MRP System Operation

Introduction (Seminar 10)

This seminar is concerned with providing an overview for the operation of the ManuDyn MRP facility and in particular identifying the key functional areas that need to be control in order to facilitate a smooth operation.

The ManuDyn MRP facility requires both the Manufacturing Control System (MCS) discussed in Seminars 6, 7 and 8 and the Manufacturing Inventory Control (MIC) system described in Seminar 9 to be operational. The MRP operation corresponds to the situation where these systems operate in such a way that manufacturing orders are generated by direct order entry onto the Sales Order file. That is all order entry and processing is in accordance with the MCS system and the MIC system is there only to provide the purchasing function for the raw materials. Where Sales Orders are processed directly as described above it is generally called MRP1.

The MRP11 operation of these modules corresponds to the situation where manufacturing order is processed indirectly. There is an intervening stage where the processing Inventory Items (those with a re-order quantity greater than zero) is delayed to allow requirements to accumulate. In fact, the MRP11 operation does may necessarily result in a manufacturing order being raised at all. The goods could have been provided directly from Stock and the stock may in fact be replaced by a purchase order.

The operational outline for the MRP system is shown in figure 1 below. This seminar is primarily concerned with an examination of this operational outline.

MRP1 Operation

As noted above the operator of the MRP1 system is concerned with the direct entry of manufacturing orders onto the Sales Order file. There are 4 key operational stages (or critical steps) as follows:

- Raise Sales Order (Sales Orders/Order Management) – This action causes the Quantity Committed (QC), for the items on the Bill-Of-Material (BOM) of the Part, which are Stock items, to be increased.
- Order Processing (Inventory Control/Order Processing) – Purchase orders are raised to cover the raw material requirements. This can be done either manually or automatically. Where the latter is the case the standard formula for determining what to purchase is us

MRP SYSTEM OPERATIONAL OUTLINE

STAGE 1

Enter
Sales Order

STAGE 2

Sales Order
Processing → Inventory Item
Processing

Purchasing
Goods provided
by SUPPLIER

Manufacturing
Goods provided
by YOU

STAGE 3

Raise supplier
order
(Purchase Order)

Manufacturing
Order Raised

Confirm P/O

Manufacturing
Job (and linked
sub-assemblies)

Print P/O advice

Process Job. When
last operation
completed goods
transferred to
STOCK

Process P/O by
receiving goods
into STOCK

Goods
In Stock

STAGE 4

Supplier Invoice
Reconciliation

Invoice Sales
Order

STAGE 5

Creditors System

Debtors System

General Ledger

Figure 1- MRP Operation Schematic

That is, an order is raised wherever:

$$NQR = QS + QO - QC < RP$$

You should examine Seminar 9 for specific details.

- Purchase Order Goods Received (Purchase Orders/Receive Purchases) – At this stage the Quantity on Order (QO), is reduced and the goods are placed in stock.

- Job Issued to Production (Scheduling/Job Issue) – At this stage the Quantity Committed (QC) will be reduced (if the Relieve Commitments option is activated). During this process options will also be provided to relieve the stock and record the job cost information. We recommend that you do this at this point.
  You should examine Seminar 7 for specific details.

One additional step may be needed depending on your system setup and/or how good your Bill-Of-Material estimates are, as follows:

- Stores Issue (Inventory Control/Store Issue/Return) – The alternative to relieving materials at the point of Job Issue is to perform this task as a separate step. If you have relieved stock at the point of Job Issue, you may still need to use this process to record the "extra" material, in excess of requirements, that are used.

These stages are summarized in figure 2 below:

MRP1 Operation

	QS	QO	QC
1) **Enter Order onto Sales Order file**			
Part Number			
⮑ **RM**			↑ **RM**
2) **Raise Purchase Order**		↑ **RM**	
3) **Receive Goods into Stock**	↑ **RM**	↓ **RM**	
4) **Issue Job to Production**	↓ **RM**		↓ **RM**
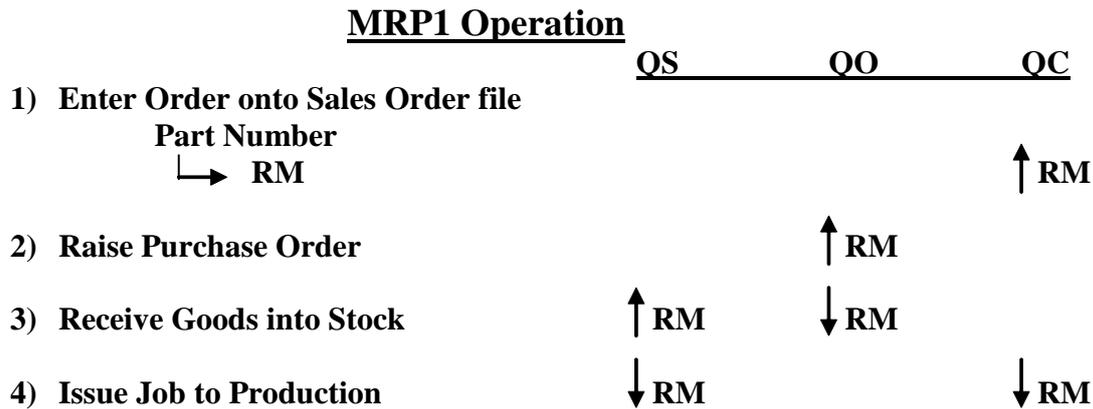
Figure 2 - MRP1 processing summary

The presence of sub-assemblies introduces one new critical step, namely:

- Sub-Assembly Job Finalisation (using job Status Update at (Scheduling/Job Progress) or via the Touch Screen) – This occurs when the last operation is complete. The sub-assembly job is removed from the Job file and the goods placed into stock. The last operation therefore becomes a critical control point as discussed in Seminar 7.

Where the sub-assembly is a stock item an inner processing loop is created as shown in figure 3 below.

MRP1 Operation with Sub-Assembly

	QS	QO	QC
1) Enter Order onto Sales Order file			
Part Number			
↳ **Sub-assembly**			↑ **SA**
↳ **RM**		↑ **SA**	↑ **RM**
2) Raise Purchase Order RM		↑ **RM**	
3) Receive Goods into Stock	↑ **RM**	↓ **RM**	
4) Issue SA Job to Production	↓ **RM**		↓ **RM**
5) Finish SA Job	↑ **SA**	↓ **SA**	
6) Issue Final Assembly to Production	↓ **SA**		↓ **SA**
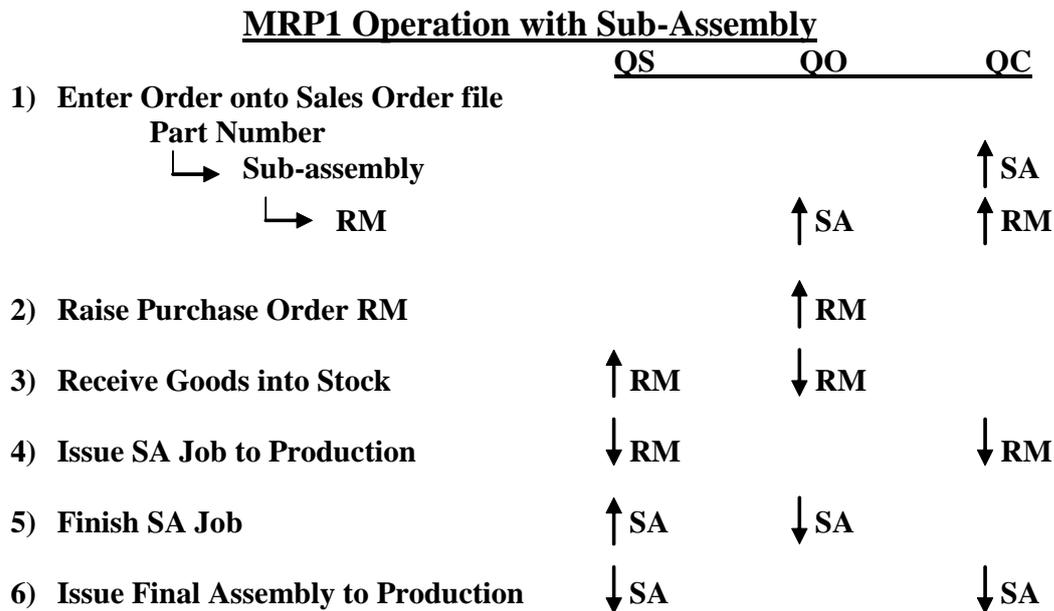
Figure 3 - Processing Summary for MRP1 with Sub-Assembly

The sub-assembly simply represents the raw material for the final assembly. The manufacturing order is created as a result of the parts explosion that occurs at the order entry stage, and the raw material commitments are established when the sub-assembly order is created.

Note i. The sub-assembly is a stock order (you are the supplier and it is on order for YOU). As such, there is a quantity on order for it recorded in the stock file (if it is a stock item of course).

    ii. The processing loop for the sub-assembly is complete prior to the final assembly. That is, you must manufacture it prior to the final assembly. The sub-assembly is therefore released to production first. The final assembly is released when the sub-assembly is finished.

This processing sequence is affected where the sub-assembly is an Inventory Stock item (the Re-order quantity is greater than zero). In this case the parts explosion that occurs in stage 1 is interrupted, immediately after the commitment for the Bill-Of-Material items has been recorded (including those for the sub-assemblies). The manufacturing order to cover these requirements is not generated at this time.

If subsequent orders are raised, which require this sub-assembly the material, requirements are simply accumulated.

A manufacturing order, to cover these requirements, needs to be raised at some point. This is done via the automatic order generation facility, (Inventory Control/Order Processing), where the supplier if YOU.

One additional critical step is added in that the Order Processing needs to be carried out in 2 stages, namely:

- Automatic Inventory Order Processing – The selection criteria needs to be set such that the supplier YOU, and a manufacturing order is raised rather than a purchase order.

- Purchase Order Processing – The purchase orders are raised to cover the raw material requirements. In this case the supplier is selected such that it is NOT YOU.

Figure 4 below illustrates these stages.

MRP1 Operation with Inventory Sub-Assembly

	QS	QO	QC
1) **Enter Order onto Sales order file**			
Part Number			
↳ **Sub-assembly (I)**			↑ SA
↳ **RM**			
2) **Raise Order for Inventory SA**		↑ SA	↑ RM
3) **Raise Purchase Order RM**		↑ RM	
4) **Receive Goods into Stock**	↑ RM	↓ RM	
5) **Issue SA Job to Production**	↓ RM		↓ RM
6) **Finish SA Job**	↑ SA	↓ SA	
7) **Issue Final Assembly to Production**	↓ SA		↓ SA
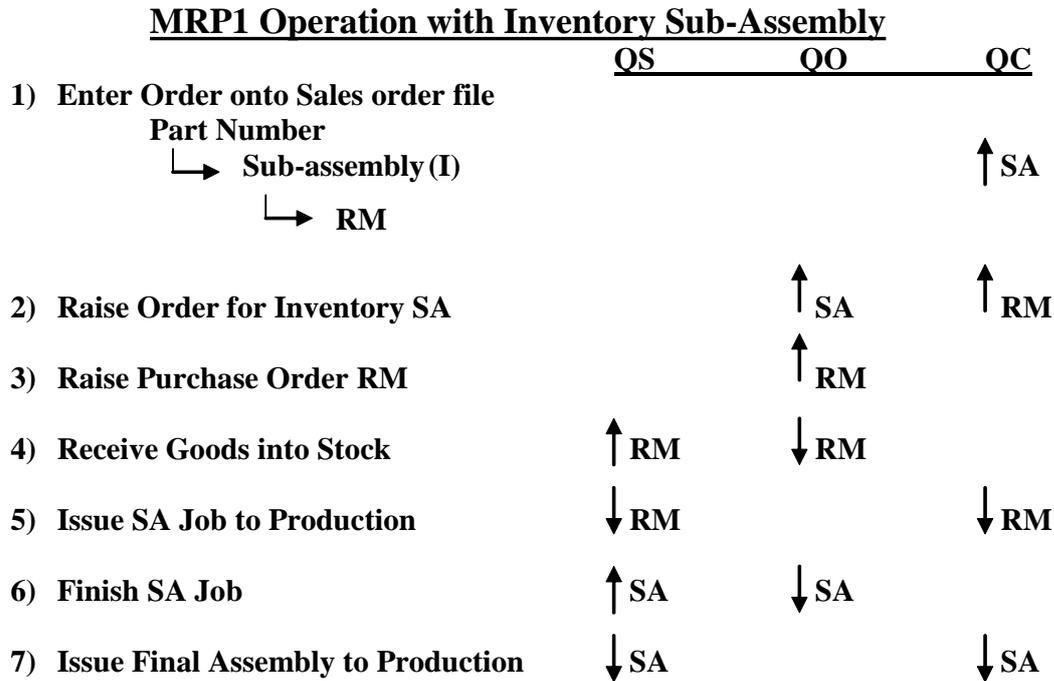
Figure 4 - Processing Summary for MRP1 with Inventory Item Sub-Assembly

There must be a delay between raising the manufacturing order for the final assembly (step 1 above) and performing Automatic Inventory Order processing (step 2), to allow time for commitments to accumulate. There is no point in "marking" the Stock Item as an Inventory Item if you are going to process the order entry immediately.

Inventory item processing (when it is eventually done), may need to be performed many times. If the sub-assembly has other inventory items associated with it, in a complex assembly, the parts explosion will stop once again, when such items are encountered.

Inventory item processing should continue to be performed, until such time as there are no more inventory items selected.

Purchase order processing should be carried out once only, immediately following the conclusion of Inventory Item processing.

As a general rule, purchase order processing (where the supplier is NOT YOU), should be carried out frequently (daily for example). Inventory Item processing (where the supplier is YOU), should be conducted less frequently (say weekly).

MRP11 Operation

The operation of the MRP11 system is concerned with the direct order entry of an Inventory Item onto the Sales Order file (no explosion occurs). Purchase orders or manufacturing orders are entered indirectly as a result of Order Processing, depending of course on the Supplier.

There key operational stages (or critical steps) as follows:

- Raise Sales Order – This action causes the Quantity Committed (QC), for the final assembly stock item to be increased.
- Order Processing – It there is insufficient stock then either a manufacturing order or purchase order is raised (that is, if the Stock item is not an Inventory item)

What happens next depends on who is the Supplier. If the Supplier is YOU the steps are as follows:

- Purchase orders are raised to cover the final assembly requirements.
- Purchase Order Goods Received – At this stage the Quantity on Order (QO), is reduced and the goods are placed in stock.
- Invoicing – The stock is reduced in line with the invoiced quantity and it is at this point where the commitments, associated with the final assembly, are relieved.

The processing schematic is as follows:

MRP11 Operation (Supplier Not YOU)

	QS	QO	QC
1) **Enter Sales Order**			↑ FA
2) **Order Processing to Raise P/O**		FA ↑	
3) **Receive Goods into Stock**	↑ FA	↓ FA	
4) **Invoice Sales Order**	↓ FA		↓ FA
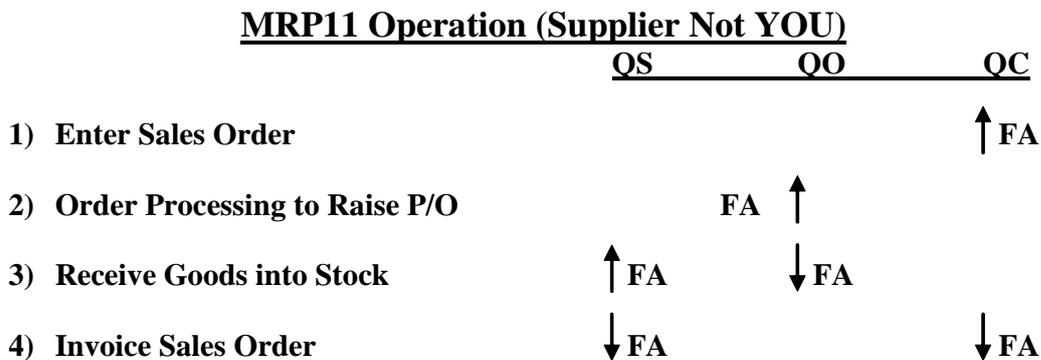
Figure 5 – MRP11 processing where you are not Supplier

This is essentially the same as figure 2 above concerning MRP1 processing of the raw material requirements for a Job. In this case however the requirements that have caused a purchase order to be generated are for the Final Assembly order rather than the Raw Materials.

The following steps occur where the Supplier is YOU:

- A Manufacturing Order is raised to cover the final assembly requirements. This action causes the Quantity Committed, for the items on the Bill-Of-Material (BOM) of the Part, which are Stock items, to be increased.
- Purchase Order Processing – The purchase orders are raised to cover the raw material requirements.
- Purchase Order Goods Received – At this stage the Quantity on Order, is reduced and the goods are placed in stock.

- Job Issued to Production – At this stage the Quantity Committed will be reduced (if the Relieve Commitments option is activated). It is also recommended that stock be relieved at this point.
- Final Assembly Job Finalisation (by job Status Update or via the Touch Screen) – This occurs when the last operation is complete. The final assembly job is removed from the Order file and the goods placed into stock.
- Invoicing – This is the same as the previous case. The stock is reduced in line with the invoiced quantity and the Final Assembly commitments are relieved.

The schematic outline is as follows:

MRP11 Operation (Supplier Is YOU)

		QS	QO	QC
1)	**Enter Sales Order**			↑ FA
2)	**Order Processing to raise Job**			
	Part Number			
	↳ **RM**		↑ FA	↑ RM
3)	**Raise Purchase Order for RM**		↑ RM	
4)	**Receive Goods into Stock**	↑ RM	↓ RM	
5)	**Issue FA Job to Production**	↓ RM		↓ RM
6)	**Finish FA Job**	↑ FA	↓ FA	
7)	**Invoice Sales Order**	↓ FA		↓ FA
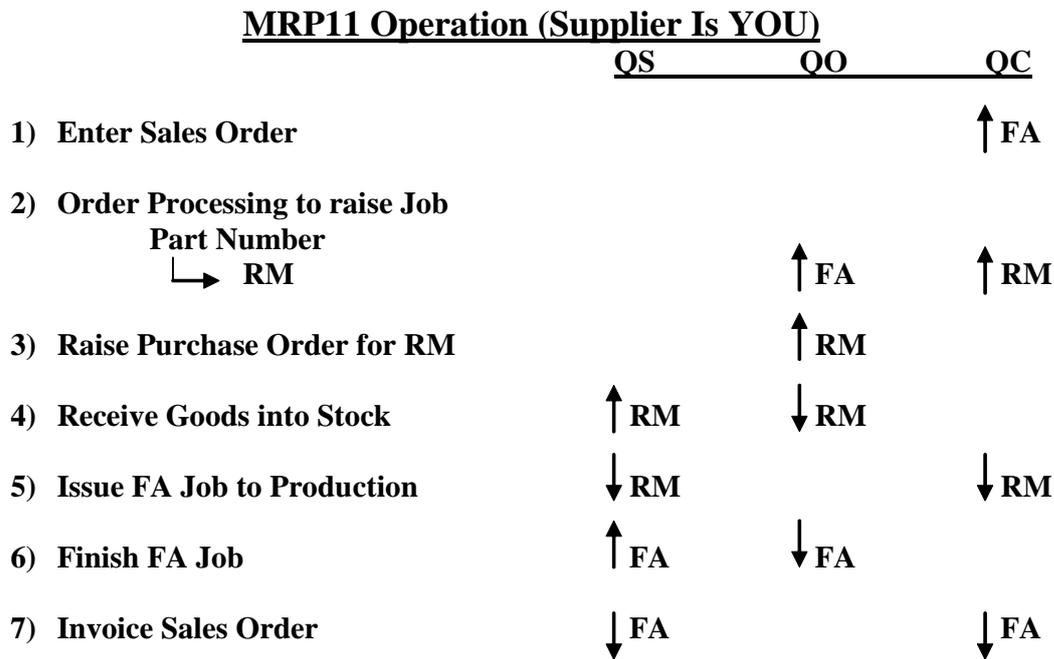
Figure 6 – MRP11 Operation where you are Supplier

In this case commitments are recorded and tracked for the finished goods as well as the raw materials required to make those goods. The quantity on order for the final assembly is actually on order against the Job file whereas that for the raw material is a normal purchase order.

The sequence of events becomes marginally more complicated where there is a sub-assembly involved as follows:

MRP11 Operation with Sub-Assembly(Supplier is YOU)

	QS	QO	QC
1) Enter Sales Order			↑ FA
2) Order Processing to Raise Job			
Part Number		↑ FA	↑ SA
↳ **Sub-assembly**			
↳ **RM**		↑ SA	↑ RM
3) Raise Purchase Order RM		↑ RM	
3) Receive Goods into Stock	↑ RM	↓ RM	
4) Issue SA Job to Production	↓ RM		↓ RM
5) Finish SA Job	↑ SA	↓ SA	
6) Issue Final Assembly to Production	↓ SA		↓ SA
7) Finish FA Job	↑ FA	↓ FA	
8) Invoice Sales Order	↓ FA		↓ FA

Figure 7 – MRP11 with Sub-Assembly and where you are Supplier

Essentially another loop is initiated to cover the processing of the sub-assembly.

To complete this section of the seminar we need to examine just 2 more situations. Firstly, the case is where the Sub-Assembly is the Inventory Stock Item. The second case is where both areinventory items.

In all cases the effect of designating an item as an Inventory Stock item will be to delay the processing, and to cause an the addition of extra critical steps.

If the sub-assembly is the inventory item then the final is raised at Customer Order Processing. The sub-assembly processing is delayed until automatic order generation in as shown below in figure .8

MRP11 Operation Inventory SA(Supplier is YOU)

	QS	QO	QC
1) Enter Sales Order			↑ FA
2) Customer Order Processing		↑ FA	↑ SA
3) Order Processing to Raise Job Part Number ↳ Sub-assembly ↳ RM		↑ SA	↑ RM
3) Raise Purchase Order RM		↑ RM	
4) Receive Goods into Stock	↑ RM	↓ RM	
5) Issue SA Job to Production	↓ RM		↓ RM
6) Finish SA Job	↑ SA	↓ SA	
7) Issue Final Assembly to Production	↓ SA		↓ SA
8) Finish FA Job	↑ FA	↓ FA	
9) Invoice Sales Order	↓ FA		↓ FA

Figure 8 – MRP11 with Inventory Sub-Assembly and where you are Supplier

There are 2 stages of automatic order generation. Firstly where you are the supplier and secondly where you are not the supplier. In the first instance manufacturing orders are raised which then generate the raw material requirements. The second automatic processing run (where you are not the supplier), will generate the purchase orders for these requirements.

The final configuration to be examined is the situation where the final and sub-assembly are both inventory items. As with the earlier case (figure 7), the effect of customer order processing is simply to mark the Sales order as processed. Automatic order processing through, in this case however, only raises the final assembly. Processing will stop after the final assembly has been raised, because the sub-assembly is an inventory item.

The automatic order processing routine will need to run a second time in order to pickup and process the sub-assembly. Once this has been done the routine will need to be run a third time in order to then process the raw material purchases. This processing is summarized below in figure 9.

MRP11 Operation Inventory FA & SA(Supplier is YOU)

	QS	QO	QC
1) **Enter Sales Order**			↑ FA
2) **Customer Order Processing**		No Change	
3) **Order Processing to Raise FA Job** **Part Number** → **Sub-assembly**		↑ FA	↑ SA
4) **Order Processing to Raise SA Job** **Sub-assembly** → **RM**		↑ SA	↑ RM
3) **Raise Purchase Order RM**		↑ RM	
5) **Receive Goods into Stock**	↑ RM	↓ RM	
6) **Issue SA Job to Production**	↓ RM		↓ RM
7) **Finish SA Job**	↑ SA	↓ SA	
8) **Issue Final Assembly to Production**	↓ SA		↓ SA
9) **Finish FA Job**	↑ FA	↓ FA	
10) **Invoice Sales Order**	↓ FA		↓ FA

Figure 9 – MRP11 both Final & Sub-Assembly are Inventory items

This illustrates the point made earlier in that, where Inventory items are involved, the processing may need to be performed many times in order to ensure that all requirements are accounted for.

Critical MRP Processing Stages

It should be clear from the preceding discussions that there are a number of critical functions that need to be managed correctly in order to maintain control in an DRC processing environment.

1) Sales Order Entry. This takes place at Sales Orders/Order Management

2) Order processing. This occurs at Inventory Control/Order Processing.

3) Automatic Order Processing. There are two stages, namely:
   a. Inventory Item processing where you are the Supplier. Once commenced Inventory Item processing may need to be performed many times to ensure that all items are processed. This is particularly the case where there is a complex BOM.
   b. Purchase Order generation where you are not the Supplier. This stage only need to be carried out once, immediately following the conclusion of the stage above.

4) Purchase Order Goods Received (Purchase Orders/Receive Purchases). The ideal situation as discussed elsewhere is to have the Suppliers Invoice received with the goods.

5) Manufacturing Job Issue (Scheduling/Job Issue). The ideal position here is to relieve inventory (QS) at the same time as commitments (QC).

6) Stores Issue (Inventory Store Issue/Return). This stage would normally be restricted to recording the "extras". That is, materials used over and above the estimated requirements. Where this function is the primary point of material issue it should be carried out as soon as possible following the Job Issue stage above.

7) Manufacturing Job Completion (Scheduling/Job Update or Touch Screen). It is important to retain control over the completion of Job that is control over the last operation, particularly where the job is a stock item, as the quantity completed will be transferred to stock.

8) Invoice the Order. This can occur at Sales Orders/Order Dispatch or Accounts Receivable/Invoices.

Each of these stages needs to be managed carefully by operators who generally know what they are doing. Operators, who will concentrate on the task at hand, make decisions based on the information presented to them, actually read the popup messages, and who will not be afraid to ask questions where they do not understand or know the answer.

We call such an operator a "responsible adult". This person is the opposite of the "Cowboy" who shoots from the hip, generally misses the target, and causes massive collateral damage.

Out of interest and so that a complete picture may be presented, the other critical control points for the ManuDyn system is as follows:

9) Companies (Database Entry/Companies) and Material Items (Database Entry/Material Items) data entry.

10) Part Number Engineering (Database Entry/Manufactured Items).

11) Quoting & Estimating (Quoting/Quote Entry and Review) and Quote Advice Generation (Quoting/Print Quote).

Problems

Can the system "breakdown"? What happens for example if this sequence of events is not followed?

Yes – all systems will fail if the rules are not followed. All systems require discipline in order for them to work effectively. This is true for manual as well as computer systems, and it is especially true for MRP systems in particular.

The most common scenario is that the job is issued to production, the commitments relieved and there is insufficient material to do some or all of the job. In this case the system has an "inbuilt recovery" facility provided the Stock is also relieved.

If the Stock is relieved the QS register will become negative. All that has happened in this case is the amount in the QC register has been set as a negative quantity in stock.

The next most common scenario is that Purchase Order Generation, proceeds before Inventory Item processing, or the latter is incomplete when the raw material purchase order is raised.

The end result in this case is that more raw material purchase orders will be generated that is needed. These can be combined, but will need to be done so manually.

The most common source of all problems associated with the operation of an MRP system are caused by alterations to Customer Orders, and manufacturing Jobs, and in particularly after the order has been processed or the job released to production.

Rule Number 4

As you may expect we have a rule to cover this situation. This rule was primarily developed to cater for the MRP11 operating environment, however it is also applicable to the operation of the ManuDyn system generally (and I would suggest to the operation of all systems). This rule may be stated as follows:

Never change a plan in progress.

What would the application of this rule mean for the operation of the MRP system, if for example, the customer alters the quantity required?

If the quantity is increased then a new order would be raised and processed for the extra. If the quantity decreases the manufacturing job should proceed through to completion and the excess quantity held in stock.

This rule also applies for the operation of the MRP1 system and also for the various scheduling systems. For example, breaking into a setup in order to process an urgent job is not recommended. The job being processed should be finalized before the setup is broken. Breaking the setup would be the same as changing a plan in progress.

Now the strict application of this rule also implies that there must be a planning cycle. That is a time frame within which the plan is unchangeable. I usually encourage clients who are first introduced to this rule to set the planning cycle as short as is practically possible. That is one (1) day for example.

This allows management, at the very least, to plan today what they intend to do tomorrow. Once the plan is "published" it does not alter during the time frame of the planning cycle. Eventually the time frame can be increased.

The degree to which this can be done varies from one company to another and depends to a large extent on the manufacturing environment and the people. Ideally, in a jobbing environment, one would like to be planning this week for next week's production.

Concluding Remarks

During this seminar I have introduced a number of concepts such as using a *"responsible adult"* to manage key operational stages and of operating in accordance with certain "*rules*" also introducing the concept of a *"planning cycle"* during which time the manufacturing plan remains "*fixed*".

Having been in the situation of managing a jobbing shop I realize that in reality some of these things are difficult to achieve. The key thing to remember however is that these concepts represent an objective, or goal, towards which you can strive. If there are no overall objectives there will be no progress and the situation tomorrow, next week and next year will be the same as it is today.

You should set a target, at the edges of the possible, and see how close you get to the mark. Sometimes you will exceed your expectations, and on other occasions you will fall short. The bottom line is that there will have been at least some progress towards the goals, compared to no progress and possibly a deteriorating situation is no goals were set at all.