

Job Shop Scheduling

Introduction (Seminar 7)

This seminar is concerned with an examination of the Job Shop Schedule and is essential introductory reading in order to understand the scheduling facilities within the ManuDyn system. The procedure to process Job is covered in detail in the Video Tutorials and as such will not be examined here. In this seminar my objective is to simply explain the basis behind the Job Shop Schedule in preparation for examining the Dynamic Touch Screen and Barcode scheduling systems, which are the subject for the next seminar.

To understand the Job Shop Schedule, we need to discuss how you would go about scheduling a factory in the absence of a computer using a manual communication aids. Assume that, the only tools you have are pen and paper, and in the first instance you do not know the status of any job.

The first thing you would need to do is determine where all the work is. You would need to “get on your bike”, or walk around the factory, to find out the status of each job. The quantity completed at each stage of production would be determined and a number of “Work Centre Job Lists” produced showing the status of each Job.

From this list you would find some jobs at many different stages, some jobs at only one stage and some jobs not yet started. You could determine the order in which each job needs to be done (based on the job due date or some other criteria), and set appropriate priorities for each Work Centre, not only for the operator but also for yourself. Which jobs for example do you need to issue to production?

The list of jobs at each stage is called a Priority Work List and it might look similar to figure 1 below, albeit with some poetic license taken. Such a list is obtained from the *Scheduling/Priority Work List* menu item in the ManuDyn system.

Job Shop Schedule Outline

The Job Shop Schedule

Stage 1 – Determine Work List & Set Priority

| Operation 1 | Operation 2 | Operation 3 | Operation 4 | To Issue |
|--|---------------------------------|---------------------------------|-----------------|---|
| Job 1 *2 Job 2 *1 Job 3 | Job 2 *1 Job 4 | Job 4 Job 5 *1 | Job 2 *1 | Job 6 Job 7 Job 8 Job 9 Job 10 |

Figure 1 - Priority Work List

So, we have reached the stage where you know where everything is and what has to be done. Unfortunately, no one else in the organization does. The obvious solution is that you convene a Production Meeting.

You gather together all the Leading Hands and Forman. The obvious time to do this is during the morning tea break after all you don't want to disrupt production too much. These employees are of course, overjoyed at the prospect of missing out on their break and are just as eager as you to attend yet another meeting.

Nevertheless, you discuss the priorities. Some adjustments are made because critical operators did not turn up for work today, or critical equipment is down for maintenance. Then you issue the Work Lists as a set of instruction to the factory operators.

This represents the second stage of the Job Shop Schedule as shown in figure 2 below.

The Job Shop Schedule

Stage 1 – Determine Work List & Set Priority

| Operation 1 | Operation 2 | Operation 3 | Operation 4 | To Issue |
|--|---------------------------------|---------------------------------|-----------------|---|
| Job 1 *2 Job 2 *1 Job 3 | Job 2 *1 Job 4 | Job 4 Job 5 *1 | Job 2 *1 | Job 6 Job 7 Job 8 Job 9 Job 10 |

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Stage 2 – Production Meeting & Discussion

Figure 2 - Operating Instructions

The operators now have their priorities so what happens next is that work gets done (all things being equal). As a result, jobs move from one stage of production to another. Job 2 for example gets completed on Operation 1 and 2, but not 3 or 4. Job 5 moves to Operation 4 and you issue job 7 to production.

The situation that now prevails is that you no longer know where all the jobs are. Some jobs have moved. As the operators know what they have done (more poetic license here), you ask them to fill out a Time Sheet. You need to know the quantity of each job done, and the time taken.

The operators of course are overjoyed at the prospect of having to fill out time sheets, and even though they don't understand why you need this information, they fill out the sheets as best they can.

Note i. In ManuDyn the Time Sheet is the Priority Work List that was distributed in stage 2 above. A separate document is not needed.

In the first instance you need to know this for scheduling purposes. You gather the sheets together and update the job status. You also require this information for variance analysis. We will discuss this latter.

Note i. In ManuDyn Job Status Update is done manually via the Scheduling/Job Progress menu item. Jobs are issued to production at *Scheduling/Job Issue*, priorities are set at *Scheduling/Scheduling* and the Priority Work List is obtained from *Scheduling/Priority Work List*.

The entire Job Shop Schedule is summarized in figure 3 below.

The Job Shop Schedule

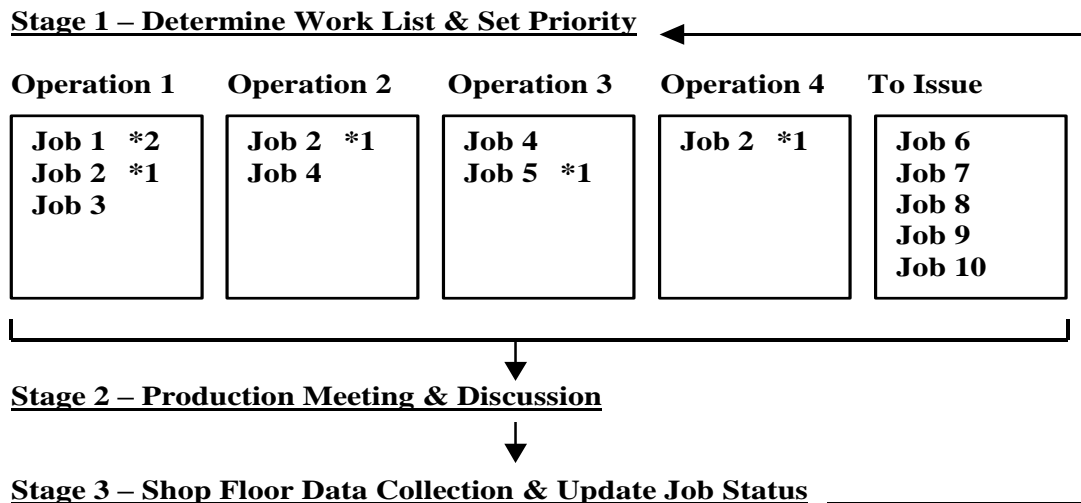


Figure 3- The Job Shop Schedule Schematic

The Job Shop Schedule is the primary scheduling aid, used by the ManuDyn system, for keeping track of work within a production facility.

Essentially there are three stages, as follows:

- Prepare a Production Work List, that is, a list of jobs at each stage of production. The work list is then issued to the factory as a set of operator instructions.
- Provide a procedure whereby the progress of jobs within the factory may be reported back to the ManuDyn system. That is, shop floor production information is reported, usually by writing on the Work List, or by means of an operator time sheet.
- Update the job status and prepare a new Work List, which incorporates the feedback information.

The Job Shop Schedule is traditionally how jobs have been scheduled through a Job Shop production facility. The first point to make is however that this is not a schedule at all.

Most people would define a schedule as some forward looking plan concerning the complete processing of all jobs. At best we have a plan for one shift (or day), and even then we are really only reacting to changes in the manufacturing environment. We are not planning.

Secondly there are some serious deficiencies and problems associated with the Job Shop Schedule, namely:

- The delay between job processing and job status update.
- Lack of flexibility with the Priority Work List.
- The potential for errors and inaccuracy.

Each of these will be examined below:

Job Status Update Delay

The Job Shop Schedule only represents the true state of production at the beginning of the shift (usually), immediately after Job Status Update and prior to issuing the Priority Work List.

A job may become available for processing on a subsequent stage, immediately it has completed the prior operation. The Scheduler may not know this until the completion job status update associated with the current cycle. As a result, some jobs may only end up doing one operation per cycle.

What if the process was such that one or more operations could be completed within a shift? The Scheduler could either try and anticipate this and indicate on the Work List the possibility that some jobs may appear on other processes during the day. There is no guarantee however that this will happen, with the result that the schedule (and the Scheduler) loses credibility.

Another solution would be to do 2 or more cycles of the Job Shop Schedule during the day.

Updating the Job Status more often does not usually represent a greater work load. The task is simply spread throughout the day. The Foreman and Leading Hands (and you), however, would also miss out on their lunch and afternoon tea breaks, and they would need to attend yet another production meeting.

The obvious solution is to place a computer on the factory floor and get the operator to update the status immediately the job is done. We will examine this shortly.

Lack of Flexibility

In stage 2 you gather the troops together to discuss the priorities and set the plan of attack for the day. This is a team building exercise. Everybody contributes and we all walk away from the meeting knowing what needs to be done, enthused about the task ahead, and confidence in our ability to achieve the impossible. We are looking forward to the sense of achievement that will come when the task is completed.

As soon as you get back to your office however, the phone rings. It's the Customer. The job that was the main topic of discussion during the Production Meeting is no longer required, or there is a change that is needed. This job which was the top priority has now been placed on hold. What do you do?

There is one thing for sure you don't call another Production Meeting. There are too many of them and the Forman and Leading Hands need to be out in the factory, not in meetings. So, you go and visit them individually. You tell them to disregard what was said during the morning meeting and give them a new set of priorities.

Unfortunately, you forget to see them all, with the result that Jack urgently finishes the job that is now on hold. Takes it to Bill as planned who then tells Jack that we don't need that job any more. The job we need now is the setup that Jack broke into to do the urgent job (now on hold).

Both operators are bemused. No sense of achievement is obtained. They moan and bitch about the Scheduler and how the fool keeps changing his mind and doesn't know what he's doing.

Does this sound familiar? The Job Shop Schedule, by its very nature, fosters disharmony and conflict within the manufacturing organization, due to its lack of flexibility, and the way priorities are set and changed.

Potential for Error

There are a number of places where errors may arise with the Job Shop Schedule. Firstly, we are asking operators to fill out a Time Sheet or indicate on the Priority Work List what they have done.

In an effort to get more accurate information we ask them to do it immediately they complete the Job. What they do of course is fill out the Time Sheet at the end of the shift (just to keep us happy). As they did many jobs during the day they start guessing how many they did, and how long it took, and it always adds up to a full shift.

Now we already have one guess concerning how long it takes to do a task. The Estimator has given us his best guess. Now the operator has given us his guess, when what we really wanted was actual time and quantity done.

A variance analysis based on the Estimators guess, compared to the operator's guess, is not worth very much. It certainly is not a firm basis upon which to make sound management decisions.

A second source of error is that the Time Sheets need to be interpreted, usually by someone who knows nothing about the factory or the processes. In addition, the operator also makes data entry errors.

In the end the information is late and wrong.

Most operators do not like filling out Time Sheets. Not all operators are totally capable of performing this task. For these operator's time sheets do not represent a good opportunity to show the boss how good they are.

Time Sheets are a bone of contention and a source of conflict between management and staff. Yet the information is needed if we wish to get control over manufacturing.

Dynamic Scheduling Systems

I have already noted that the delay problem associated with the Job Shop Schedule can be overcome by placing a computer on the factory floor and getting the operator to update the status immediately the job is done. Clearly this provides a means of obtaining immediate job status update.

The problem is that not all operators work well with computers and in particular their keyboard skills tend to be lacking. At the other extreme some operators know more about computers than you do and would relish to opportunity of experimenting with your network (and access your company information).

What is needed is a device that does not have a computer keyboard, is quick and easy to use, with a display to convey information providing a structured series of simple Yes/No questions. The use of touch screen supported by an appropriate software system is an ideal solution that meets all these criteria.

In the ManuDyn Touch Screen system the Priority Work Lists are not distributed at all. They are maintained as files (or Work Centre Schedules), within the computer system.

The operator is first required to "clock" onto the factory (which indicates that they are present), and then "sign on" to the job when it is started and "sign off" the job immediately it is finished. During the "sign off" action the operator is also required to indicate the quantity done.

In addition to eliminating the delay problem this solution also overcomes the problem of flexibility, and to a large extent, eliminates most of the causes of data errors. What happens, for example, in the touch screen environment with the manufacturing situation discussed earlier?

Firstly, there would be no Production Meeting. There is simply no need to have one. If the Forman and Leading Hands get together at morning tea they are more likely to discuss what they did on the weekend or the football results. This is good it's supposed to be a break and people return to work relaxed.

In defining a schedule of work for the factory the operator actually only needs to know what job you want them to do now and maybe which job you want them to do next. This can be done directly through the touch screen schedule and can be altered as often as is required.

When the Customers telephone call comes in, placing the urgent job on hold, the scheduler simply alters the job priorities. This job simply stops processing when the current operation(s) being carried out is finished. The causes of disharmony and conflict within the manufacturing organization are simply avoided.

The Scheduler can now change the priorities as required and the operators obtain that sense of achievement that comes when the job is done well.

There is one new requirement that is created with the ManuDyn dynamic scheduling systems. This new requirement is brought about as a result of the operator “signing on” and “signing off” jobs and the need to ensure that the operators’ time is adequately accounted for. This leads us to a discussion of the second of the ManuDyn “Golden Rules”. We will examine this rule now and then discuss this new requirement.

Rule Number 2

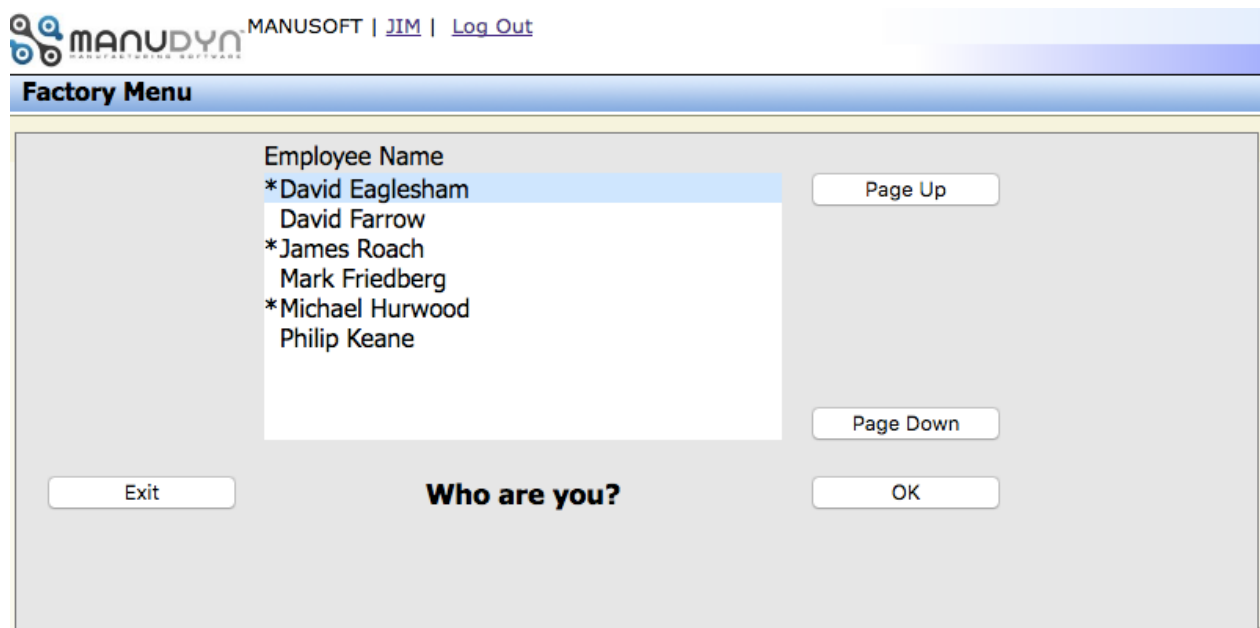
You need more than just a software system to manage a factory. You also need discipline and determination and a set of simple rules that every one understands, to govern your operating procedures.

The first rule, concerning when jobs should be released to production, was discussed earlier in Seminar 6. That rule was for the Scheduler. The second rule is for the operator and states that:

An employee must be active on a job at all times.

The requirement that the operator is active on a job at all times should be obvious. In a dynamic scheduling system, the Operator has a responsibility to account for their time. You have a responsibility to ensure that the Operator always has a job onto which they could “sign on”.

It is relatively easy to check whether an operator is active on a job or not. In the Touch Screen scheduling system an active operator is one with an asterisk (*) against their name. In the display below only three employees are active,



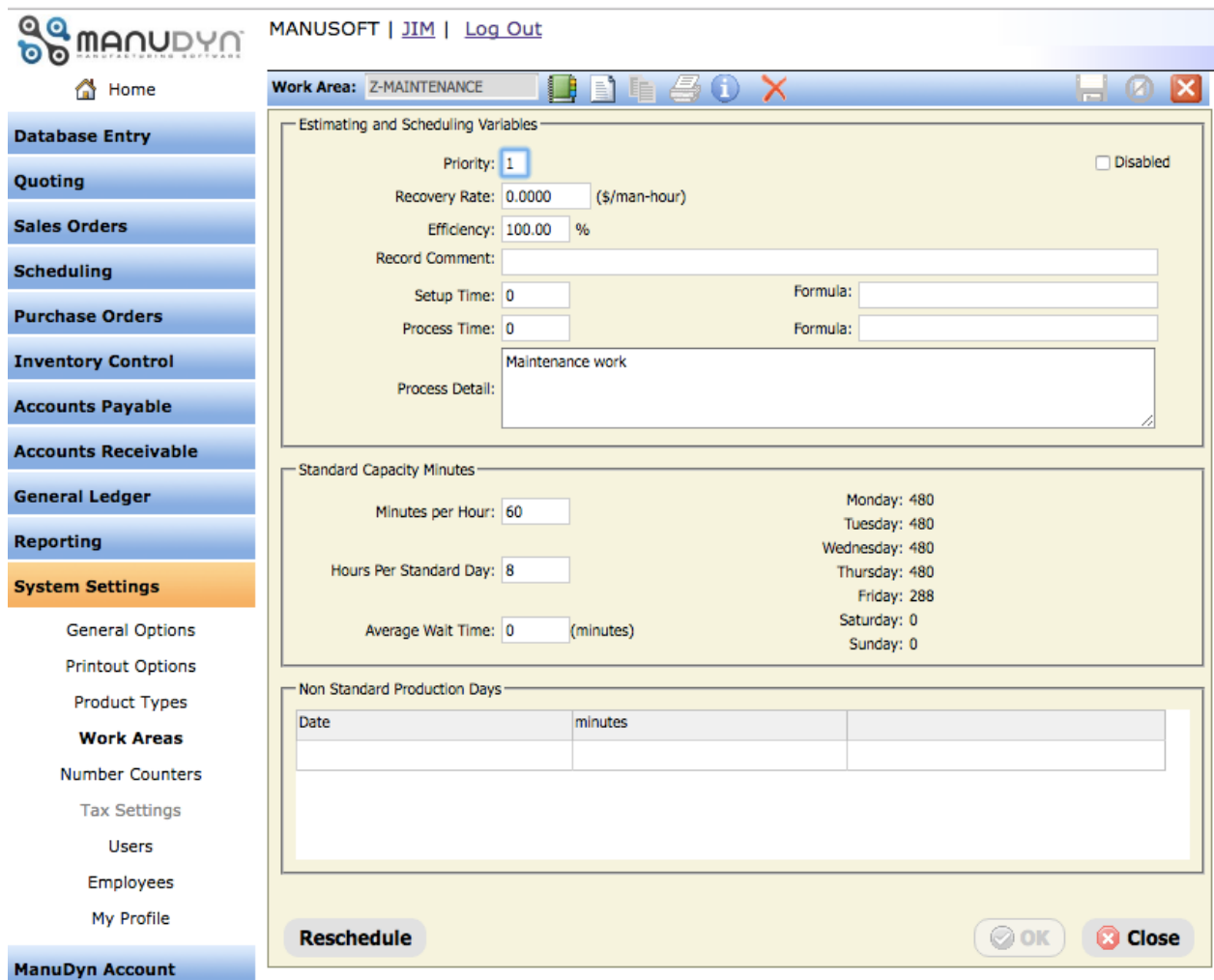
To comply with Rule 2 there would need to be asterisks against all employees present.

Now, there are times when there are no manufacturing jobs onto which the employee can work. During these times they will most likely be working on a number of non-productive activities to which they have been assigned. Activities such as maintenance, cleaning, repairs, and loading and un-loading are typical examples.

If the second rule is going to be enforced, then a number of non-productive jobs will need to be defined so that the Operator can “sign on” to them when needed. This then defines what the new requirement is. You need to create some non-productive jobs.

There are a number of different methods that may be used to achieve this. You could for example create a “down-time” Job for each employee or a Job for each “down-time” activity. The method we will examine here applies a combination of these two things. A number of “down-time Work Areas” are defined from which Parts, and subsequently, permanent or “standing” Jobs are created.

The Work Areas are defined through the *System Setting/Work Areas* menu in the usual manner as shown below:



Work Areas such as “MAINTENANCE”, “CLEANING”, “BREAKDOWN”, “LOADING” and “REPAIRS”, together with “MEETING” and “TRAINING” all need to be created. To group these “operations” together on the Touch Screen display they are usually prefixed with the same letter (a “Z” for example). This also helps distinguish them from other Work Areas

A typical example (for the Z-MAINTAIN Work Centre) is shown above.

Note i. You should set the recovery rate for the “down-time” operation as zero (0). It does not particularly matter how the other parameters are set.

Once this is done the next step is to define one Part Number that has the Z-processes listed in it’s Process Routing. A good name for this part is “Z-OTHER” This Part should have an appropriate description and contain no Size Detail and no Bill-Of-Material information. The Process Routing only requires a description with no process time as shown below:

MANUSOFT | [JIM](#) | [Log Out](#)

Home

Item Code: Z-OTHER

Item #: 1

Work Area: Z-MAINTENANCE

Setup Time: 0

Process Time: 0

Process Description: Maintenance work

Tooling:

Drawing Filename:

Record Comment:

Delete Move Record Before: 1 Move OK Cancel

The full list of Z-operations should be similar to the process shown in the example below:

MANUSOFT | [JIM](#) | [Log Out](#)

Home

Item Code: Z-OTHER

Attributes Stores Vendor Sales Sizes Materials Routing Other Notes Attachments

| # | Work Area | Setup Time | Process Time | Process Description | Tooling |
|---|---------------|------------|--------------|---------------------|---------|
| 1 | Z-CLEANING | 0 | 0 | Cleaning | |
| 2 | Z-LOADING | 0 | 0 | Load Machine | |
| 3 | Z-MAINTENANCE | 0 | 0 | Maintenance work | |
| 4 | Z-REPAIRS | 0 | 0 | Machine Repairs | |
| 5 | Z-MEETING | 0 | 0 | Yet Another Meeting | |

OK Cancel

Once this is done the “down-time” jobs can be defined. This is done through the normal Sales Order Entry routine. The Customer should be “You”, The due date some time in the future, the prices is zero (0) and the quantity is a very large number.

MANUSOFT | JIM | [LOG OUT](#)

MANUSOFT | M999999 | [Print](#) | [Ticket](#) | [Purchase](#) | [Show Effects](#)

Item #: 1

Quote Number: Quote Item #

Item Code: [Build](#) [Print](#) [Info](#)

Description:

| Pricing Information | |
|---------------------|------------|
| Category | Unit Price |
| | |

Customer Item Code:

Product Code: 1

Due Date: Estimated Finish Date: 2016-09-26

Quantity: Manufacturing Quantity:

Unit Price:

Other Charges:

Shipping:

Discount Rate: %

Taxable Item:

Comment:

Remake Order Move Record Before: 1 - Z-OTHER Move OK Cancel

Total Order Amount: \$0

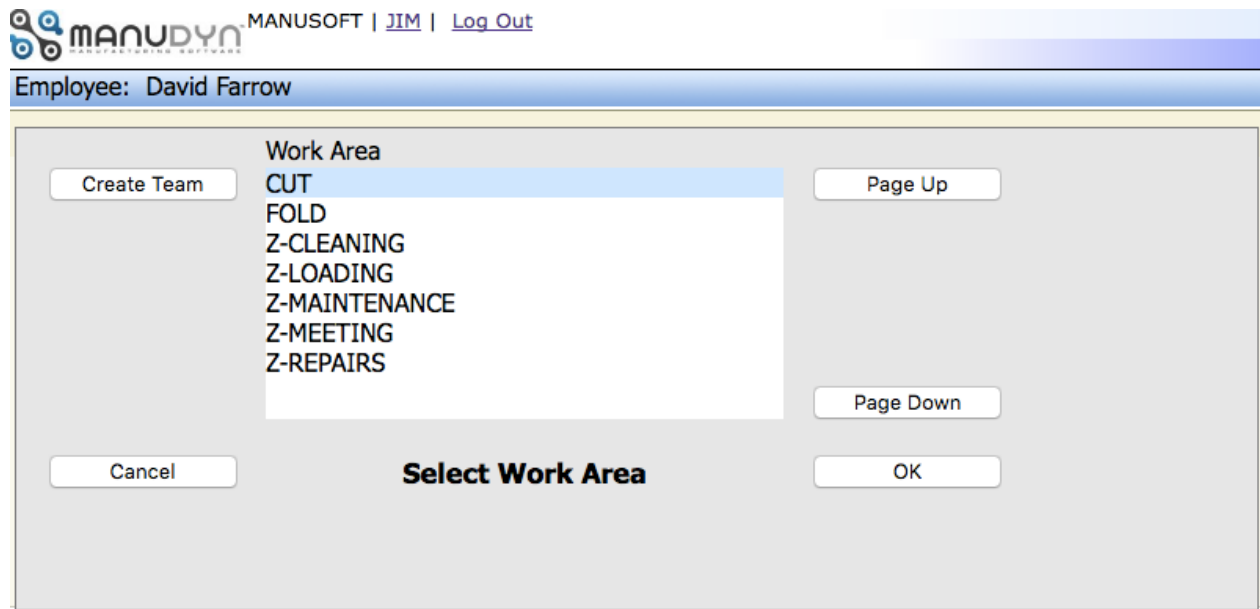
Last Emailed:
Last Modified: 9/26/2016 3:23:38 PM by JIM [OK](#) [Close](#)

Your screen display prior to saving the order should be as shown above.

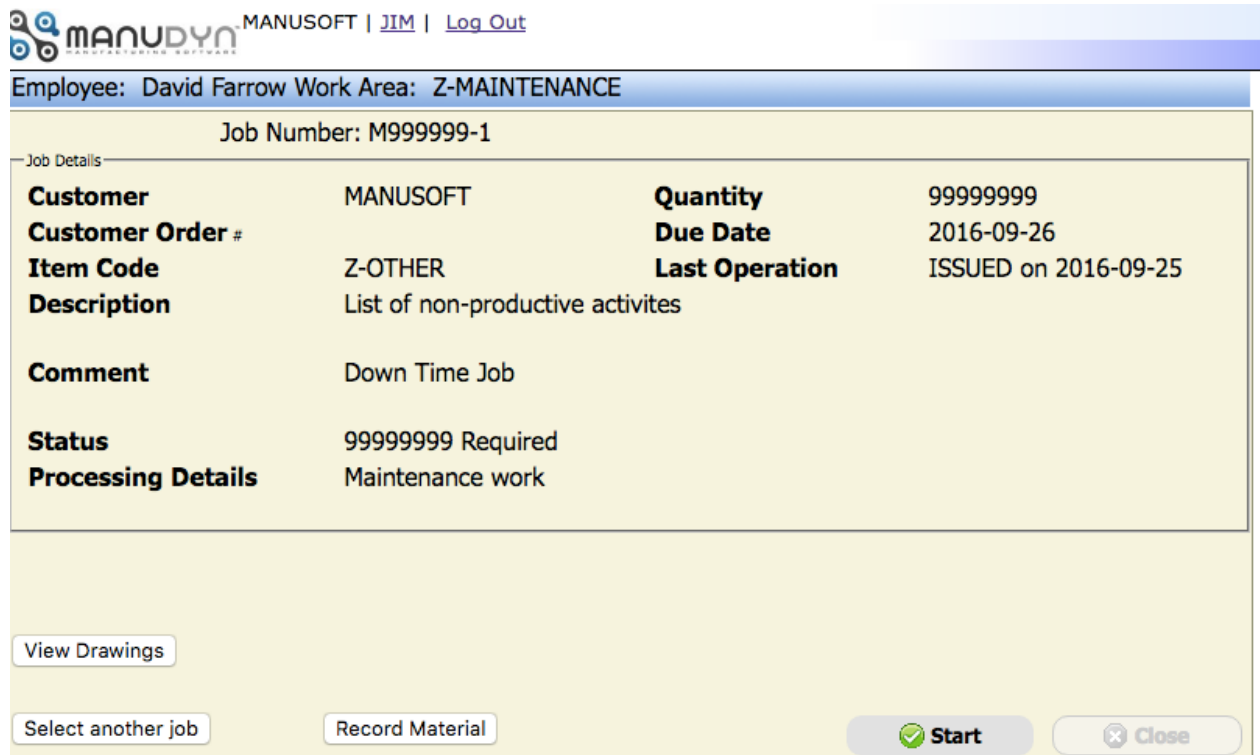
You should use the Build Icon to create a copy of many of these orders (say 10 or so). There is no need to have specific Job Numbers assigned as you will see shortly. If you wish to assign specific job numbers, you can do this by adjusting the number counter from the System *Setting/Number Counters* routine.

The final step is to “Issue” these jobs to production. This is done through Scheduling/Job Issue in such as way as they appear on all Work Centre Schedules simultaneously (default option).

Finally, we have reached the point where the operator can clock onto a “down-time” job easily if there is no other productive work to do. The operator first selects the “down-time” activity from the usual list of Work Areas as shown below:



Once the down time activity is selected the operator should select the first job that is available. The screen display will look like this:



And then the job can be started by selecting the “Start” button.

When the activity is completed the operator needs to “sign off” the job in the usual way. It is recommended that the operator either indicate that the time was for “Set Up” purposes or they enter zero (0) quantity done (otherwise the Job will be “progressed” and we don’t want this to happen).

Note i. You can see now why we needed a large order quantity for this job. No matter how many times you tell the operator to enter zero (0) quantity done they will nevertheless enter 1 or a number representing the number of minutes they were on the job. If the job gets finished (and the operation is 100% done), it will no longer be available for recording “down-time” activity. That is unless you “REMAKE” it and “re-issue” it to production.

You should note that eventually these jobs will get to the point where there is too much Job Cost information recorded against it to analyze efficiently. At this point you will need to raise and insert a new “down-time” job onto the schedule.

It is likely that new “down-time” jobs will need to be created periodically and old jobs discontinued. The Job Cost information will of course still be available after the Job is deleted.

Concluding Remarks

You need to get to the point where all of the operators’ time is being accounted for. That is, Rule 2 is being followed. To do this you will need to provide a number of non-productive jobs onto which the operator may “sign on” when there is no other work to do. Only when you reach this point can you ask the next series of questions, that is:

What portion of the operators’ time is spent on productive and non-productive activities?

What were the major non-productive activities and how can the time spend on them be reduced or even eliminated?

What is the variance between the estimated and actual process time for each operation?

If there is a significant variance is it because the original estimate was wrong or was the job manufactured incorrectly?

The task of management is to find the answers to these questions. Management can not ask these questions however, until all of the operator’s time is accounted for, and it is known what jobs they did, how long it took and how many were processed.