

# Dual Robot Photolithography Cluster Tool Throughput Improvement

Vertical

Semiconductor	Pharmaceutical	Healthcare	Portfolio	Logistics	Financial	Government	Business
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Genre

Case Study	Project Review	White Paper	Technology Overview
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Client

**Texas Instruments**



Situation

Texas Instruments is a leading supplier of high-performance analog ICs specializing in power management, amplifier, data conversion, and high-speed interface products. With future demand forecasts on the rise, they needed to understand the maximum throughput they could expect from their constraint – the photolithography cluster tool. If constraint throughput could be increased by 10%, they could avoid purchasing another cluster tool at the cost of \$4 million.

Semiconductor wafer fabrication facilities are highly complex queuing networks with process flows consisting of hundreds of steps utilizing a wide array of sophisticated manufacturing equipment. Each piece of equipment itself typically includes multiple process steps. For such equipment types, flexible simulation models can allow evaluation of configuration and process scenarios to more accurately determine throughput. After having previous success with ProModel technology, they used it again to model the photolithography cluster tool.

Objective

Determine the maximum throughput from the Dual Robot Photolithography Cluster Tool constraint, in order to meet increased future demand without purchasing new equipment or expanding the facility.

Results

A comparison of wafer level times between model and tool led to the following:

- Discovered the tool was missing the latest coat/develop track software update causing a wafer flow disruption between lots resulting in a partial break in cascade driving both a ph reduction as well as a cycle time increase due to wafer delays.

## Lithography Cluster Tool Model Output

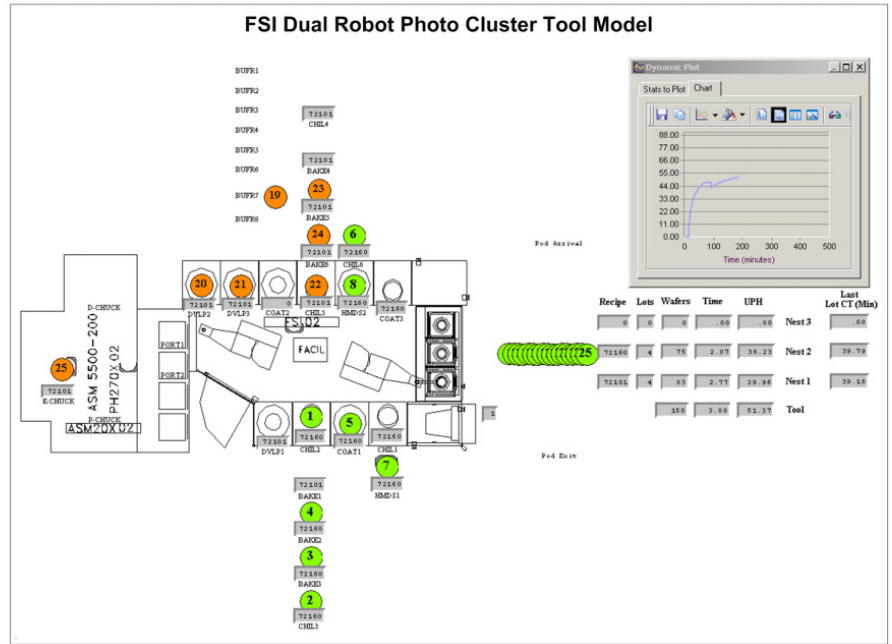
- A schedule was established to ensure roll-out of the latest software upgrade to gain the associated throughput and cycle time improvements.
- Implementing the software update improved throughput enough to avoid purchasing a new cluster tool thus avoiding a \$4 million capital expense.



**Solution**

A model was developed to study the throughput of a photolithography cluster tool configured for high capacity processing. Due to the need for higher throughput, this cluster tool was built with additional modules necessitating two robots to accomplish the required wafer movement. A simulation was perfect for displaying multiple resources servicing multiple locations for multiple entities in a reenter process flow. This kind of complexity needed the simulation over the company's previous use of spreadsheets.

**Lithography Cluster Tool Model**



Model accuracy determines the ability to confidently predict improvements using it; current accuracy is well within 5%. However they need to refine it further in an attempt to reach +/- 2% because they have run out of low hanging fruit so they must now look for smaller incremental gains and the model must be highly accurate to help accomplish that.

During preliminary model validation a question was posed about the effect an increase in processing of small lots would have on photo cluster throughput. The model was used to provide a relative understanding of the impact, and was found to have little to no impact as long as sufficient operators are available to load the cluster and mask/reticle changes are minimized to avoid breaking continuous cascade mode. They did however discover the software version issue as described in the results section.

**Wafer Level Validation (Ongoing)**

Average of Lot #	Machine #	BAK1	BAK2	BAK3	BAK4	BAK5	BAK6	CH1	CH2	CH3	CH4	CH5	CH6	COAT1	COAT2	DVLP1	DVLP2	DVLP3	HMDS1	HMDS2	Grand Total	
1	1	11	18	12	10	224	241	255	27	7	8	13	8	28	22	40	11	7	10	RDV/01	RDV/01	43
2	2	76	17	13	19	209	187	193	41	8	9	27	27	42	38	36	28	27	20	RDV/01	RDV/01	54
3	3	78	18	20	19	240	239	239	56	15	13	21	13	51	47	40	21	11	19	RDV/01	RDV/01	80
4	4	295	18	20	17	255	252	255	51	12	11	8	14	48	47	43	10	9	8	RDV/01	RDV/01	86
5	5	400	19	21	19	289	288	319	51	12	11	10	52	50	60	8	16	7	RDV/01	RDV/01	107	
6	6	414	53	54	20	279	24	24	73	73	73	73	73	73	73	73	24	21	15	RDV/01	RDV/01	124
7	7	332	19	18	17	241	245	251	54	12	11	11	11	54	54	42	14	27	16	RDV/01	RDV/01	95
8	8	430	40	42	43	390	291	292	62	87	73	11	11	62	57	61	11	7	8	RDV/01	RDV/01	123
9	9	350	18	39	38	214	215	206	80	70	79	16	16	82	77	82	32	24	20	RDV/01	RDV/01	109
10	10	289	13	20	13	264	262	274	80	13	12	22	10	62	54	59	22	12	8	RDV/01	RDV/01	91
11	11	323	17	19	19	235	228	230	80	12	10	9	11	58	57	58	11	21	9	RDV/01	RDV/01	80
Grand Total		283	26	27	24	249	241	243	60	37	34	15	15	61	55	57	19	18	14	RDV/01	RDV/01	92

Tool Wafer Times

Model Wafer Times

Tool vs Model Wafer Time Delta:

Wafer Delays Due To Partial Cascade Break In Tool

The facility now has the model as an ongoing project to use for more tools and also possibly use for sector models.