

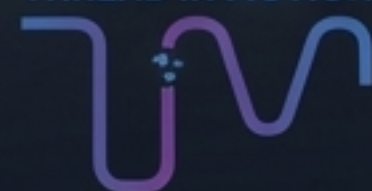


2025 STRATEGIC CASE STUDY

REDEFINING FLAWLESS MANUFACTURING

Optimizing Industry 4.0 Assembly Lines with Wearable IIoT and AI

THREAD IN MOTION



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01 INTRODUCTION | PIONEERING SMART MANUFACTURING

Automotive assembly is a symphony of logistics. With zero buffer inventory, every component must arrive precisely on time and in sequence. Ford's legacy of innovation demands a transition from traditional validation to frictionless, intelligent workflows.



Uncompromising Scale

Processing 1,500 vehicles daily, with over 500 traceable components integrated per unit.



Just-in-Sequence (JIS) Mastery

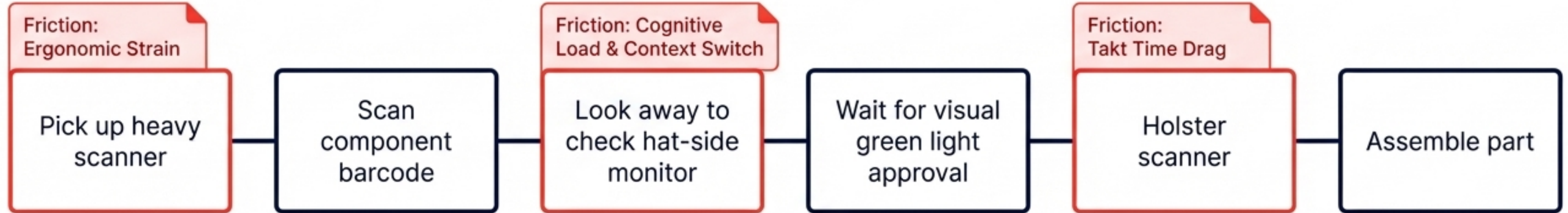
Operating without buffer inventories, demanding zero fault tolerance and split-second precision in part matching.



Industry 4.0 Vision

Investing in software-defined vehicles and advanced manufacturing to create agile, responsive, and human-centric operational ecosystems.

02 HIDDEN COSTS OF OPERATIONAL INEFFICIENCY



Takt Time Drag

A constant 4-second delay per cycle artificially caps production speed and limits line capacity.

Cognitive Load

Constant screen dependency forces mental context-switching, increasing the risk of missed visual cues.

Ergonomic Strain

Repetitive stress from gripping, lifting, and holstering conventional handheld terminals limits operator mobility.



Ultra-Lightweight Ergonomics (45g)

Replaces heavy terminals with a natural, hands-free extension of the operator's body, eliminating repetitive physical stress.

Multi-Layered Mistake-Proofing (Poka-Yoke)

Replaces screen dependency with an embedded sensory feedback loop. Delivers instant Haptic (vibration), Optic (light), and Acoustic (sound) signals directly to the user.

Frictionless Trigger Mechanism

Allows operators to scan seamlessly while naturally gripping or carrying the component, preserving continuous biomechanical movement.

Seamless IT Integration

Plug-and-Play deployment via Wi-Fi/BLE/LoRa and open APIs. Enabled **real-time synchronization** with existing MES and ERP systems, eliminating the need for complex architectural overhauls.

$$\left[\begin{array}{c} 4 \text{ Seconds} \\ \text{Saved} \end{array} \right] \times \left[\begin{array}{c} 500 \\ \text{Parts} \end{array} \right] \times \left[\begin{array}{c} 1,500 \\ \text{Cars} \end{array} \right] = \mathbf{833 \text{ Net Hours} \\ \mathbf{Unlocked \text{ Daily}}}$$

VELOCITY

4-Second Takt Time Reduction.

Eliminated the stop-and-go friction of screen checking and device holstering, compressing the overall cycle time by ~5%.

CAPACITY

833 Hours Unlocked Daily.

3,000,000 seconds of net operational time recovered, allowing the integration of higher-value assembly tasks without increasing headcount.

QUALITY

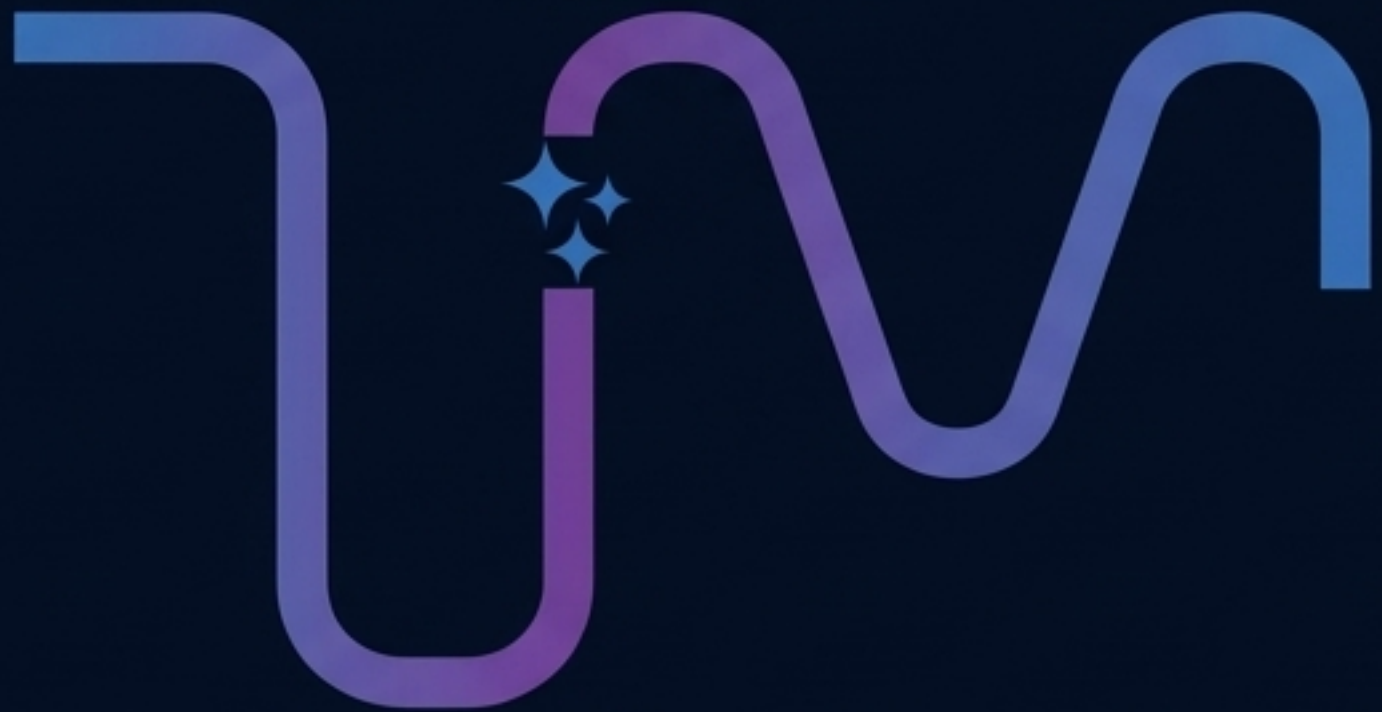
First-Time-Right Maximized.

Active haptic and acoustic interventions stop incorrect assemblies before they happen, effectively driving screen-dependency errors to 0%.

| | Traditional | Intelligent Automation |
|-------------------|---|---|
| Cycle Flow | Fragmented (Pick up, scan, check, drop) | Continuous & Fluid (Hands-free, in-motion scanning) |
| Validation Method | Visual Screen Dependency (High cognitive load) | Multi-Sensory HMI (Haptic, acoustic, optic reflexes) |
| Error Prevention | Reactive (Errors caught after visual miss) | Proactive Poka-Yoke (Physical intervention blocks the error) |
| Workforce Impact | Restricted mobility, repetitive strain | Maximum ergonomic efficiency, augmented capabilities |

“True Industry 4.0 does not replace the human worker—it augments them. By removing cognitive and physical friction, Ford and TIM have set a new benchmark for operational excellence and worker welfare.”

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