FabTime Cycle Time Management Newsletter

Volume 14, No. 6 November/December 2013

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 shipped lot days per mask layer (DPML) trend and Pareto charts and the ability to link directly to external web reports via a custom chart data table link..

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- Keywords: Industry Cycles, Reporting, Operators
- Current Subscribers

Welcome

Welcome to Volume 14, Number 6 of the FabTime Cycle Time Management Newsletter! We hope that the approaching end of 2013 finds you all well. In this issue we have a brief recap of our user group meeting, as well as an announcement about a new LinkedIn group that we've started for our software customers. Our software tip of the month is actually a list of 10 useful things that you can do with FabTime. In our subscriber discussion forum we have one response to an ongoing discussion of factors contributing to high cycle times in fabs.

Our main article this month is a bit of a change from our usual topics. FabTime's Frank Chance has taken his introductory remarks from our User Group Meeting and turned them into an article. Frank reflects on his 30 years working in the high-tech industry, particularly the breathtaking pace of performance improvement in data storage. He compares this rate of innovation to the automobile industry, and also discusses some of the new applications that are enabled through access to inexpensive data storage. We hope that you'll find this perspective interesting.

Wishing you a joyful holiday season, and a productive 2014! – Jennifer and Frank

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Community News/Announcements

FabTime User Group Meeting

FabTime's first User Group Meeting was held on September 18th and 19th, at Atmel's facility in Colorado Springs, and was a success. Approximately 30 people, representing 11 FabTime sites, participated in the meeting. The meeting was relatively small. This allowed for plenty of person-to-person connection, and direct interaction with FabTime staff. Rather than having everyone sit through presentations all day, we spent more than 2 hours of the first day working on an interactive WIP Management Challenge. This gave people a chance for hands-on learning in dispatching and WIP management, as well as allowing for networking. We also gained valuable feedback from participants on our FabTime roadmap, and enjoyed several useful customer presentations.

We would like to thank Atmel Corporation for graciously hosting this event, and for helping to keep everything running smoothly.

We would also like to thank our presenters:

- **Mike Hillis** for designing a meaningful WIP Management Challenge; and
- **Marsel Nuko** from Skyworks, **Craig Mattson** from Polar Semiconductor and **Scott Frame** from Cypress Semiconductor for providing valuable solutions showing how their fabs use FabTime to tackle specific issues.

Many thanks to everyone who took time out of busy schedules to attend the first FabTime User Group Meeting. It was great spending time with you!

New LinkedIn Group for FabTime Software Users. One for Newsletter Subscribers?

One of the suggestions that came out of our FabTime User Group Meeting was that we start a LinkedIn Group for FabTime software customers, so that people can network as well as compare best practices in using FabTime. This is a private group. If you work at a FabTime customer site, and are interested in joining this group, you can request to join "FabTime Software User Group" or connect with Jennifer Robinson on LinkedIn and request an invitation to the group.

For those of you who are not necessarily users of our software, do you think that there would be benefit in starting a FabTime Newsletter Group on LinkedIn? Such a group would allow for much more rapid feedback on your subscriber discussion questions (though any feedback would be open to the rest of the group). You could also suggest topics for newsletter articles, and things like that. Our thought is that this group would only be open to people who actually subscribe to the newsletter. If anyone has thoughts on this, please email Jennifer.Robinson@FabTime.com (or message me on LinkedIn) about it.

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

FabTime User Tip of the Month

10 Useful Things You Can Do with FabTime

In discussing FabTime software training with a customer recently, FabTime's **Sean O'Brien** suggested that we come up with a list of 10 Useful Things You Can Do with FabTime. (Well, the original idea was for a list of The Top 10 Useful Things, but this seemed impossible to quantify). Jennifer spent some time thinking about this, and came up with the following list.

This is not a list of features. These are tasks that could be helpful to anyone in improving fab productivity, and which FabTime's software facilitates.

1. Monitor a list of down tools (including how long they've been down, and why they are down). [Tool WIP and State List, with "UNSCH" in "E10St:" filter]

2. Alert someone when a key tool is available, has WIP waiting, and is not running. (Alert someone else when more time passes.) [Tool Alert for "Standby-WIP-Wait"]

3. Share a set of key performance metrics (including performance to site-defined goals) on overhead monitors throughout the site, updating in real time. [Slide Show]

4. Predict which lots will be shipping this week (or which lots will reach a certain operation), and view their expected on-time performance. [Forecast Outs Lot List, Forecast Arrivals Lot List]

5. Get early warning of fab-wide cycle time issues via dynamic x-factor and WIP turns. [Upward trend in fab-wide Dynamic X-Factor Trend chart, downward trend in Turns Trend chart]

6. Monitor the list of hot lots, and how long each has been waiting (and receive an email alert when any wait too long). Also monitor inactive lots, lots on hold, rework lots, etc. [WIP Lot List chart, with "Prio:" filter]

7. Dig into downtime by sub-state for key tools to identify improvement opportunities (e.g. time waiting for parts).[Tool Hours Pareto, filtered for key tools, filtered for "E10St: UNSCH", sliced by "SbSt::]

8. Do "what-if" analysis on expected shipment date after making a lot hot (decreasing x-factor for future steps). [Lot Progress Chart, enter target in "Xfctr:" filter]

9. Learn which toolgroups contribute the most to lot cycle time, and analyze why (variability, utilization, qualification?) [Operation Cycle Time Pareto or Factory Cycle Time Contribution Pareto, sliced by ToolGroup]

10. Use dispatching to balance your WIP or achieve moves goals. [Requires dispatch module]

If you have questions about any of these "useful things", or are interested in a PowerPoint version of the list to share internally, 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

Issue 14.04: Factors Contributing to High Cycle Times in Fabs

Bob Kotcher from Simitar Consulting wrote: "I agree with John Matthews (who wrote in Issue 14.05 about the cost/benefit analysis of adding technicians vs. operators, and the impact on cycle time). Everybody knows that capital-equipment costs are the biggest contributor to wafer production costs. So fabs tend to pay only modest attention to operator or technician staffing levels. But staffing levels do play a key role in how productive those multi-million-dollar tools are, and therefore how many the fab needs to buy.

Interestingly, whereas my study that you cited (R. C. Kotcher, "How "Overstaffing" at Bottleneck Machines Can Unleash Extra Capacity," *Proceedings of the 2001 Winter Simulation Conference*, Washington, D.C., 1163-1169, 2001) found that it was profitable to hire quite a few more operators than the company was using, another study I conducted recently on maintenance technicians found the opposite. It was a study of maintenance-technician staffing levels in an epi area of a fab. I found that, in this case, reducing the staffing level of maintenance technicians would actually increase profitability. A key difference with the earlier operator study was that these tools cost only around $400,000—much cheaper than the Nikon steppers of my earlier study. Your readers may read the case study here.

I guess the lesson is that using the proper level of operators and technicians is (1) important to fab profitability and (2) difficult to ascertain without a tool such as simulation modeling.

In a related note, a friend of mine who works for a major chip maker said that she'll spend two months building a detailed simulation model of a single complex tool. This costs perhaps $25,000 of engineering time. But the company's thinking is that if her model can squeeze out just 3% higher throughput, that means that they only need to buy 32 of those $3 million tools—not 33—so they're spending $25,000 to save $3 million. Whenever you have high variability and high equipment costs, detailed analysis becomes very highly profitable."

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

Why I'm Still in the Industry after 30+ Years

By Frank Chance

This article is based on the introductory talk that FabTime co-founder Frank Chance gave at our User Group Meeting in September. Frank looks back over 30+ years working with computers, and the breathtaking pace of technological development in the semiconductor industry in that time.

1981

In January 1981 my parents bought me my first computer. I have the receipt framed on my office wall. It was a "Black Apple" II Plus from Bell & Howell with one floppy disk drive (48K RAM!). I was a freshman in high school. Except for a TRS-80 at our high school, it was likely the first computer in our town (Wathena, Kansas – population 1,200). In such a small town, word gets around quickly, so when local businesses started buying computers and needing help with them, they would call my parents, and I would go help. That's how I got my first computer job – bookkeeping (in Visicalc) and writing an inventory system (in Basic) for a local apple orchard. Within a few years the local grain elevator had a brand new IBM PC and it had a wonderful device, the Davong Hard Disk (You can see a picture of this disk online at the DigiBarn computer museum website).

With the hard disk, we could really get to work – I debugged the accounting and inventory system they had purchased, and eventually wrote them a new system in dBASE II. But it was the Davong that made everything possible.

1984

The Davong at the grain company was 5MB, and although I'm not sure how much it cost new, I found this advertisement from 1984 for a 10 megabyte Davong:

So we have:

1984: $2,000 for 10 megabyte hard disk = $200,000 per gigabyte.

Also in 1984, I graduated high school and went off to college. My parents helped me buy my first car, a sporty (to me) 1980 Toyota Celica. Brand new, the 1980 Celica was $9,000. In 1984, we paid $3,500. In terms of raw horsepower at the original purchase price:

1980 Celica: 107 horsepower for $9,000 = $84 per horsepower.

I think it's useful to compare the arc of these two different products (The Hard Disk and the Celica) across the years. Let's fast forward 10 years.

1994

In 1994, I finished my PhD in Operations Research at Cornell. Before leaving Ithaca, I deposited my beloved Celica (200,000+ miles) at the Ithaca junkyard and collected a check for $125:

I headed west, to the Berkeley Industrial Engineering and Operations Research (IEOR) department for a year as a visiting professor. One of my jobs at Berkeley IEOR was to fix their backups – they didn't have reliable backups, which meant that every once in a while there would be a catastrophic failure, and professors would be in danger of losing months' or years'

worth of work. I did some research and spent a stunning amount ($2,000) for a new 2 gigabyte drive for online backups. Remember, this was an academic department in the early 90s in California… times were tough, so $2,000 was a lot of money. Adding 1994 to our performance summary table:

1980: 107 horsepower Celica for $9,000 = $84 per horsepower.

1984: $2,000 for 10 megabyte hard disk = $200,000 per gigabyte.

1994: $2,000 for 2 gigabyte hard disk = $1,000 per gigabyte (200 times cheaper than 1984)

At the time, I thought it was amazing that I could get 2 gigabytes of storage for only $2,000! But that was nothing – let's fast forward another 19 years:

2013

In 2013, I can buy a 4 terabyte (terabyte!) hard drive from NewEgg for $309. So now we have:

1980: 107 horsepower Celica for $9,000 = $84 per horsepower.

1984: $2,000 for 10 megabyte hard disk = $200,000 per gigabyte.

1994: $2,000 for 2 gigabyte hard disk = $1,000 per gigabyte (200 times cheaper than 1984)

2013: $309 for 4,000 gigabyte hard disk = $0.077 per gigabyte (13,000 times cheaper than 1994, and 2,600,000 times cheaper than 1984)

When I describe these changes to people outside our industry, they have a tough time wrapping their heads around this rate of change. What other industry offers products that are 6 orders of magnitude cheaper than they were 30 years ago?

Certainly not automobiles… the Celica has been retired, but its offspring is the Toyota GT86 (200 horsepower, estimated retail price $24,930).

1980: 107 horsepower Celica for $9,000 = $84 per horsepower.

1984: $2,000 for 10 megabyte hard disk = $200,000 per gigabyte.

1994: $2,000 for 2 gigabyte hard disk = $1,000 per gigabyte (200 times cheaper than 1984)

2013: $309 for 4,000 gigabyte hard disk = $0.077 per gigabyte (13,000 times cheaper than 1994, and 2,600,000 times cheaper than 1984)

2013: 200 horsepower GT86 for $24,930 = $125 per horsepower (1.5 times more expensive than 1980)

I know a comparison like this is patently unfair to automobiles… so many other things have improved in cars (safety, fuel efficiency, pollution control, etc) and I am ignoring all those factors here. But the basic performance comparison is stark:

Hard Disk $/GB (1984 → 2013)
1+ million times cheaper

Celica $/HP (1980 → 2013)
1.5 times more expensive

Are the cars that we drive today a million times "better", in any sense of the word, than the ones we purchased in 1980? By pretty much any metric, I'd have to say no.

Which industry would I rather work in? I think the answer is obvious.

Abundant Storage is an Enabling Technology

What happens when storage is cheap? You unleash a wave of innovative products that wouldn't otherwise be economically viable.

For example, a company in San Diego sells a genome sequencing machine that when run at full volume can do a sequencing for about $100. (Image below from the Life Technologies website.)

Here's the description of The Ion Personal Genome Machine® (PGM™) System (Ion Torrent™) from the company's website.

"The new Personal Genome Machine (PGM™) System combines semiconductor sequencing technology with natural biochemistry to directly translate chemical information into digital data, democratizing sequencing and making it accessible to virtually any lab or clinic. The system leverages the exponential improvements in the semiconductor industry (known as Moore's Law) to provide scalability and flexibility for various applications. The system's use of the simplest, natural sequencing chemistry eliminates the need for expensive optics and reduces complex chemistries to measure natural DNA extension. Direct, real time sequencing detection provides sequencing results typically in less than 3 hours."

The back-end server for this machine includes 16 **terabytes** of disk space (in "Eight 2 TB Hard drives in RAID5"). At current pricing, these 16 terabytes of disk space only cost $1,200. In 1994, it would have been **$16,000,000**, for the disk space alone.

If you can perform a genetic sequencing for $100, that opens another set of doors…

I was very interested in an August 13th Wall Street Journal article by **Ron Winslow** called: "Gene Breakthroughs Spark a Revolution in Cancer Treatment". This bit particularly stood out for me:

"Ms. Carey has one of at least 15 lung-cancer variations, almost all of which scientists didn't know existed 10 years ago. Researchers have identified those variations, most of them in just the past four years, by decoding DNA in tumors—akin to how crime labs analyze DNA to genetically fingerprint suspects."

Summarizing the article:

1) "Lung cancer" is not simply "lung cancer"… it's actually 75 (or more) different types of cancers, which just happen to end up in the lungs.

2) Now a cancer patient's tumor can be sequenced, and if it's one of the 15 known variants for which targeted drugs exist, they can attack it with this drug. This is much more effective than picking a chemo drug at random off the shelf and hoping that it is effective.

3) Drug companies know that if they target the other 60 variants of lung cancer and find a chemo drug that attacks it, they will have a ready market for this drug.

I have a personal interest in this fight, because lung cancer killed my father in 2004. He had a rare type of skin cancer that spread to his lymph nodes and then into his lungs. His doctors were good, but all they could offer was repeated rounds of radiation and (non-targeted) chemo as the cancer progressed. If he were going through treatment today, the story might end differently.

What Else?

Here are some other applications that are enabled by abundant storage (hard disk or flash memory):

1) Nike's iPhone running app – it keeps track of runs that I make, my pace, where I've been, and how frequently I've been running, which keeps me motivated.

2) Video on a cell phone – my son can watch his favorite show (MythBusters) on a long plane ride, which keeps him occupied and happy.

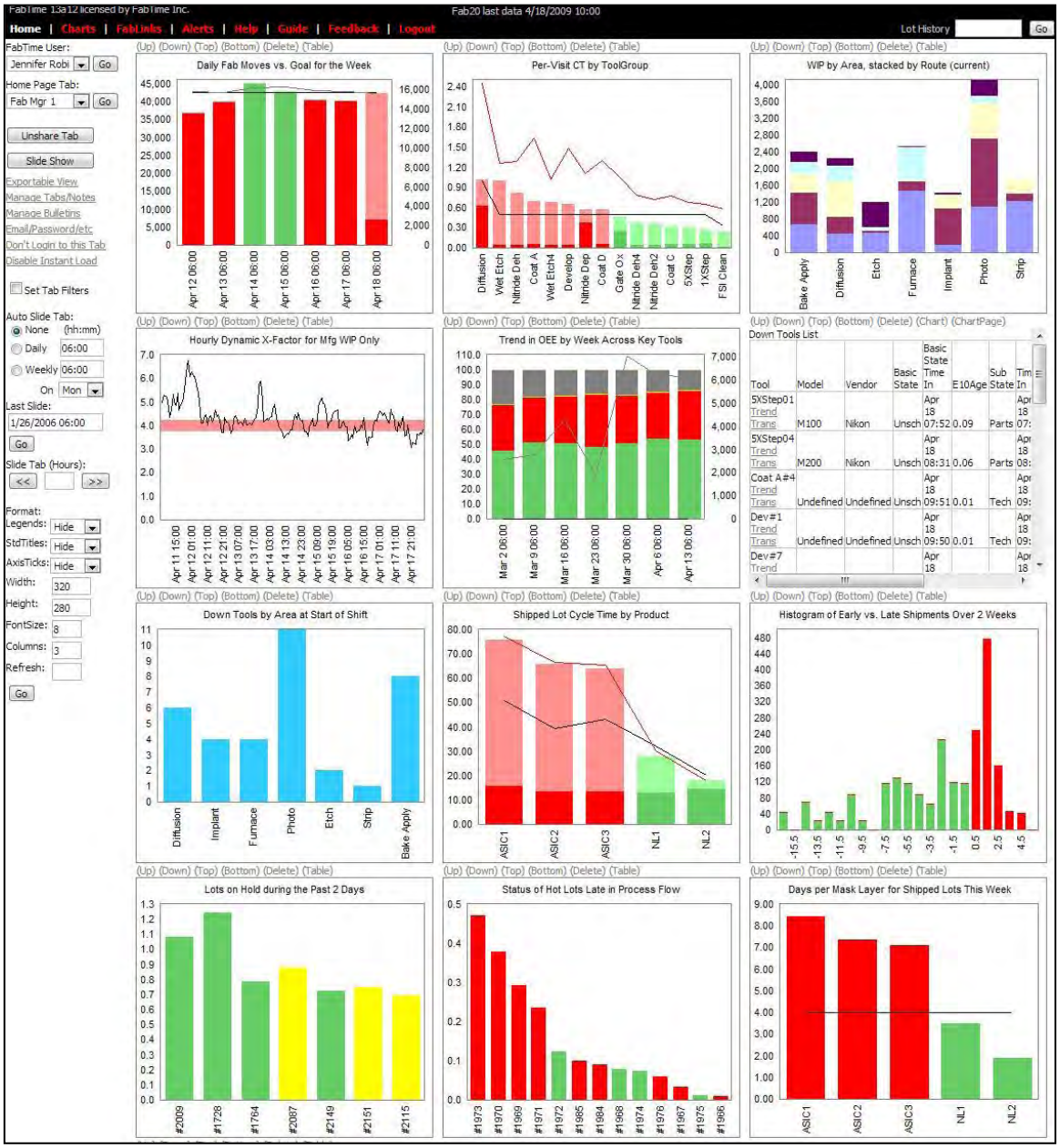
3) Birding – While visiting Costa Rica this summer, my mother could see pictures, notes, and listen to the call of every bird known in the region.

4) Languages – I'm learning Spanish with Duolingo… they get paid for translation services, and they use the people running the app to do the translations for them (with cross-checking).

5) And our favorite application that couldn't exist without abundant storage… FabTime! With FabTime, we put data into end-user's hands, enabling them to work faster and smarter. (Example below.)

2023

I can't even imagine what sorts of products and applications we'll have at our fingertips ten years from now. The pace of innovation in this industry over the past 30 years has been breathtaking… if we can keep that same pace going forward, we have exciting times ahead. And that is why I'm still here.



Subscriber List

Total number of subscribers: 2801 from 437 companies and universities.

Top 23 subscribing companies:

- Intel Corporation (149)
- Micron Technology, Inc. (141)
- Maxim Integrated Products, Inc. (134)
- International Rectifier (121)
- Fairchild Semiconductor (102)
- GLOBALFOUNDRIES (85)
- Carsem M Sdn Bhd (74)
- Texas Instruments (72)
- ON Semiconductor (71)
- X-FAB Inc. (63)
- Western Digital Corporation (56)
- STMicroelectronics (54)
- IBM (53)
- Analog Devices (52)
- Freescale Semiconductor (52)
- Infineon Technologies (50)
- Skyworks Solutions, Inc. (47)
- Seagate Technology (41)
- Cypress Semiconductor (33)
- ATMEL (30)
- Honeywell (30)
- NXP Semiconductors (30)
- Telefunken Semiconductors (30)

Top 4 subscribing universities:

- Ecole des Mines de Saint-Etienne (EMSE) (12)
- Arizona State University (8)
- Nanyang Technological University (7)
- Virginia Tech (7)

New companies and universities this month:

- Production Management Institute GmbH
- Cimetrix Inc.
- USound Technology GmbH
- Source Photonics
- St. Petersburg College
- Elmos Semiconductors AG

Sampler Set of Other Subscribing Companies and Universities:

- Bloom Energy (1)
- Continental Device India Ltd. (2)
- Draper Laboratory (3)
- Foothill Technology (1)
- Gadir Solar (1)
- HL Electronics & Engineering (1)
- Indian Institute of Science (2)
- MEMC (1)
- Mentor Graphics (1)
- Merck & Co., Inc. (2)
- Photonic Power Systems (1)
- Records RSA (1)
- Renesas Technology (4)
- SAIPA Corporation (1)
- San Francisco State University (1)
- Selantek (1)
- Semiconductor Equipment Corp. (1)
- Systems Implementation Services (1)
- Universite de Paris Sud (1)
- Westcode Semiconductor (2)

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.

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