FabTime Cycle Time Management Newsletter

Volume 15, No. 6 November/December 2014

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 the current release of FabTime include a new scrap rate goal and additional slope details on trendlines.

Editor: Jennifer Robinson

Keywords: Delivery Performance; Fab Management; Metrics and Goals; OEE

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Welcome

Welcome to Volume 15, Number 6 of the FabTime Cycle Time Management Newsletter! We hope that the holiday season is finding you all well, and we wish you a productive and joyful 2015.

In this issue, we have an announcement about new FabTime software training videos that are available to our customers, as well as an announcement about the availability of the new SEMI E10 and E79 standards. Our FabTime software tip of the month is about editing the appearance and content of individual charts. We also have one subscriber discussion topic, concerning improving cycle time and on-time delivery for a fab.

In our main article this month we address the general question of how we can become better at what we do, whether what we do is manufacture computer chips, develop software, or something else altogether. We revisit Deming's Plan-Do-Check-Act cycle, discuss several projects that we are working on internally to make our own company more productive, and then discuss the necessary steps for planning cycle time improvement initiatives. We hope, as the New Year dawns, that you find some food for thought in this edition.

Thanks for reading, and Happy New Year! – Jennifer and Frank

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Community News/Announcements

FabTime Software Training Videos Now Available to Our Customers

FabTime is pleased to announce the development of a new suite of software training videos. More than a dozen "how-to" videos are now available, ranging from "getting started" to detailed examples of how to create specific charts and alerts. The videos are designed to complement FabTime's on-site software training classes, as well as to offer training for new users at established sites. FabTime is especially grateful to Mike Krist for his efforts in preparing the training videos. We will be adding more videos as needed.

FabTime's training videos are only available for use at customer sites that are under an active subscription or maintenance agreement. The videos are available as MP4 files, which can be uploaded to your FabTime server and accessed via standard web browsers. For more information, please contact us.

Updated SEMI E10 and E79 Specifications Are Available for Download

We mentioned in an earlier issue that SEMI was working on updated standards:

SEMI E10-0814 – Specification for Definition and Measurement of Equipment Reliability, Availability, and Maintainability (RAM) and Utilization

SEMI E79-0814E – Specification for Definition and Measurement of Equipment Productivity

We learned recently that these new standards are now available for download. You can purchase individual copies in PDF using the following links:

E10 Specification

E79 Specification

Alternatively, your company may have a subscription that gives you online access to these standards. Please note that they are copyright protected, and FabTime is not able to share the files with subscribers.

We are in the process of reviewing the new standards to ensure consistency in FabTime's Tool State and OEE charts. We will likely be making modifications to how FabTime tracks and reports OEE for cluster tools, in light of the updated standards.

FabTime welcomes the opportunity to publish community announcements, including conference notices and calls for papers. Send them to newsletter@FabTime.com.

FabTime User Tip of the Month

Edit Individual Charts

FabTime's new chart functionality allows users, if they have a user-level permission enabled, to edit the appearance and content of individual FabTime charts. This feature does not require you to have a chart set as JavaScript, but it does work more smoothly (with automatic updating) for the JavaScript charts.

If you have permission to edit individual charts, you will now see two small checkboxes below the chart on any detailed FabTime chart page (not on the home page). Clicking the "Edit Chart" box brings up two tables. The top table can be used to edit the label used for the chart's Y axis (and the label for the secondary Y axis, if applicable). For example, the Tool State

Trend chart shows:

Y Axis Title: Percentages
Y2 Axis Title: Start WIP (%UnitsAlias.)

You could rename "Percentages" or "Start WIP" to be whatever you like. (%UnitsAlias) means "show whatever is set as the name for units at your site, in parentheses". Usually you'll see "(Wafers)". You may edit that, if needed.

After editing the chart axis titles, press the "Go" button immediately below the top editing table. This will update the chart with your new axis titles.

The lower table below "Edit Chart" will show a list of all fields that are included in the chart. To remove a field from the chart, simply change the "On Chart" drop-down for that field from whatever value is currently set (e.g. "Line") to "Unused". If you are using JavaScript charts, the chart will update immediately. Otherwise, you may need to press the "Go" button beneath the table.

To change the color used for a line or bar on a chart, modify the value in the "Settings" column for that field using the drop-down list. Note that colors in stacked bar charts are automatically generated based on the number of stacked items, and cannot be edited. You can, however, change the color for items that are normally fixed in FabTime. For example, on the Tool State Trend chart, you could change the color for "Productive Pct" from Green to Blue.

To add a trend line to a chart, click the checkbox in the "Trend" column for that field. For stacked data, clicking on any of the stacked fields results in a single trend line for the top of the stack. Uncheck the box to remove the trend line. You cannot currently edit the color or format of trend lines.

To add new fields to a chart, click "Show All Fields" immediately below the chart. This updates the lower "Edit Chart" table to include all fields that are associated with the chart, including those not currently displayed. You can add a field to the chart by changing the "On Chart" value from "Unused" to something else, e.g. "Line" or "Bar". You can also select the color for your new field, using the "Settings" column.

Currently, all fields that are added to a chart are added in relation to the left-hand Y axis. This means that there are fields that you could theoretically add that will not make much sense displayed on the chart. For example, "Unscheduled Down Duration CV" is associated with the Tool State Trend chart. However, coefficient of variation tends to be on the order of zero to five. If displayed on the default "Percentages" y-axis, this value will be so relatively small as to be difficult to see.

Our recommendation is to primarily only add fields that have the same units as the left-hand y axis. For example, you might add "Availability" to the Tool State Trend chart, which is expressed as a percentage, like the bars of the chart. We include the full set of fields associated with the chart to maximize flexibility to our users, and to allow for future enhancements to this Edit Chart capability.

Once you have made edits to a chart, you can save those edits by adding the chart to one of your home page tabs (or updating, if you have drilled down to a chart). You can share your edited version of a chart by sharing your home page tab.

We welcome your feedback on this new feature. If you have an updated version of FabTime (e.g. you have JavaScript charts) but do not see the "Edit Chart" option below each chart on the detailed chart page, contact your internal FabTime administrator to request permission to edit charts.

Subscribe to the separate Tip of the Month email list (with additional discussion for customers only). Thanks!

Subscriber Discussion Forum

Goals for Fab Leadership to Drive CT Improvement

A FabTime customer asked us recently: "In your Cycle Time Management framework, what goals for fab leadership have worked the best to drive improvement in cycle time and on time delivery?"

FabTime Response:

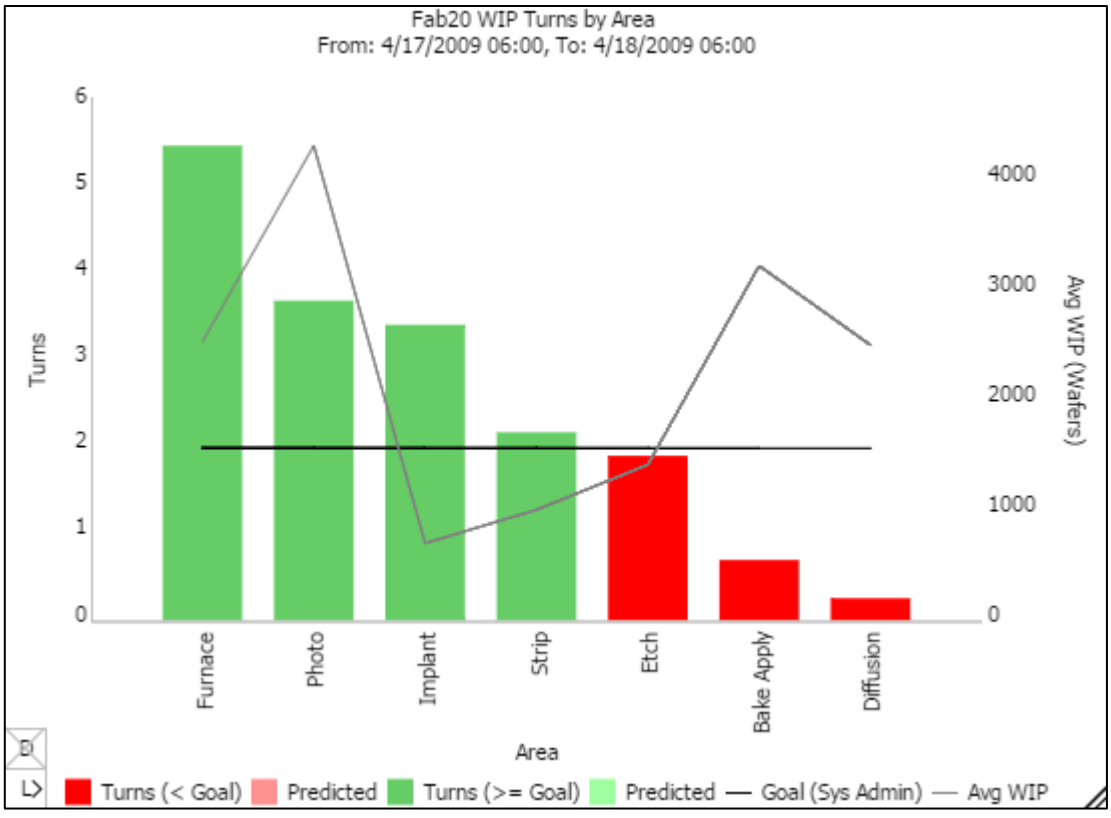
Fabs that focus on WIP Turns (moves / average WIP) rather than just focusing on moves will tend to do better in terms of cycle time. A sample WIP Turns Pareto Chart by Area is shown below.

Dynamic X-Factor is a metric that can be useful in giving an early indication of cycle time increase or decrease, as well as revealing information about systematic factors like shift change that may be affecting cycle time. See FabTime Newsletter issues 4.08, 5.03, and 15.05.

We addressed the question of "what are good metrics for capturing/reducing variability" in our newsletter three years ago, in issues 12.6 and 13.1. The second of these issues reflects feedback that we received from other fabs about how they track and improve variability.

Some fabs that we work with have had good success using a new metric called Earned Plan Hours (described in issue 14.01). Here's a quick summary taken from FabTime's online Help:

> "The earned plan hours metric is an alternative to moves for tracking production activity. When tracking moves (or major-step moves), there is an incentive to finish short production runs toward the end of a shift (or any reporting period) because that is the only way to get credit for a move. This may mean that tools are left idle at shift change, because the incentive is to track work out of tools, not to keep tools working. Operators have no incentive to start lots on tools unless



the lot can be finished within the current shift. In the worst case, this behavior causes moves to shoot up toward the end of the shift, and then to drop to a very low level at the beginning of the next shift, as the incoming shift recovers from a large number of empty tools. These large swings in moves create downstream variability and may lead to tool starvation and/or high cycle times.

The earned plan hours metric attempts to counteract this undesirable shift-change behavior by giving credit both when lots are tracked into tools, and as processing occurs on tools. When a lot is tracked into a tool, credit is given for the planned queue time of the lot at its current flow/step. As a lot is processed, credit is given for elapsed processing time, up to the end of the planned process time or shift change, whichever comes first. In this way, operators are incentivized to start a lot running on a tool, even if there are just a few minutes left in the shift, because they will immediately receive credit for the lot's planned queue time. And they receive credit for any portion of the planned process time up to shift-change, even if the lot doesn't move out of the tool until the next shift."

What do you other subscribers say? What goals would you recommend that fab management track in order to improve cycle time and on-time delivery?

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

How Can We Get Better at What We Do?

By Jennifer Robinson and Frank Chance

A question that we always think about, but that has been particularly on our minds lately at FabTime is: how can we get better at what we do? Whatever your organization is, you can always look to improve. At FabTime, we make software, and we can strive to do a better job of everything from writing code to getting our product installed quickly and correctly at customer sites.

Most of you reading this article work in some way toward the manufacturing of computer chips. One of the reasons that you read this newsletter, we would hope and imagine, is that you have at least a general idea of wanting to make your manufacturing process better (faster, with fewer mistakes, and more productive use of capital equipment).

In this article, we will discuss methods for getting better at what we do, whether "what we do" is installing software, making computer chips, or something else altogether.

Motivation

We recently ran across an article in the New Yorker by **James Surowiecki** about how the "performance revolution" has influenced industries ranging from athletics to manufacturing to teaching. Here are a couple of quotes that we especially liked:

"A key part of the "performance revolution" in sports, then, is the story of how organizations, in a systematic way, set about making employees more effective and productive."

"The ethos that underlies all these performance revolutions is captured by the Japanese term kaizen, or continuous improvement. In a kaizen world, skill is not a static, fixed quality but the subject of ceaseless labor. This idea is more applicable to some fields of endeavor than to others—it's easier to talk about improved performance in sports or manufacturing, where people's performance is quantifiable, than in writing or the fine arts—but the notion of continuous improvement has wide relevance, leading to dramatic advances in fields as disparate as airline safety and small-unit performance in the military."

(On improving K-12 education) "But the biggest problem is that we're in thrall to what Green calls "the idea of the natural-born teacher," the notion that either you can teach or you can't. As a result, we do little to help ordinary teachers become good and good teachers become great. What we need to embrace instead is the idea of teaching as a set of skills that can be taught and learned and constantly improved on."

We've also been reading **Peter Thiel's** *Zero to One: Notes on Startups, or How to Build the Future* and **Atul Gawande's** *The Checklist Manifesto: How to Get Things Right*, and mining them for ideas relevant to our specific situation. We believe that part of having a continuous improvement mindset involves continuing to look for new ideas, in different places, and bringing those ideas together.

Continuous Improvement

Here is how the **American Society for Quality** defines continuous improvement on their website:

"Continuous improvement is an ongoing effort to improve products, services or processes. These efforts can seek "incremental" improvement over time or "breakthrough" improvement all at once.

Among the most widely used tools for continuous improvement is a four-step quality model—the plan-do-check-act (PDCA) cycle, also known as Deming Cycle or Shewhart Cycle:

Plan: Identify an opportunity and plan for change.

Do: Implement the change on a small scale.

Check: Use data to analyze the results of the change and determine whether it made a difference.

Act: If the change was successful, implement it on a wider scale and continuously assess your results. If the change did not work, begin the cycle again.

Other widely used methods of continuous improvement — such as Six Sigma, Lean, and Total Quality Management — emphasize employee involvement and teamwork; measuring and systematizing processes; and reducing variation, defects and cycle times."

It's important to note in the above that continuous improvement can seek and result in breakthroughs - it doesn't have to be all slow, incremental change. But certainly cycle time improvement in a complex environment like a wafer fab lends itself more to incremental change than to major breakthroughs.

What We're Working on Internally at FabTime for Continuous Improvement

Here are some things that we are doing internally at FabTime these days, as part of our quest for continuous improvement.

1) Automating tasks that don't require creativity, for example, sending out updates of installation project statuses via email.

2) Sharing findings internally so that people don't waste time reinventing the wheel. These findings could involve useful snippets of software code, tips and tricks for using Google Docs in Chrome, or anything else that makes us more productive on a daily basis.

3) Upgrading hardware so that it isn't a constraint.

4) Creating checklists for everything that may ever need to be done again. These checklists might range from setting up a new computer system to doing a software installation on top of a particular manufacturing execution system.

5) Having personnel sometimes undertake different tasks, to see if fresh eyes see things that can be improved. For example, Frank is working as the lead on his first installation project in several years, and he has come up with some suggestions to improve the process, based on things that have changed over the years.

6) Sharing strategies for managing email, such as a guiding philosophy of first responding where by responding one enables other people (particularly those who are bottlenecks in some way) to keep working.

We realize that not all of these strategies will be relevant to each of you, but it is our guess that most companies could benefit from one or more of these approaches. We are also working on applying more of a formal continuous improvement methodology to our software installation process.

Ways that FabTime Can Help People Implementing Continuous Improvement in Fabs

Of course, we also think that FabTime's software and cycle time training can help our customers with continuous improvement efforts for their fabs. FabTime is a performance tracking tool, so it helps with both identifying opportunities for improvement and checking whether or not changes have resulted in improvements in the PDCA Cycle above.

FabTime is also a productivity tool in that it saves users considerable time. What used to take hours (digging into data to troubleshoot problems, preparing daily reports, etc.) with FabTime can take just minutes or seconds. Time savings, faster problem solving, and detecting problems before they get out of hand should all lead to fab performance improvements.

Beyond Performance Tracking Software

Just having a product like FabTime (or any other performance tracking system you might use) may help to save people time, but it will not automatically lead to improvements in your fab's cycle time. You need to take concrete actions in your fab. You need to change things, and assess whether or not those changes are working, and then change things some more.

In fact, we would propose some sub-steps to the Plan step in the PDCA Cycle for those seeking to improve overall wafer fab cycle times (or other top-level metrics).

We'll start by revisiting the subscriber discussion question shared earlier in the newsletter. Someone from a senior position at one of our customer sites was working on setting targets for improved cycle time and on-time delivery. So we know that senior management at this company wanted to see changes made. They had already looked at some data, and they contacted us to ask for some suggestions to changes in metrics.

Presumably, after getting our feedback, they went back and looked at where the ideas that we sent might match with what they wanted to do, and made some changes.

So here are steps you need to get through the Plan step of the PDCA Cycle to start a top-level cycle time improvement project:

1) Someone at the company commits to dedicating time and resources to making improvements.

2) Some resource within the company takes a hard look at data, identifying specific places where improvements can or should be made.

3) That resource, or someone else, also takes a look at ideas for improving things. This could involve reading books or articles, consulting experts, sharing ideas with colleagues, and/or talking to the gray-haired guy at the company who's been doing this for 40 years. But the point is to get some ideas for what to change.

4) You put the ideas together with the data, and then you move on to the "Do" portion of the PDCA Cycle.

It would be easy to skip one of these steps, particularly Step 3. But we don't believe that this would lead to success. You need a willingness to make changes, if you want things to improve. You need to know where you are before you can decide where you want to go with those improvements. And you need ideas. You need a plan. You can't just issue a top-down directive that cycle time should be reduced by 10%. Without ideas for how to do that, and necessary resources, your team is unlikely to be successful.

Conclusions

Whether what we do is develop software, manufacture computer chips, or teach schoolchildren, just about all of us could benefit from becoming better at what we do. A continuous improvement philosophy strives to constantly improve products and processes, whether incrementally or via a (?) "breakthrough".

The Plan-Do-Check-Act (PDCA) Cycle offers a blueprint for making continuous improvements. We are confident that this Cycle is in place in most fabs, as our subscribers work on yield improvement projects, equipment uptimes, etc. We believe that a continuous improvement philosophy can also be applied to one's personal productivity, and, of course, to cycle time improvement efforts.

To make real improvements requires three things: 1) the will to make changes; 2) data that shows where the problems are (which could include not just hard manufacturing data but also input from customers about what they see as problems); and 3) training/understanding/learning that suggests the kind of solutions that will help.

Here at FabTime, we will continue to work on improving things internally, particularly our software installation processes. As the New Year begins, we wish all of you the will, the data, and the inspiration to make changes, too.

Questions for Newsletter Subscribers

Does your company have a continuous improvement mindset? What techniques do you use for improving personal or company productivity, for getting better at what you do?

Further Reading

W. Edwards Deming, Joyce Orsini, and Diana Deming Cahill, *The Essential Deming: Leadership Principles from the Father of Quality,* McGraw-Hill, December 2012.

Atul Gawande, *The Checklist Manifesto: How to Get Things Right,* Picador, 2011.

James Surowiecki, "Better All the Time", *The New Yorker*, November 10, 2014.

Peter Thiel, *Zero to One: Notes on Startups, or How to Build the Future,* Crown Business, 2014.

Subscriber List

Total number of subscribers: 2795

Top 20 subscribing companies:

- Intel Corporation (152)
- Micron Technology, Inc. (139)
- Maxim Integrated Products, Inc. (130)
- International Rectifier (120)
- Fairchild Semiconductor (102)
- GLOBALFOUNDRIES (74)
- ON Semiconductor (73)
- Carsem M Sdn Bhd (71)
- Texas Instruments (64)
- X-FAB Inc. (61)
- STMicroelectronics (56)
- Freescale Semiconductor (54)
- Infineon Technologies (53)
- Western Digital Corporation (53)
- Analog Devices (49)
- Skyworks Solutions, Inc.(49)
- Seagate Technology (44)
- ATMEL (43)
- IBM (43)
- Cypress Semiconductor (32)

Top 4 subscribing universities:

- Ecole des Mines de Saint-Etienne (EMSE) (17)
- Arizona State University (8)
- Nanyang Technological University (7)
- Virginia Tech (7)

New companies and universities this month:

- Berkshire Corp
- Keysight Technologies
- Pro People Inc.
- Silevo/Solar City

Sampler Set of Other Subscribing Companies and Universities:

- AFPD Pte., Ltd (2)
- Ariel University Center (1)
- Cal Poly (2)
- Centum Rakon India Pvt. Ltd.(1)
- Comlase AB (1)
- GKN Driveline (1)
- Nanya Technology Corporation (4)
- nLight (1)
- Raytheon (8)
- Robins Air Force Base (1)
- Samsung (24)
- Sandia National Labs (2)
- Sitronics (1)
- Teledyne DALSA (1)
- Texas A&M University (2)
- TOCGC (1)
- University of California - Berkeley (4)
- University of Hong Kong (1)
- University of Limerick (1)
- WaferTech (14)

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.

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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

$7500 plus travel expenses for delivery at your U.S. site for up to 20 participants, each additional participant $300. Discounts are available for multiple sessions.

Interested?

Contact FabTime for a quote.

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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 and a half-day executive management version are also available upon request. The course is only available for delivery at sites within the United States, unless it is delivered in conjunction with software training for FabTime customers.

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.

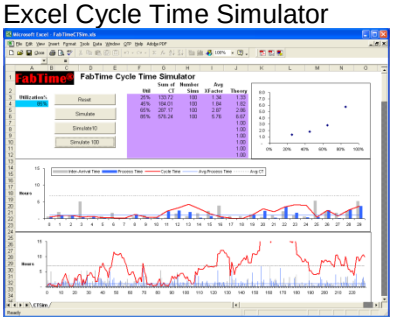
Skills Gained

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