Your Voice Matters

eBeam Initiative 2015 Survey

What part of the semiconductor ecosystem is your primary focus?

Category	Percentage
Equipment	28.1%
Materials	1.6%
Chip design	7.8%
Masks	35.9%
Chip manufacturing	4.7%
EDA/IP	12.5%
Services	1.6%
Research	6.3%
Other	1.6%

Thank you to the 64 luminaries and members for your responses (35 companies represented)

Vote of Confidence in Multi-beam for Masks

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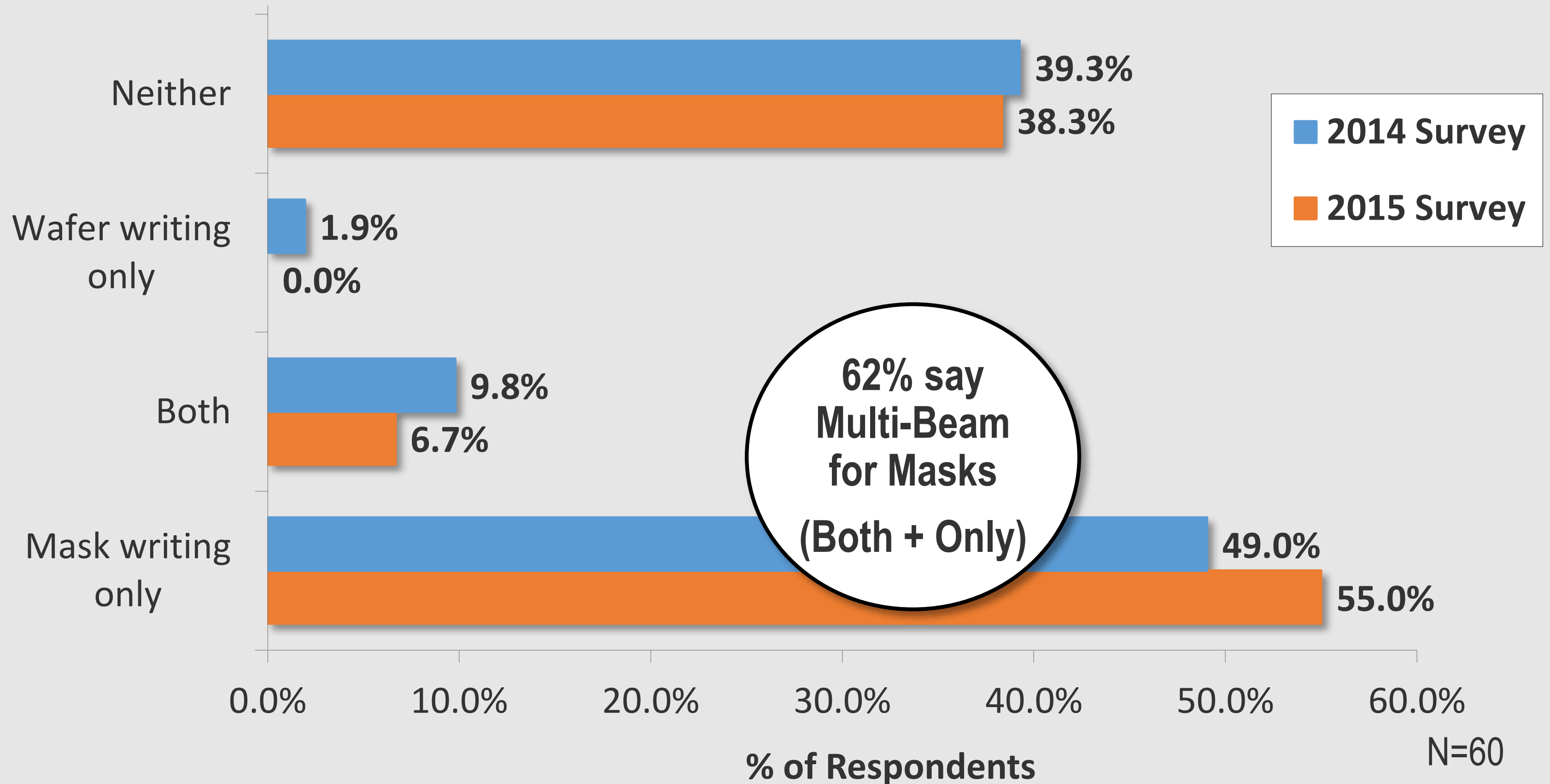
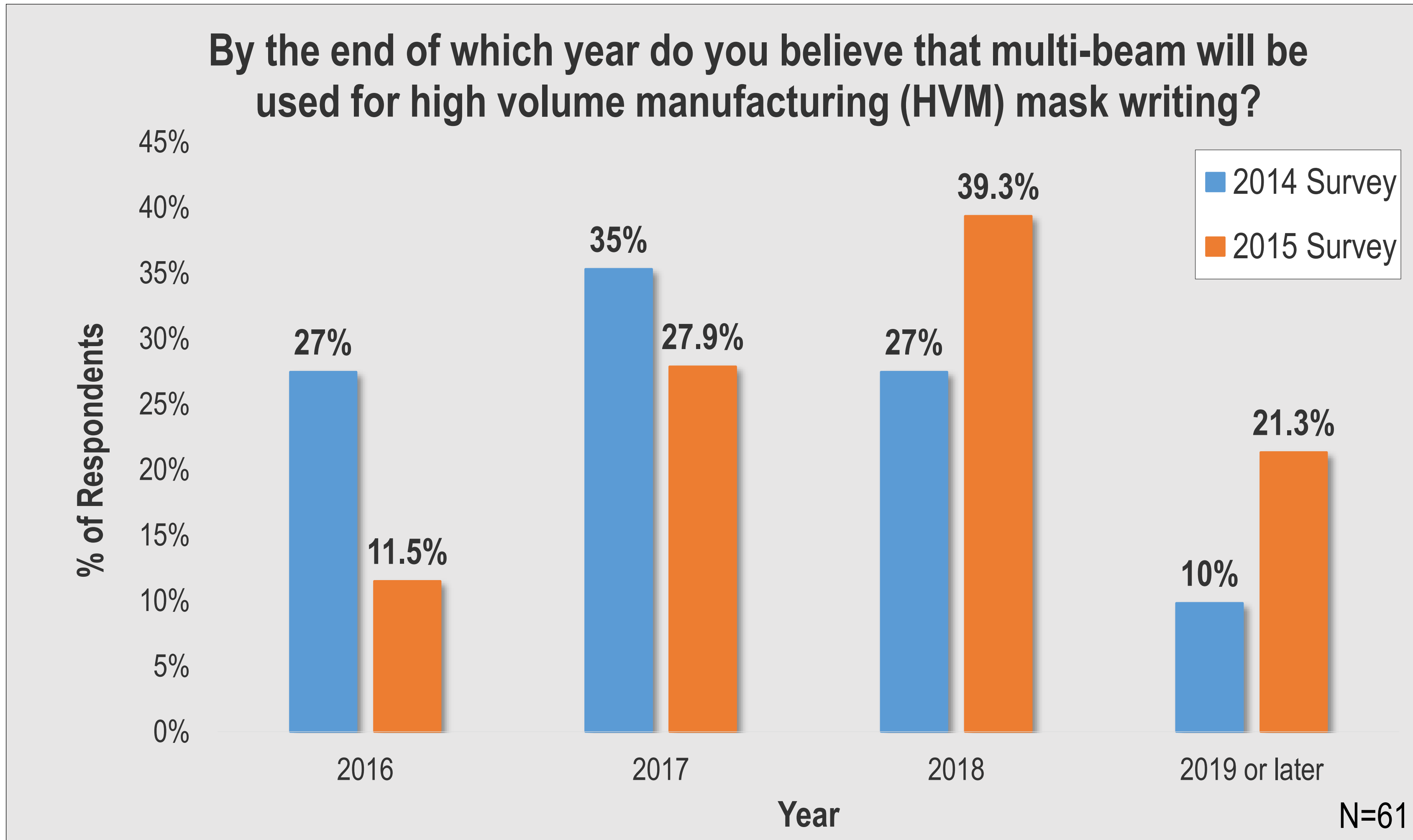


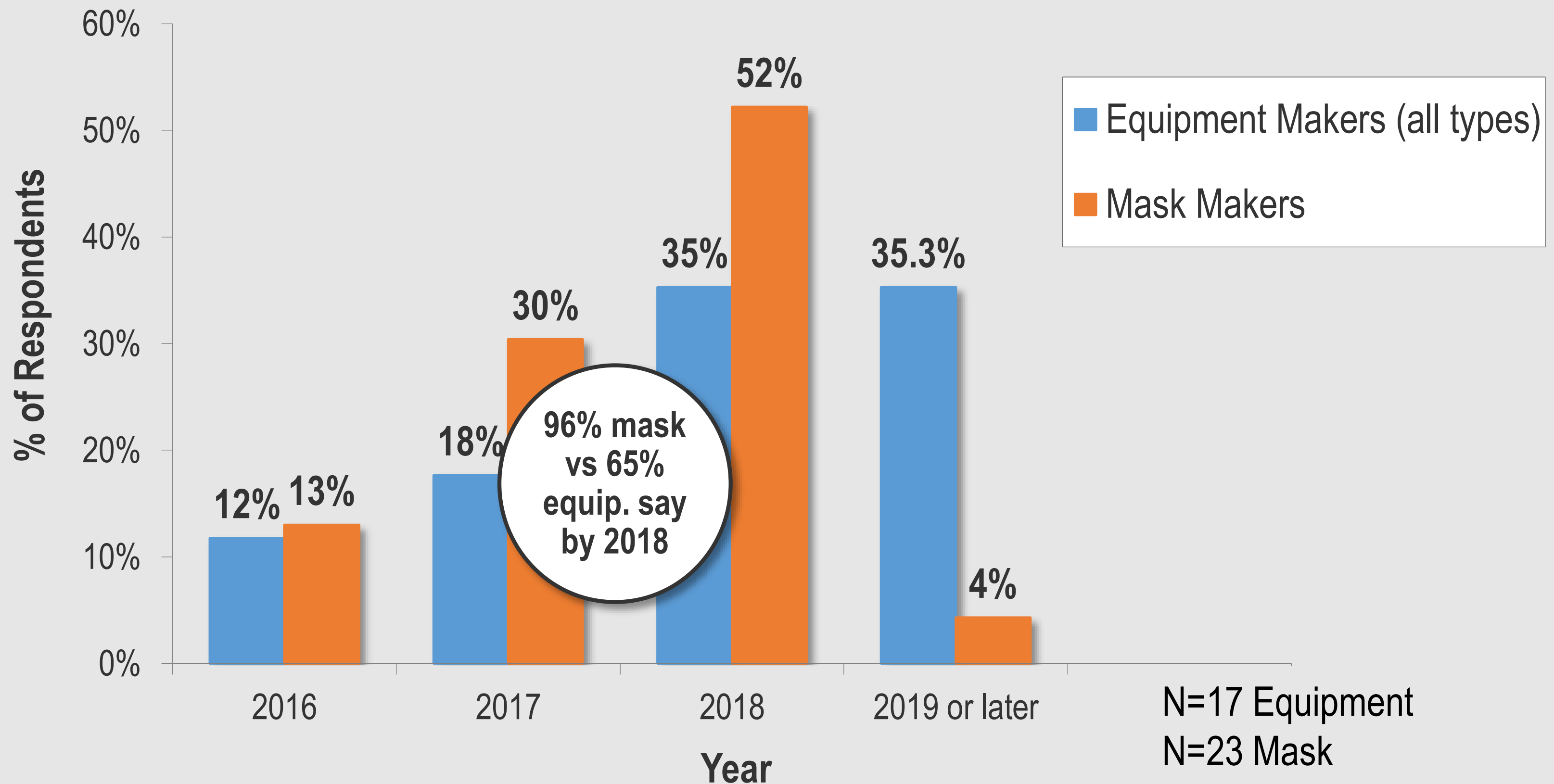
HVM Multi-beam Prediction – Late 2018

Weighted average slips 6 months from 2014 Survey



Mask Makers More Optimistic on 2018 HVM

96% Mask vs 65% Equipment Makers say by 2018



Purchasing Predictions for Multi-beam

>50% by 2020

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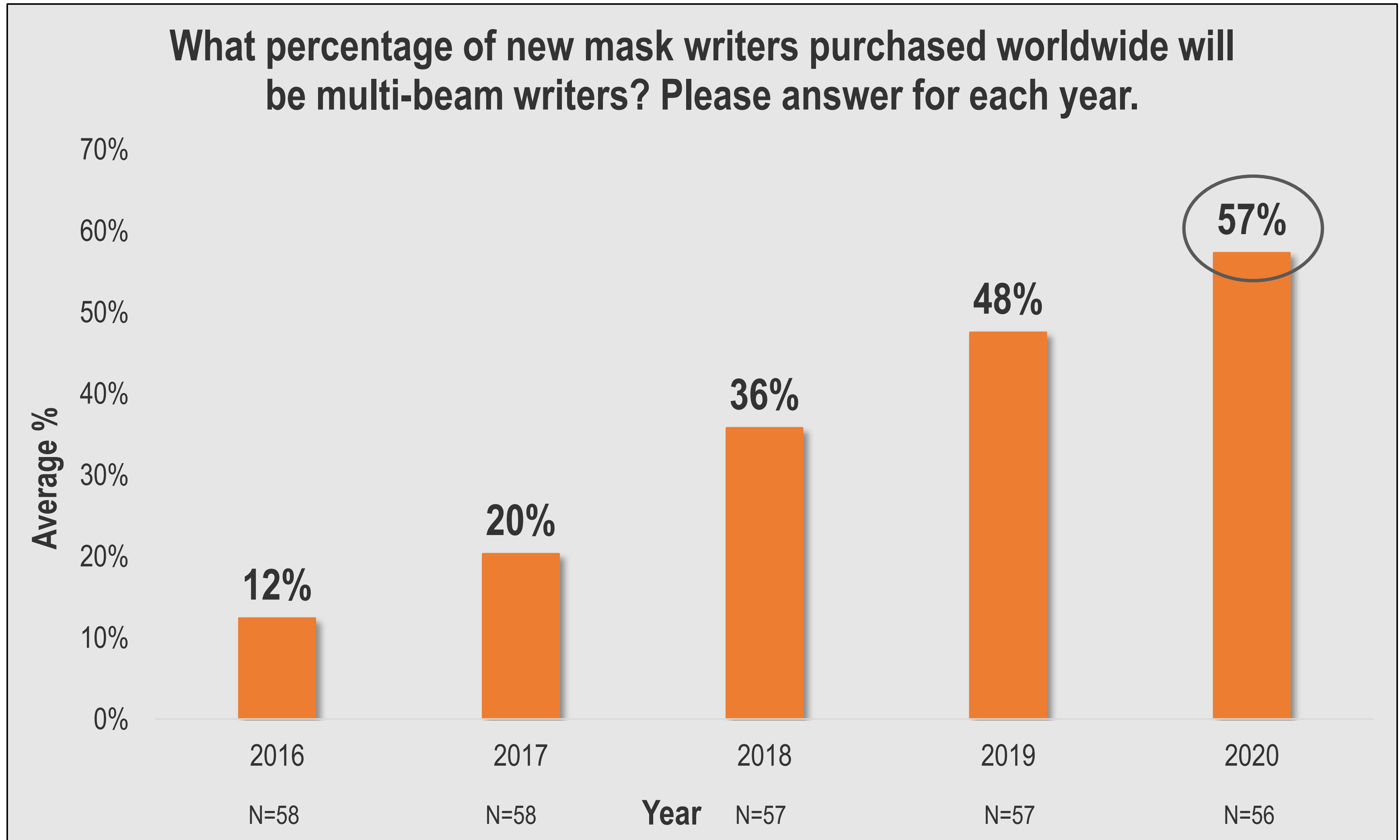
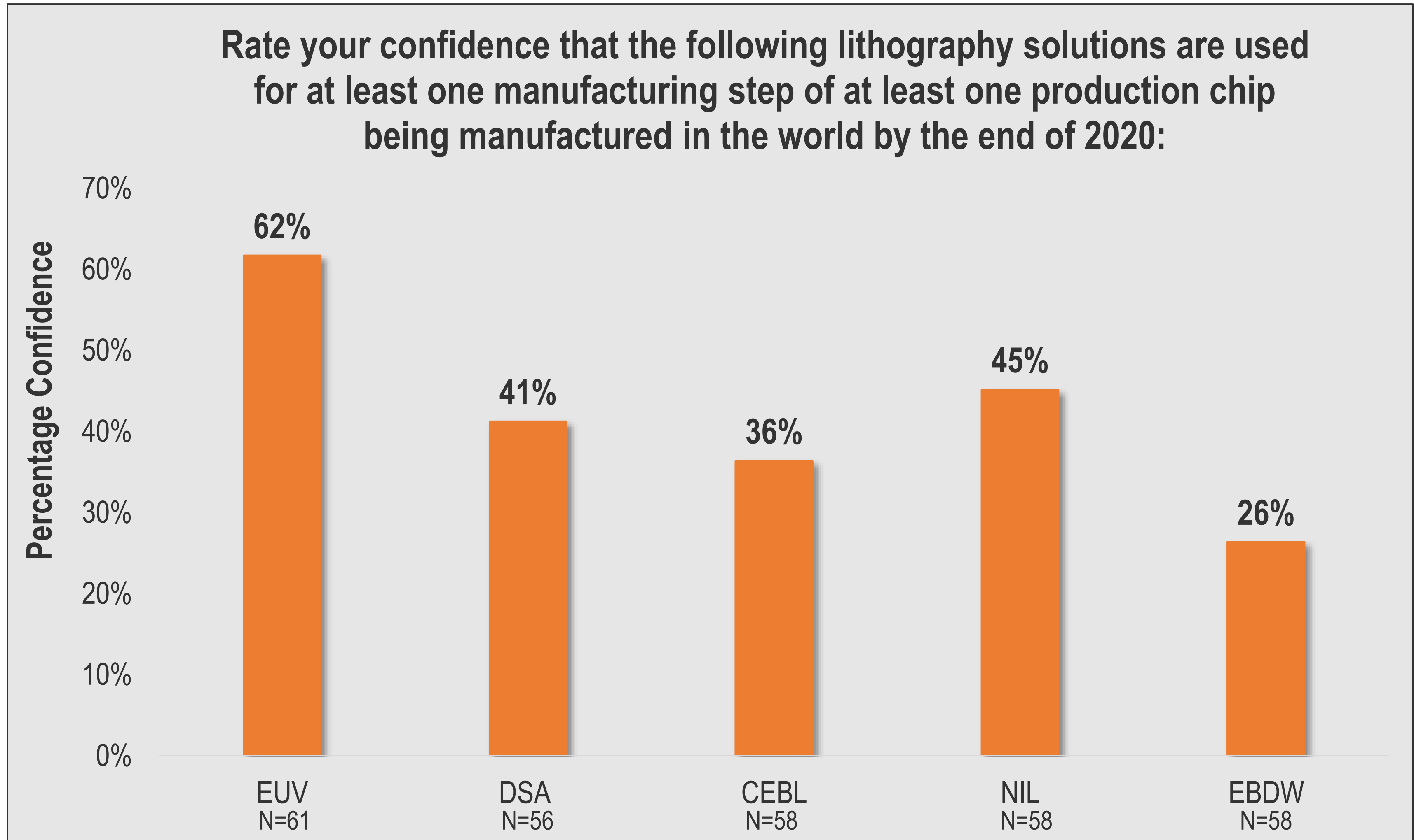


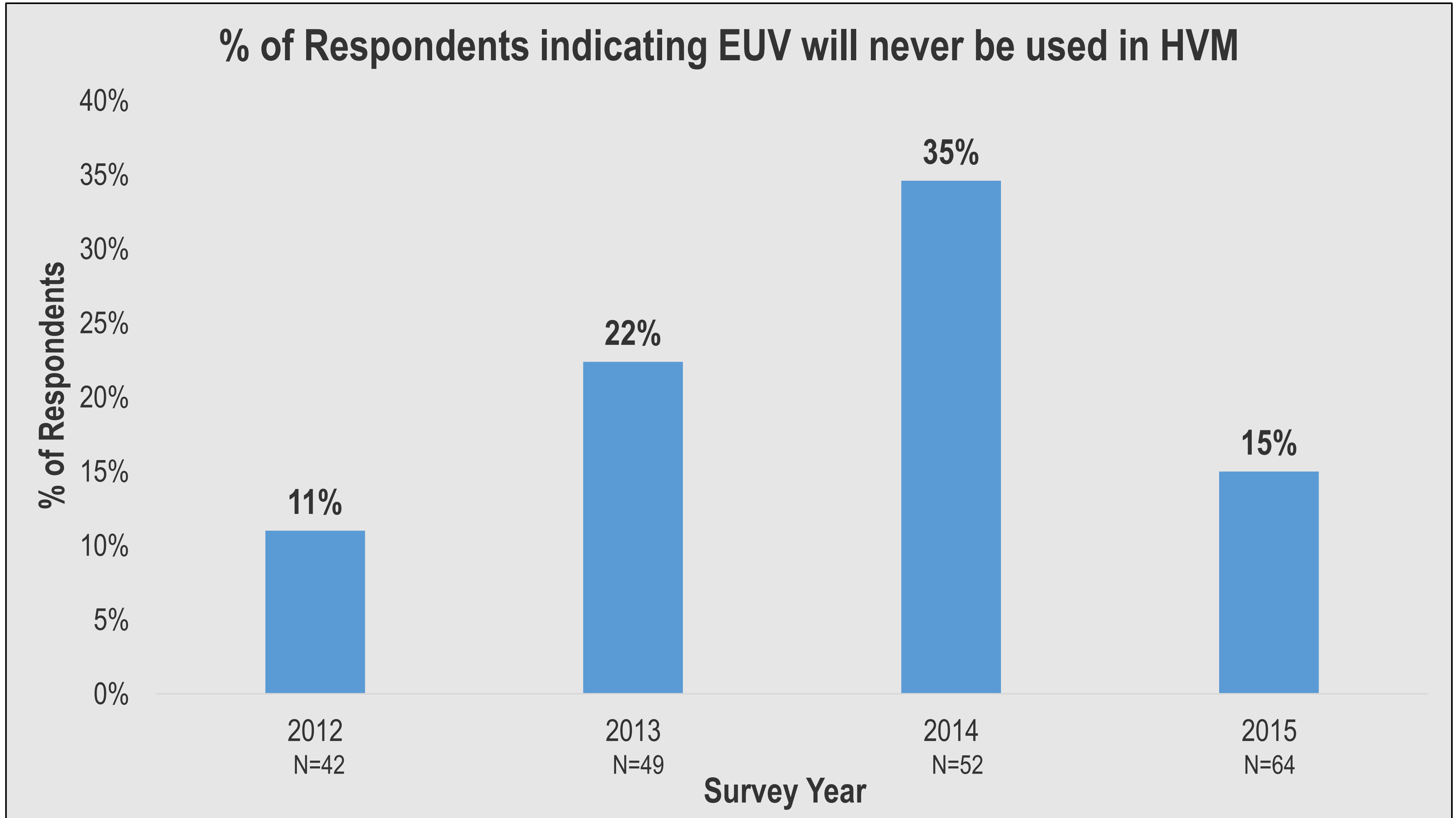
Lithography Perceptions Favor EUV

62% confidence in EUV



Optimism in EUV Increased vs 2014

Respondents answering “Never” down to 15%



EUV to Drive 3D Mask Effects

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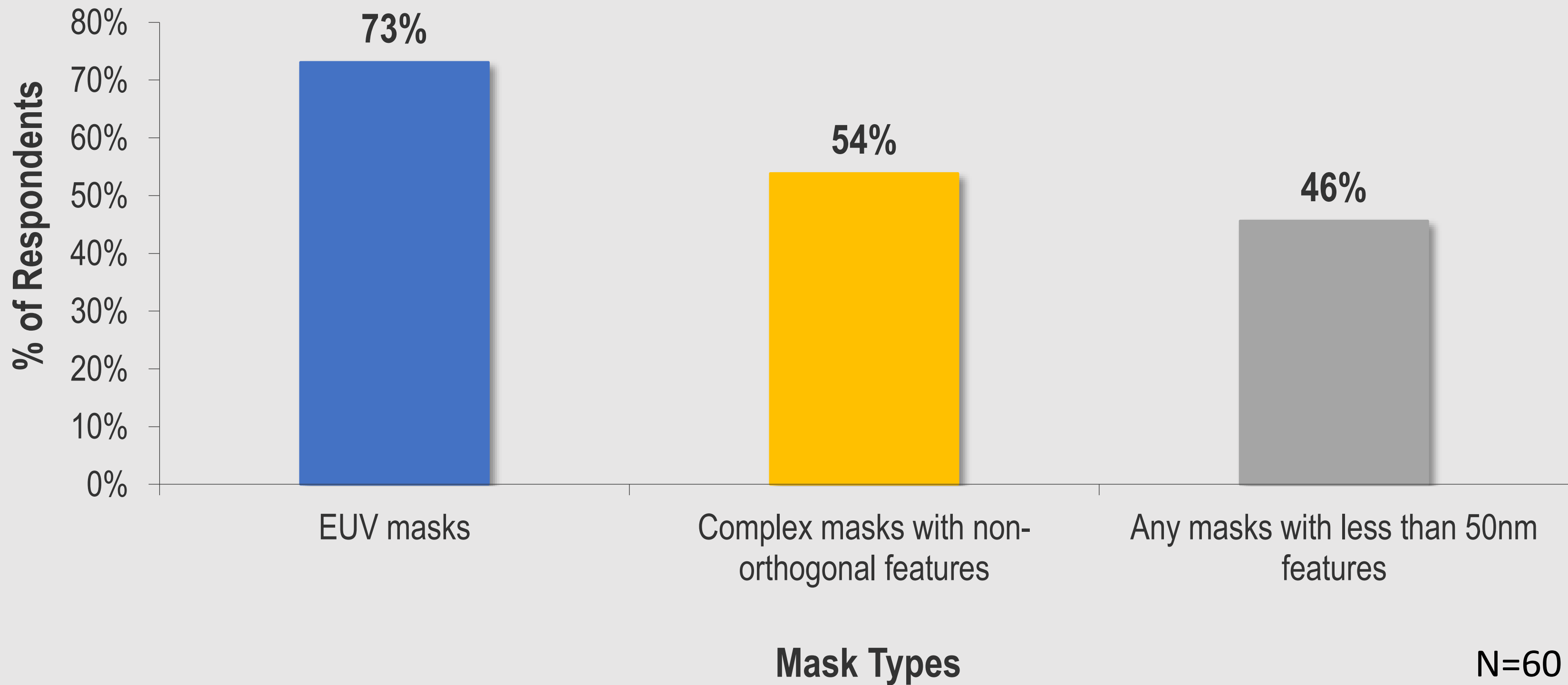
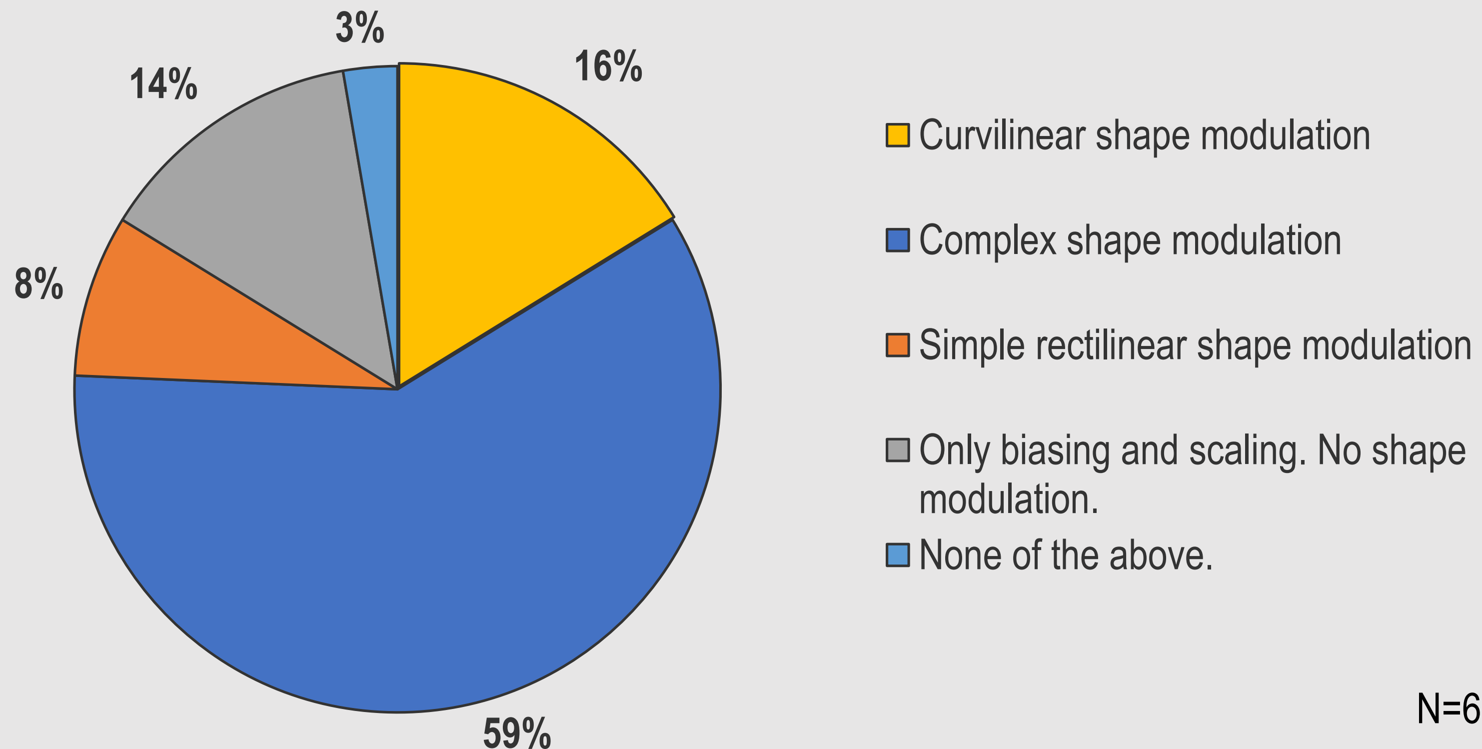


Complex Mask Shapes Predicted for EUV



Voicing Your Interests for 2016: Multi-beam for Mask, Inspection and CEBL

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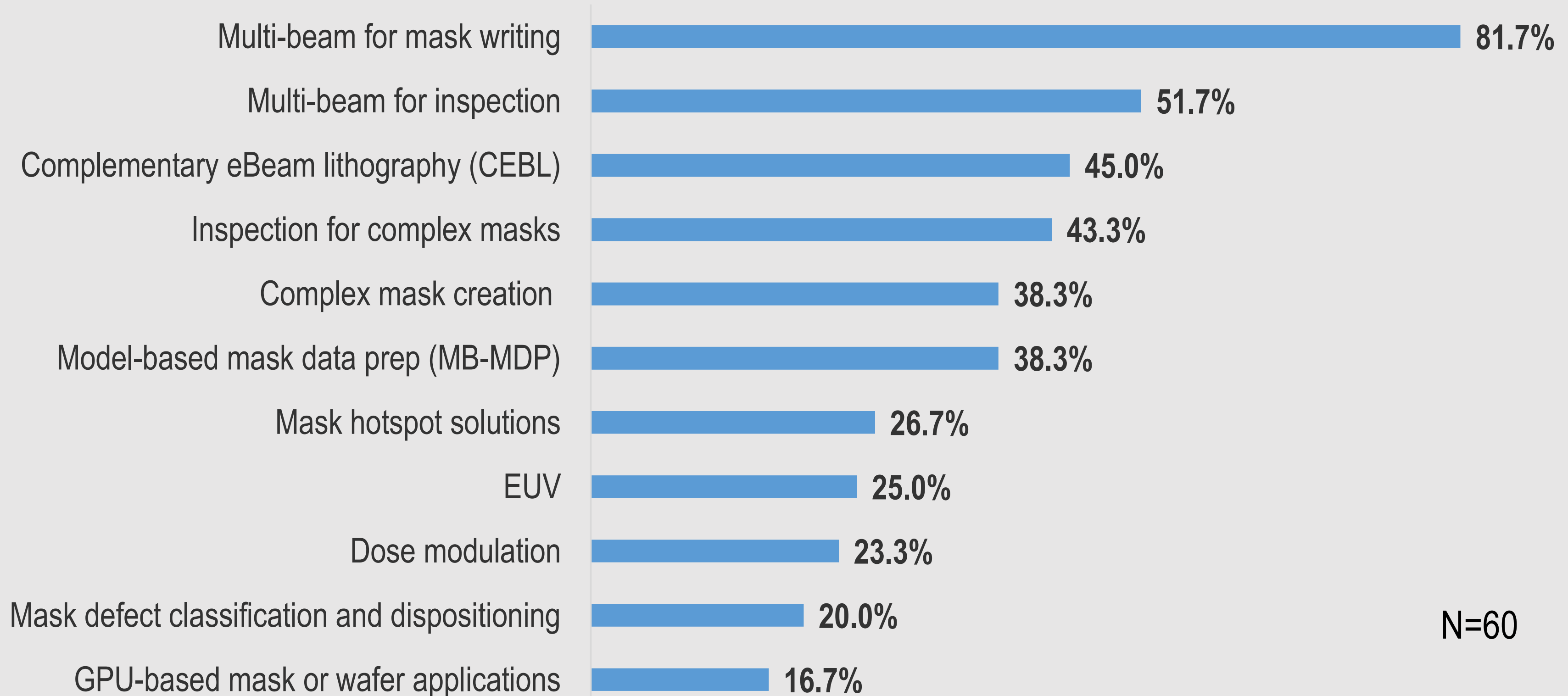

The Mask Maker Survey 2015

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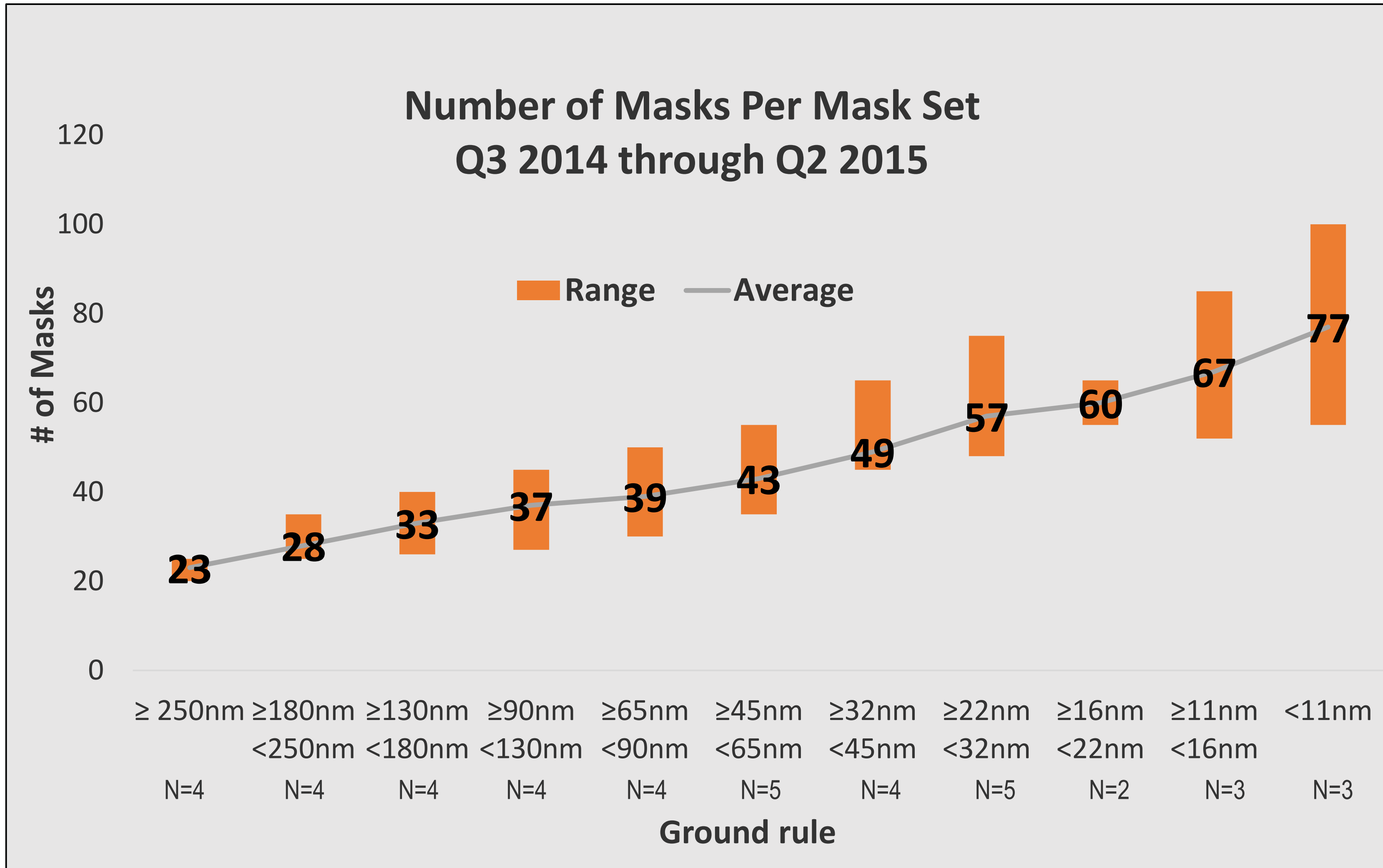
- **Members requested the eBeam Initiative to “fill the gap” which the SEMATECH survey had served through 2013**
  - Thanks to Matt Malloy, SUNY Poly SEMATECH, for his advice
  - This survey did not replicate the past ones
- **Thank you to the 8 participating mask makers:**
  - AMTC, DNP, GLOBALFOUNDRIES (IBM), HOYA, Photronics, Samsung, SMIC, Toppan

Masks per Mask Set Continue to Grow

Long term 13% per ground rule



TAT Increases at Smaller Geometries

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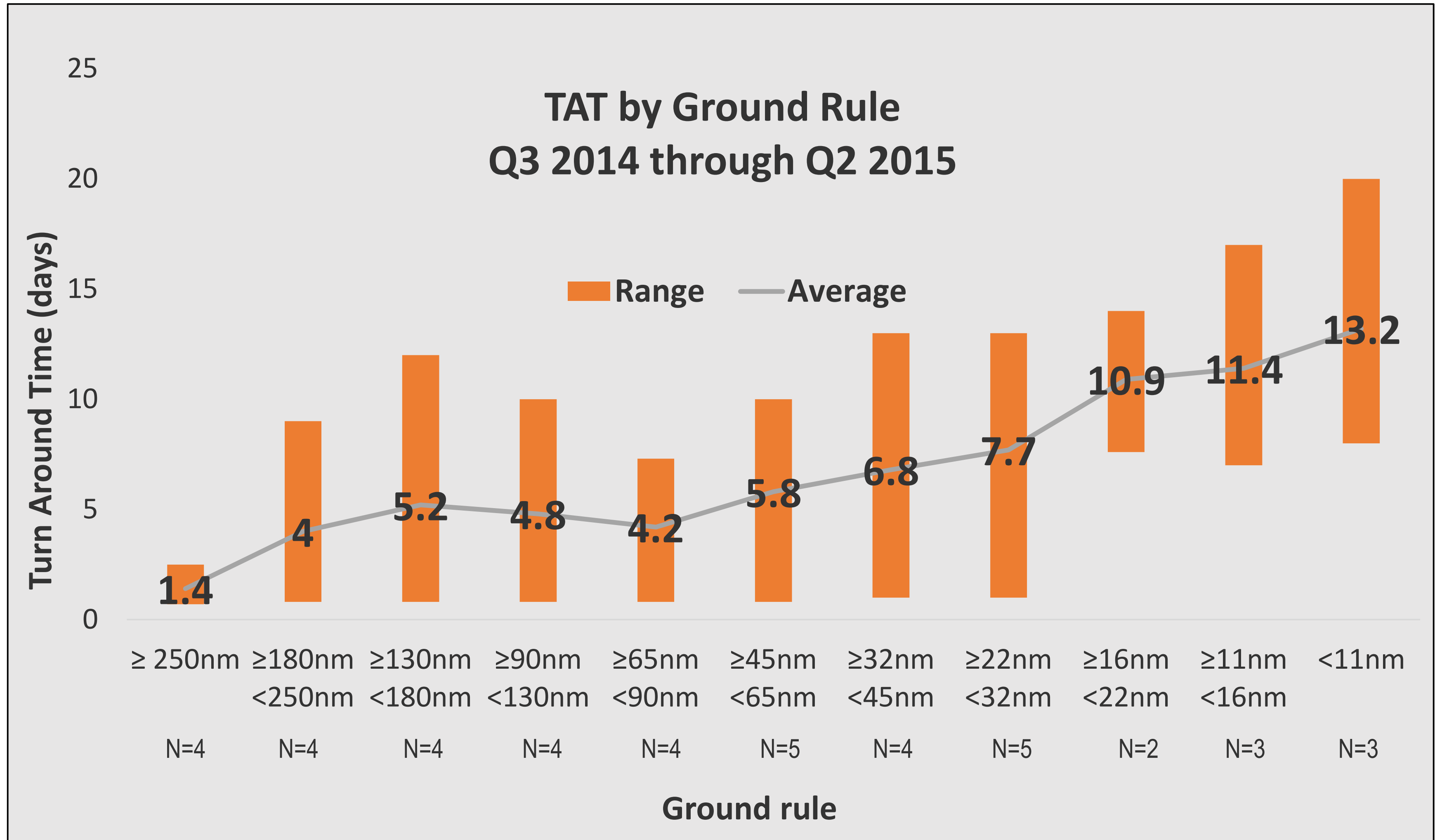
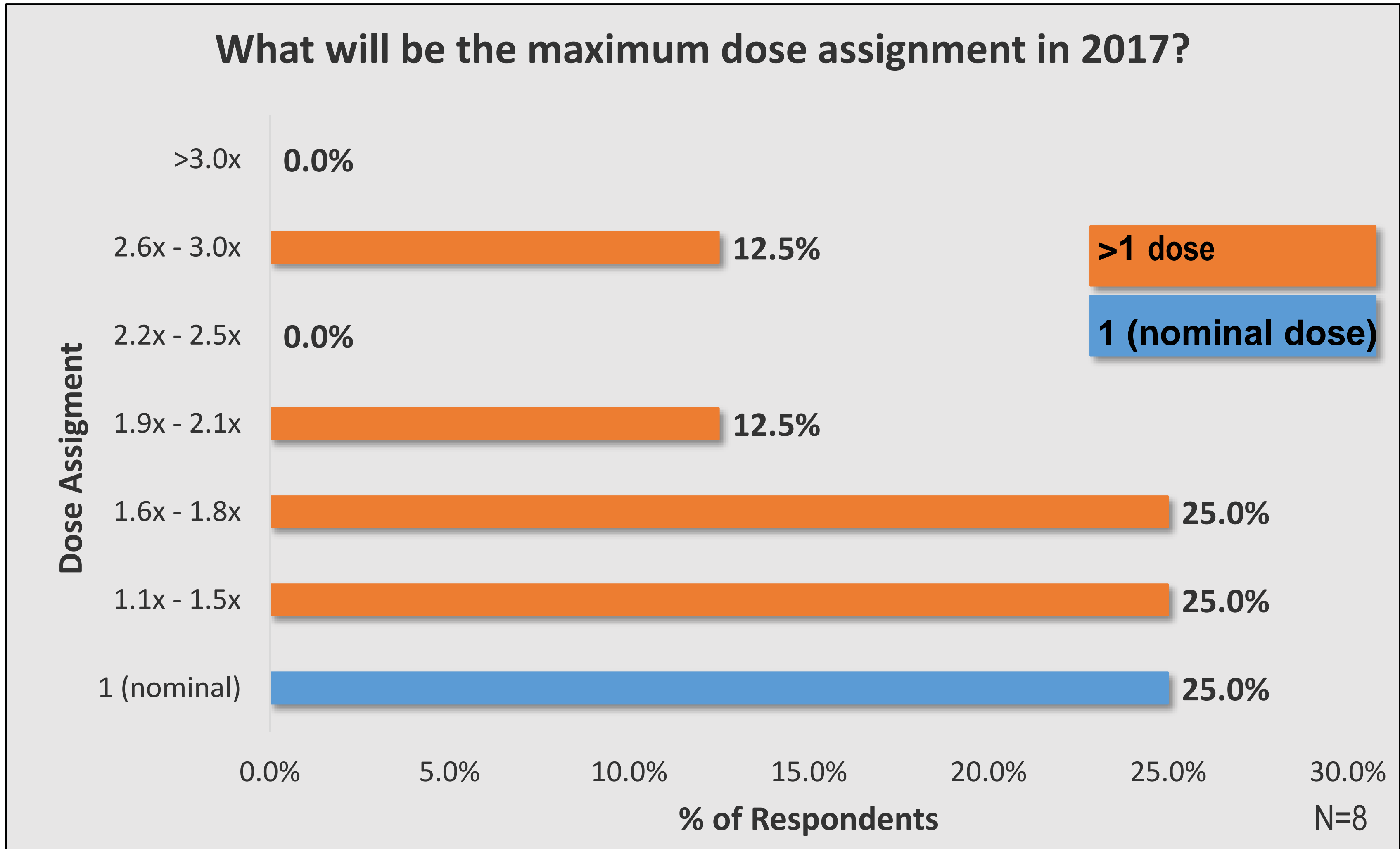


2015 Mask Shop Statistics
Q3 2014 through Q2 2015

Data	Average	Range	Median
Average mask write time (hours)	9.6	4-16	7
Longest mask write time (hours)	32.7	18-72	29
Average data file size for single mask layer (Gbytes)	38	3-100	20
Largest data file size for single mask layer (Gbytes)	343	55-800	250
Median # of mask defects <0.5µm at 40nm production logic nodes & below	17.7	3-69.7	5.5
% of 40nm & below production masks rewritten	6.8%	1-10%	7%
First repair success rate production masks	86.9%	60-99%	92.5%
Slowest resist used for production (µC/cm^2)	43.9	20.1-55	40
Max relative dose assigned to shots (1=nominal)	1.5x	1, 1.2x-3x	1.25x

75% Plan to Use >1 Dose in 2017



Range of Resists Predicted to Expand

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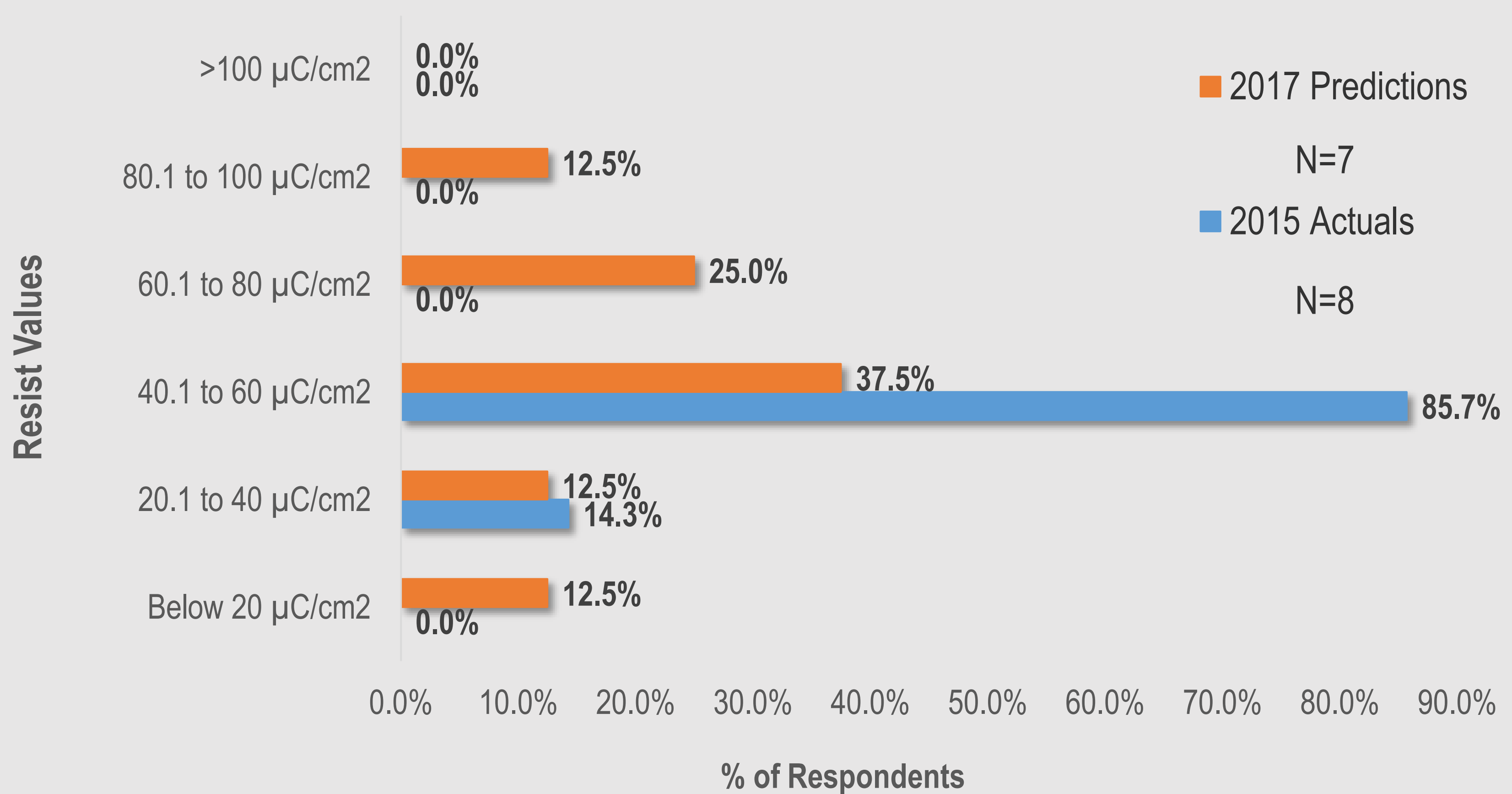

Complexity Grows for the Mask Maker

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- Longer write times and larger mask sets
- Dose modulation is here today
- EUV masks will have complex shapes
- Multi-beam for mask writing is much anticipated

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Thank you to those who participated in the survey!

Feedback and questions for future surveys welcome – send to jan@williscalibra.com