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# WHITE PAPER

## Securing increased efficiencies and lower manufacturing costs
## Finite scheduling – a staged approach

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## 1. Introduction

Manufacturing firms are operating in tough times, thanks to a paradoxical mix of challenges: advances in processes, technology and techniques have brought major benefits but also make their own demands. Product and process innovation is being driven at unprecedented rates but supply chains are, partly as a consequence, becoming more complicated. The volatility of energy markets makes the cost of both core production activities and logistics increasingly difficult to manage. While gains have been made from implementing robust management systems and adopting continuous improvement methodologies such as Lean and Six Sigma, the rate of change in production operations can erode hard-won benefits, in a surprisingly short time. All of this is happening at the same time as constant pressure to reduce inventory from the traditional high levels, which may have tied up capital but they also acted as a shield against demand spikes or supply disruptions.

Finite Capacity Scheduling (FCS), applied effectively, can be a powerful tool for managing a manufacturers' response to these issues. By helping manufacturers maintain a dynamically-updated sequence of shop floor instructions that match production demands to best-to-use resources, FCS makes it easier to systematically address the problems that ripple down from the broader business environment.

FCS capabilities cover a wide range, from simple visualisation of the complex dependencies between materials, processes and supporting operations, to fully mathematically modelling those relationships. In the latter case, it can calculate the optimum way to resolve the potentially conflicting demands of manufacturing due dates and "easiest to manufacture reliably" sequences.

Most successful users of FCS adopt their systems' functions in a staged manner. This allows them to develop new disciplines at a pace that ensures successful adoption of each new capability and this, in turn, paves the way for the next step of their program.

This paper explores how a three-stage approach can increase the likelihood of a successful adoption of FCS functions and capabilities. Doing so will give the manufacturer the opportunity to reap rewards such as:

- **Recovered capacity** - minimizing time lost to changeovers, and ensuring production is routed to most-efficient asset
- **Reduced material wastage** – by establishing sequences of production that minimise the magnitude of changes in key material characteristics from job to job. This helps to reduce the level of change in machine configurations and, consequently, cuts the risk of scrap production as processes re-start and re-establish steady-state operations

- **Reduction in excess labour activity** – Capacity-constrained producers may be focused on overtime reduction but improved scheduling practices allows all businesses to re-assess labour needs for core production and support operations
- **Reduced logistics costs** – the improved predictability that flows from an effective FCS implementation can assist both in "right sizing" purchase lots and in reducing the occurrence of high-cost freight 'expedites'. "Pull-based" operations, which respond to specific orders rather than aggregate forecasts, can incur significant excess freight charges, as logistical economies are typically sacrificed in favour of customer responsiveness

## 2. The right foundations

FCS does not stand alone. While it offers the ability to find the best ways to use factory and material resources, obtaining best value depends on the availability of other information. Figure 1 illustrates the way FCS typically works alongside financial or ERP systems, as well as shop floor data collection

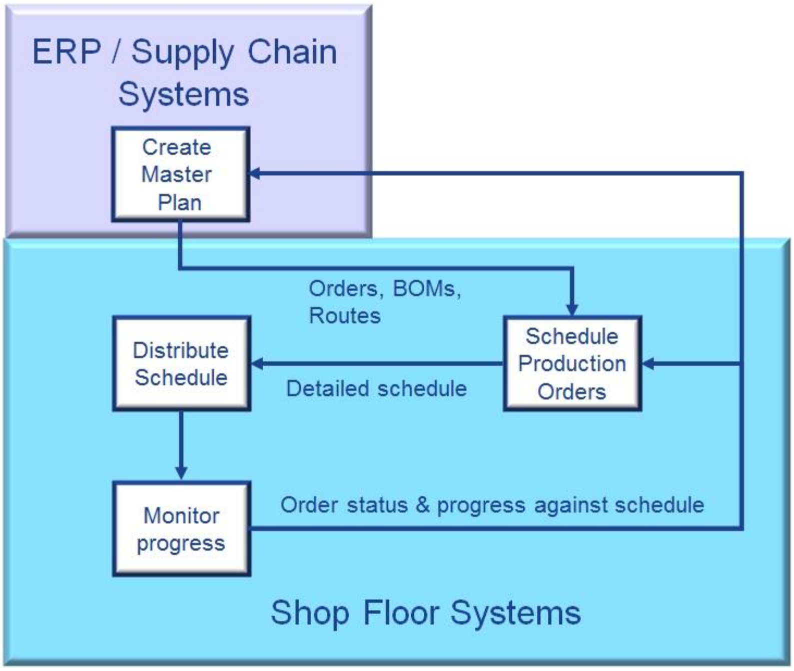


**Figure 1 - ERP, FCS and the Shop Floor**

An FCS will take master product and routing information from the enterprise systems and localise it. This will ensure that special characteristics of the local production assets are accounted for when selecting efficient production routes, and when estimating order duration and completion times. As well as tracking the progress of current orders – work in progress – shop floor data collection systems also provide critical “as run” throughput and yield information. This helps the standards in the FCS to remain accurate and, consequently, to continually improve the reliability of the projections it makes.

## 3. First step: Coordination

The first area of opportunity arising from moving to a systematised scheduling system lies in simply improving the speed and accuracy of coordinating activities. Manual or spreadsheet-based methods break down when confronted with unexpected changes to the order base on one hand, or disruptions from the shop floor on the other. With a “live system” in place, producers will able to:

- Take advantage of reporting clients or web reports to easily share updated schedules – eliminating delays related to manual scheduling
- Monitor shop floor disruptions like machine breakdowns or quality incidents and see how they affect order progress and schedule attainment, in real time. This enables faster interventions and can thus minimise the ripple effects of the initial incident

This level of real-time insight and adjustment means that supporting operations can also be properly coordinated. Other areas that can benefit from the ready availability of a live schedule incorporating progress and projected completions include:

- Staff performing off-line “make-ready” work
- Internal material dispatch teams
- Shipping and yard/traffic management teams
- Lab/quality technicians
- Sales/customer service staff
- Maintenance and engineering groups

As a firm embeds live scheduling into daily operations, benefits such as improved attainment rates and recovered capacity will be seen to be flowing from it. As a result, trust will grow in the new method of translating customer orders to daily work instructions. For many firms, especially those with relatively simple BOMs and limited choices in how to route production, this may be sufficient for site-level needs. For others, the next stage of usage can be considered.

## 4. Optimising – combining expertise with powerful tools

A good FCS system does more than calculate projected due dates. It provides a way of ensuring that the sequence of orders released to a given asset or route is going to keep the assets running as close as possible to top speed, and minimise the amount of time (and sometimes product) lost to changes from one product to another. In plants where speed and changeover can be affected by seeking order sequences that reflect gradual, rather than abrupt (or inconsistent) shifts in product characteristics, an optimising tool will help to manage the “competition for priority” between efficiency (resolved across one or more physical factors) and the due dates of the production orders. This competition becomes even more difficult to resolve without an FCS system in situations where products can be dynamically routed (can be run on one of many similar machines at each process stage).Factors that may cause sudden shifts are likely to include dimensions, colours, viscosity, allergenic content, and so on.

Once the machines and products have been modelled appropriately, an FCS tool will provide a mix of automated calculation functions and manual interventions that will enable fast responses to changing order bases and shop floor disruptions.

Figure 2 illustrates the “workbench” of Proficy Scheduler, where a GANTT style user interface enables a user to quickly ascertain the state of an order as well as route or machine loading, and see the effects of the current schedule on material inventories and staff activity.

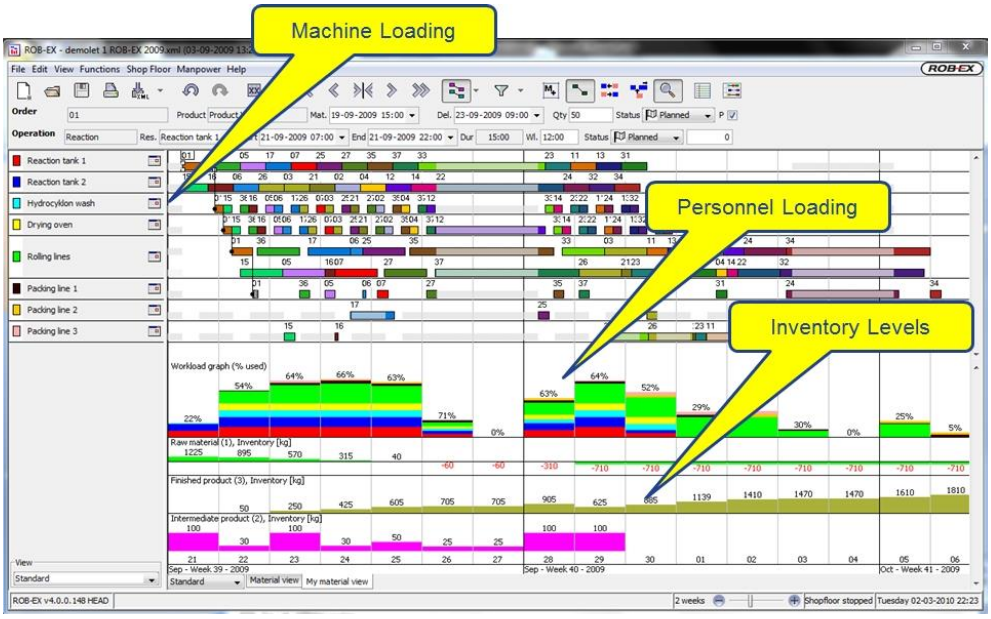


**Figure 2 - Proficy Scheduler (Workbench)**

The speed and responsiveness gained through the coordination stage remain important. Adding optimisation means that efficiency is not sacrificed for the sake of responsiveness.

## 5. Reaping benefits beyond the plant

It’s important to bear in mind that reaping the gains described is dependent on predictability, not perfection! The FCS and data collection systems may help to identify areas that require changes in maintenance practices, or broader re-engineering, in order to improve overall reliability.

However the use of plant systems data is sufficient to ensure that the standards for throughput and yield used in the FCS system are accurate and based on actual performance. This will enable the factory to ensure that materials are purchased and staged close to time of use, avoid shortage-driven excessive logistics costs, and to drive down on and reduce late production. Those standards become a matrix of actual average effectiveness, "by product, by route", as shown the example in Table 1 below (NB: this is a simplified representation and does not reflect the complexity of real-world BOMs or routes):

| | | **Route 1** | | **Route 2** | | **Route 3** | |
|---|---|---|---|---|---|---|---|
| | | **Throughput** | **Yield** | **Throughput** | **Yield** | **Throughput** | **Yield** |
| *SKU A* | | 1000/hr | 98% | 1025/hr | 95% | 1100/hr | 98% |
| *SKU B* | | 1050/hr | 95% | 975/hr | 92% | 1050/hr | 98% |
| *SKU C* | | 885/hr | 99% | 1100/hr | 94% | 975/hr | 91% |

**Table 1 - Throughput and yield by SKU**

Once those standards have been established, the insights gained can be "re-used" and fed into broader planning systems and processes. Table 2 illustrates the deployment of "average effectiveness" key performance indicators:

| *KPI* | **Site level use (beyond daily operations)** | **Supply network level use** |
|---|---|---|
| *Average effective throughput* | Determining labour needs | Rough demand vs. capacity planning & forecasting |
| | Prioritising engineering and maintenance | Determining production assignments between plants by balancing production efficiency against logistics |
| | | |
| *Average effective yield* | Staging materials in time for usage | Optimising purchase lot sizes & related freight modes |
| | Reducing inbound "expedites" | Determining overall purchase needs to support price negotiations |

**Table 2 - KPIs**

The most advanced users of FCS and supply chain systems may use these KPIs to factor into their capital equipment requirements analysis. Differences in effective throughput and yield can highlight whether total production is constrained by factors that can be improved, such as excessive downtime and inconsistent quality, or if investment in plant and capital is genuinely needed in order to keep up with new or changing demands.

## 6. Conclusions

The effective scheduling of production requires an understanding of the physical relationships between materials and equipment, as well as the clearer priorities of customer deadlines. Manual approaches to planning may provide a simple-to-use toolkit but it will generally be unable to deliver on capacity recoveries and cost avoidances. These require fast reactions to changing customer demands, production disruptions and other variables.

Structured finite scheduling systems can offer manufacturers a path to realising value through recovered capacity, reduced excess labour and lower logistics costs. These are achieved by a combination of improved coordination ability and inherently more efficient production assignments. “Best practice” is considered to be a staged approach, beginning with a focus on coordination and communication and followed by enablement of optimisation tools and techniques.

Such an approach will allow stakeholders in scheduling, operations, logistics and purchasing to collaborate progressively more effectively. Operational gains at the site will yield insight and data that can ultimately ripple out into planning and supply chain processes. The company will be able to achieve sustainable competitive advantages in the face of rapidly changing products, processes and markets.

Contact Astec on +44 1543 888334/134 or email enquiries@astecsolutions.com to discuss how we can help you take advantage of a powerful, integrated, Finite Capacity Scheduling system.