ACADZ, INC.

Efficiency Solutions for Semiconductor and Electronics Manufacturers

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Minimum Inventory Variability Policy® (MIVP®) – 3 Steps

Summary explanation

MIVP® is a scheduling and release policy (like FIFO) designed to reduce overall average production cycle time. Average cycle time of all the product mix in production is defined as the summation of all the process times plus the wait time (queue time) at each process step from the raw wafer entering the FAB until it is shipped. MIVP® is specifically designed for semiconductor manufacturing. MIVP® has been proven to work at SEMATECH member companies resulting in average cycle time reductions from 7% up to 33% (savings estimated $21 - $100 plus million per year). MIVP® implementation is done after the following three steps:

Step 1: Collection and organization of all product process flows, step by step, including the process time, number of wafers in the process step, and equipment data to calculate theoretical cycle time.

Step 2: Preparation of a baseline simulation model of the FAB using existing scheduling policies and/or FIFO policy. Operation of the model for validation, cycle time and WIP data are saved for comparisons.

Step 3: Switch existing scheduling policies and/or FIFO with MIVP® policies and rerun the model to demonstrate how MIVP® benefits the reduction in cycle time and WIP data.

Once the benefit is seen offline on the simulation model the client can decide to implement MIVP® live in the FAB to obtain improvements.

Detailed explanation

Minimum Inventory Variability Policy® (MIVP®)

MIVP® was invented to implement operations management theories and approaches developed by Dr. Donald W. Collins of ACADZ inc. One of these approaches is the Minimum Inventory Variability Scheduling and Release Policy® (MIVP®). The cycle time for a process and its work-in-process (WIP) inventory are linked, so that improvements in the efficiency of a process can be measured by either cycle time or inventory. Managers of production operations are under constant pressure to reduce costs, while at the same time the manufacturing environment is becoming increasingly complex with larger numbers of inter-dependent processes and greater potential for variability being introduced. Using the MIVP® approach minimizes WIP inventory and leads to an increase in the utilization of expensive capital equipment (and other constrained resources) as well as increased production throughput and shorter cycle times. The MIVP® policies eliminate the instantaneous inventory build-ups that develop when there is any unplanned interruption in a manufacturing process.

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Approach is factory wide

The MIVP® approach takes into account the entire process from raw material to finished product. Its objective is to reduce cycle time by maintaining the minimum WIP necessary for optimal production in view of the inherent variability of factory floor operations. This global concept, which shows how a resource's availability anywhere in the process effects the inventory at any other resource is unique from any other scheduling and release approach.

It has been proven quite effective in the semiconductor industry, for example, where a one percent reduction in cycle time can mean additional sales of $200,000 - $300,000 per month in a 6" wafer FAB. After implementing MIVP®, Motorola's cycle time to make multiple products on one line decreased by 33% over five months.

In another case, the cycle time was reduced 50% on a single product production line. In addition, the shipments to customer's on-time delivery schedule improved from 80% to 95%. In every case these results were obtained without the addition of any personnel or equipment.

Three basic ways to reduce cycle time

ACADZ inc. implements robust scheduling and release policies

Ways to reduce cycle time:

1. Add more resources to increase the capacity at the known bottlenecks in the process,
2. Re-engineer the production process by reducing the number of steps in the product's process flow or tasks necessary to produce a final product, or
3. Implement robust scheduling and release policies -the ACADZ way.

Adding resources or equipment at a known bottleneck can be costly as well as time consuming, and the changes still may not reduce the average cycle time. In fact, in some cases this approach merely shifts the bottleneck to some other point in the production process. Re-engineering an already qualified process that is producing an already qualified product can also be quite expensive and time consuming. This method will reduce the cycle time of this product but may not affect the overall average product cycle time in the FAB. Implementing a new scheduling and release policy, however, can be done virtually immediately with minimal costs and no additional personnel or equipment nor any necessity for re-qualifying the process or the product (because they don't change!). In addition, it is possible to actually observe and confirm the shorter cycle time within 1.5 times of the original cycle. For example, if the overall production cycle time has typically been 35 days then a reduction can be observed within 52 days. Using MIVP®, typical reductions in average cycle time are in the 7% to 45% range for semiconductor manufacturing. And the only costs incurred are the fees to set up and use the MIVP® policy algorithms.

There are many optimal scheduling and release approaches (both commercially available and theoretical), which can, in theory, handle the numerous variables and interactions inherent in all but the simplest of manu-

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facturing processes. The problem is the computer time needed to actually run through all the different combinations and then prioritize them to gain the optimal one. This process is very time consuming and expensive. In addition, it is normal for factory conditions to change often and require re-computation of the production schedule and releases.

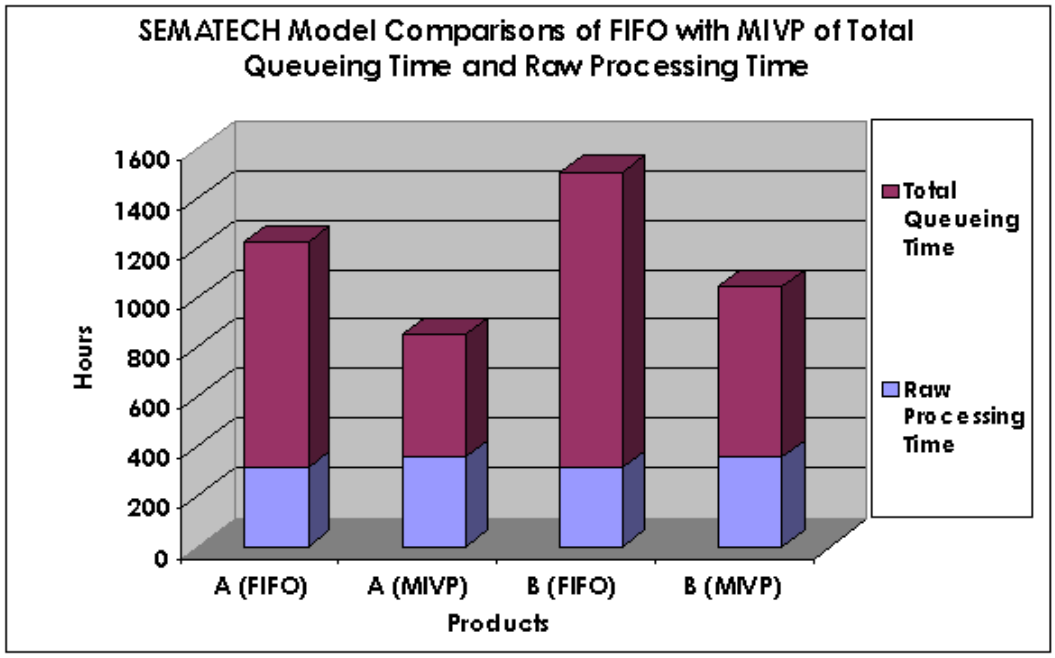
The MIVP® algorithms are distributed throughout the FAB on your local area network to accomplish better results in real time with less expense.

Proven at other semiconductor factories

The MIVP® system has already been implemented in several manufacturing plants. The achieved results have been delivered at national conferences and published in various journals. Summarizing from these various sources the results to date are: decreases in cycle time of 20% for specialty part manufacturing, 27% for aerospace manufacturing, and 33% for semiconductor manufacturing. At one semiconductor 6" wafer FAB the cost savings for 1% reduction in cycle time was estimated at $1.0 to $1.5 million after four to six months ($33 – 49.5 million in total savings).

Table 1. SEMATECH Model Comparisons of FIFO with 1-Step Ahead MIVP®

The below chart clearly shows that MIVP® reduced the total queueing time (wait time) of both product A and B compared with FIFO.



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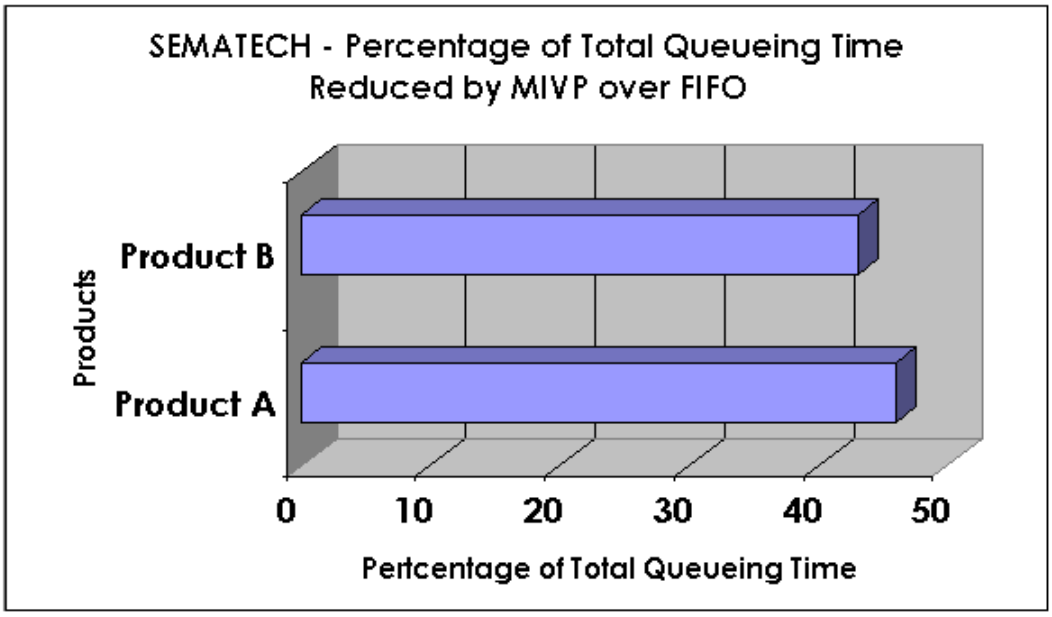

This SEMATECH chart shows the Total Queueing Time (wait time) percentage reduced for products A and B by MIVP® compared with FIFO.

Use of modeling to demonstrate MIVP® benefits

Implementation of the MIVP® system is structured to minimize the client's risk. First, the client retains ACADZ inc. to develop a simulation model of the current production process. Your company can use the simulation model to play "What If" scenarios, for example:

- How many employees are required in the Etch Bay?
- What is the bottleneck in the FAB when I run this product mix?
- If I add an extra machine at the bottleneck, will the overall cycle time be reduced? Or, will the bottleneck shift to some other location in the FAB?

These are a few questions that can be answered by simulation. ACADZ uses simulation to prove to you, our customer, that MIVP® is better than FIFO and how much better. You will know how much your proprietary scheduling rules improve over FIFO so now a comparison can be made to MIVP®.

Once the simulation model is complete and validated using the company's current set of data, the model can be run using FIFO to gather a set of baseline data for average cycle time and WIP. Next, the same model and data are used to incorporate the MIVP® algorithms, and the simulation is run again and a new cycle time and WIP data are generated.

The results from this comparison show the potential to be gained from implementing MIVP® in this specific

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manufacturing process. This analysis allows management to measure the benefits of implementing MIVP® algorithms compared to the cost of implementation for their factory. Costs for the simulation model and implementation depend upon the amount of data needed to be collected, size of factory, number of process flows, and number of steps in each process flow.

All of these activities are accomplished with no interference in the factory's ongoing production. ACADZ inc. wants to be your partner to help improve your bottom line by reducing your average cycle time for now and in the future

About ACADZ inc.

ACADZ offers a unique set of efficiency technologies to multi-step discrete manufacturers. Our best of class algorithms typically reduce cycle time by 10-15% or more. Simulation modeling services provide a cost effective method to perform capacity, planning, and bottleneck analysis, as well as verify benefits before implementation. Our hardware solutions can reduce waste due to mis-fed WIP while providing an automated, dynamic link between the factory floor and the planning model or MES.

Our company will provide you with the data needed to make decisions to implement MIVP® to augment your current scheduling and release policies. Our scheduling and release policies take into account batch processing, manufacturing priorities, changing priority mix, hot lots, engineering lots, emergency and scheduled maintenance and other potential variables. These variables can be customized into the MIVP® decision rules for your factory. Our system complements your existing scheduling and release policies by minimizing the wait time throughout the factory and not just in front of the present resource. ACADZ inc.'s MIVP® decision rules can work seamlessly with other existing scheduling simulation software such as Extend™, AutoSched™ or can be connected directly to the MES.

ACADZ inc. associates can work side by side with your management and staff to gather and organize data to prepare factory production simulation models. The major benefits to our clients are derived from the scheduling and release policies called Minimum Inventory Variability Scheduling and Release Policy (MIVP®) from ACADZ inc. - Concept Analysis Design from A to Z.

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