Togg

THREAD IN MOTION

Transforming EV Manufacturing with Wearable AI

A Case Study in Operational Excellence: From Micro-Optimizations to Macro-Scale Enterprise Gains

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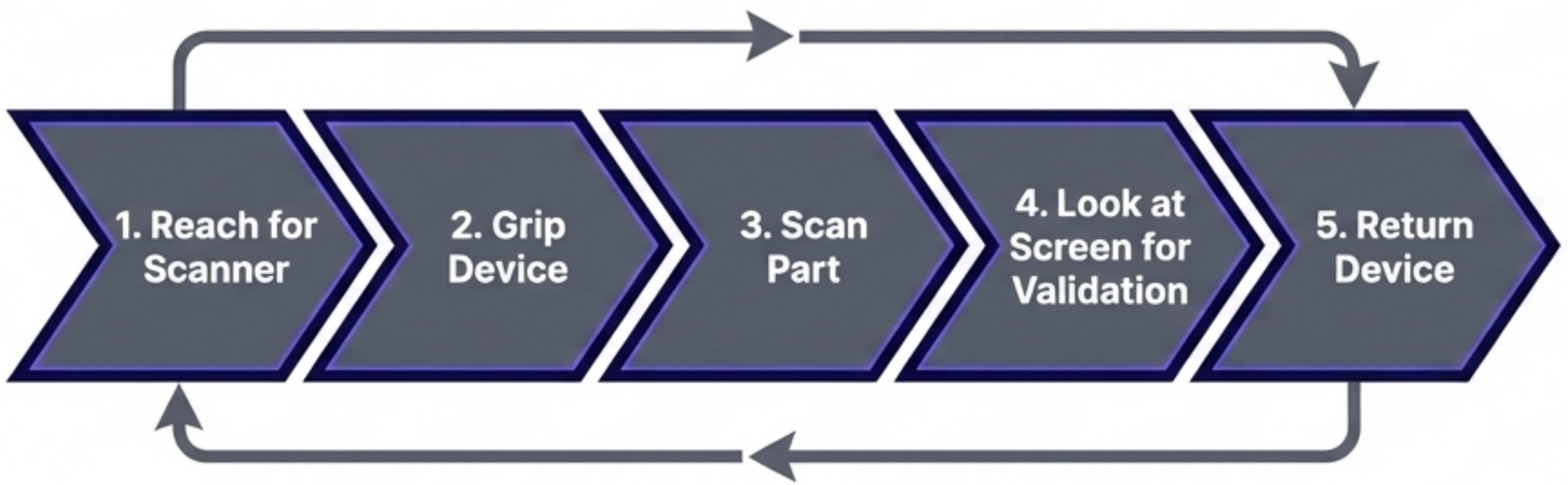
Engineering Absolute Perfection at Scale

Togg's 1.2M sqm facility represents the pinnacle of Industry 4.0, designed for an annual capacity of 175,000 zero-emission vehicles. Producing a modern EV requires orchestrating a massive logistical symphony, perfectly aligning parts Just-in-Time and Just-in-Sequence.

1.2M sqm	**Facility Size** (230,000 sqm enclosed)
5,000	**Critical parts per vehicle**
Zero	**Tolerance for Error** (Strict Just-in-Sequence manufacturing)

The Hidden Costs of Micro-Frictions

The 8-Second Legacy Cycle



Legacy Takt Time: 8 Seconds

Kinetic Interruption

Constant picking up and putting down of heavy pistol-grip scanners breaks natural biomechanical flow and introduces repetitive strain risk.

Cognitive Load

Forcing operators to look away from the physical assembly to check a separate screen for green/red light validation causes micro-delays and visual fatigue.

The Biomechanical Shift: Legacy vs. Wearable AI

Conventional Pistol-Grip Scanner		VEGA Smart Glove Ecosystem
Interrupted: Hold, Scan, Drop	**Task Flow**	**Continuous:** Seamless, hands-free integration
Screen-Dependent: High cognitive load	**Visual Focus**	**Task-Focused:** Zero visual deviation
RSI Risk: Weight isolated on wrist/grip	**Biomechanical Impact**	**Ergonomic Harmony:** Weight distributed across hand
8 Seconds per cycle	**Takt Time**	**4 Seconds** per cycle

From Manual Operations to Intelligent Automation

The Hands-Free Ecosystem

VEGA transforms operators into augmented knowledge workers. By replacing heavy handhelds with an industrial-grade conductive textile glove, the barcode scanner becomes a natural extension of the operator's thumb and index finger.

Hands-Free Picking

Operators handle tools and parts continuously without ever dropping a device.

Distributed Weight

Eliminates Repetitive Strain Injury (RSI) by shifting mass from the wrist to the back of the hand.

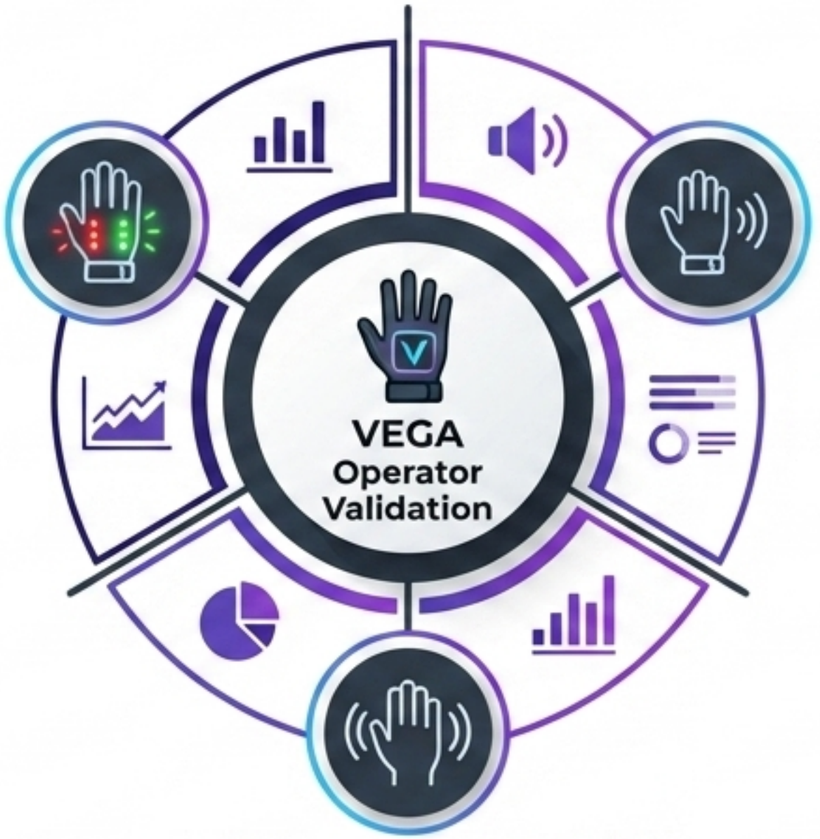
Instant Activation

Triggered by a natural thumb movement, merging digital data capture with organic physical reflexes.

Multi-Sensory Mistake-Proofing (Poka-Yoke)

1. Optic (Light)

Bright LED indicators directly on the glove module instantly confirm sequence match (Green) or error (Red).



2. Acoustic (Sound)

Distinct frequency tones confirm actions, piercing through heavy industrial ambient noise.

3. Haptic (Vibration)

Instant physical feedback to the back of the hand ensures validation is felt, not just seen.

By communicating directly with the operator's physical senses, the system eliminates reliance on external screens, enabling zero-delay error prevention directly at the source.

Resilient Connectivity Architecture

Standard communication protocols fail in heavy-metal, high-RF EV facilities. TIM bypassed Wi-Fi dead zones and massive cabling costs by integrating LoRaWAN (Long Range Wide Area Network) directly into the VEGA ecosystem.

Deep Indoor Penetration

868MHz frequency effortlessly cuts through steel structures, paint ovens, and dense factory layouts.

Zero-Downtime Integration

API bridges instantly synchronized VEGA gateways with Togg's existing MES and SAP ERP without disrupting the active assembly line.

Real-Time Bi-Directional Data

Millisecond-level sync enables instant server-side validation and command responses.

Unprecedented Operational Excellence

The Time-Scaling Multiplier

Strategic Insight: This multi-million-second operational buffer is reinvested directly into supply chain resilience, in-line quality control, and unparalleled flow stability.

Quality, Traceability, and Ergonomic Refinement

100% Digital Traceability

Every one of the 5,000 parts scanned carries an indelible digital timestamp, specific operator ID, and RTLS location data. This enables instant, bulletproof audit trails and recall compliance.

Proactive Quality Assurance

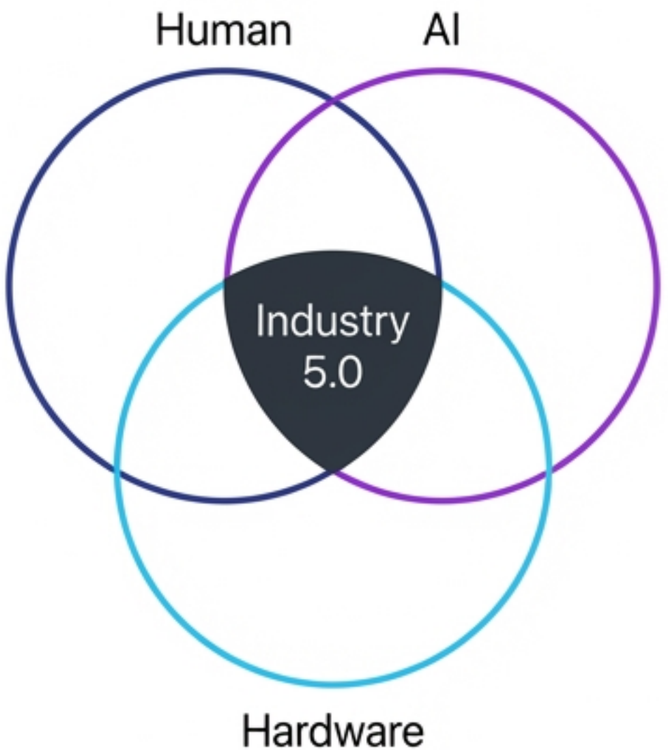
Transitioning from reactive reporting to proactive prevention. The system physically prevents an operator from installing the wrong part, embedding zero-error tolerance directly into the workflow.

Workforce Wellbeing

By returning operators to natural motion sequences and eliminating heavy terminals, physical fatigue (RSI) and visual/cognitive exhaustion are drastically reduced by shift's end.

A Strategic Step Towards Industry 5.0

Operational excellence is not a destination; it is an expanding horizon. While Industry 4.0 connected machines to data, this deployment advances Togg into Industry 5.0—where the human is placed securely back at the center of the technological ecosystem.



Core Takeaway: By augmenting operators with wearable AI, Togg has transformed its workforce into digitally-empowered knowledge workers. This cyber-physical synergy creates a future-proof manufacturing environment that marries human adaptability with machine-level precision.

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