



Mature 200 mm fabs
cannot be automated?
For sure they can!

Material Handling Automation at BOSCH

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A merger of HAP and ORTNER

FABMATICS

Automate your success

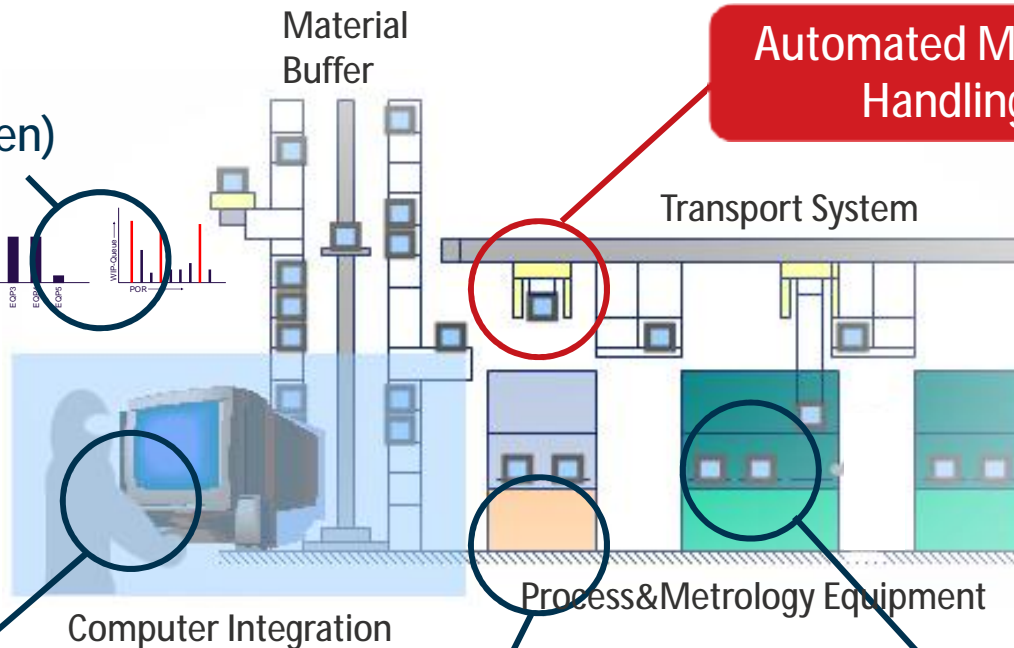
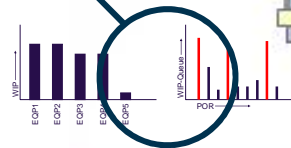
Overview

1. What's our focus on Fab Automation?
2. Challenges for Automated Material Handling in Mature Fabs
3. Benefits of Automated Material Handling
4. The Fabmatics Approach to Automation
5. Bosch's path to entire Fab Automation

What's our focus on Factory Automation?

Automated Material Handling - The „Missing Link“

WIP Flow Control Automation
(what-where-when)



Automated Material Handling

Workflow Automation:
People mainly monitor and manage exceptions



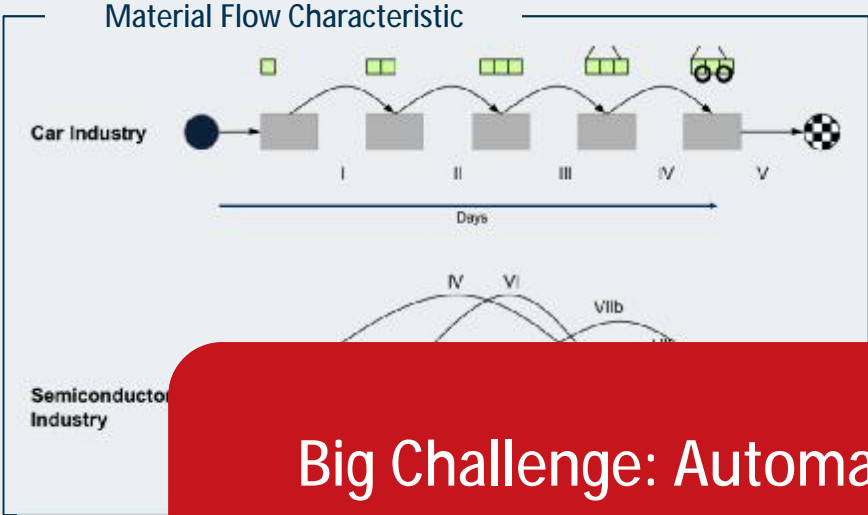
Process Automation:
Quality control based on machine data



Equipment Automation
Hands-off processing



Challenges for Automated Material Handling in Mature Fabs



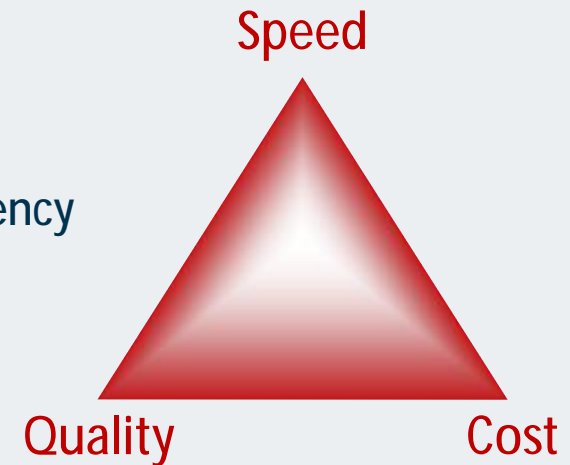
**Big Challenge: Automate the Fab in Operation!
No Greenfield Fab....**



Material Handling Automation Benefits

So much more than just Headcount Cost ...

- } Headcount Efficiency Improvements -> Cost Reduction
- } Equipment Efficiency Improvement / Better Utilization -> Delayed / Saved Invest
- } CT Reduction -> Lower Time to Market; Lower Inventory Cost; Faster Learning Speed
- } Yield Improvements through Reduction of Human Factor -> Cost Saving / Quality Improvement
- } Flattened WIP waves -> Increased Production Efficiency
- } Faster WIP Wave Processing -> Increased Production Efficiency
- } Stable Flow Factor / Improved Prediction Accuracy -> Customer Satisfaction
- } Complete Product Tracking -> Customer Requirements / Improved Quality



The Fabmatics Approach to Automation

Step by Step towards Full Automation

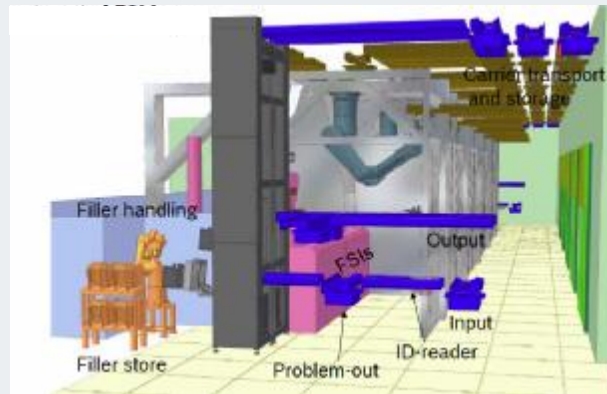


Bosch's path to entire Fab Automation

Phase 1: FSI Mercury Tools



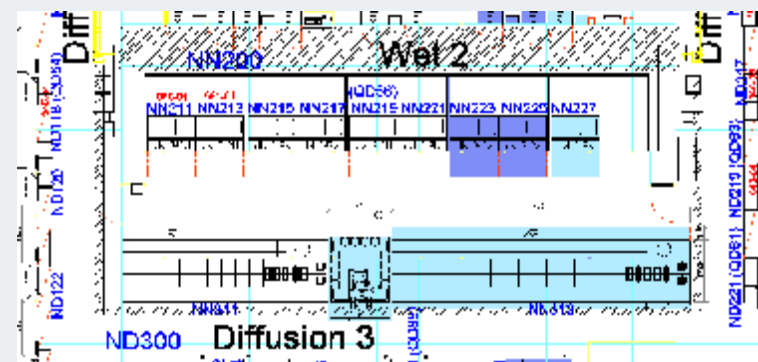
- } Selected a first hotspot with great commercial potential as „stand alone solution“
- } Stationary load/unload Robot cell for FSI Mercury Tools including RFID, notching, Wafer Barcode ID, dummy wafer filling, cassette transfer
- } I/O station as the interface to „manual world“
- } Modular control software for future extensions



Bosch's path to entire Fab Automation

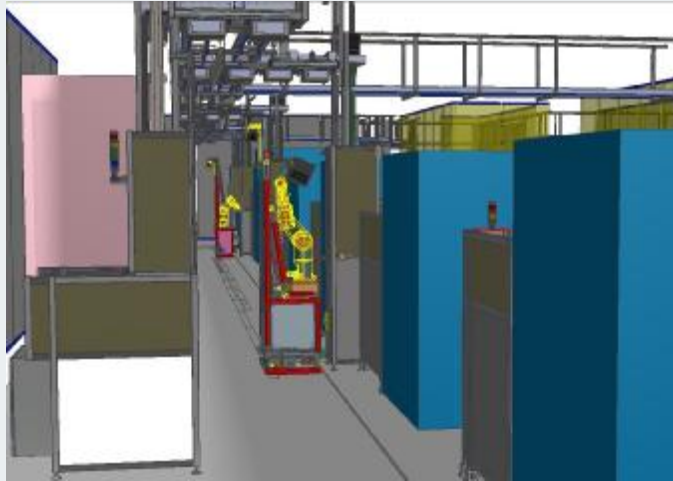
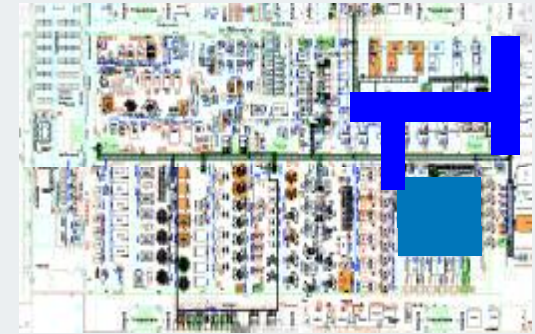
Phase 2: Wet Benches

- } Idea: Automate existing "WET" tools, connect it with FSI area.
- } ended up in a first combined process area
- } One robot serving two high throughput tools
- } Conveyor transfer from/to FSI tools (In/OUT Station)
- } Software integration with WET Cluster Controller



Bosch's path to entire Fab Automation

Phase 3: Lithography / Implantation (I)



- } Expansion into "IMP" and "LIT" process areas based on excellent experiences in "WET"
- } Next Idea: 3 independent clusters with separate Cluster Controllers interconnected via conveyor
- } Dual use of Conveyors/Turntables for transport and storage of cassettes including local lot buffers at lifts
- } First time flow simulation exercised to proof automation concept in advance
- } Interconnection of lithography tools and metrology for fast material transfer

Bosch's path to entire Fab Automation

Phase 3: Lithography / Implantation (II)



- } A mix of several different medium throughput tools required a new loading concept.
- } Direct tool loading could be achieved via fast Rail Guided Vehicles (HEROrail) equipped with standard 6-axis industry robot



Bosch's path to entire Fab Automation

Phase 4: Interbay, „Test Wafer-Kitter“ and „FlatStocker“



- } Further extension required interbay conveyor based transport system as “the backbone” to interconnect all process areas



Quelle: Infineon Technologies Dresden

- } New concept of a “Test Wafer-Kitter” as an enabler for non-productive wafer handling automation
- } Single wafer handling allows high-density storage and automatic commissioning of test lots

Bosch's path to entire Fab Automation

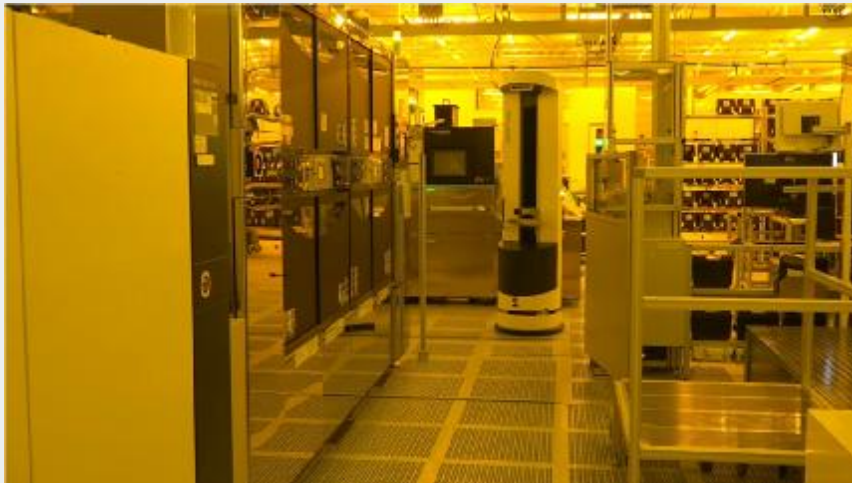
Phase 4: Interbay, Test Wafer Kitters and FlatStockers (II)



- } Cassette storage on ceiling mounted conveyors saves footprint but has longer access time
- } New concept of Flat Stocker combines zero-footprint concept with fast random cassette access to support high-throughput areas

Bosch's path to entire Fab Automation

Phase 5: Self Navigating Robots - SCOUTs



- } Self Navigating robots are a great innovation to eliminate limitations of classic transport systems like conveyors
- } Enables the flexibility to reach every load port in a given equipment layout
- } Fully autonomous driving with obstacle detection, prevention and pass around
- } SCOUT *active* with 6-axis handling robot for cassette loading of several tools
- } SCOUT *triax* with linear 3-axis system for reticle handling automation at all lithography scanners

Bosch's path to entire Fab Automation

Phase 6: Etch, 2nd Extension of Implantation, Defect Density

- } Extension of automated material handling into new process areas
- } New challenge: high throughput process bays with difficult layout conditions require direct tool loading based on new generation of Self Navigating Systems



- } HEROfab equipped with Stäubli industry robot and additional carrier buffers provides improved cost-performance ratio (e.g. carrier swap within one dock cycle)



Bosch's path to entire Fab Automation



Phase 7: Bosch 7 (Scrubber, Wet, Lithography)

- } Additional process areas will be automated in 2016/2017
- } Long term experience and achieved level of reliability allows rollout of existing solutions
- } Further deployment of conveyor based transport system, lifts, FlatStocker, HEROfabs, HEROrails and LUNA robot cells



Conveyor



FlatStocker



Lifts



LUNA Robot Cell



HEROrail



RFID



HEROfab

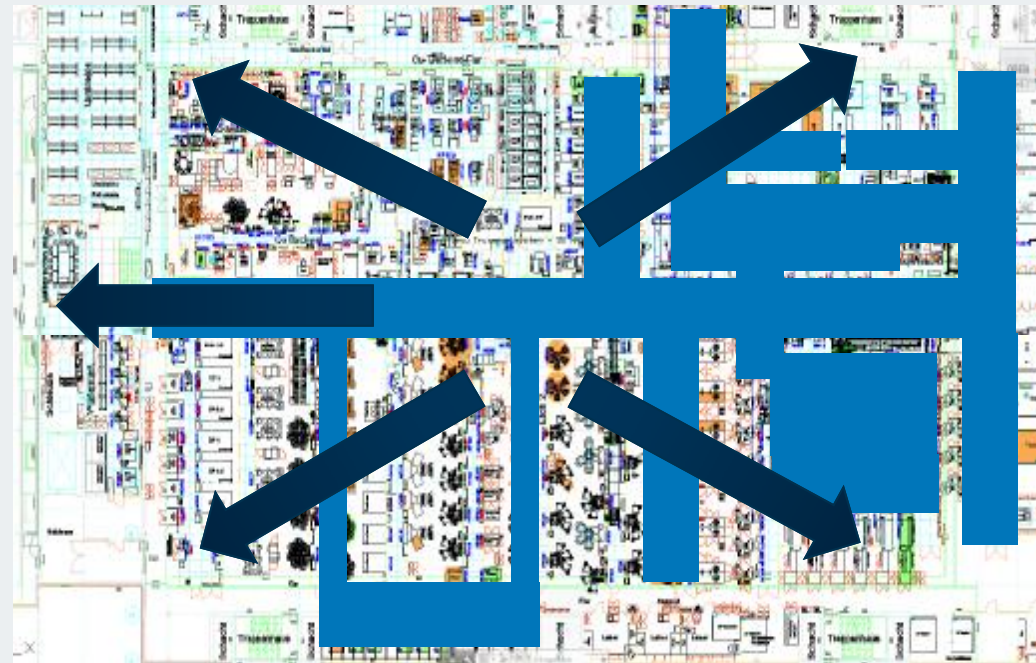


SCOUTs

Bosch's path to entire Fab Automation

Outlook

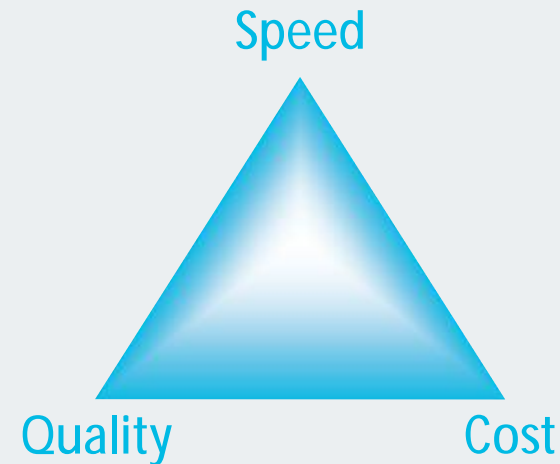
- } Vision: Complete automated material handling in all process areas
- } Automation rate > 80%
- } Acceleration of deployment
- } Permanent reduction of disturbing impact in operating fab
- } Further enhancement of automation systems (e.g. "CubeStocker")
- } Continuous improvement: performance, cost-efficiency and robustness



Bosch's path to entire Fab Automation

We created real added value!

- } Headcount Efficiency Improvements ✓
- } Equipment Efficiency Improvement / Better Utilization ✓
- } CT Reduction ✓
- } Yield Improvements ✓
- } Flattened WIP Waves ✓
- } Faster WIP Wave Processing ✓
- } Stable Flow Factor / Improved Prediction Accuracy ✓
- } Complete Product ✓



Trust in the Effects of Automation. Thank you.



Automated
Loading

Manual
Loading

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