FabTime Cycle Time Management Newsletter

Volume 9, No. 10 December 2008

Information

Mission: To discuss issues relating to proactive wafer fab cycle time management

Publisher: FabTime Inc. FabTime sells cycle time management software for wafer fab managers. New features in this month include Excel export of query results for system administrators, and the ability to force a numeric sort on chart and data table fields that are stored as text in FabTime.

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Welcome

Welcome to Volume 9, Number 10 of the FabTime Cycle Time Management Newsletter. This has been a particularly stressful fall for many of our subscribers, given the way that economic conditions are affecting the semiconductor industry. Things remain stable for FabTime, and we hope that conditions will improve for all of you sooner rather than later. In this issue we have one announcement about the next Fab Owners Association meeting. Our software user tip of the month is about the distinction between different types of filters for excluding data in FabTime. We have one response to last month's subscriber discussion question about the use of lean techniques in wafer fabs.

In our main article this month, we revisit an article that we wrote back in 2001, about methods for making fundamental cycle time improvements during a downturn (so that the fab will be in good shape to achieve great cycle times when things improve). We really do believe that, if you're in a niche that's being hit by this economy, as most people are, this is a time to hunker down and work on low-cost improvements. If you don't have great cycle times now, you certainly won't have great cycle times when demand comes back up.

Also, in the spirit of helping with cycle time improvements, we'd like to offer people access to some past issues of FabTime's newsletter. From now until January 15th, each subscriber can request up to five past issues. You can find a complete list at www.FabTime.com/newsletter.shtml (with links to abstracts). Send your request to newsletter@fabtime.com (but please be aware that it may take us several days to fulfill requests during the holidays). We hope that you find this helpful. And of course, FabTime software customers can always find the complete set of past issues available from the Help Table of Contents.

Thanks for reading! We wish you all a peaceful holiday season—Jennifer and Frank

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Community News/Announcements

Next Fab Owners Association Meeting

The next quarterly Fab Owners Association meeting (www.waferfabs.org) will be held on February 5th at the Avago Technologies site in Fort Collins, Colorado. Fab Owners Association (FOA) is an international, non-profit, mutual benefit corporation composed of semiconductor and MEMS manufacturers, along with industry suppliers. The FOA is headquartered in Cupertino, California, and was founded in 2004. FabTime has been involved with the FOA since 2005, and is currently an associate member. FabTime's Jennifer Robinson will be attending the meeting on behalf of FabTime.

FabTime welcomes the opportunity to publish community announcements. Send them to newsletter@FabTime.com.

FabTime User Tip of the Month

Using Subtraction vs. Not Filters

Back in January, we included a tip about using the subtract owner, subtract hold, and subtract operation filters ("-Own:", "-Hold", and "-Opn"). See the tip called "Eliminate Certain Time States from Operation Cycle Time Charts", which is Tip #45. It has come to our attention that there is still some confusion over how to use these filters in conjunction with the "not" filter (~) in FabTime. Therefore, we've decided to revisit this topic. The key point today is that you generally don't want to use the not filter (the ~ character) in conjunction with any of the subtraction filters ("-Own:", "-Hold", and "-Opn").

The subtraction filters are used, on certain cycle time and WIP charts, to exclude time that the lot has spent at a particular operation, or with a particular owner or hold code. The intention behind these filters is to allow you to, for example, exclude the time that a lot spent in extended marketing-driven hold from the lot's manufacturing cycle time. These subtraction filters thus look back at the history of the lot, and exclude certain time periods based on the lot's owner, operation, or hold code at that time.

The "not" filter, the ~ character, is different. It's used, in whatever field you use it, to exclude lots that have a particular attribute right now. So, putting "~9000" in the regular "Opn:" field will exclude all lots that are at Operation 9000. This not operation is commonly used, for example, to exclude monitor wafers from WIP Lot Lists, by using "~mon" in the "Own;" field (or whatever owner code your site uses for monitor wafers). It's not really designed to be used to look back at a lot's history.

When you use the not filter in one of the subtraction fields, this tells FabTime to look back at the history of the lot, and subtract out all of the time when that attribute did NOT apply. For example, putting "~9000" in the "-Opn:" field on

the Factory Cycle Time Trend Chart will subtract out all of the time that each lot wasn't at Operation 9000, and thus give you an average of the time that the lots did spend at Operation 9000. This is rarely what you'd want to do, and it's also quite likely to make the chart very slow. (If you really just want to know how much time the recently shipped lots spent at Operation 9000, you're better off using the Factory Cycle Time Contribution Pareto chart, sliced by Operation.)

We hope that this helps, in terms of clarifying the ~ vs. the subtraction fields. The important thing to remember is that you usually don't want to use them together – it's kind of a double-negative. That makes FabTime have to do extra work, and may not give you the results that you expect. If you are using the subtraction fields, however, even without the not filter, and you find the performance to be slow, please contact FabTime. There are things that we can do to speed up performance for sites that use the subtraction filters heavily. If this is your situation, or you have other questions, just use the Feedback form inside FabTime. Thanks!

Subscriber Discussion Forum

Lean Techniques

Last month, a subscriber asked: "Has anyone implemented lean techniques (Six Sigma, Kaizen, Pull System, etc.)? If so what is the success/failure story?"

Dr. James Ignizio wrote in response: "As someone who has been teaching these methods (under their original name; i.e., Industrial Engineering) for more than three decades I would have to say that their failure/disappointment rates are very much the same as Reengineering - an extremely popular fad of a decade or so ago. Surveys (see references) indicate that the failure/disappointment rates for Lean and Six Sigma are:

Lean Manufacturing (e.g., Kaizen, 5S, Toyota Production System): 70 percent or more failure disappointment rate.

Six Sigma: 60 percent or more failure rate

These failure rates are not entirely the fault of the methods. More likely they are because of the failure of management to support the efforts; the lack of training and experience of the Lean or Six Sigma team, and the naive belief that such methods are "the answer" rather than just being one part of the solution process.

While any criticism of Lean or Six Sigma is invariably met with hostility (those who questioned Reengineering were met with righteous outrage by its advocates who ignored its 90 percent failure rate), the fact is that any real or imagined successes are rarely sustainable.

Another matter that should be recognized is that Lean is intended for non-reentrant factories. Attempting to apply it to highly reentrant semiconductor fabs - without considerable modification - will result in serious problems. But that warning is often unheeded.

References:

- Del Angel, C. and C. Pritchard, "Behavior Tests Six Sigma," *Industrial Engineering Magazine*, August 2008, page 41.

I■ gnizio, J. P., "Lean Manufacturing in the Semiconductor Industry: Proceed with Caution – Part I," *Fab Engineering & Operations*, Issue 3, May 2008, pp. 37-44.

■ Ignizio, J. P., "Lean Manufacturing in the Semiconductor Industry: Proceed with Caution – Part II," *Fab Engineering & Operations,* Issue 4, August 2008, pp. 42-48.

■ Roumeliotis, Gregory "Lean Proves Mean in Drug Manufacturing," in-pharmatechnologist.com; 13-Sep-2006 (www.in-pharmatechnologist.-com/Processing-QC/Lean-proves-mean-in-drug-manufacturing)."

FabTime Response: We had not seen those statistics, though they certainly align with our gut feel on the matter. We think that in addition to the reentrant nature of fabs, the relatively unreliable equipment makes it difficult to apply traditional lean techniques. We think that it's a matter of taking some of the underlying philosophies of Lean Manufacturing, but applying them differently to fabs.

FabTime welcomes the opportunity to publish subscriber discussion questions and responses. Send your questions to Jennifer.Robinson@FabTime.com.

Improving Cycle Time during a Downturn, Redux

Introduction

The 2001 semiconductor industry downturn was considered by many to be the worst downturn ever (see this article, for example: news.zdnet.co.uk/hardware-/0,1000000091,2089348,00.htm). Yet here we are, 7 1/2 years later, with the consumer markets experiencing a meltdown, and new layoff announcements in the news every day. Semiconductor International reports (in this article: http://www.semiconductor.net/article/CA6616463.html) that "Malcolm Penn, chairman and CEO of industry analyst Future Horizons (Kent, UK), contends that the inevitable chip market contraction in 2009 will be neither as deep nor as long-lasting as the 2001 downturn." The idea in that article is that this time, the downturn is "only" being driven by the drop in demand, rather than also being driven by fabs running over capacity. It's not much comfort to think that this downturn isn't the industry's fault (in a planning sense), however, when we see companies laying off 15% or more of their workers. And in truth, we don't think that anyone knows right now how bad the economy is going to get. For a contrasting viewpoint, Reuters reports (www.reuters.com/article/-marketsNews/idUSSEO5351320081210) that the CEO of Hynix said recently that "the semiconductor industry was in its worst-ever period and a delay in the sector's restructuring could prolong chip oversupply through 2010." And the

December 17th San Jose Mercury News reported (in an article by Steve Johnson) that Gartner expects a 16.3% drop in worldwide chip revenues in 2009, with no rebound until 2010. The phrase "falling off the cliff" was used.

Nevertheless, we try to stay positive. Back in March of 2001 we published an article called Improving Cycle Time during a Downturn. We decided that this month would be a good time to issue an updated version of the article. We hope that you find it useful.

Downturns are a fact of life in the cyclic semiconductor industry. Various factors contribute to their existence - capacity buildup (and the long lead-time required in capacity purchases), decline in selling prices, inventory build-up, and the general state of the economy. This one has clearly been triggered mainly by the state of the economy, and the decline in consumer spending. The bad news is that this type of downturn can strike very quickly (as we're sure you noticed!), and revenues can drop quickly and painfully. The good news is that this downturn is still likely not to be as long as capacity utilization and selling price-driven downturns such as the 1996-1998 downturn. But even that isn't universally believed at this point.

All else being equal (staffing, number of tools, etc.), the quickest way to reduce cycle time in a wafer fab is to significantly decrease start rates. This moves your factory to the left on the cycle time vs. factory loading curve, to a region of lower cycle times. You can see a sample graph on our website, at www.fabtime.com/-ctcapac.htm#ctcap. It's kind of ironic, really. Just when customers aren't clamoring for product, your fab can delivery product with record cycle time and on-time-delivery performance. The thing is, however, that it's very easy under these conditions to get a bit sloppy, and to take the lower cycle times for granted. But then when start rates begin to increase, when customers are paying attention again, your cycle times will degrade rapidly. If you don't have great cycle times now, you certainly won't have great cycle times when start rates go back up. Therefore, we suggest using this time to focus on low cost cycle time improvement efforts.

Some Suggestions for Cycle Time Improvement during a Downturn

Setup

During a downturn, it's more important than ever to get custom/qualification lots out quickly, so that you don't lose any orders. This may mean doing more setups, even if the setup is only done to get a couple of lots through. If you have spare capacity, you can afford to spend this time on setups, and the additional setups will help to get things out quickly. Therefore, our first suggestion is to revisit setup policies in light of changes in start rate.

Tool Dedication

As we've covered extensively in past issues, tool dedication that results in single path operations is one of the biggest sources of cycle time in fabs. One reason sometimes given by fabs for having single-path operations is that manufacturing doesn't want to give up the time that would be required to qualify a second tool. All we have to say is: this might be a good time to work on those backup tool qualification projects.

Process Analysis

You can also spend time during a downturn finding out what the real raw process time (or theoretical cycle time) is for your products. For example, you could have someone hand-carry a lot through its process flow, recording only the time spent actually processing the lot. Having accurate information about the raw process time by operation can be very helpful in setting goals for operation cycle times (and, by implication, overall cycle time). By comparing the theoretical cycle time by operation to the actual observed cycle time for completed lots, you can identify operations that are disproportionately

increasing cycle time. Once you identify them, you can work on improvement.

Layout Analysis

Another thing that you can do by hand-carrying a lot through its process flow is map the process flow, and looking for savings. Could you change the layout and significantly reduce travel distances? Are lots sitting waiting to be grouped for transport somewhere? Could you reduce the transport lot size, and reduce this waiting significantly?

Bottleneck Analysis

A downturn could be a good time to work with a local university, and have some grad students in to do an analysis of your bottleneck or near-bottleneck areas. There are probably either operational or process changes that could be made that would improve cycle time, and maybe even throughput, on your bottleneck tools. But manufacturing doesn't generally have spare time to investigate these changes, let alone having spare time to answer questions from students. So have them in during a downturn, when there is some capacity to spare on the bottlenecks, and when the fab manager might even have time to think about the results of the analysis. You can often get grad students to do this type of work for free, because they are looking for real-world problems. As a side benefit, the students might be finished with their degrees by the time the downturn ends, and you'll be in a good position to hire them. FabTime can put you in touch with Industrial Engineering professors at most universities if you like - just send us an email (Frank.Chance@FabTime.com or Jennifer.Robinson@FabTime.com).

OEE/TPM Analysis

During a downturn, the traditional OEE of your tools will decrease, due to an increase in standby (idle) time. However, a downturn is a good time to focus on improvements to equipment availability, process speed, and other attributes of OEE and TPM analysis. Then when start rates begin to come back up, your tools will have better performance, and higher available capacity.

Simulation Model Validation

A simulation model can be an excellent tool for doing what-if analysis. What would happen to the cycle time if we changed the lot size? What would happen to the cycle time if we broke up this tool group into smaller, dedicated groups? What would be the benefit of an improvement in the downtime on the bottleneck? The possibilities are limitless. To be of interest to manufacturing, however, these analyses need to be done using a model that bears some resemblance to the situation in the real fab. The model doesn't need to generate the exact same cycle times, down to the minute. However, the results of the model need to be close enough to reality for manufacturing to take them seriously as a reflection on the real fab. All too often, simulation models are not kept up to date with the latest process, product mix, and equipment changes. Then manufacturing doesn't take them seriously, and no matter what conclusions the simulation analysts come up with, the results are never implemented. There are a number of underlying causes for this problem, and it is not our intent to dissect them all now. We just want to point out that a downturn could be a good time to update and validate your simulation model, if you have one, to get it closer to the real fab. And perhaps those low-cost grad students can help.

System Upgrades

Just as you can use a downturn to find time to upgrade your simulation models, you can also take advantage of extra fab capacity to perform system software upgrades. This could include version upgrades of your manufacturing execution system (MES) or other manufacturing software, or operating system upgrades on the computers that run your MES and other fab software. You probably pay a maintenance contract for your MES, and have access to the upgrades at no

additional dollar cost, but you put off doing the upgrade because it requires taking down the whole fab for several hours. Even during a downturn, this is clearly a major headache for manufacturing, but if you're ever going to do it, better now than later.

Education

When things are slower, it can be a good time to work on education and cross-training for operators and supervisors. You can find classes on cycle time, factory physics, statistical process control, and theory of constraints, for example. We've found that people who work in manufacturing generally have an intuitive understanding of many of these concepts, but can benefit from a more structured educational approach. We recommend that you find courses with plenty of graphs and concrete examples. Of course it's harder to find money to pay for courses like these during a downturn, but there are some lower-cost options. Try your internal industrial engineering department, if you have one, or the IE department at a local university, or work with a consulting firm as a kind of beta-tester for their courses. And, of course, you can forward FabTime's free newsletters to people within your company – we're always happy to have more readers, and price is certainly right!

Conclusions

A downturn is a tough time - stressful, hard on your stock portfolio, and filled with the specter of layoffs. But it does offer at least one potential benefit: time to think. Time to think about manufacturing issues like lot size and batch size policies. Time to think about tool dedication schemes, and layout changes. Time to get your fab in order, and drive your cycle times to a minimum, before the next upturn comes along. Because the upturn is coming, eventually. The bottom line: If you don't have great cycle times now, you certainly won't have great cycle times when start rates go back up, so you should focus on low-cost improvement efforts to achieve the best possible cycle times now.

Closing Question for FabTime Subscribers: Multiple Choice

Do you have any plans for housekeeping/improvement projects during the downturn?

a) What downturn? We're still busy in my fab.

b) We don't have any spare resources to work on these issues, because we just laid people off.

c) We're still running at capacity when we run the fab, but we're spending some time with the fab shut down. So, like the people who answered b), we have no spare resources.

d) Yes. We plan to

_____.

Any individual responses will be kept confidential, unless you tell us otherwise.

Further Reading

- "Industry Downturn No. 11 Won't Be as Bad as No. 10," *Semiconductor International*, November 20, 2008.
- Mark LaPedus, "Give Growth Markets for 2009," *EE Times*, December 11, 2008.

There are many references on cycle time improvement projects. Some describe actual changes made in factories, while others describe simulation analyses. References to a number of these studies can be found at www.fabtime.com/-CTBiblio.htm. We have abstracts to most of the papers (though we can't distribute other people's full papers because of copyright restrictions), so let us know if you want more information.

Subscriber List

Total number of subscribers: 2840, from 476 companies and universities. 21 consultants.

Top 20 subscribing companies:

- Maxim Integrated Products, Inc. (226)
- Intel Corporation (149)
- Micron Technology, Inc. (81)
- Chartered Semiconductor Mfg (80)
- X-FAB Inc. (71)
- Western Digital Corporation (67)
- Analog Devices (65)
- Texas Instruments (64)
- Infineon Technologies (58)
- ON Semiconductor (58)
- Freescale Semiconductor (57)
- International Rectifier (55)
- NEC Electronics (54)
- TECH Semiconductor Singapore (53)
- Cypress Semiconductor (50)
- STMicroelectronics (49)
- IBM (45)
- NXP Semiconductors (44)
- Seagate Technology (36)
- ATMEL (34)

Top 3 subscribing universities:

- Virginia Tech (11)
- Ben Gurion Univ. of the Negev (8)
- Nanyang Technological University (7)

New companies and universities this month:

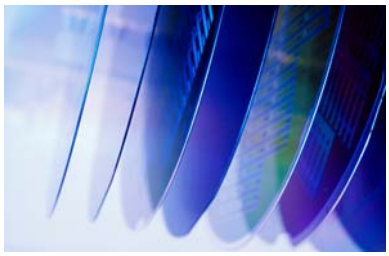
- Analysis Group
- Friedrich-Schiller-Universität
- LG Display
- SAT Simulations- und Automations-Technologie AG
- Sygentric, LLC

Note: Inclusion in the subscriber profile for this newsletter indicates an interest, on the part of individual subscribers, in cycle time management. It does not imply any endorsement of FabTime or its products by any individual or his or her company.

There is no charge to subscribe and receive the current issue of the newsletter each month. Past issues of the newsletter are currently only available to customers of FabTime's web-based digital dashboard software or cycle time management course.

To subscribe to the newsletter, send email to newsletter@FabTime.com, or use the form at www.FabTime.com/newsletter.htm. To unsubscribe, send email to newsletter@FabTime.com with "Unsubscribe" in the subject. FabTime will not, under any circumstances, give your email address or other contact information to anyone outside of FabTime without your permission.

FabTime® Dispatching Module



Dispatch Configuration and Support

We offer our dispatching and planning modules together for a single, fixed monthly fee (on top of your regular FabTime subscription). This includes:

- Dispatch rule and factor configuration.
- Training.
- Dispatch list feed to the MES (if applicable).
- Support and upgrades.

Dispatch Factors

- Batch code at the current tool.
- Lot priority.
- Downstream tool priority.
- Current tool FIFO.
- Current tool idle time.
- Downstream batch efficiency.
- Critical ratio.
- Earliest-due-date.
- Current step processing time.
- Remaining processing time.
- Current step qualified tool count
- WIP level at downstream tools.
- Up to five other site-specific factors.

Interested?

Contact FabTime for technical details.

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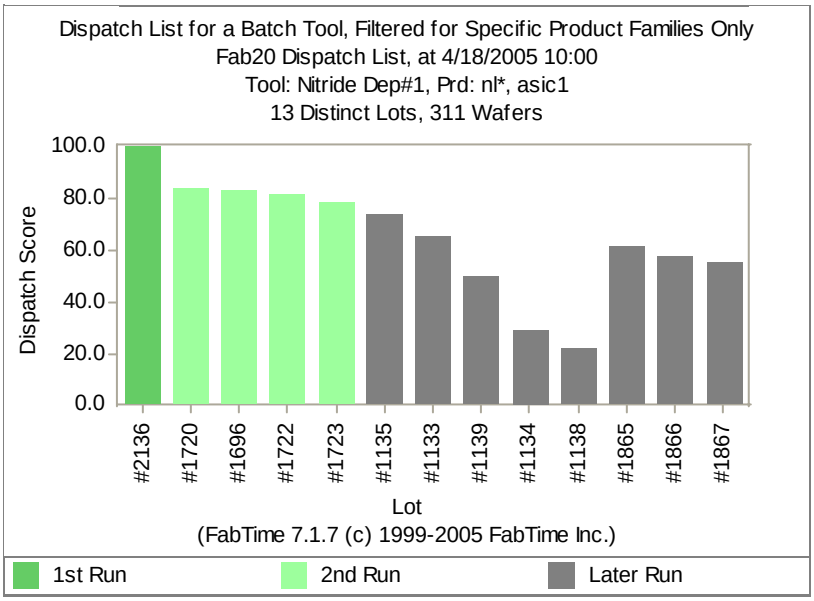
Do your operators make the best possible dispatching decisions?

- Do you struggle to balance lot priorities and due dates with tool utilization and moves goals?
- Do your critical bottleneck tools ever starve?
- Do you use standard dispatch rules, but feel that your fab's situation is more complex, requiring custom blended rules?
- Do you know how well your fab executes your dispatching?

FabTime's dispatching module is an add-on to our **web-based digital dashboard software**. At any point, for any tool in your fab, FabTime will show you the list of all lots qualified to run on that tool. This list will be ordered by the dispatching logic that your site has selected for that tool. This logic can use standard dispatch rules such as Priority-FIFO and Critical Ratio. However, you can also create custom dispatching logic using any combination of dispatch factors (shown to the left).

You can display dispatch lists in FabTime, and/or export them back to your MES. FabTime also includes a dispatch reservation system to hold downstream tools when a lot is started on an upstream tool, as well as dispatch performance reporting.



FabTime Dispatching Module Benefits

- Ensure that wafers needed by management are in fact the wafers that are run, while requiring less manual intervention on the part of management.
- Improve delivery to schedule, and the display of performance to schedule.
- Document the dispatching logic used by the best operators and make this available to all shifts.