

FabTime Cycle Time Management Newsletter

Volume 16, No. 4

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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 for FabTime include enhanced OEE calculations for cluster tools and support for longer filter entries.

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Welcome

Welcome to Volume 16, Number 4 of the FabTime Cycle Time Management Newsletter! We hope that those of you in the Northern hemisphere are enjoying beautiful summer weather. In this issue, we have a call for papers for ISMI 2015, to be held in South Korea in October. Our software tip of the month is about using the new chart gridlines feature in FabTime. Apparently many people are on vacation (or otherwise engaged) because we have no subscriber discussion topics in this issue. Perhaps our main article will prompt some discussion going forward.

In our main article, we discuss the motivational aspects of goal-setting for wafer fabs. We investigate in particular the concept of SMART goals, a methodology that has been applied to a variety of industries. We apply the SMART methodology to wafer fabs, identifying what we believe to be the core motivational issue in goal-setting for fabs. We also discuss other potential pitfalls. As always, we welcome your feedback.

Thanks for reading – Jennifer

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Community News/Announcements

1st Call for Papers: 2015 International Symposium on Semiconductor Manufacturing Intelligence (ISMI 2015)

October 16 – 18, 2015 at KAIST in
Daejeon, South Korea

AIMS AND SCOPE

Following the great success of ISMI in Taiwan (2012), Shanghai (2013) and Taiwan (2014), the 2015 International Symposium on Semiconductor Manufacturing Intelligence (ISMI 2015) will be held on the KAIST campus in Daejeon, South Korea. ISMI 2015 aims to provide a platform to foster the exchange of research developments and the latest practice on automation science & engineering, operations research, evolutionary algorithms, data mining, manufacturing informatics, and decision analysis for semiconductor manufacturing intelligence. ISMI 2015 will serve to enhance collaborations to address critical research and industrial issues.

Details [can be found here](#).

IMPORTANT DATES IN 2015:

8/1: Submission Deadline

9/7: Notice of Acceptance

9/23: Camera Ready Final Manuscript

10/1: Deadline for Early Registration

10/16–18: ISMI 2015

THREE SEPARATE SUBMISSION CATEGORIES:

Abstract: 200 – 300 words

Extended Abstract: 2 pages in IEEE
format

Full Paper: 5-6 pages in IEEE format

TOPICS OF INTEREST INCLUDE:

- Algorithms for planning, scheduling and coordination
- Benchmark studies, case studies and data sets
- Big data and statistical applications
- Data mining for yield and production improvement
- Equipment productivity improvement
- Factory modeling, analysis and performance evaluation
- Manufacturing execution systems (MES)
- Optimization methods for semiconductor fabrication

FabTime welcomes the opportunity to publish community announcements, including conference notices and calls for papers. Send them to newsletter@FabTime.com.

Subscriber Discussion Forum

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

Jennifer.Robinson@FabTime.com. There are no subscriber discussion topics in this issue.

FabTime User Tip of the Month

Use New Y-Axis Gridlines on Charts

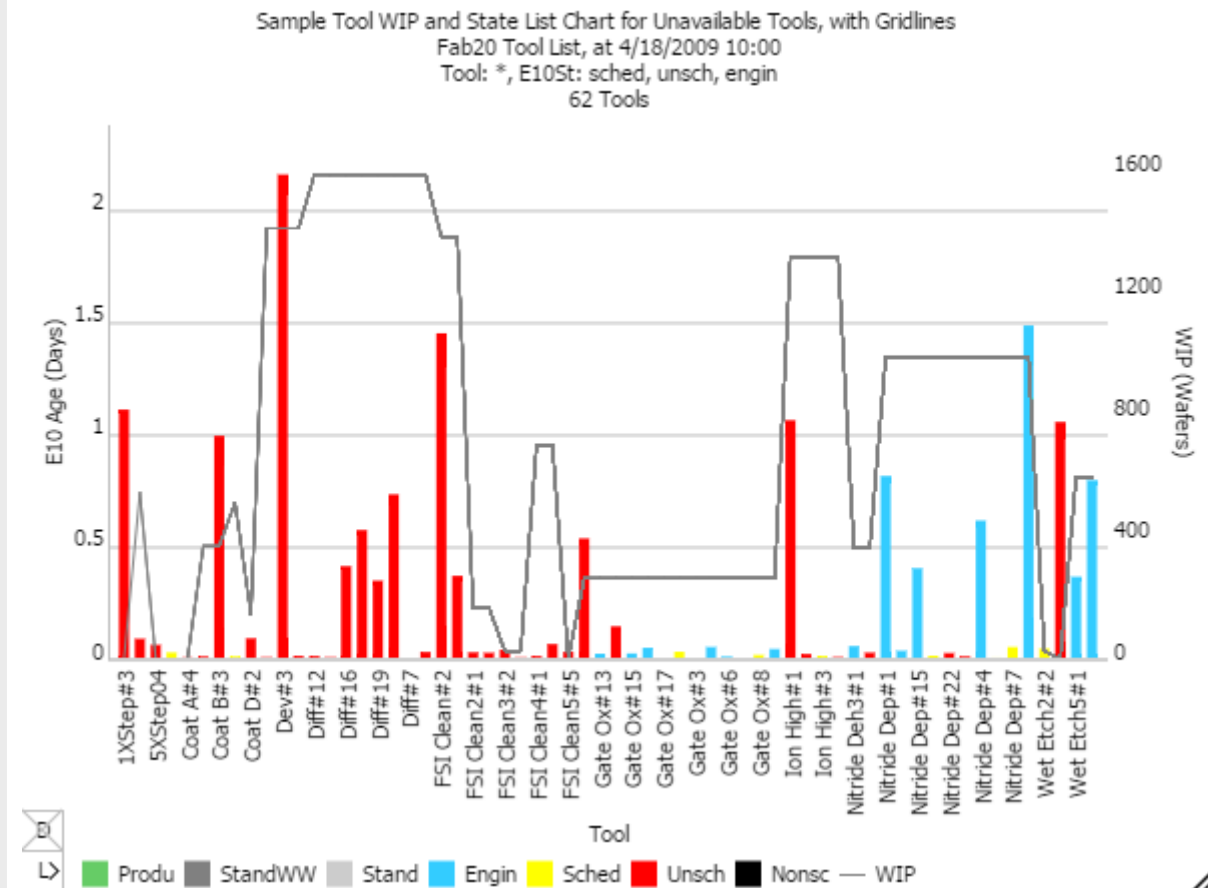
Y-axis gridlines are a new feature available on both JavaScript and ChartFX charts. Gridlines can make it easier to visually identify chart values, particularly for charts that do not have goal lines. You can apply gridlines to either the left-hand or (if applicable) right-hand y-axis.

To display gridlines on a chart, whether you are using ChartFX or the new JavaScript engine, scroll down to the format controls in the lower left-hand corner of your screen. You'll now see a "Grid:" drop-down immediately above the "Title:" field. Select "Left-Y", "Right-Y", or none, and press the "Go" button in the lower left. FabTime will re-generate the chart, now displaying light gray gridlines behind the chart columns. An example is shown at the bottom of this page, with left-hand axis gridlines on a Tool WIP and State List chart displaying unavailable tools.

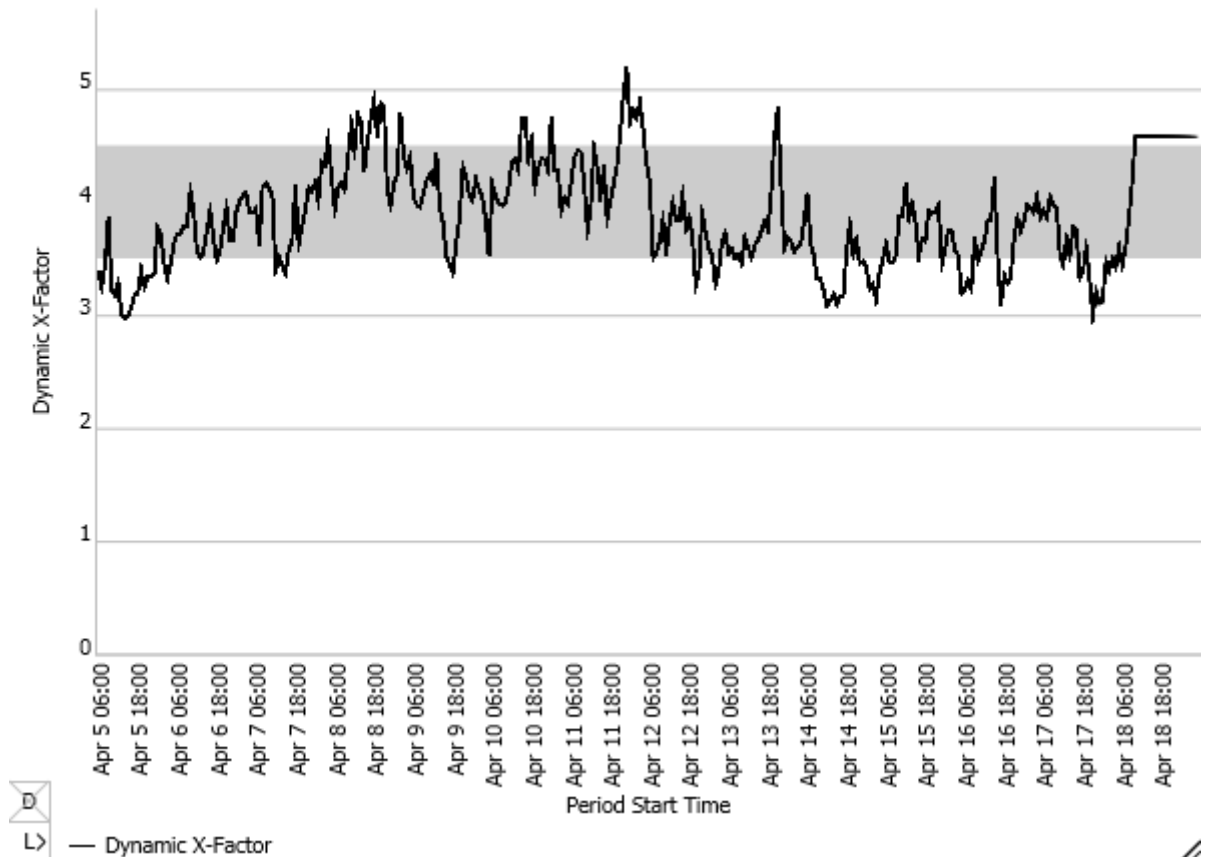
The gridlines will be drawn according to whatever labeling increment is in place for that axis. FabTime normally sets these automatically based on the values in the chart. However, you can change this increment using the "YInc:" or "Y2Inc" fields (located in the same block of format controls).

Gridlines can be used in conjunction with the existing Stripe control. The Stripe control lets you draw a single line across a chart at a point that you designate (with a color and width that you specify). An example is shown at the top of the next page.

We hope you will find the new chart gridlines useful and aesthetically pleasing. We welcome your feedback. Subscribe to the separate [Tip of the Month email list](#) (with additional discussion for customers only). Thanks!



Sample Dynamic X-Factor Chart with Gridlines and Stripe Showing Target Range
Fab20 Dynamic X-Factor (As of 4/18/2009 10:00)
From: 4/5/2009 06:00, To: 4/19/2009 06:00



Motivational Aspects of Goal-Setting for Wafer Fabs

Introduction

One of our subscribers asked us recently if we knew of any studies or literature on the impact of appropriate vs. inappropriate goals on employee performance. This question, with help from Professor Scott Mason, led us to an investigation of the motivational aspects of goal-setting for wafer fabs. We noted in particular the concept of SMART goals, a methodology that has been applied to a variety of industries. In this article, we discuss some

high-level underpinnings of goal-setting, and then apply the SMART methodology to wafer fabs.

Management, Employees, and Goals

Here are three high-level things that we know about management goal-setting and employee motivation:

1. The Hawthorne Effect suggests that setting goals, and showing people that you are monitoring them, can, in and of itself, lead to at least a short-term improvement.

The Hawthorne Effect refers to an early 20th century research study that concluded that worker productivity increases as a result of the workers being studied. This phenomenon is believed to be due at least in part to the fact that work is a group activity, and employees strive for a sense of belonging [Hopp and Spearman].

The Hawthorne Effect means that if you are looking to improve performance in a manufacturing facility, it may help to let workers know that you are paying attention to what they are doing. One way to do this is to have highly visible reports, with color that quickly shows whether things are good or bad. Of course it's not enough to just have the reports - management has to demonstrate that they are using the reports to track how people are doing. Thus the Hawthorne Effect provides justification for goal-tracking in the first place. See issue 14.02 for more details.

2. It's important for secondary goals (e.g. for areas) to be set such that in meeting them, a fab will achieve its overall goals (e.g. weekly throughput). This suggests that setting individual goals too low can lead to serious performance problems. Some employees will work to reach a particular goal, but not necessarily to exceed it. So, a lower bound on short-term or lower level goals is that they suffice to meet the overall production requirements of the factory. (See Issues 2.08 and 10.01 for details on the relationship between lower level goals and overall fab goals.)

3. There can sometimes be a temptation on the part of managers to set goals to some value higher than that which is actually necessary to meet the overall fab goal. The idea is that this will motivate people to work harder. This technique can be effective, especially in the short term. However, if goals are set too high, such that they are routinely not achievable, employees can become demoralized, which degrades performance. Thus there appears to be a sweet spot for goal setting; high

enough to keep people striving, but not so high that they become overwhelmed. The SMART method outlined below addresses this.

SMART Goal-Setting in Fabs

There has been a significant amount of research on the impact of goals on employee motivation. SMART is a mnemonic acronym that has been in use, with variations, since at least 1981 (Wikipedia). The idea, apparently inspired by Peter Drucker's thinking, is to manage by objectives. SMART stands for (again, with some variants available):

- **Specific**
- **Measurable**
- **Attainable**
- **Relevant**
- **Time-bound**

Let's discuss how each of these applies to goal-setting for wafer fabs. See the articles referenced below by Brian Tracy and Brian Francis Redmond for a more general discussion of SMART goals, among many other resources.

Specific: Each goal should target a specific area for improvement. It should be clear to all employees what will be required to attain the goal. In wafer fabs, there are typically both fab-level goals (e.g. moves and WIP turns by shift for the factory as a whole) and more specific lower-level goals (e.g. moves by production area or even operation). Fabs tend to be quite good at having very specific, very detailed goals.

However, it's important to keep in mind that the people being tracked relative to a particular goal need to have a clear understanding of what that goal is, and how performance to that goal will be monitored. While there is wide-spread understanding of the requirements for meeting moves goals in a fab, use of other goals, particularly variability-related goals, may require more education of employees.

Measurable: There must be a concrete way to measure performance to each goal. Most goals used in fabs are numeric and measured on time scales ranging from hour to shift to day to week, etc. They do tend to be concrete.

Another point, however is that the more clear the measurement of the goal is to people who are affected by it, the better they will be able to work towards that goal. Here some fabs may want to work on transparency and education. It's common for filters to be applied to goals before they are reported to management. For example, we might report the average age of WIP in the fab. But which lots are counted in this calculation? Are lots on hold included or excluded? What about parents of rework children? While this type of filtering is often useful, hiding the filtering behind the scenes can make it harder for people to work successfully toward the goal.

Attainable: The people performing a task must consider the goal to be attainable. Otherwise, there may be a tendency not to try at all (since no amount of effort will enable one to reach the goal). This is covered in detail in Brian Francis Redmond's article on Goal Setting Theory, prepared for a class at Penn State University, and shared publicly online (link below). Redmond shares a graph that shows that performance sharply declines if difficulty is too high. He says:

“Goals are proven to be an effective motivation tactic if difficulty is taken into consideration. They should be set high enough to encourage high performance but low enough to be attainable (PSU, 2012). When this grey area is achieved, goals are proven to be effective. If goals are set too high or too difficult than motivation and commitment suffers as a result. Integrity is another cost that can ensue from setting high performance goals. A study performed by Ordóñez and Scheitzer (2004) reveals that people have a tendency to be dishonest if they fall short

of their goals.... Here you can see that setting goals that are too high not only jeopardizes motivation and commitment but also can create a culture of corruption, dishonesty, and cutting corners (Bennett, 2009).”

In wafer fabs, for example, if moves goals are too high, you may drive people to move only the “easy” lots, to the detriment of overall performance. The trick is to find that sweet spot, where the goal is not too easy, but is achievable by the employee. An obvious hint that goals are being set too aggressively, of course, is if they are rarely met.

Relevant: If a goal is going to motivate people, it's important that the goal matters in some way. In the case of a wafer fab, ultimately, all goals should support the fab's overall financial performance. We strive for better yields because this ties directly to the company's profitability. We strive for better cycle times, particularly in certain markets, because this affects how many customers are willing to buy from us, which affects our long-term profitability. And so on.

Irrelevant goals can lead to the type of corner-cutting behavior mentioned above. There's the story we've heard about how fabs used to measure people based on the number of wafers started into the fab. Wafers would turn up hidden atop the ceiling tiles. Because if all that mattered was starting more WIP, why not start it and then stash it? We do believe that goal selection in fabs has improved dramatically over the years. One reason for this is that goals that are not relevant simply don't help performance.

In today's fab environments, pressure has increased to improve cycle times. Thus goals like WIP turns have increased in relevance, and come into more wide-spread use.

Time-bound: The most effective goals have some target date, a specific schedule

for implementation of the goal. This gives people a framework in which to accomplish their goals. Fabs usually accomplish this by having an effective date range for each goal. The moves goal for this week might be 25,000 moves/day, rising to 27,000 moves/day next week. A risk in goal-setting for wafer fabs, however, is that circumstances in the fab can change rapidly, sometimes more rapidly than goals can be modified to match. For example, a significant change in product mix may change the required moves goals, particularly for tool-level or operation-level goals.

Conclusions

FabTime's software is designed to display fab performance data, and help people to improve. The display of manufacturing-related goals has been integral to our product since our earliest days. We've talked extensively in this newsletter and our cycle time management course about computational issues of goal-setting. In this article, however, we've taken a step back from the mechanics of goal-setting to discuss the motivational aspects. What are the attributes of goals that motivate people? In contrast, what types of goals are demoralizing, and hence likely to be unsuccessful? We've focused in particular on the SMART methodology for goal-setting, which we believe has direct applicability to wafer fabs, and explored that in detail.

Our conclusion is that the most important motivational aspect of goal setting is to establish goals that are not too easy (otherwise people may become unmotivated, and not try), but not too hard (otherwise people may become discouraged, and again not try). It's also important that goals be specific, measurable, relevant, and time-bound, with potential pitfalls for wafer fabs as outlined above.

Closing Questions for FabTime Subscribers

How do you ensure that goals in your fab are attainable? Have you experienced management pressure to set higher stretch goals? Does your fab use the SMART goal-setting methodology?

Further Reading

- Hopp, W. and Spearman, M, *Factory Physics*, IRWIN, 1996.
- Brian Francis Redmond, "[Goal Setting Theory](#)," PSYCH 484: Work Attitudes and Job Motivation, Penn State University, updated 2014.
- J. Robinson and F. Chance, "The Hawthorne Effect Revisited," *FabTime Newsletter*, Volume 14, No. 2, 2013. FabTime newsletters referenced in this issue will be available on request to newsletter subscribers until Issue 16.05 is released. Email newsletter@FabTime.com.
- J. Robinson and F. Chance, "Setting Goals for Fab Performance," *FabTime Newsletter*, Volume 2, No. 8, 2001.
- J. Robinson and F. Chance, "Setting WIP Goals in Wafer Fabs," *FabTime Newsletter*, Volume 10, No. 1, 2009.
- Brian Tracy, "[5 Tips for Motivating Employees: SMART Goal Setting for Managers](#)," Brian Tracy International.
- Wikipedia, "[SMART criteria](#)".

Acknowledgements

We would like to thank Craig Mattson from Polar Semiconductor for inspiring us to think about this topic. We would also like to thank Professor Scott Mason from Clemson University for pointing us in the direction of Brian Francis Redmond's article about goal-setting theory.

Subscriber List

Total number of subscribers: 2787

Top 20 subscribing companies:

- Intel Corporation (148)
- Micron Technology, Inc. (137)
- Maxim Integrated Products, Inc. (127)
- International Rectifier (100)
- Fairchild Semiconductor (97)
- GLOBALFOUNDRIES (75)
- ON Semiconductor (72)
- Carsem M Sdn Bhd (71)
- Texas Instruments (65)
- X-FAB Inc. (58)
- Infineon Technologies (55)
- STMicroelectronics (55)
- Freescale Semiconductor (54)
- Microchip Technology (52)
- Western Digital Corporation (52)
- Analog Devices (49)
- Skyworks Solutions, Inc. (49)
- Seagate Technology (45)
- Atmel Corporation (42)
- IBM (39)

Top 4 subscribing universities:

- Ecole des Mines de Saint-Etienne (EMSE) (18)
- Arizona State University (8)
- Nanyang Technological University (7)
- Virginia Tech (7)

New companies and universities this month:

- ASM Singapore
- Enclos Corporation
- LFoundry (formerly Micron Italy)
- Magic Leap Inc.
- Unitec Semicondutores
- World Competition Consultants

Sampler Set of Other Subscribing Companies and Universities:

- Abbott Laboratories (16)
- Eindhoven University of Technology (1)

- Headway Technologies (26)
- Innovative Micro Technology (IMT) (2)
- K.U.Leuven (1)
- KLA-Tencor (9)
- Ocean Thin Films (1)
- Propysys Brightriver (1)
- Renesas Technology (1)
- Robert Bosch GmbH (5)
- Shanghai Huali Microelectronics (SHLMC) (2)
- Steve Perry Associates (1)
- Truesense Imaging (11)
- University of Alabama - Huntsville (1)
- University of L'Aquila (1)
- Valience (1)
- Viasys (1)
- Wichita State University (1)
- Woodgrain Millwork (1)
- XMC Wuhan China (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.

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® 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

\$7500 plus travel expenses for delivery at your U.S. site for up to 20 participants, each additional participant \$300. Discounts are available for multiple sessions.

Interested?

Contact FabTime for a quote.

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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 and a half-day executive management version are also available upon request. The course is only available for delivery at sites within the United States, unless it is delivered in conjunction with software training for FabTime customers.

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.

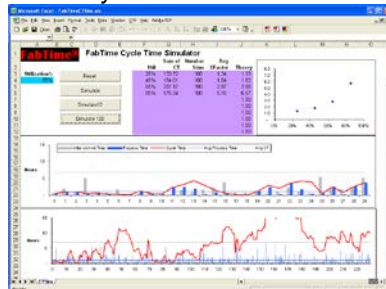
Skills Gained

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

