Bridging the Social Gap
Working Together for Continued Prosperity and Growth

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Abstract

This paper discussed the similarities and differences between the operator and engineering working groups and how they can work together to achieve company and personal goals.

INTRODUCTION

An important source of competitiveness in the compound semiconductor industry is the ability to introduce new process technologies quickly with high yields and low cycle times [1]. A lot of attention has been paid to engineering performance based on process development/integration, production performance based on WIP management, and equipment effectiveness. However, very little study has taken place on the interaction between operators and engineers. Operators and Engineers are two very distinct and somewhat independent groups with a very complex and sometimes strenuous relationship. There are many reasons for this perceived and/or real tension. This paper is an opportunity to discuss those differences and learn how to integrate our unique knowledge and experiences for the continued prosperity and innovation of our companies.

SIMILARITIES AND DIFFERENCES

Let's briefly explore the similarities and differences between the two groups. We all, operators and engineers, have a huge stake in our companies. Both groups strive every day to produce the highest quality work possible because it benefits our financial bottom line. It is also a matter of pride for all employees to do the best job that they are able. All employees regardless of job title come to work not only to provide for their families, but to ensure through their quality of work that they will continue to be employed for many years. This job security is something that everyone strives to achieve.

There are some significant differences that make a working relationship challenging. Education is a considerable difference that stresses the relationship between engineers and operators. Most if not all engineers have an advanced degree, which they have spent a huge portion of their adult life earning. Engineers have spent years if not decades honing and perfecting their expertise to make their process the best that they can by continually improving the processes. Operators are generally high school graduates, with a very small percentage having some college or a full bachelor's degree. This difference in formal education is often skewed by the experience that operators bring. Many operators have been in and around this industry for 25+ years. These individuals have experienced the field of semiconductors from its infancy and bring some very insightful and profound experiences to the discussion.

Understanding that we all have a very personal stake in our companies, what opportunities do we have? What projects can we take on together? Cooperatively can we change our process? Can we become more efficient communicators? Do we know where we fall short in our day to day experiences? Seeing the differences between the operators and engineers, acknowledging them, and using them to ensure progress in our company can be and should be a tool that we use on a daily basis.

WORKING TOGETHER

Now that some differences have been explored, let's talk about the methods that are currently being used, and explore some new ways to work cooperatively to attain the same goals with more collaboration.

Below are two examples of how problem solving generally takes place.

A few years ago, operator noticed a halo defect around resistor features. After engineering approval, operators performed another rinse which got rid of the defect, as shown in Figure 1a and 1b. As production began ramping, time based preventive maintenance schedules had to be changed. The increased throughput invalidated the previously specified schedule. Operators and process engineers proposed a new PM schedule for dryers and halo defect has not been seen for years.

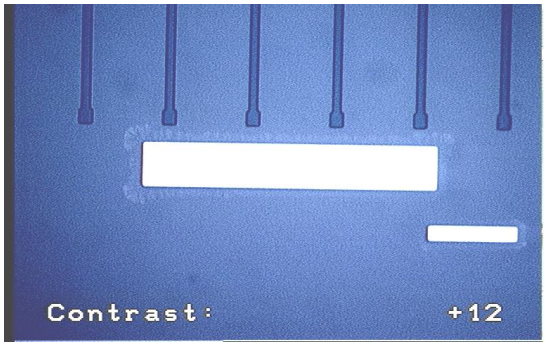

Figure 1a. Halo defect around resistor feature.

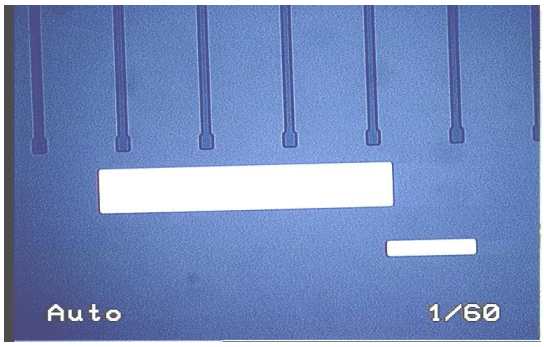

Figure 1b Halo defect was removed by another rinse in a clean dryer.

In another example, the Photo lead operator was informed by his process tech that the rework rates had jumped in May 2011. After quantifying the reworks from January-May 2011, it was noticed that the reworks had multiplied significantly, as shown in figures 2a and 2b. Operators then notified the photo and metal process engineers about the problem. Engineers did a tool commonality study, which found that one of the post plating dryers was suspect. Operators started checking all the lots unloaded from the dryer and found sometimes this dryer couldn't completely dry the wafers. Once the dryer was identified, it was passed to maintenance to fix the problem and the frequency of the defect has steadily declined in the last few months.

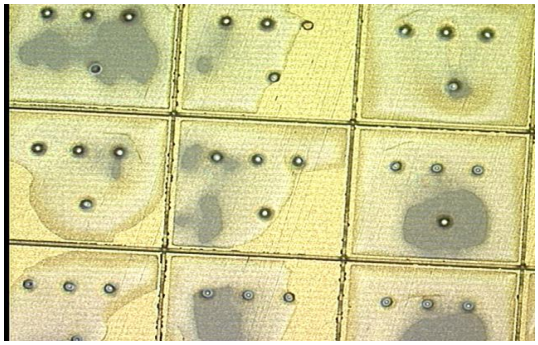

Figure 2a. Resist delamination from the plated gold on wafer backside.

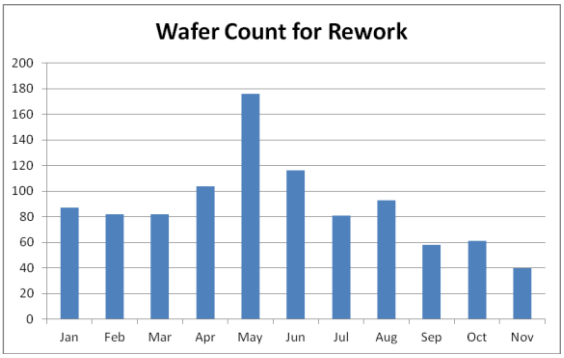

Figure 2b. Rework wafer count due to backside resist/Au delamination.

Although there was a positive outcome, these scenarios generally follow a basic formula: 1.Operator notices a problem, 2. Operator informs Engineer, 3. Engineer troubleshoots problem, 4. Engineer institutes new specifications, and 5. Operators follow new procedure. While this methodology can and does work, it leaves a huge gap between working groups. This methodology doesn't allow for the two groups to work collectively, to use each other's knowledge to further the goals of the entire company. Below are a few examples of how more collaborative efforts can make a more timely impact.

Many continuous improvement projects were completed by operator and engineer teams, such as cycle time reduction, precious metal savings, test wafer reduction, defect reduction, and wafer breakage reduction.

During a recent process change, the number of conditioning wafers that were being produced through the metal deposition tools went up dramatically. Understanding that there was a new demand, the area lead operator noticed that the recipes of both the conditioning wafers and production wafers were the same. He suggested removing the prebake step for conditioning wafers. The prebake step on production wafers is used to alleviate moisture on the wafers after the pre dip in a wet station. Knowing that the conditioning wafers didn't receive this wet step he suggested that the conditioning recipe be changed by removing the pre-bake step. This suggestion saved 75 minutes per conditioning wafer lot and greatly improved tool capacity.

Working together with Engineers, operators often give quality improvement suggestions. For example, operators noticed at an inspection step that there was a hard residue baked onto the backs of the wafers that couldn't be removed or reworked. This inspection step followed a liftoff and metal anneal process. Operators suggested adjusting the route so that the visual inspection happened after liftoff but prior to anneal. Engineers and operators got together and talked about the change prior to the new procedure being written. This minor script change dropped scrap rates dramatically due to liftoff residue.

In these two specific examples, the operators saw a problem, communicated the problem to engineering, and the

engineer had the problem fixed. How this differs from the previous examples is that there was communication. The two groups talked about the problem and came to a solution together. They added another step to the formula. This new step is the most important step in creating a cross functioning team. Without the new step in the formula you are left with the social gap. You are left with one group, engineering, who by training has more knowledge than the second group operators who are left to wonder if their contribution made a difference in the change.

Like Diane Bailey[2] stated, when operators or production techs are trained to perform simpler manufacturing engineering tasks, engineers are free to work on more challenging work that is distanced from fire-fighting duties. The result is a win–win situation. Operators and production technicians enjoy job enrichment that increases their technical skills and adds variety to their daily tasks. Cross-functional meetings can serve as a forum in which engineers, operators, and technicians, for example, can reach consensus over task assignment and job roles, thereby assuring that everyone is familiar with their responsibilities, and that they agree to the roles that they are to fulfill.

As a manufacturing team we must step away from the idea of an engineering group separate from a manufacturing production group. These divisions lead to the methodologies stated at the beginning. This leads to one group passing the issues on to the next group without much thought. Both teams need to understand the importance of holding, as Bailey stated, cross functional meetings. These meeting can serve as a medium for talking about the issues that are seen. When meetings are held, they can be organized by the process engineers. They can invite anyone who has working knowledge of the tool set, process or general interest. Once the group is assembled, they can start talking and fleshing out each problem as it arises. Once the general discussion is completed, the organizer can start to delegate portions of the solution to members of the group. After a period of time the group can once again convene with the organizer and discuss the outcome of the delegated tasks. These delegated tasks can be given to operators and engineers alike. This will, as Bailey stated, give operators job enrichment and allow the engineers to tackle the more technical portions of the solution. Once this scenario starts to be more common place, the engineers and operators will start to appreciate and respect the other groups much more. This newly found working relationship between operators and engineers will spur each group to tackle more and more technical and challenging task with each group knowing the others role and dedication.

APPLICATION IN YOUR FACILITY

Once you identify what the challenges for each group are, how does a team go about changing the culture and attitudes of their perspective groups? First of all as leaders, bring the groups together and start a dialogue about how important these ideas of collaboration are for the growth of not only your individual groups but for the company as a whole. Begin holding sessions where people from each group can get together and talk about the issues that are really plaguing the success and innovation of each group. Innovation and success does not always mean ground breaking product development; it can also be something as simple as streamlining the throughput of the prospective areas. Although the ground breaking product development is what gets us from one generation to the next, the small things are what help us to strengthen the current generation of product and helps us learn for the next generation. Most importantly, these relatively small ideas will help bolter and strengthen the overall output of your facilities. Although the ideas will be different from one company to the next, the outcome will be the same, more productive teams and happier more engaged employees.

To get these important outcomes, it is very important to hold your groups accountable for all the tasks that they have been given during the process of working together. To have all the ideas of collaboration is great, but without the follow through of accountability, the time and energy spent trying to accomplish your goals will have been for nothing.

Conclusions

In conclusion, we have an enormous opportunity as leaders in our companies, to use all of our people and their skills to benefit the growth and development of our companies. Despite the educational and social differences between engineers and operators, let's foster the growth and development of not only our products but also the people who are spending their lives working and producing for your companies. Fostering growth between groups in your companies will insure the continued prosperity and growth of your companies for many years to come.

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REFERENCES

[1] Macher, Jeffrey T, Mowery, David C, British Journal of Management, Volume 20, Supplement 1, March 2009 , pp. S41-S62(22)

[2] Diane E. Bailey, IEEE TRANSACTIONS ON ENGINEERING MANAGEMENT, VOL. 46, NO. 4, NOVEMBER 1999 417

Acronyms

WIP: Work In Process