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. New features in the current release of FabTime include our custom-built JavaScript charting engine, as well as edit chart capability for individual charts (e.g. to add or remove data).

Editor: Jennifer Robinson

Contributors: Levy Stern (Intel)

Keywords: Fab Management; Factory Behavior; Metrics and Goals; Tool Availability

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Welcome

Welcome to Volume 15, Number 4 of the FabTime Cycle Time Management Newsletter! We hope that you are enjoying summer wherever you are. In this issue we have three announcements: one about a new FabTime User Group started by the Fab Owners Association IE Team; one a call for papers; and one about an update to the SEMI E10 and E79 standards. Our FabTime tip of the month concerns the use of Tab Filters to change a filter setting for all charts on a home page tab on the fly. In our subscriber discussion forum we are pleased to announce that Levy Stern from Intel succeeded in a challenge issued by Frank in the last issue.

In the last newsletter, we talked about helping people to become better problem-solvers. In our main article this month, we review some of the many problems that there are to solve in wafer fabs. We group these issues under categories including capacity planning; starts planning; dispatching; and operations. While space does not permit us to delve into all of these questions here, we do seek your feedback regarding which of these problems would be most beneficial to work on going forward.

Thanks for reading – Jennifer

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Community News/Announcements

Fab Owners Association Launches FabTime User Group

The Industrial Engineering group of the Fab Owners Association has launched a FabTime User Group. Members meet on a monthly basis via teleconference and share ideas for improving their fabs' productivity with FabTime. Topics to date have included using FabTime data in external presentations, review of charts used during the morning meeting, and the effective use of FabTime alerts.

Members of the User Group have generously opened up membership to participants from all FabTime customer sites (whether or not the site is an FOA member). Participants from fabs that are neither FabTime customers nor FOA members will be considered on an individual basis. If you are interested in learning more about this User Group, please contact Jennifer.Robinson@FabTime.com.

Conference Announcement: 2014 International Symposium on Semiconductor Manufacturing Intelligence

The 2014 International Symposium on Semiconductor Manufacturing Intelligence (ISMI2014) will be held August 16-18, 2014 in Taipei, Taiwan. ISMI2014 aims to provide a platform to foster the exchange of research developments and latest practice on automation science & engineering, operations research, evolutionary algorithms, data mining, manufacturing informatics, and decision analysis for semiconductor manufacturing intelligence to enhance collaborations to address critical research and industrial issues.

Topics of Interest Include:
Manufacturing Intelligence
Big Data & Data Mining
Manufacturing Strategy
Manufacturing Informatics
Automation
Semiconductor Ecosystem
Equipment Real-time Decision
Advanced Process Control
450mm Wafer Migration
Modeling & Decision Analysis
Evolutionary Algorithms
Green Supply Chain
Corporate Resource Planning & ERP
AMHS Routing & Scheduling
Manufacturing Innovation
E-Manufacturing
Simulation
Optimization

Paper Submission
Extended abstract including main ideas and contributions and/or full manuscript not exceeding 6 pages in IEEE format should be submitted through EasyChair conference system) before July 15, 2014, while camera ready manuscript should be submitted before July 31, 2014. Details can be found here.

Updates to SEMI E10 and E79 Standards

We learned via the Wright Williams & Kelly Newsletter, Applied Cost Modeling, that the SEMI Equipment Reliability, Availability, Maintainability, and Productivity (RAMP) Task Force recently completed revisions to the SEMI E10 and E79 standards. The primary revision to E10 (Specification for Definition and Measurement of Equipment Reliability, Availability, and Maintainability (RAM) and Utilization) appears to be the addition of a set of example calculations for cluster tools. FabTime does use the E10 standard for our Tool State charts, and we will review the new examples to determine any applicability for our customers.

Here is a summary of the E79 (Specification for Definition and Measurement of Equipment Productivity) update, as published on SEMI's website.

"A primary accomplishment of the revision to SEMI E79 is the introduction of four new metrics under one subsection called Loss Metrics. These productivity loss metrics are:

- Availability Loss,
- Operation Loss,
- Rate Loss, and
- Assignable Quality Loss.

These four metrics support the comparison of loss categories to each other using total time as a common denominator; and the values of these metrics plus OEE (overall equipment efficiency) add to 100% by definition. They are calculated using the same fundamental quantities used in the existing efficiency metrics, and present no new tracking requirements."

We will review the calculations for these loss metrics, but suspect that this will match with the OEE loss factors currently included in FabTime.

The revised standards have been approved and are expected to be published by SEMI this month.

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

Use Tab Filters Instead of Duplicating Home Page Tabs

Tab filters have been available in FabTime for quite some time. However, it was only recently, during an FOA FabTime User Group meeting that I (Jennifer) saw examples of how people are using them in practice. This made me think that other FabTime users might wish to learn more about Tab Filters.

The idea behind Tab Filters is that you can apply one or more filters to all of the charts on a home page tab, and easily change between filter values. This means that instead of having separate tabs for say, Photo, Etch, Diffusion, etc., you can maintain a single tab, and just change the filter to view results for a different area.

This could be very useful for reviewing the performance of different areas during a morning meeting.

To use Tab Filters, simply:

1. Check the "Set Tab Filters" box in the left-hand column of your home page. The page should auto-update to display a drop-down list.

2. Select the first filter that you would like to add from the drop-down list (e.g. Area) and then click the "Add" button beneath the list.

3. FabTime will display an input box for the new filter. Enter a value for this filter (e.g. "Photo") and press the closest "Go" button. (Note that Auto-Complete does

work for these filters, as it does on the chart pages).

4. All of the charts on the home page tab will update as that filter is applied. To see the filter listed in the detailed chart titles, you may need to set "StdTitles" under the "Format-this tab" section to "Show". But the filter will be applied in any case. You can change the value of the filter at any time by editing the value that you have entered in Step 3. An example is shown below.

5. You'll now see a new drop-down list and an "Exclude" button above each chart. To exclude the new tab filter from any individual chart (e.g. if you want a fab-wide moves chart in addition to the area-level charts), just select the filter name (e.g.

"Area") from the dropdown list, and click "Exclude".

6. To add additional Tab Filters, just repeat Steps 2 and 3.

7. To remove a tab filter, select that filter from the "Set Tab Filters" drop-down list and click "Remove".

8. To remove all Tab Filters, and get rid of the "Exclude" buttons above the charts, first uncheck "Set Tab Filters" and then click "Go" next to "Remove filters." Note that simply unchecking the "Set Tab Filters" box is not enough. You also need to click that "Go" button.

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

Area Tab Filter Set to "Photo" for all Charts

Subscriber Discussion Forum

Issue 15.03: Helping People to be Better Problem-Solvers

The main article in our previous newsletter was about helping people to become better problem solvers by questioning assumptions and digging down into detailed data. In the course of that article, we shared a quest that Frank had been on to find the original source of an old Scientific American article mentioned by Steve Jobs in multiple speeches. This was in the context of a section on training ourselves to be skeptics (not assuming that something is true because someone says it is true). Frank issued a challenge offering a prize to the first person who could produce the Scientific American article referenced by Steve Jobs (a donation to the charity of the finder's choice).

We are happy to announce that Levy Stern, Production department, Intel Fab 28, Israel, uncovered a reference to the article that Steve Jobs was apparently referring to. We were quite pleased to see this original article, although on close review, Frank identified some open issues with the article itself vs. the story that had arisen around it. The article is:

> S. S. Wilson, "Bicycle Technology", *Scientific American*, Vol. 228, Issue 3, 1973. This article can be downloaded from this link for a small fee.

The gist of the story about the article was that Jobs said that when he was young, he saw an article in Scientific American about the relative efficiency of different species. In the original list, humans weren't even in the top ten. The most efficient animal was the condor. However, if you put a human on a bicycle, he goes right to the top of the list. This is because humans are tool-makers. We have come up with ways to overcome our natural limitations. Jobs said that this is how he thought of a computer; as a bicycle for the mind.

The article that Levy found does contain a graphic shown in the Jobs videos. However, what Frank found interesting was:

1) The article doesn't refer to condors at all (in contrast to Jobs' story, where he claims that condors are the most efficient species).

2) The full graph shows that man, rather than being inefficient compared to other species (as Jobs claims), is actually relatively efficient:

   a. The y axis is calories per gram per kilometer, so lower on the y axis is more efficient.

   b. A walking man is more efficient than pigeons, gulls, hummingbirds, and bees, for example.

   c. Only horses and salmon are more efficient than a walking human, and the margin is rather slim.

3) The article doesn't contain the second graphic shown in the Jobs video… so that must have been pulled from somewhere else.

4) So… we are left with some questions:

   a. Was Jobs simply embellishing to make it a better story?

   b. Is there another article (perhaps containing the second snapshot) that is more compatible with his story?

   c. Is it worth pursuing any further?

We're sharing these questions in detail because even though the article that Jobs talked about did exist, things weren't quite as straightforward as the story described. This lends further support to our thesis that just because something makes a good story, you shouldn't just assume that it is true.

In any event, Frank has made a donation to the American Cancer Society on Levy's behalf. We appreciate Levy's persistence in helping us to track down the nugget of truth to this story.

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

Identifying and Solving Problems in Wafer Fabs

Introduction

In the last issue, we wrote about ways that people can become better problem-solvers. In this issue, we'd like to review some of the problems that people are trying to solve in fabs on a day-to-day and week-to-week basis. We won't discuss these issues in detail here, but we would like to use this article as a springboard towards discussion of focusing future efforts.

Fabs are very complex entities. Process flows are long and reentrant. There may be hundreds or thousands of different products in a given fab. Tools are expensive, and in some cases unreliable. Product cycles can be short, and the overall mix of the fab can change frequently. There is a constant balancing act in most fabs between increasing throughput and decreasing cycle time. There is no shortage of things that make managing a fab difficult. It is our belief, however, that understanding what the issues are is the first step towards making improvements. We also believe, as discussed below, that fabs have made great strides towards improving manufacturing methods over the years.

Let's leave aside the top-level strategic questions like whether or not to build a fab in the first place. Let's assume that we have a fab in place, and we know core things about this fab like whether we are make-to-order or make-to-stock, what our product lines are, and whether or not we aspire to be at the bleeding edge of technology. This still leaves plenty of questions to be answered on the tactical down to operational levels. We've grouped the questions here by category, though there is of course overlap in some cases.

Capacity Planning

■ What new tools do we need and when? This question applies in particular during a ramp.

■ What is the capacity of our cluster and cascading tools?

■ What impact will a proposed product mix change have on cycle time (and hence on delivery dates)?

■ What are our capacity bottlenecks? How do those change if our mix changes?

Starts Management / Order Acceptance

■ Should we accept this order? Do we have sufficient capacity?

■ What delivery date should we commit to for this order? Does this imply a certain priority level?

■ How do I release orders into the line to minimize impact on fab cycle times (variability)?

Dispatching

■ How do we keep the line balanced in terms of WIP (no holes, no bubbles)? An example of a line that is not balanced is shown below.

■ How do we insure relative linearity of shipments?

■ How do we allocate lots to tools, to decide where things should best be processed? When do we send the lots there? Where do lots go when they finish processing at a tool?

■ How do we most effectively deliver WIP to tools? Carts? Transfer operators? Do we use staging areas for WIP?

■ What dispatch rule is best for meeting delivery commitments?

■ How does the dispatch rule change for specialty tools? For instance, how should

Example of a Line in which WIP is NOT Balanced by Segment
Fab20 WIP by Segment stacked by Route, at 4/18/2009 10:00
659 Lots, 15,621 Wafers
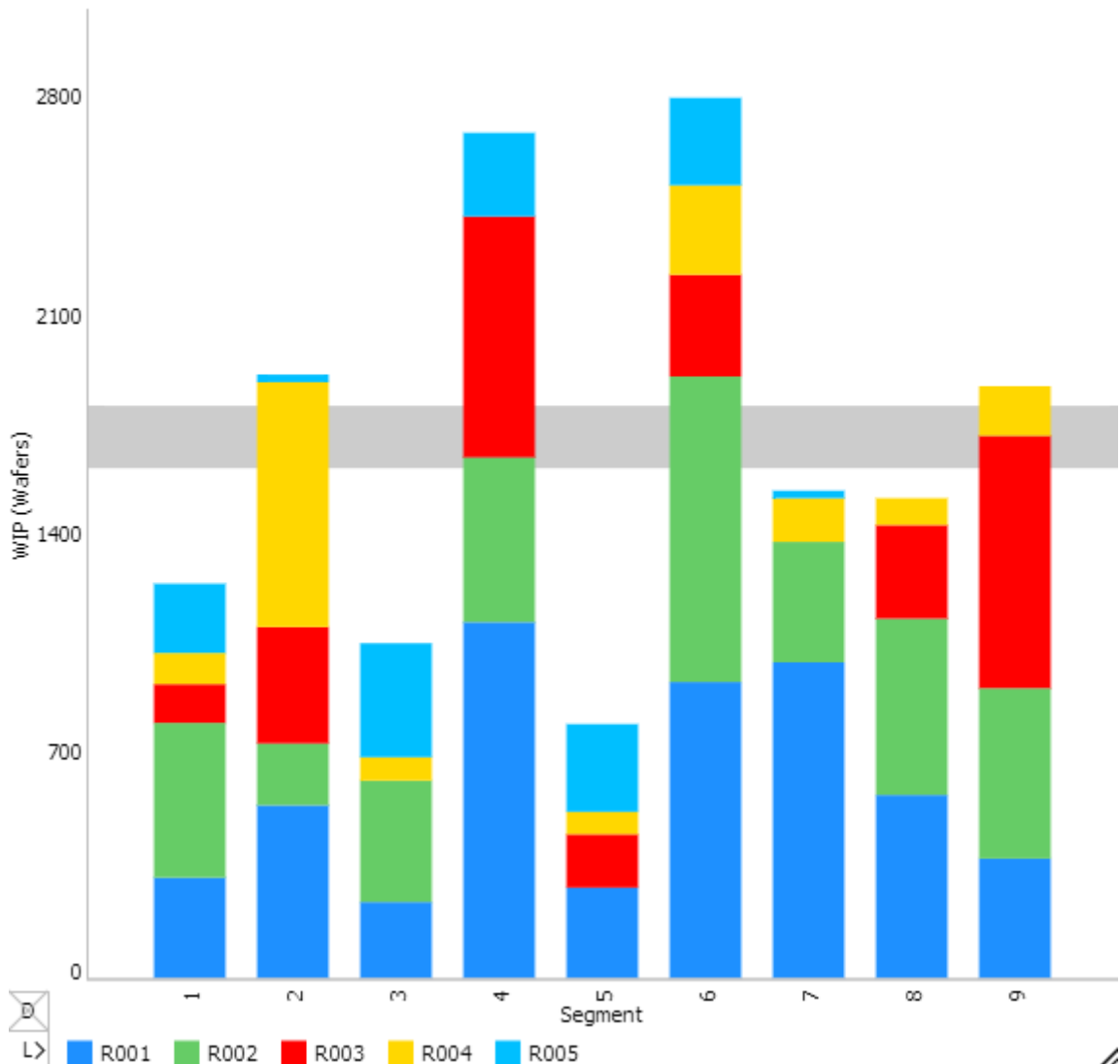
we load our batch tools? How do we minimize setups while still ensuring the low-volume recipes get processed?

Operations

■ What metrics should we be using to ensure that our fab is productive and meeting higher-level goals? What values should we be targeting for those metrics?

■ Where is WIP piling up in the fab right now?

■ What tools are performing poorly? Why are they performing poorly? Availability? Lack of operators? Rate losses?

■ How can we accurately measure the performance of cluster/cascading/linked tools?

■ How are my most capacity constrained tools performing (bottlenecks)?

■ What impact will a down tool (or chamber) have downstream? How do I minimize impact?

■ What lots are in danger of missing their delivery commitments? Which will likely be shipping this week?

■ How should I set up my tools for what's coming next?

■ And lots more...

Conclusions and Cause for Optimism

The lists above represent a mere subset of the issues that fabs face on a day-to-day and week-to-week basis. Some of these issues are well managed in most fabs, while others remain more challenging. Institutions like the FOA, SEMI and SEMATECH, businesses like FabTime, and individuals at semiconductor companies and universities, work to develop solutions. Many of the solutions to productivity improvement problems are shared publicly. The situation improves every day (even if it doesn't always feel like it).

For example, the OEE metric has greatly enhanced the ability for fabs to understand the root causes of tool performance problems, but still remains more difficult to capture for cluster tools. A number of people are currently working on dispatch rules to improve line balance in the fab, following years of more focused dispatch research in the areas of batch tools and setup avoidance.

Since we started FabTime fifteen years ago we've seen fabs shift to a greater focus on monitoring WIP turns, instead of just looking at moves. We've seen fabs become more granular in how they track WIP movement as well as tool performance. We've seen a wider understanding of the performance hit that can arise from having too many hot lots in the fab at once.

Certainly, some structural challenges have increased along the way (greater downward pressure on cycle time and time to market, and an increasing proliferation of products, for example). But it still seems to us that the base level of understanding of manufacturing methods in fabs has improved significantly over the years. We would like to think that through our newsletter and cycle time courses that we have played a small part in this development.

And Now, Some Questions for Readers

What do you think? Are the above-listed problems solved? What important questions are we missing? And more to the point, where do you think we should be focusing our efforts here at FabTime to help you all make fabs more productive? We welcome your feedback, and hope with this short article to launch discussion.

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FabTime® Cycle Time Management Software

"Instead of spending time preparing reports, shift facilitators can get the data they need quickly from FabTime, and then spend their time making real improvements."
Mike Hillis
Cycle Time and Line Yield
Improvement Manager
Spansion Fab 25

FabTime Subscription

One low monthly price includes
- Software installation and real-time connect to your MES
- End user and system administrator training
- Unlimited users via your Intranet.
- Software maintenance and regular upgrades (via our no-downtime patch system)
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Interested?

Contact FabTime for technical details and/or a web-based demonstration.

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Turn fab MES data into information and save time and money

- Are your supervisors swamped with daily reports, but lacking real-time information?
- Is it difficult to link equipment performance to cycle time?
- Does each new cycle time analysis require IT resources?

FabTime can help. FabTime saves your management team time daily by turning fab MES data into information, via a real-time web-based dashboard that includes lot dispatching. FabTime saves your IT staff time by breaking the cycle of custom-developed reports. With FabTime, the end user can filter for exactly what he or she needs, while staying in a comprehensive framework of pre-defined charts. Most importantly, FabTime can help your company to increase revenue by reducing cycle times up to 20%.

"I use FabTime every day, and so do the supervisors who report to me. The data that I need is right on my home page where I need it when I come in every morning."
Jim Wright
Production Manager
Headway Technologies
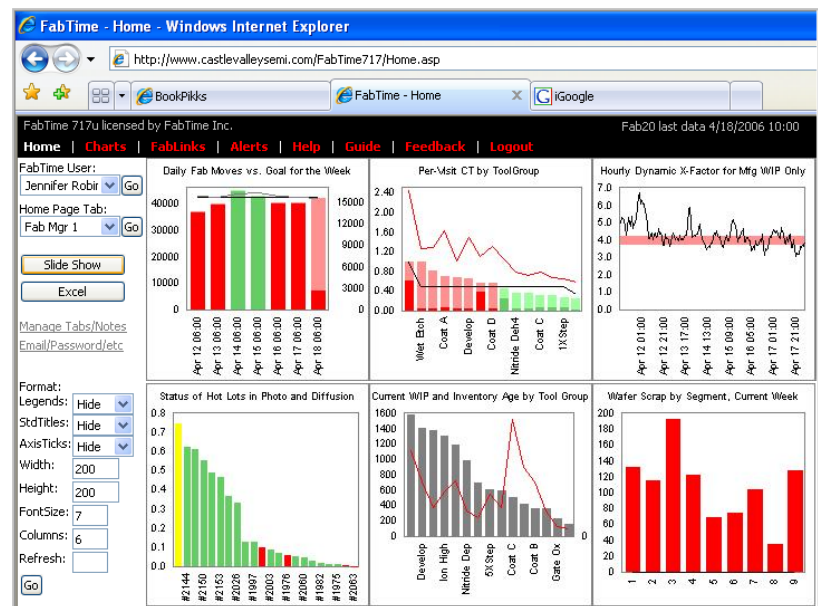
FabTime Benefits

- Cut cycle times by up to by 20%.
- Focus improvement efforts on the tools that inflate cycle time.
- Improve supervisor productivity – cut reporting time by 50%.
- Improve IT productivity – eliminate need for custom reports.