



JEITA



Selete

Device Maker's EES Adaptation

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For More Robust Equipment Operation

e- Manufacturing Workshop

December 3, 2002

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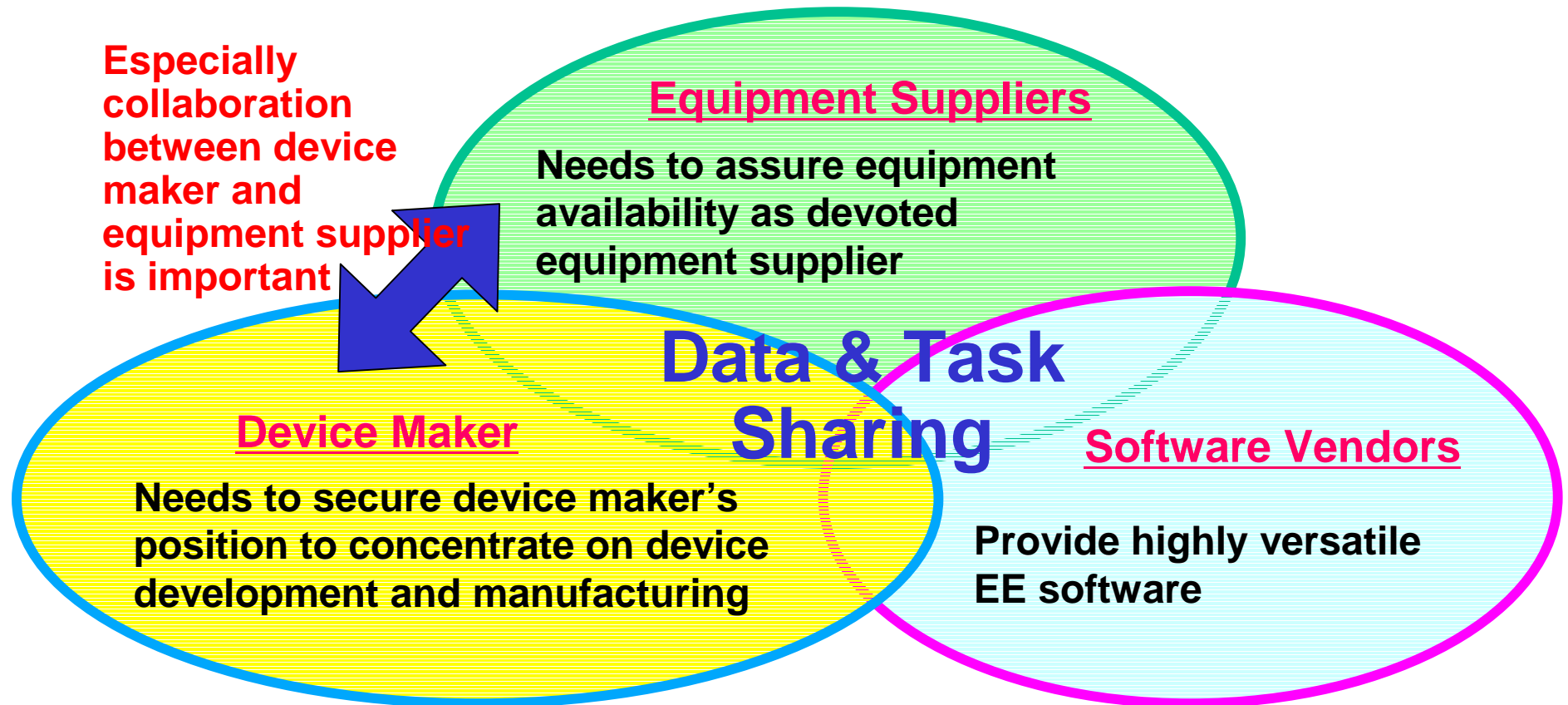


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Outline

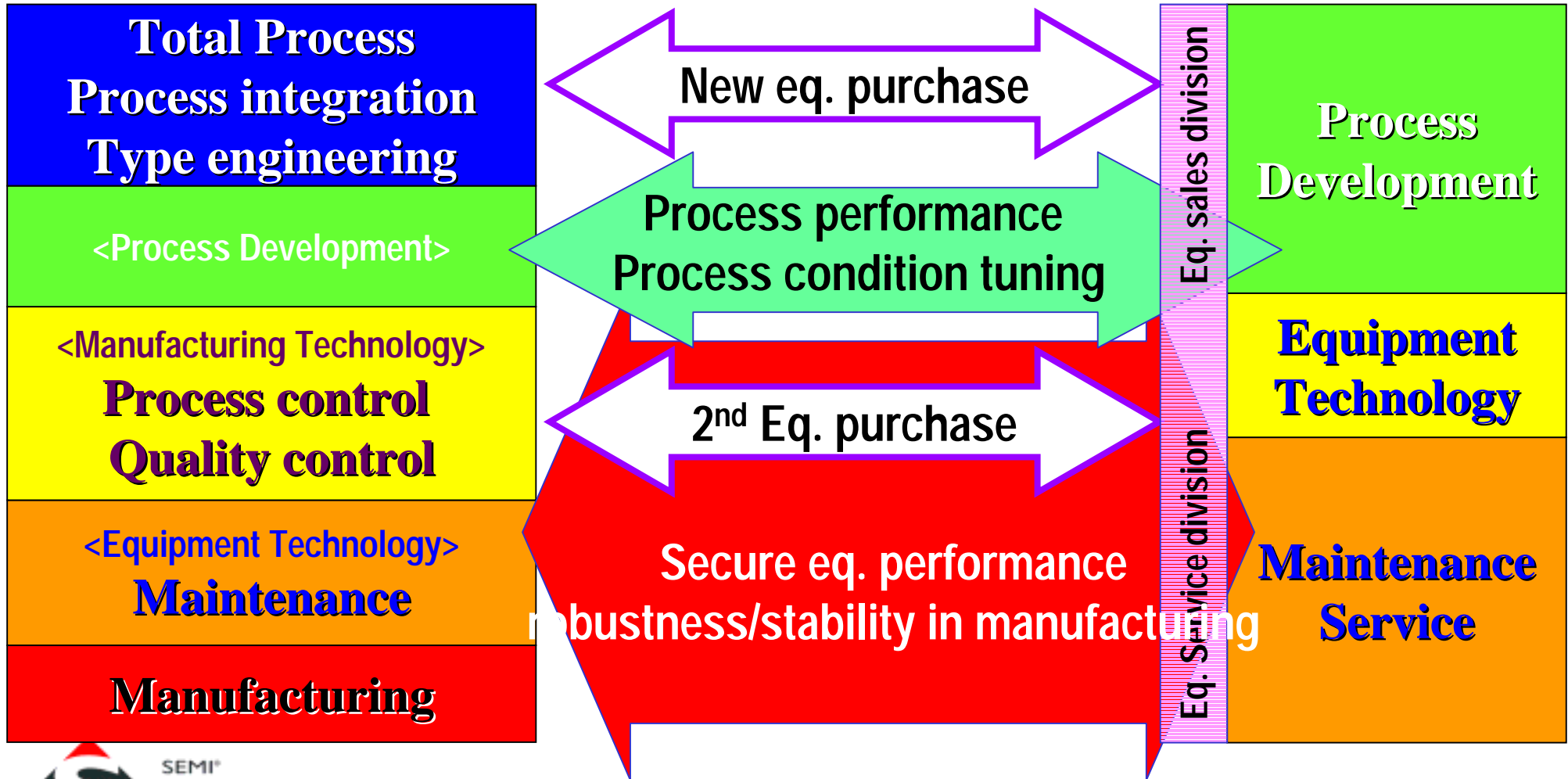
- **Task sharing scheme by EES**
- **Collaboration channel between equipment suppliers and device maker**
- ***Host-View* and *Equipment-view* EE data**
- **Examples of operation consequence analysis**
- **Importance of consequence data**
- **Device maker's EES adaptation**
 - **Comprehension of equipment and its operation**
 - Ignored consequence data
 - **Task sharing new scheme**
 - Migration to e-Diagnostics
 - **Production engineering information exchange through IT**
- **Summary**

Tasks Sharing Evolution in e-Manufacturing

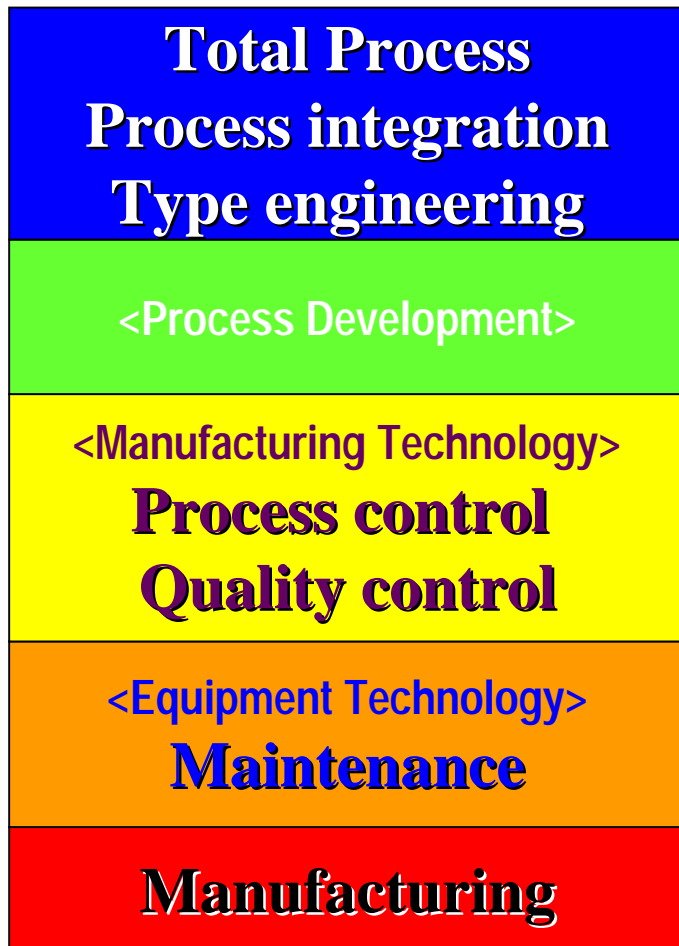


**Collaboration Goal:
Robust/stable equipment operation and manufacturing**

Collaboration Channels between Device Maker and Equipment Supplier



Collaboration Channels between Device Maker and Equipment Supplier



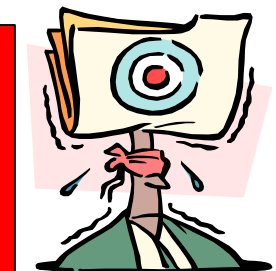
YMS data is *wafer-view* info and indirect to equipment.



Equipment-View info should be handled by IT system

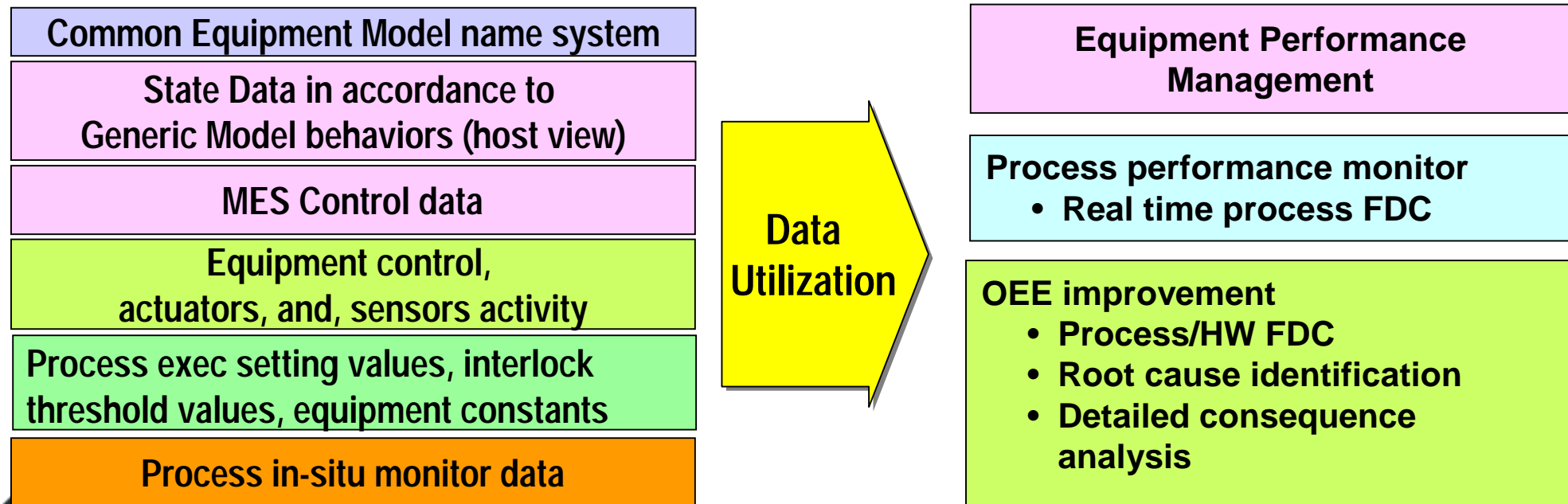


Host-View Info (MES/SCM)

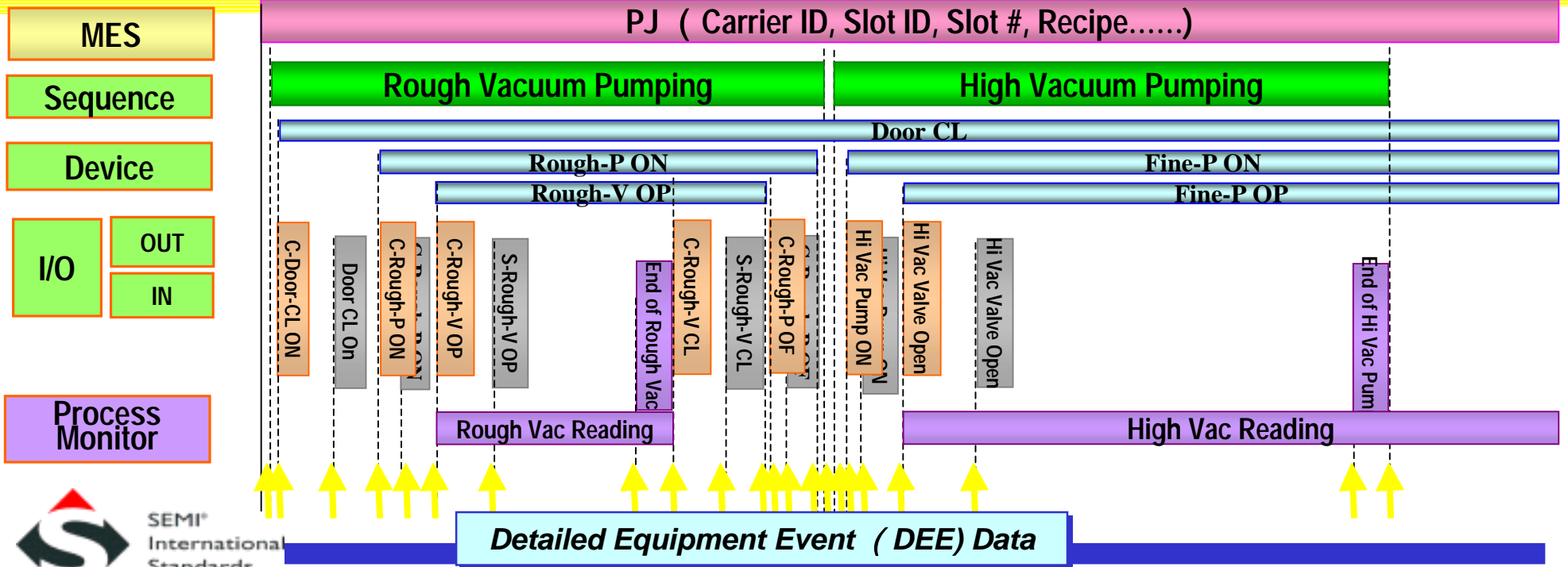
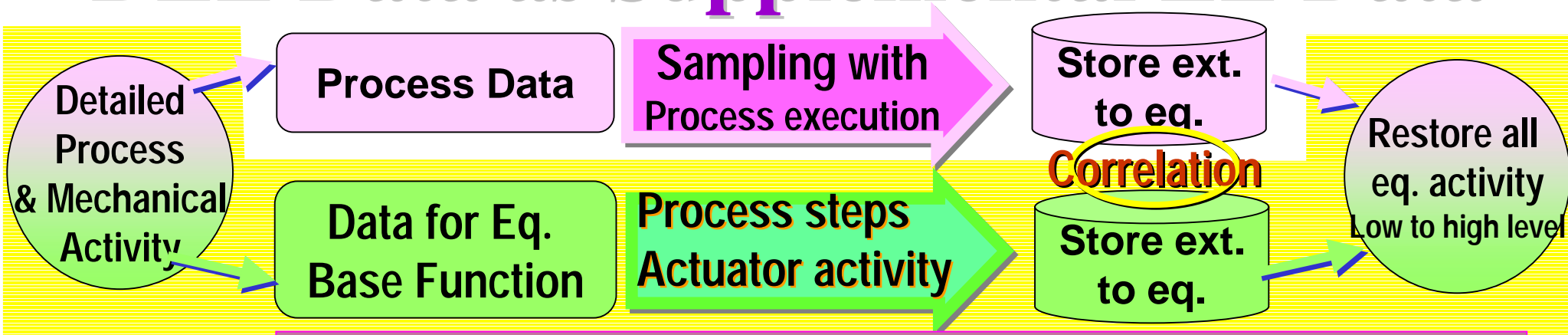


Eq. View and Host View Data

- **Host view data**
 - Supports generic equipment behavior models such as “locations” in eq.
 - Capture generic metrics
- **Equipment view data**
 - Covers equipment specific behavior
 - **Required for root cause identification and detailed analysis**



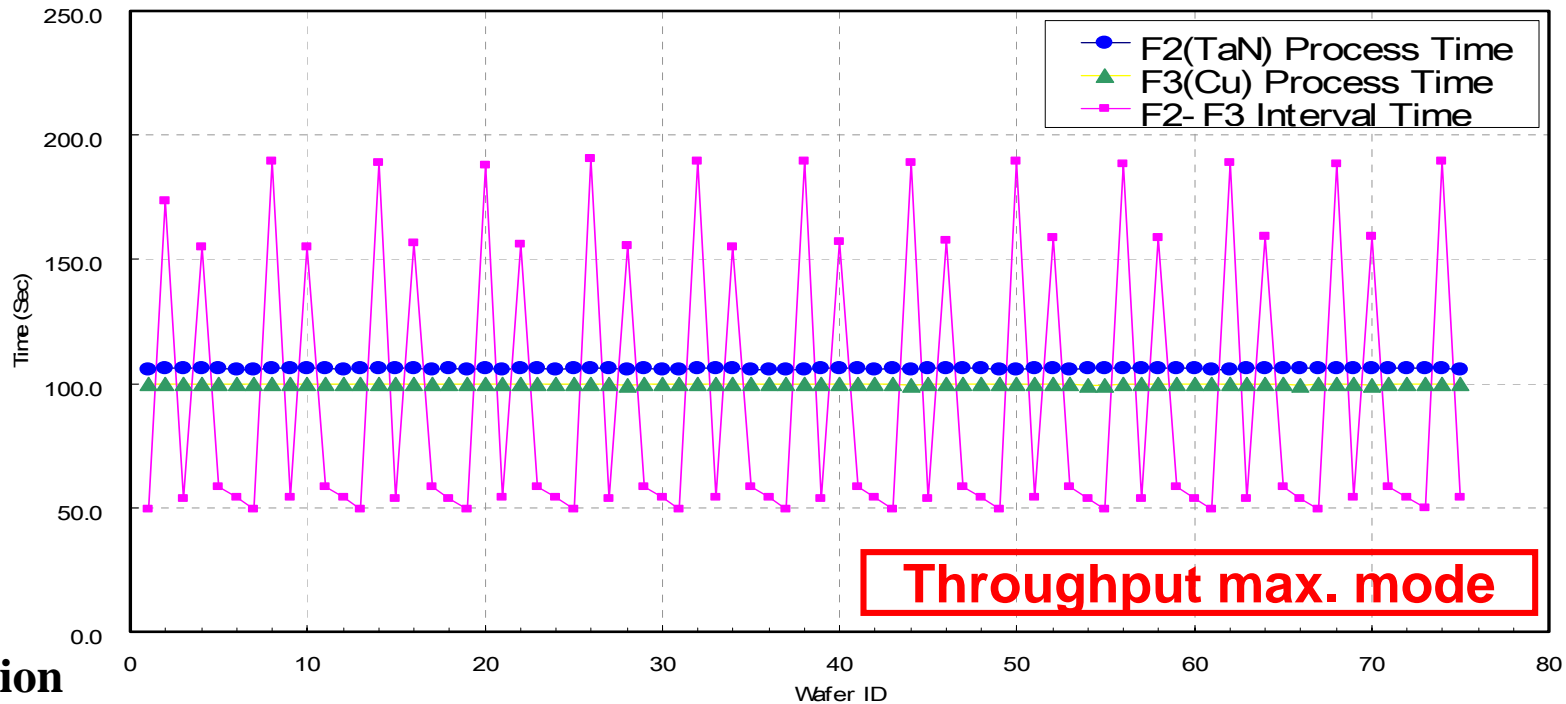
DEE Data as Supplemental EE Data



Actual Process Consequence Analysis(1)

wafer tracking: depth level 1

TaN-Cu Bi-layer Deposition



• **Observation**

– Bi layer deposition interval varies for every 6 wafers in TAT mode

• **Point to stress**

– This pattern will dramatically change with time settings

– Consequence information is again indispensable

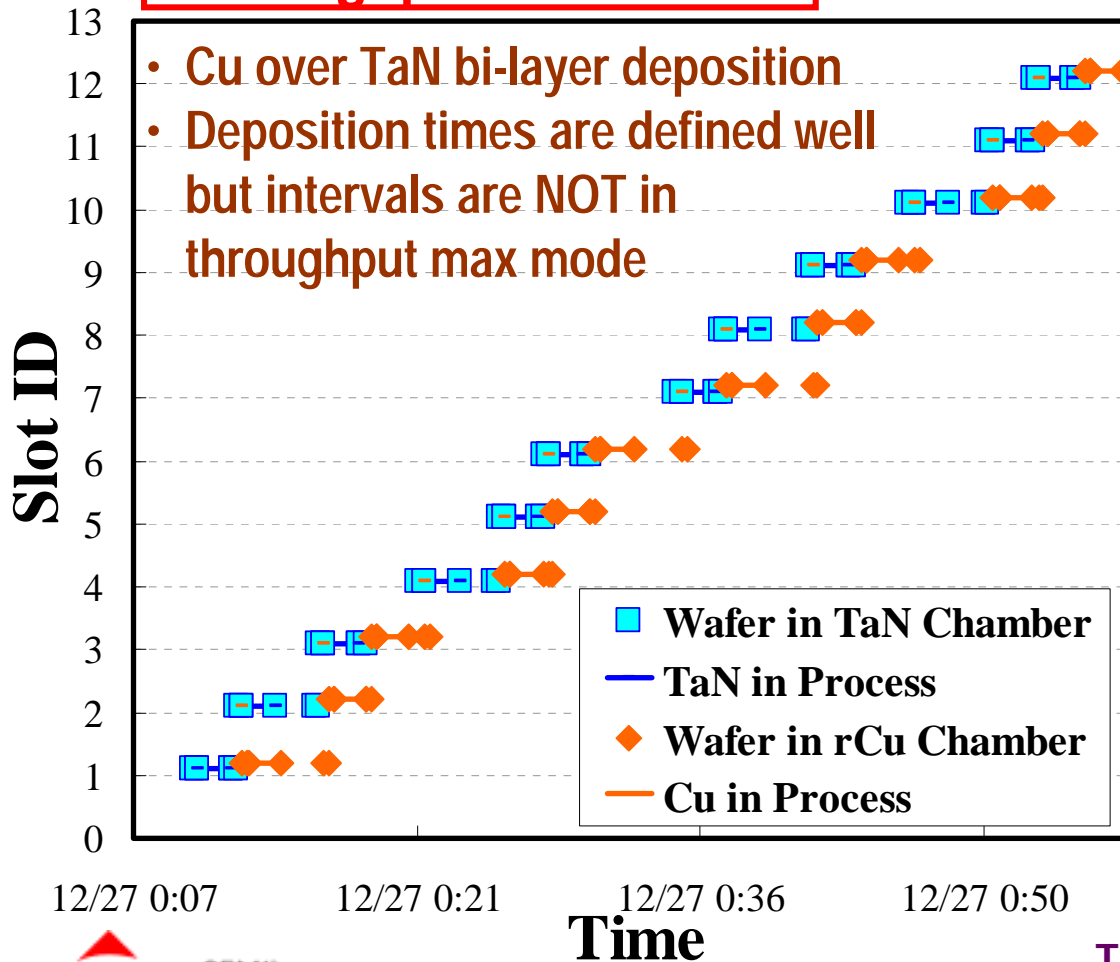
Throughput max. mode

This data is provided by a courtesy of ULVAC

Actual Process Consequence Analysis(2)

real wafer tracking: depth level 2

Throughput max. mode



- DEE data analysis was done outside of PVD tool
- Provide complete wafer tracking
 - equipment view data
- Such analysis capability reveals unseen process conditions by conventional EE effort

This data is provided by a courtesy of ULVAC

Actual Process Consequence Analysis(3)

What equipment entertains us in daily life

	1st batch	2nd batch
Slot 1	Target Cleaning	Target Cleaning
Slot 2	monitor	monitor
Slot 3	Good Yield	Good Yield
Slot 4	Good Yield	Good Yield
Slot 5	Shorts!	Shorts!
Slot 6	Shorts!	Shorts!
Slot 7	Good Yield	Good Yield
Slot 8	Shorts!	Shorts!
Slot 9	Good Yield	Good Yield
Slot 10	Shorts!	Shorts!
Slot 11	Good Yield	Good Yield
Slot 12	Shorts!	Shorts!
Slot 13	Good Yield	Good Yield
Slot 14	Shorts!	Shorts!
Slot 15	Good Yield	Good Yield
Slot 16	Shorts!	Shorts!
Slot 17	Good Yield	Good Yield
Slot 18	Shorts!	Shorts!
Slot 19	Good Yield	Good Yield
Slot 20	Shorts!	Shorts!
Slot 21	Good Yield	Good Yield
Slot 22	Shorts!	Shorts!
Slot 23	Good Yield	Good Yield
Slot 24	Shorts!	Shorts!
Slot 25	Good Yield	Good Yield

- All the sudden the yield gave a dive!
 - Shorts between wires in the same layer
 - Finally whiskers were found to bridge wires

***This is NOT what happened to ULVAC equipment.**

Actual Process Consequence Analysis(4)

What equipment entertains us in daily life

		1st Batch	2nd Batch
Slot	1	Whitely & Whiskers	Whitely & Whiskers
Slot	2	Whiskers	Whiskers
Slot	3	Good Yi el d	Good Yi el d
Slot	4	Good Yi el d	Good Yi el d
Slot	5	Whiskers	Whiskers
Slot	6	Whiskers	Whiskers
Slot	7	Good Yi el d	Good Yi el d
Slot	8	Whiskers	Whiskers
Slot	9	Good Yi el d	Good Yi el d
Slot	10	Whiskers	Whiskers
Slot	11	Good Yi el d	Good Yi el d
Slot	12	Whiskers	Whiskers
Slot	13	Good Yi el d	Good Yi el d
Slot	14	Whiskers	Whiskers
Slot	15	Good Yi el d	Good Yi el d
Slot	16	Whiskers	Whiskers
Slot	17	Good Yi el d	Good Yi el d
Slot	18	Whiskers	Whiskers
Slot	19	Good Yi el d	Good Yi el d
Slot	20	Whiskers	Whiskers
Slot	21	Good Yi el d	Good Yi el d
Slot	22	Whiskers	Whiskers
Slot	23	Good Yi el d	Good Yi el d
Slot	24	Whiskers	Whiskers
Slot	25	Good Yi el d	Good Yi el d

Whiskers grow in determined slots

No way to stop production!

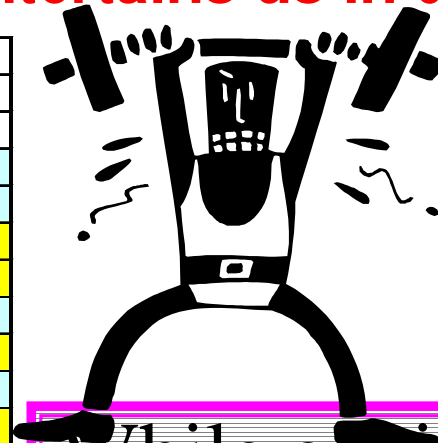


***This is NOT what happened to ULVAC equipment.**

Actual Process Consequence Analysis(5)

What equipment entertains us in daily life

	1st batch	2nd batch
Slot 1	Target Cleaning	Target Cleaning
Slot 2	monitor	monitor
Slot 3	Product wafer1	Product wafer13
Slot 4	Product wafer2	Product wafer14
Slot 5	Dummy	Dummy
Slot 6	Dummy	Dummy
Slot 7	Product wafer3	Product wafer15
Slot 8	Dummy	Dummy
Slot 9	Product wafer4	Product wafer16
Slot 10	Dummy	Dummy
Slot 11	Product wafer5	Product wafer17
Slot 12	Dummy	Dummy
Slot 13	Product wafer6	Product wafer18
Slot 14	Dummy	Dummy
Slot 15	Product wafer7	Product wafer19
Slot 16	Dummy	Dummy
Slot 17	Product wafer8	Product wafer20
Slot 18	Dummy	Dummy
Slot 19	Product wafer9	Product wafer21
Slot 20	Dummy	Dummy
Slot 21	Product wafer10	Product wafer22
Slot 22	Dummy	Dummy
Slot 23	Product wafer11	Product wafer23
Slot 24	Dummy	Dummy
Slot 25	Product wafer12	Product wafer24



Use dummies for slots corresponding to whiskers

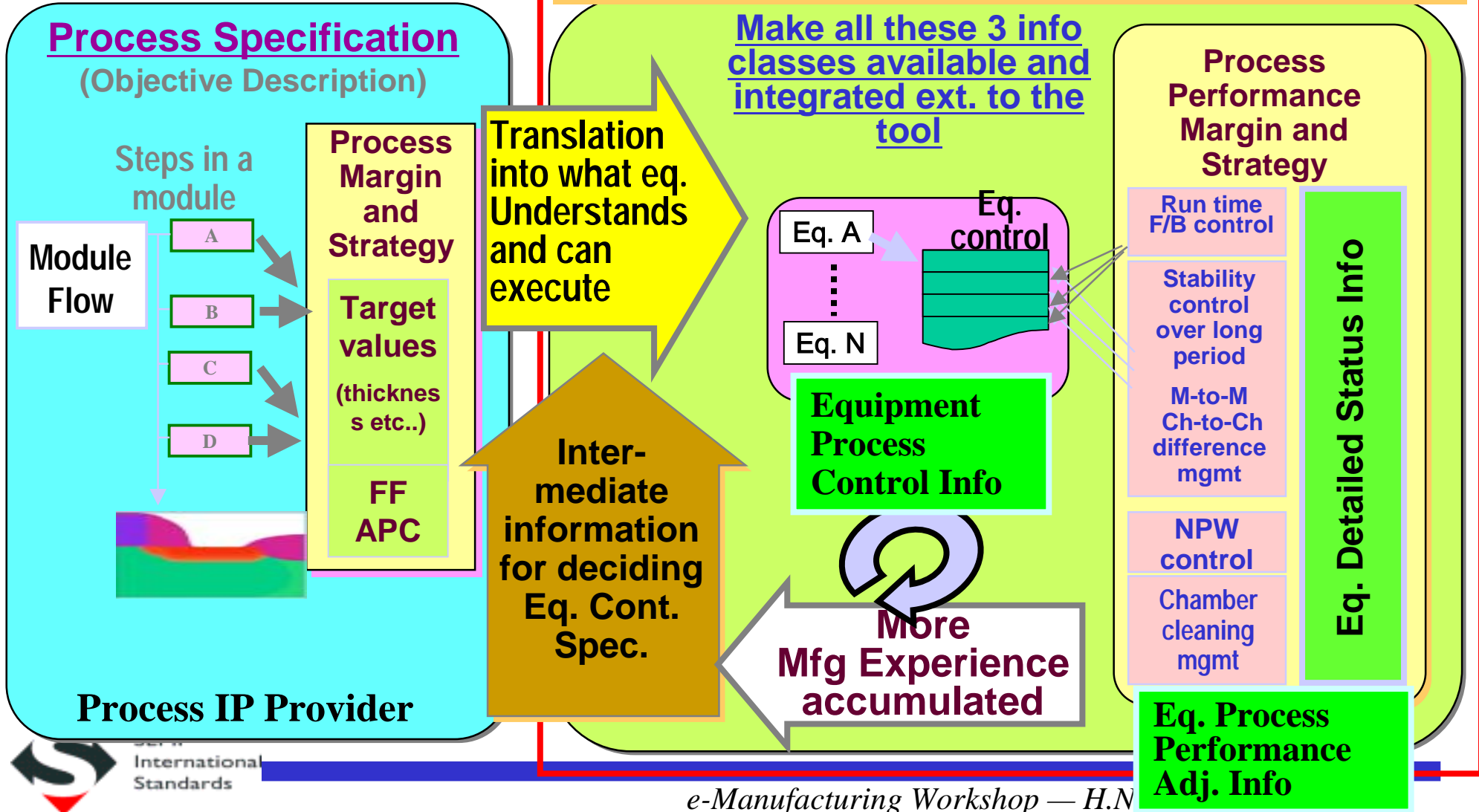
While equipment is operating in full accordance with recipe and there is NO such malfunction or blunders, still it is producing MANY defective wafers...

What we should learn

- Equipment can very easily produce defective wafers
 - Even the most stable process equipment can kill us
 - Still we need to keep running the tool forcibly.
- Equipment has its own conditions and circumstances
 - Recipe is a mere procedure manual for equipment
 - Some of the current tools deliver not enough data that allows us to explore equipment conditions and circumstances
- Equipment's operation consequence data availability is so crucial to us *who do weight lifting everyday*
 - Dear equipment suppliers, please understand this data needs.

EES EE Domain Info Integration

Integrated Eq. Process Control Information Platform



Summary: DM's Expectations

- **Process execution has to be stable**
 - **DM wants eq. suppliers to participate in full extend in this effort**
 - **Current situation is that equipment is NOT stable/robust**
 - **Equipment circumstances are prevailing**
- **This is a long range effort to improve equipment stability and robustness in all means**
 - **Both parties should pursue the best effort**
 - **Current situation requires a strong collaboration scheme**
 - **Collaboration assumes data sharing**
 - **Stress on the equipment operation consequence data to ease analysis and identification of root cause of process performance instability**