IS MANAGEMENT AFRAID OF THE UNKNOWN?

PART 2. SHOP FLOOR CONTROL - A FUNCTIONAL DEFINITION

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INTRODUCTION

In Part 1 we argued that Shop Floor Control had been neglected or trivialised by most other types of manufacturing planning system. We introduced the requirements for Shop Floor Control and set the scene for our functional model of the shop floor.

We concluded that Shop Floor Control was essential to any manufacturing enterprise, but that its requirements had been misunderstood.

People argue, 'Why Shop Floor Control? Keep it simple'. How do you simplify (trivialise) the most complex and dynamic element of a manufacturing business, and still maintain that the planning systems are serious?

OBJECTIVE

The aim of this article is to substantiate why any business strategy for a manufacturing company is incomplete unless it has addressed the key functional issues of the shop floor. We describe one of the key functional requirements, Order Control, and how this enables Shop Floor Control to be achieved. This enables the planning requirements, created through implementation of business strategy, to be met.

BACKGROUND TO THE FUNCTIONAL DEFINITIONS OF THE SHOP FLOOR

Over the years functional definitions have been developed of the source and location of shop floor data for any manufacturing company. This is represented by 11 data flow, or communication, diagrams, and is supported by the functional requirements specification necessary to achieve Shop Floor Control within any manufacturing enterprise.

In this article, two of the high level diagrams have been included. These go down to three major functional areas, Order Control, Manufacturing Management, and Inspection Management. Below these are a further 9 lower level diagrams, showing the detailed data available on the shop floor. These diagrams define the data that will be required if Shop Floor Control is to operate effectively and is the data that is available within any manufacturing business.

These diagrams show the relationships between data in manufacturing and the correct functional location of the data. That is, they describe all the shop floor communications that must take place, whether or not they have been recognised formally.

The diagrams were originally developed in 1982. Since then they have been used many times. Compared against major system requirements specifications, these diagrams have worked in every case.

PRACTICAL USES AS A MODELLING TOOL

The diagrams have been used for many different purposes over the years. Originally, it was intended to develop a complete software system that contained all the defined functionality, and would work for every environment. This is a sizeable task, but its feasibility under Unix has been proved.

The following uses have been made practically :

- as a means to develop manufacturing system requirements including CIM models
- as a checklist against which system specifications can be matched
- as a systems development tool
- to evaluate products for clients.

In all approximately 120 functions within Shop Floor Control have been defined. Practically, two models have been developed and implemented, using relevant functions for the companies concerned. These were cases where Shop Floor Control was identified as the major manufacturing requirement, but software was not available.

The implementation of 8 of the functions was undertaken for a wire and cable manufacturing company (Reference 1), which resulted in step improvements in manufacturing performance, including a 44% increase in output, at a time of decreasing overheads.

ORDER CONTROL

Following is a description of Order Control. This is a functional area of any manufacturing business and controls all orders, from release through to completion. The environment, responsibilities and processes of Order Control are described.

As stated above, these processes must take place. In many organisations, due to these processes not being formally recognised, they take place at the wrong level, by the wrong people, and often, by more than one functional area. When this happens, control is not achieved, except in the luckiest of situations. This is usually in the smaller companies, where one person tends to take on responsibilities outside of their job function. This, in turn, makes these organisations extremely people-dependent.

ORDER CONTROL - THE ENVIRONMENT

Order Control is a functional element of the Production Control organisation, providing a practical interface between Production Planning and the realities of the Factory Shop Floor.

The basis of the Order Control function is an Order Manufacturing Plan, scheduled to factory capacity (preferably finite capacity), providing:

- planned order requirement dates
- planned order release dates
- planned manufacturing operation start and finish dates.

Planned order requirement dates are generated by Production Control either manually or by automated routines such as Material Requirement/Resource Planning (MRP) or Capacity Planning.

Planned order release dates and manufacturing operation start and finish dates are generated by MRP. Through the use of an automated finite capacity scheduler, the generated dates can have a realistic regard to capacity. The resultant dates provide the basis for each manufacturing departments work-to-schedule. In the case of Order Control, they provide the planned order release schedule.

Planned material requirements are generated by MRP, while the apportioning of the materials to the appropriate manufacturing operations within an order is provided through Process Planning by Production Engineering.

Planned material commitments are provided by MRP. Current material availability is provided by Materials Management and local work-in-progress.

The primary function of Order Control is to confirm the release of orders to the Shop Floor and to ensure that the required level of shop documentation is available for work to proceed. Shop documentation consists of:

- order identity document
- order/operation material requirement requisitions
- a process routing sheet.

When and where the shop documentation is made available depends upon the system environment selected by the Order Control organisation. Typical variations are:

- documentation produced externally to the local operation at time of order entry, to be filed within the Order Control office area until the order is officially released
- documentation produced within the Order Control office area, either on-demand prior to order release or automatically at time of order release
- on the shop floor, on demand.

Order/operation material requirement requisitions, whilst being part of the shop documentation package, may be produced independently and on-demand. This applies to environments where printing facilities are available on the shop floor, within stores areas, or locally within Order Control.

Material requirements consist of:

- raw materials for detail part manufacture
- detail parts/sub-assemblies/fixing and proprietary items for assembly manufacture
- engineering drawings
- specialised tooling
- process descriptions (process planning sheets).

Amendments affecting orders under the control of the local Order Control organisation, are either entered manually by Order Control or are incorporated automatically by data transfer from MRP. Order Control ensures that the latest version of shop documentation is made available to the appropriate shop users.

There are four categories of amendments:

- amendments to ordering information
- amendments to process standards
- amendments to design standards
- amendments to order status

Amendments to ordering information are the result of changes in the Order Manufacturing Plan. These amendments come from Production Control through MRP.

Amendments to process standards are the result of changes in design or production techniques. These amendments come from Production Engineering.

Amendments to design standards are the result of engineering changes. Planning the effect of engineering changes is a function of Production Control and can cause amendments to ordering information. Urgent modifications requiring action before the official planning cycle, can cause manual intervention in the form of suspensions and cancellations and the creation of orders to satisfy new requirements.

Amendments to order status are the result of all activities and events reported during an order's progress through the manufacturing cycle.

The required amendment capabilities are:

- order requirement date
- external priority
- scheduled finish date
- order quantity.

Unplanned requirements can be caused by:

- failure of the planning system to provide a requirement
- scrap
- lost in work

- engineering change
- change in priority.

Urgent unplanned requirements requiring action before the official order cycle, can cause orders to be raised manually. Order Control ensures that the routings and process standards obtained from Production Engineering data are appropriately dated and work centre scheduled. When an official response is received from Production Control, Order Control ensure that the relevant up-dated order information and documentation reaches the appropriate shop floor user. Alternatively, urgent unplanned requirements can cause the premature release of existing orders, where accounting procedures permit, ref. Contract Control.

Order Control vet and sanction, when appropriate, Shop Control expediency requests. These are:

- increases in priority of orders causing delay
- unplanned order raising
- premature order release.

ORDER CONTROL - RESPONSIBILITIES

- Reporting the receipt and filing location of shop documentation held by Order Control.
- Releasing orders to the Shop Floor in a scheduled sequence, ensuring that the shop documentation is made available to the relevant Shop Control organisation.
- Investigating work reported scrapped or lost in shop and materials reported short, and ensuring that the required level of remedial action takes place ie. re-ordering.
- Ensuring that all amendments from Production Control and Production Engineering are incorporated and reflected in revised shop floor documentation and work centre schedules.
- Ensuring that all amendments caused by engineering changes are incorporated.
- Reporting all order movements and changes of status to Production Control.
- Reporting all unplanned processes to Production Engineering.
- Reporting all unplanned shortages to Materials Management and Production Control.

ORDER CONTROL - THE PROCESS

Remotely produced shop documentation associated with orders scheduled for imminent release are received in batches into Order Control. Documentation can be filed either by Order Number or Order Number within Order Release Date sequence, pending release to the Shop Floor.

Orders are released to the Shop Floor according to an Order Release Schedule. Shop documentation is either sent to the appropriate Shop Control organisation or printed within it. Reported material losses, affecting work-in-progress are investigated to effect their satisfactory replacement. For materials supplied by in-house manufacture, work-in-progress and stock holdings are analysed to ascertain if free stock will be available to satisfy a loss in time for it's planned usage, and if it is, to invoke any available allocation options. Similar activities are carried out for bought-out materials, which also involves the investigation of purchase orders. When material deficiencies cannot be met in this way, the schedule of pre-released orders or purchasing plan is similarly analysed, and if practical, a planned order can be prematurely released.

If these options fail to provide a satisfactory outcome, a replacement order may be raised using the formal order entry facility provided by the Production Control system. To expedite, a manual order may be prepared, which involves pulling together order data provided by enquiry into supporting systems:

- process planning, to obtain routing, operation process instructions and tooling requirements
- configuration control, to obtain material requirements and modification standards
- stock control, to ascertain material availability and to make allocations and to raise requisitions.

The data is assembled into a partially or fully complete order pack from manually prepared shop documentation, which is then released to Shop Control for manufacture. These actions are reported to Production Control who may choose to officially supercede the manual order.

Order amendments from Production Control are investigated, resulting in order cancellation, suspension, quantity and due date changes. Actions are reported to Production Control.

Production Engineering amendments to routing and process instructions are investigated, ensuring that Shop Control can incorporate their use on any affected work in progress.

Engineering Changes are investigated to determine their effects upon work-in-progress. Affected orders are suspended, pending either, their being planned to meet to the latest design revision by modification, or scrapped because they cannot and replacement orders raised. Scrap action occurs on those occasions when the incorporation of an engineering change is of the highest importance. Documentation supporting the work necessary to carry out the modification is assembled into a job-pack and then routed to Shop Control for action.

All shop floor order movements and status changes to work-in-progress are reported to Production Control, ensuring that their effects are reflected into the production plan.

Any deviations from the process plan occurring during the manufacture of an order ie. the performance of unplanned or out of sequence processes, are reported to Production Engineering for investigation which could lead to a permanent amendment to the process plan.

FIGURE 1. SHOP FLOOR CONTROL – DATA FLOW

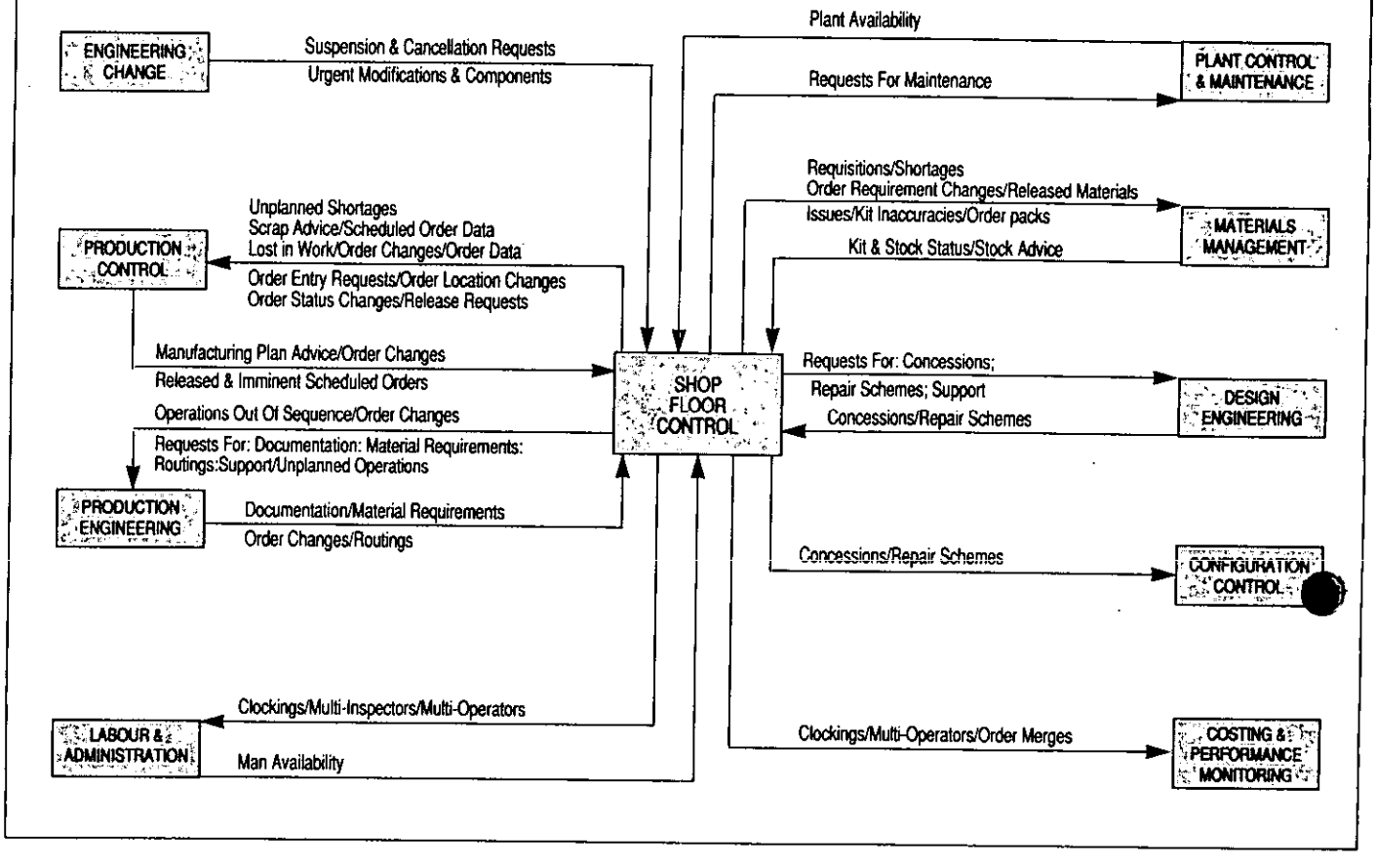
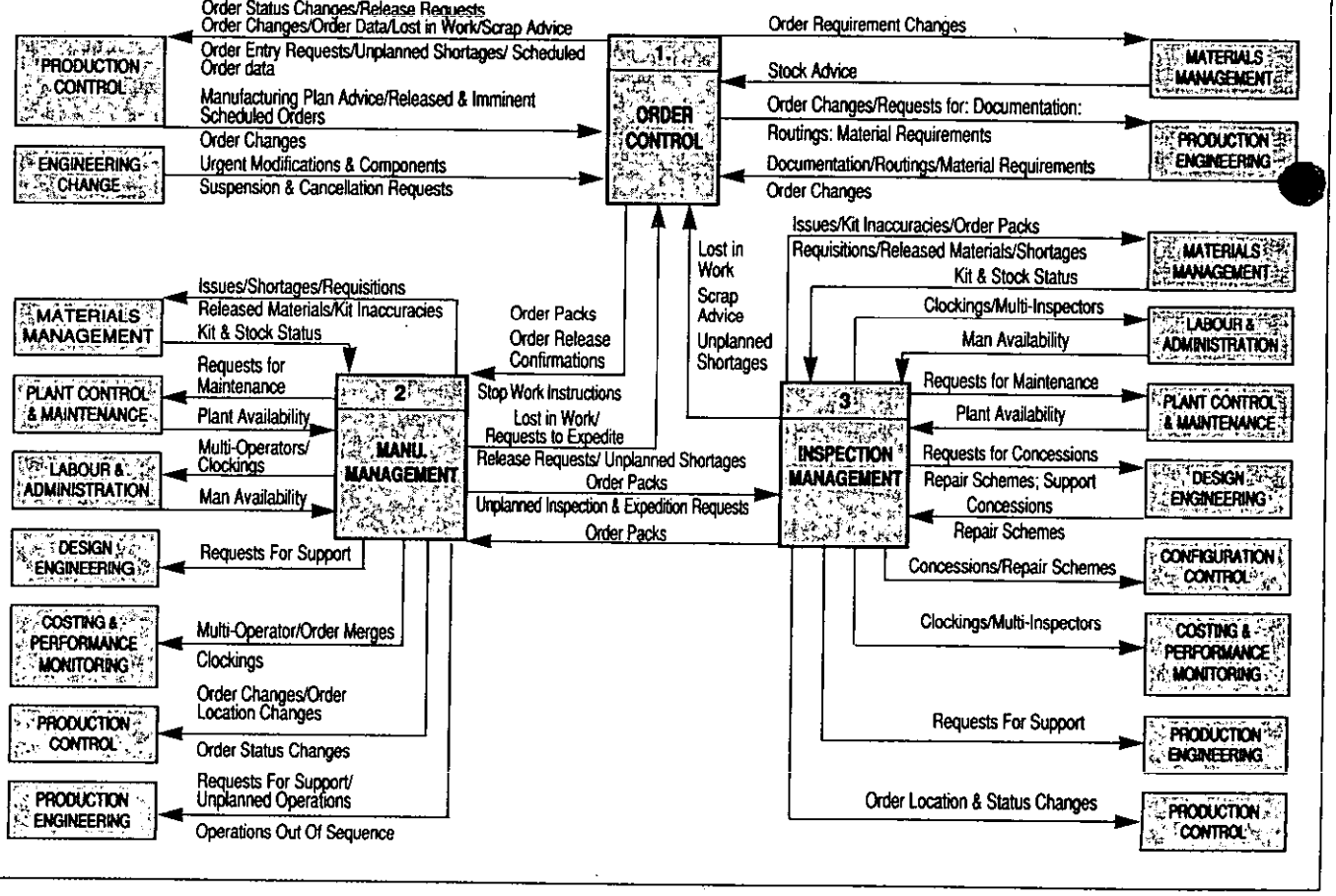


FIGURE 2. SHOP FLOOR CONTROL – FUNCTIONAL DEFINITION AND DATA FLOW DIAGRAM



CONCLUSIONS

It has been argued for many years that the shop floor is impossible to control, because it is ever-changing, and many urgent and unplanned events occur, making any plan break down. This is why it is so important to maintain control. Shop Floor Control allows management to stay in control, and to know what is happening, even when things happen outside their control.

Without Shop Floor Control, other planning systems cannot operate effectively and business strategy must be incomplete.

First-hand experience suggests massive continuing benefits from the introduction of Shop Floor Control. This presents an opportunity to users and suppliers. Because people do not talk about it, or do not have solutions, does not mean that the requirements do not exist.

Is it not talked about, because it is misunderstood? Can we afford to be out of control?

About the Authors

Nicholas Norton BSc DMS CEng MIEE MBPICS. A manufacturing industry professional of 15 years' experience. He specialises as a consultant in: Shop Floor Control and Scheduling, Shop Floor Data Collection, Optimised Production Technology (OPT), Just in Time (JIT). Nick advises companies on manufacturing performance improvement.

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Ian Skinner CEng MIEE FBPICS MBCS. A computer professional of 25 years' experience, having spent 20 years with British Aerospace (14 years in DP). During this time he led the development of all major production and manufacturing systems. He pioneered the Distributed Real-time Manufacturing, Monitoring and Control system in the Commercial Aircraft Division, completing his time with them as the Manufacturing Systems' Group Manager. Since leaving BAe, Ian has continued to be involved with the development of manufacturing systems in various industry types, including electronics and cabling. He has taken a variety of roles, from systems development manager to board-level consultant.

REFERENCE

[1] N G Norton. 'Capacity Management and the Control of Bottlenecks within a Shop Floor Control System' : Case Study. BPICS Control, June/July 1992. p39-42.