Increasing profits without capital expenditure

Ian Quest

Recent developments in manufacturing processes make it essential for a successful plant to be as efficient as possible. Newton Industrial Consultants specialise in identifying problems within companies that enable small but powerful changes to be made to the production process, often increasing productivity by at least ten per cent. In this article, Ian Quest, a partner in Newton explains some of their company's methodology

Existing processes hold the key to fulfilling new orders and contracts

In the chemical manufacturing industry there are many sectors where demand is outstripping supply. Either existing customers are crying out for more, or there are new contracts out there to be tendered for. Even in those sectors where this is not the case, many firms could sell more if they had the capacity to make more product. In this situation you can either neglect the potential market share that is available, or take action to increase your capacity.

There are a number of options available to plants seeking to increase capacity. One is to simply buy it. Installing new lines and new machines can achieve large increases in capacity, and new machines are usually more efficient than the old ones, so unit cost could be improved for the new capacity. But new lines do not come cheaply or quickly. Depreciation, the additional labour required to run the new lines and the time delay installing and commissioning them are taken into account, the costs add up.

Another possibility is to have a third-party introduce the extra capacity. That way you can offer a fixed price per unit and guarantee a profit on it with none of the issues associated with making it. Unless you have a branded product, however, the profit won't be very large, as market shares in commodity chemicals are won through lowest cost. There may also be issues around certification of the supplier and their quality standards, which could take time to overcome. Again the costs and benefits should be examined closely.

The remaining possibility is to look to the existing plant for the increase in capacity. It is unlikely that you will double outputs or even increase them by 50%, but 10, 20 or 30% increases are commonly possible in the Chemicals industry, and this is usually enough to cater for increased demands. Furthermore they can be achieved in just a few months. Achieving this will not be easy and will require a focussed manufacturing team working towards a clear goal, but there are several examples of firms who have achieved it, like the UK specialty Chemicals firm who achieved a 27% increase in process outputs in two months, or the bulk plastics plant in Germany which increased their output by 17% over 4 months. Although it is hard work, there are big rewards, and with no capital expenditure required it is of high value.

With an increased capacity from existing processes, you have increased sales without increasing labour or any overhead. The only additional costs are those of raw materials, energy and shipping costs. This means that the extra product has a very high profit margin. The UK plant above made an extra £2.5m a year with the 27% increase from a single process. This took 2 months and no capital expenditure. The German plant increased profits by €3m per year in 4 months with no capital expenditure.

There are always areas which have been previously overlooked

In most manufacturing plants, there is a continual striving to increase efficiencies and capacities. Plants that have been around for years usually have a history of incremental improvement, so it may seem improbable that there is still tem twenty or 30% more improvement to be had quickly.
Since most chemicals plants run at an efficiency of around 70% there is room for improvement. For example, a 20% increase in output would require an efficiency increase from 70% to 84%, which is well within the capability of the processes. The gap is made up of a number of problems, which must be solved to reach the 84% efficiency. These problems will not be obvious and easy to solve, as those types of problems will already have been solved years ago. They will be harder to find or more difficult to solve, or both. They come broadly into four categories.

There are often hidden losses

If you cannot see a problem, it is very unlikely that anyone will try to solve it. This means that if the hidden losses can be found, they may be quite easy to solve. In the case of most chemical processes, these hidden losses usually exist due to the way that process performance is measured and how perfect performance is defined, i.e. what we define as productive time, and what we define as non-productive time. If something is labelled 'productive' then it is unlikely that an attempt will be made to eliminate it or reduce the time it takes.

A good example is where steps that are done sequentially could be put in parallel to save time. Because each of the steps is seen as productive time, and measured as such, there is nothing to tell us that we are losing time because of this, so it is a hidden loss and the process must be looked at more closely to find it.

A British plant producing polymers found this situation in the filling stage of the manufacturing process. Each raw material was put in one at a time, and once all the raw materials were in, the mixing commenced. There were separate solids and liquids weighing systems in this process, so the first improvement they made was to allow them to operate simultaneously. This saved nine minutes on the cycle. On top of this, they started the mixing earlier, when 25% of the raw materials were in the vessel. This removed another 16 minutes from the cycle time. This was 25 minutes from a 4 ½ hour cycle time – a 10% increase in capacity of this process.

Another hidden loss can be identified where there are variations in the time it takes to complete a particular step. Let us look at a step that takes on average 60 minutes to perform, but varies between 50 minutes and 70 minutes. If the time it takes is not compared to a standard, then the variations will not show as losses in efficiency. Furthermore, if it is compared to a standard, but that standard is 60 minutes, then losses in efficiency will still not show up. It is only if we compare performance to the best time - 50 minutes – that we will expose the real potential. After all if we have achieved 50 minutes then it is not impossible, we will just have to solve one or two problems to get all cycles to 50 minutes.

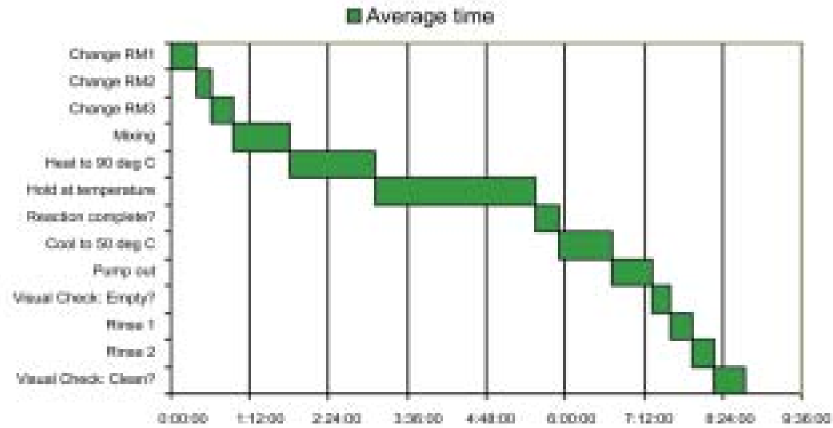
Both these types are shown in Figs.1 and 2. Fig 1 is the cycle as we see it if we look at the average time it takes for each step. Fig 2 is the cycle as we see it if we expose the areas of potential in achieving the best step times and in using parallel processing where possible.

Exposing the hidden losses requires a close inspection of the process and its performance, and a set of measures on the process, which compares performance to the best possible and then breaks that down into its individual causes. When this is done on a process, it is surprising how much potential exists and how much of it is relatively quick and easy to realise.

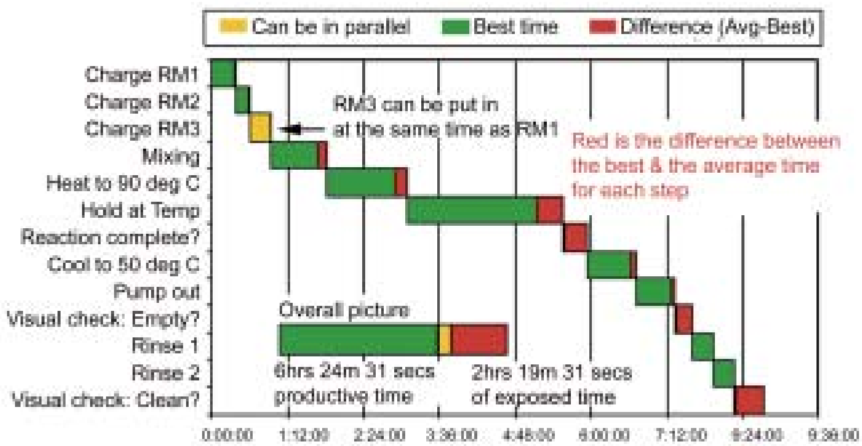
Major areas of potential are often viewed as constraints

Carefully defining productive and non-productive time will expose a number of areas of potential. It will not, however, encourage us to look more closely to reduce the productive time. This is usually viewed as a fixed limit – perfection or 100%. Often there are big wins to be had in reducing productive steps, even though they are apparently at 100%.

By understanding what determines the length of the step, we can establish the 'levers' for step length, and then use those 'levers' to reduce it. A plant in Europe offers a good example of this. The plant has a heat treatment process that operates in a vacuum, and the heating begins once all the material for heat treatment is added and the vacuum achieved. They had



improved the heating cycle with a full set of more powerful heating elements, operating at full power, and the vessel was fully insulated, so the heating time was viewed as fully optimised and efforts to reduce it had stopped. The 'levers' on the heating step length are the heat transferred to the material, the mass of material and



the heat lost from the material. Heat loss from the vessel (and hence the material) was found to be very small, as it was well insulated. The mass of material was determined by the maximum batch size and it would not be desirable to reduce this. This left only heat transferred to the material as a source for improvement.

Under a vacuum, radiation is the only form of heat transfer, except for a little conduction at the inside surface of the vessel. With air in the vessel there is much more conduction and also convection to aid heat transfer. By switching the vacuum on only when the material had reached 95% of temperature, conduction and convection through the air could also provide heat transfer and 17 minutes was saved from the cycle time, a 2% increase in output. a simpler example would be that of unloading time for a dry product under gravity.

The 'levers' on the time it takes to do this are the quantity of material (fixed by batch size), the orifice size and the flow characteristics of the material. In one case, there was a sieve under the orifice, which slowed the unloading. On investigation it was there to stop any loose bolts from the vessel falling into the material. However, by enlarging the bolt heads, a sieve 3 times as coarse could be used and 8 minutes were saved from a two-hour cycle – a 7% increase in capacity.

Whatever the step, by challenging all the ‘levers’ on the length of the step, potential for improvement can be found and quickly realised.

Some problems are as yet unsolved

There are some problems that are known about, but although many attempts may have been made to resolve them, they have not yet been solved. Often they are regarded as ‘unsolvable’ or ‘nature of the beast’. These are complex and difficult problems, but they are solvable given a structured and methodical approach to tackling them. Further to this, the solutions are normally inexpensive and trivial.

A British chemicals company producing a gel in tubes faced such a problem. Since the line had begun production, they had been unable to control the mass of product in each tube sufficiently for it to be within tolerance. This created many overweights and underweights. Domestic customers had been satisfied with an increase in the average weight and wider tolerances, but qualification for the lucrative US market required the original tolerances to be achieved. Problem solving efforts had focussed on the filler, making adjustments to the stroke length of the filling piston, the filling level of gel in the feed hopper, the filling pressure and changing the seals on the hopper. Nothing had improved the situation.

Using a more analytical approach, they revisited the problem. By checking the factors which determine the mass of gel per tube, they quickly eliminated the filler as a possible cause and traced the problem back to the manufacturing process Here, an incorrect setting on a vacuum pump led to air being entrained in the mixture. This formed air bubbles in the hopper, which led to the weight variances on filling. The root cause was a typo on the SOP – a decimal point in the wrong place. Finding and solving this allowed the US launch to go ahead – worth over $3M.

The above is just one of many examples, but given a structured and rigorous approach, any of these ‘unsolvable’ problems can be tackled and solved relatively quickly.

Without clear prioritisation of problems, progress is difficult

The way in which we decide what problems to work on and how much resource to allocate to them has a huge impact on success. Spending time in any Chemicals plant soon hits home that every day there are hundreds of different problems to tackle. Some of these are emergencies that must be dealt with immediately and some are recurring problems that the operators cope with. The challenge is in knowing exactly how much financial impact each one has, and evaluating the resource and effort required solving them. If this is not done well, then we cannot expect to get the best value from our efforts.

A useful test as to how well this is done is to independently ask the top 10 people in your company or division, the following 3 questions:

- ❑ What is the total potential that can be achieved without capital expenditure if we ran perfectly, 100% of the time?
- ❑ What are the top 3 specific problems on site?
- ❑ What are these top 3 problems worth?

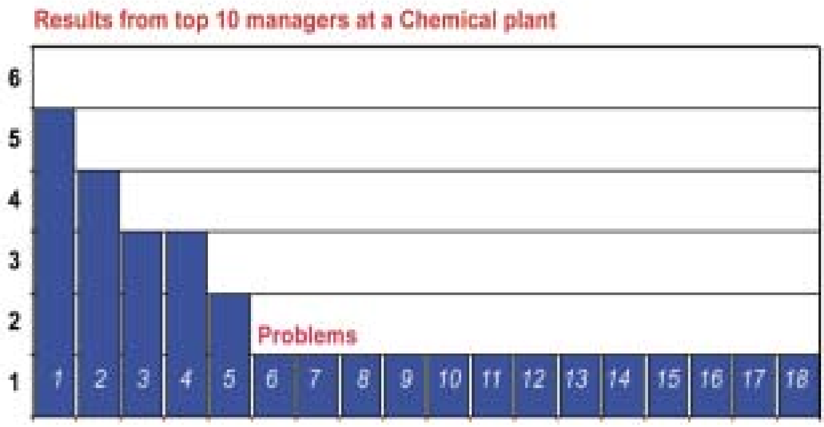
The result from the top 10 people in a chemicals plant is shown below:

- ❑ The top problem was selected 5 times with estimated values from €80,000 to €800,000
- ❑ There are not 3, but 18 different problems mentioned
- ❑ The estimates of total potential varied from €1.1M to €15M (it was actually €20M)

A result like this means there is no clear picture of either the total potential within operations or the value of problems. There are likely to be some quick-wins from hidden potential and there will be relatively little progress made in solving the known problems. Individuals will tend to have different motivations and objectives, since there is no priority list to which everyone adheres. In short it means there will be lots of potential for improvement.

A Unified, Structured and Focussed Approach is Required

The above examples describe some of the reasons why potential can still exist in long established manufacturing plants. To exploit this potential and achieve large increases in capacity from existing plant requires knowledge of what the biggest problems are and a team of people who are focussed, with the skills to solve them. Doing this will not be easy, but it will reap large rewards for little or no expenditure and in a short space of time.



Summary
Plants which have been around for a long time are usually considered ‘optimised’ or ‘at full capacity’. It is, however, always fruitful to look at how much potential can be uncovered in the existing process before embarking on a Capital Expenditure project or a 3rd Party manufacturing contract. Every chemical plant has the ability to increase its productivity by 10-30% using its existing equipment and people. By committing to a rigorous improvement process, increasing demand can be fulfilled and company profits and future prospects can be dramatically improved.