FabTime Cycle Time Management Newsletter

Volume 18, No. 5 October 2017

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 development right now include tool state Gantt charts and speed improvements for individual chart and goal pages.

Editor: Jennifer Robinson

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Welcome

Welcome to Volume 18, Number 5 of the FabTime Cycle Time Management Newsletter! In this issue we have two FabTime announcements. The first is about the release of software patch 109. The second is about our latest training webinar. Our software tip of the month is about how to open a new chart in a new tab. We have no subscriber discussion this month.

Our main article was inspired by our attempts to help a new customer as they move from a development environment to higher volume manufacturing. We mine our years of experience in working with wafer fabs to propose three core practices and six categories of key metrics for volume factories. We believe that all of these may help this new customer (and other readers, of course). As we have not personally run a wafer fab, however, our musings have raised a number of new questions. We are hoping that some of you will be inspired to share your experience in this area, which we will then disseminate in the next issue.

Thanks for reading – Jennifer

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Community News/Announcements

Patch 109 Ready for Release

FabTime is pleased to announce that Patch109 is ready for release to customers. Highlights of Patch 109 include:

- New OEE Detail Trend and Pareto Charts.
- Auto-complete functionality for the SQL filter (making complex on-chart queries easier).
- Addition of cumulative moves delta to goal field on Moves Trend (Cumulative) Chart.
- Ability to rename, copy and link home page tabs directly from the home page.
- Speedup of individual chart page and goal-viewing.
- The ability to disable auto-slide for individual home page charts.

Contact your internal FabTime system administrator to ask about when Patch 109 will be rolled out to production at your site.

FabTime Hosts Successful Introductory Training Webinar

On October 3rd FabTime's Mike Krist hosted a FabTime webinar for new users and any users looking to enhance their FabTime skills. The following topics were covered:

1. How FabTime works, and why it is a powerful problem solving tool.
2. Navigating the FabTime interface.
3. Creating charts and adding them to your homepage.
4. Filtering and slicing data.
5. Customizing your home page tabs, and setting auto-slide.
6. Creating FabTime alerts, including home-page-chart alerts.
7. Q&A and wrap up.

We were delighted to have more than 50 people participate in the webinar. We will be scheduling future sessions that are more convenient for other time zones. In the meantime, if you work at a FabTime customer site and are interested in viewing an archived video of the webinar, please contact Jennifer.Robinson@FabTime.com for the link.

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

Open New Charts in a New Tab

Earlier this year, we shared a tip for opening multiple home page tabs at once. During FabTime's recent training webinar, a related question arose, and we thought that other FabTime users might find the answer useful. The question was: how do I have new charts open up in new tabs, when slicing or quick jumping? Here's what a bit of research tells us:

- When opening a new chart from a link in the data table (e.g. "Trend" or "List"), if you right-click, most browsers will show an option to "Open in New Tab" or "Open in New Window". We confirmed that this works in Edge and Chrome on a PC, and in Safari and Chrome on a Mac.

- There is no right-click option for slicing to drill-down (via the little plus/magnifying glass icon in FabTime). We are going to look into adding this functionality. In the meantime, a workaround would be to duplicate the tab before slicing it. If you right-click on the name of the browser tab, you should find an option to "Duplicate" (Chrome or Edge) or "Duplicate Tab" (Internet Explorer). The keyboard shortcut Control+K also duplicates the current tab in Internet Explorer. If you duplicate first, and then slice from the resulting tab, your original tab will also still be available.

- Similarly, there is no right-click option for the Quick Jump menu. The same workaround of opening a new tab first should do the trick for now. FabTime will investigate other navigation options for the Quick Jump.

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

FabTime welcomes the opportunity to publish subscriber discussion questions and responses. Simply send your contributions to Jennifer.Robinson@FabTime.com. We have no subscriber discussion at this time, but we do hope that the article below will inspire some discussion for the next issue.

Helping Factories Transition from R&D to Production

Introduction

FabTime recently started an installation at a customer site that is transitioning from R&D to volume manufacturing. The majority of our existing sites, in contrast, have years of experience in volume manufacturing. Many sites have survived multiple industry boom-and-bust cycles. As we work with our latest customer, we realize that we've been spoiled, in a way, by our existing customers – by and large, these sites knew what metrics they wanted to track, even the metrics they weren't already measuring. From FabTime, our customers wanted a faster way of tracking these key metrics, digging into problems, and bringing hidden opportunities to light.

To complicate matters, our new customer has a fab-like process, but it's not a traditional wafer fab. This situation has led us to think about best practices, and to ponder the question – "what are the core practices and metrics of wafer fab manufacturing that would be most valuable to a facility that is transitioning from R&D to volume production?"

It's important to note that we (FabTime) have zero experience running a wafer fab. On the other hand, we have 25 years' experience assisting fabs with productivity improvement. Our software reflects that experience, as it has grown over time to address our customers' challenges. We feel qualified to comment on what we've seen in terms of practices and metrics, but we do not claim to have definitive answers. This is a discussion for which we would particularly welcome feedback from newsletter subscribers.

In the sections below, we share three core practices that we've observed across many fabs, as well as a selection of key metrics.

Core Practices

We have observed the following three core practices of wafer fabs.

Core Practice 1 - Morning Meeting

In our experience, every fab has a morning meeting during which current issues are highlighted. But why is the morning meeting necessary? Does the lack of a morning meeting lead to disaster? Most meetings that we've attended focus on WIP balance, move targets, progress toward weekly shipments, and down (or critical) equipment. Is that the core list that every morning meeting covers? What is the best practice in terms of who attends these meetings?

Core Practice 2 – Setting Daily Targets

Often there is a pre-morning-meeting where one person (or a small group) works with an Excel-based tool to set daily targets. Many times these targets are quantified in terms of stage moves (e.g. major-step activities, or workcenter moves). The manner in which these targets are set is fluid (and thus hard to automate), and is based on WIP condition, tool availability, progress toward weekly shipments, or the status of critical lots. Is this a core practice? If yes, how should a facility go about training a person to take on this role, as it ramps up volume?

Core Practice 3 - Passdown Meetings

Similar to the morning meeting, most fabs that we've talked with also have a passdown meeting marking the transition between shifts. We haven't had the chance to observe many passdown meetings, but our impression is that these are slightly more detail-oriented than the morning meeting. What's going on in this area? Which specific product lines should we be

focusing on? Are these meetings as important as the morning meeting? Are they attended by the same people? What purpose do they serve that is not served by the morning meeting?

Key Metrics

These are a few key metrics that we've seen fabs look at, either in the morning meeting or in a weekly assessment meeting.

WIP Balance

Many fabs that we have visited are concerned with WIP balance. We haven't seen a widely used number that quantifies WIP balance. However, we typically see WIP summarized by stage, major-step, or workcenter, displayed in some sort of process-flow order. This is true even if not all flows go through the stages in a similar fashion. A WIP chart like this gives a quick visual impression of where the WIP is piling up, and whether or not the fab is balanced across the line. An example is shown below.

Moves

Every site that we have ever visited tracks moves (operation completions). Typically moves are filtered in some way. For example, moves are often filtered to remove non-value-add steps or to measure stage activity, major-step activity, or workcenter activity. This filtering means that small changes to processes do not appear in move counts, thus taking some noise out of the metric.

On the plus side, managers can look at moves for a full or partial day, and immediately know if it's a good or bad day. Moves tell you whether you are on pace to complete what you expect to complete that day (in a broad sense). On the downside, focusing heavily on moves incentivizes operators to stretch for moves at the end of each shift or workday, which may leave the following shift with empty equipment.

Some FabTime sites track earned hours (basically planned queue time plus planned process time for tracked-in lots) in addition to major-step moves. This is a way of incentivizing operators to keep equipment loaded, even near the end of a shift.

Shipments

Most fabs track the number of lots shipped, by day and/or by week, relative to

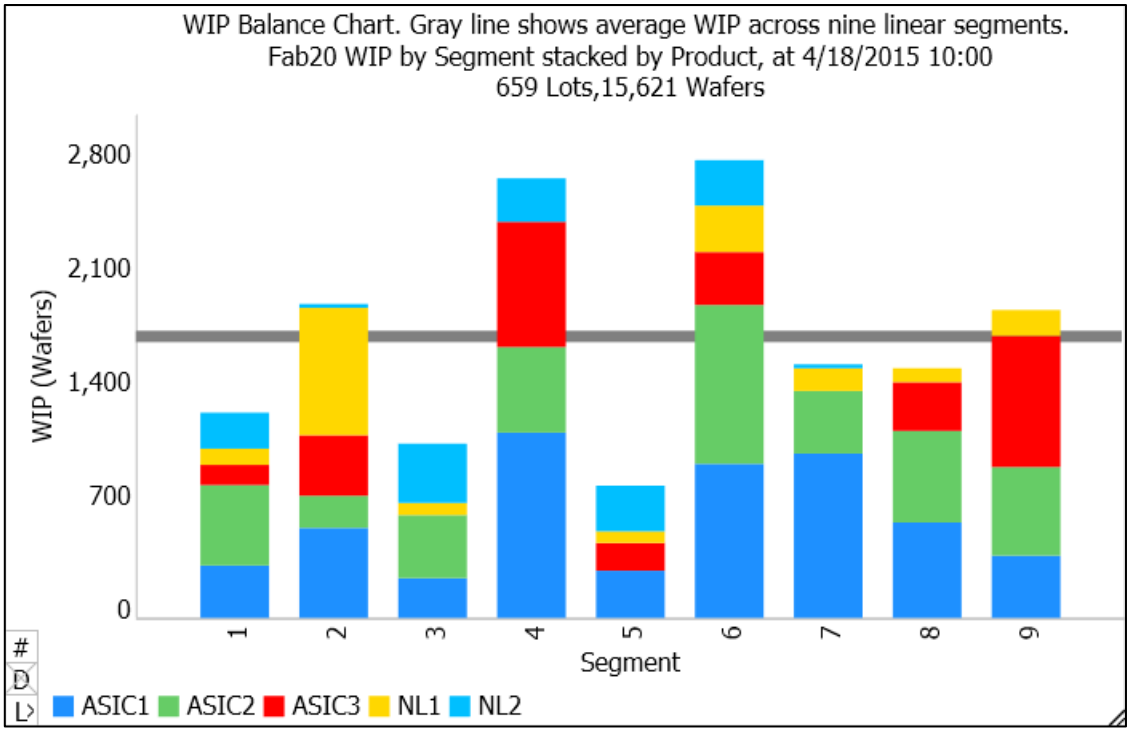

Figure 1. Example of WIP Balance Chart Sliced by Segment of the Line

the plan. Fabs that don't make shipment goals over time are going to run into problems (WIP build-up, long cycle times, and unhappy customers). Shipments are usually looked at in the aggregate as well as by product, with the cycle time for shipped lots compared to a plan or due date.

Speed (WIP Turns, Cycle Time, DPML)

Over the past 25 years, as market pressures on cycle time have increased, we've seen more and more fabs looking at line speed on a daily (or at least weekly) basis. There are a number of different metrics that can be used here.

WIP turns (moves / WIP) give a sense of how well the fab is doing at keeping things moving. A turns rate of eight per day means that, on average, every wafer in the fab is moved eight times per day. Turns also give a forward look at shipped lot cycle time. If we move every lot eight times per day, and we have to move a lot through 400 steps, then we are looking at ~50 days of cycle time.

Shipped lot cycle time is commonly reported, and is somewhat useful for planning and benchmarking purposes. However, as a trailing metric, shipped lot cycle time is less useful for predicting the cycle time of future lots. The fabs that we've seen that are particularly cycle time-focused also look at some sort of open lot cycle time. Similarly, many fabs use days per mask layer for comparing performance across different fabs or technologies. Here again, however, some sort of open lot metric may be more predictive.

Yield

Line yield (percentage of good wafers shipped) is a key metric for fab profitability. Actually measuring line yield on an ongoing basis can be a bit tricky in practice, however. We know how many wafers ship each week, and we know how many wafers start each week. However, because of the long cycle time in a fab, the wafers that ship this week are almost certainly not the same ones that started this week. Because of variability, we can't even say that we're going to compare the wafers that shipped this week to the ones that started 8 weeks ago (or whatever the average cycle time is). Still, however yield is tracked, it is clearly key to profitability.

Equipment Availability, OEE

Equipment downtime is typically reported to FabTime as the number one issue driving up fab cycle times. It is fitting, therefore, that availability of key tools usually plays a part in the morning meeting. Over the years, we've seen fabs shift to also look at overall equipment effectiveness (OEE). The nice thing about OEE is that one can look at the contributing loss factors and identify opportunities for improvement.

Another metric that we've seen used on a daily basis in fabs is a list of down tools, filtered to only show the tools that have been down for some critical time period (and sometimes filtered by area, depending on the size of the fab). These are usually the tools that are having the most immediate impact on cycle time. An example is shown at the top of the next page.

Other Open Questions and Conclusions

In this article we have outlined three core practices and six categories of metrics that we feel are useful in running a high-tech production facility. As we consider these core practices and key metrics, however, other questions come to mind. What operational practices have to change as a fab moves from development to production? Is it common in development fabs to have one (or two) key people who are responsible for most decisions, and to eventually find that the fab can't run this way as volume grows? Can we plan for the fact that decision-making has to become more decentralized? How does management of operations have to change as volume ramps up? What role do

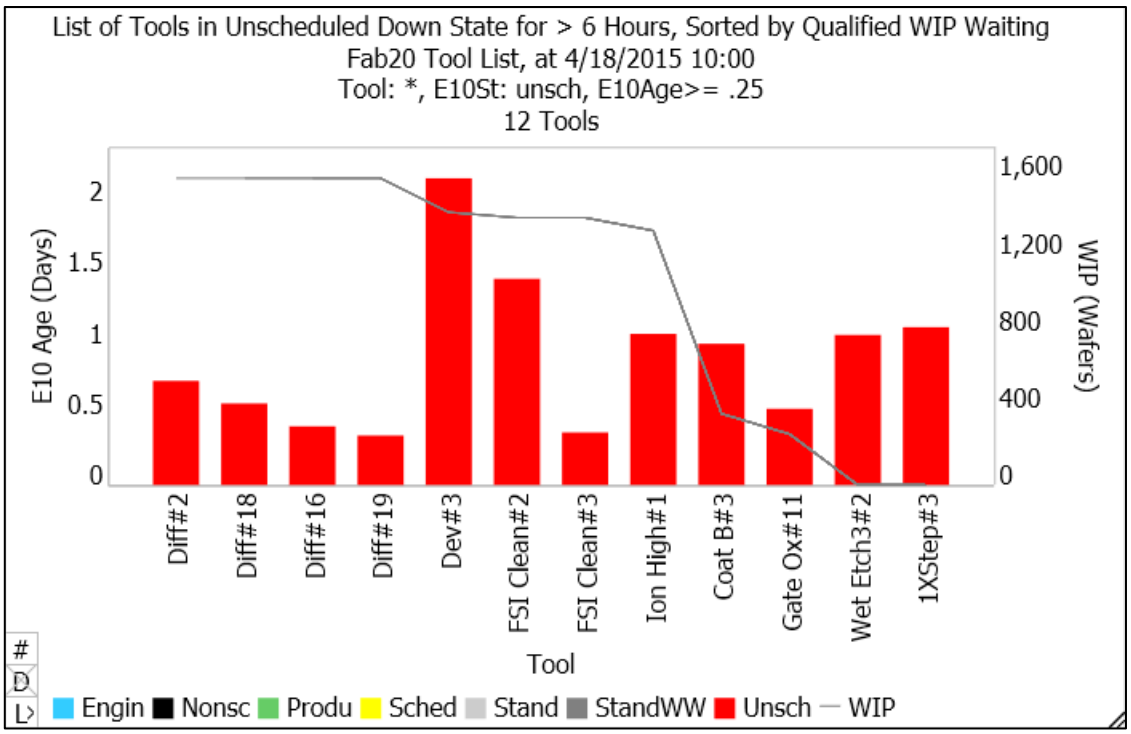

Figure 2. Example of Down Tools List, Filtered for Tools Down More Than Six Hours

checklists play in transitioning from R&D to volume manufacturing?

If you have worked in a fab that made the transition from primarily R&D to more streamlined production, what things have you seen that worked? What attempts have you seen that failed? We are interested in your feedback (either attributed to you or kept anonymous by FabTime), and would be more than happy to address any of these topics in more detail. Thanks for your feedback!

Further Reading

- James K.C. Chen, "Perspective Service Knowledge and Technology Transfer Model of Intra-Firm in IC industry," *Journal of International Management Studies*, Vol. 6, No. 3, October 2011. (PDF). This is a rare published article that mentions the morning meeting as an important wafer fab communication opportunity. Interestingly, a Google search of "morning meeting" and "wafer fab" turns up primarily job listings that require running or supporting the morning meeting.
- J. Robinson and F. Chance, "Definitions for Short-Term Line Yield Metrics," *FabTime Newsletter*, Vol. 9, No. 6, 2008.
- J. Robinson and F. Chance, "Using Short-Term Indicators to Improve Long-Term Performance," *FabTime Newsletter*, Vol. 10, No. 7, 2009.
- J. Robinson and F. Chance, "Using WIP Turns for Forward Cycle Time Estimation," *FabTime Newsletter*, Vol. 16, No. 2, 2015.
- J. Robinson and F. Chance, "What Makes an Effective Morning Meeting?," *FabTime Newsletter*, Vol. 8, No. 2, 2007.

Subscriber List

Total number of subscribers: 2753

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- Micron Technology, Inc. (139)
- Intel Corporation (115)
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New companies and universities this month:

- Wolfspeed

Sampler Set of Other Subscribing Companies and Universities:

- font
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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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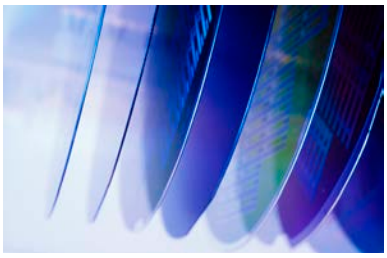
FabTime® Dispatching Module



Dispatch Configuration and Support

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

- Dispatch rule configuration via user-friendly web-based interface for standard factors
- Training.
- Dispatch list feed to the MES (if applicable).
- Support and upgrades.

Custom dispatch rules and consulting from our dispatching expert available for additional fee

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 or staging time at downstream tools.

Interested?

Contact FabTime for details.

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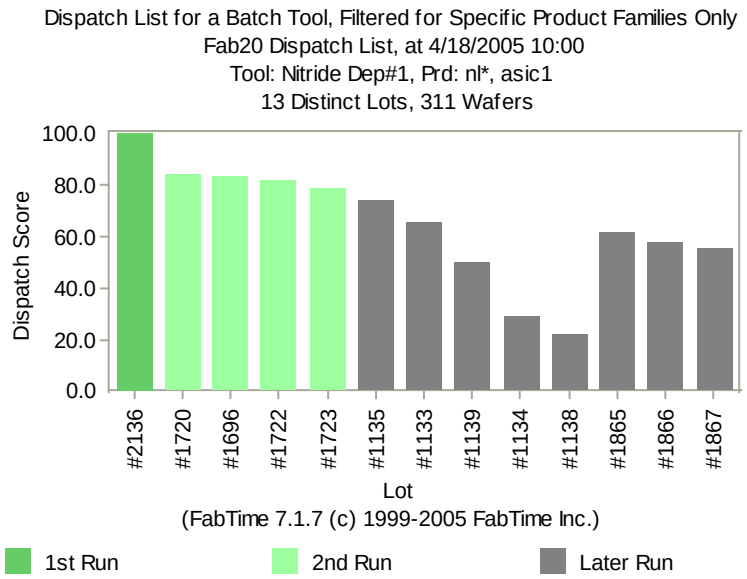
Do your operators make the best possible dispatching decisions?

- 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 dispatch strategy?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 now (as of 2016) also includes an optional **short-interval scheduler**.



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.