Cost Reduction Strategies for Equipment Repair and Maintenance

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Abstract

Average sales prices in the semiconductor industry are constantly falling. To stay competitive, it is imperative that Operations continually drives down costs. Skyworks' equipment departments have successfully reduced costs for repair and maintenance, and will share some of their strategies in this paper.

INTRODUCTION

As average sales prices of compound semiconductor devices continue to fall, successful companies need to find ways to drop their wafer cost if they want to stay profitable. Die shrink, process improvements, and increasing factory efficiencies are often at the top of the list for cost savings projects. Equipment departments are often overlooked, since many people believe you need to spend "whatever it takes" to keep your equipment up and running. The equipment departments in Skyworks' Woburn and Newbury Park fabs have proven this philosophy wrong. Both fabs have a track record of success in driving down costs, while still supporting the factory needs.

HISTORY OF SAVINGS

The Newbury Park Fab has been ramping over the past two years. In spite of starting more wafers, and making more wafer moves, equipment repair and maintenance costs have been steadily reduced, as shown in Figure 1. The Woburn Fab has shown similar success.

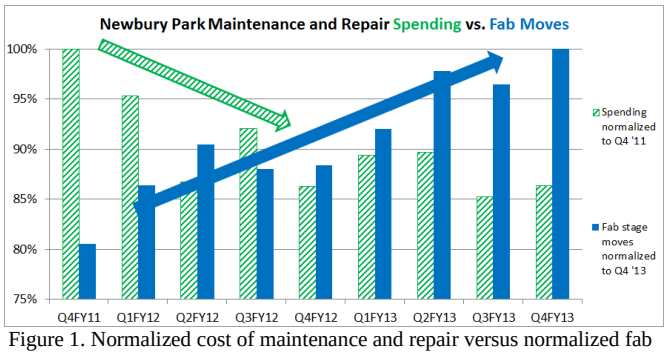

Figure 1. Normalized cost of maintenance and repair versus normalized fab moves over the past nine quarters.

COST SAVINGS STRATEGIES

TRACK SPENDING

At the top of the list of cost savings strategies is to track spending and make it part of your key performance indicators (KPI). Our fabs get weekly feedback from finance so we can monitor our spending and ensure we are on track. This is a high level report, and efforts are underway to set up a system that allows drill down to the tool level. Eventually we would like to give each engineer a quarterly budget.

The fabs are both run using a "scorecard deployment" methodology [1]. The fab VP has high-level goals (wafer cost), which are drilled down to the VP's staff (maintenance and repair cost). This budget goal is reviewed in monthly and quarterly operations reviews, and action plans are presented if goals are not met. Specific cost reduction targets are passed along to the engineers and equipment tech supervisors and tracked as a KPI as part of their annual performance review.

CREATE A COST SAVINGS CULTURE

Another critical component to saving money is to create a cost savings culture at all levels of the organization. Using a scorecard and sharing the group's successes and misses on a regular basis, and making cost savings a part of everyone's review is a good start. Our techs and engineers are committed to looking for ways to troubleshoot parts before replacing with a shotgun method. And, in cases where trial and error is necessary, they understand the importance of putting the old part back on if a new part did not fix the problem. It is also important for the managers and engineers to ask the equipment technicians to look for cost savings ideas, and to listen and act on them when they are provided.

A fun way to build awareness is by playing a "guess the cost" game. Once a year, our production control department chooses a few 'overpriced' parts, and asks the operations team to guess the cost. The person who is the closest wins a free lunch, and everybody's eyes are opened when they see a simple screw costing more than $50 (Figure 2).

Figure 2. Vespel screw, original cost $56

TAKE CORRECTIVE ACTION FOR CHRONIC FAILURES

Our fabs emphasize taking root cause corrective actions to improve parts with chronic failures. For example, a photo track had a pump which was being supported by a Teflon fixture. The fixture would wear and distort over time causing dispense volumes to be erratic, and required an annual pump rebuild at a cost of $3400 through the OEM. The fixture was replaced with an aluminum bracket (Figure 3) for a one-time cost of $400, and substantial on-going cost savings.

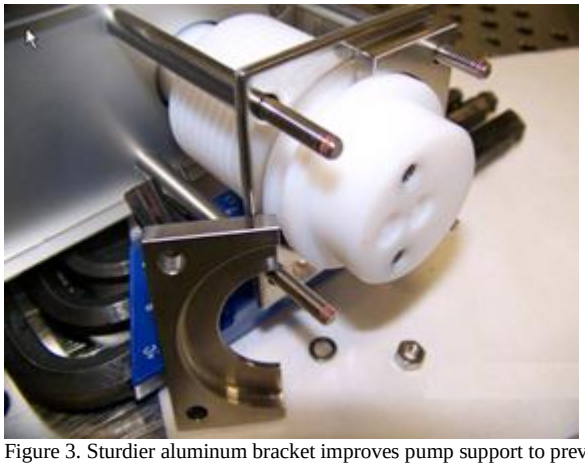

Figure 3. Sturdier aluminum bracket improves pump support to prevent premature failure.

EXTEND TIME BETWEEN PMS

Preventative maintenance is critical to keeping tool availability high. As a fab matures, and the interaction between process and equipment is better understood, it is often possible to revisit PM cycles and identify means to extend them. For example, on one of our dry etch tool sets, the PM frequency was being dictated by the end point system failing due to a dirty end point window. The process and equipment engineers worked together to modify the hardware, and were able to extend time between PMs from 65 to 95 RF hours.

Another example is from our evaporators. The time between major PMs was approximately doubled by selectively arc spraying key pieces of shielding. The process and equipment engineers again worked together to monitor critical parameters such as pump down time, sheet resistance, and particles to ensure the product quality was not impacted by this change. In both cases, extending these PMs resulted in reduced cost for shield cleaning.

RE-EVALUATE MATERIALS USED FOR CONSUMABLES

Investigating the materials being used for consumables can also provide cost savings opportunities. By using ceramic instead of quartz liners, our etch engineers were able to save costs and extend PM cycles. Quartz parts were not robust against chemical attack, and needed to be replaced after every second use. Since switching to ceramic, our liners have not needed to be replaced, and we are expecting to get more than 10 uses from them. In addition, we were able to extend the PM cycle from 125 to 140 RF hours because the chamber condition did not degrade as fast when using ceramic, providing additional cost savings reduction for shield cleaning costs. As an added bonus, by utilizing ceramic hardware our etch rate also increased, which allowed us to realize throughput and OEE gains.

Another opportunity we recognized was changing the filter material from Teflon to polypropylene on our wet strip and lift equipment. The need for Teflon was questioned during a cost savings brainstorming activity. Upon investigating, the team realized the chemicals we were using for the process did not require this material, and by keeping an open mind, they were able to qualify a new filter, and reduce costs from $620 to $150 each.

In all cases it is important that your equipment and process engineers work together to evaluate the lower cost solution to ensure product quality and equipment are not compromised.

INTERNAL AND EXTERNAL REPAIRS

Repairing parts instead of buying them new provides another opportunity for cost savings. There are many OEM and second source options for repairing pumps, boards, and custom mechanical parts. For example, a rotor for our plating tools is ~$25,000 new, but only ~$4,000 when repaired by the OEM. In this case, even more savings was recently obtained when one of our equipment technicians suggested an "in house" repair. Rotors are disassembled and sent to a local metal finishing supplier that bead blasts and anodizes the part for less than $200 per rotor (Figure 4). In addition to cost savings, this method has significantly cut lead times.

Figure 4. Plating rotor before and after "in house" repair.

It is also important to closely monitor in-house and external repairs to ensure part life meets expectations. As an example of this, we started repairing an asher potentiometer in-house. Over time we found part life diminished, and wafers were broken when the part failed. After resuming use of a higher quality, new part, wafer breakage on the toolset was reduced to less than half the level when doing the in-house repair. The cost savings for rebuilding in house was more than lost due to the equipment down time and wafer breakage.

IN-HOUSE MACHINING

As part of our company culture for continuous improvement, our engineers and technicians are constantly looking for ways to improve equipment. In many cases we use local machine shops to make improvements to consumables. Our Mexicali test facility has historically had a machine shop. In the last year, we have started machining consumables at this location for the fabs (Figure 5). This is a win-win situation, as it allows the Mexicali machine shop to run "full", and hence more efficiently and also saves costs for the fabs.

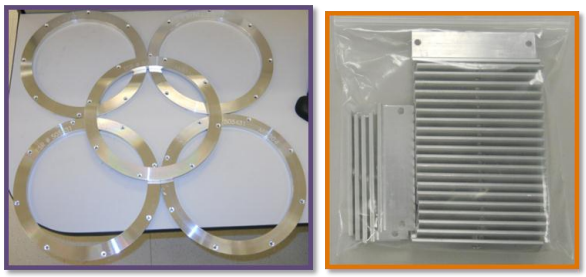

Figure 5. Example of parts machined in Skyworks Mexicali machine shop.

A formal system has been put in place to qualify parts with the process and equipment engineers, and release them to production. Our production control group orders the necessary material based on a documented spec, Mexicali machines the parts, and they are put into our stock room like any other consumable. We also have quality control checks implemented into the system.

HIRING AND TRAINING EXPERTS

Another area the Skyworks fabs have excelled is hiring experts. Wherever possible, we look to hire engineers and technicians with direct expertise on our specific toolsets. Having these in-house experts has allowed our fabs to limit the number of service contracts and service calls we need to make over the years, hence saving cost. Because we rely on, and expect our experts to share their knowledge, it has also enabled us to promote people with great attitudes and great potential from within our factory. We have a good track record in training people from our factory floor to become successful equipment technicians.

In-house troubleshooting and repair skills are especially important when you are working with dated equipment. Our engineers and techs pride themselves with going the extra mile to find solutions, even when the OEM says it is not possible. For example, the equipment manual and local field service office told us a robot was "not field serviceable" when it failed. The solution offered was a $33,000 replacement with a four-week lead time. Our engineer did not take no for an answer. Instead, he dismantled the top end of the robot, and determined the failure was due to a faulty servo motor (Figure 6). A new motor was acquired, and the repair was done and tested in two hours, with a total spend of approximately $3,500.

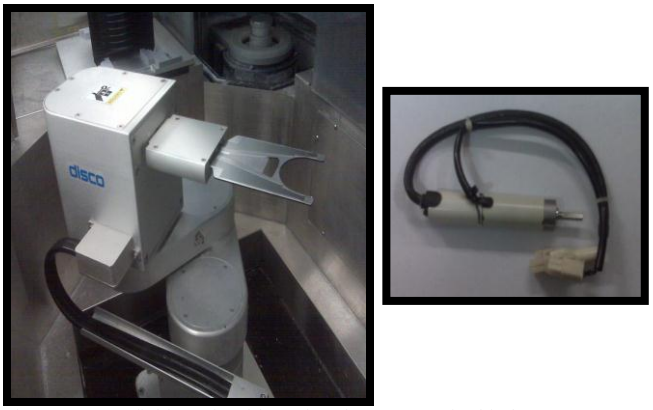

Figure 6. "Not field serviceable" robot that was repaired in house.

PRODUCTION CONTROL AND SOURCING

Our production control and sourcing departments are indispensable when it comes to cost savings. They continually find ways to save money on parts and set appropriate levels of spares in inventory. Our engineers work as a team with these groups to ensure maximum cost savings is obtained.

LEVERAGING MULTIPLE FAB SITES

Finally, we have been able to create cost savings by leveraging our multiple fab sites. We are able to carry fewer critical spares in inventory and get pricing discounts for buying "in bulk". In addition, we are able to use our equipment experts to the benefit of both sites through phone support and periodic visits. The support extended to each other includes sharing cost savings ideas, troubleshooting difficult down tools, and training.

CONCLUSIONS

By adopting a cost-savings culture across the organization, it is possible to drive substantial maintenance and repair cost savings and still support the factory needs.

ACKNOWLEDGEMENTS

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REFERENCES

[1] A. Hunt, J. Oerth "Improving Organizational Performance through Goal Deployment" 2009 International Conference on Compound Semiconductor Manufacturing.