FabTime Cycle Time Management Newsletter

Volume 21, No. 3 June 2020

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. FabTime's mission is to help the people who run fabs improve performance by: 1) letting them configure their own charts, so that they don't need assistance from IT for each new data request; and 2) including them in a community of people around the world who are all working to improve fab operations.

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Contributors: Tom Lambe (Fluence Bioengineering); Dave Kayton (ON Semiconductor)

Keywords: Fab Management; Industry Cycles; OEE

Table of Contents

Welcome

Welcome to Volume 21, Number 3 of the FabTime Cycle Time Management Newsletter. We hope that this issue finds you and your families safe and well and your communities returning to a life that's a bit closer to pre-pandemic normalcy.

In this issue, we have announcements about past FabTime newsletters, new Winter Simulation Conference papers, and SEMI resources – plenty of reading material for anyone who needs it. Our software tip of the month is about using FabTime to share data with team members from whom you are physically separated. In our subscriber discussion forum, we have an update to last month's topic of Demand OEE, a question about Factory Physics-type courses, and a question from us about our cycle time course.

In our main article, we discuss impacts of COVID-19 on wafer fabs. We highlight several changes that we have learned about from our reading and from discussions with our User Group. We also discuss ways that some of these changes may be impacting fab cycle times. As always, we welcome your feedback.

Stay safe, everyone! – Jennifer, Frank, Lara, and the FabTime Team

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Community News/Announcements

Past Newsletter Issues Now Available for Download

Finding yourself with a bit of extra time on your hands? In case you missed the announcement in the previous issue, past issues of this newsletter are now available to subscribers for download from our website. The current password is "FabTimeCommunity" (case-sensitive, no quotes). You can download a full archive of the issues, or individual issues, all in PDF format. More than 150 issues are available.

WSC Papers

If you find yourself in need of even more reading material, proceedings of the 2019 Winter Simulation Conference, held in National Harbor, Maryland in December, are now available. The MASM track consists entirely of semiconductor-related research. You can view both abstracts and full papers on topics that include dispatching and scheduling, maintenance and engineering, capacity planning, and more. Several newsletter subscribers are represented among the authors, and we thank them for sharing their work.

SEMI Resources

SEMI continues to provide a host of useful resources on their website, including Best Practices reported in different areas (ESH, FOA, etc.). SEMI is conducting regular member surveys and sharing results, lobbying for the interests of the industry, and rounding up news and links.

FabTime welcomes the opportunity to publish community announcements, including conference notices and calls for papers. Send them to newsletter@FabTime.com. Jennifer also shares articles about business management, the semiconductor industry, and productivity improvement on her LinkedIn feed. Connect with Jennifer here: http://www.linkedin.com/in/jenniferrobinsonfabtime.

FabTime User Tip of the Month

Use FabTime to Share Data with Remote Team Members

In the previous tip, we talked about using FabTime to support working remotely. That tip was focused on how you can get access to the data and training that you need to do your own job. The other part of today's remote work situation is the need to communicate and share data with colleagues even when you are not physically together. In today's tip, we highlight a few ways that you can share information from FabTime with colleagues. Of course, all methods used to send confidential data to colleagues should follow your company's security protocols.

Use Custom, Detailed Chart Titles

This capability was introduced way back in Tip25, quite a few years ago. On the detailed page for any chart, the Formatting controls in the lower-left corner of the screen include a "Title:" input box. You can enter your own title for the chart as you have configured it. Press the "Go:"

button below that section to save your title. Your custom title will be displayed above the standard titles on the chart. Once you save the chart to your home page, your custom title will become part of the chart definition.

One trick here is that if you are going to share a chart with someone by copying it (see below), you could modify the custom title first, to add extra information (e.g. some note specific to today's data). At a minimum, if you are going to share the chart, even just on your home page, it's a good practice to use a custom title so that people understand your purpose for setting up that chart, filters, etc.

Copy and Paste Chart Images

The most obvious way to share FabTime data with a remote colleague is to copy a FabTime chart and paste it into an email message or presentation. We covered this in detail back in Tip100 (~4 years ago). But here's a quick recap:

1. Make sure the chart is static instead of dynamic. For Javascript charts, that means clicking the "D" in the lower left-hand corner so that the D is crossed out. This changes the chart from dynamic to static.

2. Right-click on the chart and select "Copy Image". The exact options are browser-dependent, but there should always be a way to copy the chart as an image. Go to your email message, document or presentation and paste the image. Ctrl+V will usually do the trick. (Again, remember to follow your company's security practices regarding the sharing of fab data.)

3. Alternatively, right-click and select "Save Image As…" (or equivalent) and save the image to your computer (default is usually your Downloads folder). From here you can explore any send options available in your operating system.

Export Data Tables

Data tables in FabTime can be exported to Excel via the links above the data table. The "Copy Table" button highlights the entire table as displayed, then you can use Ctrl+C/Ctrl+V to paste the data into another application. Just be sure that all the data you need to share is displayed, via the Rows control or unhiding of columns.

Bulletins

Those who have permission to create FabTime Bulletin Board Messages can use them to share information with the entire team or with individual users. If you have permission to set Bulletins you will see a "Manage FabTime Bulletins" link on the right-hand side of your Charts page. Click on this link, then click the "Add a new bulletin board message" link at the top of the page. Each message that you create will have a start time and end time for display. You can choose whether to display the message on the FabTime login page, on all home pages, or on one or more individual user home pages.

One extra tip here is that you can use html in the text of your bulletin message to add emphasis. For example:

Please note that this is the FabTime demonstration server.

Looks like the first line below:

Bulletin Board Message capability is usually restricted to a small number of users at any site. If you feel that you require this capability, please contact your site's FabTime administrator.

While we hope that colleagues who need to be are back working in physical proximity soon, we hope that you find this tip useful in the meantime.

If you have questions about this item, or any other FabTime software questions, just use the Feedback form inside FabTime's software. Subscribe to the separate Tip of the Month email list (with additional discussion for customers only). Thanks!

Subscriber Discussion Forum

Demand OEE

We wrote in the previous issue about the concept of Demand OEE, a modification of OEE proposed by **Dave Kayton from ON Semiconductor** that accounts differently for time when a tool is starved. The idea behind Demand OEE is to not penalize the manufacturing team for periods of idle time caused by lack of WIP on non-bottleneck tools. Dave has since notified us that what he called Demand OEE aligns well with the concept of Production Equipment Efficiency (PEE) defined in the SEMI E79 Standard for Definition and Measurement of Equipment Productivity. If you are interested in this topic, we refer you to the E79 specification, which you can purchase from SEMI here.

Factory Physics Type Courses

Tom Lambe from Fluence Bioengineering asked: "Are you familiar with the *Factory Physics* book? I went to a week-long seminar 20 years ago put on by the author of the book (Wallace Hopp), but he doesn't do workshops on this anymore, and his co-author (Mark Spearman), only has public workshops in Germany. Would be great if you knew of something like this workshop that might be available.

FabTime Response: We are certainly familiar with the book. We reviewed the second edition here (see the third edition on Amazon's website). We've referenced this book for many years. Unfortunately, we don't know of any classes that directly target that content. We do cover some of it in our cycle time management class, but we only offer that at the site level, not as a general workshop that you could just have one or two people attend.

Do any subscribers know of workshops that tackle material like that in the Factory Physics text (mathematical principles that drive factory behavior)?

Virtual FabTime Cycle Time Management Classes?

Tom's question, together with a couple of requests that we received recently for information about our cycle time management course, made us wonder whether this might be the time for us to start offering a version of the course virtually. The course is usually offered as a one-day session held at company sites. The idea behind the course is to give wafer fab production personnel (including manufacturing, engineering, maintenance, production control, etc.) the skills and techniques needed to manage cycle times. It covers things like basic cycle time relationships, metrics for improving cycle time, and applying cycle time intuition to operational decisions. In other words, it's like the topics discussed in the newsletter.

The course is designed to be interactive. It includes exercises and quizzes throughout to increase understanding. A reason we do it at customer sites is so that the site can get people from different parts of the organization into the same room, to discuss how each impacts cycle time. We typically sign an NDA so that people at the site can freely discuss their specific cycle time challenges. These aspects have made it difficult to offer the course remotely.

But … here we are in a world where travel is much more challenging, and where people have become much more accustomed to virtual meetings and online learning. What do subscribers think? Is this the time for us to put some effort into figuring out how to deliver the course content via some sort of webinar or virtual meeting? The sessions would have to be shorter than our typical full-day schedule (especially where different time zones were a factor). But if Jennifer's daughter can learn about 4th grade math and the San Francisco earthquake via Zoom and Google Classroom, it does seem like this could be feasible. What do you think?

COVID-19 Impacts for Wafer Fabs and Cycle Time

Introduction

Throughout the coronavirus pandemic so far, we at FabTime have felt fortunate to be a supplier to an "essential" industry. Even as huge swaths of the world economy remain at least partially shut down, most of the fabs that we know of are operating, working to produce the chips that are needed to support:

- Computers and portable electronic devices for home offices and home schools
- Medical devices and testing
- Servers for eCommerce
- Bandwidth for home internet
- And much more.

But though demand remains high for many fabs, there are still changes and challenges. These include:

- Keeping on-site employees safe.
- Obtaining enough supplies and transporting finished products around the supply chain.
- Running with fewer operators in the fab in some cases, and with managers and other employees offsite in many cases.
- Operating with diminished access to field service engineers.
- Managing smaller pools of employees, with lower cross-coverage of skills, while also having less access to off-site training. (From SEMI's blog)

There's some evidence already that these challenges are resulting in longer cycle times. See this article, for example, which says that Broadcom in April "told clients that disruptions to the global supply chain caused by the COVID-19 pandemic means that they would need to place orders for parts six months ahead of time." We expect to see further cycle time impacts. We discuss some of the reasons for this below.

What's Changing for Fabs?

FabTime is particularly interested in what's changing for fabs. We've been collecting information on this from news stories, blogs, trade association reports, and conversations with our ever-helpful user group. Although fabs have the obvious advantage of already being sterile environments with procedures for minimizing contamination, changes have still been required. Though this is a fluid situation, here are some highlights:

- Operations meetings have moved in many cases from conference rooms into the fab. Video conferencing is used in some cases even when employees are in the same building. Where there are meetings in conference rooms, the number of participants is limited, and distancing is required. Half of the chairs have been removed from many conference rooms.
- Supply lines and safety stocks are being bulked up (lean/just-in-time manufacturing has been revealed to be a luxury of a lower variability global environment).
- Team members have been relocated in cases where crossing borders to get to work is no longer possible (GlobalFoundries website)
- Everyone who can work from home has been working from home, even if new computer equipment is required to enable this. Employees have been restricted from traveling for work and are sometimes required to quarantine on their return (even from domestic trips). Visits to the fab have been restricted, even by non-manufacturing employees, vendors, customers, and contractors. People who do come onsite are subject to temperature screening.
- Workers in the fab are being split into teams that never come into contact with one another, working on different days, using separate gowning rooms, etc., to

minimize infection risk. (IEEE Spectrum and SEMI Blog) At GlobalFoundries in Malta, NY "gowning rooms are marked off in roughly 2-meter squares, and no two people are allowed to occupy the same square." At SkyWater's fab in Bloomington, MN, "Shifts have been staggered so people are not congested at lockers, gowning areas and other places."

- Also at GlobalFoundries, engineers are spending only half their time on site.

- SkyWater reports "Hand-sanitizing stations have been set up. We are providing employees access to masks, gloves and cleaning wipes. Safety measures are posted around the building and cleaning frequency of hard surfaces has been ramped significantly. These safety measures are among several other modifications we've made to daily operating procedures." A survey of SEMI FOA members suggests that these measures are broadly in place across the industry.

- The FOA survey also reports:

  - Some companies are taking extra measures to ensure separation of gowns, putting them in bags to contain the transmission.
  - Interior doors are propped open to avoid people touching. Revolving and automatic doors in place.
  - Fitness centers have been closed.
  - And much more…

- People working from home (e.g. managers and industrial engineers) report in some cases experiencing more meetings and longer working days. These reflect both the global nature of the industry ("I have calls at 7 am with people in Europe and at 8 pm with people in Asia") as well as the need to duplicate manufacturing meetings because the team is split into two groups. In general, with fewer people onsite, meetings are sometimes needed for things that could have previously been accomplished via a quick walk down a nearby row of cubicles.

- People have reported an increased reliance on sharing of best practices via organizations like SEMI and especially the Fab Owners Alliance. In this piece, SkyWater discusses changes implemented after talking with other FOA members and reviewing the results of FOA surveys.

Where Do We See These Changes Impacting Cycle Time?

Here are a few thoughts on how some of the above-outlined changes could contribute to cycle time increases for fabs.

- Having fewer operators in the fab, even sporadically, could increase the time that tools spend waiting for an operator to load the next lot (we track this in our product as standby-WIP-waiting time). This is time that a tool is available and WIP is available to be run, but the tool remains in a standby state. While occasional standby-WIP-waiting time is not a problem on lightly loaded tools, it is a problem on bottlenecks. It can easily drive utilization into the steep part of the cycle time operating curve, resulting in higher cycle times. A similar situation can occur when operators are not available to unload a tool in a timely manner.

- Having employees covering a wider range of tools could lead to increases in misprocessing, as well as further instances of standby-WIP-waiting time.

- Lack of access to field service engineers, as well as delays in receiving spare parts and consumables, could lead to increased downtime, affecting both utilization and variability on affected tools.

- Engineers being onsite less could result in extra hold time (if a lot is on hold waiting a particular engineer), as well as fewer new recipes being qualified in a timely manner. We talked extensively in Issue 20.05 about the cycle time benefits of

qualifying multiple tools for each operation.

- Demand pressures in some segments may lead to increases in start rate that push tool utilizations beyond normal buffers. This, ironically, will increase cycle time, and make it harder to meet those demand targets. We have already heard of this situation occurring for some fabs.

Of course, these changes will not apply in all cases. If you have concerns about them, however, we suggest monitoring:

- Standby-WIP-waiting time as well as overall utilization on key tools.

- Cycle time bottlenecks (as described in Issue 21.01).

- Downtime sub-states, especially "waiting for parts" and "waiting for equipment engineers". A report showing all tools spending time in such states greater than some target might be worth setting up.

- Green-to-green time, which is the time from when a tool becomes unavailable to manufacturing until it is again available (as discussed in Issue 20.02). Long periods of unavailable time on key tools, especially where there are single path operations through those tools, are the low-hanging fruit of improvement targets.

In other cases, cycle time may be decreasing in certain fabs, due to decreased demand driving lower equipment utilization. This is akin to the situation that we've seen in previous industry downturns. We shared ideas for improving cycle time during a downturn in issues 2.3 (2001) and 9.10 (2008). The general idea is to use extra time to make core improvements to keep cycle time low when starts return.

Conclusions

The COVID-19 pandemic has been a huge shock to the world. The semiconductor industry has two key advantages relative to other industries:

1. Wafer fabs have been mainly deemed essential, because computer chips are necessary to enable remote work and medical device manufacturing and testing. This has allowed fabs to continue operating.

2. Wafer fabs are already the cleanest manufacturing environments in the world, requiring workers to gown up and wear masks and gloves. This has prevented fabs from becoming virus transmission hot spots, unlike less sterile environments such as meat packing plants.

Despite these advantages, fabs have had to adapt in many ways, from keeping non-manufacturing personnel at home to setting policies to protect workers when they are on-site but not gowned up. Some of these changes, particularly where they result in shortages of operators or engineers, have the potential to trigger cycle time increases. But we're sure that most fabs would take those increases over the lower cycle times that stem from a more traditional demand-driven downturn. Here's hoping that demand rises further as the economy recovers from this pandemic, and that the changes that are being made in the industry and in the larger world protect us all.

Closing Questions for Newsletter Subscribers

What else has changed in your fab in light of the coronavirus pandemic? What changes do you think will remain long-term? Are you seeing impacts on your fab cycle time?

Further Reading

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- "Orders need six months of lead time: Broadcom," Bloomberg, Taipei Times, April 18, 2020. https://www.taipeitimes.com/News/biz/archives/2020/04/18/2003734818

Acknowledgements

We are grateful to our FabTime User Group for discussions about what's happening in their fabs during this challenging time (shared above in only very general terms, of course). We're also grateful to the SEMI Fab Owners Alliance for sharing excellent information on this topic.

Subscriber List

Total number of subscribers: 2808

Top 20 subscribing companies:

- ON Semiconductor (218)
- Infineon Technologies (152)
- Intel Corporation (117)
- Micron Technology, Inc. (117)
- GlobalFoundries (103)
- Maxim Integrated Products, Inc. (84)
- NXP Semiconductors (81)
- Microchip Technology (71)
- Carsem M Sdn Bhd (70)
- Skyworks Solutions, Inc. (65)
- STMicroelectronics (64)
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- Texas Instruments (55)
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- X-FAB Inc. (51)
- Qualcomm (45)
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- Tower Semiconductor (34)
- Cree / Wolfspeed (32)
- Honeywell (31)
- Zymergen (31)

Top 3 subscribing universities:

- Ecole des Mines de Saint-Etienne (EMSE) (9)
- Arizona State University (8)
- Virginia Tech (7)

New companies and universities this month:

- Advanced Silicon Technology Co
- Aledia
- Collins Aerospace
- Credexo Inc.
- Fluence Bioengineering
- FTDI Chip
- HRL Laboratories
- JPG Consulting
- PragmatIC
- Rockely Photonics
- SVXR
- Washington Diamonds

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