IS JIT FUNDAMENTALLY FLAWED?

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Many implications of JIT, as a shop floor control system, are fundamentally flawed. This is the proposition argued in this article.

The qualifications in the first sentence are important. It cannot be said that all implementations have failed; clearly they have not. But the enthusiasm for a new panacea always tempts people to ignore it's limitations. We should always recognise that there are many different forms of manufacture.

This paper is concerned with shop floor control systems. The point of view taken in this paper is that of the operations manager; the man responsible for getting the product out to the customer. As we will see what he means by control is not what others mean. This difference does not only affect JIT. It is the reason why so many computerised systems are not successful.

First, there is the question of what is meant by Just in Time. The problem is not that there are too many definitions; there is a surprising reluctance to define what JIT means, except in the most general terms. To say that products should not have been made too soon is a truism. To the extent that Zero Inventory is a counter-balance to the implicit assumptions of MRP, that stock holding is beneficial, it has a point. The fact that it emphasises the importance of the material flow system, and the benefits of being able to produce in small batches, is also to be welcomed.

But there is a point when cutting back in this way becomes destabilising. It is the failure to recognise this which makes JIT potentially dangerous.

So let us start by putting JIT into some kind of historical perspective, if only because this points to the problems produced by over selling universal solutions.

The point to be made is that JIT, as a technique, is not a product of the East or of the United States as you may be led to believe. The buzzword may be, but the emphasis on material flow and against stock holding can be clearly seen in the manufacturing literature of the UK during the 1960s. Professor Burbidge's book Production Control is only one such example.

It is instructive to ask how this wealth of practical common sense came to be lost? And the answer in two words is IBM and MRP. Let me explain.

In the late sixties when I was acting as a consultant for MRP systems I called on a company making a fairly simple product. I extolled the version of the MRP system to the Production Director, who I recall had previously been a consultant with PE. At the end I was courteously informed by the director that it was a clever system but would not help them. Why was that I enquired? "Well we make in the week what we need in the week" was the reply. But surely I said, that is not economic? "It is if you buy the right machines" I was politely told.

The company prospered and a couple of years later it bought an MRP system. Why? if it could not help them. Because the system had some useful features, such as stock control, and because there was no choice. It was MRP or nothing. IBM marketing had seen to that. Other computer manufacturers had their clones but there was no real alternative to MRP. It had to be the answer to everyones problems.

Now the truth is that MRP was not designed for a company of this kind. It was designed for the large manufacturers, most of them in the defence industry. Lead times frequently ran into years and stock was not a major problem.

So MRP, including the quaint idea of "Economic Order Quantity", became the accepted dogma. By the time it's deficiencies were becoming apparent, that material management was not the be all and end all of production control, a generation of professionals had been trained in the technique and were ready to welcome the Reformation. MRP2 was the answer to our prayers.

The Japanese avoided this brainwashing. By good fortune they had no defence industries and their major manufacturers were making consumer products. They relegated MRP to what it is good at, raising provisional orders on suppliers, and looked again at the shop floor material flow system. And so KANBAN was devised.

The success of the KANBAN system rested very much on the flexibility of the suppliers. The KANBAN card is an indicator, not that parts are needed but that more parts will be received. The distinction is important; a buffer is maintained. KANBAN overrides any formal order which might have been placed with the supplier, who is fo[illegible] therefore to respond to the actual situation on the shop floor. It is this responsiveness in the system which can so easily be lost in formal JIT implementations.

At this point it is necessary to look a little more closely at shop floor control. As a system it has one overriding characteristic; it operates in the real world. And the real world is full of uncertainties. Things often go wrong and the best made plans go awry. Yet it is on the shop floor that control is actually exercised.

Control can only be exercised in the present. You may chart the course you want to go but success in reaching the objective depends on a series of decisions that are made as events actually occur.

Such systems can be contrasted with a companies planning systems which chart the future and therefore are full of abstractions. MRP makes many assumptions such as lead time are fixed and that, by the time goods are received, the situation will be as anticipated.

KANBAN recognises that this may not be the case. Buffer stocks are held on the line and the KANB[illegible] operates on the earliest time goods will be accepte[illegible] does not leave supplies to the last minute.

These buffers play an important part in stabilising the system. Without them variations in supply and demand would ricochet around the system which would move from crisis to crisis.

Now a shop floor manager understands this and plans buffers into the system. It is an essential part of his control mechanism although not often expressed or quantified. He does not seek optimum solutions which by definition are critical. He keeps his options open so that he can sleep at night.

So how does this fit in the JIT?

Well in the first place it must be accepted that buffers are essential for control. Without buffers the system will be unstable and uncontrollable. Buffers are there to smooth out the very real unpredictability which exists in the production process.

The problem is how to plan these buffers.

Now it is significant that most of the quoted references for JIT are assemblers where;

- Products are normally specified by the manufacturer
- Production is to a programme and assumes fixed lead times
- There is a simple set sequence of work

— Bought out components are a major cost
— Resources can be fairly well balanced; flexible manning helps here
— *Major shut downs are* not normally needed
— Idle time can be profitably spent in Quality Circles or similar activities

Departure from any one of these characteristics will increase the need for buffers and complicate the implementation of JIT. In the remainder of this article we will consider the effect which varying these characteristics has on the relevance of JIT, literally interpreted as not making something until it is needed.

Making to Customer Specification produces many *problems. The two we will consider are the* question of variability in the loads on the resources and how to maintain lead times acceptable to the market place.

In the jobbing industry, orders will normally create variable loads on resources. At any one time one resource will be the bottleneck. Hopefully it will be the major resource of the company. In any event it is the major profit earner. Now OPT recommends that you accept the *idle* time on the machines standing in front of the bottleneck, that they produce just in time. However it recognises the importance of having work standing at the bottleneck and later stages. In this respect it differs from JIT.

Work standing at these stages, the queue, gives the system its flexibility. It allows the bottleneck to select work from the queue to take advantage of setups and maximise the output and that means the profit. The work standing at later resources gives an opportunity to schedule the work into *its original priority*.

Another common form of manufacturing is described as "make to catalogue". This occurs when the customer selects from the many options described in a catalogue. Competition normally means that part assembled stock is held to reduce the lead times. This is another situation in which stock is needed and JIT is inappropriate.

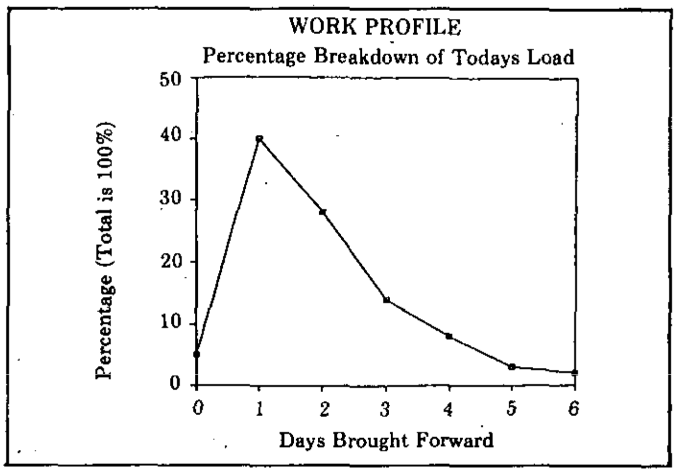
Loads may also be complicated by *complex routing*. In many jobbing shops, work takes a Cook's tour round the machines, often being worked on a particular resource *more than* once. This may not be the ideal way of producing but it is still common. One of the characteristic phrases of JIT is "if the next machine can't take it, don't make it". The assumption is the line is balanced and the future loads predictable. This is not true in jobbing.

Another consequence of complex routing is the way bottlenecks can move around. There is not much sense in *accepting an underload standing* in front of an overload, and the temptation to start work earlier is natural. This can be overdone and cause lead times to increase but even in sensible proportions it is a departure from JIT.

There is also the tradeoff between increased investment in Work in Progress and machine idle time to be considered. If the material component is expensive the balance swings toward JIT. *If the form of manufacturing* is capital intensive, higher machine output may adequately compensate for the increased investment in work in progress.

This cost equation should always be borne in mind. In some recent work on an automated line, we were able to show that work should be planned to take place in advance of the due date. The graph below shows the Work Profile which was recommended.

The proposal was that only 5% of work should be done *on the day required*; Just in Time. The 5% covered breakages which had occured on the previous day. Some 40% of work was brought forward one day and the remainder 2 days or more. By bringing work forward in this way delivery promises could be held and the resources down the line balanced. The alternative is to attempt to



anticipate the day to day situation in the plant when orders are initially accepted and this is unrealistic.

This points to another probiem with JIT when making delivery promises. If manufacture is of standard products to a production programme, there is normally some finished products down the line. A failure to output a particular product on a certain day is unlikely to be disastrous. *If it is, then the supplier will probably insist on* you holding finished stock as the buffer. So much for Zero Inventory!

But to set delivery dates critically is a recipe for disaster. It anticipates all the events which preceeds the completion of the product. Getting it right demands extraordinary flexibility in the manufacturing process and a fair measure of good luck. One of the reasons for this country's poor delivery performance is the practice of setting dates by slotting work into the first available free *date. This means it is planned critically from the start.*

Finally JIT can only work if the manufacturing processes are reliable. For this reason JIT practitioners stress the need for preventative maintenance. But preventative maintenance does not make an old machine reliable. And the problem is compounded if there is no alternative route.

To summarise, what are we saying.

First buffers, or float, is essential in a system if it is to be controlled. If there is not float the options to exercise control do not exist. The theoretical advantages of JIT, of reducing stock and therefore costs, are only part of the equation. The predictable performance of the whole enterprise is what counts.

So what do you do?

First you must recognise where float is required and plan it into the system in a form which can be recognised. The tendency is to hold it in many different forms. Buffer stock here, spare capacity there, extended lead times yonder. This complicates control and may make it impossible. The manager will revert to his backup system; the Shortage List.

The essential questions are;

Must work be done now or can it be done late?
If later, what delay is acceptable?

It follows therefore that float must always be expressed in terms of time.

Some important concepts of manufacturing control have been raised in this article which extend beyond the problems of JIT. The Float Control Concept will be developed in a later article.

Is the case against JIT proven or not proven? That will depend very much on the kind of manufacturer you are. But in the world of manufacturing there is no universal panacea whatever the consultants may say.

About the Author

Alan Jons is a Senior Manufacturing Consultant with 4GL. He has been working with computer manufacturing systems since they were first introduced by IBM. He has worked for both IBM and ICL. When he left ICL he was Manufacturing Industry Manager. He has stayed ahead of the technology and in the late 70's, as an independent consultant, he began working on minicomputers and communications in manufacturing. In the last 5 years he has specialised in workstation based manufacturing modelling. He is a regular contributor to technical journals and runs the 4GL manufacturing systems seminars. He has been instrumental in the specification of several major computer based manufacturing systems.