ITRS Factory Integration TWG

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2009 Edition Contributors:

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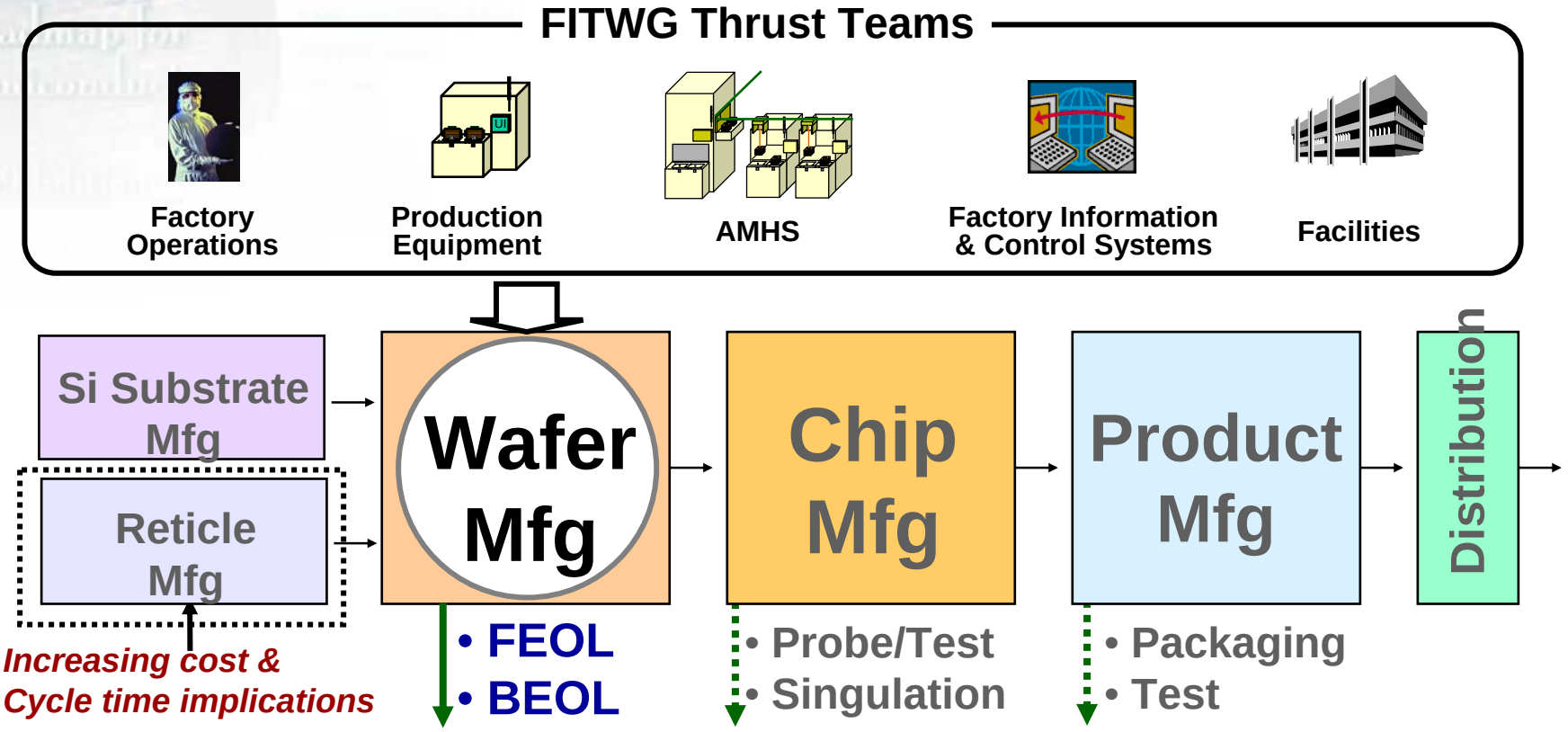
Factory Integration Scope and Drivers



Factory is driven by Cost, Quality, Productivity, Speed, and Flexibility

- Reduce factory capital and operating costs per function
- Faster delivery of new and volume products to the end customer
- Efficient/Effective volume/mix production, high reliability, & high equipment reuse
- Enable rapid process technology shrinks as well as systematic productivity waste reduction

Overall Changes in FI TR Tables

- **Reviewed all TR tables**
  - Gathered FO requirements to FO table
  - Removed (old) metrics that became business driven

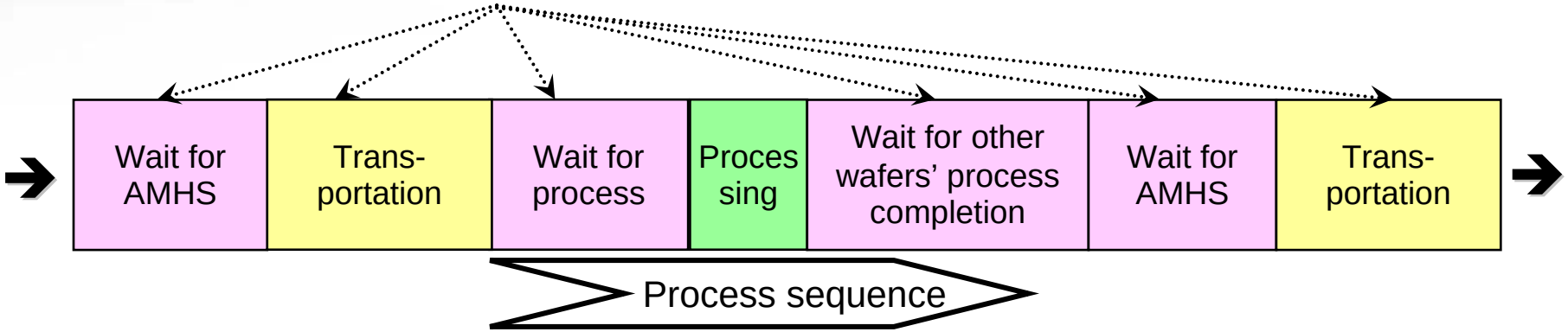
#	Sub-Teams	Change in Metrics #			
		2008	Deletion Export	Addition Import	2009
1	Factory Operation	19	13	6	12
2	Production Equipment	11	7	1	5
3	Factory Information and Control Systems	6	0	3	9
4	Material Handling Systems	16	8	0	8
5	Facility	12	2	0	10
	Overall	64	30	10	44

FI 2009 Focus Area

2009 Topics		Rationale and Address
1	Incorporate *Waste Reduction* as part of FI roadmap	➢ Si scaling alone is thought to be insufficient to drive cost reduction. ➢ Rapid market changes call for further cycle time reduction. ➢ Waste reduction approach was identified as the enabling technology to allow cost and cycle time reduction with optimization scheme. ➢ FI decided to incorporate principle waste metrics/indicator to drive waste reduction in ITRS
2	NGF/450mm	➢ Next Generation Factory is defined as systematic execution of waste reduction ➢ FI developed time waste and throughput waste indicators for waste visualization ➢ Systematic visualization implementation is required before 450mm factory implementation

Examples 1: Wait Time Waste

- **These waiting times are "Waste" from cycle time view point**



- **Cycle time waste indicator**
  - ☞ **Through-process wafer view for total waste visualization**
  - ☞ **Waite Time Waste**
  - ➔ **WTW (average) = Σ (wait time)/ N [day/mask layer]**
    - ➢ **Where N: # of total masks**

Waiting Time Waste Indicator in TR Table

- WTW (average) = Σ (wait time)/ N [day/mask layer]
  = Σ (CT^{25}-CT_{SHL})[day/mask layer]

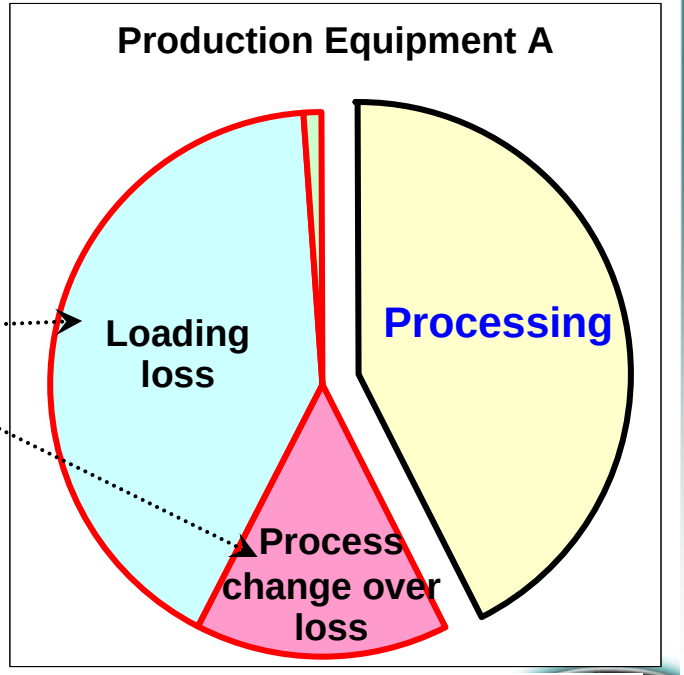
  - **CT : Cycle time for production lots [days/mask]**
  - **CT_{SHL} : Cycle time for super hot lots/mask [days/mask]**
  - **N : # of total masks**

	Year	2009	2010	2011	2012	2013	2014	2015
Cycle Time [days / mask layer]	Super Hot-Lot	0.32	0.32	0.32	0.31	0.31	0.3	0.3
	Normal production (25W)	1.5	1.5	1.5	1.4	1.4	1.20	1.20
Waste Indicators	WTW^{25} (average) [days/mask layer]	1.18	1.18	1.18	1.08	1.08	0.90	0.90

Example 2: Equipment Output Waste

- **Cost related waste indicator**
  - Wafer throughput is a direct indicator of W cost
  - Through-process equipment view for total waste visualization
  - Equipment Output Waste
  - ➔ **EOW (average) = $(\Sigma(TH^0-TH^{25})/ TH^0) / N$ [%]**
    - Where N: # of total process tools

- **Rest of processing time is considered as "Waste" from throughput view point**



Simplified OEE chart

Hypothetical comparison of OEE and EOW

★ **EOW (average) = (Σ(TH^0-TH^{25})/ TH^0) / N [%]**

- ☞ TH^0 : maximum throughput without any disturbance
- ☞ TH^{25} : the averaged throughput over a month period
- ☞ N : # of total process tools

Year		2009	2010	2011	2012	2013	2014	2015
Waste indicators	EOW (average) [%]	45	45	45	35	35	25	25

	OEE	Change-over	Rework	Set-up	USDT	Speed loss	idle	Scrap	PM, Test	EOW[%]
Before improvement	43	11	4	17	3	2	14	2	4	46
After improvement	56	11	2	10	2	1	14	2	2	33

Summary

- **2 waste indicators WTW & EOW have been introduced to address waste reduction as additional cost reduction scheme**
  - **“Fab-overall” characteristics provides high level view**
  - **Waste reduction road map will be fine-tuned as FI TWG collect more WTW and EOW data**
  - **Inter- and intra-TWG effort for waste reduction is to be promoted**
- **Waste visualization and reduction scheme can be implemented before the next wafer size insertion**
  - **Bi-directional equipment visibility**
  - **Common indicator / metrics definition and data usage**