

AINC

AI-Native Control

From manufacturing intent to manufacturing results, putting manufacturing decisions into a closed-loop system that is understandable, executable, and feedback-capable.

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1. Problem Definition

Today's manufacturing systems can repeat machine tool actions, but manufacturing decisions still rely heavily on personal experience, document transfer, and manual confirmation.

The manufacturing industry has already digitized "how to move". The next step is to digitize "why manufacture this way, how to verify, and how to improve based on results".

- **PROBLEM 01: Knowledge relies on individuals.** Process experience usually resides in the judgment of engineers and senior technicians. Experience is difficult to replicate across personnel and hard to accumulate continuously.
- **PROBLEM 02: Equipment lacks unified semantics.** Different brands, controllers, and kinematic structures use different interfaces. It is difficult for the system to have a unified understanding of machine capabilities and constraints.
- **PROBLEM 03: Results cannot flow back.** Machining status, quality results, and anomaly records do not stably enter the next manufacturing decision.

2. Boundaries of Existing Solutions

CNC, CAM, Industrial Internet, and AI Agents all solve important problems. They each cover a segment of the chain, but none uniformly defines the complete closed loop from manufacturing intent to manufacturing results.

Existing Solution	What it solves	What it lacks
CNC	Controls machine tool movements according to programmed instructions.	Does not understand manufacturing intent, nor does it continuously accumulate manufacturing knowledge.
CAM / AI CAM	Generates or optimizes toolpaths and machining files.	The output is usually still just a file. Machine semantics, on-site execution, and result feedback do not necessarily form a closed loop.
Industrial Internet / MES	Connects equipment, data, and business processes.	Connection itself does not equate to manufacturing decision-making, nor does it necessarily generate and verify process plans.
AI Agent	Performs reasoning, planning, and tool calling.	General-purpose Agents do not automatically possess machine semantics, equipment authorization, or physical verification capabilities.

3. AINC Proposal

AINC (AI-Native Control) is a manufacturing system form. It places manufacturing intent, manufacturing decisions, equipment execution, and machining results on the same information chain.

Humans express manufacturing intent, AI forms and verifies manufacturing plans, the system executes tasks within authorization and safety boundaries, and the results improve the next decision.

This path is supported by three foundational capabilities:

- **Machine Understanding:** The system can use unified semantics to describe machine identity, capabilities, status, constraints, tasks, and results. (Machine API is the interface direction).
- **Manufacturing Intelligence:** The system can understand manufacturing intent, generate plans, execute verification, and structure manufacturing knowledge.
- **Physical Feedback:** The system can connect to on-site equipment, execute authorized tasks, collect machining results, and write the results back to subsequent decisions.

4. AINC System Boundaries

Name	Definition	Judgment Method
AINC System	A manufacturing system formed by machine understanding, manufacturing intelligence, and physical feedback.	The system can understand tasks, form and verify plans, connect equipment, record results, and improve subsequent decisions.
AINC Machine Node	Physical machine tool nodes connected to the AINC System.	The node has a verifiable identity, machine capability description, edge access, and a controlled execution path.

5. Relationship between AINC and CNC

AINC is not about "adding an AI function to CNC". AINC focuses on the upward shift of control responsibility: expanding from merely executing programs to understanding manufacturing tasks, forming decisions, and continuously utilizing results.

System	Primary Responsibility	Boundaries
CNC	Interpolation, servo, interlocking, and machine tool motion control.	Not responsible for manufacturing intent and cross-task knowledge closed loops.
AINC	Enhances and assists manufacturing decisions, connects equipment, and utilizes machining results.	Does not replace CNC's motion control and safety interlocking responsibilities.

6. Future Outlook

The ultimate form of AINC is: Humans only express what to manufacture, along with quality, cost, delivery time, and safety constraints; AI is responsible for generating and verifying manufacturing plans; the system completes execution within authorization boundaries, and leverages results for the next decision.

Stage	System Form	Human's Role	AI's Role
Assisted Decision	AI participates in process planning and parameter recommendations.	Reviews the plan and decides whether to execute.	Generates recommendations.
Closed-Loop Intelligence	The system connects machines, executes tasks, and writes back results.	Sets rules, handles exceptions.	Generates, verifies, and improves manufacturing plans.
Intent-Driven Mfg.	Manufacturing tasks enter the system via intent, and the system forms executable results.	Expresses goals, authorizes execution, assumes ultimate responsibility.	Understands intent, generates plans, verifies correctness, and continuously optimizes.

Appendix: Capabilities and Glossary

A. AINC Capability Dimensions: N1–N6

No.	Capability	Brief Definition
N1	Intelligent Decision	Generates or selects manufacturing decisions based on manufacturing intent and constraints.
N2	Edge Execution	Connects equipment on-site, executes authorized tasks, and returns results.
N3	Machine Semantic Interface	Uniformly describes machine identity, capabilities, status, constraints, tasks, and results.
N4	Learning Closed-Loop	Records execution and quality results, and uses them for subsequent decisions.
N5	Open Ecosystem	Allows third parties to provide capabilities within interfaces and permissions.
N6	Machine Trust	Provides identity, authorization, traceability, and audit capabilities.

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Disclaimer: This white paper proposes the framework for the AINC manufacturing system category. Specific product capabilities, safety capabilities, and engineering adaptations are subject to actual verification results. This document does not constitute an industry standard, product certification, performance guarantee, or machining result quality guarantee.