GE
Intelligent Platforms

Improve the Agility of Demand-Driven Supply Networks

Leverage real-time production data to optimize the supply chain for a sustainable competitive advantage

Introduction

With increasing global competition in consumer products manufacturing and shrinking profit margins, it has become imperative for manufacturers to increase productivity and lower costs. While some manufacturers have been able to reap financial savings by implementing demand-driven supply strategies, many have still not exploited the full potential of even greater cost reductions from within their supply chains, which may be attainable using the wealth of information that exists within their plants.

The missed opportunity is particularly relevant for businesses that predict their manufacturing capacity based *solely* on historical cost standards defined in their enterprise resource planning (ERP) systems. If they instead enabled stakeholders on the enterprise side of the business to access near real-time manufacturing data—connecting the "manufacturing side" and "enterprise side" together—they could potentially save millions of dollars in materials, scheduling, and logistics.

This white paper discusses where untapped information may exist in the plant and how manufacturing information should be managed through the implementation of Operational Excellence initiatives. It also provides examples of how this manufacturing information can optimize production and planning within the enterprise side of the business to significantly reduce costs.

Real customer scenarios

Scenario 1

A day-to-night shift changeover planning meeting for production and planning staff at a brewery: During the day shift, the packaging area had several hours of downtime due to issues with the pasteurizer, resulting in production being several hours behind where it planned to be at the shift changeover. One of the brewery's key customers had a high priority order that was due to ship the next day, and even running through the night, it would not make the shipment time.

The scheduler was a little agitated as it was the first time that he was made aware of the delay, and no one had informed the logistics manager. Based on the fact it was 9 p.m. and the logistics manager had gone home, it was going to be the next day before he could be made aware of the issue.

All that could be done the next morning was to cancel the pickup planned for that day and expedite a special shipment on the weekend so the delivery could be made without penalty to the brewer. Expedited deliveries, as anyone buying products online knows, are hugely expensive, and in this case both the cost to expedite and cancel the original pickup were outside the negotiated logistics contract—directly impacting the profitability of the sale.

Scenario 2

Friday morning shift meeting at a CPG manufacturer: Production had been running extremely well during the last few shifts with throughput held at 4% better than planned overnight, and seemed to be on track to maintain that pace into the weekend. Just as this information was shared, the materials manager walked in and reviewed the shift report and current inventory levels report, and then abruptly ran out of the room.

Later, he explained that the manufacturer had reached a level of reliability that allowed for very low buffers of packaging material stock, so with a 4% better-than-expected pace holding, it would have run out of roll stock for packaging by Sunday, which would have interrupted its overall schedule—putting other customer deliveries at risk.

The packaging supplier in Mexico could easily provide an extra replenishment, but if it was notified too late in the day on Friday, the contract rules about notice periods for replenishment would have been broken, triggering an "off-contract purchase" premium. Furthermore, if the shipment were dispatched too late, this would require logistics to be expedited (with extra costs there, too).

There are two main takeaways from these real-world stories:

- By having better production consistency and repeatability, manufacturers can minimize disruptions to their production processes.
- By enabling better visibility into real-time manufacturing performance information, purchasing, scheduling, and logistics teams can make timely decisions to minimize additional costs to the business.

Many companies using production software may have the "parts and pieces" in place to increase the agility of their supply networks today but they have not yet fully exploited the capability, which requires making manufacturing information accessible to the enterprise side of the business. Manufacturing Execution Systems (MES) solutions such as GE Intelligent Platforms' Proficy* software, which connects to ERP systems like SAP, provide increased visibility and real-time insight into production for better business decisions.

The following section discusses how to drive better production consistency and repeatability by focusing on the manufacturing operations side of the business.

Manufacturing operations side: Baseline requirements

To optimize the savings that can be achieved in the supply chain, all the different elements must work together in harmony; any disruptions will have a "domino" effect, as described in the earlier examples. Factoring in the manufacturing constraints is a key element in managing the whole supply chain circle, and there are two main options: develop standard manufacturing performance metrics based upon historical data or implement Operational Excellence processes to accurately control and measure repeatable production.

However, using historical data typically means developing a standard performance metric with a considerable error margin built in to avoid any possible disruption to the supply chain. This means the manufacturer is consistently underachieving the potential of its business; there are no major disruptions because the margin for error is so large, they are hidden.

Going back to Scenario 1 mentioned earlier, the brewery's ERP standard production metrics for a specific product did not align with the actual throughput achievable on the filling lines. There was always two hours of downtime per shift included in the number—a classic case of disguising the problem instead of fixing it. Based on the filler capacity of 1,200 cans per minute, even if the brewery only reduced downtime by 10%, every run would finish 12 minutes earlier than planned or have capacity for an additional 14,400 cans in the same runtime.

A second example, one global pharmaceutical company acquired a subsidiary and deployed GE's Proficy Batch software solution across its new plants to roll out its best practices. Using the software, it discovered 80% additional capacity at one plant, because the plant's reported capacity measurement reflected what had been done in the past rather than what possible capacity could be achieved.

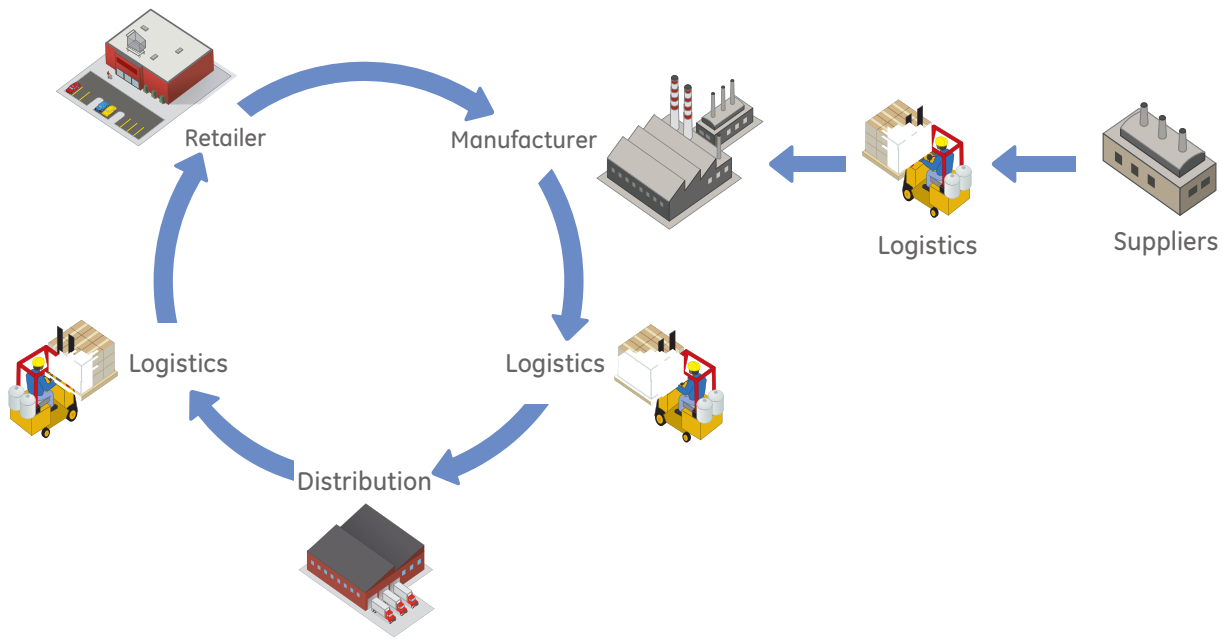


Figure 1 In a demand-driven supply network, an information-rich manufacturing environment plays a key role in supply chain effectiveness and agility.

The decision to accurately control and measure repeatable production is key as this both maximizes the production capacity and efficiency of the plant while driving the repeatability and consistency required so as not to disrupt the supply network.

Some consumer products companies have already implemented solutions such as Batch Execution, SCADA, and MES to pursue Operational Excellence, which helps drive production consistency and repeatability to maximize the cost savings from the supply chain. The other option, as mentioned earlier, would be to lower the performance expectations of the plant, which would mask the true manufacturing agility available in the supply chain.

Information needed at the supply chain level

Assuming that Operational Excellence programs are under way in the plant, below are the foundational building blocks for providing the information needed to stakeholders at the supply chain level.

Tell me what we did

Understanding the physical constraints of the process by product (SKU) type requires having a detailed, accurate history of manufacturing performance. The foundation for this is a process historian such as Proficy Historian software, which allows for the storage and retrieval of hundreds of thousands of raw data points, combined with an MES solution such as Proficy Plant Applications that provides context to the raw throughput and consumption data—delivering historical analysis by process order, SKU, unit, line, shift, and crew.

Tell me how we're doing

Knowing where the manufacturing operation is currently performing against goals is another key information element required; execution software provides in-process control and visualization of this information. Typically, to make the information more useful, companies need to know more than just the SKU/recipe number and progress, and MES solutions such as Proficy Plant Applications provide additional insight. The ability to track the current run status of a process order across multiple areas and lines in real time provides valuable information—enabling machine-to-machine, line-to-line, and site-to-site comparisons by product run.

Tell me what we're going to do

Software capabilities like in-process scheduling that tracks the current production status and calculates forward the predicted material consumption and completion time based on current data (from the control system) and historical data (from the process historian) can provide an early indicator to any disruptions that occur mid process.

The combination of the three elements above provides the base information that materials managers, schedulers, and logistics managers need to know to improve agility and avoid supply chain issues. With an understanding of how and where the information should be managed from the manufacturing side, the next section investigates how this information provides value to the enterprise side of the business.

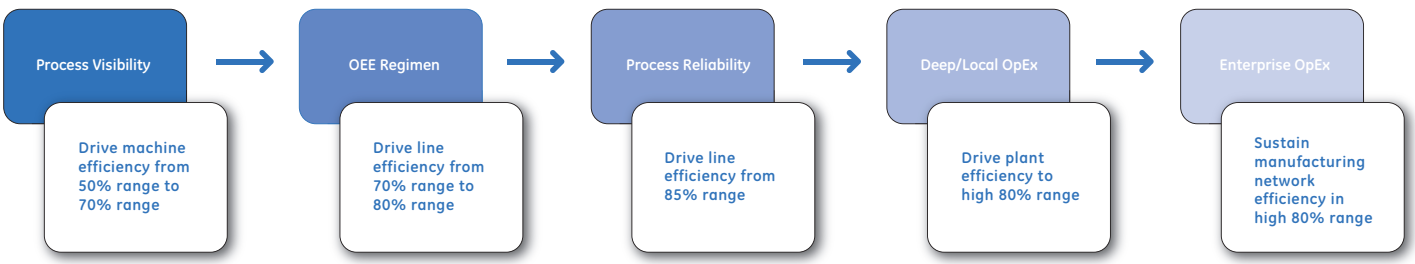
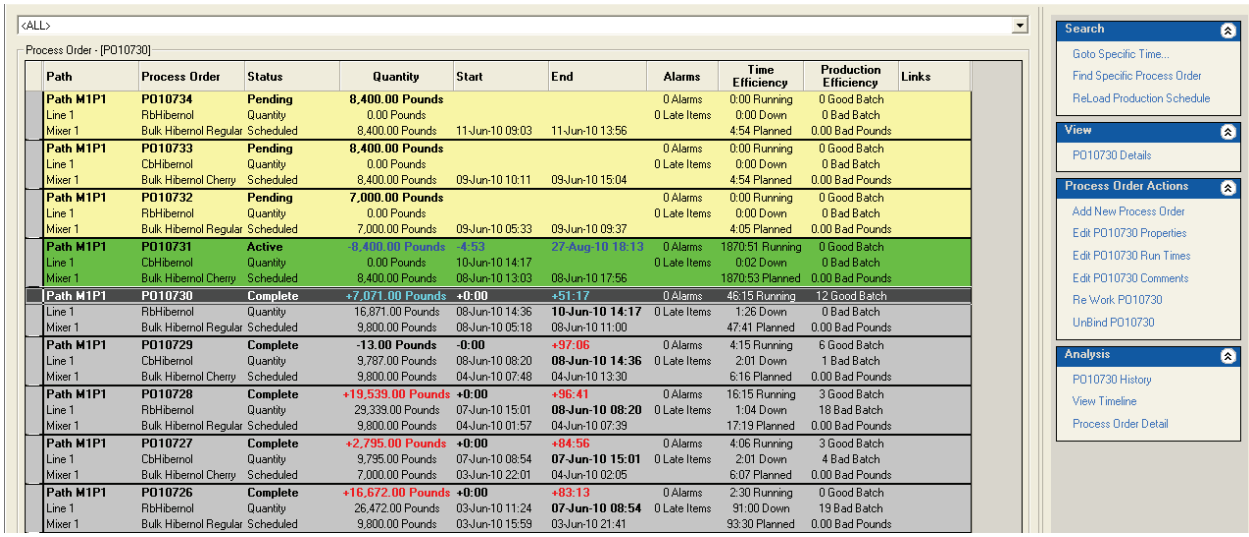
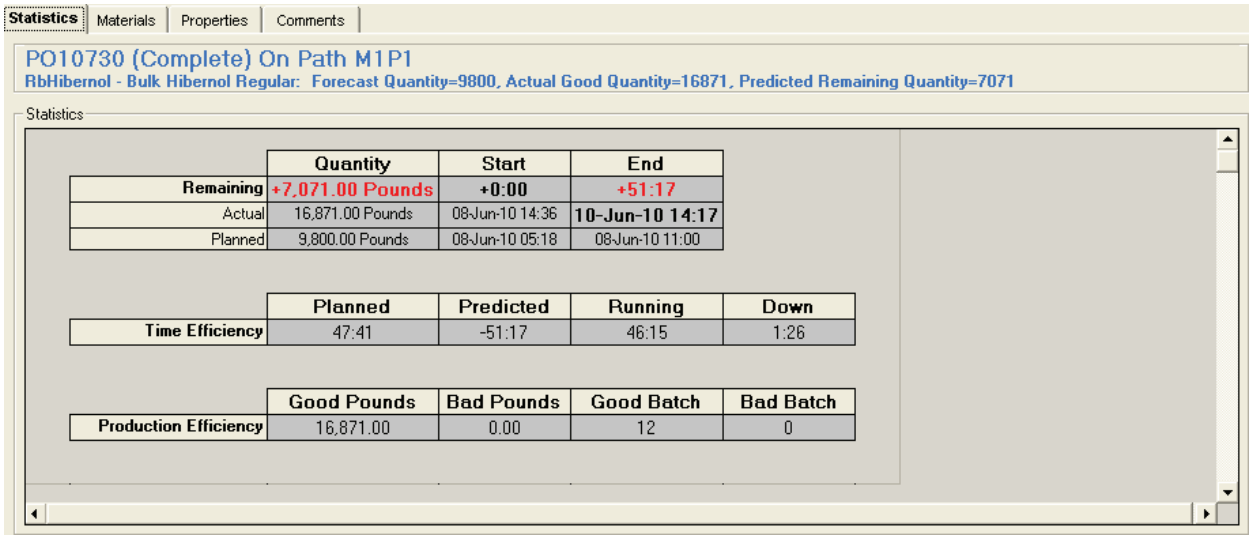


Figure 2 GE's Operational Excellence journey: Manufacturers need to implement Operational Excellence programs to drive manufacturing process stability and repeatability—providing the foundation for supply chain optimization.



Path	Process Order	Status	Quantity	Start	End	Alarms	Time Efficiency	Production Efficiency	Links
Path M1P1	PO10734	Pending	8,400.00 Pounds			0 Alarms	0:00 Running	0 Good Batch	
Line 1	RbHibernol	Quantity	0.00 Pounds			0 Late Items	0:00 Down	0 Bad Batch	
Mixer 1	Bulk Hibernol Regular	Scheduled	8,400.00 Pounds	11-Jun-10 09:03	11-Jun-10 13:56		4:54 Planned	0.00 Bad Pounds	
Path M1P1	PO10733	Pending	8,400.00 Pounds			0 Alarms	0:00 Running	0 Good Batch	
Line 1	CbHibernol	Quantity	0.00 Pounds			0 Late Items	0:00 Down	0 Bad Batch	
Mixer 1	Bulk Hibernol Cherry	Scheduled	8,400.00 Pounds	09-Jun-10 10:11	09-Jun-10 15:04		4:54 Planned	0.00 Bad Pounds	
Path M1P1	PO10732	Pending	7,000.00 Pounds			0 Alarms	0:00 Running	0 Good Batch	
Line 1	RbHibernol	Quantity	0.00 Pounds			0 Late Items	0:00 Down	0 Bad Batch	
Mixer 1	Bulk Hibernol Regular	Scheduled	7,000.00 Pounds	09-Jun-10 05:33	09-Jun-10 09:37		4:05 Planned	0.00 Bad Pounds	
Path M1P1	PO10731	Active	-8,400.00 Pounds	-4:53	27-Aug-10 18:13	0 Alarms	1870:51 Running	0 Good Batch	
Line 1	CbHibernol	Quantity	0.00 Pounds	10-Jun-10 14:17		0 Late Items	0:02 Down	0 Bad Batch	
Mixer 1	Bulk Hibernol Cherry	Scheduled	8,400.00 Pounds	08-Jun-10 13:03	08-Jun-10 17:56		1870:53 Planned	0.00 Bad Pounds	
Path M1P1	PO10730	Complete	+7,071.00 Pounds	+0:00	+51:17	0 Alarms	46:15 Running	12 Good Batch	
Line 1	RbHibernol	Quantity	16,871.00 Pounds	08-Jun-10 14:36	10-Jun-10 14:17	0 Late Items	1:26 Down	0 Bad Batch	
Mixer 1	Bulk Hibernol Regular	Scheduled	9,800.00 Pounds	08-Jun-10 05:18	08-Jun-10 11:00		47:41 Planned	0.00 Bad Pounds	
Path M1P1	PO10729	Complete	-13.00 Pounds	-0:00	+97:06	0 Alarms	4:15 Running	6 Good Batch	
Line 1	CbHibernol	Quantity	9,787.00 Pounds	08-Jun-10 08:20	08-Jun-10 14:36	0 Late Items	2:01 Down	1 Bad Batch	
Mixer 1	Bulk Hibernol Cherry	Scheduled	9,800.00 Pounds	04-Jun-10 07:48	04-Jun-10 13:30		6:16 Planned	0.00 Bad Pounds	
Path M1P1	PO10728	Complete	+19,539.00 Pounds	+0:00	+96:41	0 Alarms	16:15 Running	3 Good Batch	
Line 1	RbHibernol	Quantity	29,339.00 Pounds	07-Jun-10 15:01	08-Jun-10 08:20	0 Late Items	1:04 Down	18 Bad Batch	
Mixer 1	Bulk Hibernol Regular	Scheduled	9,800.00 Pounds	04-Jun-10 01:57	04-Jun-10 07:39		17:19 Planned	0.00 Bad Pounds	
Path M1P1	PO10727	Complete	+2,795.00 Pounds	+0:00	+84:56	0 Alarms	4:06 Running	3 Good Batch	
Line 1	CbHibernol	Quantity	9,795.00 Pounds	07-Jun-10 08:54	07-Jun-10 15:01	0 Late Items	2:01 Down	4 Bad Batch	
Mixer 1	Bulk Hibernol Cherry	Scheduled	7,000.00 Pounds	03-Jun-10 22:01	04-Jun-10 02:05		6:07 Planned	0.00 Bad Pounds	
Path M1P1	PO10726	Complete	+16,672.00 Pounds	+0:00	+83:13	0 Alarms	2:30 Running	0 Good Batch	
Line 1	RbHibernol	Quantity	26,472.00 Pounds	03-Jun-10 11:24	07-Jun-10 08:54	0 Late Items	91:00 Down	19 Bad Batch	
Mixer 1	Bulk Hibernol Regular	Scheduled	9,800.00 Pounds	03-Jun-10 15:59	03-Jun-10 21:41		93:30 Planned	0.00 Bad Pounds	

Figure 3 GE's Proficy Plant Applications Scheduling Display: The software shows actual performance and calculates predictive performance for process orders for both quantity and time, information that can be used for more accurate planning purposes.



	Quantity	Start	End
Remaining	+7,071.00 Pounds	+0:00	+51:17
Actual	16,871.00 Pounds	08-Jun-10 14:36	10-Jun-10 14:17
Planned	9,800.00 Pounds	08-Jun-10 05:18	08-Jun-10 11:00

	Planned	Predicted	Running	Down
Time Efficiency	47:41	-51:17	46:15	1:26

	Good Pounds	Bad Pounds	Good Batch	Bad Batch
Production Efficiency	16,871.00	0.00	12	0

Figure 4 GE's Proficy Plant Applications Scheduling Analysis: Access to historical records of all process orders for both time and production efficiency enable better planning.

Enterprise side: Materials, scheduling, and logistics

There has been much effort invested in leaning out the supply chain, which has increased cost savings for companies undertaking this task. The three key performance metrics that companies tend to focus on are return on assets (ROA), inventory turns, and revenue growth, as reflected by AMR's research (recently acquired by Gartner, Inc.), "The 2010 Retail Handbook for Becoming Demand Driven," that says, "Having a better handle than their peers on three key supply chain performance metrics, demand-driven retailers deliver 73% greater return on assets, improve inventory turns by 19%, and see 55% more revenue growth."

To the right are these metrics and a discussion on how providing more agility from the manufacturing plant impacts them.

Demand-driven Leader Performance			
Measurement	**Demand-Driven Retailers**	**Retail Peers**	**Difference**
Return on assets (ROA)	7.1%	4.1%	73.2%
Inventory turns	13.5	11.3	19.5%
Revenue growth	9.4%	6.1%	55.1%

Gartner, Inc., The 2010 Retail Handbook for Becoming Demand Driven, (M. Griswold et al), December 2009

Return on Assets (ROA) links Operational Excellence to profitability as increased plant-level efficiencies drive higher profits on the same capital base, hence a higher ROA. Having more agility in the manufacturing process allows manufacturers to confidently replenish products in the timelines required, and the extra capacity that Operational Excellence programs uncover allows for faster NPIs, as time to market is critical in the competitive consumer space.

Inventory Turns (also known as "Stock Turns") are driven by customer behavioral patterns to ensure delivery of the right type of product to the right customer at the right time. High inventory turns result when a predictable plant can accept and use many small lots of ingredients/materials, and relatively quickly turn them into outbound shipments—thus, avoiding cash tied up in stale, slow-moving inventory at both ends of the production process.

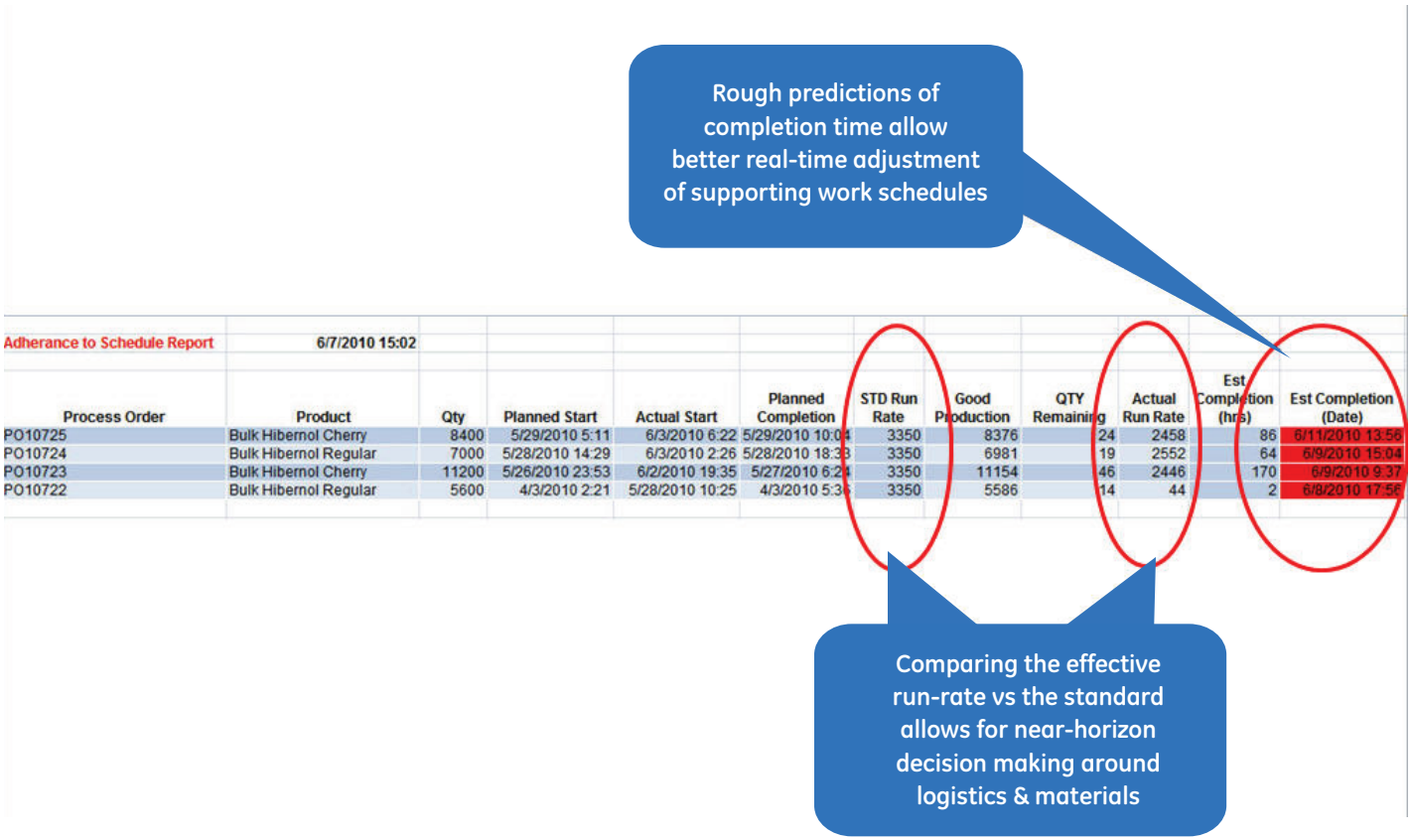
Revenue Growth is a key measurement for all sales companies, whereby consumer companies use analytical tools along with product development teams to drive growth by development, evolution, or acquisition of new technologies and products. This adds the "what else can I sell and what can I sell it for?" dimension to the Inventory Turns data. Increasing OEE (Overall Equipment Effectiveness) helps manufacturers gain additional capacity for new products without large capital investment—allowing them to drive maximum capacity within the existing infrastructure for improved top line growth.

Bringing it all together

Companies need to understand the types of information available in the plant and how they can be used to increase ROA. Typically, corporate ERP systems such as SAP contain performance metrics for the ***theoretical*** run rate, production counts, and yields per product type (SKU); these are used by the stakeholders to form part of the inputs for their predictive planning processes.

The real impact is going to be adjusting the action plan based on the differences between the historical performance metrics that most materials managers and schedulers have to use today and the real-world data from the manufacturing systems—enabling additional accuracy and agility for supply chain excellence. Below is an example of a web report that pulls information from GE's Proficy Historian and Plant Applications software. Plant Applications pulls a number of key data items, including the "***tell me how we're doing"*** and the "***tell me what we're going to do"*** information categories mentioned previously. The included standard (STD) run rate number comes from the existing ERP system and is the only item in this spreadsheet that did not come from the Proficy software.

Using this information, materials managers, schedulers, and logistics managers can make informed decisions regarding any deviations from the forecast plan, avoiding the real-world scenarios shared at the beginning of this paper.



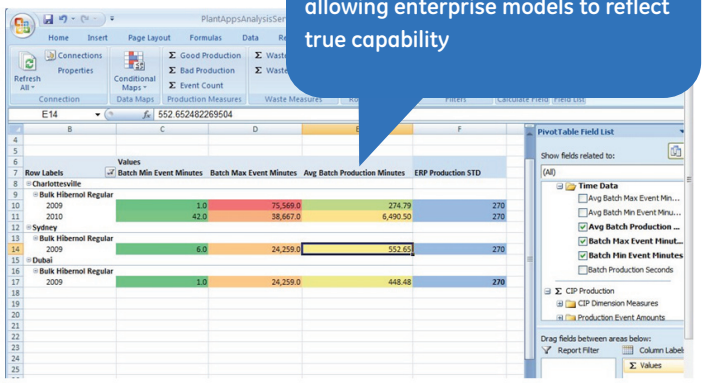
Improve the Agility of Demand-Driven Supply Networks

Scalability and going global

The importance of impacting the supply chain goes beyond a single plant to multiple plants. For example, manufacturers that have Proficy software deployed across multiple plants have gained agility across their operations in global sites—fully realizing cost savings in the development and manufacturing of products, which can have an even more significant impact on ROA.

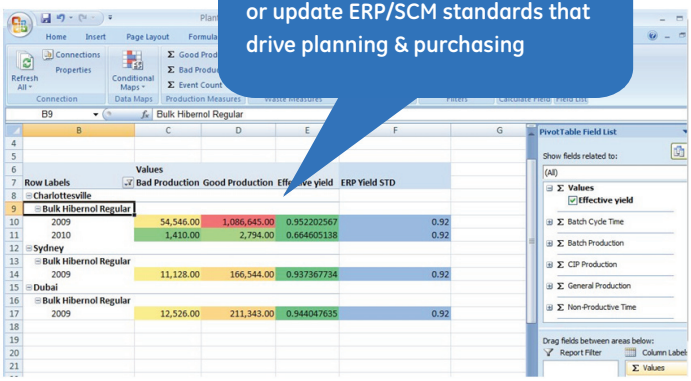
Shown below is a Proficy DataMart report that has pulled data from several global sites. It compares the Proficy effective yield calculation based on 18 months of data across three sites, with the ERP standard metric. Companies can close the loop between the historical metrics from the ERP system and the reality of what was actually achieved to optimize planning with greater accuracy—driving continuous improvements.

A picture of effective throughput over time and across sites can lead to better logistics planning—again allowing enterprise models to reflect true capability



Row Labels	Batch Min Event Minutes	Batch Max Event Minutes	Avg Batch Production Minutes	ERP Production STD
Charlottesville				
Bulk Hibernol Regular				
2009	1.0	75,569.0	274.79	270
2010	42.0	38,667.0	6,490.50	270
Sydney				
Bulk Hibernol Regular				
2009	6.0	24,259.0	552.65	270
Dubai				
Bulk Hibernol Regular				
2009	1.0	24,259.0	448.48	270

Aggregating consumption and yield data provides means to validate or update ERP/SCM standards that drive planning & purchasing



Row Labels	Bad Production	Good Production	Effective yield	ERP Yield STD
Charlottesville				
Bulk Hibernol Regular				
2009	54,546.00	1,086,645.00	0.952202567	0.92
2010	1,410.00	2,794.00	0.664605138	0.92
Sydney				
Bulk Hibernol Regular				
2009	11,128.00	166,544.00	0.937367734	0.92
Dubai				
Bulk Hibernol Regular				
2009	12,526.00	211,343.00	0.944047635	0.92

The next example shows the same data set but views data by average batch production time such as "how well did we make the same product at different sites?" This information is very useful in understanding the real capability of the plants using true "apples-to-apples" comparisons. Again, the only information in this example that does not come from Proficy is the ERP production STD number.

Conclusion

To add true value to a demand-driven supply network, reliable and predictable manufacturing practices are the baseline requirements, which Operational Excellence programs can help achieve—not only to drive production consistency but also to uncover capacity and improve efficiency. Advanced software solutions can help companies achieve Operational Excellence for continuous improvements and deliver cost savings in the supply chain.

Once manufacturing operations are stable and repeatable, the coordination of the real-time status of orders, inventory changes, and overall process performance with ERP systems can significantly increase the agility of a manufacturer's supply network—using the "what we're doing" data rather than the "what we think we can do" data—to optimize production and planning for a sustainable competitive advantage.

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