ITRS Factory Integration

Shige Kobayashi, Tom Jefferson

July 2008

San Francisco, USA

2008 Contributors:

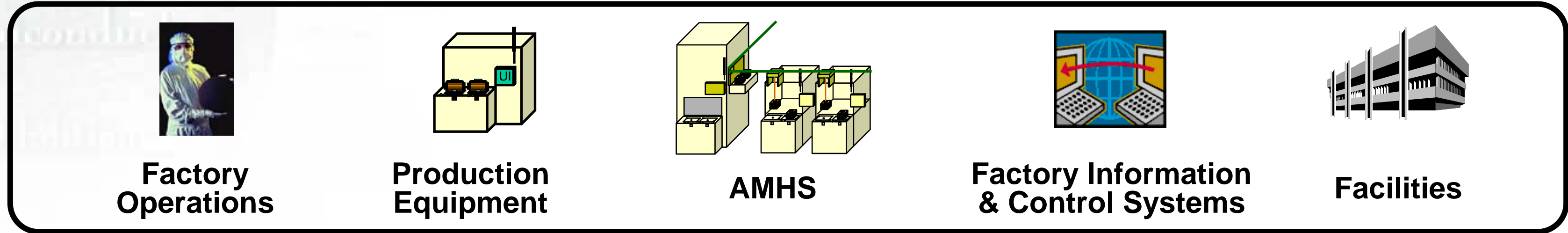
Terry Francis, Gopal Rao, Al Chasey, Les Marshall, Todd Lasater, Brad van Eck, Kenjiro Nawa, Daniel Babbs, Dave Eggleston, Mutaz Haddadin, Gavin Rider, Andreas Neuber, Eric Englhardt, Peter Csatary, Adrian Pyke, Mikio Otani, Bill Fosnight, Richard Oeschner Junji Iwasaki, Mazafumi Fukushima, Tomoyuki Masui

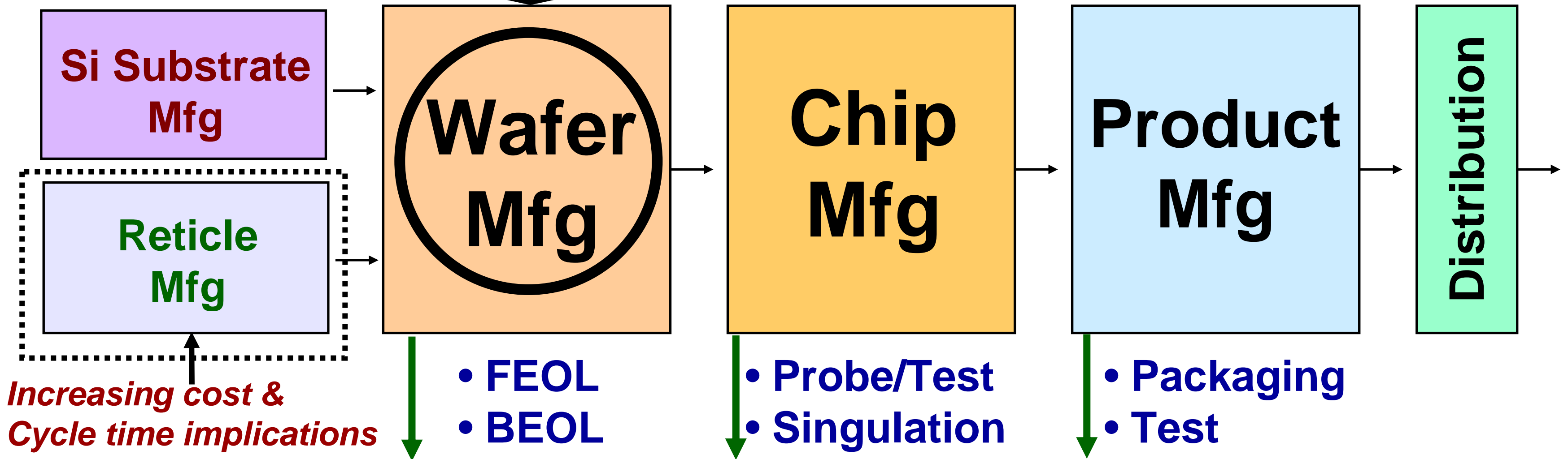
Global Co-Chairs:

Europe:	**Arieh Greenberg**
Japan:	**Shige Kobayashi, Michio Honma**
Korea:	**S. H. Park**
Taiwan:	**Thomas Chen**
US:	**Tom Jefferson**

DRAFT – DO NOT PUBLISH

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 and wafer size changes

DRAFT – DO NOT PUBLISH

Key Technologies that will Impact Factory Design

- 2008 and future years are targeted to meet productivity and capture technology requirements
- Key process & device technology intercepts that will impact the factory design are Extreme Ultraviolet Litho (EUVL), new materials, 450mm conversion, significant productivity improvements, and waste (inefficiencies) reduction
- Economic and business challenges are equal to our manufacturing and process technology challenges in scope and breadth to attain efficiency and effectiveness

	Near Term Years			
Year	2008	2009	2010	2011
Technology trend (nm)	65	55	50	45
Wafer Size (mm)	300	300	300	300

Planning for NGF/450mm

	Long Term Years									
Year	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Technology trend (nm)	40	35	32	28	25	22	20	18	16	14
Wafer Size (mm)	450	450	450	450	450	450	450	450	450	450

EUVL in Production?

450mm ?
NGF ?

DRAFT – DO NOT PUBLISH

FI 2008 Focus

Enable the Transition to NGF / 450mm for cost, cycle time & productivity improvement		
2008 Topics		Result
1	Incorporate waste (inefficiency) reduction as part of FI roadmap	-Defined initial factory integration high level metrics for creation of a waste reduction roadmap -Equipment Output Waste -Wait Time Waste -Completed initial draft of package to communicate waste reduction roadmap approach
2	Improve data quality, & time to information	- Defined strategy for integrating time synchronization and data handling requirements between production equipment and factory information and control systems.
3	Develop Facilities modeling methodology	- Initial development of a modeling methodology for evaluating factory size and cost relationship
4	FOUP Airborne Molecular Contamination (AMC) requirements	- In conjunction with the Yield Enhancement TWG, reached consensus on monitoring and control methods, and developed initial requirements

FI 2009 Focus

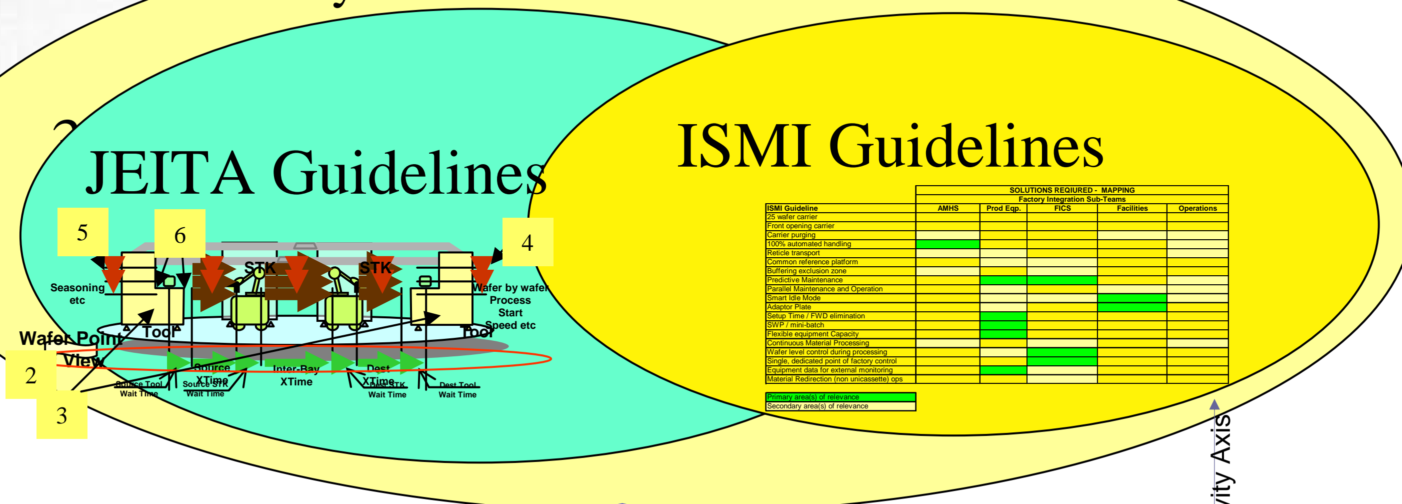
Enable the Transition to NGF / 450mm for cost, cycle time & productivity improvement		
	Focus Areas	**2009 Goals**
1	Incorporate waste reduction as part of FI roadmap	Inclusion of initial high level Waste Reduction metrics and roadmap in FI Technical Requirements tables
2	Improve data quality, & time to information	Definition of requirements for equipment and factory data handling rates to improve equipment and productivity monitoring
3	Airborne Molecular Contamination Requirements	Incorporate AMC limits for wafer carriers into technical roadmaps and document potential solutions
4	Facility Modeling Methodology	Completion of a functional model validated against benchmarked data
5	Address FI Cross-cut issues	Address NGF/450mm and identify common areas of waste reduction needs and challenges. Address FI key issues with FEP (Carrier Purging), Litho (Reticle Electrostatic Field, Double Patterning), ESH (Energy conservation), YE (AMC, PCS for Yield) and Metrology (Wafer map standards).

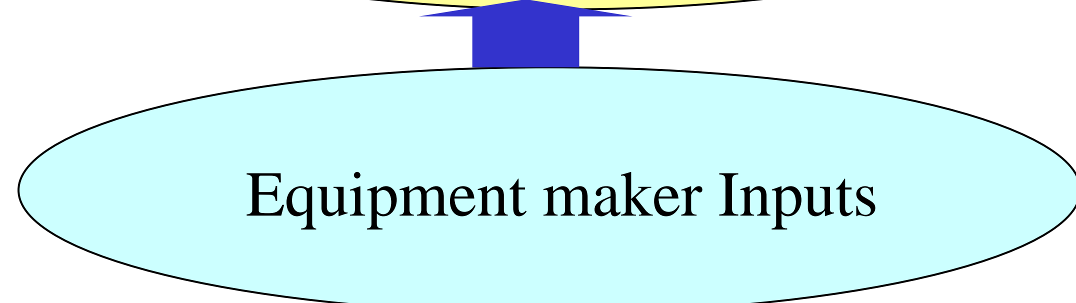
Other Focus Areas will be Addressed as Required

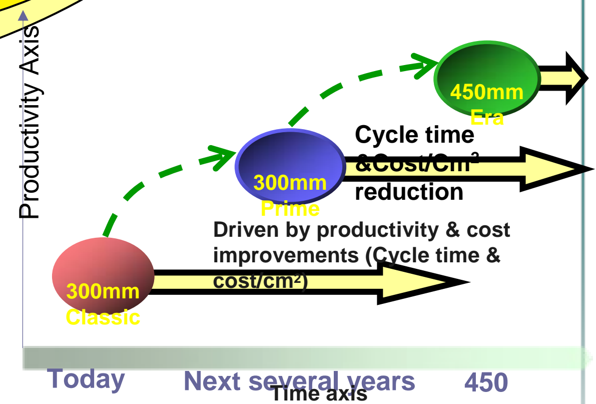
Supporting Materials
For ITRS Factory Integration 2008 and 2009 Focus Areas

NGF/450mm Fab Guidelines

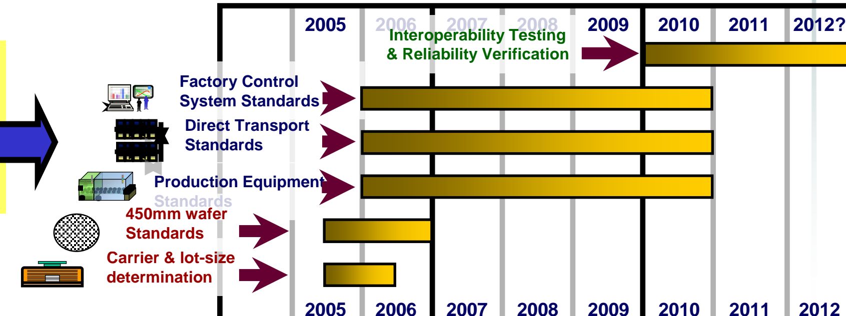
NG Factory Guidelines combined with ITRS TR & PS







ITRS FI TWG will synchronize with NGF and 450mm guidelines to address FI challenges, technology requirements and potential solutions



Courtesy: JEITA/ISMI

DRAFT – DO NOT PUBLISH

More Detailed Representation of Factory Waste

Factory Integration Working Group Focus

Factory View	***Wait time Waste***	***Equipment Output Waste in Factory***	***People Output Waste in Factory***
Unit View	***Silicon Waste***	***Equipment Resource Waste***	***People Capability Waste***
	Wafer	***Equipment***	***People***

Waste Reduction Activity Time Table

	2008				2009						
	July	Aug-Oct	Nov	Dec	Jan	Feb	Mar	April	May	Jun	July
ITRS Events	☆ Summer Mtg			☆ Winter Mtg				☆ Spring Mtg			☆ Summer Mtg
2008 Focus Area manuscript	Manuscript →										
Winter meeting preparation		Work with other TWGs to pilot W/R →									
Material for IRC consideration				Review of W/R approach →							
Spring meeting preparation				FI W/R TR tables development → Working with Other TWGs →							
Finalizing '09 ITRS								W/R Write Up for 2009 ITRS →			

DRAFT – DO NOT PUBLISH

Wait Time (WTW) and Equipment (EOW) Output Waste

Issue: Comprehensive data collection of factory resource activities

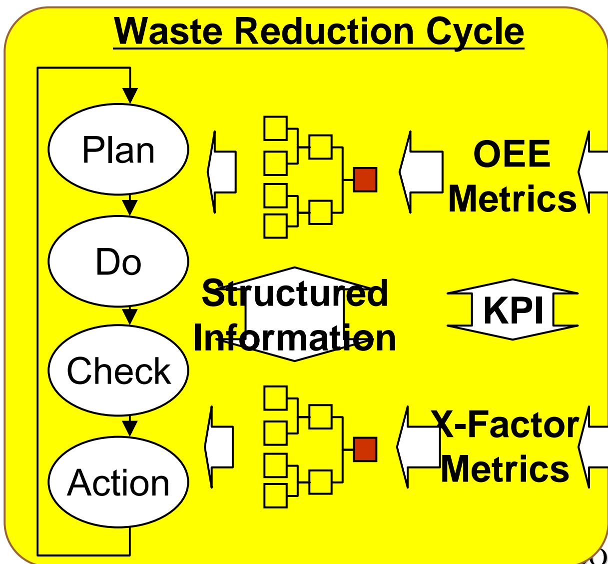
Addition of related factory resource activity data(; equipment, AMHS, operators, facility)

Standardization of data definition

Data collection automation

W/R :Waste Reduction
WTW :Wait Time Waste
EOW :Eqp Output Waste

E79



EOW Reference

W/R

WTW Reference

Bottleneck Resource

by Lot
by Wafer

1

2～N

AMHS

Operators

Facility

Availability Efficiency Losses

Operation Efficiency Losses

Rate Efficiency Losses

Assignable Quality Losses

Theoretical Production Time

Operation View
- Lot Size
- Batch Size
- Dandori
- Hot Lot
- Dispatch Rule

Trade-Off

Raw Process Time

Wait Time

Product View

Resource View

Cycle Time

by Process Steps

DO NOT PUBLISH

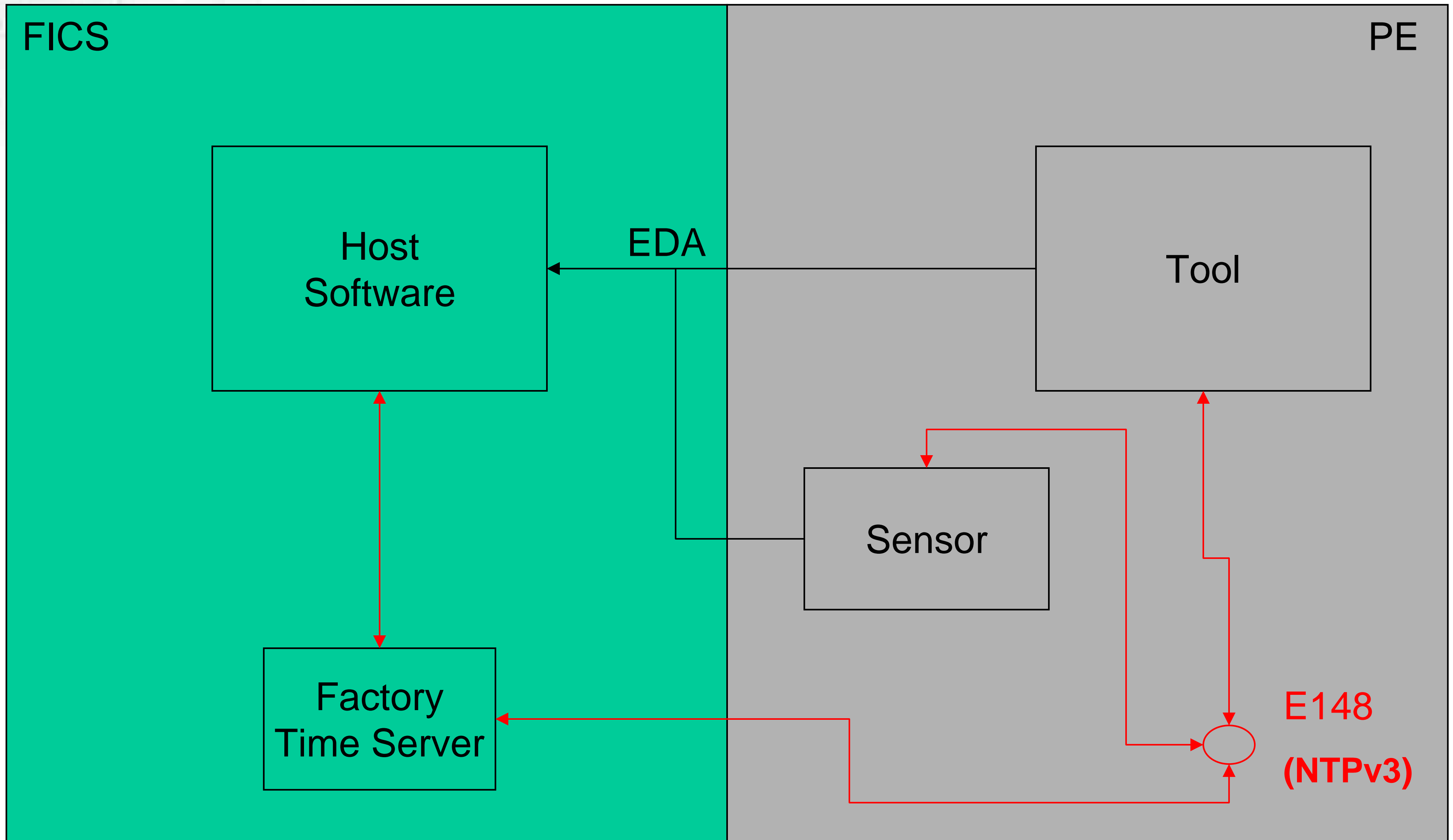
Applying Waste Reduction to Drive The Industry in the Proper Direction

- Wait Time Waste
  - **Baseline = time to process a single wafer in an un-loaded tool = CTmin**
  - **Actual performance = cycle time of wafer when processed in production with large lot**
  - **Waste = (actual CT-CTmin)/CTmin**

- **Equipment Output Waste**
  - **Baseline = designed equipment output capability (wph)**
  - **Actual performance = actual good production wafer output of the equipment in production**
  - **Waste = (capacity-actual good wfrs)/capacity * 100**

DRAFT – DO NOT PUBLISH

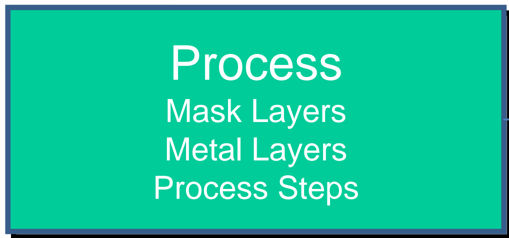
Data Collection Roadmap

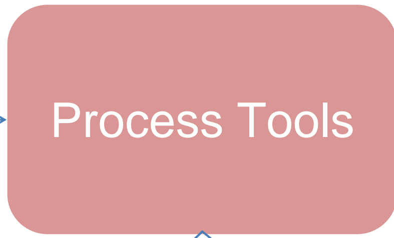


Data Frequency

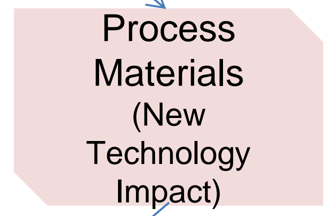
Time Synchronization

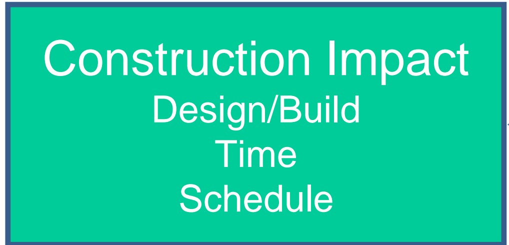
Methodology for Future Facility Modeling High Level Approach



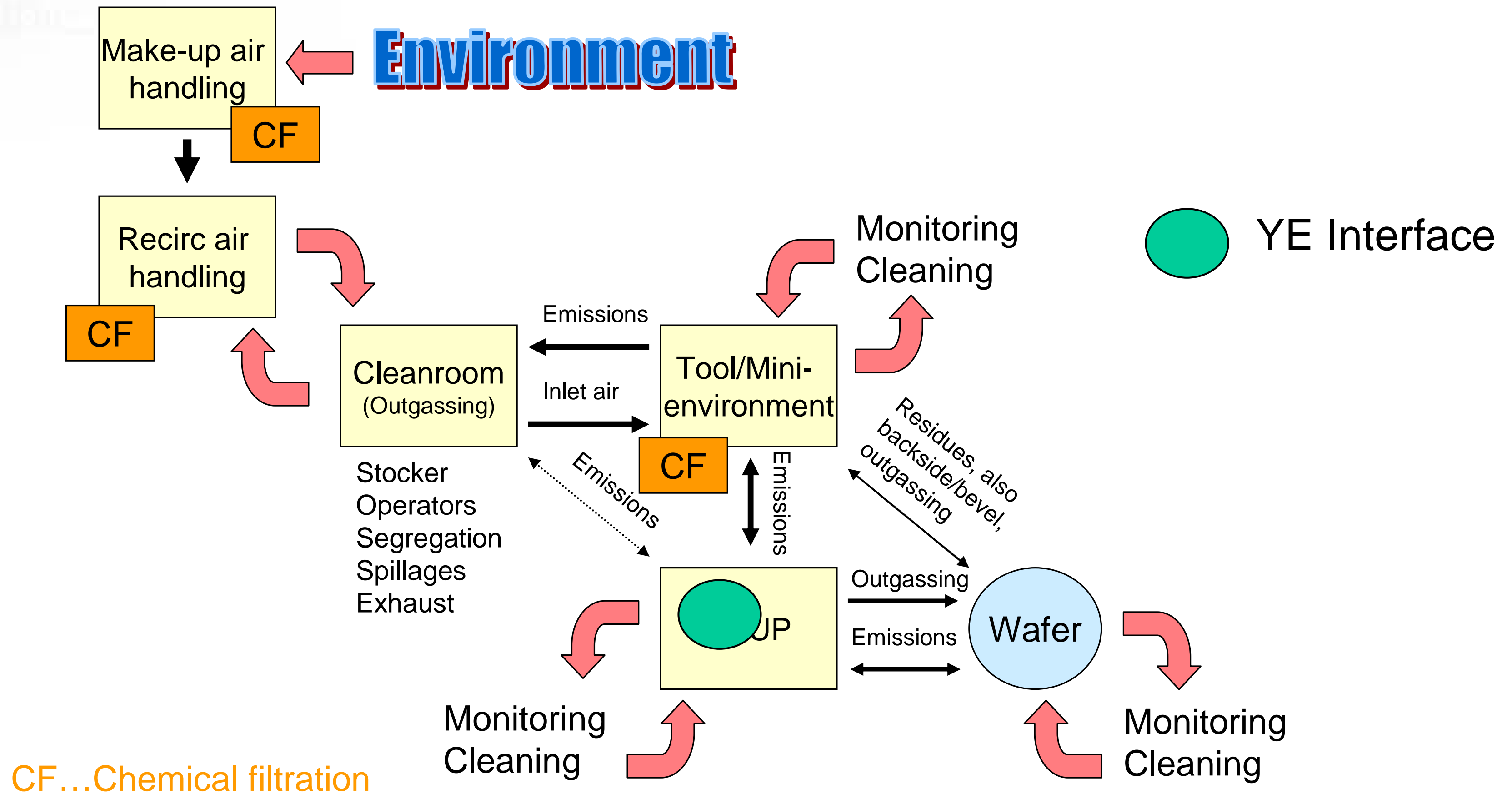


HIGH LEVEL
First Draft
Average Tool Size
Tool Scaling Factor
Admin Scaling Factor
Support Space Scaling Factor
Cost per square foot





Total AMC Concept



CF…Chemical filtration