

The Magic of Levelled Scheduling

By Alan Mitchell

Levelled scheduling. It doesn't sound very sexy, and it doesn't loom as large as other terms in the lean lexicon such as 'eliminating waste' or 'kaizen'. But in a growing number of companies, the introduction of levelled scheduling is having dramatic effects not only on output, quality, service levels and profitability but also on organizations' internal working atmosphere and culture ... their human bottom line, if you like.

One 3M operation has boosted output by a third and almost halved material waste, without any extra investment in machinery or people. Kimberly-Clark has seen throughput increases of 15% at no extra cost, with much more predictable and stable production. For Wrigley, the chewing gum company, an output jump of 10% at its Plymouth factory was just the beginning. After levelled scheduling was introduced, huge amounts of space were freed up (50% on the packing floor), and that space is being filled with new machines to produce new products for new markets. In other words to deliver real growth.

In discrete manufacturing, lean performance improvements of this magnitude can be commonplace as companies move towards flow: where each item is worked on one piece at a time so that production can be adjusted to match actual demand. The concept of flow was pioneered in manufacturing plants that assembled products from many discrete parts. But the companies in this article are different. They all work in bulk process industries which, by the very nature of what they make - paper, gum, bulk liquids and so on - means they manufacture large amounts using big machines that live and breathe high volumes. In such an environment, the ideal of flow - being flexible enough to produce each item one at a time rather than the 'lumpiness' of batches - seems so far out of reach as to be impossible. So how have they squared the circle?

The answer is quite simple. While the ideal of flow may seem like a distant dream, it is possible to get much closer - and to become far more flexible - via levelled scheduling.

Their starting point is to recognize that today's production schedules are far from stable. The complete opposite, in fact. Today's all-too-common Materials Requirement Planning or MRP systems start out with the best of intentions - to act on customer orders - but end up creating chaos. Here's how.

MRP is designed to be responsive to customer orders. Every time the plan is calculated, the MRP system adjusts planned production schedules to reflect all the new customer orders before re-balancing back to a target stock level. As a result, each time the plan is calculated it triggers a change to the plan because actual orders will always be different to what was forecasted. What's more, because something always seems to go wrong in production (a machine breaks down, a vital supply doesn't turn up on time, somebody is off sick) very few production plans are ever met 100%. So, to make up for the difference between plan and actual output – and to accommodate the endless spikes and troughs of batch ordering from customers who are also using MRP to plan their orders – MRP systems end up issuing plans and replans on a frequent basis. Result: chaos rules. Fire-fighting becomes the norm.

The breakthrough for 3M, Kimberly-Clark and Wrigley is that they are learning how to avoid this chaos. First step is to realize that while *customer orders* often gyrate up and down in apparently unpredictable ways, actual, underlying *consumer demand* for most products is often pretty stable. Producing in line with actual demand and 'producing to order' are not the same things.

Second step is to realize that demand for some products is more stable than for others. By using a nifty device called the Glenday Sieve, it is possible to identify those products where demand is particularly stable. Typically a small number of 'stable' products, around 6% of the total product range, account for a very high proportion of demand, about 50%.

Once this stable, high volume 'green stream' (as Glenday Sieve inventor Ian Glenday calls it) has been identified, levelled scheduling can be brought in. Instead of producing in one huge batch, how about producing the same volume through frequent regular shorter runs, planned according to the same fixed, consistent repetitive cycle? So, for example, instead of producing 100 units of Product A once every four weeks or so, produce 25 units once a week, regular as clock-work. This fixed, repetitive cycle then becomes sacrosanct. The less predictable low volume 'red stream' items (as Ian Glenday calls these products) are dealt with separately – either using separate machines and staff, or else slotted into the cycle at fixed, planned points.

What are the effects of this apparently simple shift? The first thing that happens is that stability and predictability begin to replace chaos and fire-fighting. If everyone knows, say, that Monday is the day for Product A, Tuesdays are for Product B, and Fridays are for

'red' stream unpredictable, then they all know what they should be doing, when, and they can plan for it. That means, for example, that all the necessary materials, packaging and so on can be prepared for each day so that (surprise, surprise) more things go to plan. That means less fire-fighting.

A second effect is that both stock-outs and inventory levels of finished items, materials and work-in-process fall. That's because production of big batches has two simultaneous effects: the need to store the outcome of long runs (leading to high inventory), plus more stock-outs because while the long run uses up plant, machinery and manpower, other items can't be produced, even if stocks are running low.

Thus many, shorter runs helps to tackle both problems at the same time – and the effects can be quite remarkable. Wrigley, for example, had one warehouse with 5000 pallet spaces and it was chock-full. So full, in fact, that Wrigley also had to book 1000 spaces off-site at a rented warehouse too. "We now have 4000 spaces left and we are producing more volume than we were, and our finished goods stock is very low for our green items," says Wrigley's production director Alan Richards. "We have started dismantling racking in our warehouse because we just don't need it any longer". What's more, by shifting things round to put free space together, Richards now has room for new machines to produce new products – a massive saving for the company, which previously thought it needed to build a new factory.

A third effect is outputs increase. One reason for this is that as you move to a fixed repetitive cycle for the green stream items, bottlenecks and obstacles that have always been there pop out of the woodwork. They become obvious problems that have to be removed, if the cycle is to be maintained. "Our bottleneck in production of pellets was being able to coat," says Richards. "We had nine big machines running 24 hours a day, five days a week, and they were so busy we had to run overtime every weekend and to send volume to another factory to help us out. After going to flow through fixed frequent repetitive cycles, we only needed to run eight of those machines, we had no overtime, and we didn't have to send any volume to another factory. Simply by organizing ourselves better!"

One common obstacle to improved output is changeovers. Long changeovers are a major obstacle to a system based on short runs repeated many times. In the old batch environment, which focused on long runs repeated only a few times, the time costs of changeovers did not loom so large. Now everyone has to focus on

them. "Historically management have been not very interested in the set-up process, because the mindset is long runs," notes Steve Ackroyd, lean project manager at 3M UK and Ireland. "As a consequence the equipment, the procedures and the design leaves many opportunities for improvement. The frequent runs force us to focus on improving changeovers"

The stable, predictable environment created by fixed, repetitive cycles also allows operatives to practice changeovers and, as we all know, practice makes perfect. The more often changeovers are made – and always done at the same time in the cycle – the better people get at it. At 3M one of the most important changeovers took over 5 hours. By focusing on it, Ackroyd's team have already reduced it by 50%, freeing up one day's worth of machine time a month. At Wrigley, the average changeover time was 100 minutes. Now it is down to seven, and Richards believes that is just the beginning. He thinks he can see ways of getting it down to one minute.

Practice makes perfect – or 'economies of repetition' as Ian Glenday calls them – underline a crucial benefit of flow: better use of human resources. Under the old system, the best people focus their efforts on fire-fighting: dealing with crises, solving urgent problems. With the new system they can switch their attention from fire-fighting today's mistakes to focusing on how to improve tomorrow.

"Before we introduced the green stream, shift coordinators would spend the first three to four hours of each shift in the warehouse trying to locate all the materials for that schedule," remembers Fred Boyd, Manufacturing Director for Kimberly-Clark. After introducing levelled scheduling, he asked one coordinator how his life had changed. "He told me 'I haven't been out there [to the warehouse] for three months'. He knows what he's going to be making, and he knows that it will be there. So, now he is saying, 'last week, what were the biggest issues that impacted the green stream?' ...and he's working on planning what to do differently, for instance - how to make that grade change better. He is proactively planning rather than reactively looking for materials. That's 3-4 hours that was spent on fire-fighting now focused on improvement. That's the really big effect. Now we can focus on what is really important for flow."

And there's more. Because moving to a fixed and repetitive cycle of production immediately surfaces bottlenecks and obstacles, it also helps to set priorities. Whatever the problem – machine capacity, machine reliability, materials quality, supplier reliability, changeover times – it becomes clear what has to be fixed. So the focus of

improvement shifts to what really matters, *now*. "One of the real barriers in our green stream was a grade change that took five hours," remembers Boyd. "There were many possible changeovers on which to focus. But, we realized that this is the one! So we just worked on that one and we reduced the time by 43% in five weeks. We created focus on the one issue that was really important."

Another major bottleneck for Kimberly-Clark was a supplier quality issue. "We put an improvement team on to attack it, and they eliminated 73% of those defects," says Boyd. "It got us working with the supplier to solve a problem that we have had forever!" (That's another one of the benefits triggered by flow: the need for closer cooperation with customers and suppliers.)

All of which serves to underline a simple but often-missed point. As a goal, nobody can object to the idea of continuous improvement. But not everybody can actually achieve continuous improvement because their best peoples' best efforts are squandered on fire-fighting rather than improving, and because improvement efforts are not always directed at what matters most.

Flow makes continuous improvement possible by freeing up people's time to do what humans do best: be creative, see and judge alternative opportunities, apply their minds. In this way, it helps create a virtuous spiral. Thus at Wrigley, even though huge benefits followed its shift to an 'every product every week' cycle, Richards is already planning for a shift to 'every product twice a week'. Likewise, 3M. Says Ackroyd: "We have a production plant that makes abrasives and the main machine has to produce a large number of products. 3-weekly used to be the maximum frequency. We started running one family of products weekly – 40% of our volume. When we got that sorted and we moved another group of products to a two-weekly cycle. The second wave took us to 65% of our volume. Step by step you build it up."

But better use of physical and human resource doesn't only lead to better financials: with flow it also creates a happier workplace. Theoretically they shouldn't, but MRP systems create finger-pointing, blaming cultures. Because their plans are never met, there's always somebody at fault. Planners blame operations, operations blame suppliers and so on ad infinitum. Back-biting becomes the norm.

A stable, repetitive production cycle on the other hand underlines a point obscured by the MRP environment. Failing to meet the plan is not the fault of any individual or group, it's the fault of the system itself. MRP sets people up for failure. And that's demotivating.

“Fundamentally, people want to do a good job. But if operators’ routines are repeatedly changed, they lose interest,” notes 3M’s Steve Ackroyd. And that’s what constant re-scheduling does all the time: people do not like short term changes. With flow, “it’s a much better life with much less frustration,” says Fred Boyd. Jayne Kelly, Planning Director at Kimberly-Clark, agrees, “Nowadays, people spend less time arguing each other and more time solving the core issues. Informal relationships have improved. People simply like working with each other more.”

Better use of physical resources. Better use of human resources. A more positive, motivated ‘can do’ culture. Given these benefits, it’s hard to see why companies don’t move to flow.

The reason, of course, is that it’s hard. When confronted with the theory, many managers – steeped in the traditions of batch production – simply don’t believe it can work. Their minds are already made up. Many more managers are sceptical about the likely benefits – while many operatives aren’t keen for another reason: they’re afraid they might lose their job.

Making the change is also hard. MRP systems, which are built around batch logic, need to be amended or even discarded (as Wrigley has done with its MRP system). Accounting rules get in the way. Taking a hit on the balance sheet by accepting a machine is not really an asset doesn’t make the numbers look good; on current incentive schemes, factory managers are incentivized for producing more (even if it is for stock), rather than producing the right amount.

Also, it takes guts to commit the scale of changes rapid implementation workshops generate (see box). “It does challenge how you run the business,” says Fred Boyd at Kimberly-Clark. “We couldn’t have done it without senior leadership’s understanding, acceptance, and sponsorship. Otherwise, there are too many opportunities to abandon the effort when something small goes wrong. You have to have people who understand the journey, including the pitfalls.”

The sheer discipline of root cause analysis and problem solving is another challenge. To make a fixed, repetitive cycle work, problems have to be solved when they arise: which may mean stopping production to correct an issue. No one wants to see a production line stop. “Prior to RFS (Repetitive Flexible Supply), we were more likely to switch over to another product if we ran into difficulty. The manager of the mill would, more than likely, never have heard about it.” says Jayne Kelly. “With RFS, the Mill Manager would have to hear about it. It would be a break in the schedule. That pain of

shutting down big production assets is one of our biggest challenges. But, if shutting down helps you fix the problem long term, it's better than continually struggling or never addressing the problem at all."

Also, you have to be pragmatic. "By moving to this repetitive schedule you are actually forcing these issues to be raised, for the first time. They have to be sorted out, but in the early days of change, things go wrong," says Steve Ackroyd at 3M. "Sometimes we have to say, 'OK. This week is a wipe-out. We will go back to normal fire-fighting and start again on Monday'.

But perhaps the biggest obstacle of all is also the simplest – and most subtle. "Most people see lean as cost-cutting; saving money," says Wrigley's Alan Richards. "But you can't save your way to prosperity. People think that if we go lean we are going to cut out cost by reducing heads. But a true lean business is not about that. It is about being able to do *more* with what you have got. With the same amount of people and the same assets, how much *more* could we do?"

Flow and levelled scheduling

"At Wrigley's we have learnt how levelled scheduling, flow and fixed repetitive cycles are related lean terms" explains Alan Richards. "With lean one is trying to achieve perfect flow i.e. making exactly what is required and when. So "one piece flow" is the ultimate objective. This is counter to batch logic of making big runs to get economies of scale. This is the logic used in MRP systems.

"Levelled scheduling aims to produce closer to actual consumer demand. As consumer demand is often flatter than orders determined by MRP systems, it can be more stable. Also, in order to achieve sustainable continuous improvement you need to have a stable foundation – a platform to build upon. To create further stability, you start with fixed repetitive cycles i.e. fixed sequence of products at a fixed time using ideally fixed machines and people. With the fixed cycle in place, people can work upon improving quality, change-over times – indeed, every aspect of production. As you make these improvements it becomes possible to make the fixed cycles more frequent. And the more frequent the fixed cycles becomes, the closer you get to the ideal of one piece flow – making what is required, when.

"It is a paradox that you first use a fixed rigid schedule to increase efficiencies in order to become more flexible. But this is the best way of getting out of the vicious circle of fire-fighting, and reduction in overall performance that constant fire-fighting brings".

Using Rapid Implementation Workshops

Ian Glenday recommends companies use 'Rapid implementation Workshops' to implement their first green stream. Compared to most change initiatives these Rapid Implementation Workshops - consisting of five days focused on identifying and removing barriers to flow in the green stream - represent a departure. Three things mark them out as different.

First, they are thoroughly 'democratic' in the sense that they recognize that if you really want to know how work actually gets done, you need the skills and knowledge of shop floor operatives as much as those of senior managers, engineers or planners. The trick is to get them all in a room together, focused on the same challenge, each inputting their own specialist skills and experience. Hierarchy is irrelevant. Understanding how 'the real world' works – and what we could do to change it – is all that matters.

Second, the point of a Rapid implementation Workshop is not to make a plan or issue a report. It is to make rapid changes. To do it. *Now*. At Kimberly-Clark, they had a packing machine standing in the middle of the floor that hadn't been used for years. The machine was an obstruction to everyone else, but they had kept it there just in case a special order came in. When the Rapid implementation Workshop team realized just how much of an obstruction it was, they went straight out from the workshop to dismantle it.

Likewise, at Wrigley, when the workshop realized that it would be far more efficient if one machine was moved closer to another, they went straight out on to the factory floor, unbolted it and moved it. "How we ran that machine was a sacred cow for us," remembers Alan Richards, Wrigley's production director. "It had been that way for decades. Moving it like that opened up the eyes of everybody. They realized, 'hey! We can change things'."

In fact, the entire aim of the workshop is to create a new way of working which will kick in as soon as it ends. "At the end of the week," notes Richards, "you have changed fundamentally the way in which you run your factory. You have changed layouts. You have moved machines around. You have changed peoples' jobs. You have changed the way you plan. So by the time Friday comes, you are a completely different organization."

The third thing about Rapid implementation Workshops is that nobody knows in advance what the end result is going to be. It's not a top-down exercise where some elevated guru guides participants to some pre-determined conclusion. It's a journey of discovery. The bare bones are there of course. The idea is to eliminate fire-fighting and create a stable, orderly production environment: to break through to flow. But nobody knows what they will find out during the course of the week, or what solutions they will come up with. The workshop is empowered to make its own decisions. And management is committed in advance to supporting them, even if that involves (as happened at Kimberly-Clark) writing off equipment and taking a hit on the balance sheet, or investing new money in new equipment.

"Sometimes, initiatives can be viewed as completely driven by headquarters or staff locations, notes Jayne Kelly, Planning Director at Kimberly-Clark. With RFS, this effort required the inclusion of operating personnel and many different functions in the decision-making. It is complete involvement. All teams, management and tactical operations, have no preconceived notions on the outcome. The solutions are going to be discovered in the workshop and usually far exceed our normal expectations. We get things done in this workshop week!"

Putting these three differences together brings two advantages. First, speed. With Rapid Implementation Workshops change happens and it happens fast. The whole purpose is to get change moving, within the week. It's a 'Just Do It' rather than 'let's analyze and talk about it' approach.

And this has a knock-on effect on attitudes: Rapid Implementation Workshops are energizing. "People come in from the shop floor high sceptical. As far as they are concerned, this is just another management initiative that won't make a blind bit of difference. And the level of interest is consistent with that," observes Steve Ackroyd, lean project manager for 3M in the UK and Ireland. "Then you start talking about the vicious circle of planning, replanning and fire-fighting and people relate to that. They start to become sceptically interested. And it builds from there. It creates a motivation to move away from the chaos. All of a sudden they've got a chance to actually influence things and get results on things they have been moaning about for years."

"Ian Glenday told us that people wouldn't want go home at night. I didn't believe him," says Alan Richards at Wrigley. "But it happened. They were so excited by the potential of what they were doing they worked into the evening every evening. Then they took stuff home. Empowerment is such a glib word. But here we said 'whatever you come up with, we'll support you'. And they revolutionized our factory."

"The energy that is created is amazing" agrees Jayne Kelly at Kimberly-Clark. "Realizing far greater potential than any of us previously thought is very exciting. Imagine our company if we do all these things identified! But it can be 'scary' as well... in the sense of 'Wow! Are we ready to do all these things that we now know we can do?' "