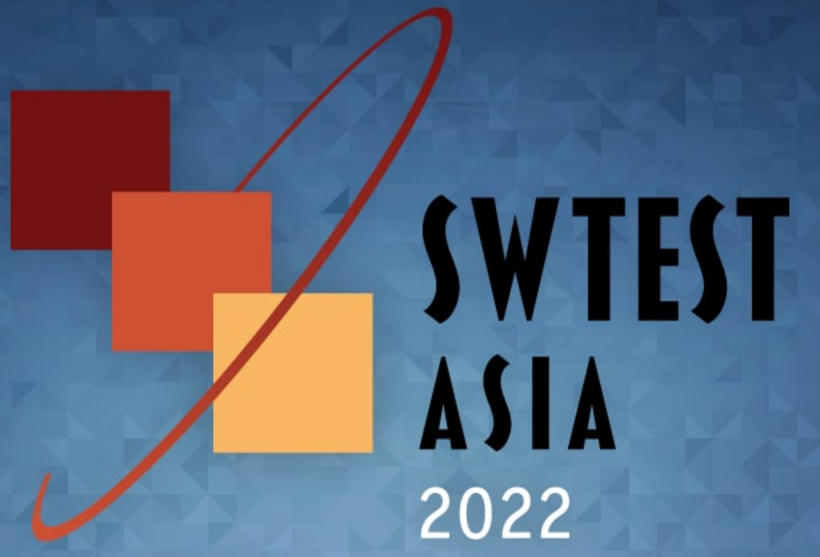


Advanced Testing Technology for Future Requirement

CP Testing Division
Scott Huang
BH.Huang@Koresemi.com

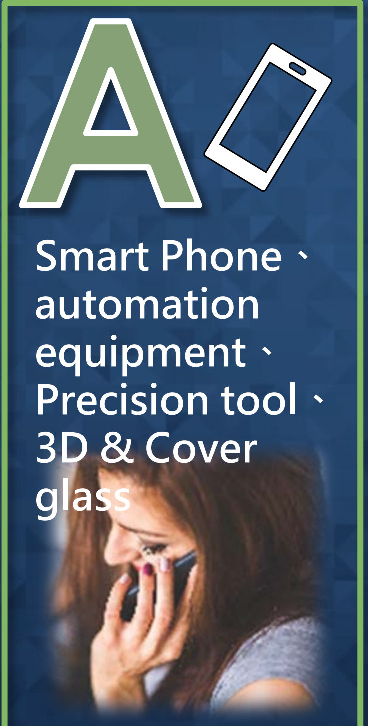
Hsinchu, Taiwan, October 26-28, 2022

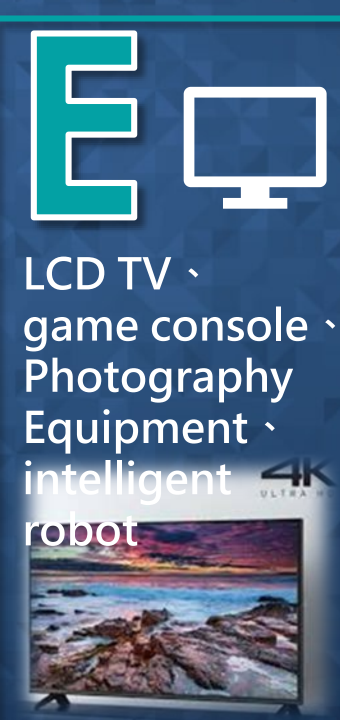
Overview

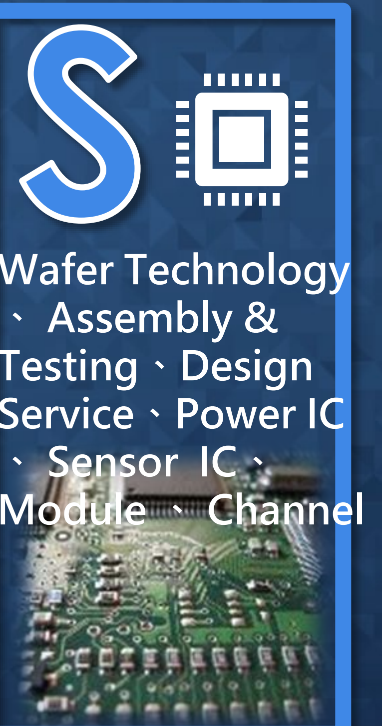
- **Introduction of KoreSemi**
- **The Opportunity for Advance Testing Technology**
- **Relevance of Product Development and Advance Probing Challenges**
- **Ideal Testing Structure & Integration**
  - Introduction of unmanned handling technology
  - EDA System further integration & Development
- **Conclusion**
- **Follow-On Work**

About KoreSemi

- **Foxconn Technology Group and the Qingdao government jointly invested in the establishment of KoreSemi in Qingdao in July, 2020 .**
- **KoreSemi belongs to S Business Group which is under Foxconn Technology Group to support 3+3 strategy**
  - 3 Innovative Industry : Electric Vehicles、Digital Health、Robotics
  - 3 Core Technology : AI、Semiconductors、Next-Gen communications

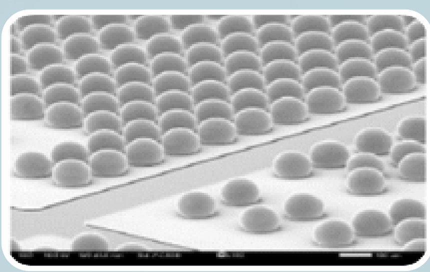


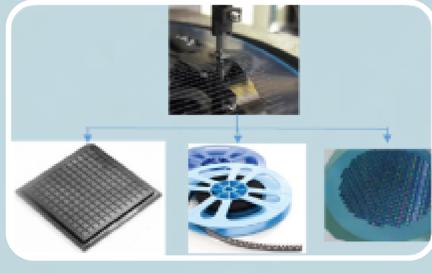


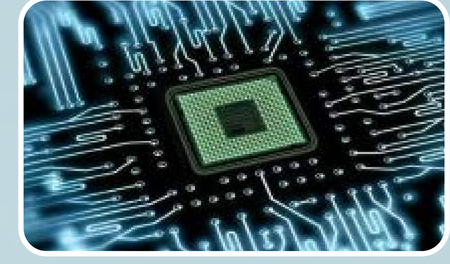


KoreSemi Turn-Key Solution

- **3 Production Lines in MP：Bumping / RDL, WLCSP, DPS and CP.**
- **FOStrip is ready for customer new tape out.**







WLP	**CP**	**DPS**	**Turnkey Service**	**RD & FOStrip®**
-Cu Pillar Bump -Lead Free Bump -RDL -WLCSP -Glass Wafer RDL -Gold bump	- Memory (DRAM , Flash, MCPs) - Logic (Mixed-signal, digital, Analog) - CIS - Driver device	- Grinding - Laser Marking - Saw - Wafer , Reel, or Tray	- Bumping + CP + Assembly + FT - SMT and Module - FATP(Final Assembly, Test and Packing)	- 2D/2.5D Tech. - 3D Integration - Wafer on Wafer - AiP

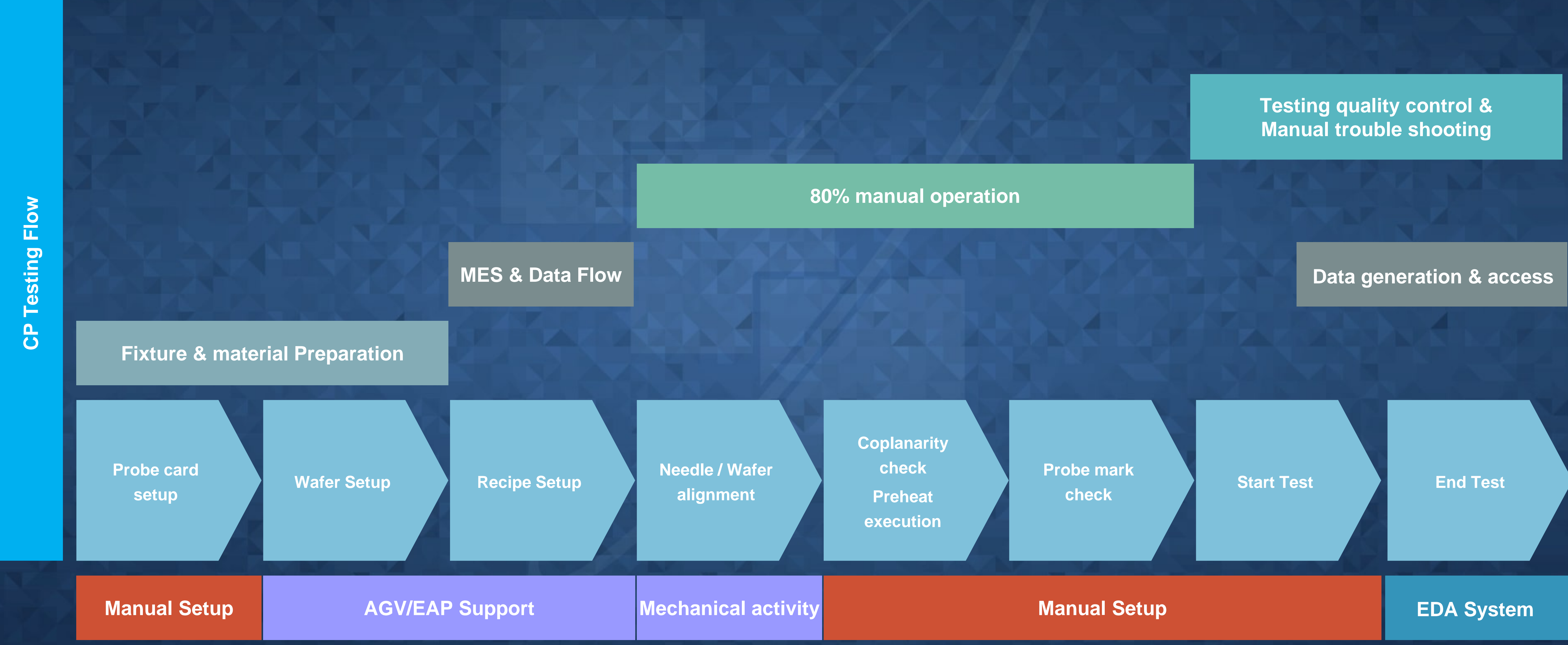
The Opportunity for Advance Testing Technology

More new technologies and products for heterogeneous integration, Those business opportunities are for advanced packaging and high-end testing. The trend of heterogeneous integration led by "advanced packaging and testing" technology is clear, and it also brings out the highlights of 3D wafer stacking technology, which will cooperate with 2D miniaturization of advanced processes to build an era of "surmount Moore's Law".

Relevance of Product Development and Advance Probing Challenges

- Trends of next-generation product development
- In response to product development, upcoming challenges
- The requirement of Probing Capability and Service

CP Testing Flow



Ideal Testing Structure & Integration

Total Solution of CP Testing

AGV Solution	Automation Control (UI & Driver)	Test Data Analysis	Probe card Information	Probe Log Application	AOI & Physical Data

Unmanned Handling Technology | **EDA System further integration & Development**

Integration of big data , IoT , AI , automation & unmanned handling technology

Fundamentals of the Industrial Metaverse ; digital transformation

- **UTILIZATION**
- **QUALITY**
- **HIGHER YIELD**
- **COST SAVING**

Ideal Testing Structure & Integration

- **Unmanned Handling Technology**

  a. AGV Application (Probe Card/Wafer)

  b. Application of Automated Control

- **EDA System further integration & Development**

  a. Integration of testing result & probe data

  b. Application of probe log analysis

  c. AOI & PMI data using

  d. Smart auto-retest

Ideal Testing Structure & Integration

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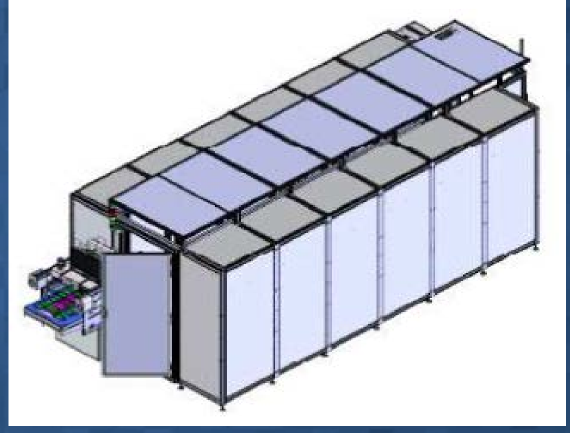
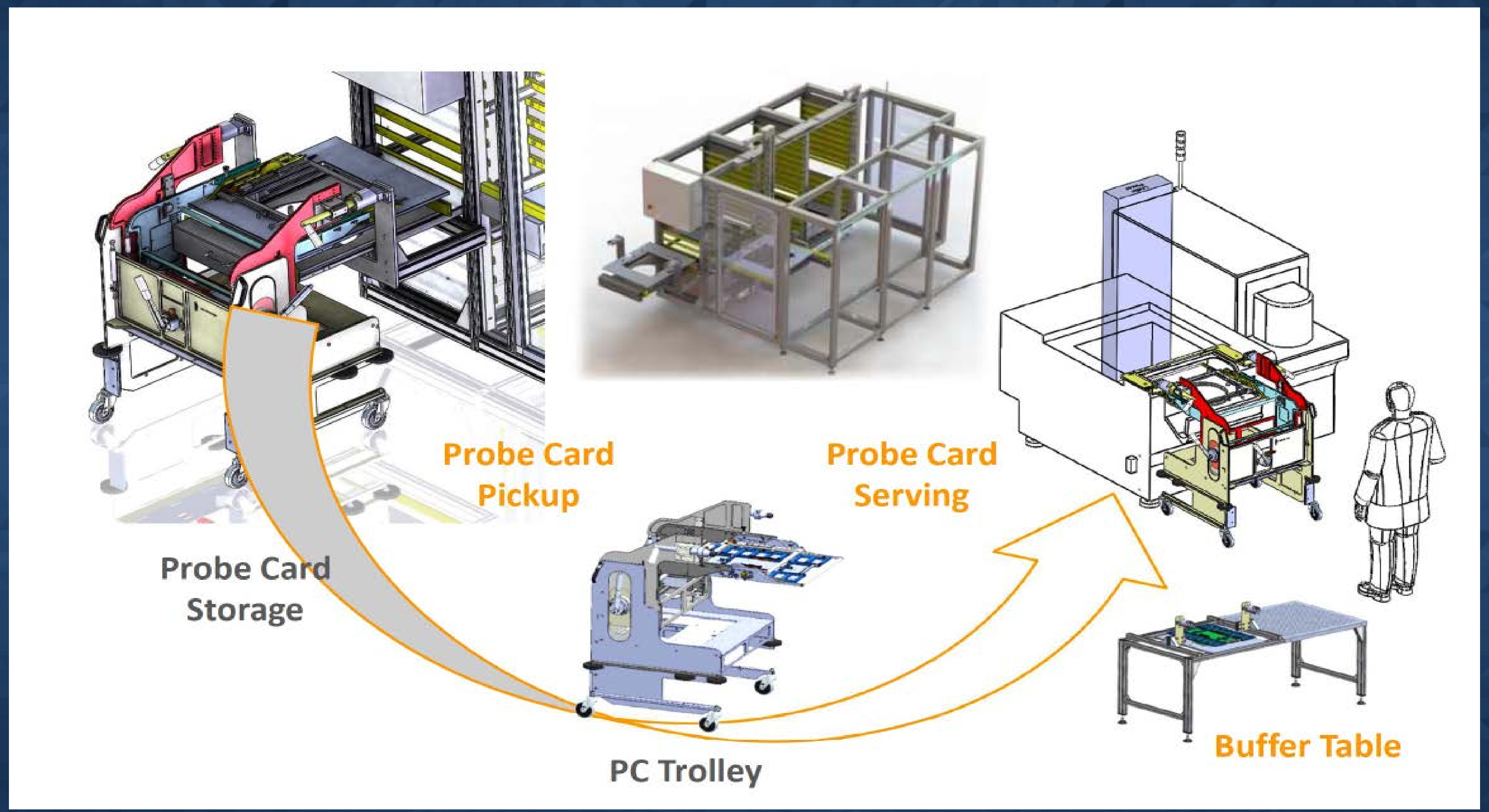
Storage System with Probe Card Trolley

Scenario set for 12 Cabinet of V93K/P1600 , the total capacity is estimated **342 pcs**.
(The first cabinet will be 23 pcs and others are about to hold 29 pcs per cabinet – totally will be 29 pcs x 11 cabinets + 23 pcs =342 pcs)

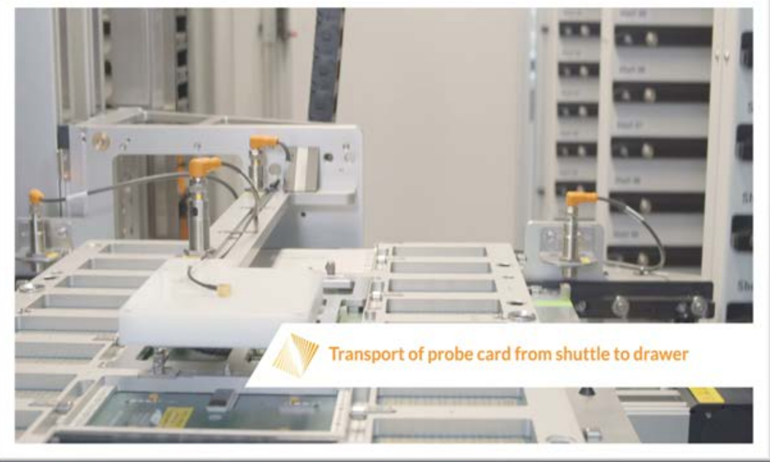


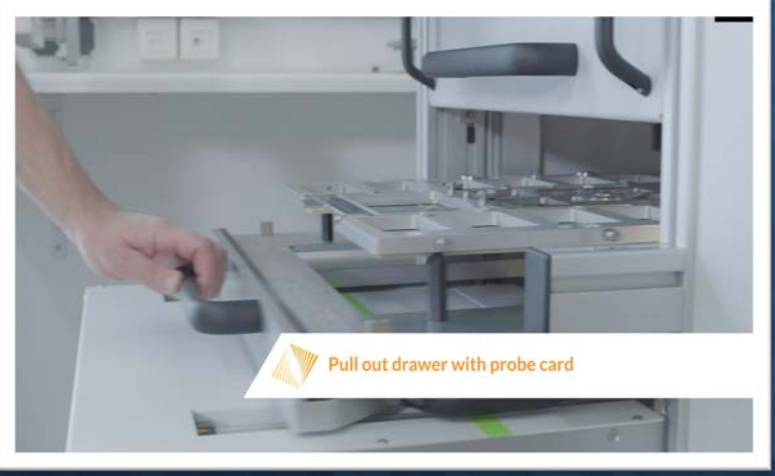
TD Storage Cabinet
stack up illustration
(sample shown for 6x Cabinets)

Probe Card Trolley



Probe Card Trolley

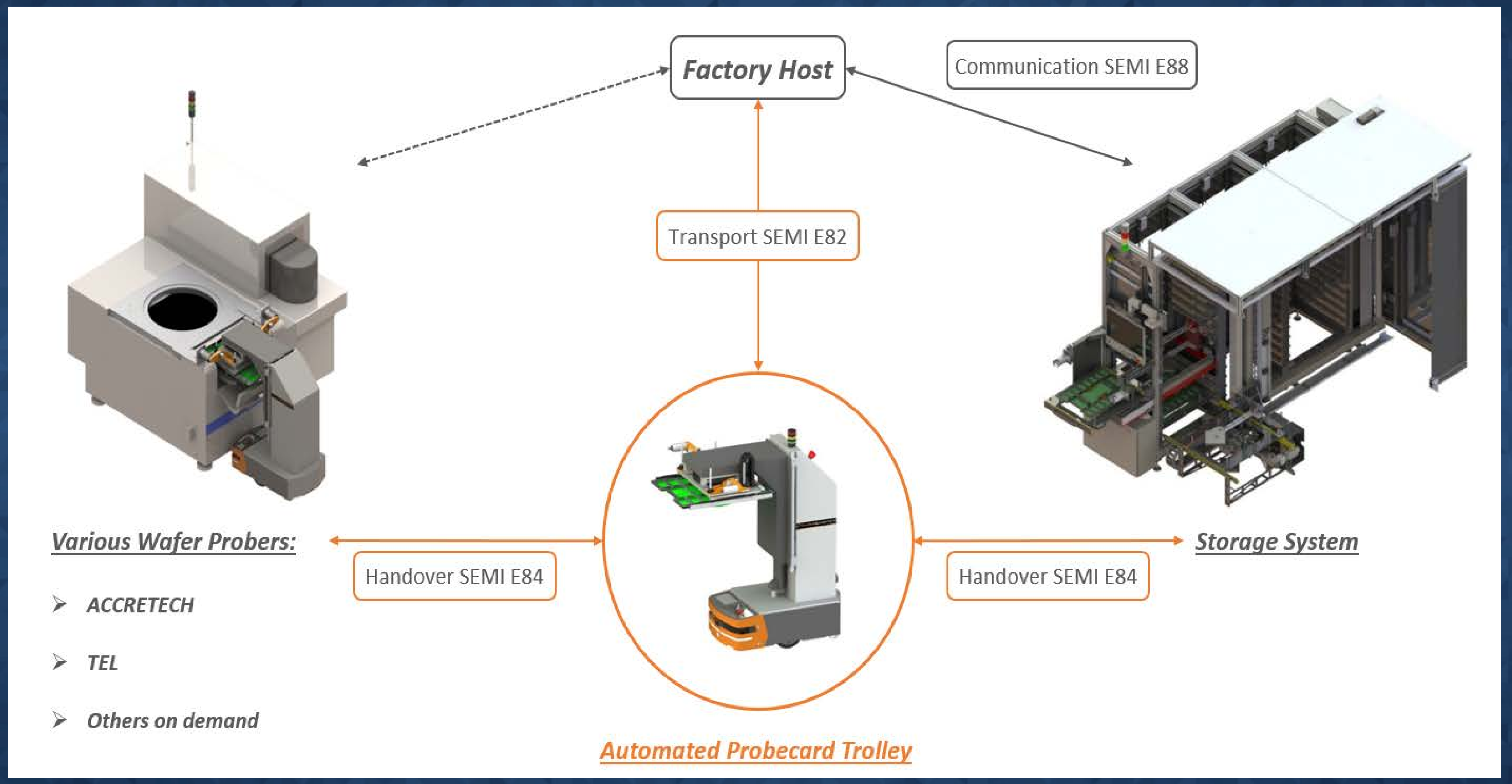




Probe Card Trolley

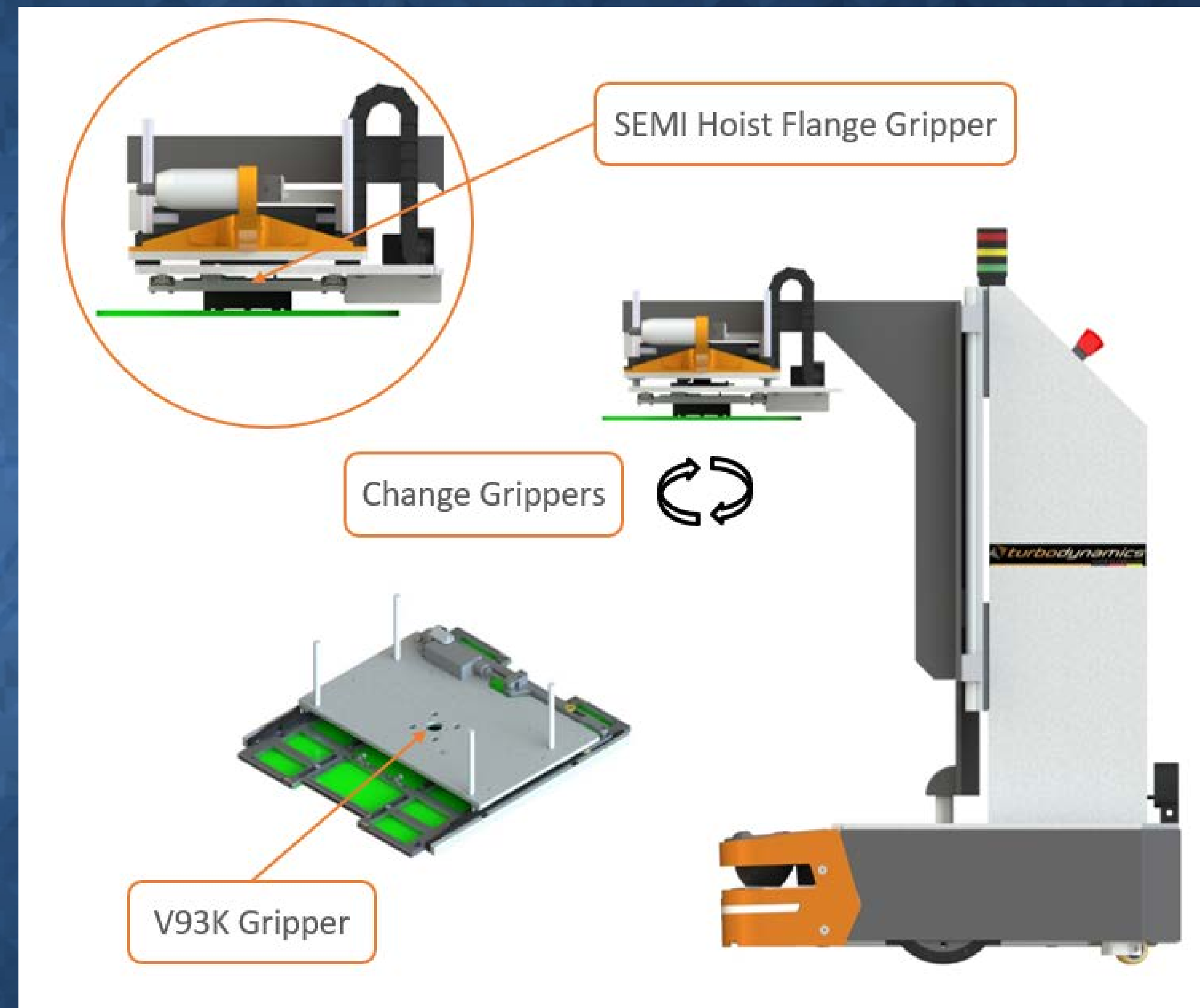
- Structured Work Flow & Process
- Secure handling & storage of high cost fixture
- Hands-free process / Avoid human error
- Relief from heavy carriage
- Efficient usage of floor space
- Universal Device Carrier for different
- SECS/GEM Interface / Industrial 4.0 ready

Automated Material Flow



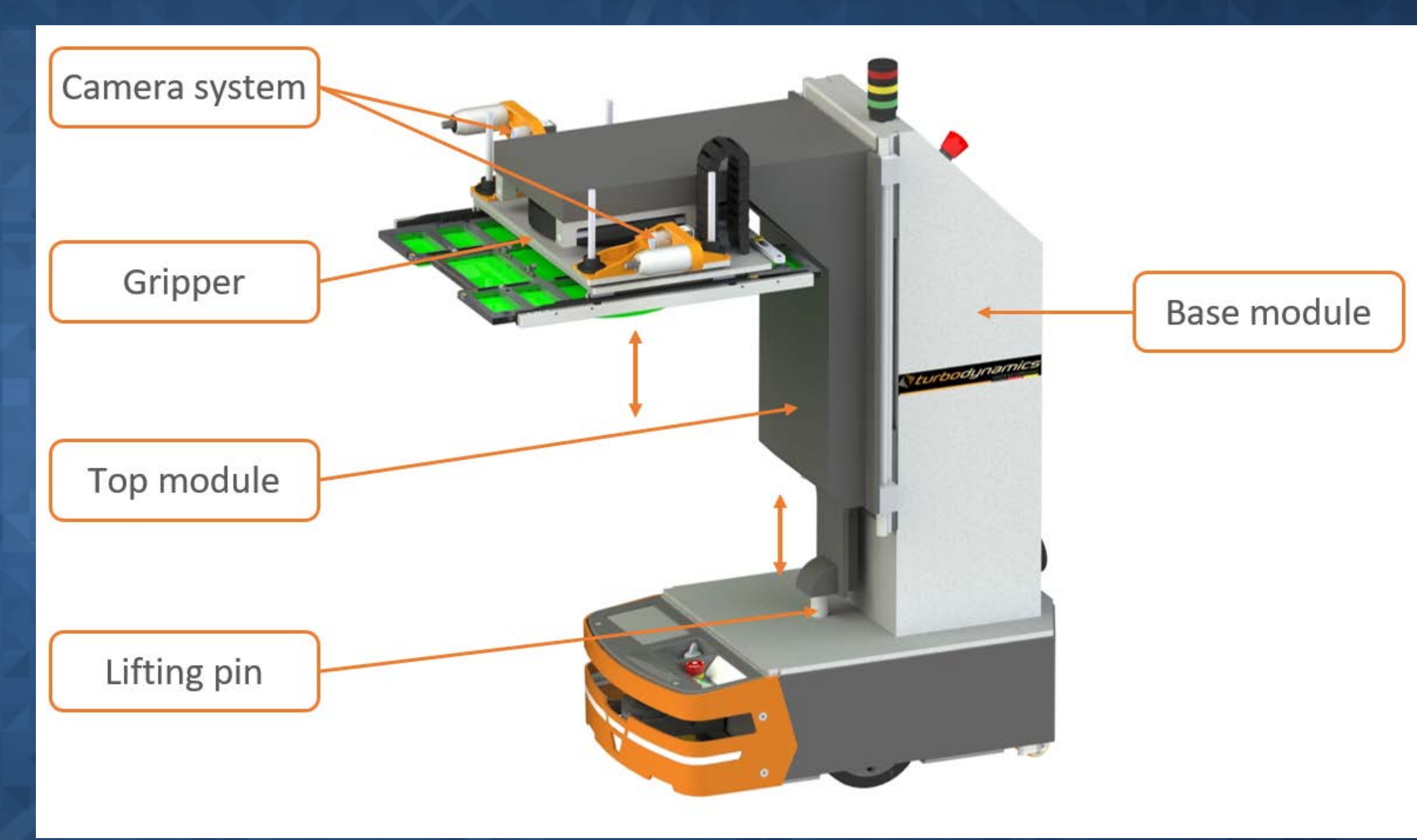
Modular Design

- Modular design for handling of different stiffeners/flanges:
  - Advantest: T2000, V93K
  - Teradyne: U-Flex, M-Flex
  - SEMI Hoist Flange
- This is achieved by manually changing the individual grippers (≤ 1 hour)
- The change of the grippers is monitored through an RFID- technology and is transferred to the host



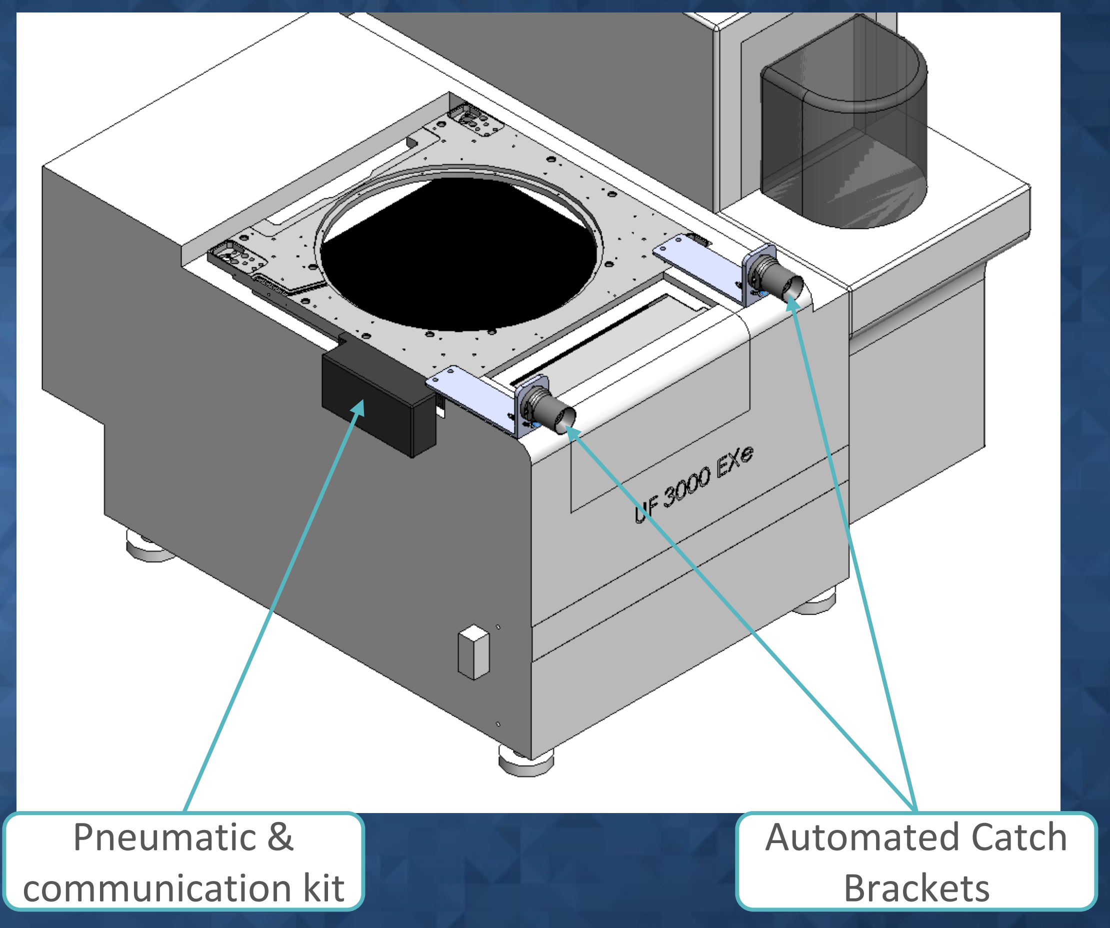
Probe card Handover

- Alignment to the height of the auto catch brackets is achieved by an intelligent camera system
- A deviation of the different heights of the probers can be compensated
- Handover according to the SEMI E84 standard via parallel I/O interface



Prober Preparation

- Attaching the automated catch brackets to the head plate
- Attaching the pneumatic & communication kit to the side of the head plate (size 300x150x80 mm)
- Simple installation
- Automatic open front access door is required

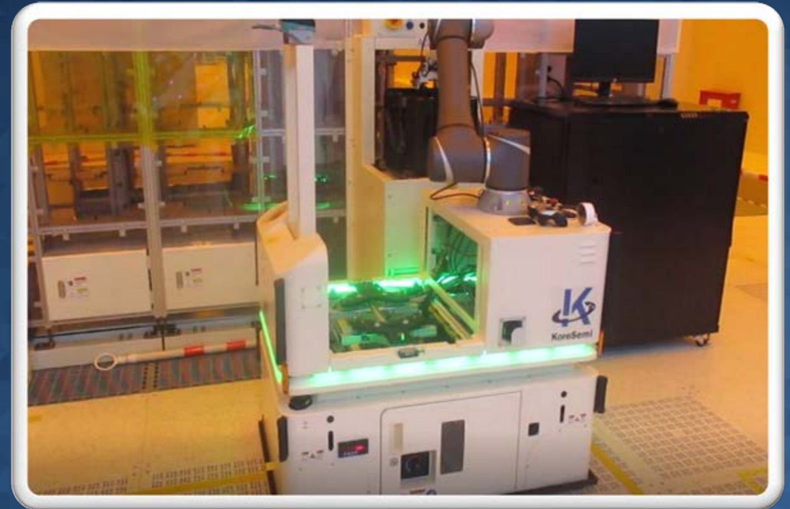


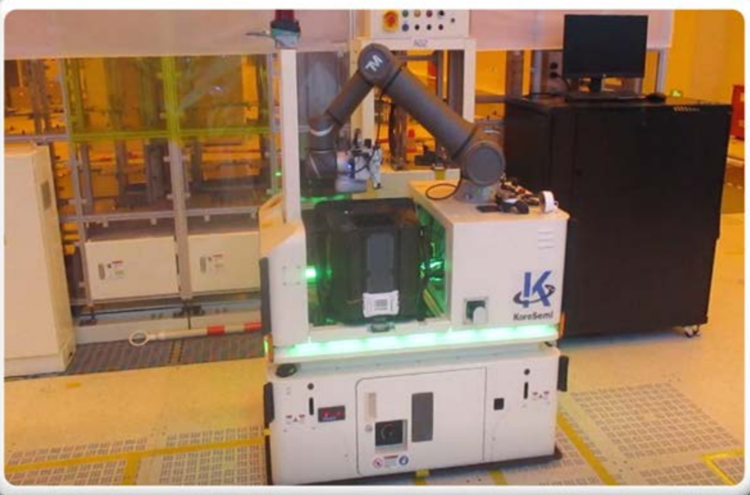
Workflow on UF3000EXe test floor with V93k and auto trolley

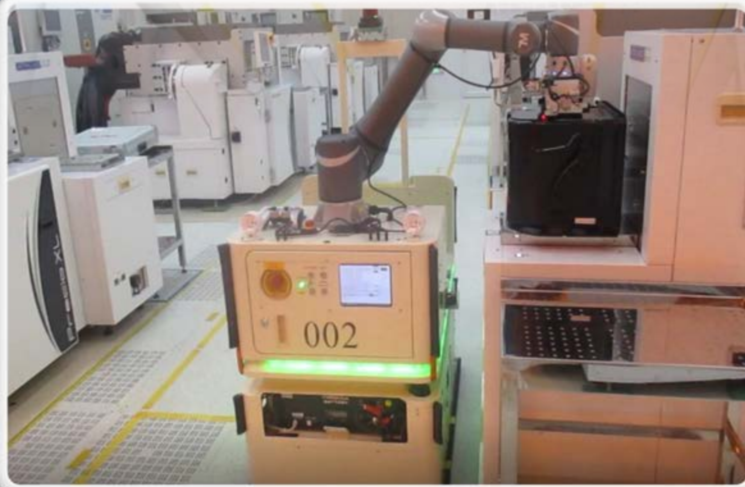
AGV Trolley moving in the corridor

AGV Trolley at docked positon onto UF3000 Exe

AGV Application for Wafer







Ideal Testing Structure & Integration

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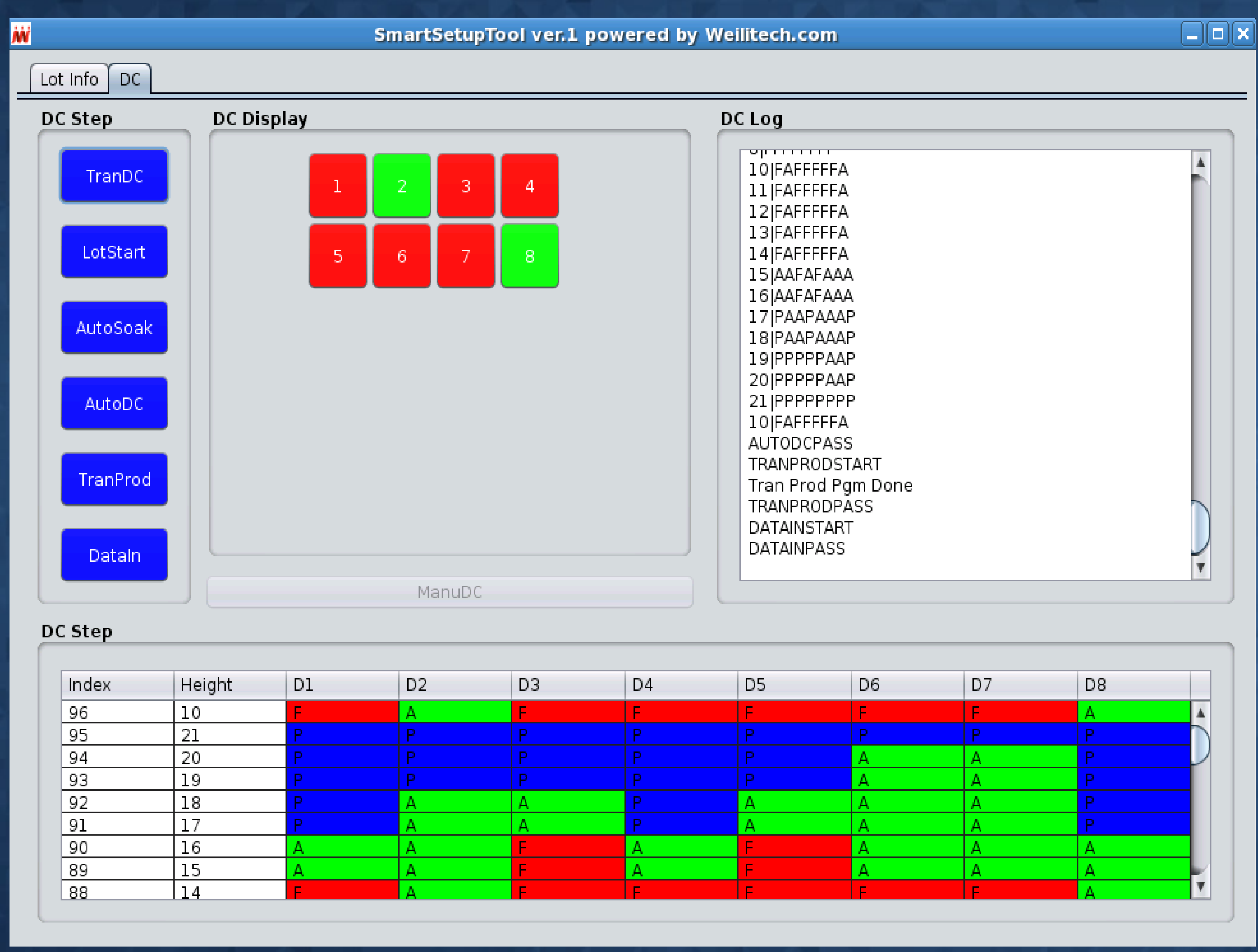
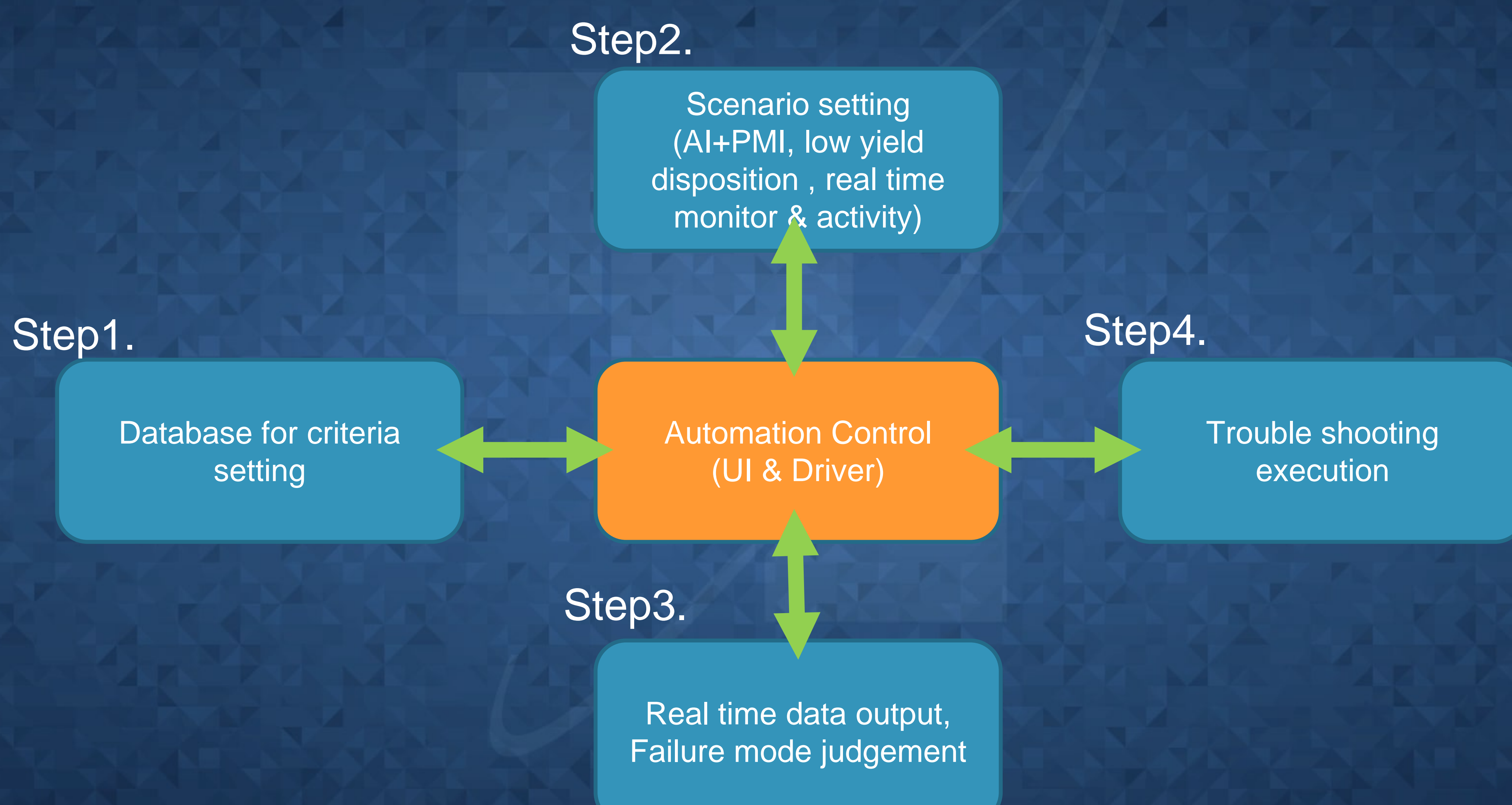
  d. Smart auto-retest

Application of Automated Control



- Lot information Setup
- Testing Program Download
- Probe File Setup & Probe Start
- Probe Setup
- Testing parameter check
- Log record for setup process
- Real time yield ,condition monitor
- Real time control & machine stop
- On line repair & parameter change

Structure of Automated Control



Ideal Testing Structure & Integration

- Unmanned Handling Technology
  - a. AGV Application (Probe Card/Wafer)
  - b. Application of Automated Control
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  - b. Application of probe log analysis
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  - d. Smart auto-retest

EDA System Development

- **EDA is not only used for testing data analysis after wafer testing**

  ex. Combine with data log, physical data & parameter to have more value

- **How to integrate real time data & automated function for quality control**

  ex. Realize execution of dynamic trouble shooting by real time monitor

- **How to integrate probe log & AOI data for further analysis**

  ex. For alarm analysis, early warning of PM , probe card status confirm

- **How to provide useful information to scheduling system for best testing combination or condition**

- **How to provide the useful testing information for yield improvement**

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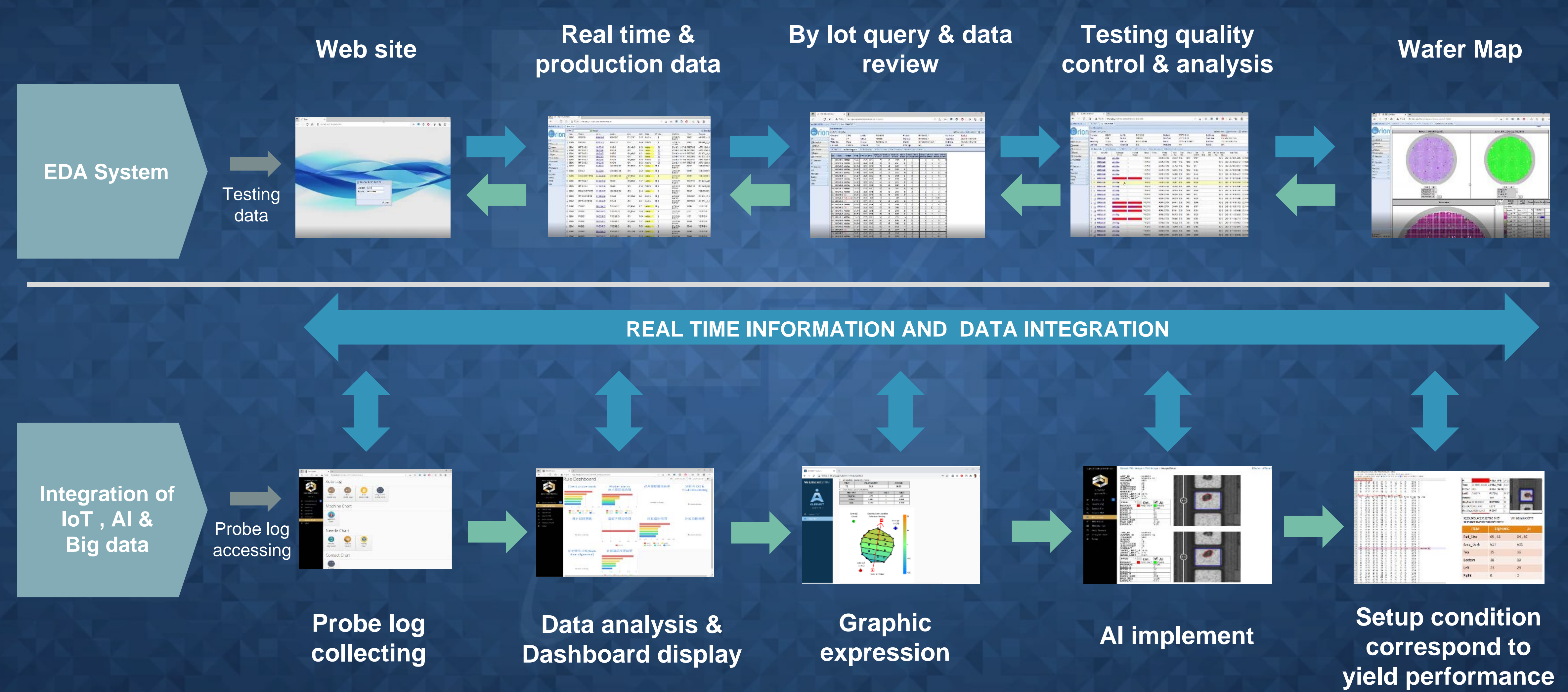
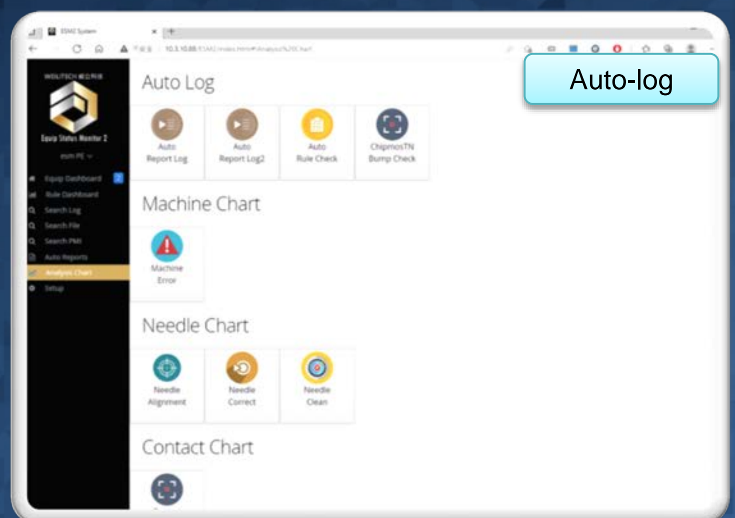
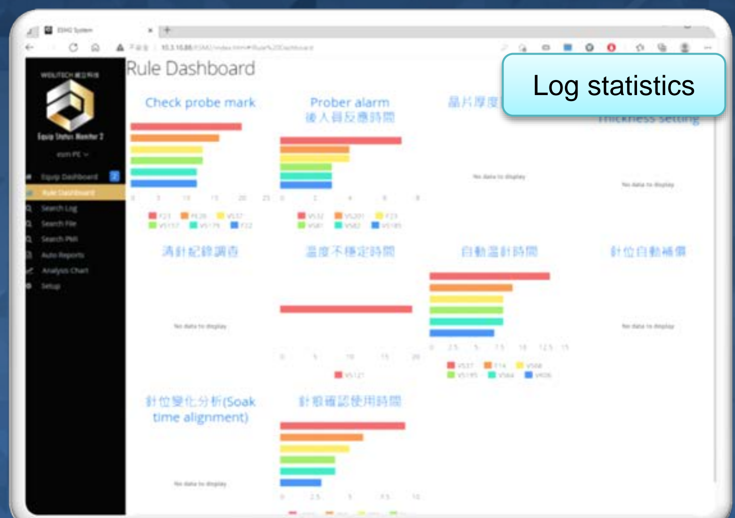
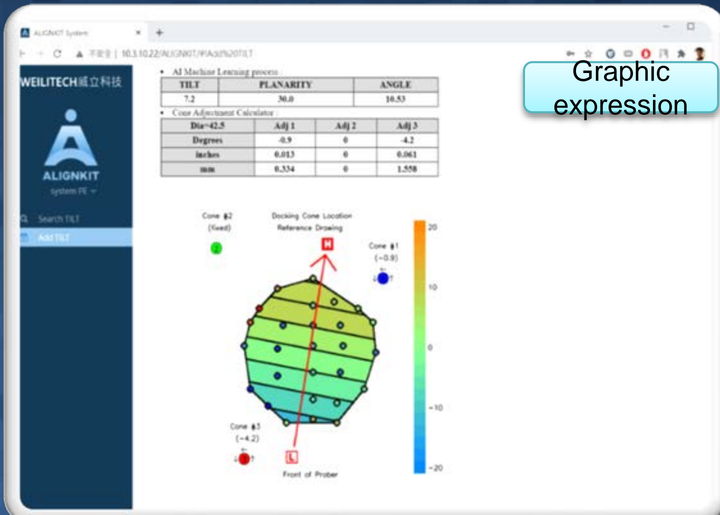
Integration of testing result & probe data

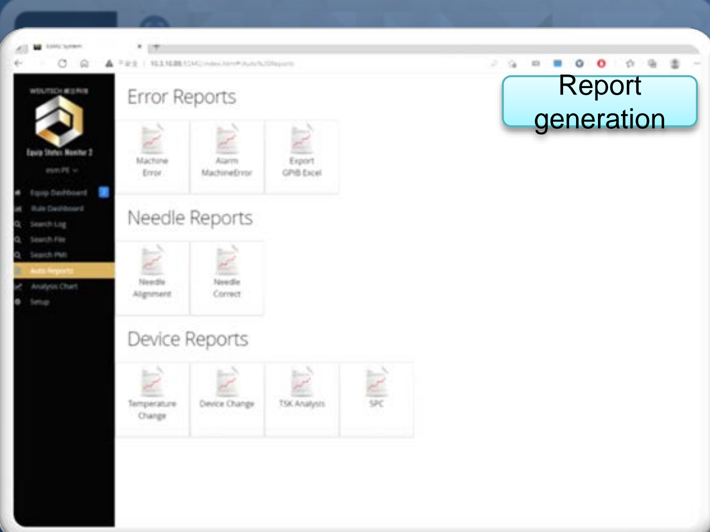


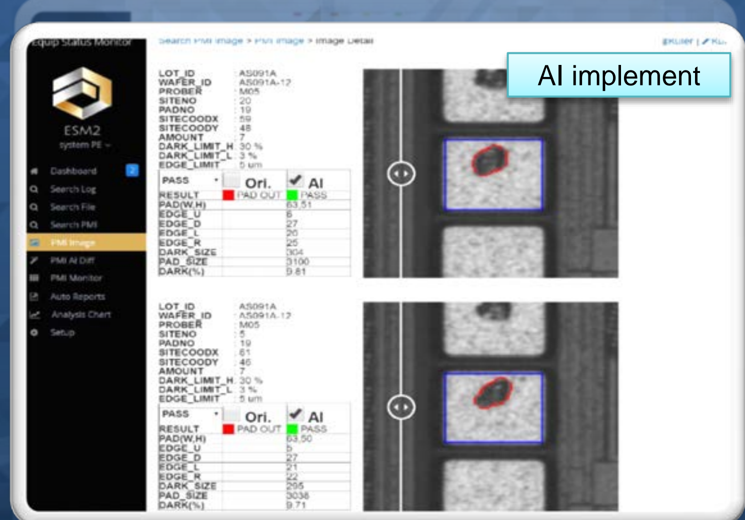
Application of probe log analysis

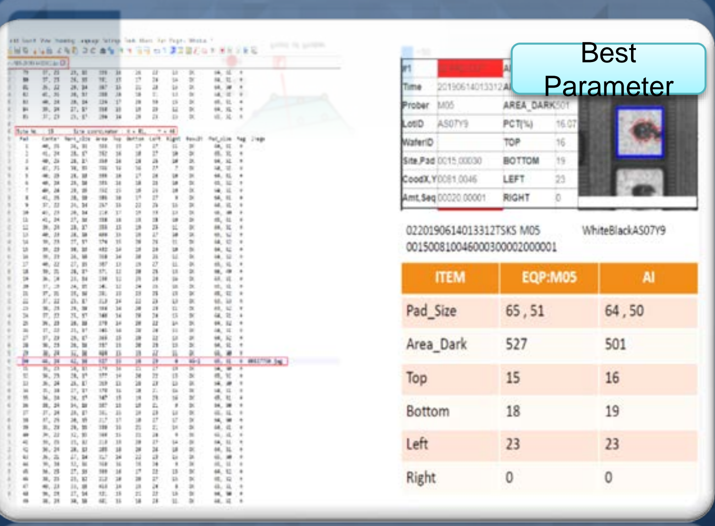






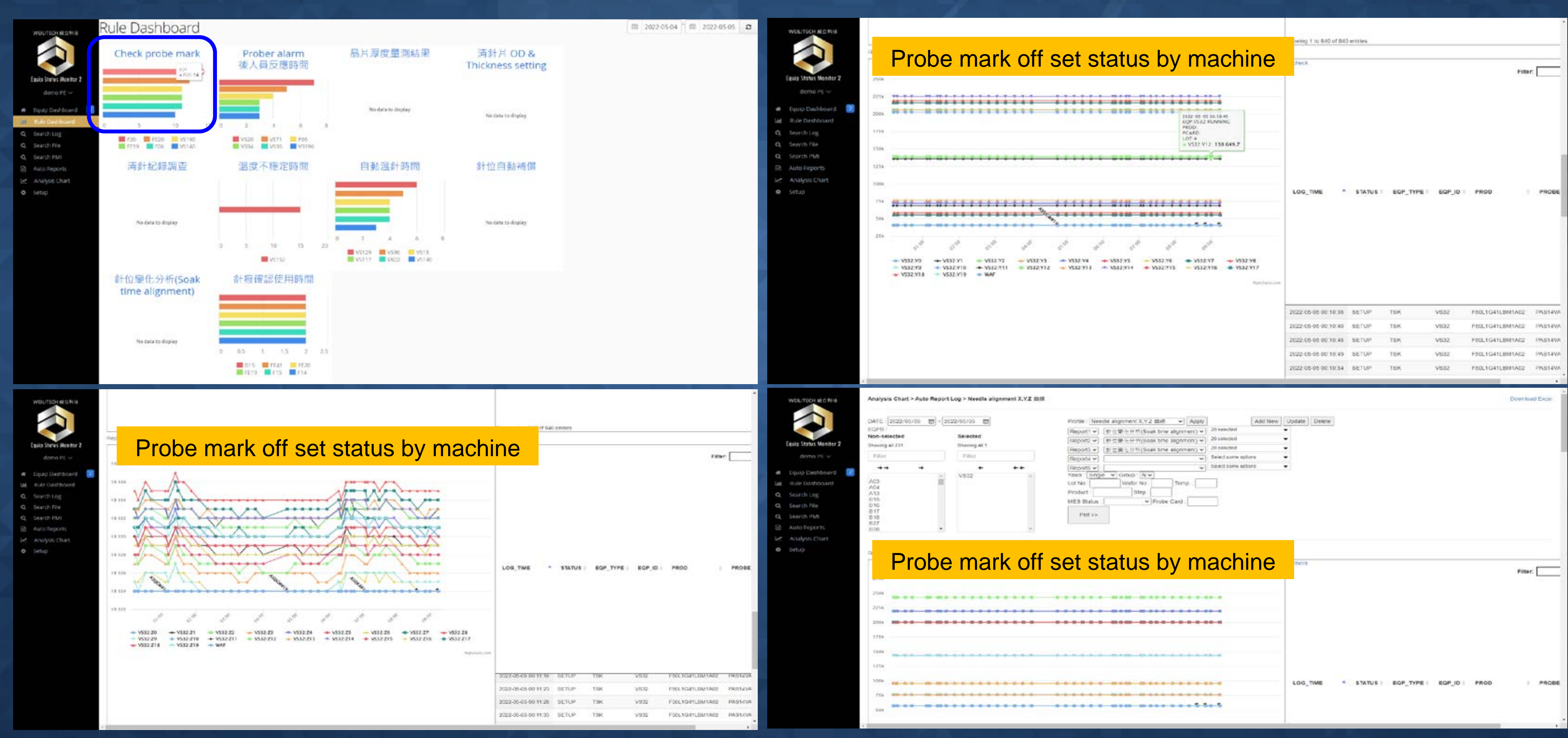






Application of probe log analysis

- Probe mark status monitor



Application of probe log analysis

■ Contact / Coplanarity Check Display

WEILITECH 威立科技
ContactCheck
system PE

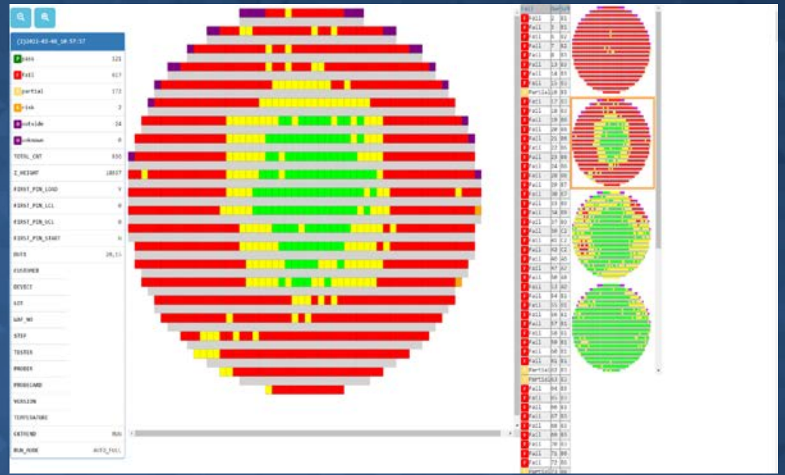
- Search Wafer
- Search PC Check
- Search By EQP
- Search CKS Result
- Trend Monitor
- Setup

[VPG]	(1) 2022-02-08 14:12:27	(2) 2022-02-08 14:12:31	(3) 2022-02-08 14:12:35	(4) 2022-02-08 14:12:38	(5) 2022-02-08 14:12:42	(6) 2022-02-08 14:12:46
Pass All	0	4	122	327	459	470
Fail All	466	417	149	15	0	0
FailPatial	4	49	199	128	11	0
PassRisk	0	0	0	0	0	0
Outside	28	28	28	28	28	28
Z Height	19057	19066	19075	19084	19093	19102
OD	0	9	18	27	36	45

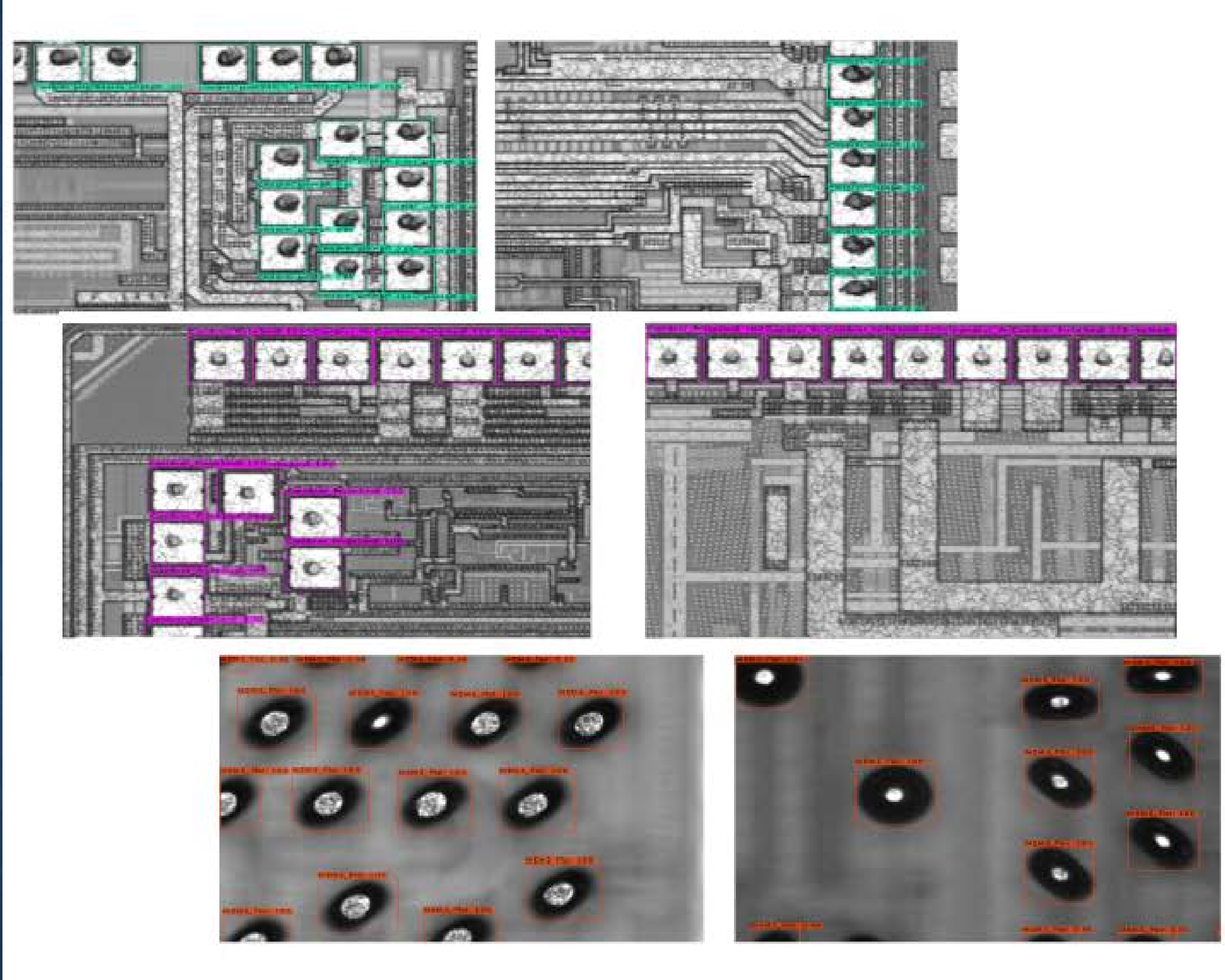
[VPG]	(1) 2022-02-08 13:41:27	(2) 2022-02-08 13:41:32	(3) 2022-02-08 13:41:37	(4) 2022-02-08 13:41:43	(5) 2022-02-08 13:41:49
Pass All	0	133	520	568	572
Fail All	552	283	0	0	0
FailPatial	20	156	52	4	0
PassRisk	0	0	0	0	0
Outside	0	0	0	0	0
Z Height	23736	23745	23754	23763	23772
OD	0	9	18	27	36

[VPG]	(1) 2022-02-08 13:40:31	(2) 2022-02-08 13:40:37	(3) 2022-02-08 13:40:43	(4) 2022-02-08 13:40:49	(5) 2022-02-08 13:40:54	(6) 2022-02-08 13:41:00
Pass All	0	185	633	849	948	1014
Fail All	1037	613	299	134	66	0
FailPatial	24	263	129	78	47	47
PassRisk	0	0	0	0	0	0
Outside	36	36	36	36	36	36
Z Height	18327	18336	18345	18354	18363	18372
OD	0	9	18	27	36	45

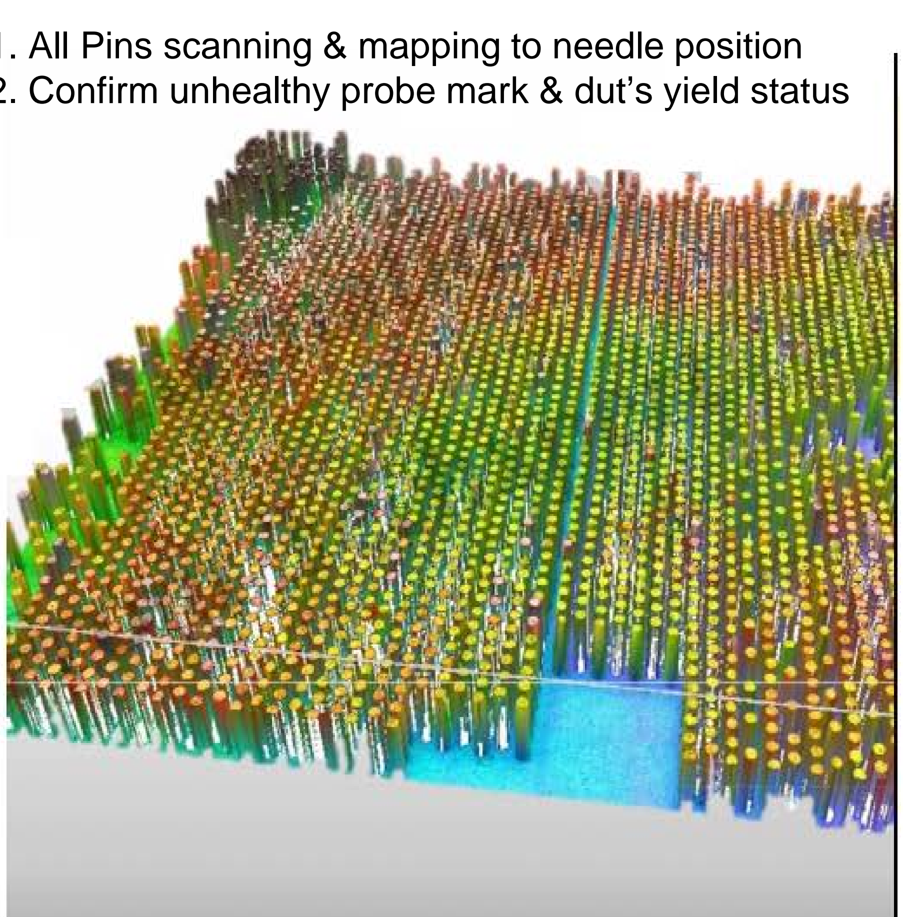
[VPG] (1) 2022-02-08 13:39:05 (2) 2022-02-08 13:39:10 (3) 2022-02-08 13:39:15 (4) 2022-02-08 13:39:21



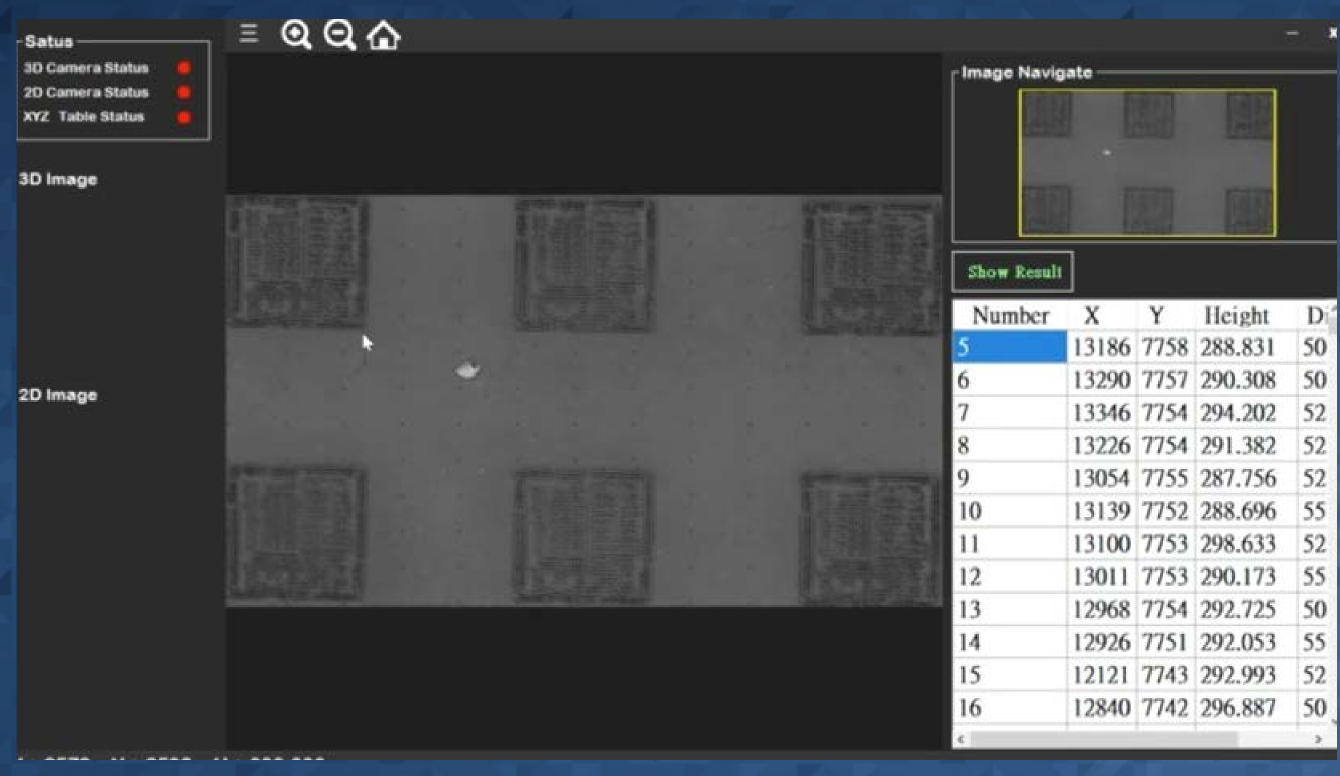
Off line PMI & Probe Card Check

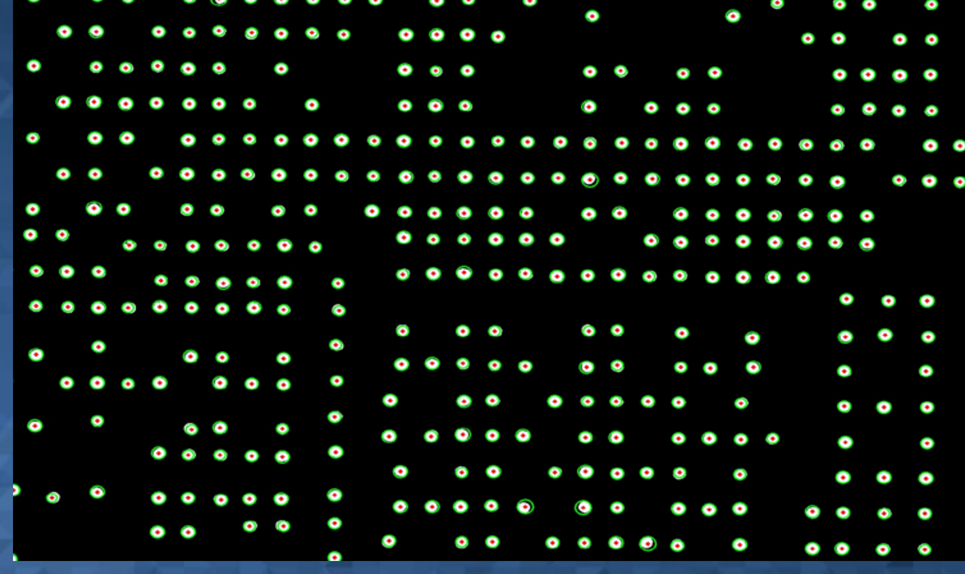


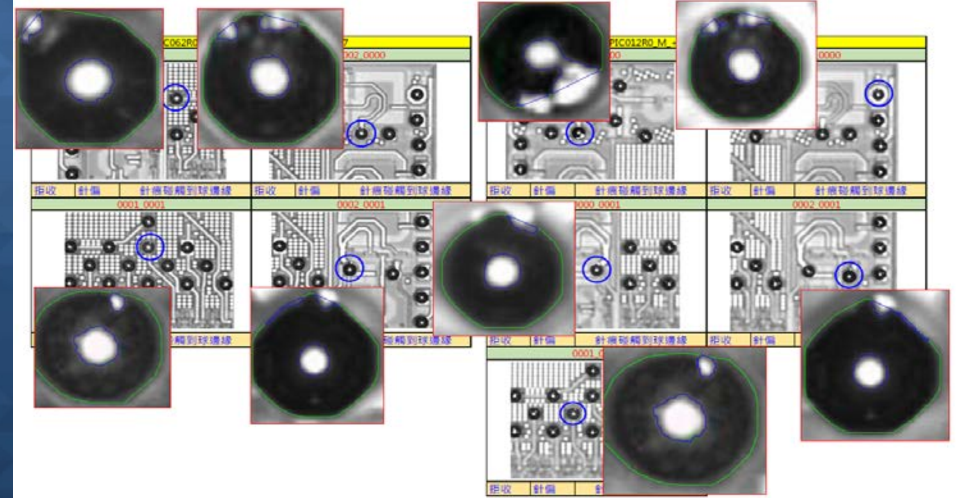
1. All Pins scanning & mapping to needle position
2. Confirm unhealthy probe mark & dut's yield status



Off line PMI & Probe Card Check

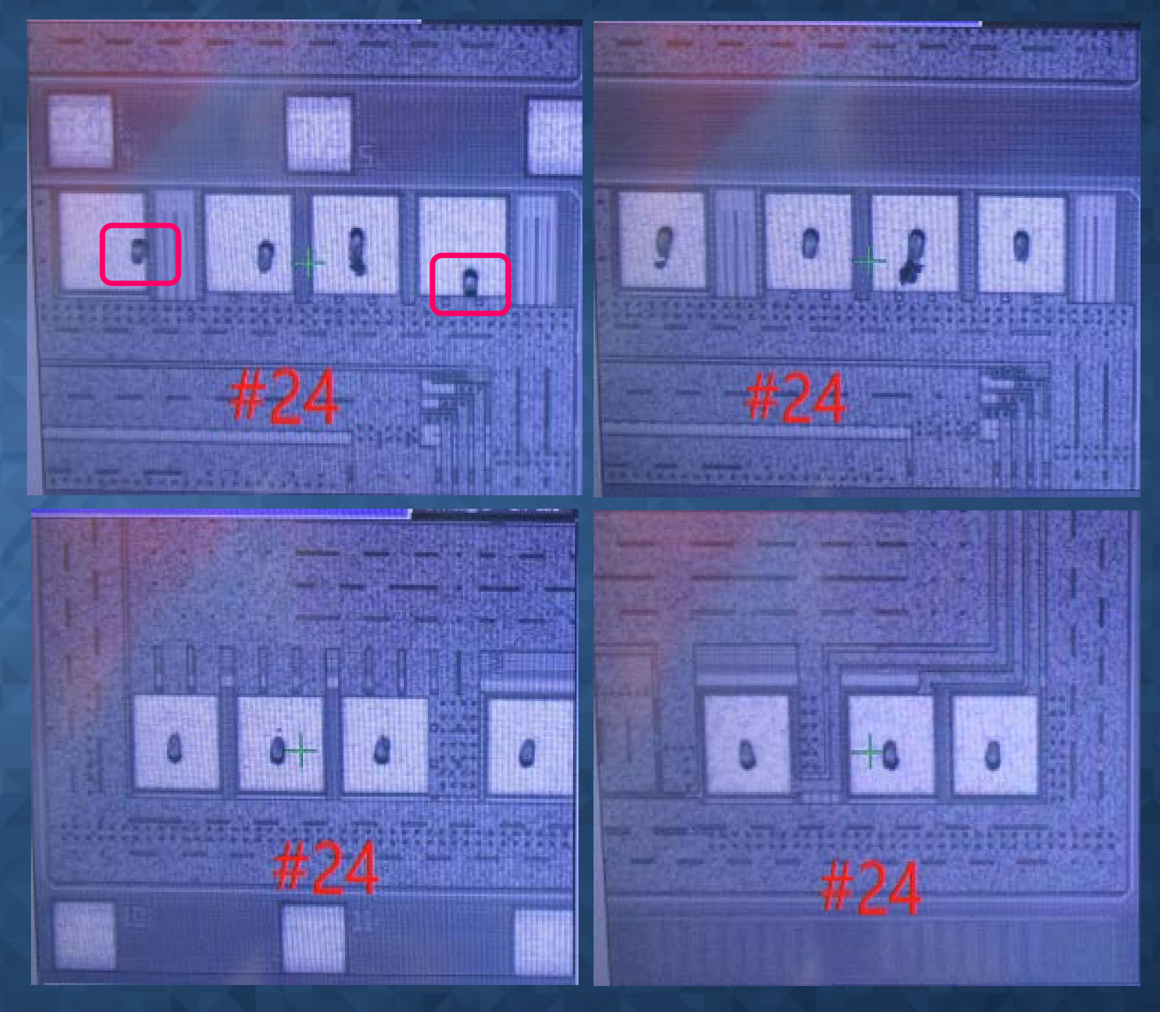




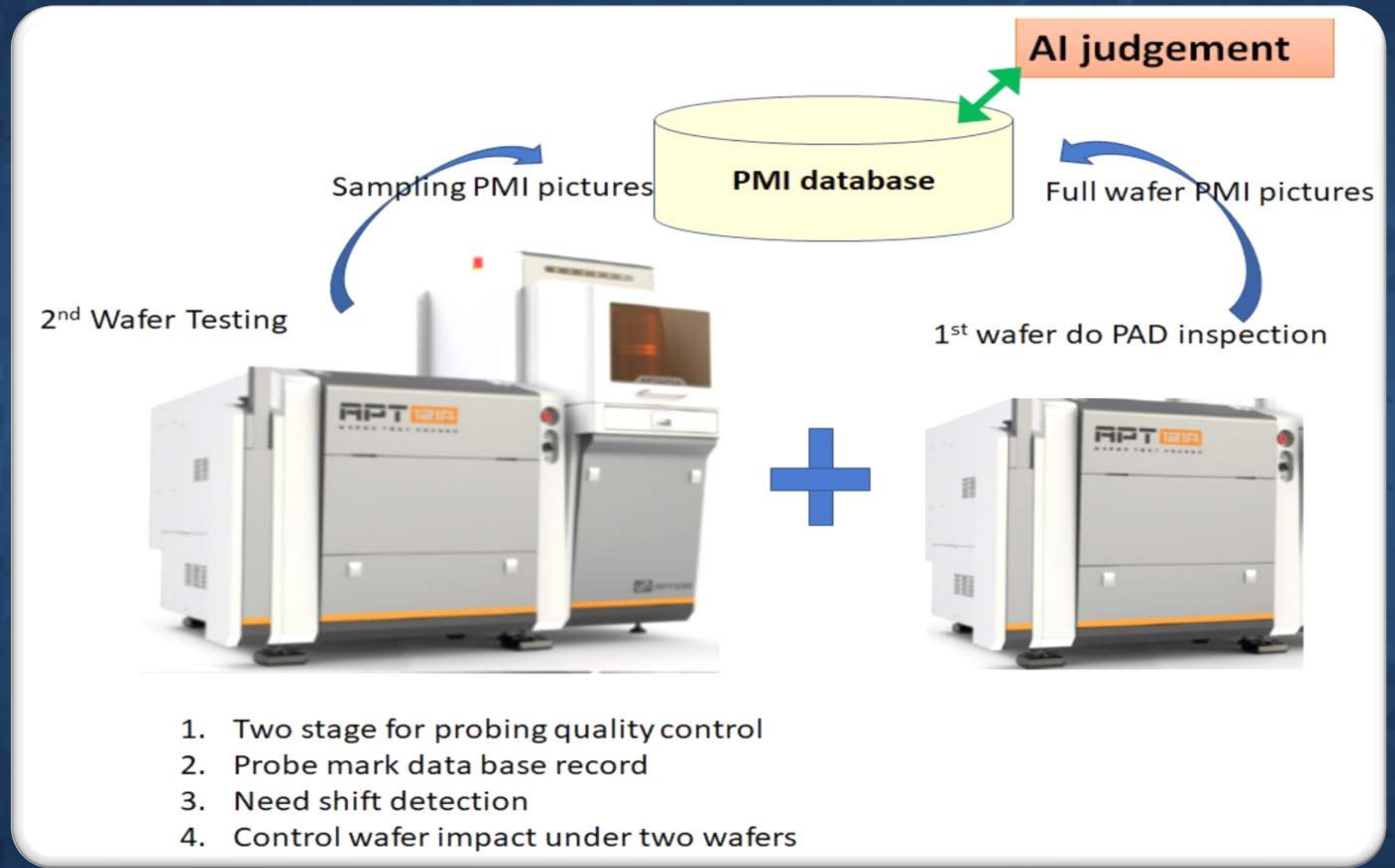


- New algorithm can support to judge result of bump to confirm needle status

Single Pin Shift Issue For High Pin Count Device



On line PAD Inspection & Quality control



coming soon !!

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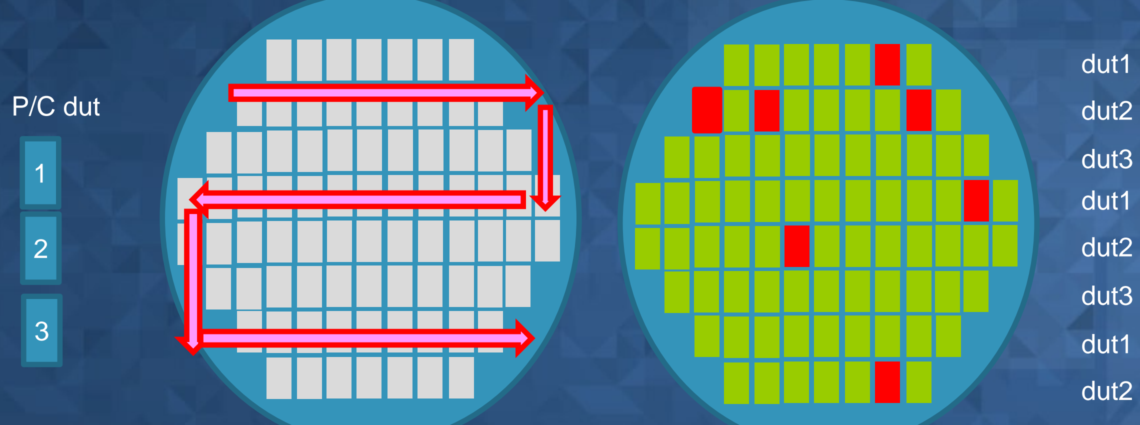
Smart on-line retest

- To replace the same dut retest the same fail die
- To enhance final yield



1st test yield : 73/80 = 91.25%

Dut1 yield = 27/29 = 93.10%

Dut2 yield = 24/29 = 82.76%

Dut3 yield = 22/22 = 100%

Take duts 3 to retest fail bin

Gain more yield than retest by original dut

Final test yield : 79/80 = 98.75%

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EDA further integration in the future

Testing data

Timing for data analysis will be from wafer end to during testing to make real time & dynamic monitor

Prober log

For real time environment & condition check. Statistics for machine alarm ,efficiency & performance

Probe Card Information

Make effective disposition when low yield or overkill occur. Real time monitor abrasion status of needle

AOI & PMI Data

To make good quality for probe card needle & probe mark. More analysis for yield , parameter & probe mark.

KoreSemi /Scott Huang

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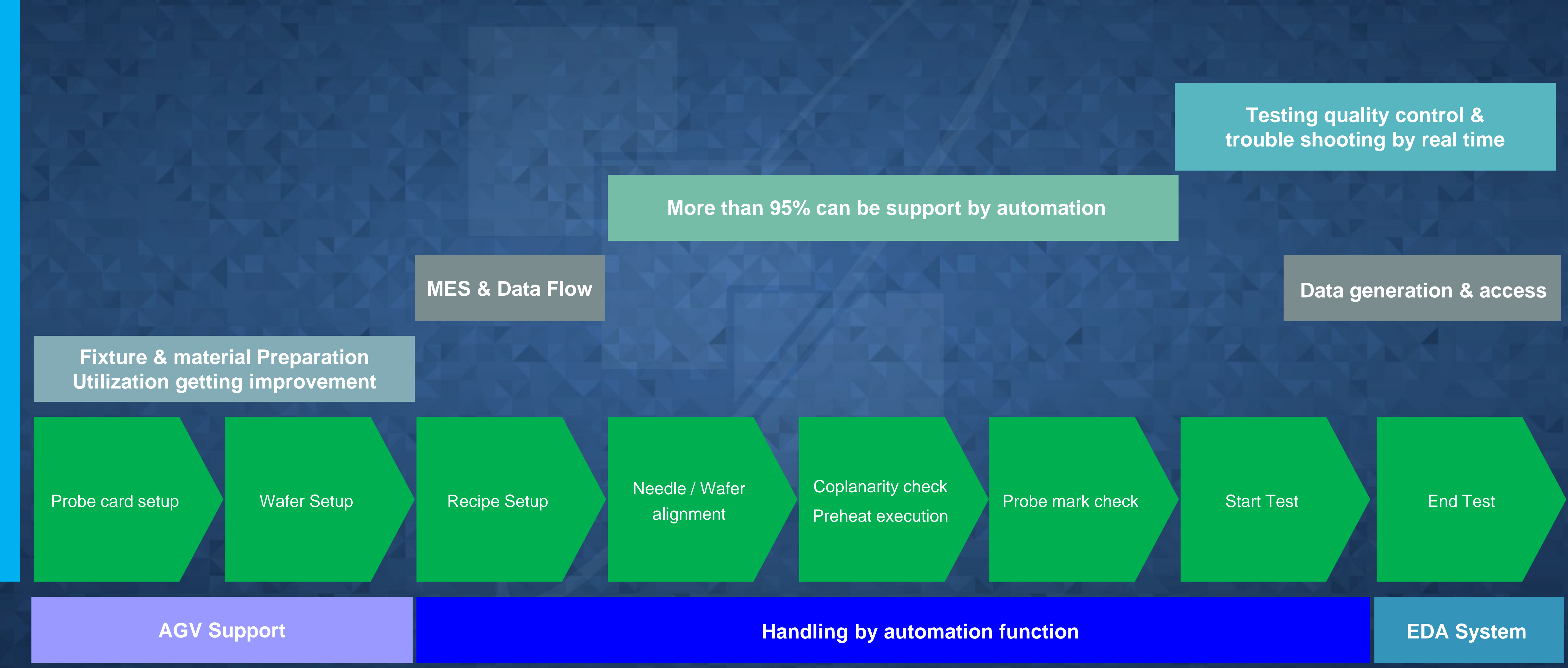
CP Testing Flow After System Integration



Benefit for system integration

Real time monitor & on line trouble shooting

Real time judgement for testing quality and disposition

Gross margin Maintain

Improvement of efficiency & flow
Best production & fixture arrangement

Cost saving for probe card & clean material

Probe card life time extend
Reduce cost of clean material

System integration & Real time output monitor

Dash board for real time monitor
Integration by different system
Real time output control

Testing Quality improvement

Dynamic yield monitor
Auto on line cleaning execution
Optimize auto-resort process

Efficiency Improvement

Real time data analysis
Optimize auto-resort process
Real time handling for trouble shooting

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Conclusion

With the shrinking of process and requirement of quality , how to maintain and improve testing efficiency & gross profit is the target of every testing factory. Integration of big data , IoT , AI , automation & unmanned handling technology with creative & reciprocal cooperation model will be the key technology to decide if testing house can put the strengths in the lead and provide the best service to customers.

Follow-On Work

- How to control data flow with edge computing
- Big data management & control (testing data, log , AOI & PMI data)
- Affordability of automated function
- More background job & analysis tool development

Cooperation Partners

- **Jetbond Technology Co., LTD. :**

  Probe card storage & Automated Probe Card Trolley Service,

  AOI integrated solution , AI implement for bump analysis

  Contact Window : Roden Hsu (roden@jetbond.com.tw)

- **Weilitech Technology Co., LTD. :**

  EDA system integration service (Testing data & Probe log) ,

  AI Algorithm for PMI support

  Automated testing function development

  Contact Window : Edward Jiang (ed@weilitech.com.tw)