FabTime Cycle Time Management Newsletter

Volume 19, No. 4 October 2018

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 addition of predicted moves to stacked charts and simplifying the creation of new home page tabs.

Editor: Jennifer Robinson

Keywords: Metrics and Goals; Variability; Batching

Table of Contents

Welcome

Welcome to Volume 19, No. 4 of FabTime's cycle time management newsletter. First, a quick announcement: Under the EU's General Data Protection Regulation (GDPR) FabTime is now required to obtain the Informed Consent of subscribers prior to sending them the newsletter. Informed Consent basically means that you agree to allow FabTime to use your personal information (e.g. name and email address) to send you this publication. Your continued reading of this newsletter issue constitutes your agreement to our Informed Consent document, which you can review in full here: http://www.fabtime.com/GDPR_policy.php. If you do NOT agree, please reply to this email stating your withholding of consent. We will then remove you from the subscriber list.

In this issue we have an announcement about a new FabTime webinar on OEE that we will be hosting in late October. (Sorry, the webinar is for software customers only.) Our FabTime software tip of the month is about identifying tools that have been defined as batch tools in FabTime and looking at their performance. In our main article, we explore possibilities for a new metric that captures variation from move goals (by fab, area, or tool group) over time. The idea behind the metric is to reduce variability by meeting moves goals more consistently from day to day.

Thanks for reading – Jennifer

FabTime

Tel: (408) 549-9932
Fax: (408) 549-9941
www.FabTime.com
Sales@FabTime.com

Community News/Announcements

Next FabTime Webinar Will Be Held October 23rd: Learn Overall Equipment Efficiency Concepts

For those FabTime users interested in learning more about Overall Equipment Efficiency concepts, FabTime's **Mike Krist** will be hosting a specialized webinar on this topic on October 23rd. The webinar is only for people who work at FabTime customer sites. Here are the goals for the webinar:

1. Understand **why** and **when** we should use Overall Equipment Efficiency (OEE).
2. Understand definitions – Availability Efficiency, Rate Efficiency, Rate loss, etc.
3. Compute OEE for simple examples with Excel.
4. Use FabTime OEE charts, and replicate the results in FabTime with Excel.
5. Investigate rate loss on FabTime OEE charts.
6. List the data sources necessary to compute OEE, and the challenges of OEE (including cluster tool OEE).

FabTime customers can register for the webinar here.

Previous webinars are also available:

- Introduction to Using FabTime (for new users)
- Tool State Analysis Using FabTime
- Testing and Taking Advantage of Patch108

Contact FabTime for links to archived versions of the previous webinars. (These links will be included in future software patches, available from the Help toolbar.)

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

Identify Batch Tools Defined in FabTime

We had a question recently from a customer about how to identify which tools in FabTime are defined as Batch Tools. The quickest way to do this is to use the View Data page for Tools. To access this page, go to any chart that has the Tool filter or go to the set of default filters on the left hand side of the Charts page. Click on the gray hyperlinked name of the filter labeled "Tool:."

This takes you to the Data List page for Tools. Look for the "Process Type" column in the main table (15 columns to the right) and select "Batch" from the drop-down list at the top. FabTime will then display a list of tools identified as Batch Tools. To see all of the Batch Tools, you may need to edit the Records fields at the top of the page. By default, FabTime shows only the tools with "Record ID" up to 100. You'll also be able to see other attributes of the Batch Tools, including the Tool Group and Area for the Tool and the dispatch rule defined for each Tool (if applicable).

Charts in FabTime specific to the performance of Batch Tools include:

- Batch Lot List (list of individual lots grouped by batch number for selected batch tools during a time period). An example of a Batch Lot List Chart is shown below in Figure 1.
- Batch List (list of the batches run on the selected batch tools during a time period)
- Batch %Full (Lots) Trend (batch %full (based on lots) trended by time)
- Batch %Full (Lots) Pareto (batch %full (based on lots) sliced by another attribute)
- Batch %Full (Wafers) Trend Trend (batch %full (based on wafers) trended by time)
- Batch %Full (Wafers) Pareto (batch %full (based on lots) sliced by another attribute)

Sites that have the Dispatch Module enabled can also view maximum batch sizes entered into FabTime by going to the View Dispatch Parameters page (from the Charts page, right-hand side) and selecting "MaxRunSizeLots" or "MaxRunSizeUnits" from the Parameter Type drop-down.

We hope you find this tip useful. Subscribe to the separate Tip of the Month email list (with additional discussion for customers only). Thanks!

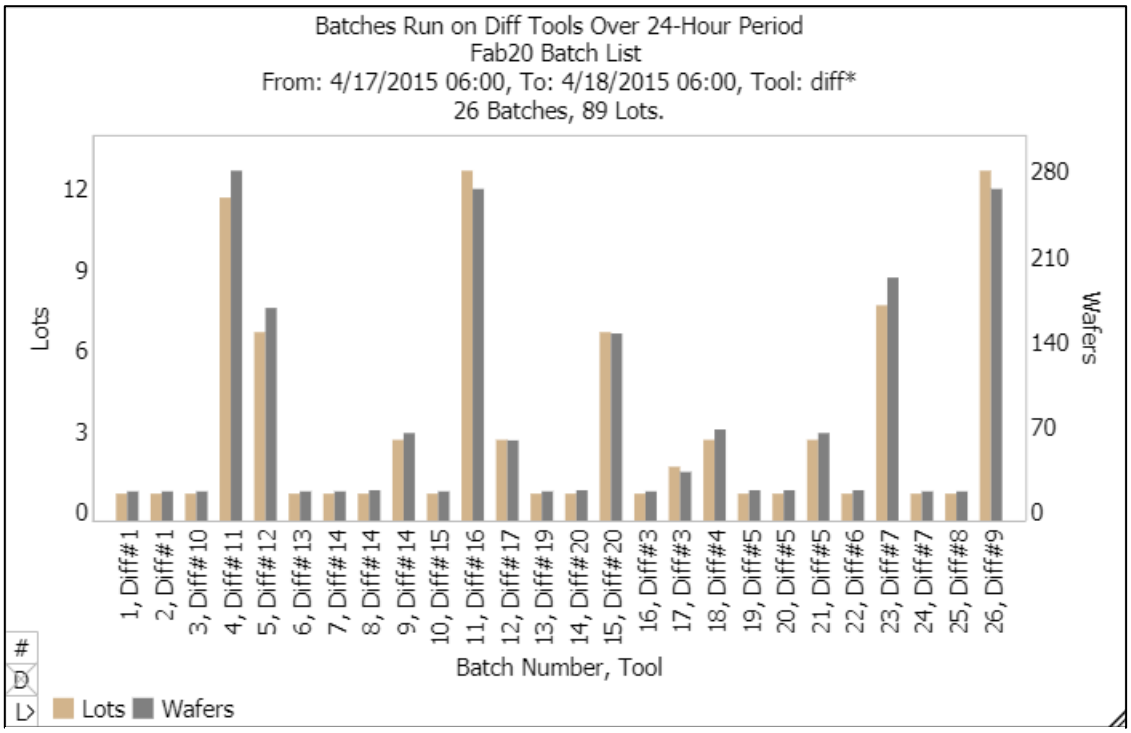

Figure 1. Example of Batch Lot List Chart

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.

A Possible Metric Regarding Delta to Moves Goal

Introduction

Most fabs that we work with track moves relative to a goal, generally at multiple levels of aggregation (fab, area, tool group, etc.). We plot the trend in moves relative to goal in FabTime's software using green and red bars to indicate whether the goal was met or not in a given period (e.g. hour, shift, or day). Looking at this data over longer times periods (e.g. week or month) indicates whether or not the moves goal is being met over time.

Looking at the moves trend bars by hour, by shift, or by day we can get a visual notion of how variable the data is. We know from experience, and from many discussions in this newsletter, that higher variation is associated with higher cycle times (and vice versa). As a small example, if the moves by hour are highly variable at one tool group, this tool group is likely sending that variability downstream as arrival variability to other tools.

In this article, we consider a possible metric to quantify the variation in delta to the moves goal over time. This metric could be measured for the fab as a whole as well as for Areas or Tool Groups. Our thinking on this was sparked by a recent newspaper article, discussed below.

Degree Days

The Wall Street Journal published an article by Jo Craven McGinty on September 14th entitled "How Do Energy Companies Measure the Temperature? Not in Fahrenheit or Celsius". At first glance, this article would not seem to have anything to do with wafer fabs. Yet this is the article that got us thinking about quantifying variation in moves relative to goal.

Here's the introduction to the article:

> "When temperatures turn sizzling hot or glacially cold, averages may obscure the extremes.
>
> That's a problem for companies eager to account for the effect weather has on demands for energy, which peak when temperatures soar or plummet.
>
> So instead of relying on averages, the companies use a metric that captures the variability.
>
> It's called degree days.
>
> Degree days are the difference in one day between the average temperature and an arbitrary threshold, usually 65 degrees Fahrenheit. When the daily average is hotter than 65 degrees, buildings need air conditioning; when it's colder, they need heat.
>
> On a warm day, with a daily average of 75 degrees, the difference from the threshold is 10 cooling degree days. On a cool day, with a daily average of 55 degrees, the difference is 10 heating degree days.
>
> Over a span of time—perhaps a month or a season—degree days can be summed up to look at the impact of the daily extremes. The larger the number, the greater the energy demand."

Imagine a year with many colder than normal days and many warmer than normal days. In this case a city might have a reasonable average temperature, yet require a high degree of energy consumption for heating and cooling. Energy companies realized decades ago that they could use this type of data to assess risk (e.g. for insurance). It seems to us that fabs could use a similar type of data to assess cycle time risk.

A Fab Analogy to Degree Days: Summed Absolute Delta to Moves Goal

A fab that meets its moves goal, cumulatively, across a month or a year would seem to be in good shape. But the

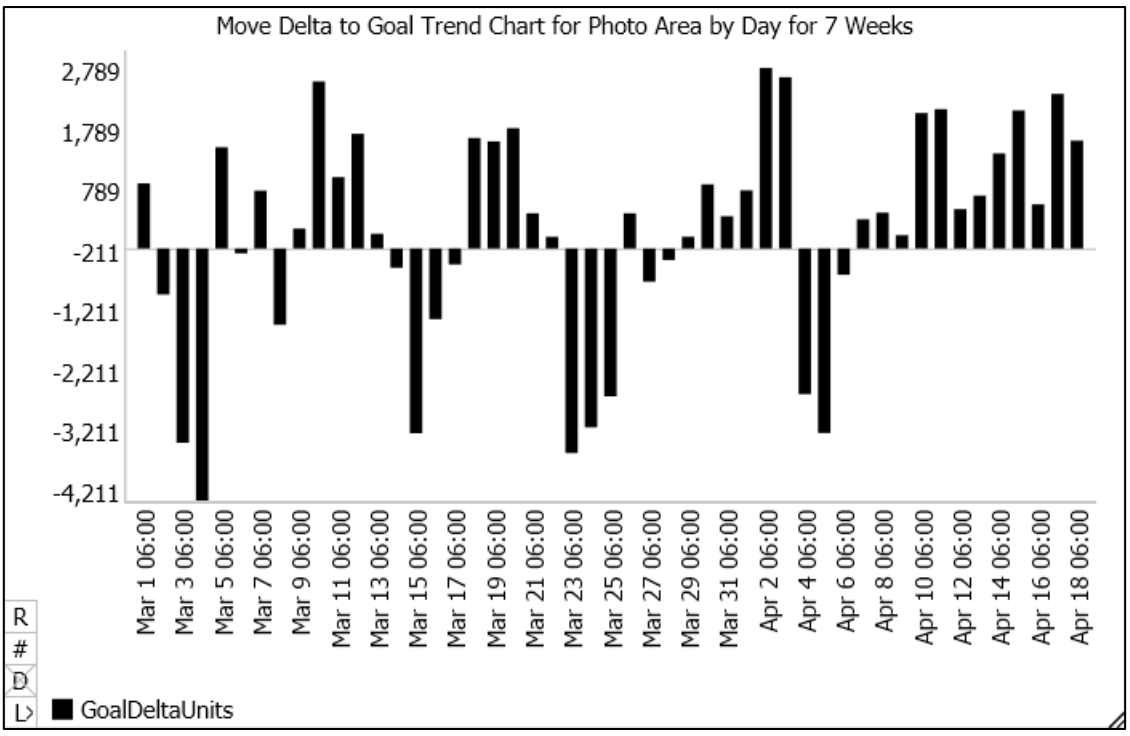

Figure 2. Example of Moves Delta to Goal Trend Chart for a Photo Area

fab that does this by, say, missing the move goal on many days and then exceeding it dramatically near the end of the month or the quarter is probably not going to do very well in terms of cycle time-related metrics (cycle time, delivery performance, variability). A fab that meets the longer-term goal by meeting short-term goals consistently over time will tend to have much lower cycle times and more predictable delivery performance.

Let's think about possible ways to calculate a fab equivalent to degree days, something that captures variation in meeting moves goals by day (or other time period).

The simplest way to start is to create a variant of a moves trend chart where, instead of total moves, we display the delta to the moves goal for each time period. Note here that while Degree Days uses 65 degrees as a standard "goal" baseline, in the case of a wafer fab we would clearly want to use the defined goal for each time period. This could vary over time. An example for a (fictional) photo area (by day) is shown above in Figure 2. In an actual implementation of this metric the bars would be edited to display as red or green depending on whether or not the goal was met for that period, and the time window and period length would be configurable.

The analog to Degree Days would then be the sum of the absolute value of the bars on the chart (the delta to goal for each time period). In this case, the sum of the absolute value of the bars is 72,054 moves over the full seven week time period. This compares with a total goal during the time period of 661,500 moves. In a perfect, zero variability case, the sum of the absolute value of the bars would be zero. For comparison purposes, if we sum the goal delta bars without taking the absolute value, the total is 12, 250 moves, indicating that over the seven week period the photo area exceeded the move target by 1.85%.

To look at this over time, we could aggregate the sum of the absolute value of the daily move delta to goal by week and trend that over the seven weeks of the observed time period. That chart would

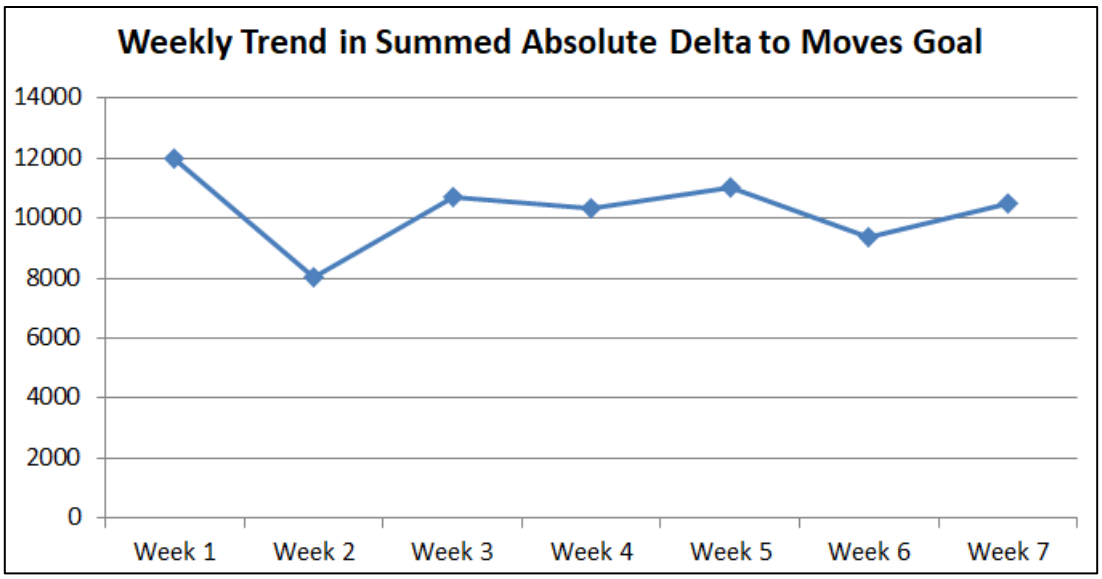

Figure 3. Trend Chart Showing Summed Absolute Delta to Move Goal per Week

look something like Figure 3 above (though of course if we were to add it to FabTime it would be formatted accordingly – Figure 3 is a simple Excel mock-up).

The overall chart time period (7 weeks), the period length for data values (one week), and the sub-period length for the observed delta to goal values (one day) would all need to be configurable to use this chart on an ongoing basis. What we would be looking for in terms of improvement with this chart would be a downward trend over time.

As another option, we might use the same data to compare the performance of two or more different tool groups over time. In this case the data might need to be scaled according to the goal for each tool group (as some tool groups have much larger move goals than others, and thus more potential for significant deviations).

A Possible Variant: Summed Absolute Delta to Cumulative Moves Goal

Alternatively, we could look at the delta from the cumulative moves goal over time, as shown in Figure 4 (top of the next page) for the same photo area over the same time period.

In this case the sum of the deltas is higher than in the previous example (-80146 for the sum of the values as shown, 175792 if we take the sum of the absolute values). This reflects the fact that in this case, when the photo area missed the moves goal, it missed it by a lot, and thus took extra time to recover (hitting the cumulative goal over several periods). Figures 5 and 6 show the moves trend (by day) and the cumulative moves trend, both relative to the (same) goal.

So if we are to look at this summed absolute delta to goal metric, there's a question of whether we should calculate based on the regular moves trend or on the cumulative moves trend. The first case is simpler to calculate, and the results are a bit easier to interpret. The second case does include some additional information (though that information is harder to tease out).

Either way, however, it seems like there is some value to looking systematically at the delta from the moves goal over time. If the sum of the absolute values of the deltas decreases when you compare, say, one week to the next, there's a fair chance the cycle time will also decrease.

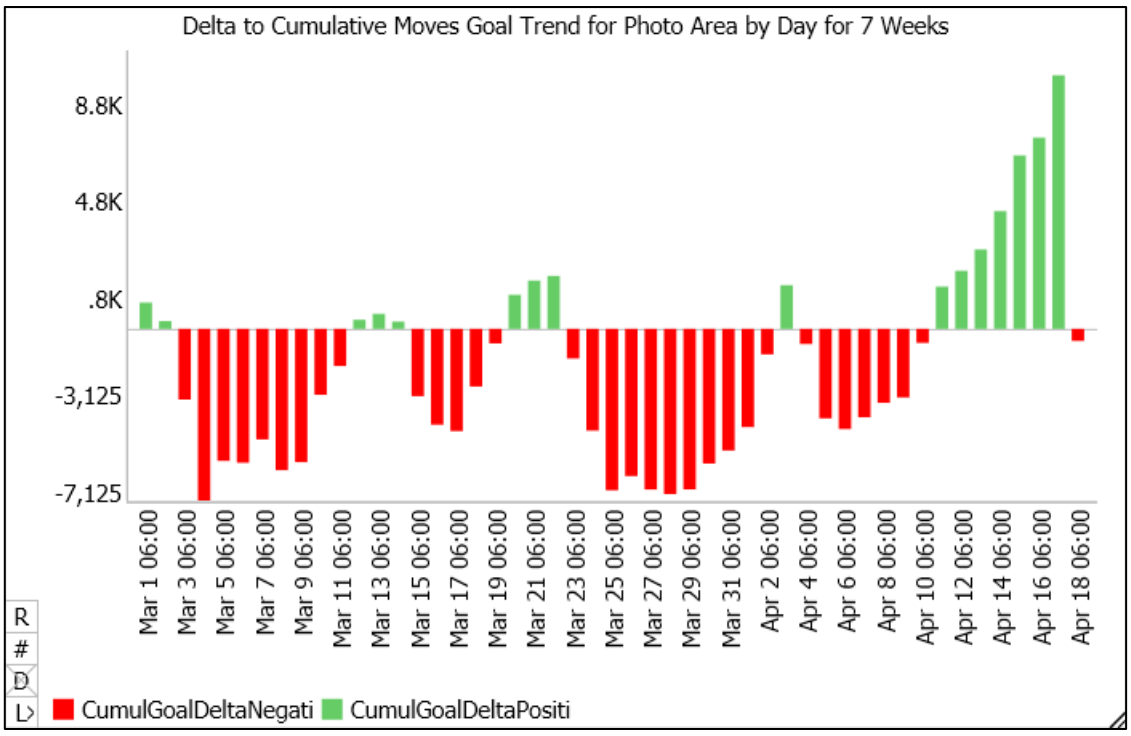

Figure 4. Example of Delta to Cumulative Moves Goal Trend Chart

Implementation Questions

There are obviously open questions here

- How should we display and report the sum of the absolute deltas? As a line chart as shown above, or in some other format?
- How can we capture the most information?
- Should there be some sort of scaling done to be able to compare across tool groups, or time periods of different

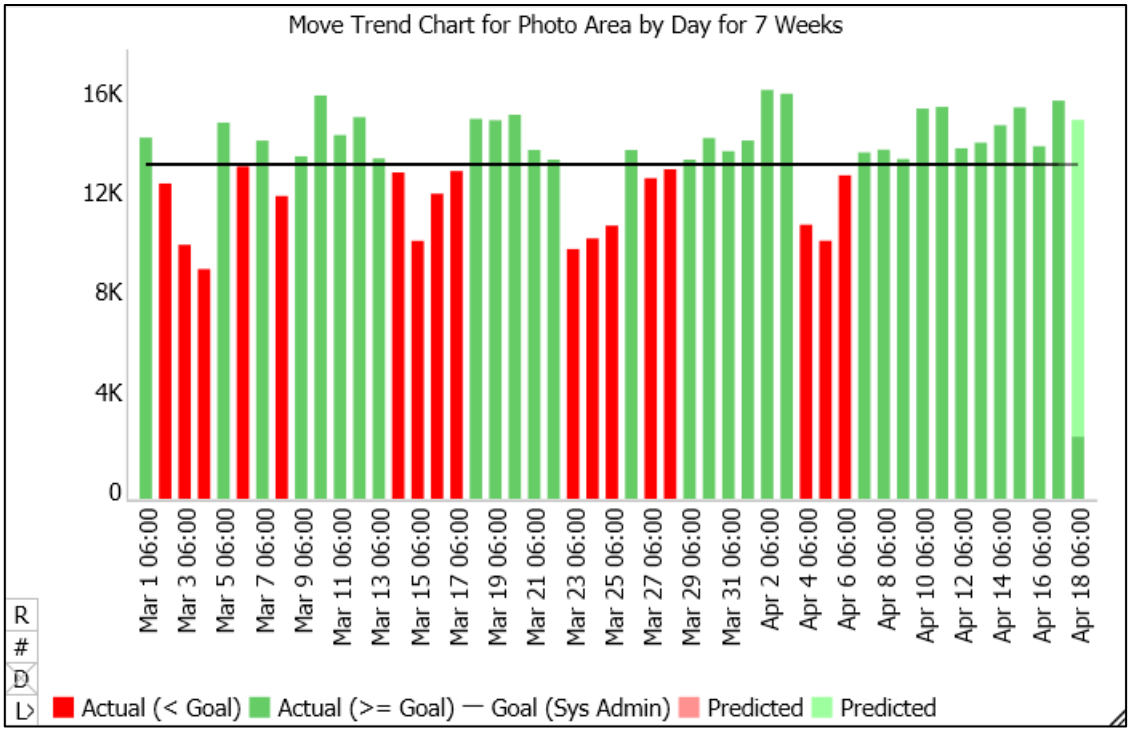

Figure 5. Moves Trend Chart by Day over 7 Week Period

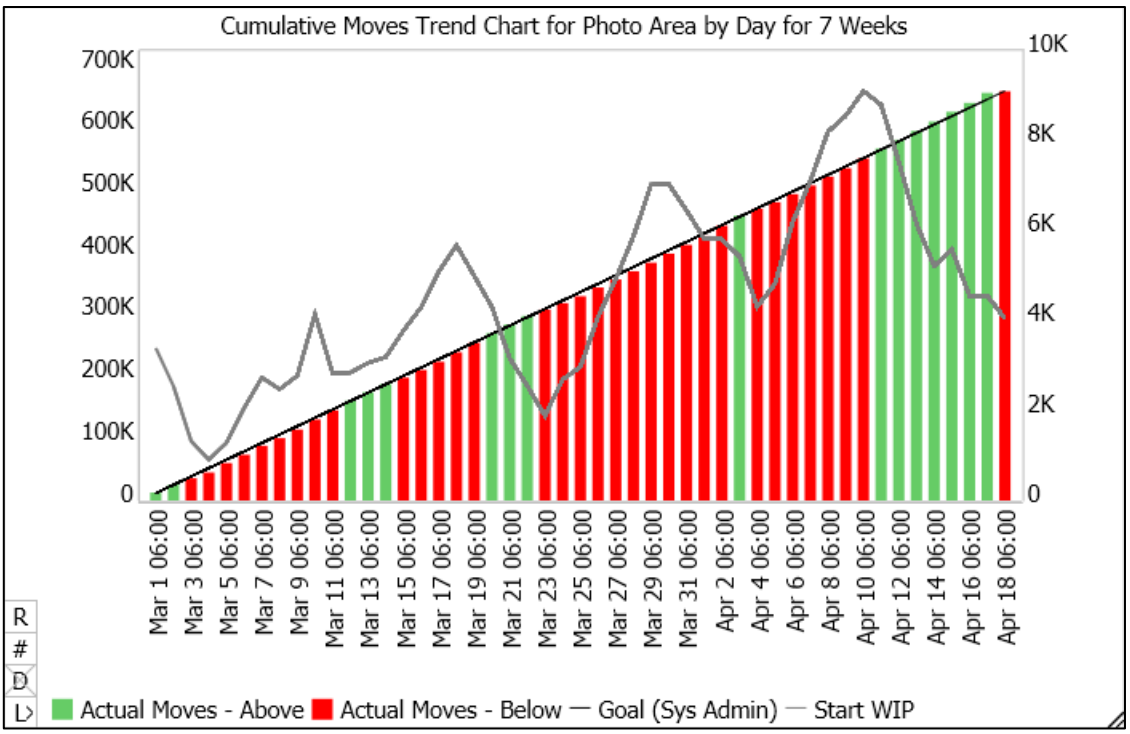

Figure 6. Cumulative Moves Trend Chart over 7 Week Period

lengths? Should we look at the average absolute delta per day? Or scale to the cumulative goal for the period?

- What should we call this metric? Trend in Summed Absolute Delta to Moves Goal is a bit of a mouthful (and even more so if we add "Cumulative").

Conclusions

We ran across an article recently about capturing temperature variation by looking at the sum of the delta between each day's temperature and a goal temperature (65 degrees, in this case). The idea is that summing the deltas gives much more information than simply looking at average temperatures over a time period. This, naturally, sparked us to think about the implications of a similar approach for wafer fabs.

In this article, we consider two possible approaches for adding a fab metric that sums up the absolute delta from the moves goal per period over time. The benefit of such a metric is that it quantifies variation that is hidden when one simply looks at whether or not the moves goal was met overall. And we know, from our studies of fabs, that the first step to reducing variation is to understand where it is occurring. While more work is needed to tease out the right approach for applying this metric, we thought that it would be worth introducing to our subscriber base. We welcome your feedback.

Further Reading

Jo Craven McGinty, "How Do Energy Companies Measure the Temperature? Not in Fahrenheit or Celsius", Wall Street Journal, September 14, 2018.

Closing Questions for Newsletter Subscribers

Do you think there is a value to a metric like this that captures variability from goal for moves? If so, do you think it makes more sense to look at the trend version (the first case) or the cumulative trend version (the second case)? Do you do anything like this in your fab? Do you have any input into the implementation questions listed above?

Subscriber List

Total number of subscribers: 2752

Top 20 subscribing companies:

- ON Semiconductor (184)
- Infineon Technologies (146)
- Micron Technology, Inc. (134)
- Intel Corporation (112)
- GlobalFoundries (106)
- Maxim Integrated Products, Inc. (99)
- NXP Semiconductors (78)
- Microchip Technology (74)
- Carsem M Sdn Bhd (69)
- STMicroelectronics (66)
- Skyworks Solutions, Inc. (63)
- Texas Instruments (58)
- Western Digital Corporation (58)
- X-FAB Inc. (53)
- Seagate Technology (52)
- TDK (includes RF360) (46)
- Analog Devices (41)
- Zymergen (35)
- Honeywell (30)
- Cree, Inc. (includes Wolfspeed) (30)

Top 3 subscribing universities:

- Ecole des Mines de Saint-Etienne (EMSE) (15)
- Arizona State University (8)
- Virginia Tech (7)

New companies and universities this month:

- Knowles Electronics

Sampler Set of Other Subscribing Companies and Universities:

- Abbott Laboratories (11)
- Automated Manufacturing Solutions (1)
- Automatiseringsteknik (1)
- BAE Systems (12)
- Booz Allen Hamilton (1)
- CAMDesigns (1)
- Dublin City University (3)
- Foothill Technology (1)
- II-VI Inc. (2)
- Khosla Ventures (1)
- Middlesex General Industries, Inc. (1)
- MSEI/Biotronik (1)
- Northrup Grumman Aerospace (2)
- Raytheon (14)
- SanDisk (5)
- Silterra Malaysia Sdn. Bhd. (27)
- Smoltek AB (1)
- Structural Integrity (1)
- University of L'Aquila (1)
- ZHAW (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.

To subscribe to the newsletter, send email to newsletter@FabTime.com, or use the form at www.FabTime.com/newsletter-subscribe.php. To unsubscribe, send email to newsletter@FabTime.com with "Unsubscribe" in the subject. FabTime will not, under any circumstances, give your email address or other contact information to anyone outside of FabTime without your permission. Your subscription is subject to your agreement to FabTime's GDPR policy.

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)
- Add-on dispatching and capacity planning modules for an additional monthly fee

Interested?

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

FabTime Inc.
Phone: +1 (408) 549-9932
Fax: +1 (408) 549-9941
Email: Sales@FabTime.com
Web: www.FabTime.com

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 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.