WORLD CLASS MANUFACTURING: PART 2
THE BUSINESS REQUIREMENTS FOR WORLD CLASS MANUFACTURING CONTROL

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INTRODUCTION

This is the second article in a series that discusses the business requirements for world class manufacturing control. Meeting those requirements will deliver quality products and service, at minimum cost, on time, while providing the means to reduce lead times and investment and to improve cash flow.

The business requirements include finite capacity planning, finite capacity scheduling, and a shop floor control (manufacturing execution) system. Together these satisfy the manufacturing control requirements that exist between process and management systems, such as materials requirements planning (MRP) or other core business applications, while allowing the manufacturer to maximise benefit from all of those complementary technologies.

OVERVIEW

In the first article, published April 1998, a policy and strategy for world class manufacturing control were determined. These recognised current demands on companies, particularly the requirement to provide excellent service at low unit costs. This article explores in more depth the business requirements identified to meet the policy and strategy outlined.

The rationale for each business requirement is discussed, how the elements relate to each other and where they fit between overall business systems and process control.

The tools already in use within manufacturing industry are discussed and alternative approaches suggested.

COMPONENTS OF A WORLD CLASS MANUFACTURING SYSTEM

The elements of a manufacturing control system to support world class have been detailed below, with examples of features. These follow the sequence of activities that will be required for planning and controlling orders. The hierarchy is shown in Figure 2.1.

THE LAYERS OF PLANNING AND CONTROL

Delivery Date Estimation

This function is required to allow estimated delivery dates to be calculated for customer enquiries. New orders are overlaid onto the existing manufacturing plan, before committing delivery dates. This typically requires two alternatives. The first assumes no disturbance to the existing manufacturing plan, by utilising residual capacity. The second option requires a lower level of detailed planning, when dates calculated using the first are unacceptable to the customer.

Where a company understands and is in control of its lead times this might be a simple calculation.

Rough-Cut Capacity Planning

Once new orders have been accepted, they need to be tested against reality. The first process undertaken is rough cut capacity planning. This process assumes infinite capacity is available and is used to check whether machines will be overloaded. This is normally supported through proprietary materials requirements planning (MRP) type packages, which assume delivery dates can be met.

If during this process any machine overloads are encountered, then further detailed evaluation must take place. This creates a requirement for finite capacity planning.

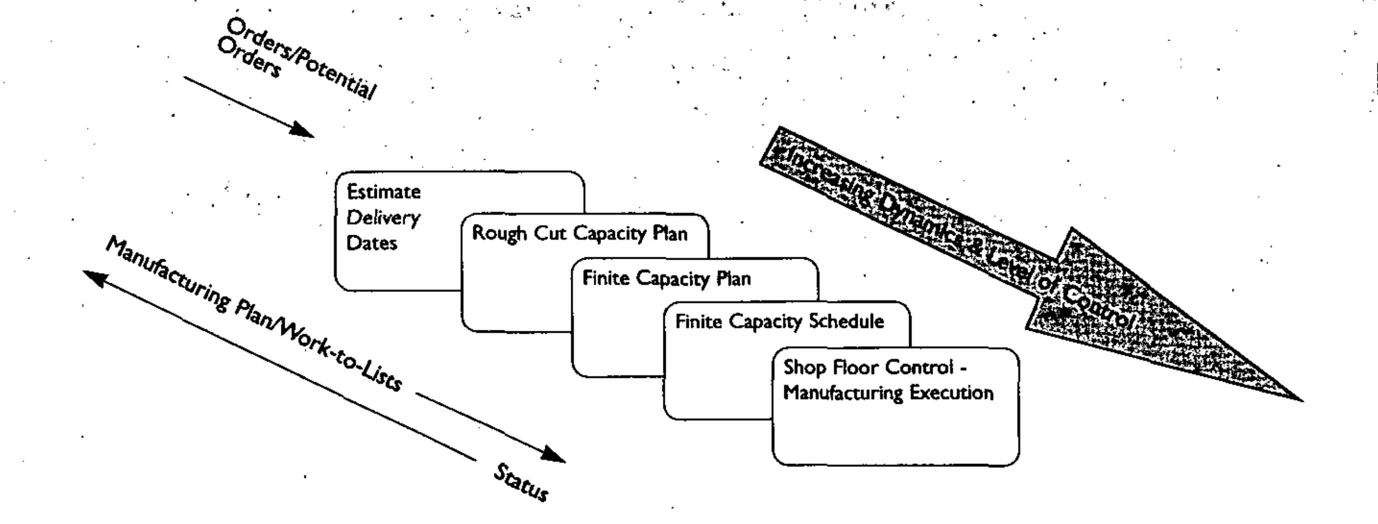
Finite Capacity Planning

Finite capacity planning takes account of available capacity within the planning process. This will then allow orders to be delivered late or early against requirement, dependent on resource commitment and work load.

It is used for longer term simulation of orders against resources and provides *What If?* evaluation. It includes simulation of changes in resource levels, including use of additional shifts, machines, or sub-contract, as well as possible

FIGURE 2.1

THE LAYERS OF PLANNING AND CONTROL



changes to requirement dates. A diagrammatic representation of the role of *What If?* is shown in Figure 2.2.

The result from finite capacity planning is a manufacturing plan and once agreed this must immediately become the current plan, being executed in the factory.

An end product of this process determines delivery dates, which are both believable and realistic. Once any changes are made and agreed then the new manufacturing plan arising, must be automatically used for all associated activities.

Bottlenecks Control Output

The most important feature of finite capacity planning is to identify future bottlenecks, before they happen. Bottlenecks can be caused by capacity constraints or work sequencing problems.

Finite capacity planning comprises the heart of a bottleneck control (or OPT - Optimised Production Technology) system.

Planning Materials Requirements to Finite Capacity

Materials can be a major cost element and they can also be a constraint on start dates. The most effective use of finance is to know the material requirements well in advance. Actual materials required must be carefully planned and dates determined according to the manufacturing plan, calculated to finite capacity. This ensures that valuable and potentially scarce resources are committed when known, subjected to close control, and planned to when capacity determines they can be consumed.

Capacity planning and scheduling and the shop floor must also be aware of shortages, whether planned or unplanned, such that the manufacturing plan is automatically adjusted. For example, information that material will be a week late, must be communicated such that the plan is adjusted now.

Materials and Materiel

The planning and scheduling of **all** materials required to support manufacturing processes is necessary. Materials may be added at any stage of manufacturing.

The total package of materials is known as materiel (sic). Materiel will include for example skills, documentation, tooling, drawings, and process specifications and anything else that may be required to perform a manufacturing operation.

Finite Capacity Scheduling

Finite capacity scheduling enables short term work-to-lists.

If finite capacity scheduling is operational, then the resulting work-to-lists can be achievable and realistic, at the point of production. This is because finite capacity scheduling can take into account the constraints and flexibilities of manufacturing, most notably, that due dates may be unachievable or resources are limited.

Infinite capacity scheduling provides limitless work-to-lists. While this will indicate a sequence of work, it cannot resolve resource conflicts between work centres. It will assume due dates can be achieved, even if they are already delinquent.

Batching

There may appear to be a requirement to batch common items together, or to have a favourable changeover sequence. This may particularly apply to process-type operations and the process industries where common factors apply across orders.

Any batching must be done **prior to order release** to the shop floor. In my experience, batching of work, in an uncontrolled way, is the biggest single factor leading to poor performance. Dynamic batching is dangerous and is likely to cause synchronisation problems at other work centres and within orders.

This does not mean do not batch, but batching must be controlled prior to order release.

Use of Knowledge Based Scheduling Algorithms

On their own, algorithms will not take into account the realities of the shop floor. Unless the schedules (work-to-lists) are linked to execution, then they will break down fairly quickly. This factor limits the value of the algorithmic approach. The answer is not to reschedule quicker, rather to have the ability to overlay the manufacturing plan onto what is happening right now.

Any argument that develops a requirement for fast rescheduling, undermines the validity of the schedule in the first place. If the sequence of work breaks down that quickly, then perhaps it is invalid to start with, and control does not exist. This requirement suggests a control rather than a scheduling problem requiring an execution system.

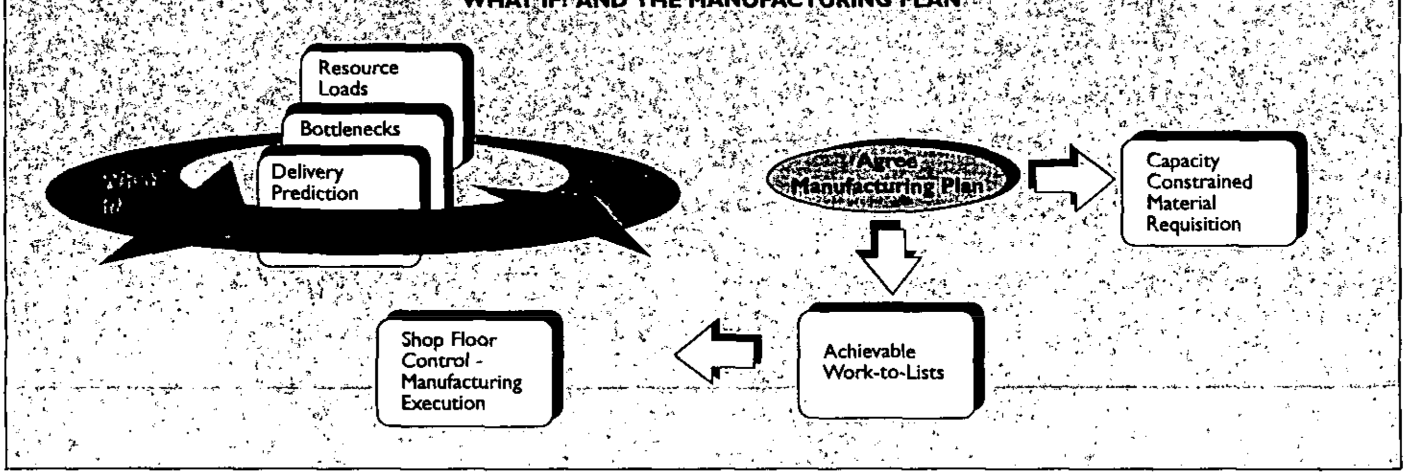
Process Planning

Planning of processes provides the fundamental data for manufacturing by applying the processing standards against the design and product requirements. Data include materials requirements, process information, routings and product structures. Process planning defines the requirement, and the feedback system provides data to compare planned against actual.

Companies often say they cannot plan, due to unplanned things happening. This is not an argument against planning. The more unplanned things that occur, the less in control and the more reason for control.

FIGURE 2.2

WHAT IF? AND THE MANUFACTURING PLAN



Other functions of production control cannot operate without this fundamental data. If formal data is unavailable, then feedback systems can be used to provide data about what has actually happened, and this can be used as a first attempt to model the future.

Detailed process planning will provide the data to indicate, at an early stage, whether there are quality problems. This derives from feedback of actual against planned.

Poor process planning will mask manufacturing problems and is often the root cause of these problems. This is usually the real reason behind arguments against detailed planning. The truth is sometimes frightening, and sometimes easy to ignore. Poor process planning cannot be circumnavigated.

THE ROLE OF THE FEEDBACK SYSTEM

Shop Floor Control - Manufacturing Execution System

The shop floor controls a manufacturing business in financial terms. Most of the capital of a company is tied up on the shop floor through plant and machinery, material resources and work-in-progress (WIP). Subtle changes onthe shop floor can result in major changes to the company's fortunes. Without control of the shop floor, companies are not in control of their businesses.

Shop floor control is the execution system that makes other planning systems effective. It provides data for feedback and comparison of actual against planned against estimate. All the layers of planning and control will not work properly unless shop floor control is in place.

CONCLUSIONS

Finite capacity planning and scheduling provide key components of a world class manufacturing control system.

They can provide the interface between management systems and the shop floor. They are particularly useful in providing realistic and achievable plans for the factory. On their own however, they do not provide all the solutions to maintain control in a dynamic environment and they are of limited use as stand-alone applications. They are, however, a desirable element of a total system, that also includes the manufacturing execution, or shop floor control system.

The input to shop floor control is a work-to-list, preferably calculated to finite capacity.

The theme of the third article will be shop floor control, or manufacturing execution and this will be detailed in the next article. The disappointments of implementing materials requirements planning (MRP) will also be discussed, and how this approach has often proved totally unsuitable for needs of many manufacturing industries.

Acknowledgement

This series of articles is based on a World Class Manufacturing trilogy, first published in *Wire Industry*. Part I was published in September 1996, Part II in March 1997 and part III in July 1997.

About the author

Nick Norton FIOM, is consultancy partner of Borderbow. He has 20 years experience applying the described methodologies across the spectrum of manufacturing industry.

Borderbow is a manufacturing consultancy specialising in the definition and implementation of shop floor control and finite capacity planning and scheduling.