CASE STUDY

WHEN LEAN COLLIDES WITH MATERIAL SCIENCE!

Quality
Support
Group

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LEAN tools and techniques have made huge improvements in all industries. They have resulted in significant waste reductions one of which has been cycle times in process industries. Time between process steps has been reduced resulting in reduced inventory and improved time to market.

In one particular situation the time between a metal deposition and the subsequent pattering lithography step was being reduced using value stream mapping techniques. Initial times were initially greater than 24 hours and were currently reduced to less than 6 hours. Management was congratulating the area for their LEAN progress. But at this point the quality of the lithographic patterning was impacted and defects were seen. Features became irregular many of which were below the minimum dimensions. What was also puzzling is that this problem was not seen in two other factories running the identical process on identical tools with the same materials and chemistries.

Process engineering was tasked to “fix” this problem quickly. Numerous DOE’s were run to identify what parameters significantly impacted the quality in a search for optimum process targets and tools parameters. Minor improvements were achieved. Management was getting impatient since the other two factories kept reporting no issues.

Due to facility issues the area had to shut down for three days. When the process was restarted the defects were gone. Process engineering reviewed all the data and could not find any changes to tool setting or operator techniques. Meetings were held with facility engineering to find if changes were made to their control settings. Nothing was identified until a quality engineer was asked to review the data. His conclusion was that queue time had an impact and the area had to go back to a 24-hour hold time. Management was not happy.

Experiments were run and defects generation was evident at <12 hours of queue time. What was queue time and thought to be a waste was actually part of the over all process time. The deposited metal surface was oxidizing, as it sat in the room while in queue for the lithographic step. The oxide was a necessary feature and improved the adhesion of the lithographic materials.

Management was still not happy even when process engineering said a 12 hour queue was still better than the other two factories' queue times. Process engineering needed to find a countermeasure and get the queue time lower.

Solution:

An oven was moved in place and added was a bake process step between the metal deposition and the lithography steps. Experimentation was able to totally eliminate the queue time with was a 1-hour bake which was equivalent to a 24-hour room temperature queue. Management was happy again.