

Dual Robot Photolithography Cluster Tool Throughput Improvement

Vertical

Semiconductor | Pharmaceutical | Healthcare | Portfolio | Logistics | Financial | Government | Business

Genre

Case Study

Project Review

White Paper

Technology Overview

Client

Texas Instruments

ProModel

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.
- 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.

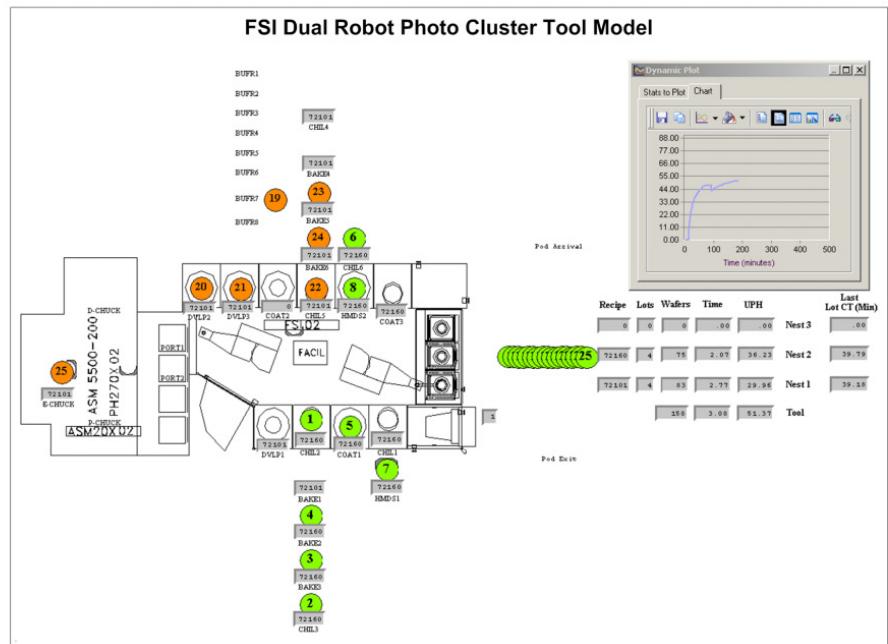
Lithography Cluster Tool Model Output



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

Wafer Level Validation (Ongoing)

Lot ID	Machine	x/y	Tool Wafer Times												Model Wafer Times											
			ASIM	BAKE1	BAKE2	BAKES	BAKE4	BAKES	CHIL1	CHIL2	CHIL3	CHIL4	CHIL5	CHIL6	COAT1	COAT3	DVLPI1	DVLPI2	DVLPI3	HMDSI	HMDS2	Total				
#1	V001CHTA	11	18	12	10	224	241	255	27	7	8	13	18	28	22	40	11	7	10	IV0/V01	IV0/V01	9				
#2	V001BSEG	76	17	19	19	209	187	191	41	8	9	27	27	42	38	36	28	27	20	IV0/V01	IV0/V01	5				
#3	V001EHTB	78	18	20	19	240	239	239	56	15	13	21	13	51	47	40	21	11	19	IV0/V01	IV0/V01	6				
#4	V001EHTC	291	18	20	17	255	252	255	51	11	11	8	14	48	47	43	19	8	8	IV0/V01	IV0/V01	8				
#5	V001A8KIC	409	19	21	21	240	239	219	50	8	21	10	52	50	60	8	16	24	21	IV0/V01	IV0/V01	12				
#6	V001P0KA	324	19	24	34	240	279	244	50	8	21	10	52	50	60	8	16	24	21	IV0/V01	IV0/V01	12				
#7	V001PKPA	324	19	18	17	241	241	241	50	8	21	10	52	50	60	8	16	24	27	IV0/V01	IV0/V01	5				
#8	V001EBCU	430	40	42	43	290	291	292	52	87	73	11	11	62	57	61	11	7	8	IV0/V01	IV0/V01	12				
#9	V001DFTB	350	28	39	38	214	215	206	80	70	79	16	16	82	77	82	32	24	20	IV0/V01	IV0/V01	10				
#10	V001PKX3	289	13	20	13	264	262	274	60	13	12	22	10	62	54	59	22	12	8	IV0/V01	IV0/V01	9				
#11	V001P0Y1	523	17	19	19	235	228	230	60	12	10	9	11	58	57	58	11	21	9	IV0/V01	IV0/V01	9				
Grand Total		283	26	27	24	249	241	243	60	37	34	15	15	61	55	57	19	18	14	IV0/V01	IV0/V01	9				
ASIM	BAKE1	BAKE2	BAKE3	BAKE4	BAKES	BAKES	CHIL1	CHIL2	CHIL3	CHIL4	CHIL5	CHIL6	COAT1	COAT3	DVLPI1	DVLPI2	DVLPI3	HMDSI	HMDS2							
1	16	0	9	7	11	17	29	15	6	10	18	26	19	12	19	24	18	13	19	13	19	19	19	19		
2	12	20	19	21	21	16	21	20	15	16	18	17	20	12	18	18	23	18	13	20	13	20	23	25		
3	16	24	16	17	15	18	25	20	15	15	17	27	20	25	25	25	25	25	25	25	25	25	25	25		
4	18	18	17	17	19	19	24	20	15	15	17	27	24	25	25	25	25	17	12	19	19	19	19	19		
5	18	0	13	14	10	14	10	15	15	15	15	15	11	24	11	24	11	11	9	36	34	36	34	36		
6	17	13	15	14	15	15	16	19	11	11	15	15	10	18	17	16	13	15	15	15	15	15	15	14		
7	13	11	14	15	16	19	18	16	12	12	10	13	19	20	16	16	16	17	15	18	16	17	16	16		
8	17	13	14	14	16	18	13	13	11	10	10	10	23	24	24	23	17	19	15	23	24	24	24	24		
9	18	9	12	13	17	15	15	14	12	12	16	17	13	17	17	17	17	11	21	21	22	21	21	22		
10	14	0	13	7	11	10	16	10	11	8	13	10	21	19	12	21	21	21	21	21	17	17	16	16		
11	14	25	14	10	16	17	10	14	7	11	10	10	16	14	13	15	18	11	15	15	15	15	15	15		
1	4	-18	-8	-9	-213	-224	-226	-18	0	1	5	-18	-24	-9	-28	8	17	8								
2	-55	3	-1	-1	-188	-211	-213	-13	0	1	5	-13	-16	-16	-13	-13	-13	-4	-4	-4	-4	-4	-4	-4		
3	-60	5	-1	-1	-211	-221	-221	-13	0	1	5	-13	-16	-16	-13	-13	-13	4	4	4	4	4	4	4		
4	-274	0	-1	-1	-228	-233	-233	-13	0	1	5	-13	-23	-23	-13	-13	-13	-10	-10	-10	-10	-10	-10	-10		
5	-382	-19	-7	-7	-280	-280	-281	-304	-18	4	-4	1	-3	-29	-29	-39	-38	9	4	2						
6	-597	-40	-40	-6	-264	-281	-278	-65	-84	-55	-1	-8	-64	-57	-51	-10	-10	-6	-6	-6	-6	-6	-6	-6		
7	-275	-13	-7	-7	-253	-252	-257	-90	-4	-4	-9	0	-41	-35	-47	-1	9	9	9	9	9	9	9	9		
8	-309	7	-9	-9	-219	-211	-220	-49	-6	2	1	-1	-42	-43	-48	-1	-8	2								

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