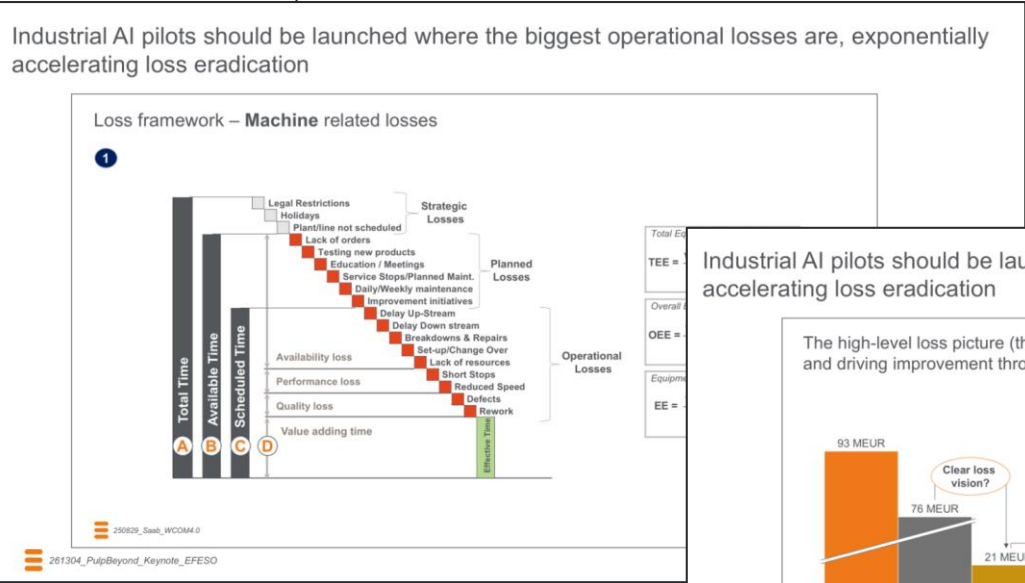
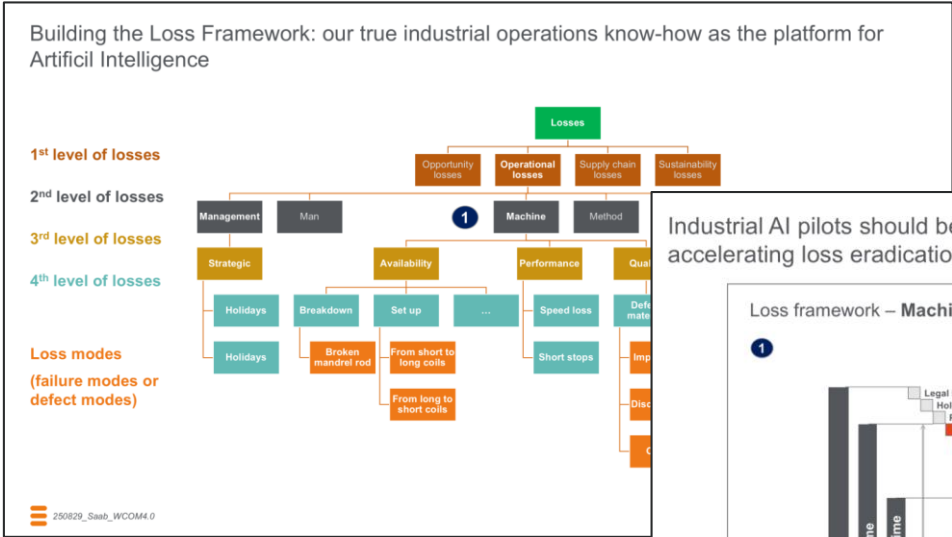
- Sufficient time and depth of learning time
- Pilny use-cases and feedback
- Establishing in-team SMEs
- Availability of support in launch phase
- Taking and responding to learnings

EFESO Human Dynamics Positioning © EFESO 7

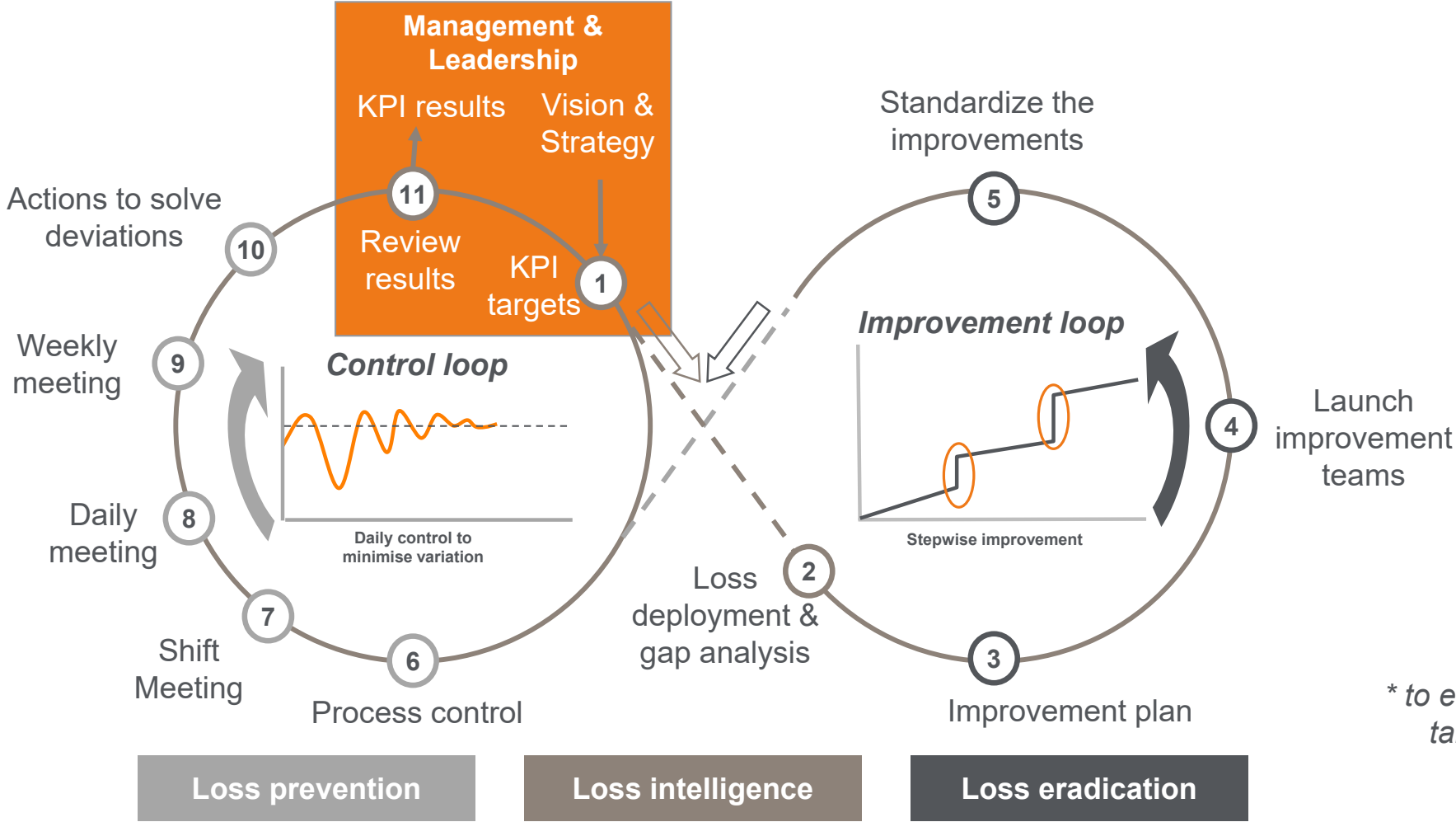
2 SOURCE 3 MAKE 4 DELIVERY

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Manufacturing Transformation should be launched where the biggest operational losses are, exponentially accelerating loss eradication

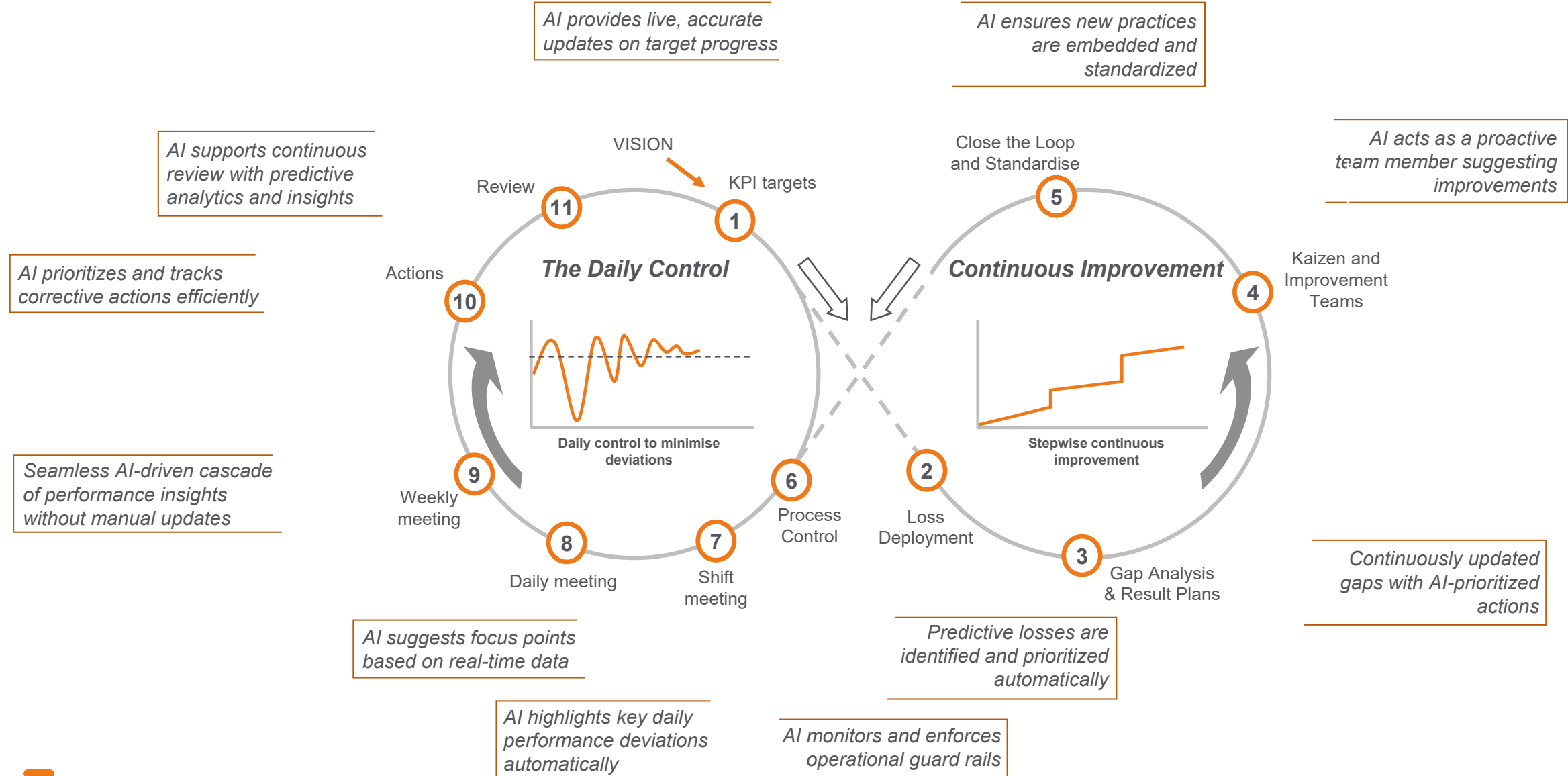


The OPEX 4.0AI transformation journey is founded in the World Class model with the Infinite Loop at the core, a system to identify-, eradicate-, and prevent losses*



* to ensure that operational targets are achieved

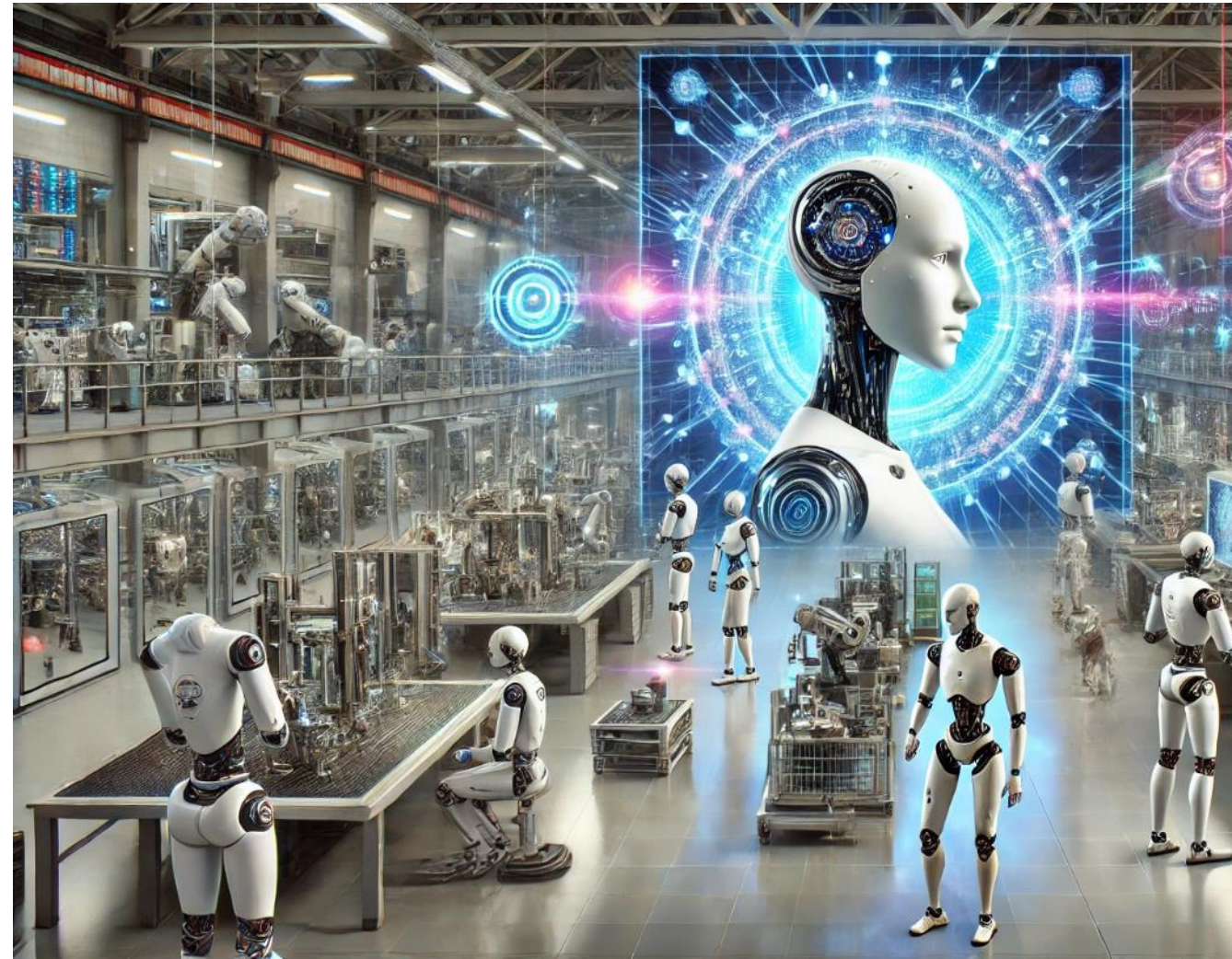
The next-gen infinite loop and OPEX4.0^{AI} system takes operations excellence from robust foundation to AI-driven automation



What is **Industrial AI** and why is it important

Industrial AI refers to the application of artificial intelligence technologies in industrial settings to improve **efficiency**, **productivity**, and **innovation** in core processes. It involves leveraging advanced AI techniques like machine learning, deep learning, and data analytics to address challenges in manufacturing, production, supply chain, and other industrial domains.

- Key features of Industrial AI include Predictive Maintenance, Quality Control, Demand Planning Process Optimization, Robotics/Automation and Digital Twins
- In EFESO's experience, Industrial AI solutions when embedded into core processes produce the quickest ROI in the coming years for Industrial Companies
- It is essential for established companies to apply wide ranging Industrial AI programs to stay competitive in the global markets
- The value creation in core processes ranges between 20-50% when implemented and scaled correctly



Global Leading Board producer:

Why continuous process industries resist darkness

Challenges of Continuous Process Industries

Continuous industries have high energy use and complex processes requiring constant monitoring to avoid disruptions.

Role of Experienced Operators

Operators rely on intuition and sensory cues to maintain stability and prevent quality or safety issues.

Limits of Full Automation

Variability and uncertainty make fully automated operation risky in highly optimized continuous processes.

Augmenting Human Roles with Intelligence

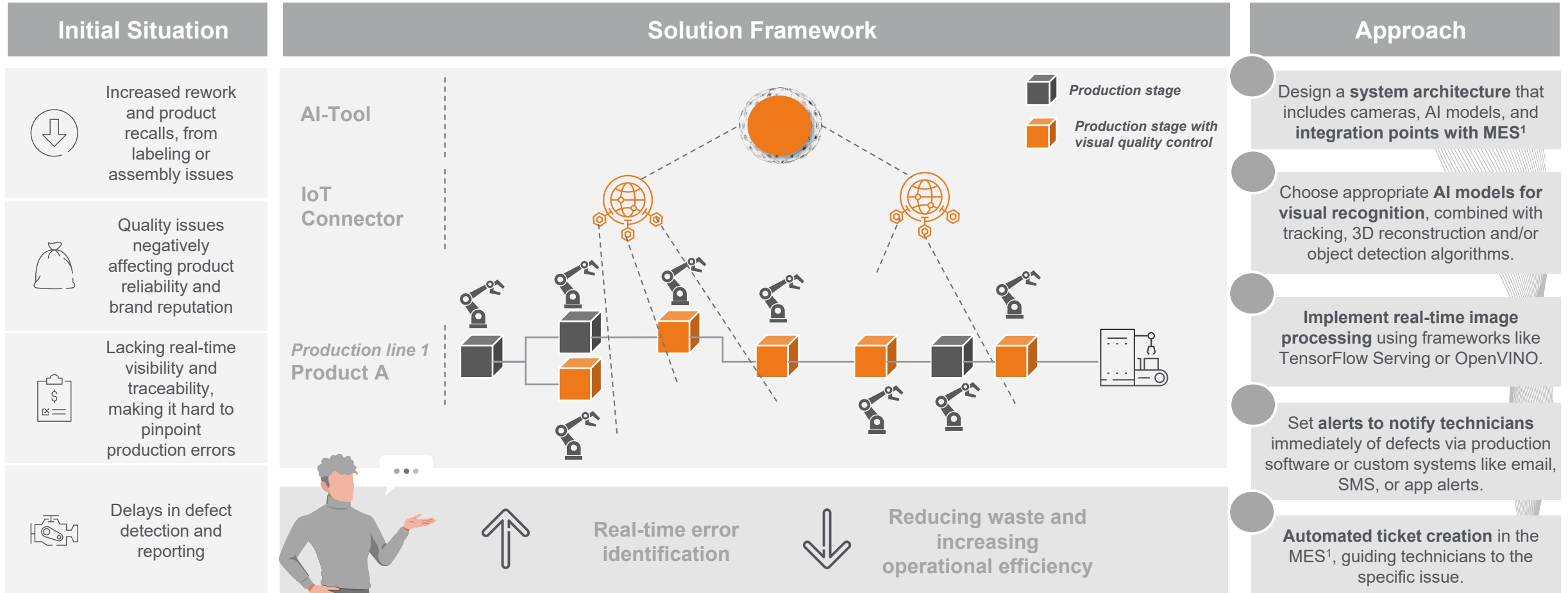
Embedding intelligence into processes replicates operators' stabilizing roles without full human replacement.



Deep Dive: **Dark Night shift for Global Leading Board Producer**

Real-Time Defect Detection and production control with AI and Computer Vision

AI-Assisted Defect Detection



Chocolate factory: The human dependency of food manufacturing quality

Human Inspection Necessity

Human inspectors ensure quality by evaluating appearance, texture, and defects under strict regulations.

Challenges of Food Manufacturing

High SKU variability and frequent changeovers complicate automation and require human accountability.

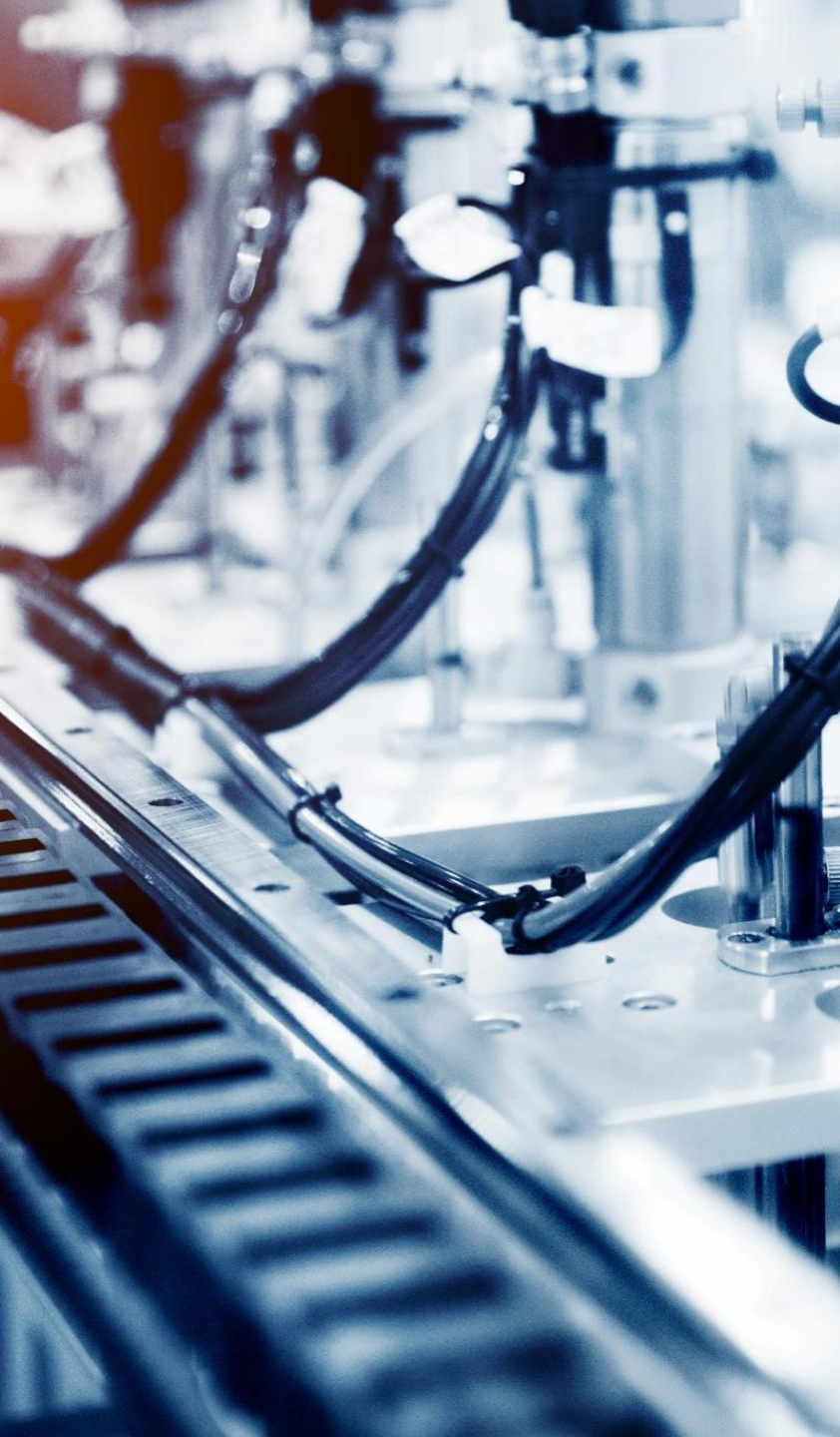
Quality Assurance and Trust

Maintaining regulatory trust demands accuracy, consistency, and explainability in quality decisions.

Limitations of Dark Factories

Without reliable machine-based quality decisions, dark factories remain impractical in food manufacturing.





Chocolate factory in 2028:

Trustable AI quality decisions enabling darkness

Predictable Quality via AI

AI to make quality predictable, replacing manual inspection with continuous inline verification.

Automated Decision Integration

AI-driven quality decisions integrate directly with execution systems for automated release or rejection.

Shifting Human Roles

Quality professionals transition from inspection to system design, data curation, and bias detection roles.

Embedded Quality Assurance

Quality assurance is embedded into production, enabling trust without continuous human oversight.



Global Truck Company, Powertrain manufacturing: Complexity in discrete manufacturing

Complex Mixed-Model Assembly

Mixed-model assembly lines create intricate dependencies and combinatorial complexity in powertrain production.

Operational Disturbances Impact

Late parts, equipment faults, and quality holds propagate rapidly, demanding constant replanning.

Planning and Coordination Challenges

Night shifts were necessary for planning and line balancing despite advanced automation technology.

Decision-Making Constraints

Dark factories are limited more by decision-making speed than task execution capability.

Global Truck Company, Powertrain manufacturing : Flow autonomy at industrial scale

AI-Driven Flow Autonomy

AI systems continuously manage scheduling, logistics, and execution to optimize industrial flow autonomously.

Predictive Bottleneck Management

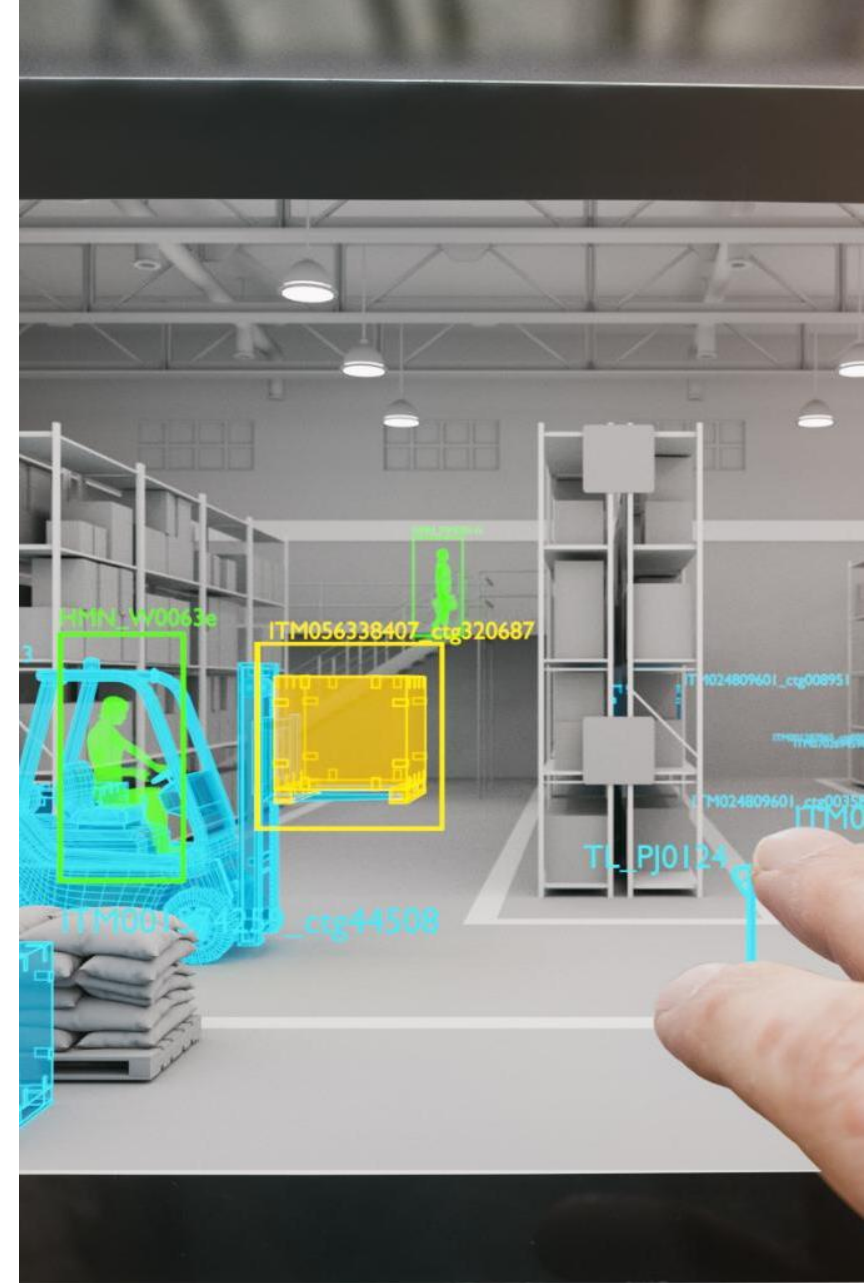
Predictive models foresee bottlenecks and disturbances, preventing disruptions before they occur.

Autonomous Logistics Synchronization

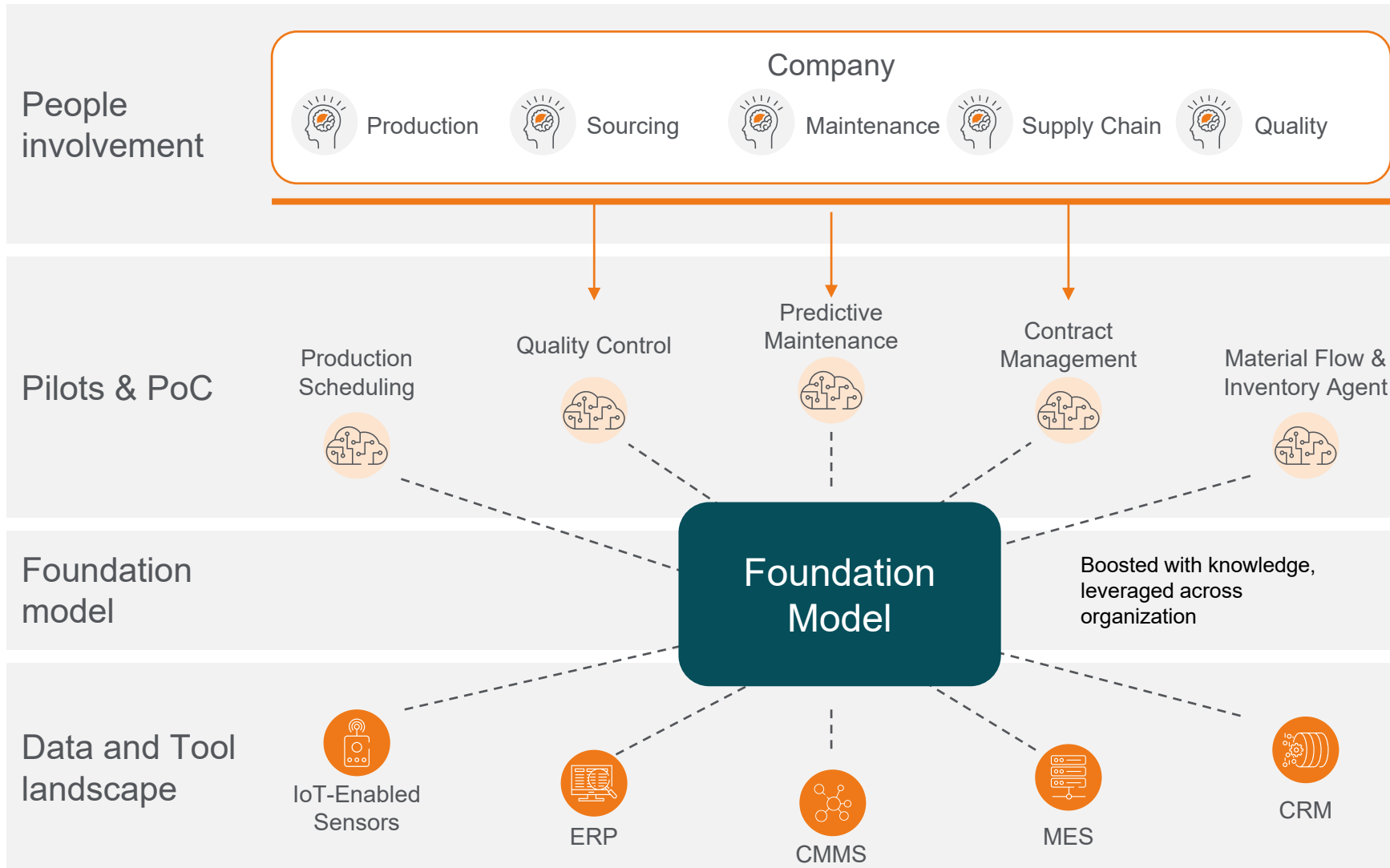
Robotics and logistics systems operate in sync with optimized plans for seamless execution.

Human Role Evolution

Planners now focus on scenario design and system tuning, intervening only in exceptional cases.



The next-generation Foundation Model driving continuous strengthening of the operating model and value creation



EXAMPLE GUIDANCE DOCUMENT:

“Group IT’s ‘Foundation Model’ platform is avoiding cash-out spent on costly ‘off the shelf’ cloud alternatives. Continued development recommended to avoid any vendor lock-in in this rapidly changing domain, keep running cost control over licenses, LLM models, as well data control regarding leakage and privacy matters.”

Functions / Use case to leverage AI	Main Losses Impacted	AI Benefit
1 AI-Based Sheet Break Prediction & Prevention (Pre-Coater + Coater)	<ul style="list-style-type: none"> Predict and prevent downtime of precision Machining and tooling equipment 	<ul style="list-style-type: none"> Machine learning models detect instability patterns minutes before a break (moisture drift, speed mismatch, edge cracks, coat weight oscillations, vibration peaks). Gives operators early warnings with the exact variables causing risk.
2 AI-Optimized Trim & Deckle Planning	<ul style="list-style-type: none"> Edge trim & standard trim Format mix & width utilization 	
3 AI for Coating Stability & Coat-Weight Optimization	<ul style="list-style-type: none"> Minor broke Coating defects (holidays, wash-ups & flushes) Off-spec start-up lengths 	
4 Automated "Golden Start-Up Curve" Generator	<ul style="list-style-type: none"> Start-up/off-spec lengths at changes Minor broke during ramp-up 	

Functions / Use case to leverage AI	Main Losses Impacted	AI Benefit
5 AI-Assisted Quality Root-Cause & Downgrade Prevention	<ul style="list-style-type: none"> Quality downgrades Surface & coating defects 	<ul style="list-style-type: none"> Learns the nonlinear relationships across 500–5000 process variables (wet end, dryers, coater, calendar, colour kitchen). Automatically identifies which variables most explain each defect type: pinholes, coating voids, gloss/roughness anomalies, porosity swings, surface streaks Provides real-time defect-risk scoring and control recommendations.
6 AI-Driven Chemical and Fibre Efficiency Optimization	<ul style="list-style-type: none"> Fibre/chemical efficiency (yield) Minor broke Coating chemical losses 	<ul style="list-style-type: none"> Predicts optimal retention aid dosing, refining intensity, sizing levels, and coating solids in real time. Suggests adjustments that maximize yield without compromising strength, porosity, or coating adhesion. Identifies "overdosing zones" that operators usually miss.
7 Predictive Maintenance for Coater, Dryer & Wet-End Equipment	<ul style="list-style-type: none"> Sheet breaks Coater/dryer-based broke Energy losses Minor coating defects 	<ul style="list-style-type: none"> Uses vibration, acoustic, thermal, and process signals to predict: roll bearing failures, dryer can steam irregularities, buildup on application rolls, misalignment of coaters, felt deterioration Triggers timely cleaning or maintenance before defects or breaks occur.
8 AI for Energy & Water Optimization (Dryers, Vacuum, Hood Systems)	<ul style="list-style-type: none"> Energy & water waste Indirectly: quality variability & minor broke 	<ul style="list-style-type: none"> Models heat, steam, and airflows to suggest minimum-energy settings for: dryer steam pressures, hood temperatures, exhaust flows, vacuum pump loading

Functions / Use case to leverage AI	Main Losses Impacted	AI Benefit
1 Vision AI for Lumber Grading & Defect Detection	<ul style="list-style-type: none"> Value loss from over- or under-grading Quality variation and customer claims Late defect detection and rework 	<ul style="list-style-type: none"> Computer vision models detect knots, splits, wane, discoloration, resin pockets, and warp in real time Predicts optimal lumber grade with consistent, repeatable accuracy Provides immediate feedback to upstream processes
2 Yield & Cutting Optimization	<ul style="list-style-type: none"> Yield loss in p Sub-optimal p Sensitivity to l 	
3 Predictive Maintenance for Critical Assets	<ul style="list-style-type: none"> Unplanned do Catastrophic e Inefficient mai 	
4 Kiln Drying Optimization & Digital Twin	<ul style="list-style-type: none"> Energy overco Drying-related over-drying) Long and varia 	

Functions / Use case to leverage AI	Main Losses Impacted	AI Benefit
5 Energy Optimization & Demand Forecasting	<ul style="list-style-type: none"> High and volatile energy costs Peak load penalties Inefficient heat and compressed air usage 	<ul style="list-style-type: none"> Forecasts energy demand and optimizes setpoints across boilers, CHP, and kilns Enables peak-shaving and smarter load planning Detects inefficiencies such as compressed air leaks or heat losses
6 Process Control with Soft Sensors	<ul style="list-style-type: none"> Quality variation and process instability Rework and downgraded products Delayed detection of process deviations 	<ul style="list-style-type: none"> Predicts critical quality variables that are difficult or impossible to measure directly Enables proactive process adjustments before quality limits are exceeded Improves process stability and consistency across shifts
7 Log Yard & Raw Material Allocation Optimization	<ul style="list-style-type: none"> Sub-optimal log allocation to production lines Yield loss driven by poor raw material matching Inventory imbalances in the log yard 	<ul style="list-style-type: none"> Predicts downstream yield and grade outcomes from incoming log characteristics Optimizes log allocation by product, line, and order demand Improves raw material utilization and purchasing decisions.
8 Production Planning & Order Promising	<ul style="list-style-type: none"> High WIP and finished goods inventory Missed or late customer deliveries Inefficient use of capacity constraints 	<ul style="list-style-type: none"> Creates constraint-aware production plans from saw line through kilns to finished goods Improves Available-to-Promise (ATP) and Capable-to-Promise (CTP) accuracy Reduces inventory while improving OTIF performance



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