FabTime Cycle Time Management Newsletter

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. We are currently installing Version 5.6 of FabTime. New features in this version include the ability to slice and filter scrap charts by an MES scrap code, and the ability to share individual home pages with other users.

Editor: Jennifer Robinson

Contributors: Jeff Neve (Agere Systems)

Table of Contents

Welcome

Welcome to Volume 4, Number 10 of the FabTime Cycle Time Management Newsletter. In this issue, we are pleased to include a press release about our recent cycle time management training courses at Agere Systems in Orlando. In one change to the newsletter's format, we have decided to stop including the full profile of subscribing companies, because the list has grown so long. Instead, each month we will list the number of subscribers at each of the top 10 subscribing companies, as well as highlighting companies and universities new to the subscriber list. We may occasionally publish the entire list. Shortening the subscriber list leaves space for us to include a FabTime advertisement at the end of each PDF issue – that's important to us because the money that we make from our paid software and services make this newsletter possible.

Last month we wrote about Identifying Temporary Bottlenecks in the Fab. We did not receive any responses to this topic. We're not sure if this means that our readers are not interested in identifying temporary bottlenecks, or if the method that we discussed was too complex. In any case, this month we are taking a step back to talk about a more fundamental issue – using MES data to calculate fab performance measures. More specifically, we discuss the cycle time management benefits of tracking standby and productive time, in addition to tracking tool downtime states.

Thanks for reading!—Jennifer

Community News/Announcements

FabTime Delivers Cycle Time Management Training Course at Agere Systems Orlando

Menlo Park, CA. October 15, 2003 - FabTime Inc. today announced the successful completion of an intensive cycle time management training effort at Agere Systems' 8" wafer fabrication facility in Orlando, Florida. The training began with a session of FabTime's 2-day cycle time management course, held for representatives from the production, process engineering, industrial engineering, and equipment maintenance organizations. This was followed by two sessions of FabTime's more focused one-day course, delivered to area supervisors and process engineers.

"Cycle time is a key metric for Agere," said Jeff Neve, Senior Manufacturing Manager. "FabTime's cycle time training class provided us with tools for understanding current cycle time-related issues and focusing our cycle time improvement efforts. It was also a useful refresher for our team on the relationships underlying fab behavior."

"Agere's support of this training shows their strong focus on cycle time," said Frank Chance, FabTime's President. "This site is constantly working to deliver to customers with shorter, more predictable cycle times - critical performance issues in today's market."

FabTime's Cycle Time Management Training is available as a one-day or two-day course, both designed to provide production personnel with an in-depth understanding of the issues that cause cycle time problems in a fab, and to suggest approaches for improving cycle times. More information about the courses can be found at www.fabtime.com/ctmcourse.shtml.

About Agere Systems

Agere Systems (NYSE: AGR.A, AGR.B) is a premier provider of advanced integrated circuit solutions for wireless data, high-density storage and multiservice networking applications. Agere's wireless data portfolio enables seamless network access and Internet connectivity through its GPRS offering for data-capable cellular phones, as well as Wi-Fi/802.11 solutions for wireless LANs and computing applications. The company is the market leader in providing integrated circuits for the hard disk drive market, with number one positions in sales of system-on-a-chip solutions and preamplifiers. Agere also provides custom and standard multiservice networking solutions to move information across wired, wireless and enterprise networks. Agere's customers include the leading PC manufacturers, wireless terminal providers, network equipment suppliers and hard-disk drive providers.

FabTime welcomes the opportunity to publish community news and announcements. Simply send them to Jennifer.Robinson@FabTime.com.

FabTime User Tip of the Month

Multiple home-page tabs (groups of home page charts, displayed as separate pages) have been part of FabTime since version 2.5. However, because this feature has been in place for so long, we think that some users may have forgotten about it. Therefore, we are highlighting it here. When you add charts to your home page in FabTime, they are initially added to your Default home page tab. However, because most FabTime users follow many charts, the Default home page can become quite long. Suppose that you have 20 charts on your home page. Even if each chart takes about half a second to update, this still adds up to a 10-15 second delay every time you refresh your home page. If you have charts that you do not check frequently, moving these charts to a separate home page tab will speed the delivery time of your primary home page tab. And you can group your charts into logical groups (e.g. Long-Term Trends, Photo charts, Inactive Lots, etc.).

To move charts among home page tabs, click on the "Manage My Home Page" link (visible from any home page tabs that currently contains charts). The table displayed includes a row for each chart. The first column of the table is labeled "Home Page Tab". To move a chart to a new home page tab, just enter the name of the new home page (e.g. Long-Term Trends) in the Home Page Tab box, and press the Save button at the bottom of the page. FabTime will then build a separate home page tab for each unique home page name entered. Be careful here - if you enter two different tab names that are almost the same, like Move Charts and Moves Charts, you will get two separate home page tabs.

When you are finished moving charts to different home page tabs, just click on the "Return to my Home Page" link. This returns you to the home page that you used most recently. To switch between home page tabs, simply select the tab that you wish to display from the drop-down list in the upper left corner, and press "Go". Once you have created a home page tab, you can also add charts directly to that home page tab by selecting it from the drop-down list on the charts page before you press the "Add" button.

We hope that this tip will help you to improve the quality of your day-to-day FabTime experience. If you have any questions about this feature (or any other software-related issues), just use the Feedback form in the software.

Subscriber Discussion Forum

This section is dedicated to subscriber discussion, including responses to previous newsletter articles, and other questions or topics raised by subscribers. This month we do not have any subscriber discussion. If you have a question related to wafer fab cycle time, or a response to anything discussed in recent issues of the newsletter, we encourage you to send it to Jennifer.Robinson@FabTime.com for inclusion in the next issue.

Tool Standby and Productive Time Reporting

Introduction

Whenever we visit a fab, one of the things that people ask us about is performance measures. What metrics are good for improving cycle time? What metrics are other people using? How do we calculate this or that performance measure, from the data that we have available? And one thing that we've noticed is that some fabs are limited by the data that they're tracking in their manufacturing execution systems (MES).

Specifically, we've been to fabs where tool state tracking does not distinguish between standby time and productive time. The rationale here is that the maintenance engineers are evaluated based on how much time each tool is available, regardless of whether that availability is spent as productive time or standby time. Therefore, some fabs don't ask their operators to log separate standby and productive tool states into the MES. Tool state charts for these fabs will show time lost due to scheduled and unscheduled downtime, and engineering time, and then one bucket that reflects time that each tool was available for production.

This is fine if all you care about is maximizing availability (or even if you are tracking availability variability, as discussed back in issue 4.2). However, if you are looking to monitor and improve cycle time in your fab, you need to know about actual tool utilizations. In the short term, tool utilization directly impacts operation-level times.

Tool Utilization and Cycle Time

There are various definitions of utilization in use in fabs. The utilization measure that we prefer (because it most directly influences cycle time) is defined as:

■ Utilization = Productive Time / (Productive Time + Standby Time)

where Productive Time is time spent working on products. A very simple approximation for cycle time x-factor (actual

cycle time / theoretical cycle time) for single-path tools is:

- X-Factor ~= 1 / (1 - Utilization).

This means that when utilization approaches 1 (or 100%), the denominator approaches zero, and cycle time grows very large (1 / 0 approaches infinity). That is, when standby time approaches zero, utilization approaches 1, and cycle time becomes very high. While this exact approximation for cycle time is only accurate in certain cases (one-of-a-kind tools, medium variability in arrival and process times, independence), the general behavior (cycle time increases as standby time decreases) holds in most circumstances.

What this means is that utilization is the largest driver of cycle time in a fab. Most people who work in fabs know this. They know that as their bottlenecks become heavily loaded, they can expect cycle time to increase. They plan capacity to prevent standby time from going to zero on any tools, especially single-path tools. What doesn't seem to be quite as universal, however, is tracking of real-time tool utilizations on a short-term basis. And the fact is that this same behavior holds in the short-term as well as the long-term. Equipment downtime and other capacity losses cause WIP and cycle time to build by temporarily taking away standby time.

If you track tool utilization on a shift basis, and flag cases where standby time approaches zero (and hence, utilization approaches 100%), you may be able to proactively identify short-term cycle time problems. But you can only do this if you break out standby time from productive time. One way to do this by logging tools into standby vs. productive states in the MES, or configuring your MES to do this logging automatically. Alternatively, if you

don't want to burden your operators with logging additional transactions (and you don't have the capability to log them automatically), you can do it by creating implicit transactions whenever the number of lots in a tool goes from zero to 1 (log the tool into a productive state) or from 1 to zero (log the tool into a standby state). We do this in our FabTime software for sites that do not break out standby time from production times.

Subtleties of Standby Time Reporting

There are some tricky issues related to measuring and reporting standby time, beyond what was stated above. First of all, standby time will tend to include some time in which the tool is available and WIP is available, but there is no operator available for loading. This "operator unavailable" time should by rights be treated as a capacity loss, since it is time that the tool cannot be used. Certainly this time takes away from "real" standby time, and tends to drive up cycle time (see Issue 3.9 for details).

Measuring this operator unavailable time is difficult, however. If the operator is not available, there probably isn't anyone there to log the tool into a "standby no op" state. One way to identify this time, if your MES can't identify it automatically, is to cross-reference standby time against number of lots in queue, and look for time intervals where the tool was in a standby state, despite having WIP available.

Similarly, standby time will sometimes include time when the tool, operator, and WIP are all available, but no reticle is available. Again, this time should really be broken out from regular standby time, and not counted in the reported utilization figures (for indicating cycle time, that is).

Cycle time is inversely proportional to Productive Time / (Productive Time +

FabTime

Cycle Time
Management
Newsletter

Volume 4, No. 10

Page 5

Standby No WIP Time). As "standby no WIP" time grows small, cycle time grows large, no matter how much "standby no op" or "standby no reticle" time there is on the tool.

However, breaking out "standby no op" and "standby no reticle time" and not counting them in utilization calculations may be difficult, because of either technical or management-related issues. And it may not be necessary, depending on your fab's situation (staffing levels, number of reticles, etc.). The more important point is that if you aren't reporting short-term utilizations at all, you may be missing an opportunity for proactive identification of cycle time problems.

Summary

Tool utilization, defined as Productive Time / (Productive + Standby Time) is the largest driver of operation-level cycle times. For this reason, we recommend reporting tool utilizations on a short-term (e.g. shift-level) basis, and automatically flagging situations where utilization approaches 100%. You may be able to do proactive things, like reassigning operators, or deferring engineering or maintenance time, to nip short-term cycle time problems in the bud. To do this, however, you'll need to ensure that your fab either tracks productive and standby state changes directly in the MES, or generates them in some other manner.

Closing Questions for FabTime Subscribers

Do you log tools into standby vs. productive states? If not, do you get this data on a short-term basis in some other way (e.g. by creating implicit transactions based on the amount of WIP in process at the tool)? Do you look at tool utilizations on a short-term basis? Are there other areas in which you might be able to generate additional performance metrics if you logged more MES transactions (but don't because of technical or management-related issues)?

Further Reading

■ "The Impact of Staffing on Cycle Time", FabTime Newsletter, Volume 3, Number 9. Can be ordered ($9.95 fee) from http://www.fabtime.com/news_abs3.shtml.

■ "Quantifying Availability Variability", FabTime Newsletter, Volume 4, Number 2. Can be ordered ($9.95 fee) from http://www.fabtime.com/news_abs4.shtml.

■ "Wafer Fab Cycle Time Management Using MES Data," J. K. Robinson and F. Chance, Proceedings of the 2000 Modeling and Analysis for Semiconductor Manufacturing Conference (MASM 2000). Tempe, AZ, May 10-12, 2000. Can be downloaded (no charge) from http://www.fabtime.com/abs_MASM00.shtml.

Current Subscribers

Total number of subscribers: 1414, from 365 companies and universities. 28 consultants.

Top 10 subscribing companies:
- Intel Corporation (71)
- Motorola Corporation (57)
- STMicroelectronics (45)
- Infineon Technologies (44)
- Philips (44)
- Seagate Technology (42)
- Micron Technology, Inc. (40)
- Advanced Micro Devices (35)
- Texas Instruments (33)
- Agere Systems (32)

Top 3 subscribing universities:
- Arizona State University (12)
- Virginia Tech (7)
- University of California - Berkeley (6)

New companies and universities this month:
- Advanced Semiconductor Manufacturing Corp. (ASMC)
- Cessna Aircraft
- Fujitsu
- General Physics Corporation
- Mikron Corporation
- Universidade Federal do Rio Grande do Sul (Brazil)

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. To subscribe to the newsletter, send email to newsletter@FabTime.com. Past issues of the newsletter are available from FabTime's Amazon zShop, at www.amazon.com/shops/fabtime. You can also subscribe online at www.FabTime.com. 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 explicit permission.

FabTime® Cycle Time Management Training

"It was helpful to see best-in-class methods for wafer fab cycle time management. Discussing these matters in-depth with you was quite valuable, as we could ask questions specific to our fab and processes."

Shinya Morishita
Manager, Wafer Engineering
TDK Corporation

Course Code: FT105

This course provides production personnel with the tools needed to manage cycle times. It covers:

- Cycle time relationships
- Metrics and goals
- Cycle time intuition

Price

$4950 plus travel expenses. On-site delivery for up to 15 participants, each additional participant $195. Discounts available for multiple sessions.

Interested?

Contact FabTime for a quote.

FabTime Inc.
325M Sharon Park Drive #219
Menlo Park, California 94025
Phone: +1 (408) 549-9932
Fax: +1 (408) 549-9941
Email: Sales@FabTime.com
Web: www.FabTime.com

Do you make the best possible decisions?

- Do your supervisors possess good cycle time intuition?
- Are you using metrics that identify cycle time problems early?
- Can you make operational changes to improve cycle time?

FabTime's Cycle Time Management Training is a one-day course designed to provide production personnel with an in-depth understanding of the issues that cause cycle time problems in a fab, and to suggest approaches for improving cycle times. A two-day version is also available upon request.

Prerequisites

Basic Excel skills for samples and exercises.

Who Can Benefit

This course is designed for production personnel such as production managers, module managers, shift supervisors, hot lot coordinators, and production control.

Skills Gained

Upon completion of this course, you will be able to:

- Identify appropriate cycle time management styles.
- Teach others about utilization and cycle time relationships.
- Define and calculate relevant metrics for cycle time.
- Teach others about Little's law and variability.
- Quantify the impact of single-path tools and hot lots.
- Apply cycle time intuition to operational decisions.

Sample Course Tools

Excel Cycle Time Simulator

Staffing Delay Simulator

Additional Half-Day Modules

- Executive Management Session.
- Site-Specific Metrics Review.
- Capacity Planning Review and Benchmark.