SWTEST ASIA

Probe Card Maintenance with Artificial Intelligence Assistance System

MPI CORPORATION

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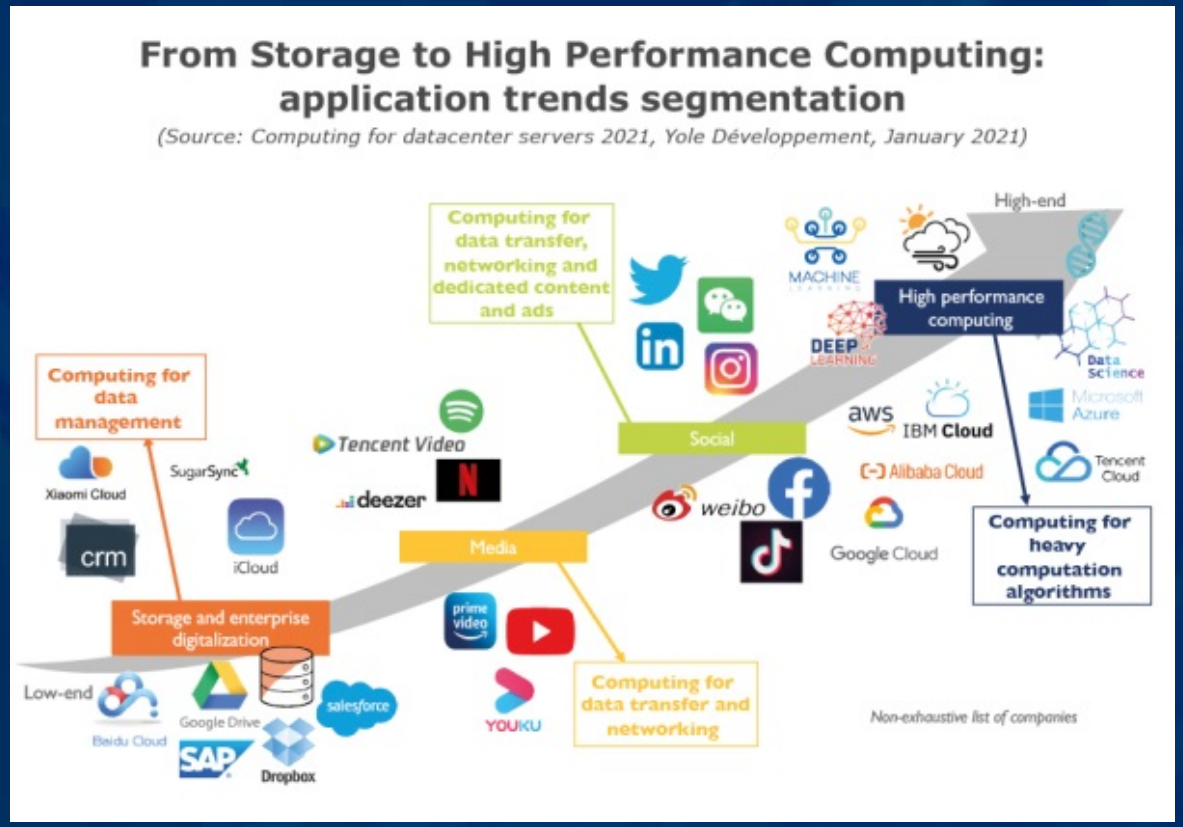
Outline

- IoT、Data Center and AI Effect to Chip Probing
- Bottleneck of Probe Card Maintenance
- Benefits of Artificial Intelligence Assistance System
- Artificial Intelligence Assistance Methodology
- Summary

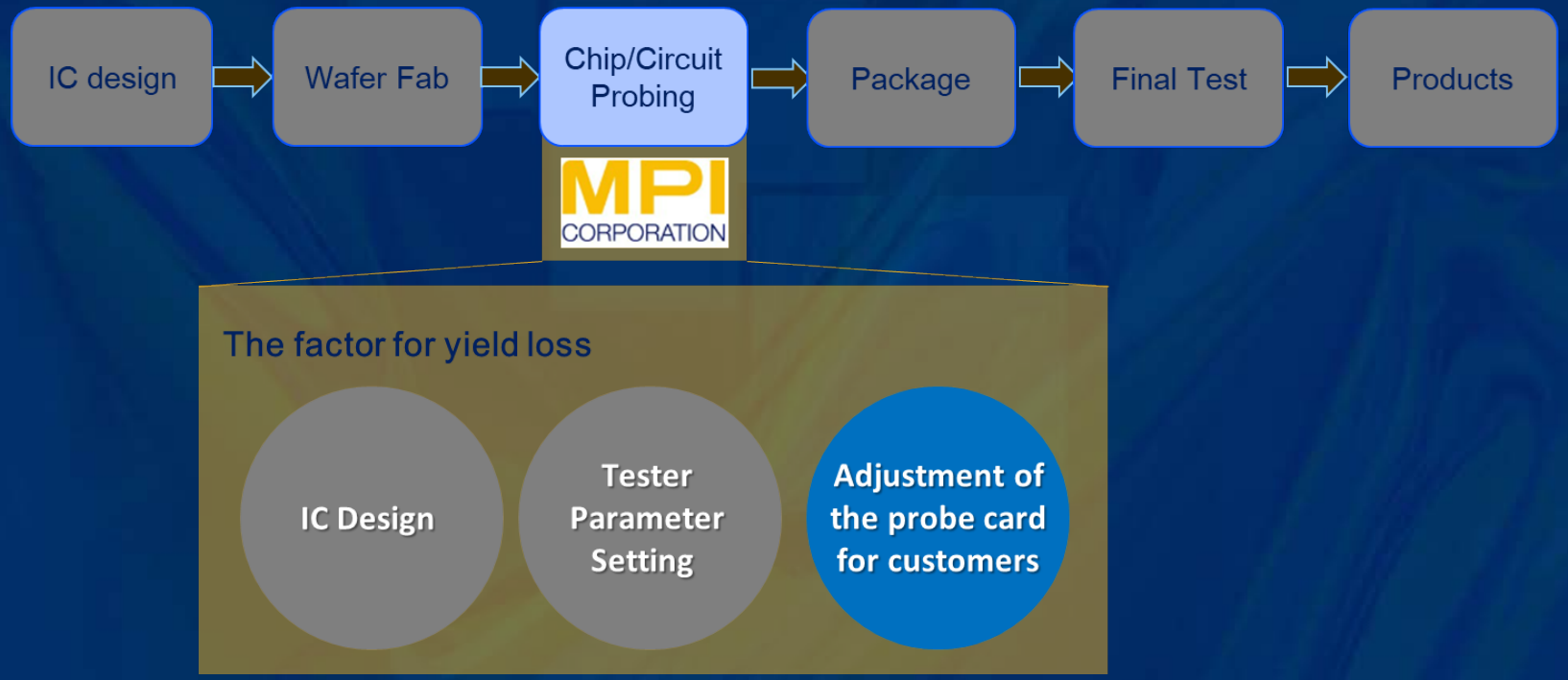
IoT、Data Center and AI Effect to Chip Probing

- **With the development of technologies such as IoT, Data Center and AI, the terminal applications of integrated circuits have become more diverse, which has also led to an increase in the complexity of chip probing.**



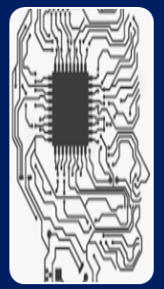
IoT、Data Center and AI Effect to Chip Probing

- In the face of increasing test complexity, the entire test system of integrated circuit still has many adjustments to be made in the test function design and the tester parameters and usage settings.
- If the combination is not good, yield loss or even loss will occur in the test. It cannot be tested, so the probe card manufacturer must adjust (repair) the probe card to assist customers in smooth mass production troubleshooting.



Bottleneck of Probe Card Maintenance

- No easy to train maintenance personnel with multiple professional abilities.
- Due to know-how and business secrets, the tester program is locked, causing the testing factory to be unable to provide accurate abnormal information.
- How to reduce the timeliness and improve the accuracy of repairing abnormal probe cards is very challenging.

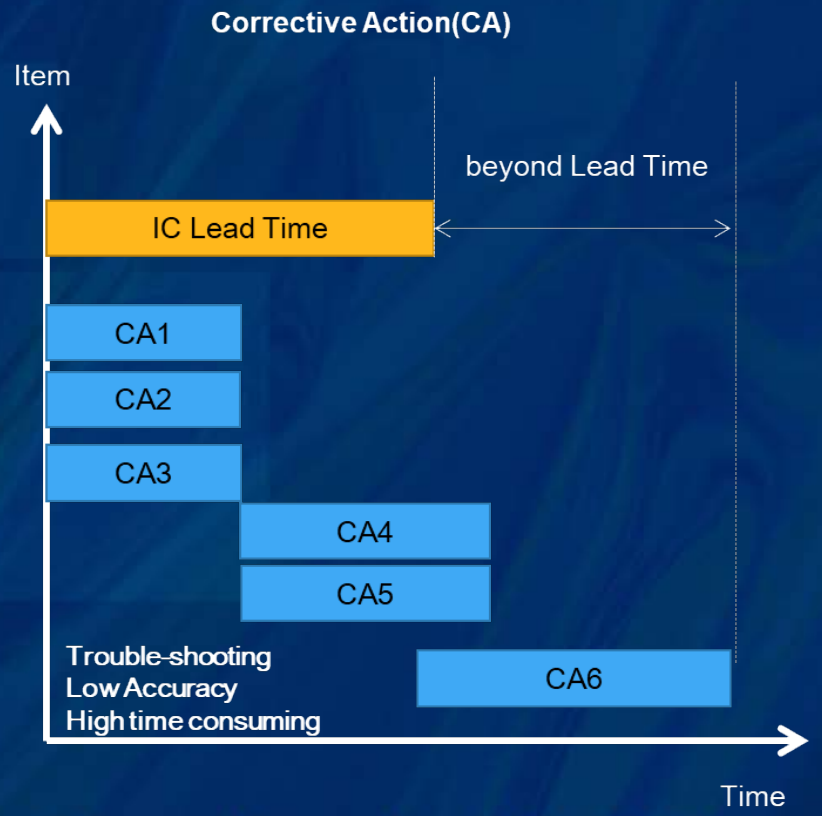


Not easy to train personnel

- Personnel with Diverse professional abilities in the use of mechanical/electrical/tester hardware and software

Information Lacking

Due to know-how and business secrets, the program is locked, causing the testing factory to be unable to provide accurate abnormal information.



Benefits of Artificial Intelligence Assistance System

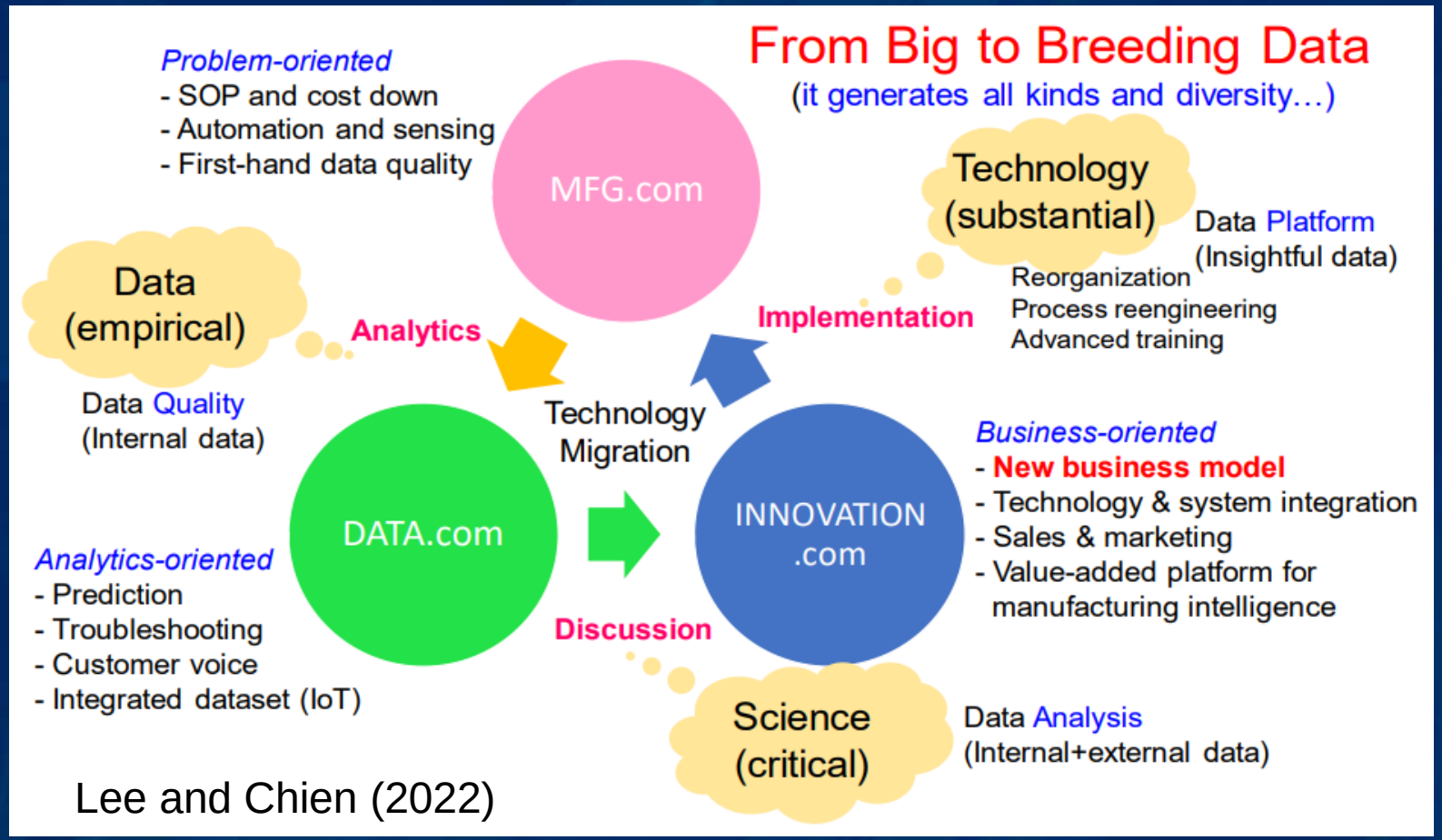
- **With only 0.5 years of training time, maintenance personnel can propos the 60% overall accuracy of corrective action.**

Maintenance Personnel
First Time Right

Overall Accuracy 60%
with Only 0.5 Years Training

Data Health Check-up

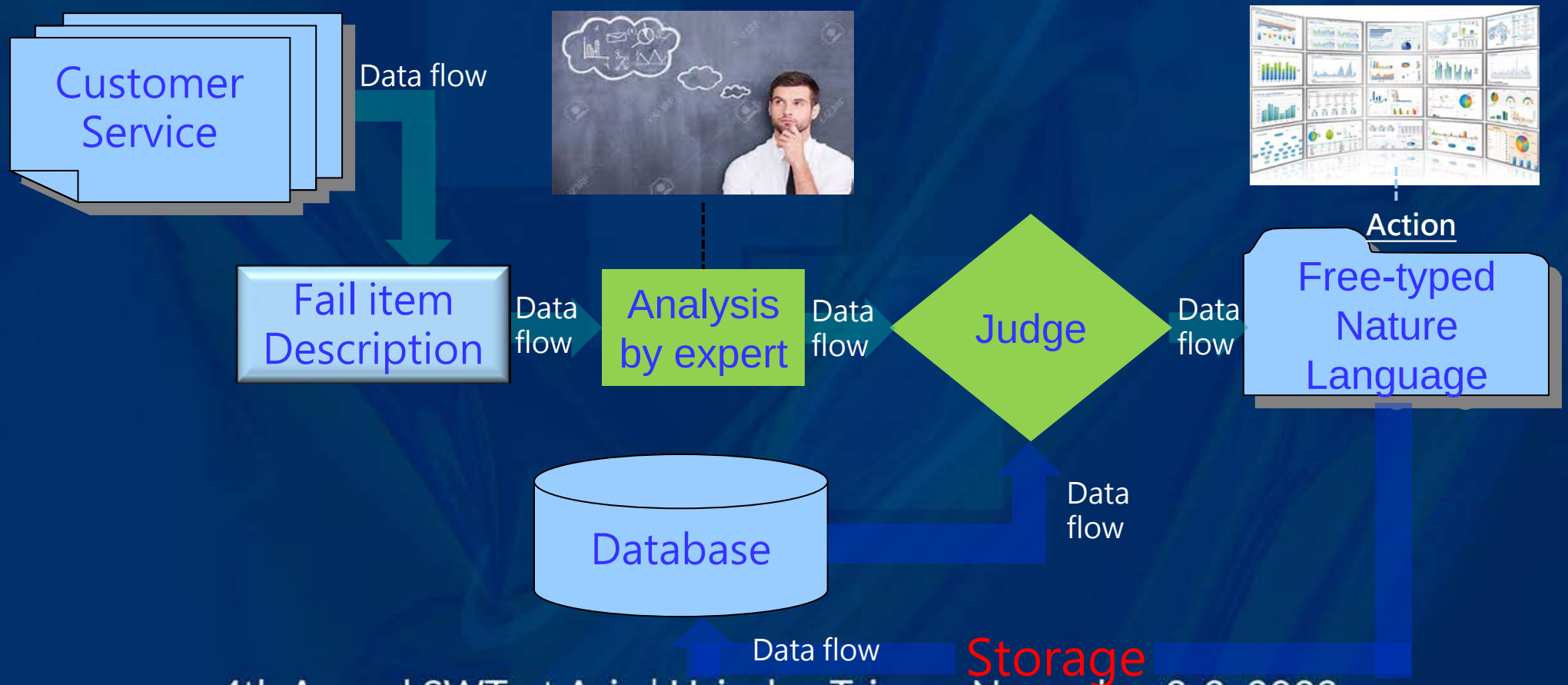
- **Begin with the end in mind! How data is used determines data value as well as IT system design.**
- **Analytic-oriented IT system design: collecting data for analytic purposes, under the existing operation process.**



Lee and Chien (2022)

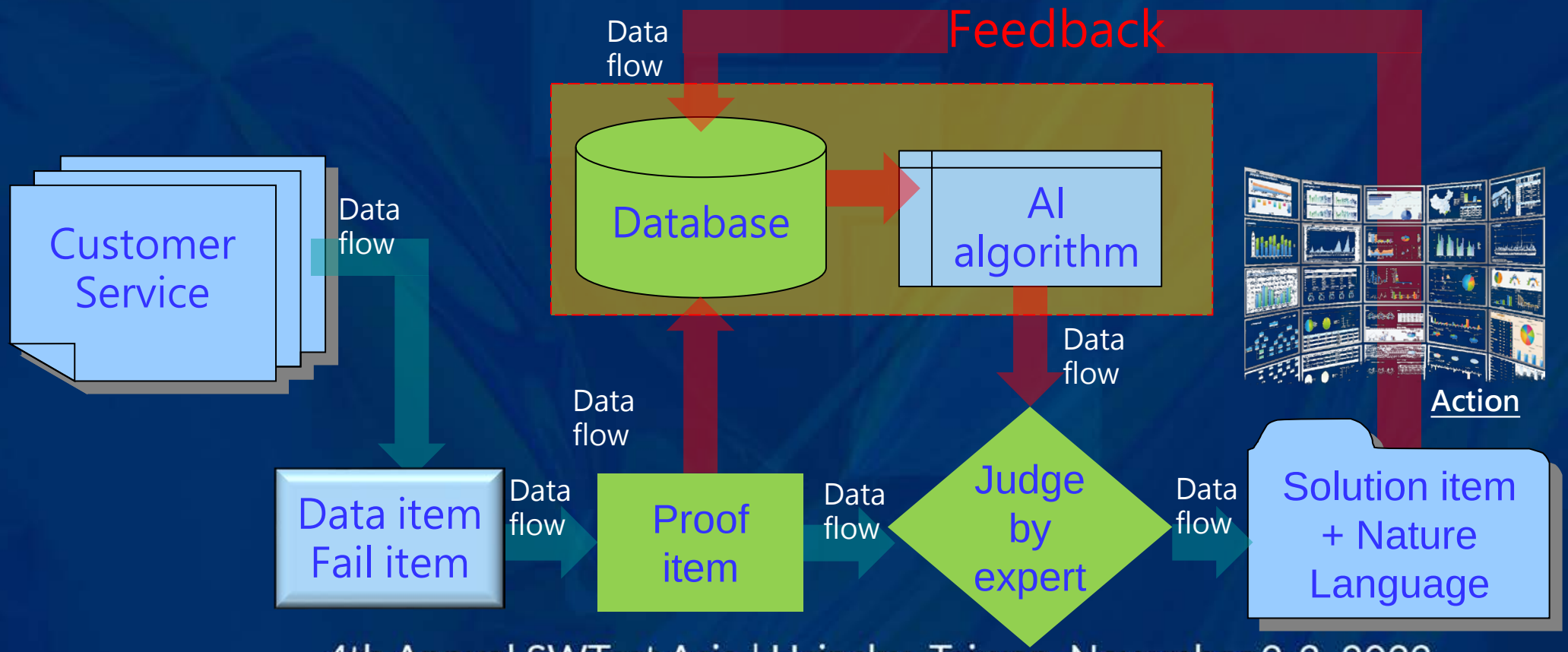
MPI Digital Transformation (MFG.com)

- **Data collected from the IT system is unstructured and only for domain expert judgment and operation purposes.**



MPI Digital Transformation (DATA.com)

- **Structured data is now used for constructing the MLBI algorithm to provide effective solutions in a few seconds.**



Multi-labeled Bayesian Inference (MLBI)

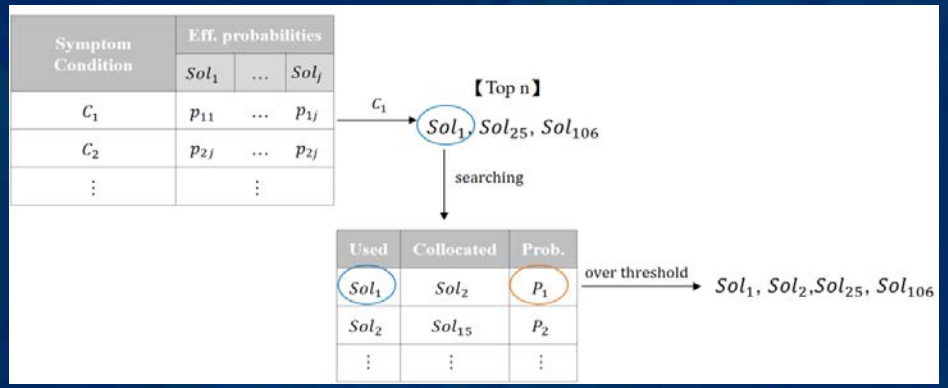
- **Calculating effective probabilities of maintenance actions under different abnormal conditions and collocated probabilities of two different maintenance actions**

Condition	Sol_1	Sol_2	…	Sol_j	Eff. Level
C_1	$u_{11} = 1$	u_{12}	…	u_{1j}	$r_1 = 1$ (effective)
C_2	$u_{21} = 0$	u_{22}	…	u_{2j}	$r_2 = 0.5$ (half effective)
C_{76}	u_{31}	u_{32}	…	u_{3j}	$r_2 = 0.01$ (non effective)
.	.	.	.	.	.
.	.	.	.	.	.
.	.	.	.	.	.
C_{xxx}	u_{N1}	u_{N2}	…	u_{Nj}	r_N

$$P(Sol_j|C_k) = \frac{P(Sol) \cdot P(C_k|Sol_j)}{P(C_k)}$$

$$P(Sol_a|Sol_b) = \frac{P(Sol_a) \cdot P(Sol_b|Sol_a)}{P(Sol_b)}$$

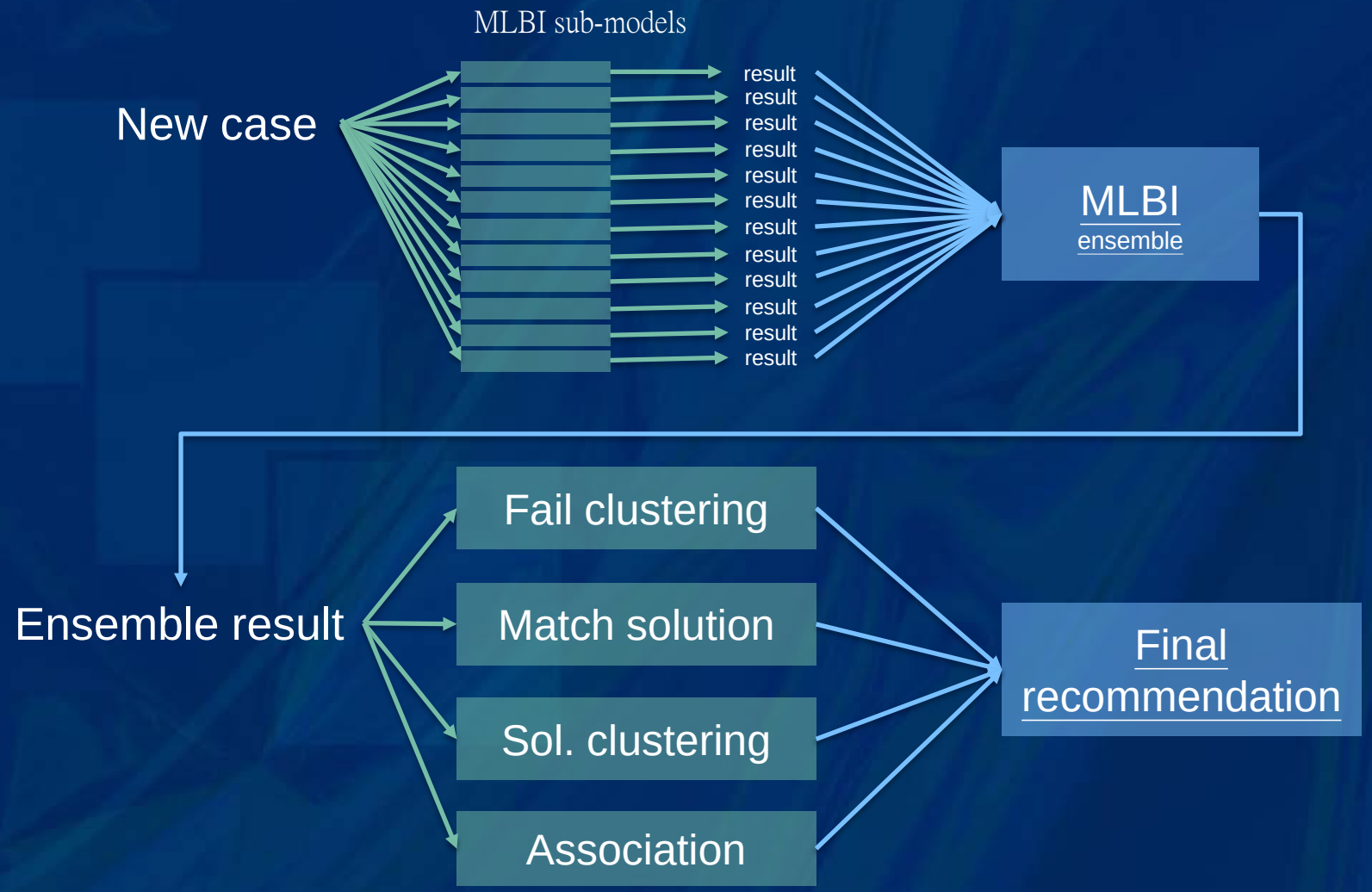
- **Predict the data that inputs certain symptom condition**
  1. suggests a certain number of maintenance actions with top n effective probabilities
  2. searching the suggested maintenance actions from (1) having collocated actions or not (over threshold)



Chien and Wu (2022)
Fu, Chien, and Tang (2022)

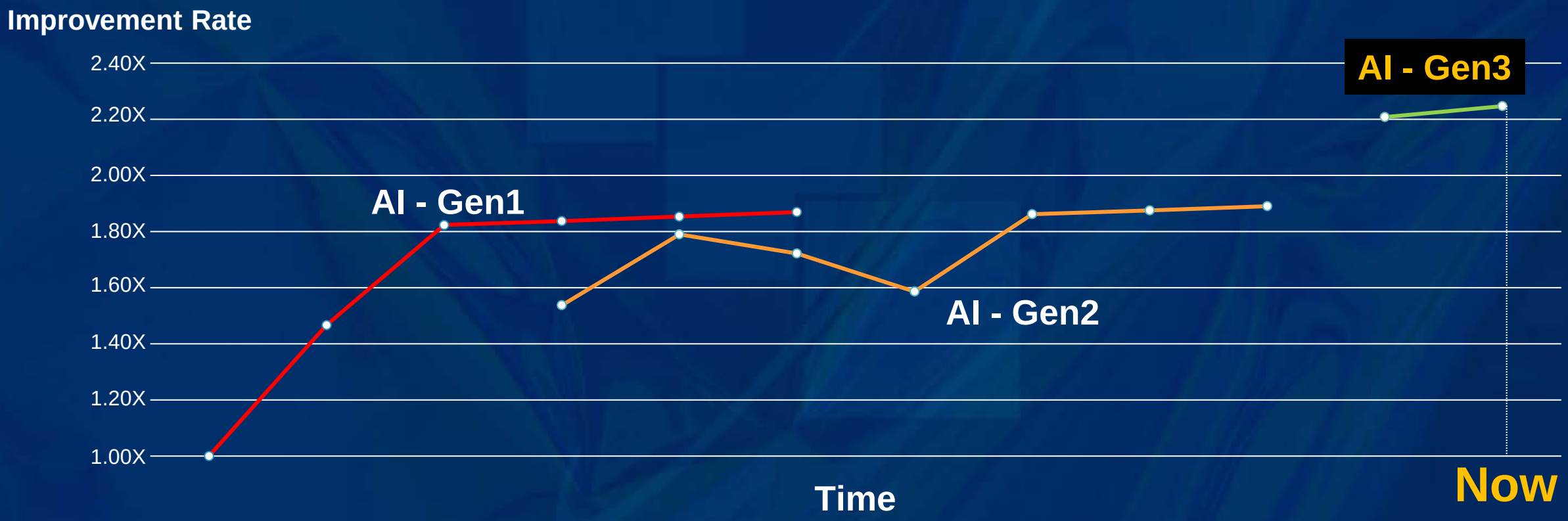
AI recommendation for Probe Card Maintenance

Sub-modules	Sub-models
A	M_I1
	M_I2
	M_I3
	M_I4
B	M_D1
	M_D2
	M_D3
	M_D4
C	M_F1
	M_F2
	M_F3
	M_F4
D	M_A1
	M_A2



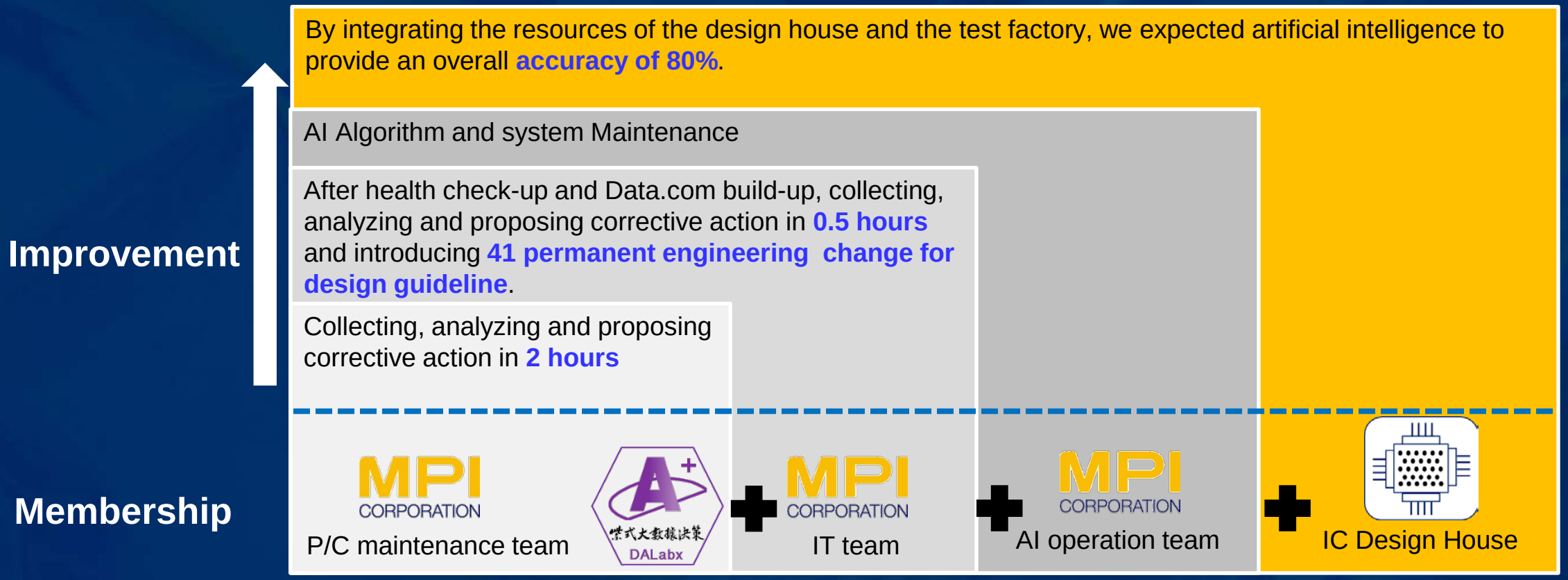
Accuracy Improvement Rate Ramping

- After data health check-up, accuracy improvement rate of AI-Gen1 model ramps up 1.87X.
- Accuracy improvement rate of AI-Gen3 ramps up from 1.87X to 2.25X because of good data accumulation and model structure improvement.



Summary

- **Our AI assistance system can propos 60% accuracy of corrective action in 0.5 hours.**
- **For higher overall accuracy, we expected artificial intelligence to provide an overall accuracy of 80% by integrating the resources of the design house and the test factory.**



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Questions

Reference

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