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 software this month include dynamic auto-complete drop-down lists for all filters and Shipped lot DPML trend/pareto charts.

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Welcome

Welcome to Volume 14, Number 4 of the FabTime Cycle Time Management Newsletter! We hope that, for those of you in the northern hemisphere, you are having a good summer. In this issue we have two FabTime announcements, one about a new software release, and one about the status of our user group meeting plans. Our FabTime user tip of the month is about using a new filter auto-complete functionality. Our subscriber discussion forum has a response to recent articles about reentrant flow, as well as a newly introduced question about making decisions when key staff members are not available.

In our main article this month, we share the results of the informal survey of cycle time-related issues that we have been conducting for the past 10 years. Specifically, we list the top 30 issues cited by people filling out forms on our website, in response to open-ended questions. In part because the top items on this list have not changed much over the years, we feel that this list suggests improvement opportunities to a number of fab stakeholders. We welcome your feedback.

Thanks for reading – Jennifer

Community News/Announcements

FabTime Releases Core Patch 104

FabTime is pleased to announce the release of Core Patch 104 of our software. This patch is now available to all FabTime customers on active subscription or maintenance contract. Highlights of the new release include:
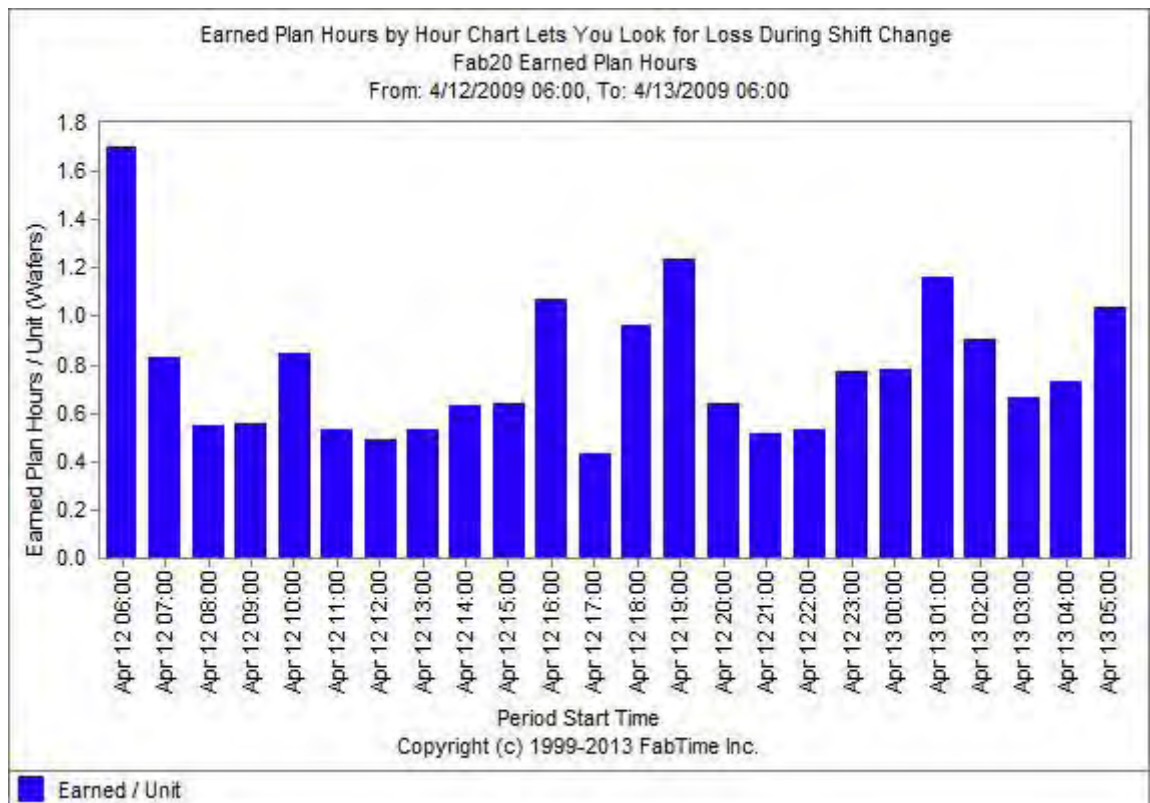
■ Dynamic auto-complete drop-down lists for all filters – search is based on object names or object descriptions (when available).

■ Client-side support for data table sorting and searching on "view data" page.

■ Earned plan hours trend/pareto charts, to look for shift-change productivity losses. (See example below.)

■ Tool count trend and pareto charts, for example to track the number of down tools at the beginning of each shift.

■ Shipped lot DPML trend/pareto charts.

■ New WIP State Pareto chart.

FabTime User Group Meeting Shaping Up

Progress continues on planning for FabTime's first-ever User Group Meeting, to be held September 18th and 19th at Atmel's site in Colorado Springs, CO (and with many thanks to Atmel). Customers at FabTime software sites can sign up here: http://www.fabtime.com/usergroupmeeting.shtml.

We put this event together in response to suggestions from our customers, and we hope that many of you can take time out to join us for this opportunity to:

■ learn about how other fabs are using FabTime to improve their operations;

■ understand and take maximum advantage of new software features;

■ review and comment upon FabTime's roadmap; and

■ network with FabTime staff and colleagues from other customer sites.

Earned Plan Hours by Hour Chart Lets You Look for Loss During Shift Change
Fab20 Earned Plan Hours
From: 4/12/2009 06:00, To: 4/13/2009 06:00

We have accepted proposals from our customer sites to make presentations on Goal Automation, Using Plan Earn Hours Charts for Shift Change Tool Utilization, and Managing Tools belonging to Multiple Areas. If any other customer sites would like to present a specific FabTime implementation topic, we will make room on the agenda. This meeting is about FabTime users for FabTime users! We're also pleased to announce a special Dispatch Game, hosted by Mike Hillis. All

in all, the meeting promises to be both useful and entertaining.

We regret that people who do not work at FabTime software customer sites will not be able to attend the User Group Meeting at this time. But we hope that you'll become customers in the future!

FabTime welcomes the opportunity to publish community announcements. Send them to newsletter@FabTime.com.

FabTime User Tip of the Month

Use New Auto-Complete Function to Edit Filter Entries

Patch 104 (now available) includes a feature that we expect to be of interest to many FabTime users. As you know, most of the filters available on the FabTime charts do not have associated drop-down lists. This is because the inclusion of long drop-down lists of items could slow down page loading. Also, we have always considered it important to maintain the flexibility of entering comma separated lists and using wildcards in your filters (something that you couldn't do if simply selecting a single value from a drop-down list). However, the absence of drop-down lists has meant that you needed to click on a link to view eligible data for each field.

FabTime has now solved this difficulty by adding an auto-complete function for filter entries. Here's how it works:

1. Tap the space bar in any object filter (Area, Location, Operation, etc) to display a drop-down list of object names, sorted by name.

2. As you type into an object filter, FabTime will dynamically update the auto-complete drop-down list to match what you have typed so far.

3. Use your mouse or down arrow to highlight the value of interest, and then hit the enter key. FabTime will populate the filter with that value. You can then edit it if needed (e.g. to add a wildcard) or type a comma to add another value.

4. Hit enter, or press the "Go" button at the bottom of the list of filters, and FabTime will update the chart with your selections.

Here are a few other notes about using the auto-complete functionality

■ The auto-complete functions for multiple entries in a comma-separated list, e.g. if you type "Photo,St" in the area filter, the auto-complete will display area names that match the last entry in the filter, e.g. all areas that contain "St", and display your new selection along with "Photo".

■ The auto-complete drop-down list displays the object name and (if known by FabTime) the object description. The description will not be listed in the filter unless it is part of the object name - it is shown for your convenience.

■ The auto-complete drop-down displays up to 20 entries. This limit is controlled by the site configurable parameter

tblSystem.AutoCompleteMaxResults. Please contact your site's system administrator if you think this needs to be changed for your site.

■ If the objects in FabTime contain descriptions, the search is performed against both object names and object descriptions. E.g. if operation 1000 is Photo1 and operation 2000 is Photo2, then typing "photo" in the operation filter will display the following auto-complete list: "1000 - Photo1" and "2000 - Photo2".

We hope that you find the filter auto-complete functionality useful. If you have any questions about this feature, or any questions about the software, just use the Feedback form inside FabTime. Subscribe to the separate Tip of the Month email list (with additional discussion for customers only) here. Thanks!

Subscriber Discussion Forum

Decisions When Key Staff Are Not Available

An anonymous subscriber wrote: "Working in a foundry company with very high variability I always love to read the FabTime newsletter. Improving cycle time is of course a major issue in daily work. But very often we face the problem that a wafer lot needs a decision of a responsible person, e.g. an engineer. When this happens on the weekend the lot has to wait until Monday, i.e. two days are gone. I am interested in how other companies handle this problem. Do any other subscribers have input on this topic?"

FabTime Response: We discussed this topic a little bit in Issue 6.06, Cycle Time and Holds (in the context of the "future hold"). But we are interested to hear how people handle this issue on a regular basis.

Reentrant Flow

Tash Anestos from Micron Technology, Inc. submitted this in response to Issue 13.04. "The article was very good. It's an interesting perspective to say that reentrant capacity is impacted by line variability more than single-step capacity. There are some who suggest the opposite due to a reentrant workstation's ability to process "other" work when one step is temporarily choked elsewhere in the line. Likewise, a reentrant workstation can prioritize spikes in the line over holes as a form of inherent smoothing capability. I'm not suggesting one thought process is right over the other, but I am interested in learning more and seeing some simulations if you decide to exemplify it with your software.

FabTime Response: There are certainly benefits to having reentrant flow, such as the ability to have larger tool groups (vs. pulling apart the line, and having separate toolgroups for each visit). And, as you say, the ability to keep tools busy even when one operation is starved. It wouldn't be cost-effective to run most wafer fabs in a non-reentrant setup (you'd either need very short flows or a VERY large fab to make that work). But we still believe that reentrant lines cause, and are impacted by, variability in many ways. It would be nice to have some simulation to look at this… This is something that we'll have to work on for the future.

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

Factors Contributing to High Cycle Times in Fabs

Introduction

For the past 10 years, FabTime has been surveying people, albeit informally, about the issues in wafer fabs that cause high cycle time. Whenever someone subscribes to this newsletter, we ask:

- What is the biggest cycle time problem in you fab?

Similarly, whenever someone requests information about our software we ask:

- What is the biggest hurdle to cycle time reduction in your fab?

We also raise these questions whenever we do a cycle time class at a customer site, though we don't necessarily collect those responses. But we do have a spreadsheet containing all 775 responses received on our website to date. These questions are not required, and not everyone answers them, but we very much appreciate it when people do.

We revisited this list recently, and compiled those responses, looking for patterns in what people have reported as important cycle time drivers in their factories. This is not a scientific survey. We asked open-ended questions, and some judgment was required in how to aggregate the responses. Some people listed two or three things, and we broke those out as separate responses. There were a few responses that we didn't understand, and we didn't include those. But we think that the overall result contains some useful information for people who work in, and people who support, wafer fabs.

The Top 30

The top 30 contributors to fab cycle time, in descending order of number of responses (shown in parentheses), as reported by people filling out forms on our website, are shown on the next page.

Clearly, a couple of these are really non-responses, including #10: Queue time / cycle time/ turns (sort of answering the question with the question). In item #26, a few people actually said that they didn't have any cycle time problems, or considered it too soon to tell for their fab or job. We do wonder if we asked those people the same question today if they would have the same response.

But there is certainly some consistency in the responses, particularly at the top of the list. The number one response (and this has been true since we started this survey), is equipment downtime, specifically the variability caused by downtime. High equipment utilization, product mix, other sources of variability, and one of a kind tools round out the top five. This makes sense, considering that the three fundamental drivers of cycle time at the tool level are utilization, variability, and number of tools in the tool group. Downtime is most likely in the top five because of its impact on both variability and utilization, as is product mix.

These five issues all tend to be intrinsic to fabs. That is, management can try to improve them, and work around them, but (with the exception of some forms of variability) they are largely driven by top-level management decisions and market realities (How heavily are your tools loaded? What product mix do you need to stay competitive? How reliable are the new tools that you purchased?).

After the top five, we get into a mix of structural issues, like batching, and issues that are more directly controllable by fab management, like how you manage your WIP. Several of these listed issues offer opportunities for companies like FabTime who work with fabs from the software side. Dispatching systems, real-time data, line balance algorithms, metrics and goals,

Top 30 Factors Contributing to Wafer Fab Cycle Time (per FabTime survey)

1. Downtime / availability, including availability variability (126)
2. Bottlenecks / utilization / capacity (79)
3. Product mix (61)
4. Other variability (not including availability variability) (54)
5. One of a kind tools (51)
6. WIP management (including dispatching and scheduling) (46)
7. Identifying problem operations/tools/variability sources (real-time data), and focusing improvement efforts (31)
8. Running development or low volume lots in a production fab (31)
9. Prioritizing lots / hot lots (24)
10. Queue time / cycle time / WIP turns (24)
11. Non-linear WIP / WIP balance (22)
12. Holds (21)
13. Metrics / goals (selecting the right ones) (21)
14. Furnace / diffusion / batching (17)
15. Photo / metrology (15)
16. Non-linear loadings from customer or fab (12)
17. Material handling / transport (11)
18. Operators (including shift change) (11)
19. Yield / yield improvement activities (11)
20. Starts / lot release (10)
21. Other process areas (9)
22. Assembly and test (8)
23. Management (e.g. my boss, our workforce structure) (8)
24. Planning (variation and lack of tools) (7)
25. Engineering time (6)
26. No problems or too soon to tell for this fab (6)
27. Manufacturing compliance (meeting goals, due dates) (4)
28. Lot size (3)
29. Raw material problems (3)
30. Software problems / MES (3)

and planning tools are all in our sphere. (Of course there's a bit of selection bias going on, too - the people answering these questions are already at FabTime's website, so they may tend to have more interest in these topics).

How Has This List Changed Over the Years?

The only change to the ordering of the Top 10 list above since 2007 was a flipping of entries 9 and 10 (which are now tied). To us, this suggests that the basic issues confronting fab managers have not changed very much. Earlier versions of this list had Product Mix showing up a bit lower down, below One Of A Kind tools, but that's the only significant change that we've noticed to the top entries on the list. The only new topics that we see on the Top 30 list, with any significant number of responses, are Planning (variation and lack of tools) and Manufacturing Compliance (meeting due dates, goals, etc.). This may reflect increased focus in these areas, or it may just be an artifact of how we chose to aggregate the data.

The bottom line is that although we've added more responses, the substance of this list hasn't changed very much over the years. Downtime, utilization, product mix, variability, one of a kind tools, and WIP management are the top six issues. People in fabs around the world, large and small, struggle with most of these issues (even larger fabs may have issues with one of a kind operations).

What's Not on the Top 30 List?

We also found it interesting to note several items that do not show up in the top 30 (though they each did receive one or two responses):

- Reentrant Flow
- Setups
- Time Constraints between Process Steps

We mention these three topics because they have all been the source of considerable academic research. We've highlighted them (particularly reentrant flow) in past newsletters. We are enhancing our capability for handling time constraints between process steps in our dispatch module right now. And yet ... these are not the things that people running fabs tend to bring up. Perhaps these are viewed as intrinsic issues that can't be helped, although several others on the list would also fall into that category. Or perhaps these just aren't viewed as major problems. You may draw your own conclusions on that.

Conclusions

What this list suggests is that if one really wants to help people who run fabs, whether as senior management of said fabs, or as a researcher, or as a supplier, what people are really struggling with is:

- Downtime variability
- High equipment utilization
- Product mix

- Variability
- One of a kind tools
- Dispatching (particularly to make WIP more balanced)
- Identifying problems in real time
- Running development lots in a production fab
- Managing hot lots
- etc.

Equipment vendors may want to note that just under one in six responses to this survey involved equipment downtime. People in fabs are struggling every day to cope with the variability caused by availability variability. Researchers may want to note that fabs seem to be expressing a need to balance their WIP, while also managing development lots and hot lots. Here at FabTime, we're going to continue our efforts to educate people on methods to reduce variability, and continue to help people get better access to data.

Closing Questions for Newsletter Subscribers

What are the top issues contributing to cycle time challenges in your fab? Do you think this list has the issues pretty well covered, or are there other things that you would add?

Subscriber List

Total number of subscribers: 2781, from 437 companies and universities.

Top 20 subscribing companies:
- Intel Corporation (148)
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- International Rectifier (121)
- Micron Technology, Inc. (117)
- Texas Instruments (77)
- Carsem M Sdn Bhd (76)
- GLOBALFOUNDRIES (71)
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- Skyworks Solutions, Inc. (47)
- Seagate Technology (39)
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- Arizona State University (8)
- Nanyang Technological University (8)
- Virginia Tech (7)

New companies and universities this month:
- Celerant Consulting

Sampler Set of Other Subscribing Companies and Universities:
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- DMEA (14)
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- Middlesex General Industries, Inc. (1)
- Nanya Technology Corporation (4)
- Novellus (2)
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- Philips (4)
- Silanna Semiconductor (4)
- ST Assembly Test Services (1)
- Superconductor Technologies, Inc. (1)
- Tsinghua University (1)
- United Monolithic Semiconductors (2)
- Valience (1)
- Wacker Siltronic (4)
- Win Semiconductor (1)
- Zetex Semiconductors (1)

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® Software for Assembly and Test

"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

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One low monthly price includes
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- End user and system administrator training
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- Software maintenance and regular upgrades (approx. 4 per year, via our no-downtime patch system)
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FabTime's Web-Based Dashboard is Fully Applicable for Assembly & Test Facilities

- Do your customers (internal or external) want more visibility into your factory?
- Is it difficult to look at trends in equipment performance, or tie equipment performance to throughput and cycle time?
- Does your factory lack real-time reporting?

FabTime can help. FabTime saves your management team time daily by turning 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. Most importantly, FabTime can help your company to increase revenue by reducing cycle times up to 20% for regular lots, and even more for high-priority lots.

Although FabTime was originally designed for front-end manufacturing, you can use FabTime for your assembly or test facility. You simply need to have a transaction-based manufacturing execution system. FabTime can link to all commercial systems commonly used in the industry (e.g. WorkStream, Promis, Eyelit, Mesa, FactoryWorks) or can link to internally developed systems. FabTime can pull data from multiple databases if needed (e.g. WIP transactions from the MES, tool transactions from another system). FabTime is currently being implemented in two assembly and test facilities, with no major technical hurdles.

FabTime Applicability for Back-End Factories

- FabTime handles lot merging and splitting, with full tracking of overall cycle times.
- All chart quantities (moves, WIP, etc.) can be displayed as die, with data tables formatted for readability of large quantity values.
- Custom assembly and test parameters (applicable to WIP or tool state transactions) can be mapped.
- Specific reports for wire bond area are in process (die and component placements, etc.).
- Custom dispatch factors allow for incorporation of back-end-specific data used in dispatch decisions (e.g. availability of boards, and minimization of sequence-dependent setups).