Lean, Agile - and Simple

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NEW IDEAS OR NEW NAMES FOR THE OLD IDEAS?

Whilst the attention in recent times has moved away from the old battle-ground of MRP vs JIT to the new conflict between Lean and Agile we remain in danger of perpetuating one of the greatest failings of our profession.

We are also continuing to give insufficient credence to one of our basic truths.

We can choose to approach all improvement exercises under the banner of a particular set of jargon if we feel this to be appropriate within our business. We can introduce all change as *Kaizen;* we can seek to achieve *Kaikaku* rather than progressive improvement; we can look to make all our activities *Lean or Agile*. Equally, we can change the way we do things and call it *Business Process Re-engineering,* in which we would hope these days to introduce a considerable degree of *Innovation.* One of the authors of this paper presented a case study at, the then, BPICS Conference in which a BPR project was launched as the latest phase in that company's TQM programme.

What does this tell us?

- That we are always looking to do things better and have a number of tool boxes into which we can dip for the techniques by which we can achieve this aim.
- That we can promote our improvement work within the organisation in a number of ways. In some companies Kaizen may well be the answer if the use of the Japanese term for continuous improvement will inspire confidence and commitment. In others a cynical workforce may see this as hype (or, in political parlance, 'spin') rather than something which will deliver.

THE GREATEST FAILING?

And the greatest failing?

That we can so easily waste our time on all this jargon.

Some businesses spend more time debating whether to launch *Kaizen* or *Lean* than they do in assessing and getting on with whatever needs to be done to improve customer service, shorten lead times, reduce inventories, improve productivity. Some people – and the IOM has its fair share! – can spend many happy hours debating whether a particular approach is *World Class,* or *TQ,* or *Lean,* or even basic old *Just-in-Time.* Where do all these new names come from? Sadly, from the consultants and educators who are either looking to sell their services by some new buzzword, or from their competitors who have to appear up to date. Just as the MRPII system suppliers decided that it was easier to change the generic form of their software to Supply Chain Management or Enterprise Resource Planning than it was to come up with something genuinely new, lots of *JIT* courses were suddenly re-labelled *Lean* with no change in content.

This is not to say that the term *Lean* has no value at all. Just as Mr Schonberger made us think a little broader than stockless production when he coined *World Class,* so Messrs Womack and Jones reminded us that we should be looking to attack all forms of waste, and that when *JIT* was ascribed to all that had been seen within the *Toyota Production System* and its Japanese counterparts it didn't tell the whole story. Equally, we can now use the term *Agile* as a prompt that we must be responsive to change. No doubt we could come up with a number of other qualities required of our management systems and processes, all of which exist within those companies already working at the level of best practice.

No doubt somebody will. Give it time.

DO ALL THESE NAMES HAVE VALUE?

(That is, apart from to the consultants and educators who are looking to use them as a way of stealing a march on their rivals?)

Well, yes, they probably do.

In those companies where projects based around industry-standard terminology, stand a greater chance of generating the confidence and belief essential to bring about change, then new names are needed every so often. If a *JIT* project had delivered significant benefits five years ago but the impetus for continuous improvement had been lost, then a re-launch under the *Lean* or *Kaizen* flag may well have been a perfectly valid step. If that company is now seeking some way of stepping up its improvement activities then the emergence of *Agile* as the latest goal may well be manna from heaven.

In the cynical environments where statements like "we did TQ, then became lean and we are now going to become agile" would inspire nothing but contempt, then they have no value at all.

THE NEGLECTED BASIC TRUTH

The fundamental danger that can be hidden by all this jargon?

Quite simply that **simple approaches stand a better chance of success.** We can easily fall into the trap of starting from the standpoint of 'which approach should we adopt and which techniques should we use?' when we should be looking pragmatically at our own business and identifying opportunities for improvement.

AN EXAMPLE OF AN IMPROVEMENT EXERCISE

In the mid-nineties an additional product, the safety relief valve, was introduced to the Skelmersdale facility of Dresser Industrial Valves. This plant's existing products were larger, lower-volume units for the power supply industry with high engineer-to-order content. These were sold on market lead times of up to 20 weeks covering specification, design, procurement of castings/ forgings and manufacture. Because of the variety of products, sizes, configurations and metallurgies it was very difficult to eliminate foundry lead times through forecasting and stock-holding. Each new order was effectively taken on the cumulative lead time of all the elements of design, material procurement and manufacturing.

In addition the existing product range included a number of very different model types and a wide variety in sizes. As a result the production area was laid out functionally and there was a lot of movement of components around the shop. Cellular manufacturing was a distant dream!

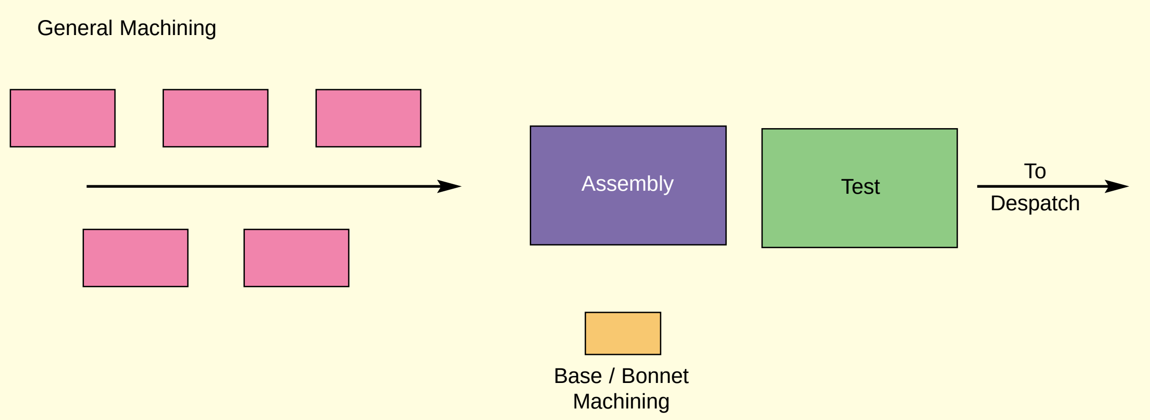
SRVs offered a new series of challenges to the factory. Sold primarily into process industries – chemical plants and refineries – they had to be offered on typically 6 to 8 week lead times although many of the components were themselves only available on lead times longer than this. However, as a (relatively) standard product it was possible to forecast demand for at least the more common variants of the longer lead time items – primarily base and bonnet, essentially the 'body' of the valve, and other castings and forgings. This was not foolproof in that the demand was highly variable and the old truth that forecasts are more accurate over longer periods applied with a vengeance. Short term planning of sales orders was undoubtedly a problem.

It was recognised that the introduction of a volume product into a factory which was until then essentially a job shop called for new approaches. In particular, the new product required – where possible – dedicated facilities free from any interference arising from the high variety of work flowing through the rest of the factory. A considerable investment was thus made in the acquisition of new, dedicated plant for machining the high-precision components required in this safety-critical product. A small 'factory within a factory' production line was created in which components flowed through the machining facilities, into a kitting area and then onto assembly, as shown in Figure 1.

This dedicated unit had several key pieces of plant. The first of these is an Okuma MC600 machining centre for machining the valve bases and bonnets - the major components of the product. This machine, which produces finished components in one pass, was felt to be the most constrained resource within the operation in most circumstances (though this could change – see later). Of the other in-house parts produced all require several operations but the primary processing is carried out on one of two Yamazaki lathes - these being a Super Quick Turn 15 and an Integrex 40.

When the product was introduced to the plant it was decided that in order to meet market lead times the business would hold stock of castings, forgings and other raw materials. An exercise was carried out to explode the forecast volumes into safety stocks of these items. Sales orders were then taken in a relatively uncontrolled manner. That is, products were sold on a standard lead time, no attempt was made to regulate volumes per week and there was no visibility at the

FIGURE 1



time of taking an order of the material supply situation for that order. If the product mix were to be significantly different than average then key components could well become shortages. This did not happen in the early days and the product was thus successfully introduced and output grew in line with sales plans.

THE IMPROVEMENT PROJECT

The exercise described here arose primarily to address the problems of the product's success - ie its growth. As volumes had increased it had become increasingly more difficult to maintain the short lead times required, and on-time delivery was suffering. Two separate issues were identified. Firstly, the product mix did often differ from that envisaged and certain components became shortages necessitating the usual fire-fighting and recovery exercises. Secondly, the volume of output varied from one week to the next resulting in a lot of effort needed simply to move work and dates around in order to manage overloads

The improvement programme was managed as a series of TQM initiatives addressing specific issues in various areas of the business. In fact its major consequence was actually a recognition that the Power and Process markets, with their different requirements, should be handled separately. Whereas the split had previously been defined only within the shop floor operations and all support functions were shared, it was now decided that the company should comprise separate business units, each using tools and techniques appropriate to its own market-place. This re-organisation proved very successful in allowing each arm of the company to operate in the most appropriate way whilst retaining the advantage of shared resources in those areas where this remained the best approach.

Whilst SRV order acceptance and scheduling was recognised as a major area for improvement, the TQM programme comprised several elements, including projects to reduce set-up times in those areas where this was an issue, a focus on method improvement to improve quality and productivity, improved supplier partnership, improved communications to speed up the order acceptance and product specification process and a re-definition of responsibilities to flatten the organisation and allow greater initiative and team-working within the manufacturing area.

SRV SCHEDULING

Although established as a separate dedicated cell within the factory, this business unit inherited the traditional methods of production planning and scheduling, centred around the BAMCS integrated MRPII system supplied by Unisys. This package uses standard Material Requirements Planning logic where component orders are scheduled for completion based on parent item lead times, with their operations scheduled backwards from the due date taking account of queue, move, set-up and run times at each operation. The impact of this scheduling is displayed in load graphs and analyses through the system's Capacity Requirements Planning module.

Within the rest of the business the MRP system was driven directly by sales orders – it was not possible to introduce any form of forecasting given the nature of the product so each sales order was assessed to determine the longest lead time element and this was used to determine the planned despatch date.

The first aim in the SRV improvement plan was to achieve a smooth programme. Had the exercise been managed as one of introducing *Lean* or adopting the *Toyota Production System* the aim may have been promoted as *heijunka*. Basically the objective was to avoid the peaks and troughs which so interfere with productivity and on-time delivery. We wanted to set our manufacturing plan around an established level of resource and component availability and 'slot' new orders into that plan.

The first step in this exercise was relatively simple – establishing a Master Production Schedule with which to drive the company's MRP system (the BAMCS package from Unisys) and which would also be the mechanism used to establish customer deliveries. There were some complications here:

- The product was sold in a significant number of variants – forecasting each possible end item was impossible. The forecast had to be established at the generic level using option planning, with absolute 'specials' catered for by the contract engineer, working establishing the best delivery through discussion with all parties. Some safety stock would be held on low-volume raw materials to ensure acceptable lead times on these.
- People in other industries may ask, "why bother with these 'specials' if they require cash tied up in inventory for minimal sales?" and this is a good question. However, when specifying equipment for, say, a new chemical plant, the customer does not want to deal with a number of suppliers. Valve manufacturers have to meet all the demand; they cannot simply 'cherry pick' the low–hanging fruit. These 'specials' are an essential part of acquiring much larger orders and have to be available realistic lead times.
- Some customers placed orders for a large number of valves to be shipped together. The manufacturing plan would be based around a smooth level of output but the despatch plan may be anything but.
- Establishing a 'smooth' programme was made difficult by the way in which the workload could be stated. The obvious aim was to set out a plan based on a fixed number of units per week, but this took no account of some key factors such as size or material – bigger valve bodies take longer to machine, as do smaller items in harder-wearing materials.

This last problem could, it may be argued, be resolved by the good old MRP approach of capacity planning – either in 'rough cut' mode when the MPS is being set or by detailed CRP when the plan has been exploded into component plans. The team looking at the issue gave consideration to these approaches and ruled against for several reasons:

- 'Rough Cut' is precisely that – it is 'rough.' It is based on averages for product types and provides approximations.
- Detailed CRP includes similar approximations when allowing for changeovers. With this product type the product mix can lead to bottlenecks moving around, despite Dr Goldratt's teachings. In most cases the Okuma machine producing bases and bonnets was the constraint, but a high proportion of particular configurations or metallurgies could mean that another machining centre was the determining factor. Since set-up time at the point of launching the project was a significant element, and since this is dependent upon what we are moving from and to, planning around such approximations did not appeal.
- The clinching factor was that both approaches relied heavily on the computer and its mystique. It was felt that we could do as well with the planner for the product family using his judgement to establish the overall level in line with the usual mix, and subsequently revising the plan as demand changed or as other factors came to light.

Working to such an ***'order slotting***' approach would have several benefits. As well as each sales order being given an achievable date which should lead to good customer service, any change in demand patterns would be immediately apparent. If the availability of one product came in to 3 or 4 weeks while another was moving out to 9 or 10 then clearly the first was selling at less than anticipated and demand for the second was outstripping the forecast.)

Theoretical calculations established that the Okuma capacity, given a standard mix of valve types and sizes, was around 50 units per week. This 50 valves per week was established as the ***drumbeat*** around which everything was paced. Formal order slotting procedures were introduced to regulate assembly to this figure and to drive procurement of raw materials and purchased items with a four-week time fence inside which only actual sales orders would be permitted.

The resultant approach, in this area at least, conformed to standard MRPII logic. As each order for a unique, configured valve was loaded to the manufacturing programme, the MPS for the equivalent 'standard' item (a planning bill of materials) was consumed. True 'specials' were loaded to the manufacturing programme in the week when all materials would be available – usually determined by the procurement of a special casting (either an unusual metallurgy or an item needing special certification, witnessed test, or similar).

The business then had a master plan of sales orders plus unconsumed forecast driving all procurement and component manufacturing activities. The unconsumed forecast could be presented to sales personnel as 'availability' as shown in Figure 2. '123' is a type of safety relief valve. The suffix '30' denotes a product with bellows and the final letter indicates orifice size. A sales engineer asked to give a delivery on 4 size E with bellows (ie 123-30E) knows that 2 as yet unsold units are scheduled for manufacture in the week of 25th October and 3 for the following week.

STILL ROOM FOR IMPROVEMENT

The assembly area now worked to a 'drumbeat' based around 50 standard units per week – a takt time of roughly ninety minutes. This was very successful in improving performance but there remained too many problems in shortages arising within the machining area. The business had clearly not achieved *heijunka* (a smooth plan) in this key area. This became the next area for examination.

The traditional approach to production scheduling and operation dating within the plant was the standard CRP logic. In such a job-shop environment, laid out functionally as a result of the great variety of products and components to be manufactured, it is necessary to have discrete schedules at every work centre and ensure that the job sequences at each work centre are co-ordinated to aid the smooth flow of components to their respective due

FIGURE 2

PRODUCT AVAILABILITY CHART

Product	27-Sep	04-Oct	11-`Oct	18-Oct	25-Oct	01-Nov	08-Nov	15-Nov	22-Nov	29-Nov
123-00D					2	3	5	5	5	5
123-30D					1	1	1		3	5
123-00E						1	2	2	4	6
123-30E					2	3	3	4	5	8
123-00F						1		1	1	
123-30F							1	1	2	2
123-00G						2	1	1	2	3
123-30G					1	2	2	2	3	3
123-00H						1		1	4	4
123-30H							2		1	2
...etc										
Total					19	20	35	51	60	71
Production	55	48	50	51	52	52	45	50	48	48

dates. Dates are then presented to supervisors and operators as being sacrosanct on the understanding that there is, in fact, some flexibility – where queue and move allowances, for example, can be over-stated to enable some delays to be incurred and later recovered.

It has to be recognised, of course, that MRP and CRP are difficult tools to utilise. MRP generates orders for purchased items and for in-house manufacturing irrespective of capacity. CRP highlights overloads only after MRP has ordered the raw material. This requires that where a problem is identified, planning staff quickly examine the cause and take appropriate action. This can be troublesome in that the company's flexibility to move dates around and resolve capacity issues is limited by suppliers' ability to respond. In this type of business market requirements demand the best lead time available so foundries, in particular, are normally already being pushed for the best possible delivery so pulling work forward is rarely an option.

The first conclusion of those re-visiting the approach to planning for the SRV was that it was too sophisticated, introducing complexity to what is essentially a simple, self-contained unit comprising a flow of components through cells into a rate-based assembly department.

Why were we presenting each work centre with a work-to list which may call for some nozzles, followed by some disk guides, followed by adjusting rings, followed by more nozzles, then retaining rings, more disk guides, and so on? If followed blindly this list could lead to many set-ups, and consequently reduced output. Although the obvious solution might appear to be to give operators licence to cut across system sequences and hence obtain reduced set-ups, this is a difficult area. How much licence? With lead times of only 5 to 8 days and a policy not to hold buffer stock of finished components, any delays thus arising could jeopardise supply to assembly and hence customer deliveries.

Parallel initiatives were in hand to empower operators to take ownership of their area. Set-up times were being attacked as one of the ways to enable volumes to be increased and at the same time the production team were being given more responsibility – and authority – for the identification, resolution and, in future, prevention of problems. Why, then, were we pursuing this approach in all areas except the key essential of what to make, and when?

As a further valid question, how could it be that we were setting out to assemble 50 valves a week and could end up with requirements at one machining centre for 100 nozzles?

The answer to this latter question, of course, was batching. Many items had been defined with 'economic' batch quantities to avoid too much time lost to set-ups. As well as the economic reasons, this lost time can make the planned output unachievable. Batching, however, brings its own problems. Taking nozzles as an example there were 6 basic types of this component in about 15 sizes – almost 100 discrete components, each of which may be required in any of several materials. Batch sizes were defined with the high-usage variants being manufactured, say, once every two or three weeks and others once every two or three months. (Very low-usage items were made strictly to order.) The vagaries of statistics meant that at some times a few of the runners cropped up together - calling for, say, 100 items in a week - while on other occasions demand may be as low as 20.

And the solution? Well, quite simply, the ideal is to only make the quantity required, when required. But this wasn't practical given the fact that set-ups could still be a significant problem. Or was it?

TIME TO RE-THINK

Clearly some fundamentals had to be re-assessed.

Batch sizes were recognised to be one of the contributing factors so these began to be progressively reduced. However, it was then found that the machining area was beginning to struggle to meet output levels so the methods of manufacture also came under scrutiny. Clearly the factor - set-up times - which had led to the adoption of batch manufacturing had to be attacked.

The Okuma was always felt to be the key machine in the business - around which all work was loaded - so this was examined first. Firstly the actual machining times were questioned. These had been developed synthetically at the time the SRV product was brought into the factory and it was believed that there were inaccuracies in that the standards related only to actual machine time and not the time taken to index pallets in or out of the working area. Additionally, the synthetics had been based on the assumption that a stainless steel product would be a small proportion of total output and would be handled as 'specials' on conventional plant elsewhere in the factory. As the UK proportion of stainless steel had grown to around 15% this was no longer feasible, so this work was also being loaded to the Okuma.

It was obviously necessary to develop alternative methods. Among the issues tackled were improved flexible fixturing, back-up tooling and a routing change so those flanges were back spot-faced during the machine's cycle time. It was found that as the exercise to improve methods and reduce set-up times gathered momentum, new ideas were continually brought forward by operators and these enabled the performance against standard to improve very considerably. As a result of the various changes it became possible to eliminate batching and machine bases and bonnets strictly to customer orders.

On the other work centres the thrust was double-pronged. Methods and set-ups were vigorously attacked but it was also determined that the fundamental way in which work was loaded had to be changed. These thoughts led on to what has become known as the 'structured manufacturing cycle'. After much consideration it was suggested that if we presented the machining area each Monday morning with the assembly requirements for the following Monday, the team could sequence the work in such a way as to minimise set-up times. For example, all the week's nozzles would be processed on a piece of plant, followed by all the valve stems, followed by the retaining rings, and so on. Within each component type the operator could start with smallest and move up through the range, or start at the largest and move down.

Another key was to schedule for early days in the week any parts which have substantial additional work before being ready for assembly - disks are a good example since these are subsequently made into a sub-assembly and further machined. In the same vein, some components went elsewhere in the plant, outside the focussed unit dedicated to SRV, and time had to be allowed for these items to be held in queues. These too had to be scheduled for early in the week.

And thus it was. All the batching rules were removed from the system. The finished products were set up with a one-week assembly time and all manufacturing completions on a Friday, which meant that all the components were scheduled for completion the previous Friday. A new report was written to present the machining team with the component list sorted by description (some work on rationalisation was needed, but this was no more than a minor irritation). The machined components themselves were all set up with a one-week lead time so that the MRP system ensured that all the material requirements for the week were fulfilled by the start of the week – leaving the machining team with total flexibility as to what to make first.

THE BENEFITS OF THIS APPROACH

This brought several benefits

- the elimination of stock of finished machined parts arising from batching.
- the opportunity to avoid double-handling of machined parts - all could go directly to their designated assembly order.
- improved on-time delivery performance.

Most importantly the approach brought simplicity. Anybody presented with an order for 9 particular retaining rings could see exactly from where the quantity derived – his friends the fitters were going to assemble 9 valves the following week requiring exactly these items.

This simplicity also highlighted problems very quickly. Rather than rely upon complicated graphs or operation dates derived from all these elements of set-up and run times accompanied by a move time matrix and queue times defined by work centre, the team leaders put together a plan as to which components to complete first and could quickly spot when some delay might require additional resources later in the week. Control of manufacturing was where it belonged – in the manufacturing team.

IS THIS LEAN?

If we were to perform a value stream analysis on the manufacturing activities of machining and assembly then this process may be described as anything other than lean. We were presenting a week's worth of machined parts each weekend to an assembly team who could assemble a valve in a couple of hours. We were allowing two weeks from the issuing of a major casting for the item to be machined and the finished product assembled, when this could actually be completed in less than a day.

On the other hand the unit very quickly achieved 100% on-time delivery and shortening the time allowed in manufacturing would not have reduced lead time to market. This sentence often causes some debate and even outright disagreement at first, but when it is considered at length, realisation dawns. We were talking of a business with an order book of 6-8 weeks' production. In such a case, what determines the lead time we can offer a customer? Quite simply, the length of the order book. If we can produce 75 units each week and have an order book of 450 units still to be produced when can we promise to make the product for which we now receive an order? The answer, of course, is that we can start in 7 weeks' time. The cost of the approach now adopted is simply to plan to have the raw materials ready in 5 weeks and hold an average of two weeks' worth of stock and WIP.

This is not then totally 'lean' but consider the alternatives. The total elimination of set-up times would enable the removal of any need for producing similar components together and a sophisticated scheduling system could then produce detailed finite plans. However, such an approach is limited by its dependence on the accuracy of routing times and the true capacity of our plant – neither of which can be considered sacrosanct. Such an approach is also constrained by the problems that are undoubtedly going to crop up. Castings will be found occasionally to contain blow-holes, tools will occasionally break. Clever scheduling systems can react to such events and present us with the consequences – if we are truly using finite planning they tell us that some components will be late.

(This can be a real difficulty – planning systems may schedule items to be late even though we may be able to avoid this by alternative resources or even simple overtime. When some delay is inevitable they may 'select' the wrong components to be late. How does the system choose between components some of which are for large sales orders, some for small, some for export orders with letters of credit expiring next week, some where the customer's inspector has his flights booked for witness test, and so on?)

SUMMARY

This exercise helped to bring about considerable improvement in business performance. The success is attributable in part to some good people in a number of project teams all working hard to apply best practice in their particular area.

The success of the scheduling system, in particular, is down to that basic adage – KISS (or Keep It Simple, Stupid). It is very easy to be carried away with all the jargon surrounding Lean and Agile, MRP and JIT, Kaizen and Kaikaku and all these terms have a meaning. The tool boxes all have something to offer (and Mr Bicheno's excellent book summarises them all nicely) but nothing can replace the fundamentals:

1. Understand your business.
2. Identify the issues to be addressed in order to improve performance.
3. Identify the technique best suited to bringing about that improvement.4. Get on with it.

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