FabTime Cycle Time Management Newsletter

Volume 7, No. 5 June 2006

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 include the ability to specify different email addresses for individual alerts and the ability to include ancestor lot cycle time in the cycle time of split lots.

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Welcome

Welcome to Volume 7, Number 5 of the FabTime Cycle Time Management Newsletter! We hope that you're enjoying the summer. We're keeping pretty busy with new software customers, sessions of our cycle time management course, and associated travel. In this month's issue, we have an announcement regarding the IEEE Robotics & Automation Society's Technical Committee on Semiconductor Manufacturing Automation. They have a useful new website available. Our software user tip of the month is about setting alerts for individual lots at specific operations, highlighting two new alerts requested by a FabTime customer. In our subscriber discussion forum, we have a response to last month's main article about cycle time variability. We're also pleased to welcome 11 new companies and universities to the subscriber list.

In our main article this month, we revisit a topic that we last touched in the very first year of publication of the newsletter: lean manufacturing and wafer fabs. Lean manufacturing is a philosophy focused on reducing waste and developing a more flexible and efficient manufacturing process. This philosophy has application to many types of manufacturing environments, including wafer fabs. However, many of the lean manufacturing implementation techniques currently in use were developed for automotive manufacturing, and are problematic when applied to wafer fabs. This does not mean that the underlying principles of lean manufacturing can't be applied to wafer fabs – merely that we have to look at the underlying techniques, and focus on more relevant industry-specific implementation methods. We hope that you will find this article of interest, and we welcome your feedback regarding lean manufacturing and wafer fabs.

Thanks for reading!—Jennifer

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Community News/Announcements

IEEE Robotics & Automation Society - Technical Committee on Semiconductor Manufacturing Automation

The IEEE Robotics & Automation Society's Technical Committee on Semiconductor Manufacturing Automation has a new website available at http://ford.ieor.berkeley.edu/tzhang/TC/index.htm. Anyone who is interested in joining this technical committee can send a message to mike.zhang@intel.com. All comments, suggestions, and contributions to the technical committee activities are highly welcome.

Technical Committee Objectives: Semiconductor manufacturing is a rapidly growing cornerstone industry. But it is also a very harsh environment due to complicated production processes, sophisticated equipment, and fluctuating demand. With the emerging highly automated wafer fabrication facilities (fabs), there is a compelling trend to promote the interdisciplinary R&D field integrating automation with advanced decision technologies (such as Operations Research and Artificial Intelligence). This technical committee was founded in August 2001 to provide a forum for exchanging ideas among semiconductor manufacturing researchers and engineers through scientific events, such as special conference sessions, workshops, and symposia, as well as through publications, such as special journal issues.

The committee is interested in, among many other topics:

- Factory modeling, analysis, performance evaluation
- Planning, scheduling, dispatching, coordination
- Wafer release policies
- Equipment productivity improvement
- Lean Manufacturing
- Cycle time reduction
- Benchmark and case studies

For more information, visit the Technical Committee website (http://ford.ieor.berkeley.edu/tzhang/TC/index.htm), or contact Mike Zhang (mike.zhang@intel.com).

Call for Papers: The 4th AEC/APC-Asia Symposium 2006

International SEMATECH Manufacturing Initiative (ISMI) and Taiwan Semiconductor Industry Association (TSIA) are pleased to announce the AEC/APC-Asia Symposia 2006 Call for Papers. This call for papers is directed to the semiconductor community, although other relevant industries employing AEC/APC may also submit abstracts. The conference will be held November 30-December 1, 2006 in Taipei, Taiwan.

This is the fourth Advanced Equipment Control/Advanced Process Control (AEC/APC) Symposium staged on an Asian platform, for both international professionals and regional practitioners alike, to present their latest developments and to exchange their experience in AEC/APC. The Symposium will review recent technological advancements in order to assure alignment with the needs of integrated circuit manufacturers, semiconductor equipment suppliers, software suppliers, sensors and metrology suppliers. Major AEC/APC issues and experiences will be discussed in this two-day event, which includes a technical tutorial and supplier exhibits.

More information about the Symposium can be found at www.sematech.org/meetings/aecapc/asia/index.htm (English) or www.tsia.org.tw/seminar/aecapc/2006/index.shtml.htm (Chinese).

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

FabTime User Tip of the Month

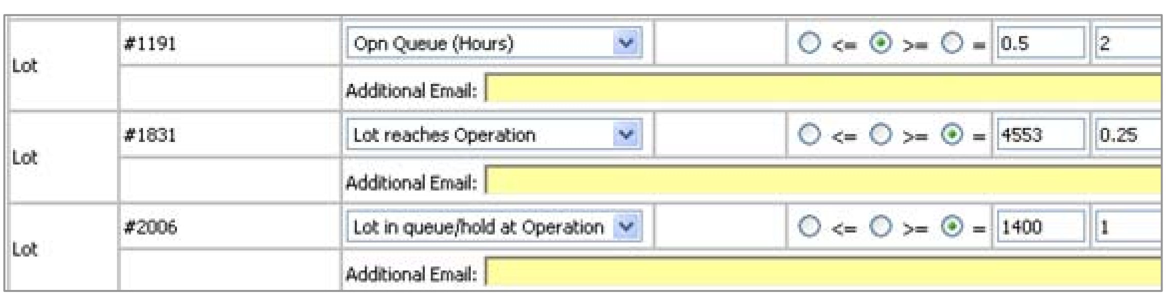
Receive Alert Messages for a Lot at a Particular Operation

This month's FabTime software tip highlights new alert functionality that you might find useful. We have recently added two new lot-level alerts to the software, in response to customer requests. The first is the Lot Reaches Operation alert. This alert is triggered if any transaction occurs for the specified lot at the specified operation. The alert is triggered even if the lot is no longer at the triggering operation at the time alerts are checked, but has moved on past. If the lot stays at the same operation and no new transactions are received, the alert will not trigger again. To set the Lot Reaches Operation Alert, select your lot of choice from the Alert Object column in the New row for lot-level alerts. Select "lot reaches operation" from the Variable column. Set the comparison operator for the alert to be "=". Enter the operation name or number in the Alert Value column. After being triggered initially, if any new transaction is received for the lot at the same operation, the alert will trigger again if the sleep-after time has elapsed. If you do not wish to receive additional alerts for new transactions at the same operation, set a large sleep-after time, e.g. 1000 hours. Press the "Save" button in the lower right-hand corner, and FabTime will move your new alert to the top part of the alert table, and give you another new row.

The Lot in Queue/Hold at Operation alert is set similarly to the Lot Reaches Operation alert. This alert is triggered if the specified lot is currently in queue or in hold at the specified operation when alerts are checked. This alert does not trigger if the lot was previously in queue or in hold at the specified operation, but is no longer in queue or hold when alerts are checked. If the lot stays at the same operation and no new transactions are received, the alert will trigger again if the sleep-after time has elapsed. This behavior is by design, because the alert only looks at the most recent lot history transaction, and does not require any activity since the last time alerts were checked. Therefore, if you want to know, for example, if the lot is still in queue, or on hold, you might set the sleep after interval to be one hour. In this case, you'll get a new alert notification every hour until the lot is not longer in a queue or hold state at that operation (e.g. the lot starts being processed).

One other new feature of the alerts is that you can now specify that each alert can be sent to an additional email address (in addition to your default address, which is always used). This is useful if, for example, you would like to notify an engineer about a lot on hold, or if you are concerned about email delays from a particular email address, and would like a backup just for one critical alert. An example is shown below.

If you do not see the additional alert variables or the additional email address field, this means that the appropriate patch still needs to be applied at your site. Please contact your internal FabTime system administrator to ask about this, or use the Feedback form in the software.



Subscriber Discussion Forum

Cycle Time Variability

An anonymous subscriber wrote in response to our article in the last FabTime newsletter. Specifically, he responded to our statement "It seems to us that anything that you can do in your fab to reduce process time and arrival time variability will tend to reduce cycle time variability, along with reducing the mean cycle time" with the following comments: "Yes and no. We track the CT and coefficient of variability for our 11 major technologies monthly, as the variability is key to making on-time order deliveries in our foundry environment (after removing priority lots from the data). We have found the biggest impact on cycle time variability is the raw utilization of the bottleneck tools as you get to near 100% capacity. Because of the large number of possible recipes from the 11 technologies, the "run rules" for a tool near 100% capacity tend to violate some of the classical methodologies that would normally reduce tool output variability. There is a clear tradeoff between tool node output variability and utilization rate in a complex recipe environment and this is compounded when multiple toolsets affecting various technologies are close to 100% utilization simultaneously."

Lean Manufacturing and Wafer Fabs

Introduction

Manufacturing methodologies come and go over the years. Recently we've noticed a resurgence in efforts to apply "lean manufacturing" to wafer fabs. In particular, when we teach our one-to-two day cycle time management class, people frequently ask "but what about lean manufacturing?" In this article, we will discuss the lean manufacturing approach, and what aspects we feel are and are not directly applicable to wafer fabs. We also, of course, will consider lean manufacturing in the context of cycle time improvement efforts.

Lean Manufacturing Background

There is a detailed history of lean manufacturing at Wikipedia (http://en.wikipedia.org/wiki/Lean_manufacturing); outlining basic principles back to Ben Franklin's views on wasted time and cost avoidance. You can also find an excellent timeline and history at the Strategos website (www.strategosinc.com-/just_in_time.htm), or in Chapter 4 of Factory Physics, by W. Hopp and M. Spearman. Here is a capsule summary: After people like Frank and Lillian Gilbreth and Frederick Winslow Taylor did some groundwork in manufacturing improvement methods, Henry Ford formalized and implemented many of the tenets of lean manufacturing as The Ford System in the early 1900s. These were later modified and put into production use by Taichii Ohno at Toyota, as the Toyota Production System, starting soon after World War II. A major tenet underlying the Toyota Production System was Just in Time manufacturing (JIT). The central idea behind JIT was that each workstation in a factory would receive material from upstream workstations exactly as needed. In 1990, James Womack wrote the book "The Machine that Changed the World", which described the history of automotive manufacturing and coined the phrase "lean manufacturing".

Lean Manufacturing is a philosophy for improving manufacturing performance. It was developed primarily by people in the automotive manufacturing industry. The main idea behind lean manufacturing is to reduce waste and improve flexibility in manufacturing environments to improve quality, reduce costs, reduce cycle time, and make customers happy.

Some principles of lean manufacturing are:

- Quality improvement
- Minimizing waste and non-value-added activities
- Continuous improvement
- Pull processing
- Manufacturing flexibility
- Running small batches

Some methods by which lean manufacturing is implemented include:

- Cellular manufacturing configurations
- Kanban (pull scheduling) systems
- Six Sigma initiatives
- Setup reduction programs
- Drum, Buffer, Rope
- CONWIP lot release systems

Methodology vs. Implementation Technique

We believe that the above separation of lean manufacturing principles from lean manufacturing application techniques is important. Toyota had a great deal of success with just in time manufacturing, because Taichii Ohno and others spent time understanding and developing the methodology for manufacturing improvement through lean manufacturing. Other companies have sometimes found less success when they skip over the methodology and just implement some of the just in time practices (like kanbans). There's an excellent discussion of this idea in "Decoding the DNA of the Toyota Production System" by Spear and Bowen, Sept. 1999, *Harvard Business Review*. We first discussed this back in Volume 1, Number 5 of this newsletter.

As pointed out by Spear and Bowen, many companies have not been able to replicate the just-in-time manufacturing success of Toyota. The authors hypothesize that these latecomers have skipped past the methodology, going straight to the implementation techniques. Spear and Bowen argue that the methodology is part of the magic – if a latecomer attempts to short-circuit the process with direct application of a technique like kanbans, the improvement will be minimal. Or it could be that an application of just-in-time methodology to the latecomer's particular situation would result in an entirely different set of implementation techniques. We believe that this is the case in regards to many lean manufacturing techniques in the semiconductor industry. There are some specific attributes to semiconductor wafer fabrication that are very different from those in the auto industry, where the primary lean and JIT manufacturing techniques were developed.

Lean Manufacturing Techniques and Wafer Fabs

Let's take a look at some of the better know lean manufacturing techniques, and their applicability for wafer fabs.

Kanban Systems: Kanban is a way of implementing just in time manufacturing via a pull process. Under a kanban system, production is triggered by some demand signal, usually indicated by a kanban card. When a part is removed from the system, authorization is given to the immediate upstream workstation to replace the part, which in turns gives authorization to the next workstation upstream, and so on. In order to work on something, an operator must have both the WIP to work on and the authorization signal, as indicated by the kanban card. The number of kanban cards allowed at each workstation limits the amount of work that can be stored there, and the throughput rate allowed at that toolgroup.

Essentially, kanban uses cards to limit the WIP allowed at each workstation, and pull that WIP evenly through the factory. These are worthwhile goals in any manufacturing facility. However, the implementation of kanban cards has not, to our knowledge, been very successful in wafer fabs. What tends to happen in practice is that a tool will go down, limiting flow to the next tool, and causing a starvation of the downstream tool or tools, and eventually starving the bottleneck. To combat these problems of bottleneck starvation, the people managing the fab will authorize additional kanban cards. This keeps happening over time, until there are so many kanban cards in the fab, that the system isn't having any effect. Alternatively, if more kanban cards are not added, then throughput from the fab may drop (due to that bottleneck starvation).

The fundamental problem is that fabs have a number of attributes that make them different from automobile manufacturing. Process flows can consist of hundreds of steps. Process flows are reentrant, instead of linear, with lots returning to the same toolgroup many times throughout the flow. And finally, because of the constant changes in technology in wafer fabs, the equipment tends to be less reliable than it is in other industries. The long process flows, reentrant flow, and less than reliable equipment makes the application of kanban systems extremely difficult in practice.

Cellular Manufacturing: The idea behind cellular manufacturing is to take a collection of different machines and group them together, with their own staff, so that lots can be processed quickly on one machine after the other. For example, in a wafer fab this could entail splitting up the traditional group of etchers, and putting one etcher with each developer, inspection tool, etc., so that a lot would go through one layer in one cell, then move on to the next cell for the next layer, etc. Here again, however, people in wafer fabs are stymied by the unreliability of the equipment. What we do when we go from a tool group with many tools in it to a workcell that has one of each type of tool in it is create a whole bunch of one-of-a-kind tools. And whenever any one of these tools goes down, the entire line is stopped.

Wafer fabs have had some success with limited application of workcells (e.g. linked steppers). However, a fully cellular layout, at least with the existing technology of tools, seems impractical. Also, cellular layouts tend to require extra tools. This is also impractical in semiconductor manufacturing, where the many of the tools cost millions of dollars each. For example, a 1997 study by Geiger et. al. compared cellular layouts to the traditional process layouts in fabs. They concluded that "cellular layouts, where machines are dedicated to a limited number of process steps, require more machinery but perform well when setup and transfer times are high and machinery is reliable. As machines become more unreliable, the flexibility of the process layouts becomes a major advantage."

CONWIP: CONWIP is a system by which the total WIP in a factory is held constant. Once the factory is "full", a new lot is only released into the factory whenever an existing lot is shipped. CONWIP can be applied to wafer fabs more readily than can detailed kanban cards. However, the long process flows in fabs make CONWIP difficult to sustain over time, too. Here the problem tends to be that because cycle times are so long, product mix may change considerably between when a lot is started, and when that lot leaves the fab. This makes it difficult to only release a new lot whenever an existing lot leaves the fab, because the new lot might be of a completely different technology. Similarly, critical hot lots may need to be released into the fab, regardless of whether or not any other lot has shipped that day.

Lean Manufacturing Principles and Wafer Fabs

In the previous discussion, we highlighted some attributes of wafer fabs that make it difficult to apply traditional lean manufacturing methods. Does this mean that lean manufacturing doesn't apply to wafer fabs? Of course not. The philosophy underlying lean manufacturing is relevant to any type of manufacturing, including wafer fabrication. However, in order to apply lean manufacturing to wafer fabs, we need to come up with implementation techniques that can accommodate the essential attributes of wafer fabs: the heavily loaded and expensive tools, the long process flows, the reentrant flow, the less than perfectly reliable equipment, and the frequently changing product mixes.

To do this, let's revisit the principles of lean manufacturing, and see what they hold for wafer fabs, and how they relate to cycle time improvement methods.

1. Quality improvement (zero defects): Clearly, yield improvement techniques are applicable to wafer fabs. They are particularly important in wafer fabs, where tools are expensive and each wafer can be worth tens of thousands of dollars. We do hear about Six Sigma and TQM projects applied in fabs. There are some tradeoffs between yield improvement and cycle time improvement (mostly around process restrictions that lead to tool dedication, and the time required for inspections), but there can also be a positive interaction cycle. Improving yield in the fab allows you to start less material (for the same outs), which increases standby time on the equipment, and hence improves cycle time. Improving cycle time means that WIP spends less time in the fab, and may thus have better yield. Overall, quality improvement is a lean manufacturing principle that is relevant for wafer fabs, and that will mostly likely help to improve cycle time.

2. Minimizing waste and non-value-added activities (no excess lot sizes, no setups, and no rework): Here we recommend an approach that we introduced in the newsletter last year, measuring WIP States and Overall WIP Effectiveness. The idea is to look at all of the time that a lot spends in the fab, and break it up into different states (in queue, on hold, etc.), and then work to maximize the time that lots spend in value added states (mainly non-rework process time). This will in turn minimize cycle time. Most fabs that we know of do track and try to reduce rework, setups, and hold time. So, minimizing wasted time is certainly a lean principle that is applied in wafer fabs, and will tend to improve cycle time.

3. Continuous improvement (less downtime, more efficient material handling): Continuous improvement is a

general enough term to be applied anywhere. But we think that it is particularly relevant for fabs in two areas: equipment availability and operator handling of WIP. Anything that can be done to improve availability on any tool in the fab will tend to improve cycle time (because the tool will have more standby time to recover from variability problems), and/or will allow more throughput at the same cycle time. Operator variability can also have a significant impact on cycle time, particularly when tools lie available and idle with WIP waiting that could be processed. We recommend tracking this time, and using it to re-assign operators, or justify cross-training or hiring initiatives. Both of these types of efforts reflect the application of lean manufacturing principles to wafer fabs, and will help cycle times.

4. Pull processing (smooth flow of material, short cycle times): Pure pull processing is probably not practical for wafer fabs at the present time, level of technology, and tool utilization level. However, what we can drive to in fabs is variability reduction. Variability reduction will improve cycle times, and reduce WIP in the fab, making fabs run more smoothly. This will allow more predictable due dates, and smooth the flow of material to customers. Which is really the end goal of pull processing, and lean manufacturing, isn't it?

5. Manufacturing flexibility (ability to recover quickly from problems, cross-trained personnel, and ability to change product mix quickly): Driving towards more flexible manufacturing in fabs will entail having more cross-qualified tools, and more cross-qualified operators and technicians. This is going to be essential for fabs going forward in time, because product mix changes are likely to become more and more frequent. There is, as discussed above, a potential conflict between attempting cellular manufacturing and flexibility improvement in wafer fabs, because of the reliability of the equipment. But there is quite a bit of potential for improving fabs through working on fab-specific projects to increase flexibility.

6. Small batches: As we have discussed in detail in this newsletter, running smaller loads through batch tools (such as furnaces) that are not heavily loaded can have a significant cycle time reduction impact. In the longer term, in order for wafer fabs to continue to improve cycle time, technology improvements will hopefully reduce or eliminate large batch size requirements. As our fabs have smaller batch sizes, they will run in a leaner manner, and cycle times will improve.

In summary, all of the lean manufacturing principles described above have applicability for wafer fabs, and are things that people we talk with are working towards. What we believe is that instead of focusing on historical lean manufacturing techniques, fabs should use the above principles to derive improvement methodologies relevant for fabs. Variability reduction, for instance, which is a strong focus of this newsletter (and our course and our software), is a way of attacking underlying problems in the fab, to reduce cycle time and WIP. Other techniques may ebb and flow in popularity. However, if you keep working away to understand and eliminate the sources of variability from your fab, you will end up with a lean, smoothly running operation.

Conclusions

Lean manufacturing is a philosophy focused on reducing waste and developing a more flexible and efficient manufacturing process. This philosophy has applicability to many types of manufacturing environments, including wafer fabs. However, many of the lean manufacturing implementation techniques currently in use were developed for automotive manufacturing. There are a number of attributes to semiconductor manufacturing that make it difficult to implement existing lean techniques such as kanban and cellular manufacturing. This is not to say that you shouldn't apply lean manufacturing principles like improving quality, eliminating waste, and making your fab more flexible. It just means that you need to come up with the right lean manufacturing implementation techniques for wafer fabs.

If you are going to adopt a lean manufacturing mindset, we recommend that you set aside sufficient time to apply the entire process. Saving time by skipping to the answers (e.g. using existing implementation techniques such as kanbans) will likely result in little long-term gain. To our knowledge, there is little documented proof of substantial long-term gains from the application of kanbans in wafer fabs, for example. Perhaps the perfect lean manufacturing implementation technique for wafer fabs is just waiting to be discovered. We believe in the meantime that the best way to approach lean manufacturing for wafer fabs is to focus on variability reduction. Reducing variability will allow your fab to reduce cycle time, which will in turn reduce WIP in the fab. This will allow you to respond more quickly to customer requests, and make your customers happier.

Closing Questions for FabTime Subscribers

Has your fab tried a formal "lean manufacturing" implementation? Have you ever worked in a fab that successfully implemented kanban cards?

Further Reading

- "A Brief History of Just in Time," Strategos Inc., www.strategosinc.com-/just_in_time.htm.

- F. Chance and J. Robinson, "Theory of Constraints," *FabTime Cycle Time Management Newsletter*, Volume 1, No. 4, 1999.

- F. Chance and J. Robinson, "The Theory of Constraints and Just-in-Time Manufacturing," *FabTime Cycle Time Management Newsletter*, Volume 1, No. 5, 1999.

- L. F. Fuller, K. D. Hirschman, and P. C. Waldrop, "Total Quality Manufacturing At The RIT Integrated Circuit Factory," *Proceedings of the 11th Biennial University/Government/Industry Microelectronics Symposium*, Austin, TX, 52-56, 1995.

- C. D. Geiger, R. Hase, C. G. Takoudis, and R. Uzsoy, "Alternative Facility Layouts for Semiconductor Wafer Fabrication Facilities," *IEEE Transactions on Components, Packaging, and Manufacturing Technology. Part C: Manufacturing*, Vol. 20, No. 2, 152-163, 1997.

- Eliyahu Goldratt and Jeff Cox, "The Goal," North River Press, New York, 2004.

- W. Hopp and M. Spearman, "Factory Physics: 2nd Edition," McGraw-Hill/Irwin, Chicago, IL, 2000.

- "Lean Manufacturing," Wikipedia, http://en.wikipedia.org/wiki/Lean_manufacturing.

- Spear and Bowen, "Decoding the DNA of the Toyota Production System", *Harvard Business Review*, September 1999.

- J. Robinson and F. Chance, "Setup Avoidance and Dispatching," *FabTime Cycle Time Management Newsletter*, Volume 6, No. 7, 2005.

- J. Robinson and F. Chance, "A WIP-Centered View of the Fab," *FabTime Cycle Time Management Newsletter*, Volume 6, No. 2-3, 2005.

Subscriber List

Total number of subscribers: 2090, from 449 companies and universities. 23 consultants.

Top 10 subscribing companies:

- Intel Corporation (125)
- Analog Devices (75)
- Atmel Corporation (66)
- Infineon Technologies (64)
- Micron Technology (61)
- Freescale Semiconductor (57)
- STMicroelectronics (55)
- Texas Instruments (52)
- Philips (48)
- TECH Semiconductor (44)

Top 3 subscribing universities:

- Virginia Tech (11)
- Arizona State University (7)
- Ben Gurion Univ. of the Negev (7)

New companies and universities this month:

- Altera
- Booz Allen Hamilton
- Door King
- Feng Chia University
- Macquarie Electronics
- New Jersey Institute of Technology
- Powerchip Semiconductor
- SinoMOS Semiconductor Inc.
- Tara Technologies
- University of Glasgow
- University of Liverpool

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.htm. 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.

FabTime® Cycle Time Management Training

"It was helpful to see best-in-class methods for wafer fab cycle time management. Discussing these matters in-depth with you was quite valuable, as we could ask questions specific to our fab and processes."

Shinya Morishita
Manager, Wafer Engineering
TDK Corporation

Course Code: FT105

This course provides production personnel with the tools needed to manage cycle times. It covers:

- Cycle time relationships
- Metrics and goals
- Cycle time intuition

Price

$5950 plus travel expenses. On-site delivery for up to 15 participants, each additional participant $295. Discounts available for multiple sessions.

Interested?

Contact FabTime for a quote.

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

Do you make the best possible decisions?

- Do your supervisors possess good cycle time intuition?
- Are you using metrics that identify cycle time problems early?
- Can you make operational changes to improve cycle time?

FabTime's Cycle Time Management Training is a one-day course designed to provide production personnel with an in-depth understanding of the issues that cause cycle time problems in a fab, and to suggest approaches for improving cycle times. A two-day version is also available upon request.

Prerequisites

Basic Excel skills for samples and exercises.

Who Can Benefit

This course is designed for production personnel such as production managers, module managers, shift supervisors, hot lot coordinators, and production control.

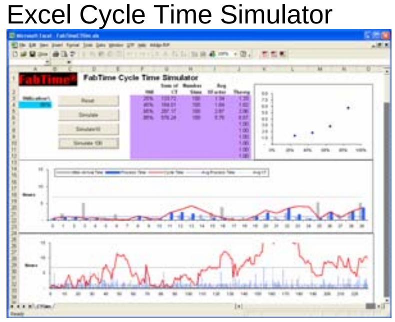
Skills Gained

Upon completion of this course, you will be able to:

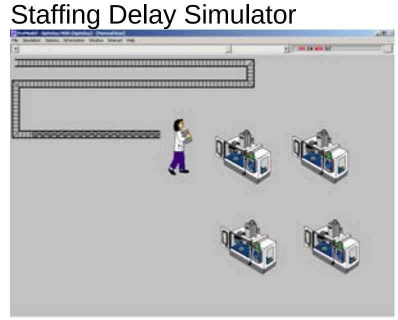
- Identify appropriate cycle time management styles.
- Teach others about utilization and cycle time relationships.
- Define and calculate relevant metrics for cycle time.
- Teach others about Little's law and variability.
- Quantify the impact of single-path tools and hot lots.
- Apply cycle time intuition to operational decisions.

Sample Course Tools

Excel Cycle Time Simulator



Staffing Delay Simulator



Additional Half-Day Modules

- Executive Management Session.
- Site-Specific Metrics Review.
- Capacity Planning Review and Benchmark.