

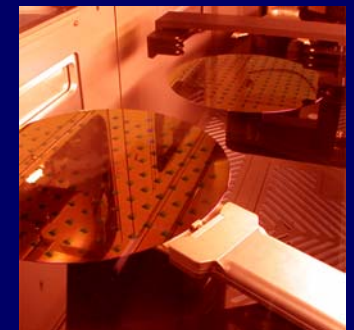
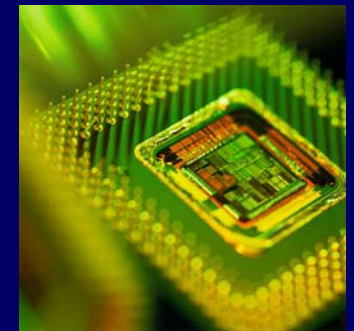


SEMICON West 2009

Accelerating Manufacturing Productivity

ISMI Next Generation Factory Program Industry Briefing

Olaf Rothe
NGF Program Manager
July 15, 2009
San Francisco Marriott



ISMI NGF Program 2009

ISMI Background

Briefing Updates

Vision and Mission

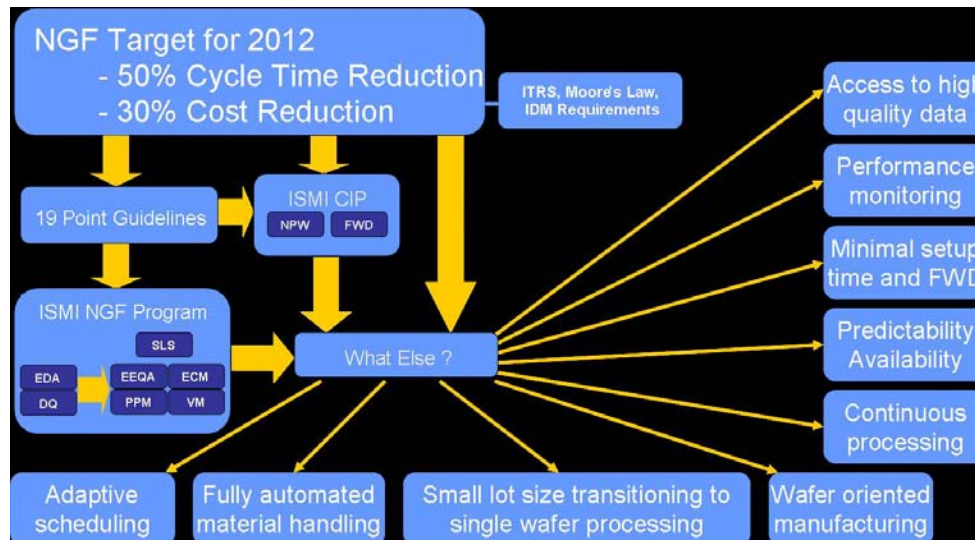
Capabilities & Infrastructure

ISMI NGF Project Updates

Metrics: Cost and Cycle Time

OEE, Visualization, and Waste

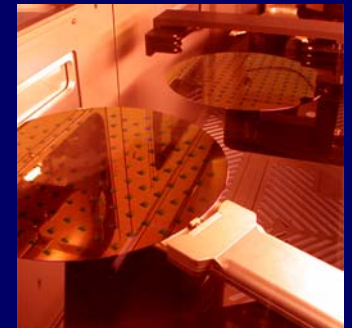
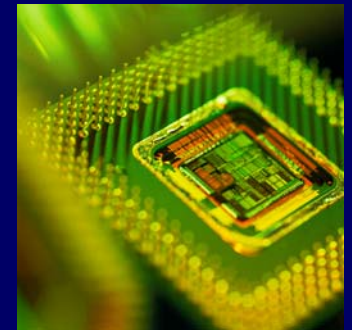
NGF Key Messages





Accelerating Manufacturing Productivity

ISMI Background



Worldwide Cooperation



GLOBALFOUNDRIES



TOSHIBA



UMC

FULLER ROAD
MANAGEMENT
CORPORATION



AGC



tok

What Does ISMI do for Members?

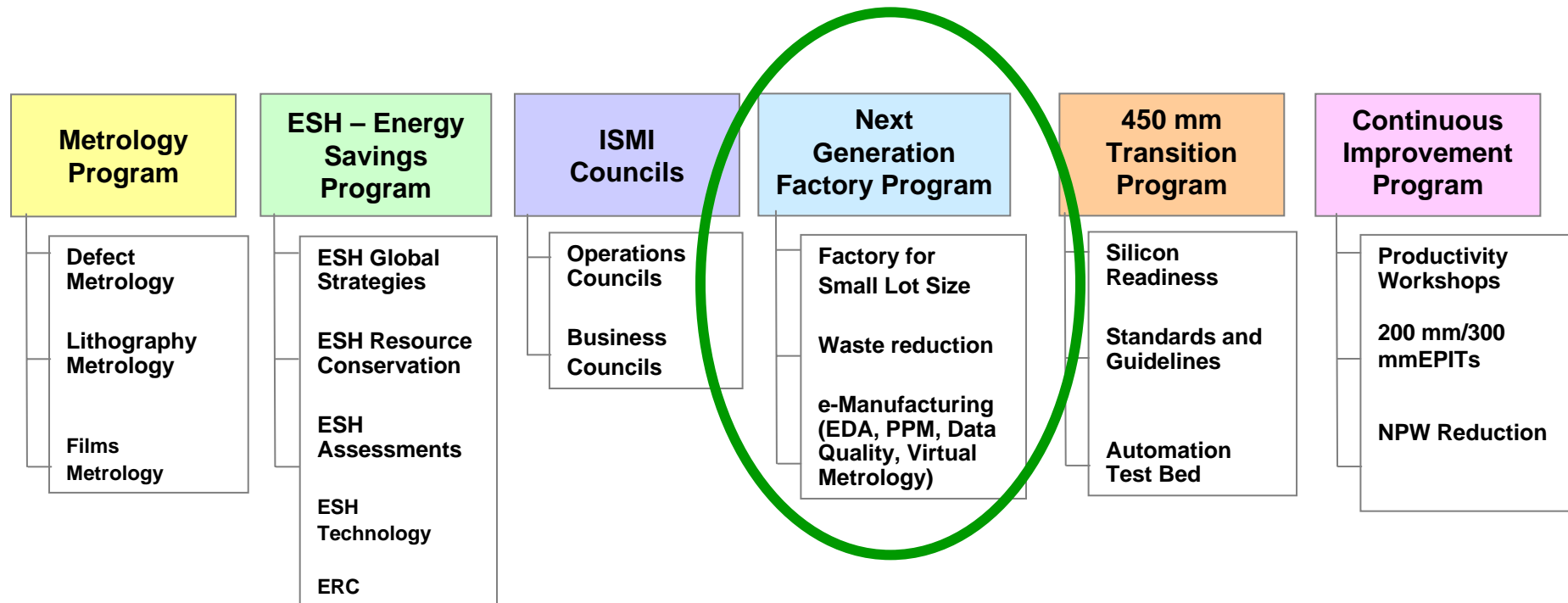
- The Productivity Challenge
 - How to achieve and maintain world class fab productivity
 - How to solve both today's productivity problems and tomorrow's
- The Cost Reduction Challenge
 - How to continuously reduce costs in today's fabs
 - How to manage ever increasing capital,



ISMI Programs



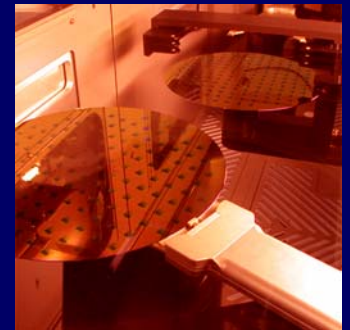
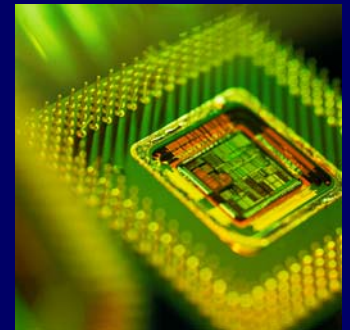
- An extensive set of 30 projects in 6 programs – focus on increasing productivity and decreasing cost





Accelerating Manufacturing Productivity

ISMI NGF Briefing Update



ISMI NGF Program 2009

Update Since Last Industry Briefing



- Economic downturn has brought tactical, short-term benefit requirements, especially cost reduction to the forefront; the NGF program continues to maintain a long-term strategic component
- Same timeline and same target
- Clearer vision and mission
- Focus on fewer projects
- More balanced approach on cost and cycle time
- Participating member companies have greater degree of alignment, involvement, and engagement
- Recognition that ISMI projects' contribution to target may leave a gap
- Time waste reduction included in the NGF program with emphasis on metrics development and measurement
- Complementary forward-compatible approach of 300 mm NGF to 450 mm

ISMI NGF Program 2009

Vision and Mission

ISMI NGF Program Vision

Enable an industry collaborative productivity improvement path for next generation factories that contributes to the ISMI member company targets of 30% cost reduction and 50% cycle time improvement by 2012.

Mission

The ISMI NGF Program is committed to accelerating cost-effective manufacturing through the collaborative development of infrastructure elements and industry guidance to enable the capabilities that improve next generation factories.



ISMI NGF Program 2009

Member Company Requirements

- Substantial productivity improvement is still required for 300 mm factories
- New NGF capabilities are expected to be implemented in new and existing 300 mm factories
- Most NGF capabilities are expected to be implemented in less than three years
- Availability & Predictability, Continuous Processing, First Wafer Delay & Set-up, and Access to Data are the most important NGF capabilities
- ISMI is now placing a higher priority on waste reduction and a systematic approach to improve Overall Equipment Efficiency (OEE)
- Enhanced Equipment Quality Assurance (EEQA) gained member company support as a methodology to improve equipment performance

ISMI NGF Program 2009

Relation to CIP and 450 mm Program

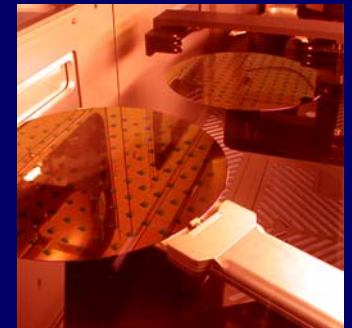
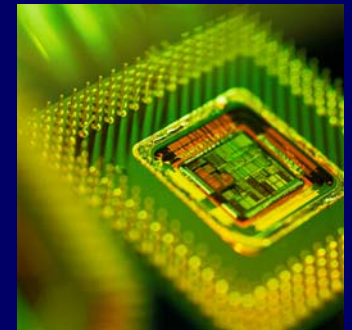


	Continuous Improvement Program (CIP)	Next Generation Factory (NGF)	450 mm Program
Differences	Tactical Specific/spot solutions Shared learning and best practices	Tactical and Strategic General capabilities and infrastructure development	Strategic Wafer size and material handling standardization
Similarities	<p style="text-align: center;">Focus on productivity improvement Equipment & factory improvements Waste reduction Strategic orientation</p>		
Synergies	300 mm tool and factory productivity gaps identified	300 mm equipment and factory infrastructure solutions	NGF solutions implementable in 450 mm factories



Accelerating Manufacturing Productivity

Capabilities and Infrastructure



ISMI NGF Program 2009

Capabilities and Infrastructure

Objectives

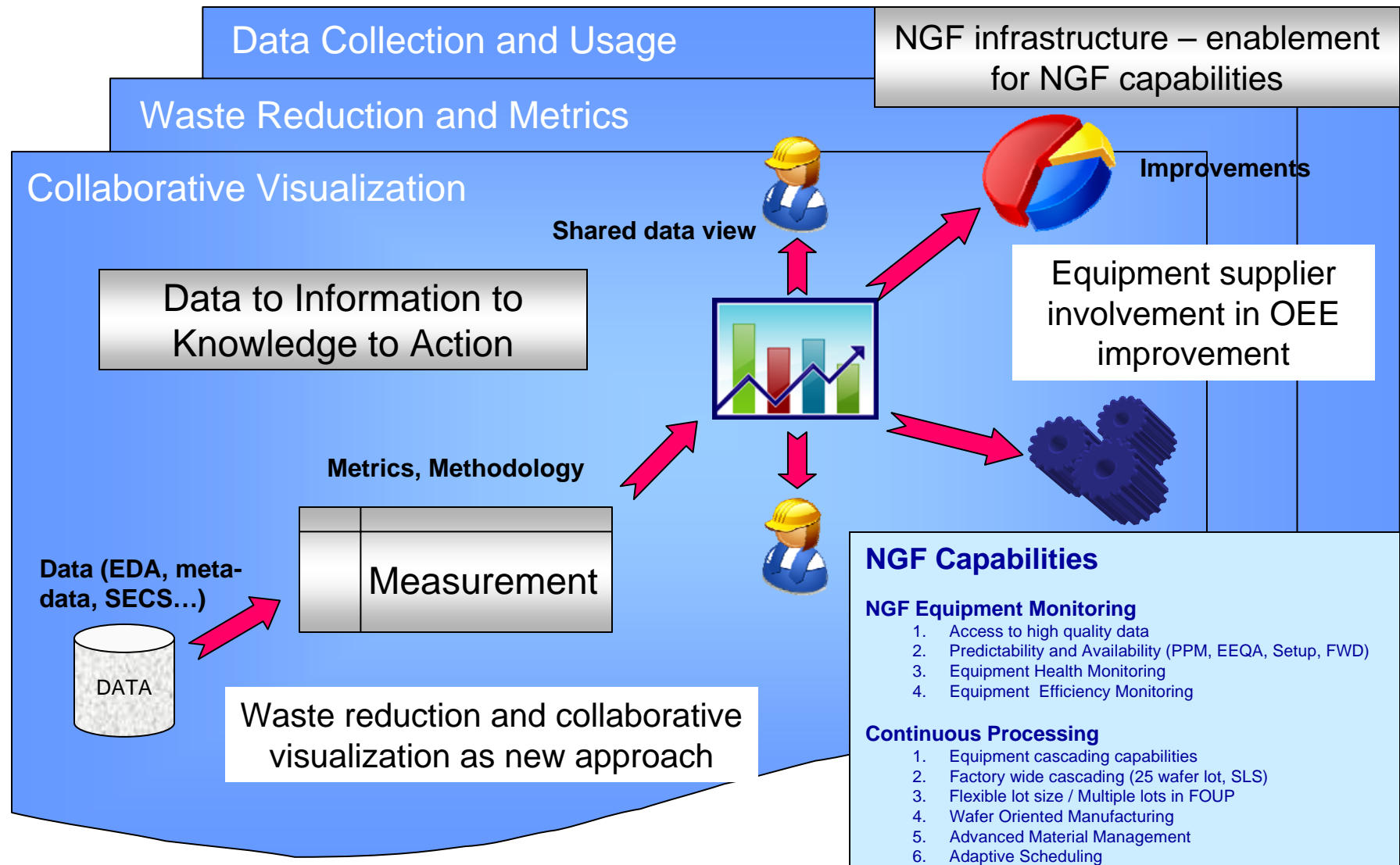
- Develop NGF **capabilities** and **infrastructure** that help achieve the ISMI member company targets
 - **Capability** is the ability to perform actions*
 - **Infrastructure** is basic physical and organizational structures needed for the operation of a society or enterprise (supporting technical structures). Viewed functionally, infrastructure facilitates production of goods and services.*

Approach

- Establish commonly accepted **metrics to enable waste reduction**
- Develop NGF capabilities to reduce **waste**; improve **equipment availability** and **performance**; and reduce **costs of factory operations, equipment maintenance, facilities and consumables**
- Develop infrastructure to support the identified capabilities

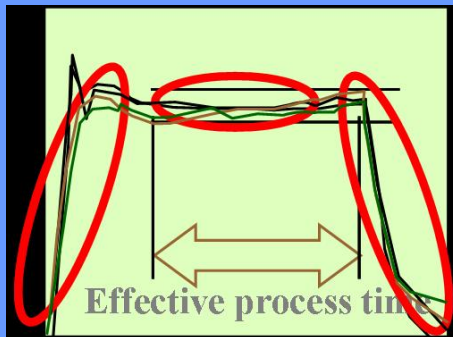
* Courtesy of Wikipedia

NGF Infrastructure and Capabilities



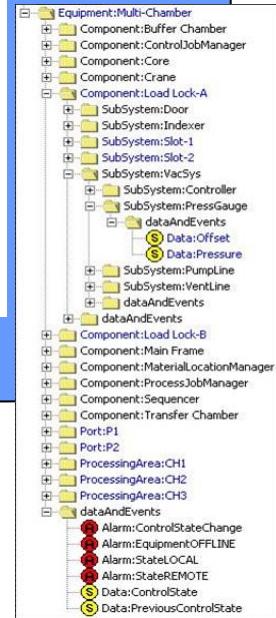
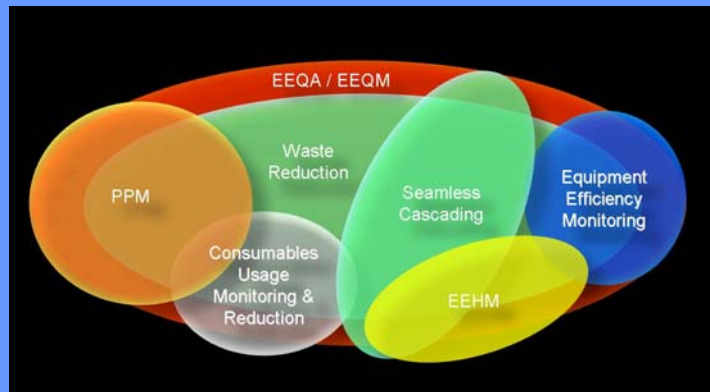
Data Collection and Usage

Data Collection & Usage - **Data** to Information to Knowledge to Action



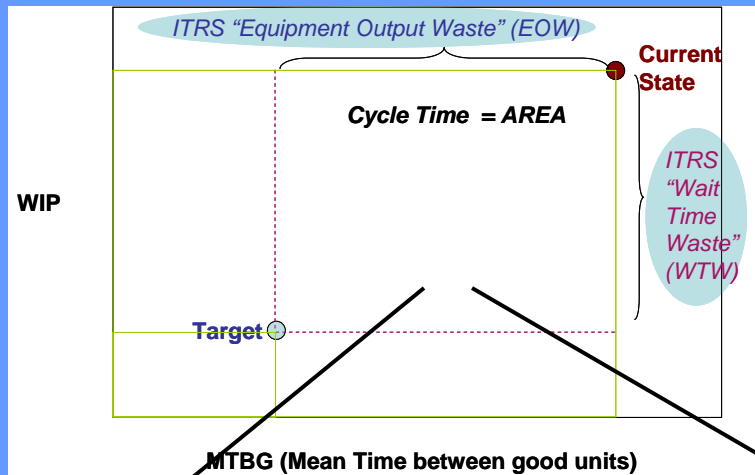
EE Data Models & Data Usage

- Next generation data collection, data usage, and waste reduction are key NGF enablers
- Data completeness and event-driven data collection: Equipment (performance, parametric, context, consumption, control) and factory data
- Data quality and time synchronization
- Data standardization: Metadata - structured, comprehensive
- Consolidation of data requirements

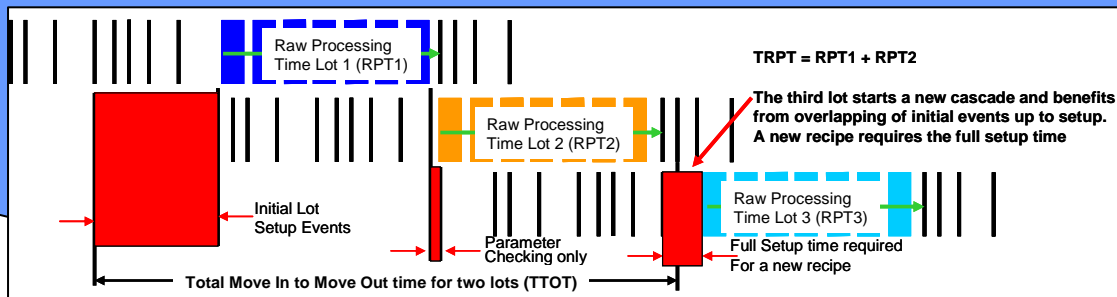


Waste Reduction and Metrics

Waste Reduction and Metrics - Data to Information to Knowledge to Action



- Waste as in muda (Lean):
 - Transportation
 - Inventory
 - Motion
 - Waiting
 - Overproduction Over Processing
 - Defects
 - → Wait Time Waste, Equipment Output Waste
- Equipment, factory, and wafer view
- Definition of waste elements
- Common metrics dictionary facilitates communication
- Measurement of current state and improvement
- Visualization of productivity and performance



Collaborative Visualization

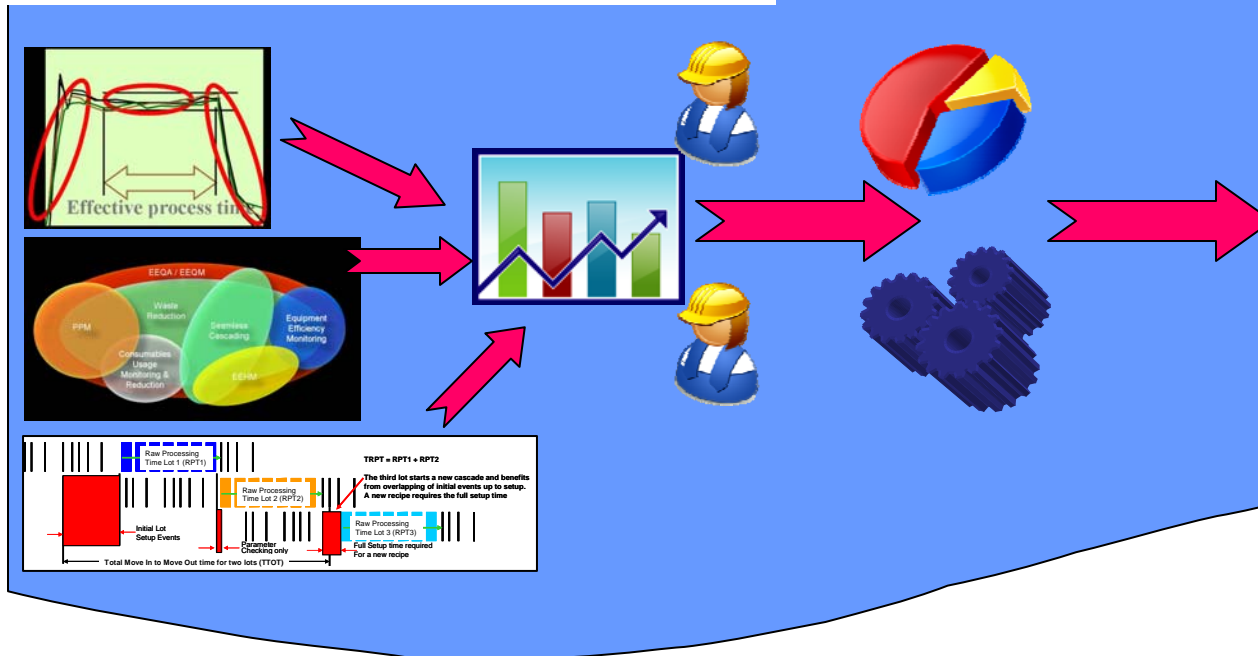
Collaborative Visualization - Data to Information to Knowledge to Action

- Shared view by IDM and OEM
 - Same data
 - Same methodologies
 - Same conclusions

PPM Project
 Maintenance waste reduction
 Prediction of failure
 Maintenance coordination

SC Project
 Hot lot insertion
 End Of Lot prediction
 Setup reduction

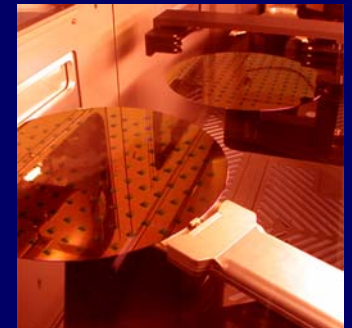
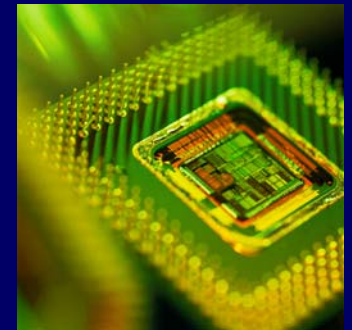
EEQA Project
 Equipment matching
 Acceptance time reduction
 Performance monitoring





Accelerating Manufacturing Productivity

ISMI NGF Project Updates



Next Generation Data Collection

Next Generation Data Collection – Infrastructure Element



2009

- Metadata evaluation
 - >10 key equipment types and supplier
 - Rating system for comparison and adherence to standard
 - Implementation guideline for structure, comprehensiveness, and standardization
 - Overall adherence, quality, and maturity of EDA implementations are not satisfactory
- Update to SEMI standards and suites based on extensive evaluations and learning
- Demonstrate unique value of EDA in member companies' factories

2010

- NGF data requirements consolidation
- Condition-based data collection
- Automated metadata evaluator

Seamless Cascading

Seamless Cascading – NGF capability element

2009

- Equipment cascading capabilities
 - List of cascading improvements (lot complete prediction, recipe change impact estimate, hot lot insertion, deterministic AMHS delivery)

- Metrics requirement exposed for status and improvement measurement

- OEE not specific enough
- No waste metrics available

- Basic scenario development

Cost Impact

Performance and Utilization (as part of OEE)
3.7%

Cycle Time Impact

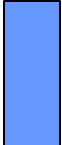
25 Wfr model 19%
12 Wfr model 39%

2010

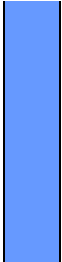
- Proof of concept for prioritized cascading capabilities
- Metrics development, measurement methodology
- Visualization (visibility into waste)

Predictive Preventive Maintenance

Predictive Preventive Maintenance – NGF capability element (availability & predictability)


2009

- Proof-of-concept demonstration
 - Key supplier, university, and member company engagement
 - Proof of concept of prediction of remaining useful life (RUL)
 - Selected maintenance cases
- Implementation guideline


2010

- Economic value of pilots
- Integration of CBM+PdM+SchM
- Data requirements and standardization
- Guidelines and recommendations

Cost Impact

Availability (as part of OEE) 1.8%

Cycle Time Impact

25 Wfr model 6%
12 Wfr model 9%

Enhanced Equipment Quality Assurance



Enhanced Equipment Quality Assurance – NGF capability element (availability & predictability)

2009

- Development of an EEQA data usage scenario including data collection plan and data extraction method
- Demonstration of an EEQA implementation example
- Definition of EEQA requirements

2010

- EEQA equipment guidelines
- OEM assessment
- EEQA methodology implementation guidelines and data model

Cost Impact (combined with waste reduction approach)

Performance and Utilization (as part of OEE)
7.4%

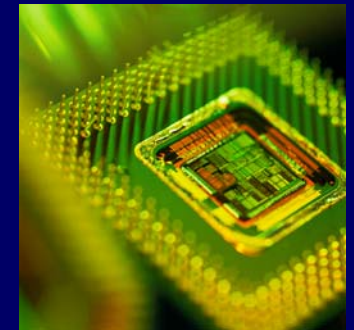
Cycle Time Impact

25 Wfr model 3%
12 Wfr model 4%



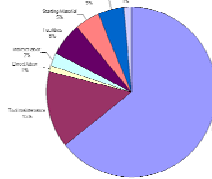
Accelerating Manufacturing Productivity

NGF Productivity Metrics Cost and Cycle Time



NGF Metrics – Analysis Approach

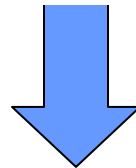
Leading Edge Logic: New 300mm Fab
 32nm, 35k wspm, 44% OEE, 87% Utilization



Top Contributors

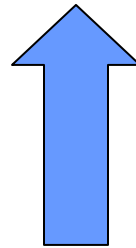
- Depreciation
- Tool Maintenance
- Facilities
- Consumables

2009 top-down approach
 economic modeling



30% Cost Reduction
50% Cycle Time Improvement

2008 bottom-up approach
 factory modeling



- Availability
- First Wafer Delay
- Setup
- Single Wafer Processing
- Cascading
- Non-Product Wafer

Cycle Time		Cost	
25-Wafer	12-Wafer	25-Wafer	12-Wafer
??%	??%	??%	??%

Cycle Time		Cost	
25-Wafer	12-Wafer	25-Wafer	12-Wafer
46%	62%	7.5%	8.0%

NGF Projects

- SLS
- EDA
- EEQA
- PPM
- ECM
- VM
- SC
- FWD
- NPW

NGF Metrics - Cost Reduction Focus

Cost profile and modeling approach

Logic Processed Wafer Cost Profile



2013

Base Case
New Fabs

Leading Edge Logic: New 300mm Fab
 32nm, 35k wspm, 44% OEE, 87% Utilization

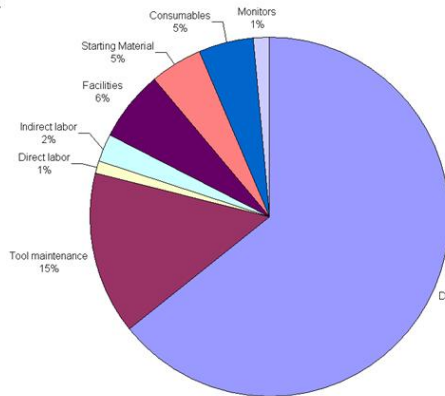
\$3606 / wafer

Top Contributors

- Depreciation – \$2317
- Tool Maintenance – \$531
- Facilities – \$226
- Starting Materials – \$167

Cost Drivers

- Depreciation – \$755
- Tool Maintenance – \$179
- Facilities – \$37
- Consumables – \$23



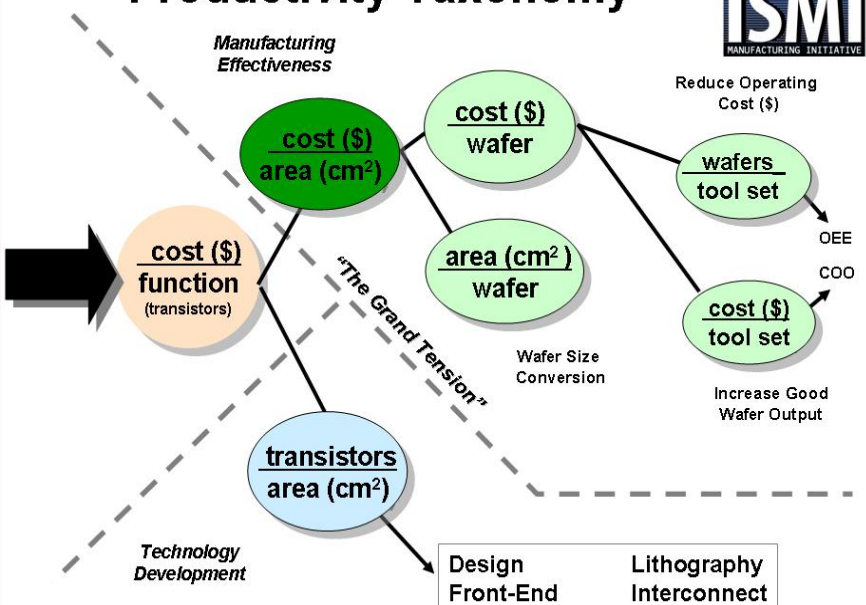
Sources: IC Knowledge, Sage

6 July 2009

19

- Equipment – single biggest cost contributor
 - Price
 - Equipment output

Productivity Taxonomy

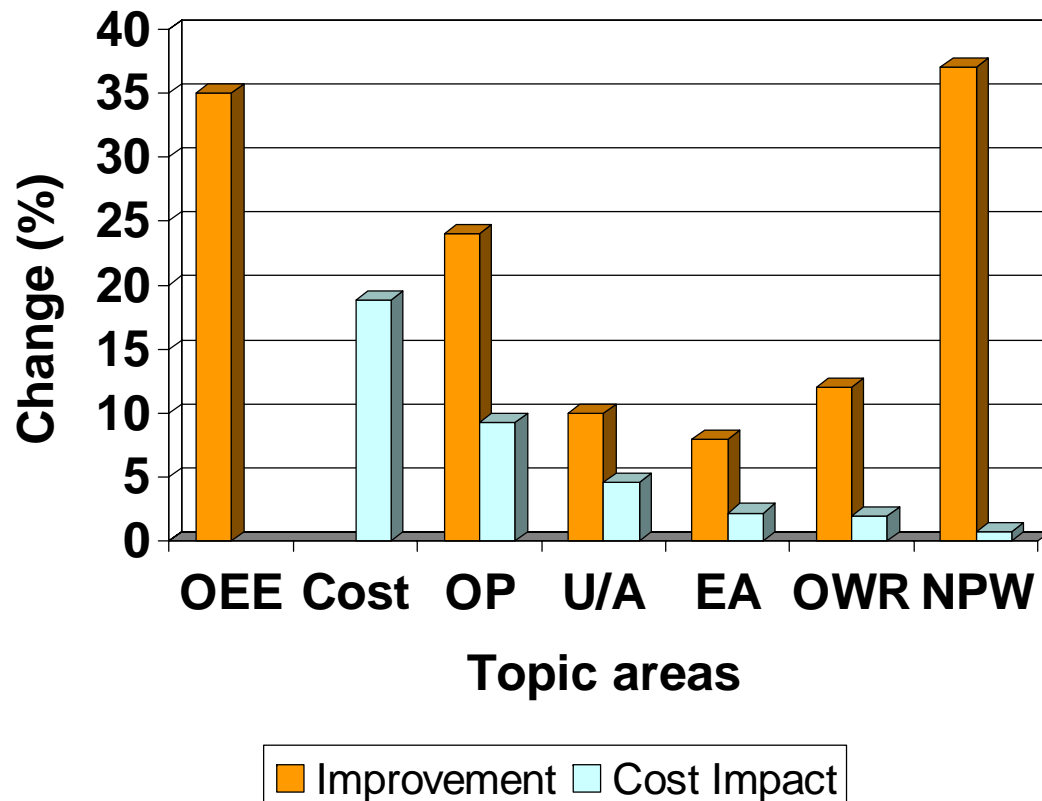


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$$\begin{aligned}
 \text{OEE} &= \\
 &\text{Availability} \times \\
 &\text{Performance} \times \\
 &\text{Quality}
 \end{aligned}$$

NGF Metrics - Cost Modeling Scenario



Baseline Assumptions	
OEE – Overall Equipment Efficiency	41%
OP - Overall Performance	49%
U/A - Utilization	82%
EA - Equipment Availability	85%
OWR – Other Waste Reduction (Maintenance, Facilities, Consumables)	
NPW (moves)	6%

Top-down analysis contains 2008 bottom-up improvement topics

NGF Target – OEE Improvement

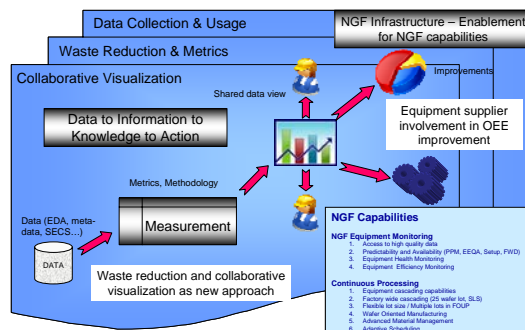
$$\text{Availability} \times \text{Performance} \times \text{Quality} = \text{OEE}$$

Availability

- NGF Projects - PPM, EEQA, NGDC
- CIP
- OEM collaboration

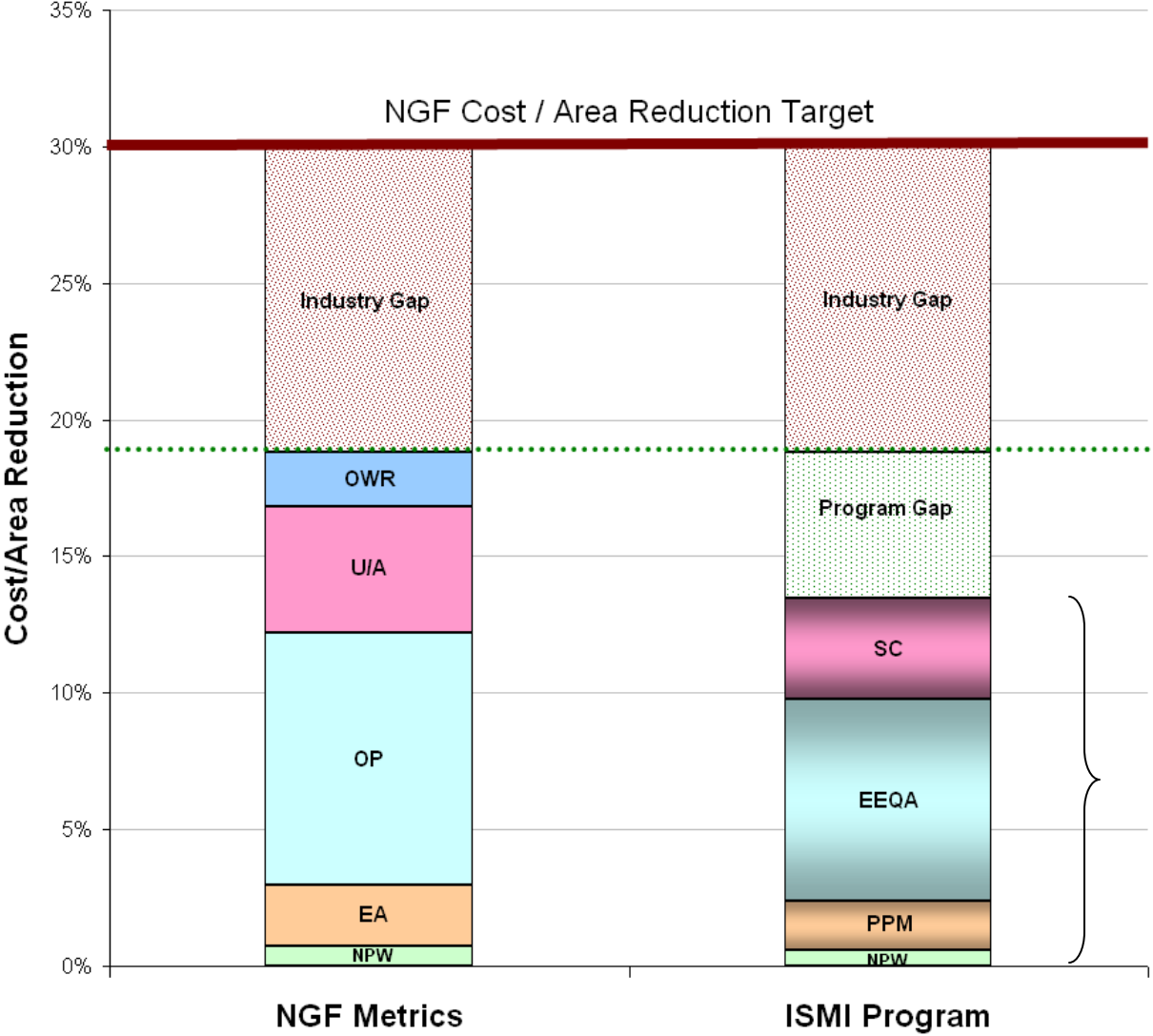
Performance

- NGF Projects - NGDC, EEQA and Waste Reduction
- Individual member company efforts have resulted in up to 10% OEE improvement
- NGF with focused approach expected to result in even better OEE improvement
- Introduction of waste metrics
 - Wait Time Waste (WTW)
 - Equipment Output Waste (EOW)
 - Alignment with ITRS





NGF Metrics - Cost Modeling Results



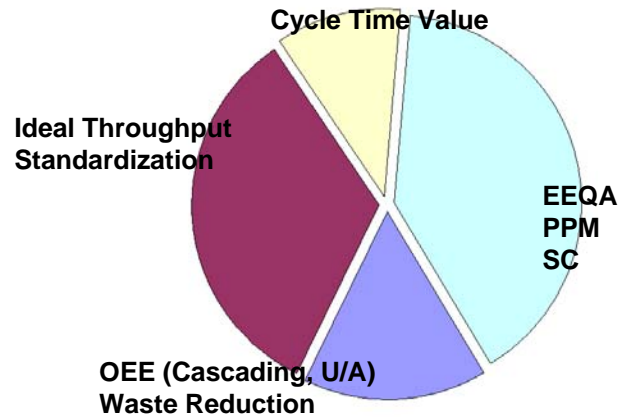
- OWR=Other Waste Reduction
- U/A=Utilization/Availability
- SC= Seamless Cascading
- EEQA=Enhance Equipment Quality Assurance
- OP=Overall Performance
- PPM=Predictive Preventive Maintenance
- EA=Equipment Availability
- NPW=Non-Product Wafer

Max. modeled improvement from ISMI projects through EA/OP and U/A

Tops down modeling approach results excluding cycle time value with enabling cost embedded

NGF Metrics - Modeling Results

300mm NGF 30% Cost/Area Reduction Target
 2009 Tops Down Analysis



Modeled, no likely project

Current ISMI projects

Future ISMI projects

Innovative Solutions

Cost Driver: OEE (Availability, Performance), Utilization, OWR

25k wspm base factory
+ 10k wspm through improved
OEE / NPW / Utilization

25 wafer lots
 AV = 92%
 OEE = 56%
 U/A = 88%
 CT = 42 days

300mm NGF 50% Cycle Time Reduction Target
 2009 Tops Down Analysis

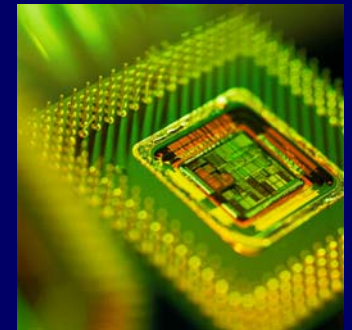


Cycle Time Driver: Availability, Cascading, Single Wafer Process Tools



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NGF Key Messages





Key Messages: ISMI NGF Program

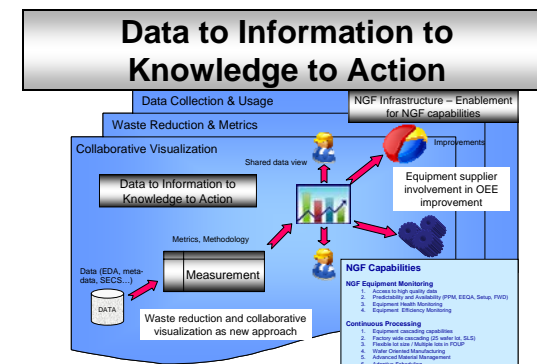
- The ISMI NGF timeline and target remains 30% cost reduction and 50% cycle time improvement by 2012
- OEE improvement is a key component to cost reduction
- ISMI's contribution may not close the 30% cost reduction gap completely
- The economic downturn has brought focus on tactical, short-term benefits, especially cost reduction, but the NGF program continues to maintain a long-term strategic component

Key Messages: ISMI NGF Program

- The 30/50 target requires new capabilities. The most important NGF capabilities identified as OEE drivers by the ISMI member companies are
 - Availability & Predictability
 - Continuous Processing
 - Access to Data
 - First Wafer Delay & Set-up Reduction
- IDMs and OEMs must collaborate to establish the infrastructure to enable NGF capabilities and realize productivity improvements and cost reduction
 - Equipment data structure and collection
 - Standardized metrics and measurement methods
 - Equipment data visualization and applications
- ISMI is developing metrics and measurement methods for wait time waste (WTW) and equipment output waste (EOW)
- EEQA and waste reduction identified as key new areas to improve equipment performance

ISMI NGF Supplier Expectations

- The participating NGF member companies encourage suppliers to collaborate with ISMI to establish the capabilities and infrastructure needed to meet NGF targets (30% cost and 50% cycle time reduction)
- Key areas for collaboration are
 - Predictive Preventive Maintenance (PPM), Seamless Cascading (SC), and Enhanced Equipment Quality Assurance (EEQA) to implement NGF capabilities
 - Adherence to EDA standards and improvement of implementations
 - Development of industry metrics for wait time waste and equipment output waste (WTW and EOW)
 - Development of productivity waste measurement and visualization methods
 - Proposals for innovative solutions to fill the cost reduction gap



NGF/450mm Unified Messages

- The ISMI NGF program provides a complementary forward-compatible approach of 300 mm NGF to 450 mm to address the needs of our various member company constituencies and minimize the R&D expenditure by the industry
 - Complementary converging paths are key to efficient use of industry resources
 - ISMI continues to proceed consistent with the principle that NGF is a productivity continuum to 450 mm

For more Information...

- This presentation material will be made available for download at the SEMATECH public website:
www.ismi.sematech.org
- Meetings and news – past meeting proceedings – ismi industry briefings
- To initiate individual discussions with the ISMI team, please contact:
 - Olaf Rothe, NGF Program Manager
(olaf.rothe@ismi.sematech.org)
 - Brad Van Eck, NGFR Project Manager
(brad.van.eck@ismi.sematech.org)