WORLD CLASS MANUFACTURING AND SHOP FLOOR CONTROL: PART 4
A SOLUTION TO THE BUSINESS REQUIREMENTS

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INTRODUCTION

The earlier articles in this series introduced the business requirements to meet a business policy and manufacturing strategy of excellence, or world class, for manufacturing companies.

In the first article, published in April 1998, a policy and strategy of world class manufacturing control were determined. These recognised current demands on industrial companies, particularly the requirement to provide exceptional service at low unit costs.

The second and third articles, published in May and June 1998, explored the business requirements for world class manufacturing and shop floor control. They also discussed why many of the traditional and previously available manufacturing control tools available to users, especially MRP, can be difficult to apply.

In this concluding article, the development and implementation of the major components of a solution are described. This solution has been implemented in the wire and cable industry, which is a length based industry. Similar requirements also exist in volume based industries. This niche was chosen as many of the traditional manufacturing control tools available to other industries are particularly unsuitable to the wire and cable industry.

The reader should note that earlier articles argued that the requirements for manufacturing control are generic to all types of industry and true packages should be applicable to all manufacturing processes. When applying these technologies in other type of industry, including traditional piece part and assembly type manufacture, benefits have been consistently achieved. These have included increasing output by 20-100% and more in some cases.

The technologies described in this series provide the ability to link management and process control systems for the first time. This is achieved through an integrated set of tools, specifically developed to address the needs of length and volume based industries. They provide finite capacity planning and scheduling, with a shop floor control (manufacturing execution) system. Together they satisfy the manufacturing control requirements that exist between process and management systems, such as MRP, while allowing the user to maximise benefit from **all** of those complementary technologies.

Up to now, length and volume companies have been excluded because this interface was not available and they only had process control, stand-alone scheduling and management systems available. They were difficult to integrate and did not provide all the control requirements.

THE DEVELOPMENT AND IMPLEMENTATION OF A PACKAGE

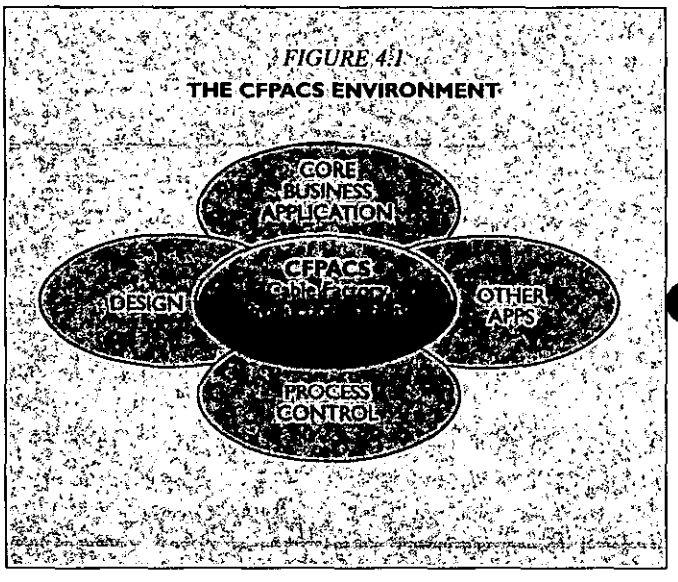
I spoke at a conference in 1991, whose theme was 'Control of Manufacturing Using Computer Systems'. I initially thought I had gone to the wrong conference, because all the other speakers were talking about control of discrete and independent processes, or process control.

My paper covered the requirement for and implementation of, control between process control and the management system. The system I described had turned round a client company by:

- Increasing output by 45%, without increasing head count
- Reducing work-in-progress
- Halving lead time
- Reducing scrap
- Improving delivery performance.

The demand for such a solution provided the motivation to develop a set of tools in this area. As a direct result Borderbow developed a product for all companies in the wire and cable industry. The result is known as CFPACS - Cable Factory Production Activity Control System. It has been designed as a package, for all wire and cable manufacturing companies, whether complex, simple or a mixture. It is based on direct knowledge of manufacturing wire and cable products, as well as experience of control of manufacturing, using the tools described in articles 2 and 3, in a variety of industries since the early 1970's. This environment is shown in Figure 4.1.

FIGURE 4.1



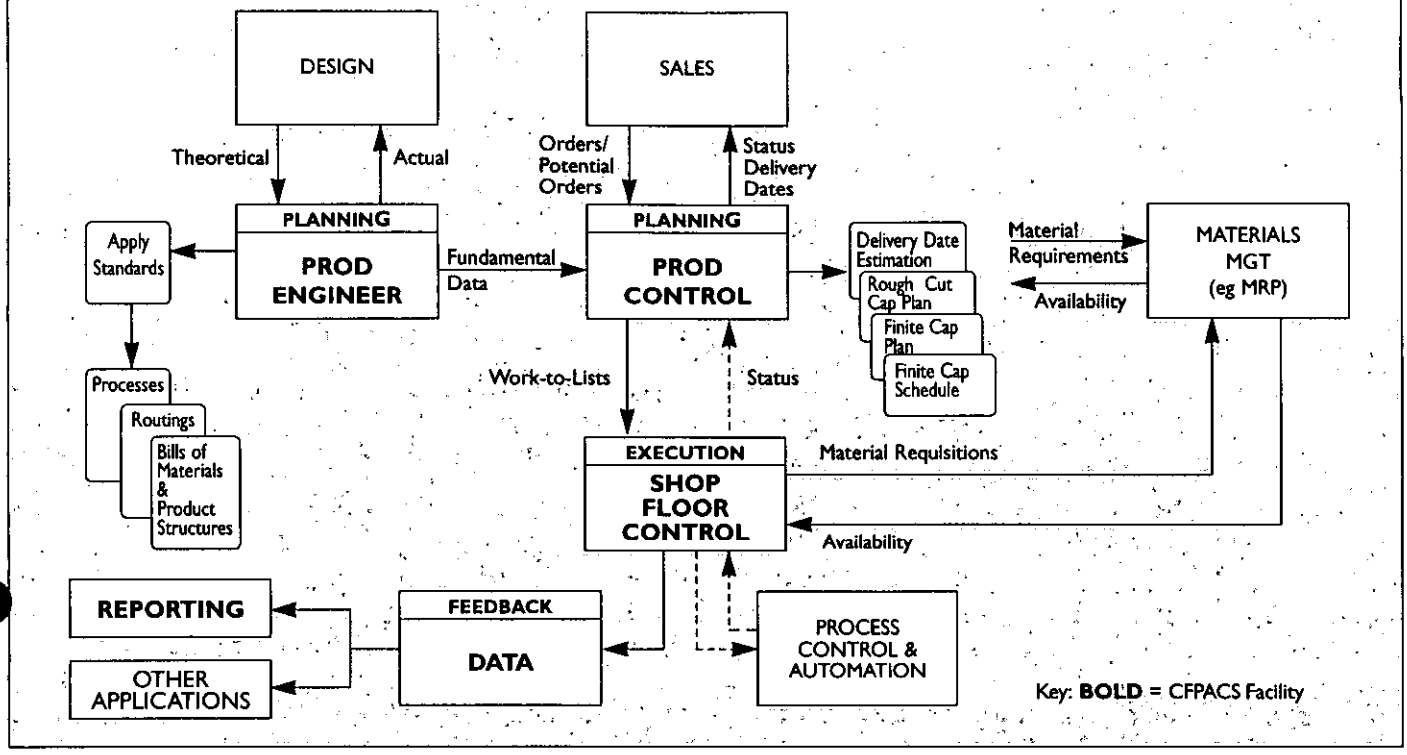
CFPACS is an original tool designed to enable full functional support for the shop floor from associated areas. It is based on our definitive model that details the functional requirements for shop floor control within any manufacturing company. The design of the product will allow for expansion to other industrial applications.

The concepts are applicable as a stand alone system for companies who do not have mainstream business applications, or integrated to existing core business applications for larger user companies.

The major functions of CFPACS are shown in Figure 4.2. Figures 4.3 - 4.9 follow a typical sequence of activities in planning and controlling work, together with examples.

FIGURE 4.2

CFPACS - FUNCTIONAL MODULES



FEATURES

A brief description of CFPACS is given in this section, together with typical examples from the system, based on the product illustrated in Figure 4.3.

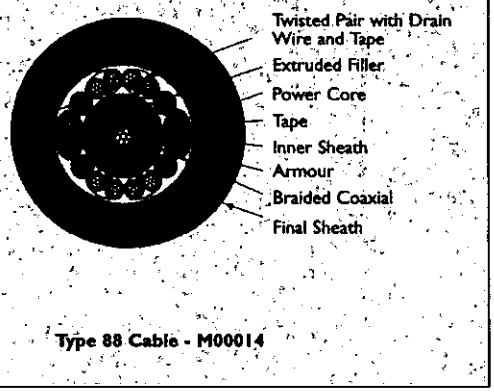
Production Engineering

This is to apply the company's process and materials' standards to the production requirements, working from the product design.

- Materials specified at each manufacturing operation
- Product structures and dependencies
- Differing input and output lengths, critical stage lengths
- Processing and materials standards applied
- Material types classified, to allow identification and grouping of similar or identical materials
- Standardisation, to obtain the same result each time.

FIGURE 4.3

A COMPLEX DESIGN TO PROCESS PLAN



Orders are then raised for various requirements for this and other cables. An example is shown below. The scheduled completion date is predicted to be early against requirement.

FIGURE 4.4

A LIVE ORDER

```
CFPACS - CFY001              ORDER ENQUIRY (CF5)              PAGE 1     18:30 09/02/98

ORDER: 000068 TYPE 88 CABLE                    STATUS: SCHEDULED    LEN:   1.20Km
SPEC : SP3456   TYPE: PARENT                   REQMT: 30/05/98      QTY:   1
W/ORD: 3792AB05  M00014/  1  FOR       /       SCHED: 23/05/98

OP   W/C   START DATE  SCH.FINISH LENGTH SETUP   RUN   PROCESS    DESCRIPTION          STATUS

 100 AH1 1 06:00 02/05 06:00 04/05   1.36  4:00  8:00 LAY UP     LAY-UP & TAPE          DUE
 200 AP1 1 06:00 04/05 12:00 05/05   1.31  4:00 10:00 SHEATHING  INNER SHEATH           DUE
 300 AJ0 1 09:30 15/05 11:30 18/05   1.27  8:00 30:00 ARMOURING  APPLY 48 ARMOUR SET DUE
 400 AP1 2 11:30 18/05 11:30 22/05   1.21  4:00 12:00 SHEATHING  OUTER SHEATH           DUE
 500 AQ2 2 11:30 22/05 12:30 23/05   1.21  1:00 24:00 INSPECTION PRESSURE TEST          DUE
```

Shop Floor Control - Manufacturing Execution

- Supports the manufacturing functions with dynamic screen-based work-to-lists
- Screen-based, real time and multi-user
- Priority sequence automatic
- Stays in control when unplanned events occur
- Shop floor documentation, for manufacturing operations and kitting of materials
- Status reporting via bar codes
- Traceability.

FIGURE 4.5

A WORK CENTRE

```
CFPACS - CFY001              WORK CENTRE ENQUIRY (CF4E)   PAGE 1     18:31 09/02/98
                                                          STATUS: ALL

CURRENT W/CENTRE: AJ0 Armouring
                                                                    -----CURRENT----
  ORDER   OP M/C START DATE   QTY   SETUP   RUN   W/ORDER          OP  STATUS W/C

  000001  500 1 10:30 24/02   0.64 10:00  24:00 9012XY01 ARMOUR   100 LOADIN AH13
  000025  300 1 06:30 06/03   1.27  8:00  30:00 3792AB01 ARMOUR   100 LOADIN AH11
  000007  500 1 08:30 09/03   0.64 10:00  24:00 9012XY02 ARMOUR   100 DUE    AH13
  000033  300 1 12:30 16/03   1.27  8:00  30:00 3792AB02 ARMOUR   100 DUE    AH11
  000013  500 1 11:30 27/03   0.64 10:00  24:00 9012XY03 ARMOUR   100 DUE    AH13
  000019  500 1 10:30 05/04   0.64 10:00  24:00 9012XY04 ARMOUR   100 DUE    AH13
  000041  300 1 06:30 13/04   1.27  8:00  30:00 3792AB03 ARMOUR   100 DUE    AH11
  000061  500 1 15:30 24/04   0.64 10:00  24:00 9012XY05 ARMOUR   100 DUE    AH13
  000049  300 1 11:30 02/05   1.27  8:00  30:00 3792AB04 ARMOUR   100 DUE    AH11
  000080  500 1 13:30 05/05   0.64 10.00  24:00 9012XY06 ARMOUR   100 DUE    AH13
  000068  300 1 09:30 15/05   1.27  8:00  30:00 3792AB05 ARMOUR   100 DUE    AH11
```

Below is an operation ticket for the manufacture of a component part, the stranding operation, of the power cores, automatically made as a sub-order to the parent order.

FIGURE 4.6

AN OPERATION TICKET

```
CFPACS SHOP DOCUMENTATION

STRANDING   OPERATION TICKET                    BORDERBOW WIRE & CABLE COMPANY
                                          FILE: SP3456\3792AB01  \000028/0100

WORK CENTRE:Stranding - 19 Wire MACHINE:AD11 Northampton 1000 Issued 15.24  7/ 2/98

SHIPPED TO:

-------------------------------------------------------------------------------
Order/Op      Order Proc Spec   Contract      Order Description    Op Description
-------------------------------------------------------------------------------
000028/0100   SP3456            3792AB01      POWER CORES          STRAND 1 LENGTH

Minimum Total Output Length:     3.10 Km   Operation Process Spec: B00003
Input Length from Previous Op:   3.20 Km

Setup:  0.30   Run:   4.00   Clean:  0.30
Recommended Minimum Number of Operators for Start Up: 1

OPERATION START

-------------------------------------------------------------
OPERATION COMPLETE

-------------------------------------------------------------
OPERATION INTERRUPT

-------------------------------------------------------------
ORDER/OPERATION NUMBER

-------------------------------------------------------------
```

When the operator is ready to start, the bar code reader will record operation start. Completion will be similarly reported, or any operating conditions resulting in the order/operation being stopped, such that the appropriate authority can be immediately alerted.

Performance Monitoring

- Real time data for on-line and periodic reporting of performance
- Delivery performance and lead time
- Operations completed
- Planned and unplanned work
- Performance threatening conditions monitored and highlighted, before adverse effect.

For any issue arising, the responsible function is alerted, and therefore any support gaps are highlighted and addressed. This puts enormous pressure on those functions responsible for supporting manufacturing and encourages complete work planning, through design, production engineering and production control, prior to release of orders into the factory.

- What If? is used to resolve **potential** problems
- Automatic and immediate effect to dynamic factory schedules on release of manufacturing plan
- Finite capacity constrained material requirements.

FIGURE 4.7

SCHEDULED DELIVERIES FOR DIFFERENT ORDERS OF THE SAME PRODUCT

CFU025 - CFPACS DELIVERY PREDICTION REPORT - OUTSTANDING PARENT ORDERS, PERIOD 09/02/98 -

WORKS ORDER	ORDER NO	ORD QTY	DESCRIPTION	REQMNT DATE	COMPLT DATE	EARLY(+) LATE (-)	ORDER STATUS	CURRENT W/C STAT	LAST TRANS
3792AB01	000025	1	TYPE 88 CABLE	23/03/98	14/03/98	+9	SHOP CO	AH11 LOAD	16:47 09/02
3792AB02	000033	1	TYPE 88 CABLE	13/04/98	25/03/98	+19	SCHEDUL	AH11 DUE	16:47 09/02
3792AB03	000041	1	TYPE 88 CABLE	02/05/98	21/04/98	+11	SCHEDUL	AH11 DUE	16:47 09/02
3792AB04	000049	1	TYPE 88 CABLE	16/05/98	10/05/98	+6	SCHEDUL	AH11 DUE	16:47 09/02
3792AB05	000068	1	TYPE 88 CABLE	30/05/98	23/05/98	+7	SCHEDUL	AH11 DUE	16:47 09/02

FIGURE 4.8

PROJECTED RESOURCE LOADS

CFU024 - CFPACS CAPACITY PLAN - FORWARD LOAD HOURS BY START DATE - W/CENTRES

	<< WEEKLY >>									<< MONTHLY
ENDING PERIOD	11/02 WK 0	18/02 WK 1	25/02 WK 2	03/03 WK 3	10/03 WK 4	17/03 WK 5	24/03 WK 6	31/03 WK 7	07/04 WK 8	14/04 WK 9	12/05 10-13	09/06 14-17	07/07 18-21
AB0	10												
AD0	51	81	23										
AD1	26	24											
AE0	49	49	49	98	49	49	49						
AF0	52	48	24	48			26	26			52		
AG0	64	75	26										
AH0	9	25	34	17									
AH1	21	37	41	13	26	25	25	13			24		
AJ0			34		72	38		34	34	38	106	38	
AK1	20	20	40	20									

FIGURE 4.9

MATERIAL REQUIREMENTS TO FINITE CAPACITY PLAN

CFU028 - CFPACS MATERIAL REQUIREMENTS REPORT FOR FULL CAPACITY PLAN

MATERIAL TYPE	MATL CODE	UOM	MATERIAL DESCRIPTION	ENDS/MIN	NO.	DIAMETER	STOCK NUMBER
WIRE	KD01	km	HTSS	01	01	2.100	521263

WORKS ORDER	ORDER	OPN	OP PRC SPEC	OP LENGTH	OP TY	ORDER STATUS	EARLIEST START DATE	SCHEDLD START	PREV SCH START	ORD QTY	MATL TOTAL QTY	TOTAL WEIGHT(KG)
9012XY01	000002	100	R00073	0.70	MA	SHOP C		09/02/98	STATIC	1	64.0	1706.88
3792AB01	000026	100	R00073	2.10	MA	SHOP C		14/02/98	STATIC	1	68.0	1814.62
9012XY02	000008	100	R00073	0.70	MA	SCHEDU		17/02/98	STATIC	1	64.0	1706.88
3792AB02	000034	100	R00073	2.10	MA	SCHEDU	20/03/98	20/03/98	23/02/98	1	68.0	1814.62
9012XY03	000014	100	R00073	0.70	MA	SCHEDU	23/03/98	23/03/98	28/02/98	1	64.0	1706.88
9012XY04	000020	100	R00073	0.70	MA	SCHEDU	03/04/98	03/04/98	03/03/98	1	64.0	1706.88
3792AB03	000042	100	R00073	2.10	MA	SCHEDU	10/04/98	10/04/98	09/03/98	1	68.0	1814.62
9012XY05	000062	100	R00073	0.70	MA	SCHEDU	17/04/98	17/04/98	14/03/98	1	64.0	1706.88
3792AB04	000050	100	R00073	2.10	MA	SCHEDU	25/04/98	25/04/98	17/03/98	1	68.0	1814.62
9012XY06	000081	100	R00073	0.70	MA	SCHEDU	28/04/98	28/04/98	23/03/98	1	64.0	1706.88
3792AB05	000069	100	R00073	2.10	MA	SCHEDU	08/05/98	08/05/98	28/03/98	1	68.0	1814.62
TOTAL FOR MAT. CODE KD01 SCHED ALL											********** 19314.410	

BENEFITS

- Productivity increases of 20 - 100% likely, dependent on current user status
- Reduced inventories, lead times and work-in-progress
- Reduced scrap and re-work, through more effective planning and dynamic control on the shop floor
- Increased responsiveness to change.

WHERE DO THE BENEFITS COME FROM? SUPPORT REQUIREMENTS

Meeting the Customer Requirement

Successful application of these tools will unlock huge improvements in operating performance and therefore lower costs and will provide a way to compete. Using this technology, output has increased by 20 - 100% in user companies, without increasing resource levels. Similar improvements have resulted in delivery performance, scrap and rework and lead times. These have been achieved in a variety of manufacturing companies, large and small.

These benefits can be quantified and will lead to rapid pay back.

However, perhaps the greatest benefits are the ability to meet the customers' requirements, delivery when promised, being responsive, at minimum cost. Reliability is what will secure future business and this cannot be quantified financially.

The Roles of People and Organisation - Making it Work

People are the most important consideration. Education probably accounts for more than 50% of the effort. People do not like change, and will initially resist. For the technology to work people are required to believe in the philosophy and take ownership of the result. It can take considerable time and effort to install this message. They are often not used to the time scales involved in running efficient factories and the demands of world class manufacturing.

It takes a strong blend of skills, knowledge and perseverance to successfully apply these tools. The activities undertaken are beyond the scope of this series. A minimum of 100 days' effort will be probably be required to get up and running, and will involve most users in fundamental change.

Systems are only tools, not solutions. The benefits arise form how the tools are used. They enable companies to operate effectively and provide the support necessary for the shop floor. The design of the system supports the shop floor, and provides the tools necessary to ensure that manufacturing support functions are carried out effectively, thus inverting the traditional organisational hierarchy. This puts the shop floor at the centre of the business.

A clear and objective focus is provided, thereby ensuring that factors associated with loss of performance are objectively identified and addressed. Systems should provide the tools necessary, but themselves do not solve any problems or issues uncovered. The solutions are provided by management actions.

Companies have to take ownership and commit from the top.

CONCLUSIONS

To survive and grow, manufacturing companies need to take advantage of the control techniques described in this series. Companies that have adopted these techniques, have been able to compete in the global marketplace. Unless companies are able to adopt these, they will wither and die. If companies believe this will happen, they will need to implement these methodologies. This technology has been successfully implemented and is available to all, large or small.

The way that systems are used determines success. The important rule about systems is to apply them to your business, not to change or contort your business to meet the requirements of any system.

The design of a world class manufacturing system must support the shop floor and provide the tools to ensure that manufacturing support functions are carried out effectively. This will ensure that conditions causing loss of performance are objectively identified and addressed. Systems can provide the tools necessary, but themselves do not solve any issues uncovered. The solutions are provided and benefits arise thorough management actions. Using tools, such as CFPACS, have enabled companies to organise their businesses to support the manufacturing function and address the functional requirements of the organisation.

These tools will enable industry to implement a policy and strategy in pursuit of excellence, therefore providing a secure future. This type of project is not for the fainthearted, as it reveals what is really happening in companies. Successful implementation requires a total commitment from top to bottom. The potential is enormous and benefits ongoing.

Embarking on such a project is a partnership between supplier that carries the responsibility of a lifelong commitment to support.

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 world class manufacturing control, including organisation definition and support.

The series is dedicated to his late partner, Tom Parsons, FIOM, who provided the inspiration and focus for the definitive shop floor control package.