

A decorative border on the left and top of the slide. It features a yellow square in the top-left corner, followed by a vertical strip of overlapping circles in purple, orange, and yellow. To the right of this strip, there are larger overlapping circles in purple, orange, yellow, and blue, each with a different grid or dot pattern.

# **Assembly & Test Benchmarking Study**

**max**



# Why Engage in an A&T Benchmarking Study?

- Cost structure shifts to back-end
- Missing a centrally organized benchmark entity
- Strong interest from multiple ASAT suppliers and IDM companies – knowledge sharing
- Turn knowledge into driving actions
- Significant potential for efficiency and cost improvements
- Proven track record from FOA best benchmarking administrator



# Performance efficiency Examples

Area	Typical Level	Benchmark
Full Lot Size	75%	90%
Changeover Frequency	>70%	
First Pass Yields	95%	98%
X-Factor	>4X	2X
Staffing Levels	120%	100%
Bottleneck OEE	55% - 65%	>90%
M-Ratio	<1:1	9:1
Availability – Mean / CV	<88% / >30%	>93% / 10%

From MAX Engagements





# Proven Success (Front-End)

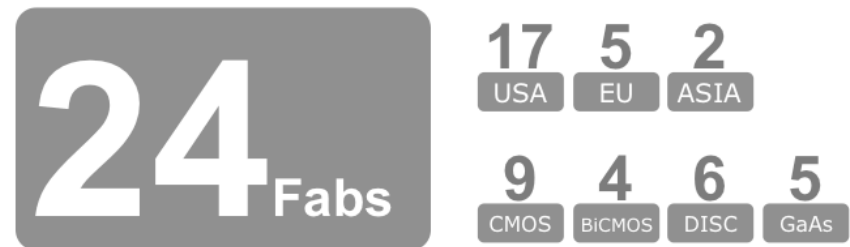
## Fab Owners Association

- 26 IDM Companies
- 100mm – 200mm Fabs
- 40 participating Fabs

## Survey #3

- Most detailed benchmark survey covering Fab performance
- 253 indices and metrics
- Automated analysis tool developed by MAX
- Robust validation process

## Survey #3 2014 Fabs at Glance



**0.9M**  
Wafers / Qtr  
200mm equivalent

**20M**  
Aligns / Qtr

**9,000**  
Tools

**4,000**  
Operators

**1,300**  
Technicians

**700**  
Engineers





# Objectives

Provide the most extensive and complete operational benchmarking analysis to participating companies

## Study Quality

- Drive Data Accuracy
- Standardize Questions Definition and Scope
- Evaluate Year on Year Data
- Provide Actionable Information
- Incorporate Participants Feedback



## Participants (Signed On)

### IDM

10 Companies

15 Sites

### OSAT

4 Companies

10 Sites

# Typical Survey Process

## Phase 1 – Preparation

- Final Participants List Closure
- NDA & Benchmarking Agreement Signoff
- Study Questionnaire Review & Participants feedback
- Agree on Data Capture Period
- Questionnaire Revision

2 months

## Phase 2 – Data Collection

- Study Questionnaire Distribution
- Kick-off Conference Calls with Each Site
- Data Collection By Site

2 months

## Phase 3 – Data Validation

- First Data Review
- Second Data Review
- Third Data Review
- Data Review by Participating Sites

1 months

## Phase 4 – Data Analysis

- Data Analysis
- Data Analysis tool Distribution (MS Excel w Macros)
- Final Report Distribution

1 months

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# Data Validation Process

1

Individual Site Check

-Historical Data  
-Theoretical Indicators

2

Intra-Group Analysis

-Outliers  
-Correlations

3

Survey Wide Analysis

-Statistical Analysis  
-Ratio Analysis

4

Participant Check

-Participant Feedback  
-Data Verification



# Benchmarking Scope

Area	Operation Group	Operation Type
FOL	BACKGRIND	BACK_GRIND_INCOMING_INSP
FOL	BACKGRIND	BACK_GRIND
FOL	BACKGRIND	BACK_GRIND_THICK_MEAS
FOL	BACKGRIND	BACK_GRIND_FINAL_INSP

Area	Operation Group	Operation Type
PROBE	PROBING	PROBE_INCOMING_INSP
PROBE	PROBING	PROBE_PROBING
PROBE	PROBING	PROBE_OPTICAL_INSP
PROBE	PROBING	PROBE_INKING
PROBE	PROBING	PROBE_OPTICAL_INSP

Area	Operation Group	Operation Type
FOL	SAW	WAFER_MOUNT
FOL	SAW	WAFER_SAW
FOL	SAW	WAFER_MOUNT_CURE
FOL	2ND OPTICAL INSP	2ND_OPTICAL_INSP
FOL	2ND OPTICAL INSP	2ND_OPTICAL_GATE
FOL	2ND OPTICAL INSP	2ND_OPTICAL_INKCURE
FOL	DIE ATTACH	DIE_ATTACH
FOL	DIE ATTACH	POST_DA_CURE
FOL	WIREBOND	WIREBOND
FOL	3RD OPTICAL INSP	3RD_OPTICAL_INSP_SAMP
FOL	3RD OPTICAL INSP	3RD_OPTICAL_GATE
FOL	CLEAN	PLASMA_CLEAN
EOL	MOLD	MOLD
EOL	MOLD	POST_MOLD_CURE
EOL	MARKING	BOTTOM_LASER_MARK
EOL	MARKING	TOP_LASER_MARK
EOL	MARKING	LASER_MARK
EOL	TRIM AND SINGULA'	TRIM_SIN_AUTO
EOL	TRIM AND SINGULA'	TRIM_SIN_AUTO
EOL	4TH OPTICAL INSP	4TH_OPTICAL_INSP_SAMP
EOL	4TH OPTICAL INSP	4TH_OPTICAL_GATE

Area	Operation Group	Operation Type
PRE_TEST	REFLOW	REFLOW
PRE_TEST	TEMP CYCLE	TEMP_CYCLE
PRE_TEST	OPEN SHORT	OPEN_SHORT_1
PRE_TEST	OPEN SHORT	OPEN_SHORT_1
PRE_TEST	BURN IN	BURN_IN
PRE_TEST	OPEN SHORT	OPEN_SHORT_2
PRE_TEST	OPEN SHORT	OPEN_SHORT_2
PRE_TEST	TEMP CYCLE	TEMP_CYCLE2
PRE_TEST	X-RAY	X_RAY
PRE_TEST	MVI	MVI

Area	Operation Group	Operation Type
TEST	TEST	TEST_PASSES
TEST	TEST	TEST_PASSES
TEST	TEST	TEST_PASSES
TEST	TEST	TEST_PASSES
TEST	TEST	TEST_PASSES
TEST	TEST	TEST_PASSES
TEST	TEST	TEST_PASSES
TEST	TEST	CI
TEST	TEST	CI

Area	Operation Group	Operation Type
BACK END	BACKEND	LEADFORM
BACK END	BACKEND	TAPE_AND_REEL
BACK END	BACKEND	FINAL_INSPECTION



# Benchmarking Questionnaire

## Sections:

- Site Information
- Production
- Facility Area
- Cycle Time
- Technology
- Staffing
- Yield & Quality
- Cost
- Maintenance

Assembly & Test Survey #1 2014  
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Standard Survey					
Site Information	Units	Description	Formula / Scope	Answer	Comments
Site Location	Continent	Continent where the Site is located.			
Site Size and Layout					
Site Layout	Type	Layout type of the Site (i.e. Clean/Bay, Ballroom, Mixed, Other (add description))			
Site Manufacturing - Assembly		Specify site manufacturing functions for Assembly only			
Site Manufacturing - The Test		Specify site manufacturing functions for The Test Only (i.e. Temp Cycle, Burn In)			
Site Manufacturing - Test		Specify site manufacturing functions for Test Only			
Total Manufacturing Level Area	Sq ft	Total area of clean room. For ballroom Sites this is the total area of the ballroom. For Clean / Bay Sites this is the total area of the bays plus all Change rooms.			
Total Gray Area	Sq ft	Total gray area inside and around the Site. For Clean / Bay Site this includes all the change area. For Ballroom Sites this includes the sub-floors and mezzanines.			
Total Sub-Floor Area	Sq ft	For multilevel Sites this is the total sub-floor area. Sub-floor should be large enough for people to walk inside to be defined as a sub-floor.			
Percent of Clean Room Used	%	Percent of clean room area where Units processing activity is performed. Clean Room Area with Activity = Total Clean Room Area routinely (e.g. what percentage of your clean room is being used?)			
Clean Room Class	Particles / ft <sup>3</sup>	Clean room class according to US FED STD 209E standard. If you have more than one class within your Site, please use the one with the lowest particle count.			
<b>Assembly Tools</b>					
Major Process Tools	Tools	Total number of major active process tools. Multihand tools are counted as one tool.	Examples: Crimpers, Units Saw, Die Attach, Screen Print, Cap Attach, Wirebond, Mold, Mark, DTS, Solder (SFC) or Surch, etc. Exclude: Handling Tools, Sprockets, R&D and sled tools, metrology tools, minor processing tools.		
Minor Process Tools	Tools	Total number of minor active process tools.	Examples: Mounting, Tongs/Clampers, Solder Curlew/Flow Chems, UV Harder, Fixing Claws. Exclude: Units handling tools, R&D and sled tools.		
Major Metrology Tools	Tools	Total number of metrology tools. Multihand tools are counted as one tool.	Examples: Measured strength testers, Depth/Thickness testers. Exclude: R&D and sled tools.		
Minor Metrology Tools	Tools	Total number of minor metrology tools.	Examples: Microscopes, inspection. Exclude: R&D and sled tools.		
R&D and Engineering Tools	Tools	Total number of tools dedicated solely to R&D and engineering work.	Include: Major and minor tools, metrology tools. Exclude: Units handling tools and sled tools.		
Assembly Handling Tools	Tools	Total number of tools used for assembly handling.	If any (write 0 if none)		
Tool Types	Tool Types	Total number of tool types. A tool type is a tool set from the same manufacturer with the same model and used for the same function.	Exclude: Handling Tools, Sprockets, R&D and sled tools.		
Percent SMT	%	Percent of the tools that are equipped with a Standard Mechanical Interface system.			
Type AHS	Type	Types of AHS: Fully Automated, Inertial, Strobby or Manual.			

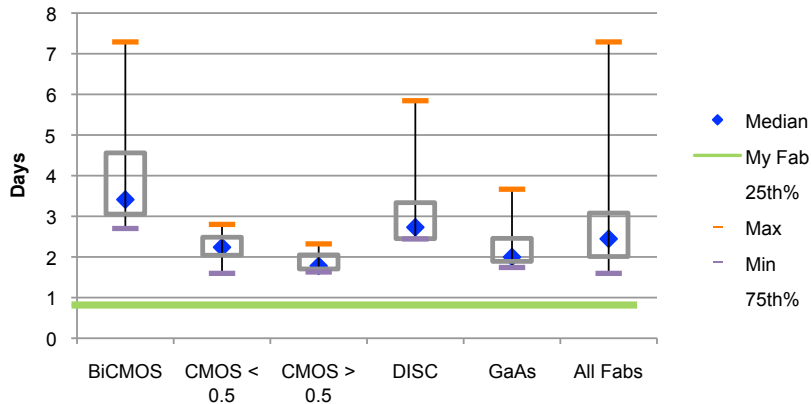
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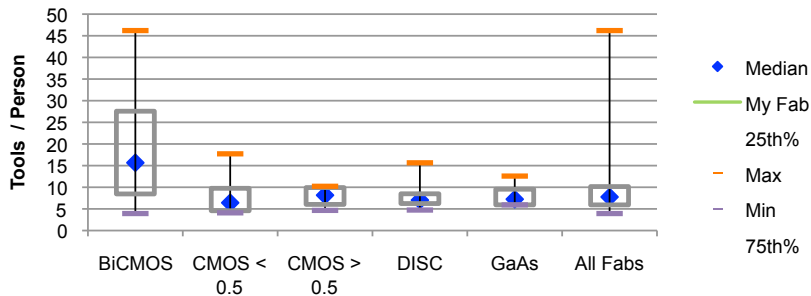


# Analyses Sample

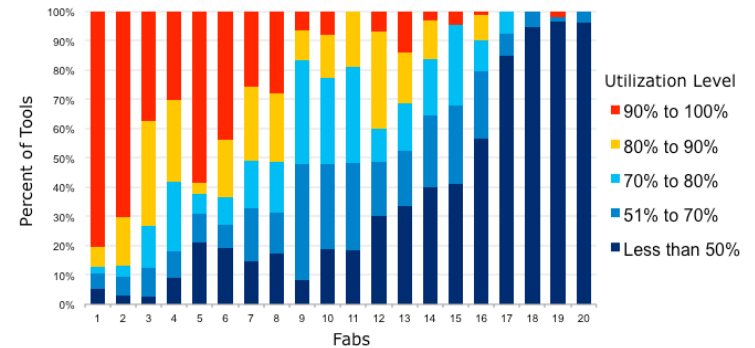
## Average Cycle time Per Layer



## Tools per Operator



## Tools by Utilization Level





# Timeline Proposal

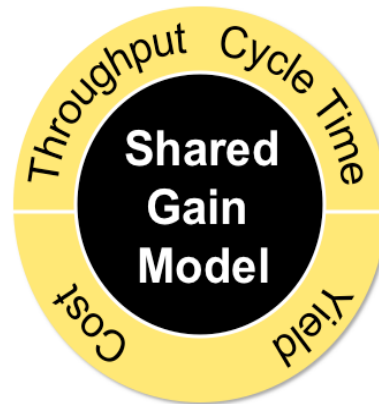
Time Line	1 <sup>st</sup> Qtr	2 <sup>nd</sup> Qtr	3 <sup>rd</sup> Qtr
Questionnaire Definition			
Questionnaire Distribution			
Data Submission			
Data Analysis			
Survey Results			

# Who we are

Transforming Semiconductor, Solar and LED factories' performance

88  
Experts

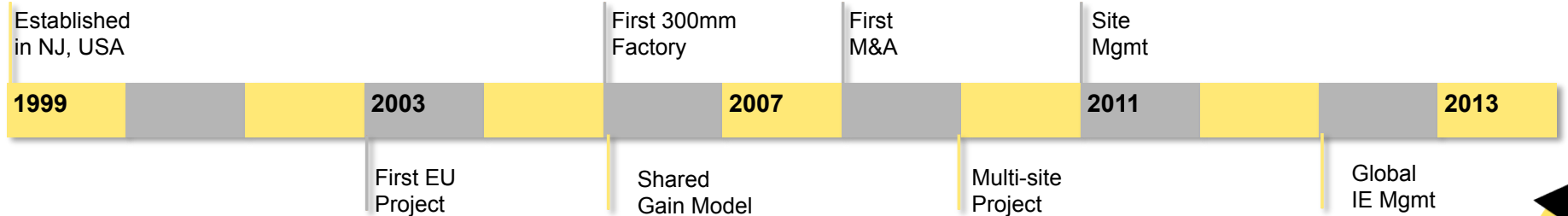
140  
Programs



>10:1  
Return on our fee

- CAPEX Avoidance
- Personnel Productivity
- Yield Improvement
- Cost Savings

## Lineage



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# Lean Six-Sigma Foundation

MAX Black Ops™ - The Villanova University Lean Six Sigma Program

5

Master Black Belts

35

Black Belts

45

Green Belts

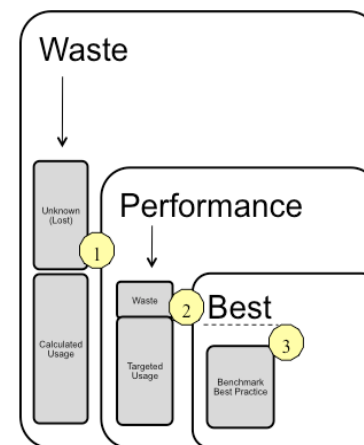
Program - ASQ Certified

Tailored for Semiconductors/LED Industry

Lean principles as a way of life

Find reduce and eliminate waste

1. Quantify loses comparing cost to bottom up calc.
  - Investigate where significant
2. Look for performance improvement in equipment or process.
3. Compare revised performance to benchmark where possible



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# MAX - The Benchmarking Authority in Semiconductors

## Associations

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**FAB OWNERS  
ASSOCIATION**

Benchmark Admin  
Associate Member  
of the Year - 2009



ITRS Member  
ISMI Member



Board of Directors  
TPC Member

## Papers and Presentations

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# Client Experience

Quantify Potential

ORE™ Study

Implement Solutions

Gain \$\$

Manufacturing Operations

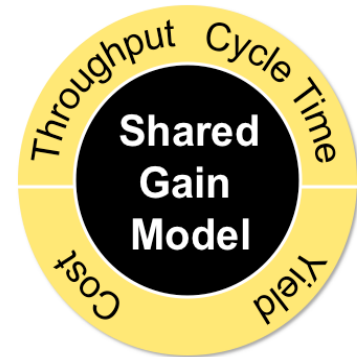
Factory Design & Build

Supply Chain Management

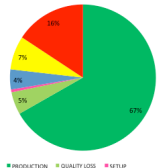
Driving Operational Excellence

Factory Management Systems

Site Management Services



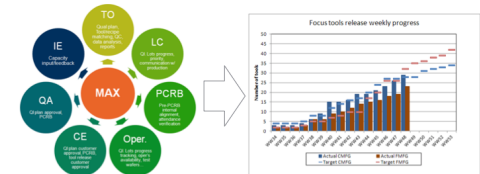
Litho Stepper - OEE



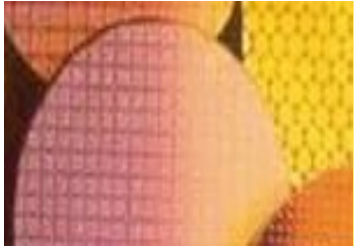
Benchmark: 90% OEE  
 \*Based on stepper OEE  
 \*Track down time included in stepper downtime

State	Activity	Average
PRODUCTION	Load	0.2%
PRODUCTION	Process	66.4%
PRODUCTION	Unload	0.0%
QUALITY LOSS	Rework	5%
SETUP	Setup	6.9%
ENGINEERING	Eng Working	0.3%
ENGINEERING	Qual	2.5%
ENGINEERING	Wait Qual	1.3%
ENGINEERING	Assisted by Op	0.1%
IDLE	Wait Opr (Interfere)	0.3%
IDLE	Wait Opr (Unavail)	1.6%
IDLE	Wait WIP (EXT)	3.1%
IDLE	Wait WIP (INT)	2.9%
DOWN	Sched Maintenance	0.9%
DOWN	Sched No Tech	0.6%
DOWN	Unsched Maintenance	1.5%
DOWN	Unsched No Tech	3.0%
DOWN	Wait Tech	1.7%
DOWN	Wait Cluster down	4.1%

Impact of operator attendance







# THANK YOU

**To Participate Contact:**

[asatbenchmarking@maxieg.com](mailto:asatbenchmarking@maxieg.com)

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