

# IMPROVING BATCH PRODUCTIVITY INTEGRATING APF PRODUCTS

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## ABSTRACT

The APF Dispatching/Reporting Software has played a key role in providing real-time logistical data to an existing tool level interface. This provides an integrated view of the FAB from the tools perspective.

## INTRODUCTION

Status information about the manufacturing tools and work in process inventory are critical to making the hundreds of decisions needed to successfully operate a wafer manufacturing line on a daily basis. With a complex multitool, multi-technology, multi-product manufacturing facility like National Semiconductor's wafer FAB in Arlington, Texas the need to execute to a plan is critical. Just knowing who is planning what next, in which tool can be a time consuming communication exercise. These plans are always somewhat flexible in responding to WIP mix, tool availability changes, associate work schedule and skill sets. Working in a "Just in Time" environment while being on the look out for exceptions ("queue jumping hot lots", or "Static WIP" as well as Special Work Requests for certain portions of lots) makes the planning process even more difficult. Being able to project output by the "end of business" adds its own special status requirements when attempting to measure turns and operational outputs. On demand "up to the minute", as provided by leveraging information from APF, is preferred to "hourly updated" batch reports. Combined with a GUI interface by JGA, operational staff productivity increases in the 30% range are obtainable.

## MANUFACTURING EXECUTION SYSTEMS

There is a love/hate relationship with Manufacturing Execution Systems, you can't live without them but sometimes combining the right tidbits of information can become a daunting task for the typical user. Using APF on the Brooks-PRI tap into the Workstream Classic MES is like the difference between ledger books and an accounting database. The advantage comes from as simple a thing as the command line reporter interface. A rather simple DOS/Perl script can launch a query, whose results are

presented in an Excel file full of customized information to assist in the planning for maximized

load sizes in a diffusion tube. Before those "theory of constrain" police get all in a huff, lets look at the total time spent in queue for a typical semiconductor line. Queue time is typically driven by poor equipment availability. The tool is unavailable for this lot because it is already busy with another typically partially full batch of something else. This is particularly true in a highly mixed, multi-flow, multi-product wafer fab. Adding a rule like "wait for full batch" to the scheduling system can drive the total cycle time out the roof. Getting a handle on "batch size" can create many hours of work for a discrete event simulator/modeler. The key to successful manufacturing is not having to wait at all, but to rather have a full batch, no more or less, arriving 'just in time'. Just forget about "buying more capacity" just to cover every contingency and change of product start plan. Using an airline industry analogy, travelers plan to arrive at the airport based on the daily scheduled departures. When an airline can stick to the published schedule, passengers can avoid being tangled in queue and it can seem almost as good as chartering, just not as expensive as buying a private one. Ok, they can't stick to every published schedule exactly but if every passenger could get that update instantly then many other choices become available vs. waiting in the terminal. The key is near as possible real time data.

## ADVANCED PRODUCTIVITY FAMILY TOOLS

Here is where APF comes to the rescue by integrating data with the dispatching (DLIS) and presenting that information in a Graphical User Interface. Since APF can accept a command line with arguments it is possible to create links either on a web page, for the whole enterprise to see, or locally within the GUI. These links launch highly customized queries written by users not just programmers since they take advantage of the APF Formatter's block approach to joining databases tables that are updated through the

'real time' MES tap. These reports can be complex yet run in a scheduling mode every couple of minutes since the database access is so much faster than retrieving bits here and there from the MES. Figure 1 shows an APF formatter view of a query that joins 12 tables yet runs within a matter of seconds.

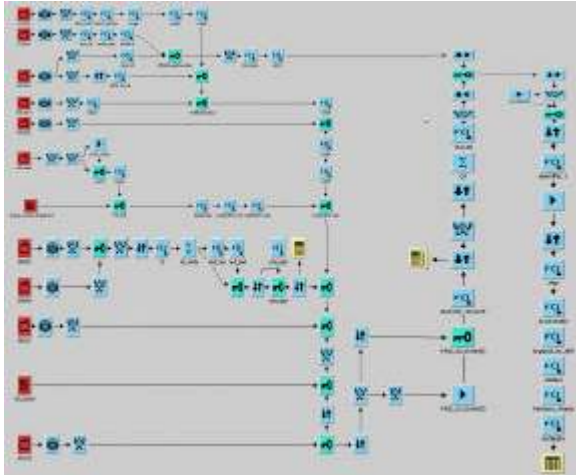


Figure 1 - APF Formatter Example Diagram

## TOOL AND LOGISTICAL DATA

The MES, and hence APF, has a wealth of information about the virtual tool and WIP. This combination can be called "logistical data" as contrasted to the physical "tool data" (e.g. alarms, temperature, boat speed, time remaining, etc ...). Both types of data are essential to making the 'best possible decision' about the use of a tool. Examples of logistical data include:

- Lots/Routes/Operation in Current Process
- Wafer count of Current Process
- Next Process Planned
- Wafers Available for Next Process Planned
- Rank of Next Process Planned
- Person making Next Process Planned
- Qualifications / Preventive Maintenance
- Work In Process Inventory (WIP)
- Unloading scheduling

This "logistical data" from these background queries has been combined into an existing graphical user interface called Bayview.

## BAYVIEW INTERFACE

Bayview was produced by Jon Goldman Associates and historically has displayed the real time "tool side data". This exists within each production bay and typically displays data for the tools within that immediate vicinity. Think of them like those ubiquitous monitors in the airport that display arrival and departure times. The Bayview GUI can, however, be any combination of tools including up to 76 within one window. Typical groupings include:

- Gate Oxidation Focus Area Tubes
- LPCVD Poly Deposition Focus Area Tubes
- North Work cell Tubes
- All Diffusion Area Tubes

The ability to have multiple ways to display the information makes it easier to manage a groups of processes, tools and people. The Bayview interface provides a common look and feel for different tools. Adding buttons makes a launching off point for APF queries. In this way Bayview provides a standard set of "logistical data" for each tool and the ability to query for a larger context. Figure 2 shows the GUI for one tube.

 PFT420 115P75A	<b>DRIVE</b> X2
	02:41 JUN 26, 16:42 <b>06260636.JGA</b>
Qty In: 96	Next Rank: 1 by cswltx
Qty: 60 of 322	Next Plan: PF1173

Figure 2-Shows 8 Logistical and 6 Tool level facts.

## SUMMARY

The combination of APF's "real time" and "on-demand" queries, linked with Bayview provide a tool for improving the productivity of batching tools within the diffusion area. The merging of physical tool level data and the virtual WIP enable improved planning. This allows many groups of loads to be well planned in advance yet taking into consideration the dynamic situations on a manufacturing floor.

## **BIOGRAPHY**

**GEORGE LOGSDON**, Principal Process Engineer, has over 24 years experience in semiconductor manufacturing, joining National Semiconductor in 1983. Mr. Logsdon holds a B.A. in Education from Concordia College in St. Paul.

**RAMESH RAO**, Manager, Decision Tools Group has been with National Semiconductor Corp. since 1996. Prior to that he was at the University of Virginia where he received his Ms and PhD Degrees. His interests include simulation, RTD, algorithms, factory analysis tools, e-Manufacturing, and factory automation architectures.