The Amnesiac Machine: Institutionalizing Shop-Floor Intelligence Through Human-Machine Co-Evolution

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What has been the greatest loss in the manufacturing over the past decade?

Knowledge

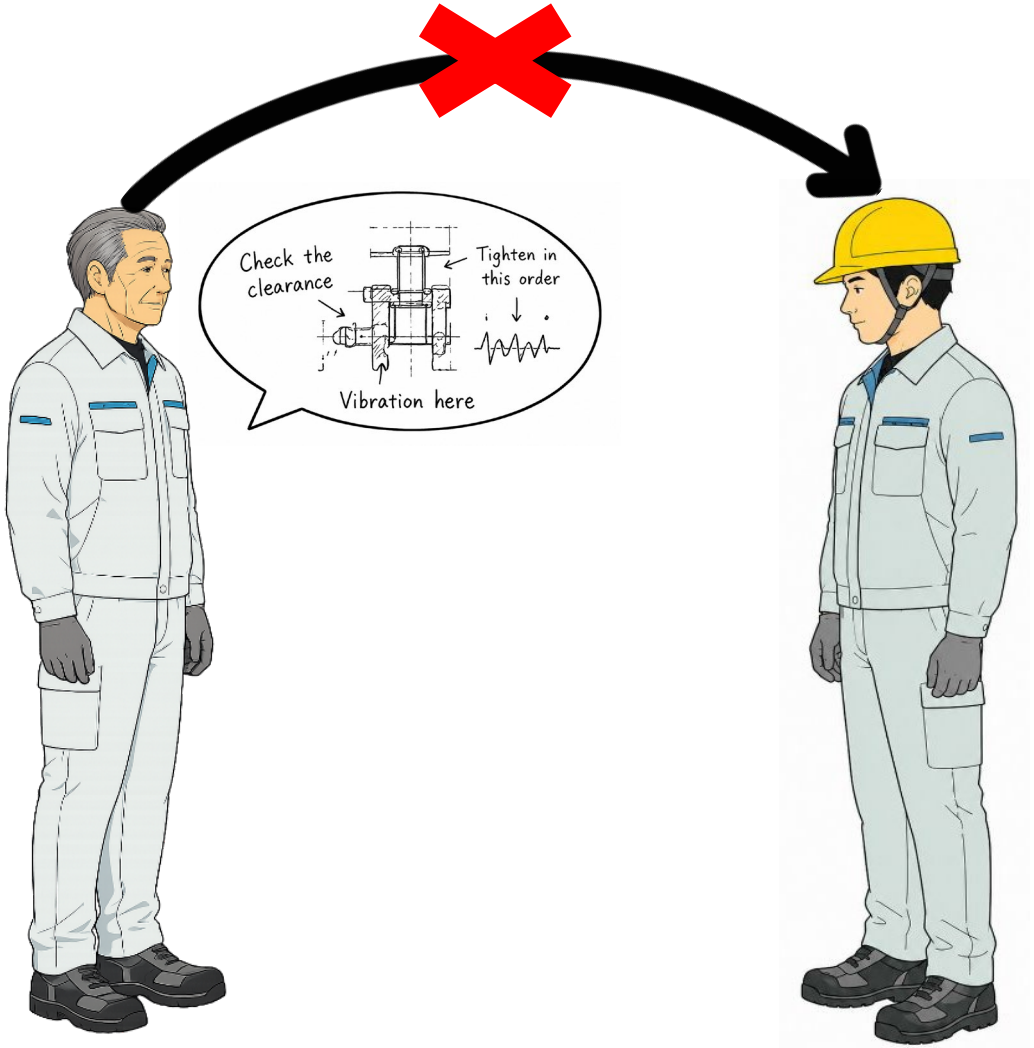
Materials

Equipment

Biggest Loss: Retiring Workers Experience

30 Years of Expertise

Retirements



Novice Worker

Not Enough Experience

"We are in the early stages of the largest retirement-driven workforce turnover in our nation's history."

Jason Fichtner, Alliance for Lifetime Income (2024)

A National Grand Challenge

10k+

Daily Skilled Retirements in U.S.

$2.5T

Productivity Risk

Zero

Persistent Memory Layer

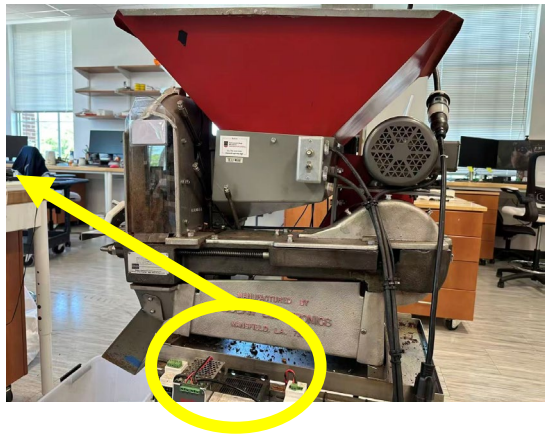
How do we protect and retain human knowledge, instead of losing it forever?

Beyond the Machines

Industry 4.0

This led to the interaction between machines and systems.

IOT Sensors and Equipment



Industry 5.0

Improving the interaction between humans and machines

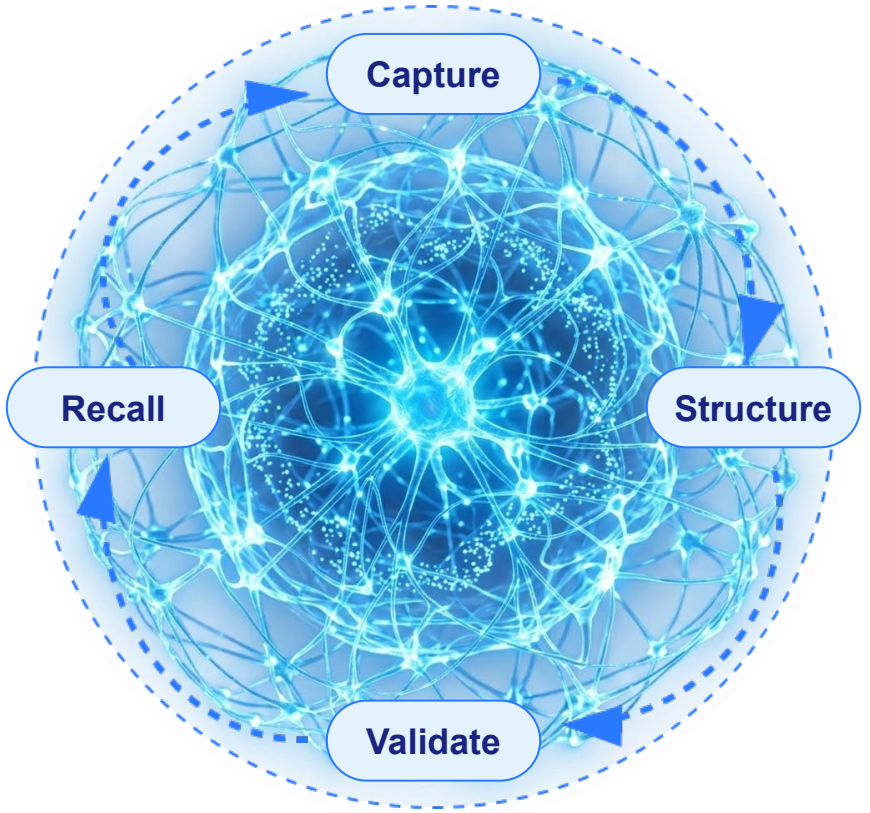
Industry 4.0 advanced the intelligence of our machines;
Industry 5.0 restores the human to the heart of the operation

Our Proposal: Machine Memory Layer

Human Expertise

- Fault
- Judgment
- Fixes
- Knowledge

Machine Memory Layer



Accumulated Factory Knowledge

- Reusable Factory Knowledge
- Faster troubleshooting
- Cross-machine knowledge transfer

The Machine Memory Layer makes human knowledge durable, transferable, and cumulative.

Example: Experience for Interaction

1. The machine embodies the expertise of its operator

2. Fault occurs again

3. System recalls a validated case

4. Novice worker fixed

Past years' experience

Novice can use experience now

Example: Experience for Interaction

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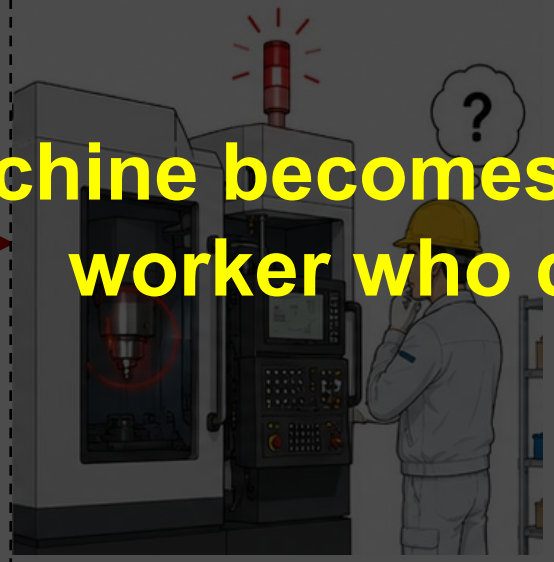
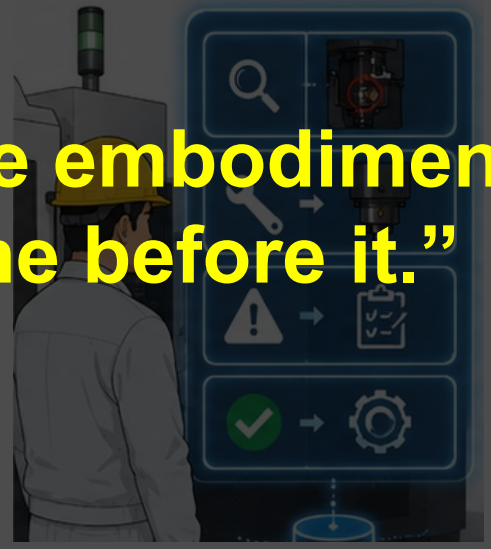


3. System recalls a validated case



4. Novice worker fixed

“The machine becomes the embodiment of every worker who came before it.”

Past years' experience

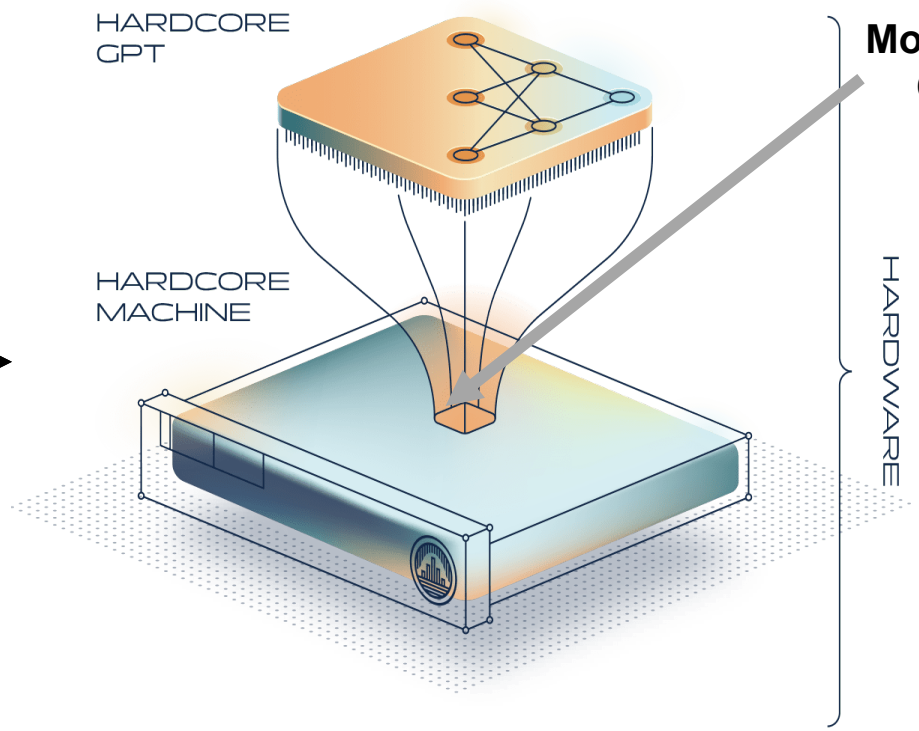
Novice can use experience now

The Technology Is Almost Ready

Semantic Information

VLM

Visual Information



Model Compiled Into Custom Silicon

Experience and Memory

Fast Inference, Low Power, Low Cost, and Low Latency

Observe and learn workers' experience through the use of models.

Where Disciplines Converge

From Research to Reality

1

Scientific

Formal Framework

New evaluation metrics

Opens a new research field

2

Industrial

Factories that compound Intelligence

New CHIPS Act facilities

Supply chains

3

Societal

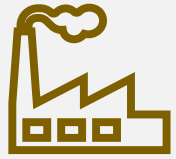
Every retirement stops being a knowledge extinction

Less experienced worker develop

U.S. manufacturing competitiveness

National and Global Impact

1



$39B

Reshoring competitiveness

2

$210B

Supply chain resilience

3

$3.5M

Workforce development

4

$2.74

Federal research infrastructure

Thank you!

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