Window and Glazing Topics – Manufacturing strategy for window fabricators

TANGRAM TECHNOLOGY Consulting Engineers

Tangram Technology Ltd.

33 Gaping Lane, Hitchin, Herts., SG5 2DF

Phone: 01462 437 686

E-mail: sales@tangram.co.uk

Web Pages: www.tangram.co.uk

Window and Glazing Topics – Manufacturing strategy for window fabricators

Contents

Window and Glazing Topics – Manufacturing strategy for window fabricators

Part 1: Where to now?

1. Starting out

Do any of these sound familiar?

- ‘I can sell it but they can’t make it’
- ‘It’s no use telling me you can make doors this week, we need windows.’
- ‘Production output is down this week and orders are stacking up.’
- ‘What do you mean we don’t have the equipment to produce it?’

These statements show the need for a manufacturing strategy to direct window fabrication. The problem is that you cannot buy a manufacturing strategy off the shelf. You must create it, work on it, develop it and make it become part of the business. It is a vital part of the business but it can only come from within.

This series on developing the future of manufacturing is a combination of both asking questions and prompting some questions to ask. The answers will be different for every fabricator. There are no right or wrong answers, only appropriate answers to appropriate questions.

The market is changing, getting tougher, and the competition is getting better. In addition to existing local competitors there are new competitors and the rising national super-fabricators. The market demand has changed from a mainly retail one to a fragmented market with retail, specifier, new build and other high-growth and demanding sectors. Minor improvements will be enough to survive and excellence is only a ticket to the game.

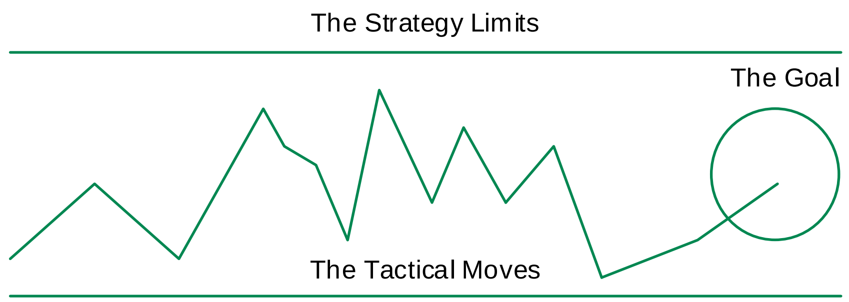
Before trying to create a strategy for manufacturing we should define what it isn’t:

- Manufacturing strategy is not another phrase for automation.
- Manufacturing strategy is not another phrase for buying new machines.
- Manufacturing strategy is not another phrase for computers.
- Manufacturing strategy is not another Japanese management fad.
- Manufacturing strategy is not about technological excellence.

Manufacturing strategy can be about all of these things but only if they are appropriate to the business.

Strategy – Tactics – Operations

So, what are strategy, tactics and operations and how do they relate to the real business? Strategy is about planning for a business. Tactics is the detailed direction and control of the efforts to achieve the plans and operations are what really happens in the market or factory.



The relationship between strategy and tactics.

Window and Glazing Topics – Manufacturing strategy for window fabricators

> The strategy sets the overall limits and directions for the achievement of the goal but does not specify the exact tactics to be used. Tactics may change with time but only those tactics that move towards the goal should be considered.

Many companies develop a ‘sales strategy’ or a ‘marketing strategy’ but few see the need to develop a parallel and integrated ‘manufacturing strategy’. Yet without a manufacturing strategy, any investment in machinery or systems is probably a series of unrelated and ‘ad-hoc’ responses to current operational problems. Without a manufacturing strategy, what initially appears to be a routine manufacturing decision locks the company into specific equipment, personnel or systems. This can make it both difficult and costly to adapt the business to future changes in the market. Worse still, having invested in inappropriate equipment or systems there may not be enough time or money to re-invest in the right systems just when they are really needed.

2. Business strategy

Any manufacturing strategy must be integrated into the overall business strategy alongside the marketing, finance, sales and other strategies. The manufacturing area has often been thought of as a ‘liability’ in terms of the overall business strategy and this has led to comments like those at the start of this article. Integrating manufacturing into the overall business strategy can transform manufacturing into the asset that it deserves to be.
This approach requires that production managers are pro-active in the business rather than reactive. For too long production has been seen as responding to external demands – producing what the sales department sold without it. Production managers must begin to think of themselves as businessmen!

The full business strategy must take into account manufacturing capabilities as well as market needs and product design. Production management must become actively involved in the development of the overall business strategy. Improving manufacturing performance gives companies a competitive edge and production managers must begin to think and act in a strategic manner. They must learn to manage their activities strategically so that the manufacturing function gives the company a competitive edge in the market place.

Before developing a manufacturing strategy, it is necessary to have an overall business strategy because this is the framework that manufacturing fits into.

Setting the goals

The business goals give the essential limits, direction and motivation for the other strategies.

The goals may be:

- Profit
- Market Share
- Growth

There should always be actual targets to aim for in both the long and short term. It is not enough to say that you want to increase profit, you must state how much you want to increase it by and over what period, e.g., profit to increase from £10,000 to £20,000 in the next twelve months. The goals should be bold (to provide a challenge), measurable (to see if you get there), prioritised (to give focus) and timed.

These should be less than half a page in length and there should be less than five key goals.

The key factors for success (KFS)

These are the factors that determine growth and success in a specific market. The KFS may be product related or systems related. Typical KFS could be:

- Price
- Quality – Responsiveness

- Lead times (absolute)
- Lead times (reliability)
- Product choice
- Service (Technical/Sales/ Marketing)

Every company needs to find out what the KFS are for their market and to try to improve these. If there is nothing to distinguish you from the crowd then your future is limited.

3. Manufacturing strategy

Once the business goals and the KFS are established, it is possible to develop a manufacturing strategy to deliver these.

It used to be assumed that cost-efficiency based on high machine and labour utilisation was the way to be competitive. The market and battleground have changed and now total system effectiveness and customer responsiveness are the vital factors.

The new manufacturing strategy must deliver products faster, better and cheaper. Delivering the combinations of the diagram makes manufacturing a truly potent weapon in the market place.

The new manufacturing strategy must also relate to factors such as:

- Minimal inventory.
- Minimal Work-in-Progress (WIP).
- Zero defects.
- Low but reliable lead times.

In developing manufacturing as a strategic tool, it will be necessary to examine how production is controlled, how quality is controlled and how performance is measured. Some of the areas will require machinery investment but most of the gains can be achieved by improving the methods used. There is a lot to do and not much time to do it in.

Focusing on what the strategy must deliver.

This is what the manufacturing strategy must deliver. The product and manufacturing should both provide a competitive advantage rather than simply competing on a price basis. A strategy to deliver all of the combinations of this diagram would be a truly potent weapon in the market place.

4. What can we achieve?

It is important to set some overall goals for the manufacturing strategy. These could be:

- To reduce stock, work in progress and cash tied up in product by at least 50%.
- To reduce lead times from order to delivery by a factor of 10.
- To increase lead-time reliability by a factor of 3.
- To increase quality by a factor of 4.
- To increase overall profitability of the company by 20%.

These are achievable goals!

Window and Glazing Topics – Manufacturing strategy for window fabricators

Part 2: The systems

1. Introduction

In general terms, everybody understands ‘production lines’. The production line cranks along and tasks are allocated to each worker according to machine rates. This model requires direct labour to be visibly working at all times and the scheduling of the line is largely based on direct labour activity and machine utilisation. The traditional production line is generally a ‘push’ system, i.e. a schedule exists and the continuous flow of the production line supports the schedule. This may have worked in the ‘any colour as long as it’s black’ days but the world has changed. Fabricators must deliver an infinite range and variety of products from the same production line and production management systems must change to recognise that product variety is a key competitive weapon.

2. The systems – an overview

The three main systems for production management are:

- The MRP type (MRP, MRPII, & ERP).
- Just In Time (JIT)
- Optimised Production Technology (OPT).

For manufacturers of complex items MRP/MRPII is a powerful tool, it is inherently a ‘push’ system. A forecast for sales of standard items is generated by Marketing/Sales and a manufacturing plan is created from this. The forecast demand is used to push the production line in advance of the actual demand.

JIT is a ‘pull’ system and the actual orders for the products pulls the system along. In JIT, the phrase ‘sell daily – make daily’ encapsulates the concept. JIT requires reduced inventories and improved system responsiveness at all stages because of the short time scales involved. JIT assumes other parallel improvements and change to both the working practices and the culture of the company.

OPT is new in terms of production management systems and is an overall philosophy for running the complete business rather than just production. OPT assumes that manufacturing is all about making money and optimises the complete system rather than individual operations. OPT is a proprietary system but is excellent for the identification and management of production bottlenecks.

As systems, the three basic systems are complementary in some areas and can be mixed and matched. It is important not to regard them as mutually exclusive, you could use MRPII for the rough-cut prediction of purchase requirements, JIT to run the basic production and OPT to cope with bottlenecks and system optimisation.

Production Line	The traditional production management system. Not responsive to market changes or time based competition.
Materials Requirements (MRP), Manufacturing Resource (MRPII), Enterprise Resource (ERP)	'Push' based systems driven by a forecast for demand. High inventory accuracy of both parts and finished goods is essential. The system does not act as an agent of change for production improvements.
Just In Time (JIT)	'Pull' or demand based system driven by orders in the system. JIT requires many parallel improvements to manufacturing and other areas of the company.
Optimised Production Technology (OPT)	OPT looks at the company as a 'machine' for making money and tries to optimise the amount of money made by the system. The concept of 'bottlenecks' is vital to improvements in profitability.

Production management systems

The systems used vary but are essentially one of the four models, they are very different in terms of what they expect the production management system to deliver and the degree of changes they require in order to function correctly. They are not mutually exclusive and can be 'mixed and matched' to give a system that meets the strategic needs.

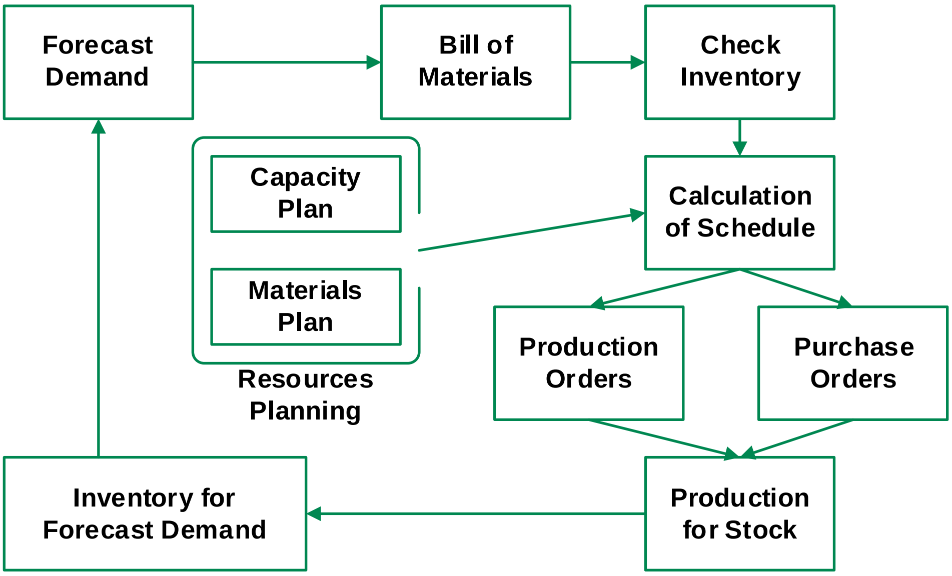
3. MRP /MRP II / ERP systems

MRP (and the later extensions) are the most widely used production management system in the world. MRP started out as Materials Requirements Planning (MRP) for ordering and scheduling materials. Computer technology extended MRP into Manufacturing Resource Planning (MRPII) for the whole manufacturing environment. The latest extension is Enterprise Resource Planning that takes the concept even further.

The basic MRP type of system is:

- The Sales Department calculates and forecasts the production requirements.
- The forecast requirements are used to create the Bill of Materials files, which break a product down into the parts.
- The inventory is deducted from the forecast requirements to generate the actual production requirements.
- The production requirements are used to generate Works Orders for internal production or Purchase Orders for bought-in items.
- The schedule 'pushes' the system and products are available in the forecast volumes at the forecast dates.

Window and Glazing Topics – Manufacturing strategy for window fabricators



The basic MRPII flow chart for production planning and control.

The process is highly computerised and is sometimes too inflexible for the production of custom items such as windows. The system is excellent for items made up of many discrete parts (such as engines) but can fail if inventory accuracy is not adequate.

MRP is essentially a database of parts, components, work-in-progress (WIP), finished inventory and forecast requirements, which are linked by lead and production times. The database calculates how to meet the forecast requirements and produces the production schedule. The database is based on historical data and in many companies is rarely updated. This leads to high lead times even if improvements are made in production and sometimes forces a 30-day lead-time for an article that may only takes 30 minutes to make.

MRPII is excellent for companies making discrete multi-component items and accurately tells management what is going on in the factory but does not change quality control, relationships with suppliers or levels of stock. It also enables management to make accurate predictions and highlights problems.

MRP is excellent as a planning tool but it tends to computerise everything and change little. It must be operated by a competent and committed management if it is to make a positive impact, e.g., inventory or lead times are only reduced by improved management control.

Replanning

MRPII plans must be regularly reviewed if they are to remain valid as customer demands change. If, in Week 1, the Sales Department forecasts a demand in Week 6 of 20 off Item A, 10 off Item B, and 30 off Item C then this is what the system will schedule and prepare to produce. If in Week 3 the actual orders for Week 6 change then it is difficult for the system to produce these, even if the components are physically in stock, without substantial replanning. MRPII is designed primarily for markets which can be accurately predicted and rapidly changing customized products such as windows can lead to continual time consuming replanning.

For and against MRPII

For	Against
• Long term planning tool. • Gives accurate completion date. • Fits in with conventional accounting.	• Files and database must be accurate. • Inventory accuracy is vital to prevent system collapse – 99% accuracy is a typical requirement.

• Production progress always available. • Inventory size available at all times. • Control of Work Orders and changes. • Many types of software available.	• Highly computer based. • Does not affect other production management issues. • Inflexible and relies on forecast. • Temptation exists to over-ride and go manual.

4. Summary

MRPII is excellent for ‘stock’ products where many parts have to come together in predetermined numbers and variants.

For window fabrication, where products are always ‘made to order’, MRP/MRPII has a limited applicability. It is possible to allocate each type of window an Article Number and then explode produce a general Bill of Materials. This gives a rough estimate of part usage to enable control of raw materials stocks and purchase orders.

Window and Glazing Topics – Manufacturing strategy for window fabricators

Part 3: Just in Time

1. Sell daily – make daily

JIT began life in Japan during the 1960s at the Toyota company and for many years it was referred to simply as the 'Toyota Manufacturing System'. The rapid rise in quality and low costs of the system began to be noticed by other companies in Japan and by companies in the West in the 1970s and the group of techniques developed by Toyota was renamed 'Just-In-Time'.

One of the major attractions of JIT is the simplicity of the basic initial concept. The goal of JIT is the production and delivery of the required items at the required time in the required quantity to specific orders and not to a theoretical forecast or schedule. JIT is therefore well suited for 'bespoke' industries, such as window fabrication, where manufacture is always to order. JIT is known as 'pull' or demand driven because nothing is produced until just before the customer or the next work station needs it. The demand for parts or finished goods thus pulls product through the system with essentially no production for stock or inventory. The phrase 'sell daily – make daily' encapsulates JIT but in terms of moving the product along the production line there is an essential difference between JIT and the conventional line.

In a conventional production line, the individual work stations produce goods at a speed dictated by the line speed irrespective of whether the subsequent operator is ready or not. One of the major problems with this is line-balancing to make each operation take exactly the same amount of time. Where line-balancing fails (as is almost inevitable with a mix of products) there is a build-up of Work in Progress (WIP) in front of the bottlenecks or slower operations. This ties up cash, in the form of WIP in the production line. The result of this is often seen in fabrication units – there is a build-up of stock in front of the slowest operation (which moves depending on the product mix).

Unfortunately, this means that just when the orders are greatest and the factory is busiest then the WIP builds up and makes production the most difficult! It is easy to see the difference – if the factory looks any different when it is busiest then JIT is not running.

In the proper JIT system, an item is only passed to the next station when they are ready for it and want it. This prevents cash being tied up in WIP and decreases the product throughput time. In the words of an American JIT practitioner 'Don't make nothing, no how for nobody, make them come and get it!' JIT factories look exactly the same when there are lots of orders as they do when there are few orders – the only product is that being worked on and, of course, the finished goods awaiting despatch.

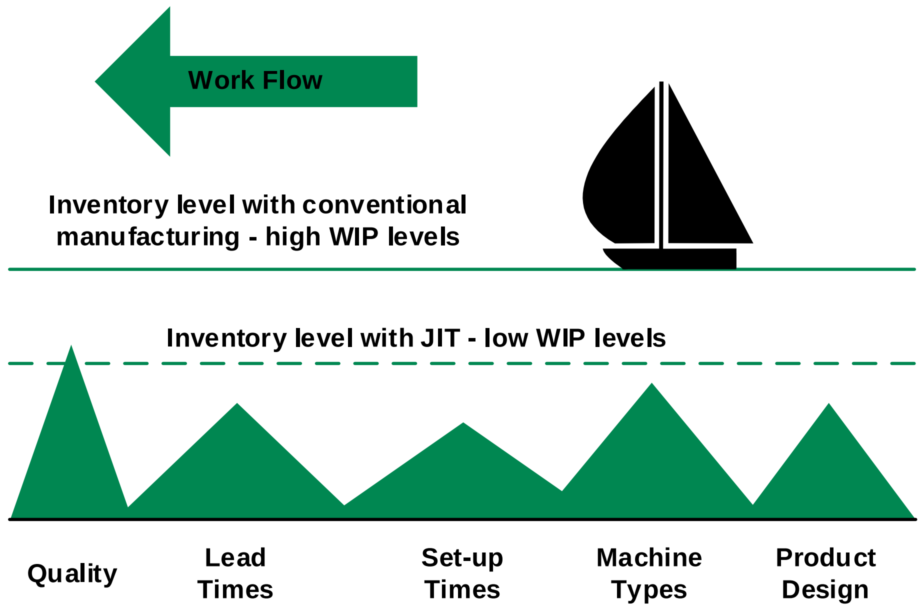
In the 1990s, many companies misunderstood the basics and saw JIT as a supplier problem; they simply reduced their raw materials stock levels and required their suppliers to deliver more frequently. This was JIT, or so they claimed, but this 'VAT approach' of simply forcing the inventory reduction back up the supply chain did nothing for the internal inventories of WIP and finished goods, forced no radical internal production improvements and was generally judged to be relatively ineffective. Any good idea can fail if implementation is misunderstood and only takes the soft option.

2. Low tech – high results

While regarded as a production management system, JIT is much more involved with methods than with technology. It is a total philosophy for production improvement and a radical change that drives all production areas with the single concept. The real strengths are the simplicity and the ease with which it can be explained to all levels of staff. 'Don't make anything until the next station needs it' sounds simple but preventing people from working is often difficult when we have been programmed to seeing all the labour busy (even if they aren't doing useful work).

Computerisation of JIT is at an early stage but even when computerized it only involves limited computing power to replace the manual systems. This makes it accessible and can serve as a method for uniting employees in the common goal of improved performance.

The process of production under JIT can be compared to the progress of a boat on a river with large rocks under the water. The moving river is the movement of materials and the depth of water represents the WIP. As the water level is lowered (by the JIT process of driving down inventories) the rocks are gradually revealed. These rocks must be removed to allow the river to have less total water in it but to continue to flow smoothly and swiftly. Typical rocks encountered are quality, changeover times, vendor conformance, and product design. Failure to 'remove the rocks' will lead to system failure. Too many companies lowered the water, failed to do anything about the rocks and then blamed JIT for the problems.



The river and rocks model of JIT

The depth of the river is the inventory and work in progress in the factory. Under a conventional manufacturing system, the inventory allows all of the other concerns to be hidden – at the cost of time and money. JIT removes the inventory and this exposes some of the rocks. Action must be taken to lower or remove the rocks or serious problems will result. Simply lowering the inventory is easy; it is dealing with the problems that this exposes that is difficult.

Despite the many good things in the concept, JIT can also be a risky manufacturing system. Minimal inventories make planning essentially short term and if the rocks are not removed swiftly once they are found then there is no inventory to rely on and the whole business can founder.

3. Push versus pull

Conventional production planning and developments such as MRP and MRPII (discussed last month) are of the 'push systems'. Materials and jobs are issued to production so as to hopefully achieve the required completion dates while at the same time minimising labour and machine downtime. An important measure in push systems is machine usage and the attempt to balance production lines is given a lot of effort. The build-up of WIP in the production line is made worse by floating bottlenecks in the operation. Push systems are often unresponsive to changes in customer requirements, i.e., they tend to be inflexible and cannot cope with the need for increased variety and short runs. The concept of Economic Batch Quantities (EBQ) is generally very important in such systems and the need to schedule and run 'push' systems generally results in complex computer databases and programmes.

By contrast, in 'pull' systems the products are only produced when there is an order or requirement for them. This generally results in simpler control systems where inventory levels and batch sizes are greatly reduced. In a JIT environment, machine and labour utilisation are not relevant because machines are only used when they are needed. An operator passes work along only when a signal (KANBAN) is given that the next operator is ready for the work. Such signals are generally visual and easily understood.

Despite this easy sounding explanation, JIT is not simple to implement and many ‘rocks’ need to be worked on simultaneously. JIT is not a quick fix and it needs quick reactions when things go wrong!

Successful implementation demands careful planning, a firm strategy, the right environment (awareness, industrial relations etc.) and determination. The rewards of successful implementation are dramatic, improved cycle times, improved customer response time, improved quality and reduced costs.

For and against JIT

For	Against
• Radically reduces product throughput times. • Reduces or eliminates conventional inventory. • Concentrates the mind on quality and set-up times. • Provides a conceptual framework for strategic developments in many areas.	• Real cultural changes are necessary and these can be difficult to implement and hold. • Close involvement with suppliers who may not share your goals is necessary. • Lack of contingency planning can give problems (Life is both in the fast lane and on the edge of a razor). • No long-term planning method.

4. Summary

After these pages on JIT, you probably find that it involves more than you first thought it did. JIT is well suited to the window industry because that it makes simple control possible and can have a dramatic effect on the throughput of the factory. It is easy to experiment with JIT by letting your work in progress go down and then only making things as they are necessary. Fabricators who have carried out this simple experiment often find the results amazing.

Window and Glazing Topics – Manufacturing strategy for window fabricators

Part 4: Optimised Production Technology (OPT)

1. The goal

OPT states that the goal of a manufacturing business is to make money both now and in the future. This might seem to be rather simple but it provides a framework for all the other decisions involved in the business.

OPT aims to increase ‘throughput’ (the rate at which the company generates money through sales) whilst simultaneously decreasing both ‘inventory’ (the money the company has invested in things it intends to sell) and ‘operating expenses’ (the money the company spends to turn inventory into throughput). If an action does not directly improve one of the three measures, then it is irrelevant at best and damaging at worst, do not do it.

The traditional approach has been to optimise every sub-system irrespective of its importance, i.e., to improve the output of the welder, but the OPT tries to optimise the total system to maximise throughput, i.e., if the welder is not limiting the throughput, then don’t work on it and put the efforts somewhere else. OPT states that the optimum of each sub-system is not necessarily the optimum of the whole system.

OPT defines a ‘bottleneck’ as a resource whose capacity is equal to or less than the market demand placed upon it. This is the constraint that is preventing increased throughput from the factory. Improving the bottleneck will start to optimise the whole system and directly increase throughput and profit. Bottlenecks are easy to spot in the factory – they are the operations with lots of WIP stacked up in front of them. Conversely, a non-bottleneck is a resource whose capacity is greater than the market demand and improvements here will not increase throughput.

Balance the flow not the capacity

Gearing is the obvious bottleneck for the factory. Running cutting at capacity will lead to a build-up of inventory in front of welding. Running welding at capacity will lead to a massive build-up of inventory in front of gearing. Investment or improvement in cutting, welding or glazing will do nothing to improve throughput, the only meaningful investment area would be at gearing where the ability of the plant to earn money would be rapidly improved.

Gearing must be protected from loss of output for any reason. It is the operation that controls the income of the factory.

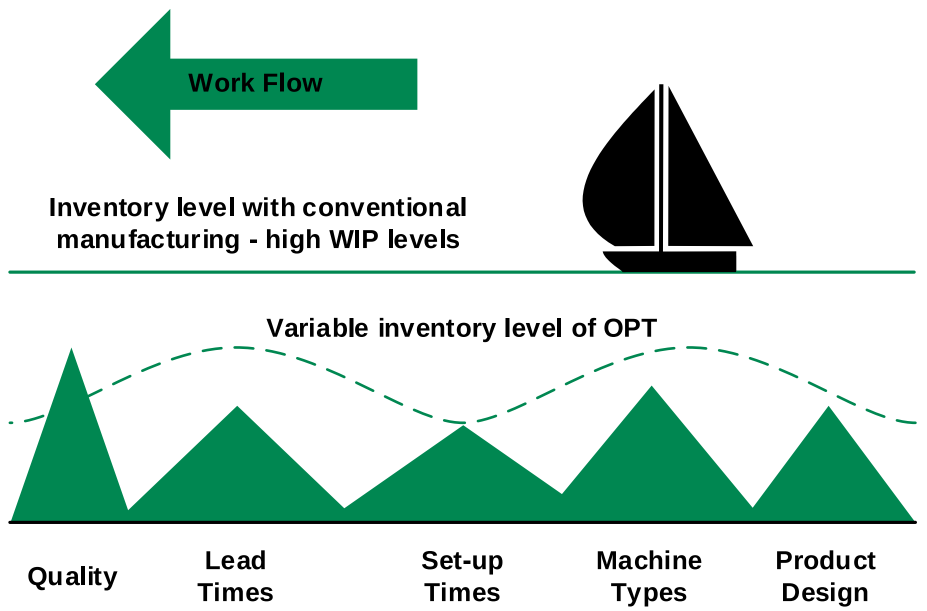
In reality the choice is never this clear and the bottlenecks move as the product mix changes. Gearing may be the bottleneck when making a lot of doors but glazing will be the bottleneck when making lots of fixed lights.

The bottleneck concept is best explained in the hiking analogy from ‘The Goal’. The speed of a group of hikers must be maximised to get to the campsite by nightfall – but the speed of the group is limited to the speed of the slowest hiker (the bottleneck). If the slowest hiker is at the front of the group this slows down the whole group and increases the time required, i.e., reduces the throughput. If the slowest hiker is anywhere else in the group, they still slow the whole group but also increase the length of the group (the inventory).

The only way to reduce the length (the inventory) and achieve the fastest time (the throughput) is to find a way of moving the slowest hiker faster, i.e., working on the bottleneck. An hour lost at a bottleneck, *for any reason* is an hour lost to the whole system and cannot be recovered. Don't think you can get it back later because you can't. The cost of the lost hour is the total cost of running the factory for one hour because the bottleneck is governing the throughput.

The location and management of bottlenecks is the heart of OPT. An hour saved at a bottleneck is an hour saved for the whole system but an hour saved on a non-bottleneck machine simply increases inventory and does nothing to improve throughput. It is wasted effort.

OPT and JIT both concentrate on quality, lead times and batch sizes but OPT regards the 'river and rocks' analogy of JIT as flawed. In OPT terms, the river is not a flat and evenly flowing stream but has waves of inventory (WIP) moving through it depending on the order situation in the factory. All will be fine until the inventory is at the bottom of a wave. A problem then it is likely to rip the bottom out of the boat and sink the business! This is closer to reality than the JIT model.



The river and rocks model of OPT.

OPT considers that the inventory river is not smooth but consists of waves of inventory going through the factory, depending on the order state at any given time. Rocks that may be acceptable when on an inventory peak are not acceptable when in a trough.

OPT and MRPII share a computer-based approach with databases of product and machine information for schedule calculation. OPT also requires information on how the product is made, the production route, set-up times and run times. Whereas MRPII assumes that a machine can always work at capacity, OPT accepts that the actual capacity is affected by statistical fluctuations and a dependence on previous operations to supply product for processing. This makes OPT can be more realistic in scheduling than MRPII by taking this into account and also allowing for improvement in times and routing.

2. The OPT rules

OPT is based on a set of rules:

1. Balance the flow, not the capacity.

2. Let bottlenecks determine usage of the non-bottlenecks and do not seek machine utilisation. If a resource is activated when output cannot get through the constraint then all it produces is inventory.

3. Utilisation and activation of a resource are not the same thing. Activation is when a resource is working but utilisation is when it is working and doing useful work. Producing stock for inventory is not useful work.

4. An hour lost at a bottleneck is an hour lost for the whole system and cannot be recovered and an hour saved at a non-bottleneck is a mirage.

5. Bottlenecks govern both throughput and inventory.

6. A transfer batch is not necessarily equal to a process batch, i.e., because you cut 20 frames at a time on the optimiser saw it does not mean that you have to push them all to the welder at once. Break the process batch (20 frames) down into smaller process batches (1 order).

7. Process batches should be variable and not fixed.

Bottlenecks beat out the pace like a drum and should be protected from interruptions such as breakdowns, quality, labour shortages etc. This can be achieved by building in time buffers that are a focus for process improvements. The other operations are synchronised to the bottleneck operation and work is pulled through as if it were on a rope.

OPT rarely requires large investment in machinery but seeks to improve the flow of the product and get inventory moving to show that production area as the real profit maker for the company.

For and Against OPT

For	Against
• Easy to start at practical level and easily understood by the shop floor • Quickly targets areas of concern such as bottlenecks, quality and inventory. • Gives quick results and financial feedback. • Suitable for discrete, batch and process industries.	• Challenges traditional cost accounting. • Requires accurate database and complex computer process modelling for the full form.

3. Summary

OPT is a philosophy for running the business rather than simply production. It tries to optimise the complete system rather than simply optimising individual operations on a piecemeal basis.

The full version of OPT is a proprietary system owned by a software and consultancy company but this does not prevent using the excellent ideas it contains. OPT is a trademark of the Scheduling Technology Group. The only, but excellent, book on the subject is ‘The Goal’ by E Goldratt and J Cox.

Window and Glazing Topics – Manufacturing strategy for window fabricators

Part 5: Work cells

1. Fast, flexible and short

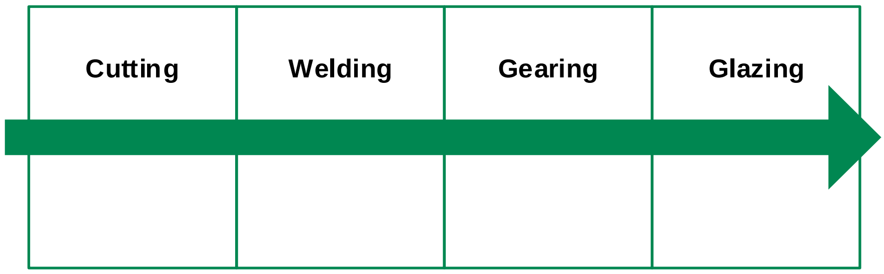
When fabricators start out, they normally have around 3 people and produce around 60 windows per week. Generally, as they expand, they buy new machinery and set up their factory based on the traditional production line. On this basis: When they expand to 6 people what does their production output go up to?

Logic tells us that it should be 120 windows per week but if it was then it would be very surprising, the general result is around 100 windows per week. So, what happens to the missing output and who isn't pulling their weight?

The answer is that small groups of 2–3 people can be run by 'team leaders' who also do productive work. But by the time you get to 6 people you start to need a manager who does no productive work but simply manages the rest – he becomes a 'wealth dissipater' rather than a 'wealth creator'. For the conventional factory there is little linearity between the numbers of people and actual output, i.e., doubling the number of people rarely doubles the output. Work cells give us a way out of this common dilemma.

A work cell is a small natural group of machines and/or people and skills. The various machines and skills will be such that a cell can manufacture a whole product or component, e.g., rather than have a welding area where all welding is carried out, the welders will be distributed around the factory in small cells where they are making products. This will result in reduced transport costs (a non-value activity or waste), reduced WIP and better control of quality. Work cells create an environment of ownership and autonomy; they also control quality and almost naturally seek to improve the process and product.

The work cell idea can best be explained by considering the work flow in the current factory. Work moves around the factory along a long production line, which is never truly balanced, so that some areas require more labour than others. An increase or decrease in sales requires staff changes but they are never whole numbers of people and you always end up with a few more or less people than you need.



Work flow in the conventional factory.

Work moves around the factory in a long linear flow. There is little attempt to minimise the distance travelled (a good indicator of the time taken to produce the product), handling activity is high, WIP is high and balancing of the line is a continual struggle as the product mix changes from day to day.

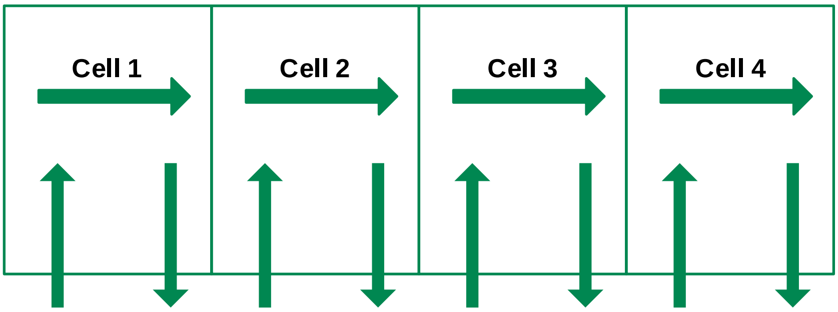
The distance parts travel (a crude but simple measure of efficiency) is quite high, indicating low efficiency. In this model of the factory, we have a 'serial' type of production flow, i.e., the work passes along one line via a series of individual stations. This is the conventional production line model that we all feel comfortable with.

The production line gives a well-defined flow of materials but always gives problems with line-balancing and most importantly with poor operational reliability. If a work station in a 'serial' line fails then the whole line either stops or inventory rapidly builds up in front of the failed work station. Line balancing also means that most stations will be working at less than the full capacity (to match the bottleneck) and the total line will be working at greatly less than its full capacity.

Serial lines have some advantages in that it is easy to change the number of work stations and if the volumes are high enough for each product variant, then changeover between different types can be easy. The disadvantages are:

- Only one type of product can be produced at any one time.
- Full production cannot be started until the whole line is changed and ready to operate.
- The standard order of assembly cannot be easily changed.

The work cell approach is to divide the factory up into separate cells where similar operations are performed in various independent cells.



Work flow in a work cell-based factory.

Work moves around the factory in short cell-based flows, distance travelled is minimised, handling activity is low, WIP is low because there is nowhere to hide it, cells are self-balancing for production flow, operatives become multi-skilled.

Work cells are most effective when the cell forms a U shape. Work flows into the cell, around the U and out the other end. This gives a small, compact and easily defined cell boundary that the operators can be responsible for.

The cell approach is the equivalent of having many small fabrication shops running side-by-side and using cells it is possible to:

- Produce many different types of product at any one time to cope with the need for variety. You could have a woodgrain cell, a white cell, a door cell, a T/T cell, etc. Product variations are easily coped with by the cell concept.
- Change production, repair or service machines in one cell whilst all the others keep producing at normal rates.
- Get good linearity between the number of people and output. Doubling the number of fabricators really can double the output.
- Cope with varying sales levels by opening up setting up or closing down individual cells.

Work cells offer a proven method for increasing output, increasing quality, improving workforce involvement and skill whilst at the same time providing greater flexibility for the fabrication process.

2. Failure proofing

Serial line layout

If a serial line machine stops working then the whole line stops producing (once any buffer stock has been used up). For example: if each machine has a reliability of 95% (it is capable of working 95% of the time when needed) and the line contains 8 work stations then the probability of the line delivering completed product is only 66%.

Parallel lines layout

If a parallel line machine stops, the other cells are free to keep working and production continues. Labour can be transferred to the operating cells and customers continue to get products.

Increasing the number of cells increases the probability of continued output from the line

Parallel lines based on work cells have a much higher operational efficiency and many different products can be produced at the same time

For the same line conditions given in the example above, the probability of the parallel line delivering completed product is 100%, i.e., the system is highly reliable.

Perhaps this explains why some companies seem to spend more time fixing machines than producing product and why every machine breakdown stops the output totally?

3. Multiple benefits

Work cells have many additional benefits such as:

- Standard working practices can be developed for each product.
- Visual control of scheduling is easier.
- Reduced waste.
- Easier labour balancing.
- Multi-skilled labour that can carry out all of the cell activities.
- Multiple machines:
    - Cheap to purchase.
    - Built in redundancy and capacity.
    - Easy to maintain (by operators).
    - Backup for machinery.
- Reduced and visible WIP.
- Improved quality from experience and more involvement in complete production.
- Short flow routes – when the distance travelled is short the throughput is increased and the inventory is decreased.
- Ownership of the process by the operators.

4. Summary

Work cells set the scene for significant cost reductions through additional techniques that affect many other production areas. Most significantly work cells lead on the ‘one-piece’ flow concept where the whole system is set up to produce one piece at a time – flexible, fast and cost effective.

Window and Glazing Topics – Manufacturing strategy for window fabricators

Part 6: Machines

1. Big and sexy

There seems to be an industry fascination with big super machines and automation that goes beyond the simple ability to justify these financially. Is it because small machines are not as exciting to have in the factory? Is it because we believe that technology can solve all the production problems and if we invest in enough of it then they will all go away?

The traditional approach has been to buy large, complex and highly computerised machines and to seek high utilisation times to try to pay for them. A cell-based pull approach (see Part 5) decreases this drive towards high technology and encourages the use of small machines that can be copied easily as they are needed.

Capital investment in large new machinery is almost always justified on the basis of a reduction in labour costs but these are rarely achieved in practice. When did you hear of a company sacking somebody after their super machine was delivered? Normally the staff are simply moved somewhere else in the factory! The financial justification rarely considers the additional overheads that are inevitably incurred with expensive new machinery. These extra overhead costs appear in the product price of every product (not just those being produced on the large machine) and affect the overall profitability of the company.

Unfortunately, the complexity of the large, complex machinery (super machines) means that maintenance and continued operation becomes a crucial issue, in both time and available skills. In-house servicing and repair are more difficult when the high technology machines arrive and there is a need for either improved and costly in-house maintenance skills or even more costly external maintenance. In some cases, the extra skills needed to service the new machinery are cost more than the direct labour that was allegedly reduced by the purchase of the machine.

When the super machines in the serial production line fail (as they must do) the line stops immediately. These failures are always on a Friday afternoon, the service technician can't get there (from Germany) until Tuesday and it is fixed on Thursday. Just in time to fail again as the technician's flight leaves from Heathrow on Friday afternoon!

How familiar does this sound:

'This new super-machine has twice the output of the older machines.'

'That's good because it's not working half the time!'

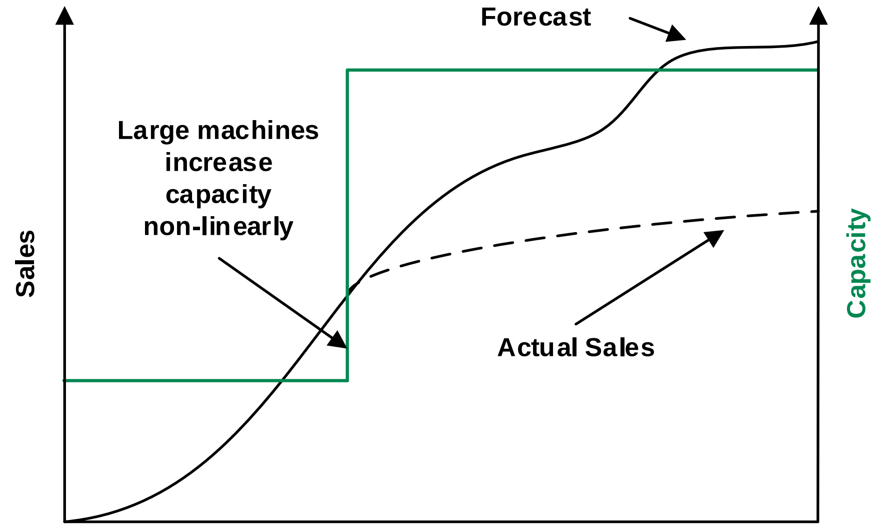
Conversely, when a small machine in a parallel line fails, the other cells can keep on running without being affected and sometimes can even take some of the load from the failed cell. Production continues for the majority of the factory.

2. Linearity of capacity and sales

The biggest benefit of small machines is that they allow a closer linearity between capacity and sales. This means that the capacity of the factory can be directly increased in line with actual sales increases rather than in line with sales forecasts. Large machines invariably mean that capacity outstrips sales until the actual sales catch up with the increased capacity. The major problem is that 'costs are certain, but sales never are'. The truth of this is self-evident – it is always easier to prepare the cost budget than the sales budget. If sales have been increasing over the past then the forecast will generally say that this will continue. The 'forecast' says that there is sufficient volume to buy a super machine that will be fully utilised. The money is borrowed from the bank to fund the purchase. But sales are never certain, if they tail off then you are left with an overdraft, a machine that never gets into its stride and possibly a failed business.

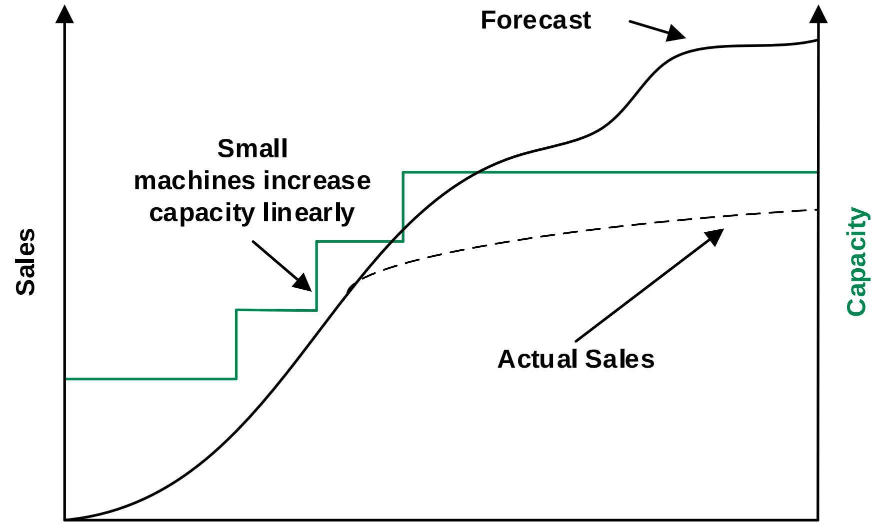
Small machines require much less investment at any one time and the investment can be staggered as sales increase and finances allow, no overdrafts and a healthier business.

This close linearity between capacity and sales gives a well-balanced factory capacity and a business with the lowest possible debt servicing load.



Super machines have little linearity between capacity and sales.

The purchase of a large super machine generally results in over-capacity immediately after the purchase. This is often based on the theory that sales will increase. If sales do not increase because of rising costs (which can sometimes be associated with the super machine) then the over-capacity will become detrimental to the business. In this company, there is no linearity between capacity and sales.



Small machines give closer linearity between capacity and sales.

The purchase of many small machines is easier to fund, allows closer linearity between capacity and sales and allows investment to match the real needs of the business as opposed to the forecast needs of the business.

'Costs are certain but sales never are'.

3. Hidden benefits

Linearity between capacity and sales is a strong reason for using small cheap and flexible machines but there are a multitude of other benefits:

- They are easier for operators to maintain – small machines are simple to repair and keep productive. Multiple copies means that staff can become familiar with the machines being used.

- Multiple standard machines can be made to give quick changeovers and multiple machines working on the same product can maintain the same overall output as a super machine.
- Many work cells can be developed to allow parallel flow to take place with increased production reliability. A super machine that is not running produces precisely zero parts. Several small machines will never totally fail.
- Work cells can often be rapidly developed and deployed internally using small machines parts to meet specific needs, e.g., a 'Door Shop' to take pressure off the main production.
- There is a lower emphasis on individual machine utilisation and more on total factory capacity related to sales.
- Overall company requirements can be steadily increased rather than with a huge jump.
- Simpler controls and control systems can be developed to cope with the expansion rather than being forced to go for the great leap forward. The introduction of high technology is often painful and rarely as trouble free as the suppliers would have you believe.
- Small machines have a lower capital cost at any one time.

These benefits show why some companies with relatively crude equipment can out-perform companies who have invested heavily in super machines. The one drawback with small machines is that they are not very sexy and you can't boast about them at the pub but that is sometimes the price you must pay for survival.

4. Caveat Emptor

Whenever buying new machines remember the following:

- Never budget on an immediate increase in production. With new machines there is always an initial *decrease* in productivity during the learning and debugging curve, the length of the decrease depends on the complexity of the machine.
- Always deduct about 20% from the rated output of any machine to give a realistic long-term output.
- Always consider small machines.

•Never invest in non-bottleneck areas as these do not increase the output of the factory and do not increase your ability to make money.

Part 7: Machines (2)

1. Total Productive Maintenance

Small machines do not remove the fact that when a component is required it must be produced. When WIP levels are low there is little slack in the system to work on should a machine fail to be capable of operation. This demands high machine reliability for all machines and fast repair in the event of failure. Another reason for the use of simple, low functionality machines over the use of complex multi-function machines?

A planned maintenance programme is a vital requirement to remove unscheduled stoppages and increase the dependability of machine availability. The Total Productive Maintenance (TPM) approach is used to ensure that unscheduled stoppages do not occur.

Any unscheduled stoppage causes problems in many ways:

- Bottleneck machines may run short of product and create a loss of production to the whole system.
- Bottleneck machines become more overloaded and time is lost.
- Production planning is difficult, if not impossible.
- Lead times increase.
- Scrap and re-work are increased.

The TPM strategy is developed to reduce these problems and the costs associated with them. TPM ensures that machines are available when required and should include the following points:

- Maintenance is planned into the production schedule.
- Machines are designed for fast repair.
- Maintenance is decentralised to the operators.
- Tool kits are provided close to machines.
- Stocks are carried of trouble prone items or better still the trouble prone item is designed out of the system.
- Predictions are made for machine breakdown via a written history and performance measurements. Most machines suffer the same breakdowns repeatedly, a history will let you diagnose the problem quickly and predict what is going to go wrong. To star in this process, go for those faults that occur most often at the bottleneck.
- Maintenance problems are designed out of the machines.

Note: TPM can also be applied to tooling and other critical production items.

This idea of planned maintenance and stoppages for maintenance does not fit well with the old concept of trying to increase machine utilisation – another one of those traditional accounting measures. Machine utilisation obviously falls if the machine is undergoing routine maintenance but the machine reliability almost inevitably increases. Plan for it to control it and reduce the ultimate costs.

TPM is an investment to protect future production capability. Look at the factory. Which pieces of equipment would stop the factory if they failed? How long would it take to get them fixed and how much would it cost? Don’t just look at the production equipment but also at the support equipment. If you lost the compressor right now then what happens to your output, and when was the last time that the compressor was serviced?

2. Owner-operators

Window and Glazing Topics – Manufacturing strategy for window fabricators

One of the basics of using TPM in a work cell environment is to use the cell team to carry out basic preventative maintenance on the machines in the cell. This is sometimes termed ‘autonomous maintenance’ or ‘cell-based maintenance’. Maintenance at the cell level brings many benefits:

- Cell members are ideally suited to carry out first response maintenance. They can lubricate, clean and inspect to prevent minor concerns developing into major problems.
- Cell members know more about their machines than almost anybody else. They know the special quirks of each machine and how to get good production out of the machines.
- Cell members have a good idea of the history of the machine, what has gone wrong with the machine in the past and what is likely to fix it now.
- The cell members become owner-operators of the machines and take more interest in maintaining them. The cell members become more responsible for their activities and their involvement increases.

An outline process to implement cell-based maintenance with owner-operators is:

Step 1: Operator cleans, inspects and checks machine with maintenance staff in attendance.

Note: Pay particular attention to Health and Safety issues.

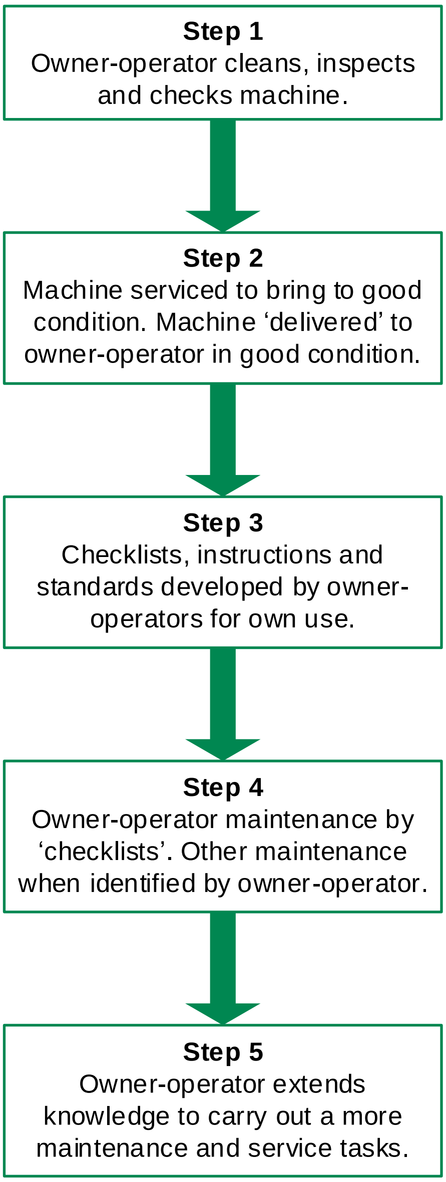
Step 2: Machine is serviced to eliminate oil or air leaks and to bring up to good condition. Any defects noted by operator are repaired and machine is ‘delivered’ to the owner-operator in good condition.

Step 3: Checklists, instructions and standards are developed by owner-operators for use by owner-operators.

Step 4: Maintenance carried out to checklists by owner-operators. Maintenance staff only involved for exceptional projects and service identified by owner-operator.

Step 5: Maintenance work with owner-operator to extend knowledge and skills base. This allows owner-operator to carry out a greater range of maintenance and service tasks.

Cell based maintenance can keep machines operating when they are needed but the important point is to only use them when they are needed – setting the right level of machine utilisation is also critical to operating effectively.



Five easy steps to starting the Total Productive Maintenance process in the factory.

3. Machine utilisation

It is recommended that the maximum machine utilisation sought is around 80%. This might seem low to those people used to seeking high machine utilisation (generally just to keep the numbers up) but it is the optimum figure to allow enough time for the total productive (planned) maintenance activities and the basic philosophy says that you do not operate a machine if the output is not immediately required. This is in contrast to the concern with super-machines where optimising machine utilisation is considered critical.

Accountants have had a fascination with machine utilisation and this has been one of their key measures of factory efficiency. This is despite the fact that the production area largely does not determine the machine utilisation, this is determined by the demand generated by sales. Production Managers generally have little control over this! Seeking high machine utilisation without matching sales is one sure way to cripple a company (see box below).

Where standard products are being produced, seeking high machine utilisation can result in the production of products that are not needed – simply to get the numbers up – this leads to over production, high inventory values and wasted time in the long run.

OPT says that 'Utilisation and activation of a resource are not the same thing. Activation is when a resource is working and utilisation is when it is working and doing useful work. Producing stock for inventory is not useful work.' What we have previously termed utilisation has often been simple activation without utilisation. Unless the product is going to be used immediately after being processed then the process is simply costing time and effort before it needs to – it is locking capital up in the business that could be used to produce goods for sale.

Remove the current idea of machine utilisation (the machine is working) from your ideas and replace it with true utilisation (the machine is working and doing useful work). Accept that over-capacity (as generally defined) is necessary to cope with the need for maintenance and the flexibility to respond to customer demands.

Machine utilisation kills.

Whilst working with an aluminium window fabricator some years ago there was a fascination by the management with 'hearing the saws work'. Sawing was the first production step and the management thought that as long as they could hear the saws working then everything else was OK. It didn't matter that the rest of the factory wasn't doing anything with the sawn profile - the saws were working. The concept of machine utilisation was so prevalent that immediately on receipt of any order the Production Manager gave it to the sawing area irrespective of the delivery date. One look at the production area showed a different and sadder story.

The saws generated so much work-in progress (WIP) at the front end of the process that the whole production line was totally clogged up. Sawn profile was 'lost' in the stacks of WIP for weeks on end and every piece of product was moved, stacked, moved again, stacked again about 5 times before it even got to the next step of the production process. The production process was so chaotic (because the saws had to be kept running) that it actually took 16 weeks to produce an order that could be run through the factory in 3 hours.

The company had a turnover of around £5 million and the WIP on the factory floor was worth nearly £1.5 million - the company was running out of cash fast. Despite this, the idea of stopping the saws running was so alien to the company that they could not see that this was the main cause of their problems. They refused to stop the saws and machine utilisation claimed another victim within 3 months.

Window and Glazing Topics – Manufacturing strategy for window fabricators

Part 8: Scheduling

1. Scheduling

The fabrication market is extremely competitive and one advantage is the ability to meet short lead time orders as well as to meet orders that have been in the system for some time. Scheduling of the factory to meet these requirements is a major difficulty but also a major source of competitive advantage. Setting and achieving a robust but simple schedule is often a major concern for factory managers. The daily schedule seems to change randomly as customers change their minds or as situations change and because the order book is rarely longer than 10 to 15 days, window production is almost always based around short term planning schedules and simple planning methods.

Despite this it is also necessary to take into account the longer-term schedule needs and to set up a 4-layer system to cope with the various time frames. This system can be used to funnel in to the precise daily production requirements. The time frames are:

Long term (4 to 12 months):

There is a need to develop some long-term planning for machinery and factory needs. This level is the scheduling horizon for strategic decisions regarding machine purchases, factory requirements, supplier development, major customer acquisition and implementation of JIT plans. Fabricators need to examine the monthly trends in ordering (down in the early part of the year and up in the latter part of the year) and separate these from the underlying trend for the business – is real business growing and what needs to be done about new production capacity?

Medium term (2 to 4 months):

At this level, seasonal demands can be predicted and included in the schedule, regular and large customers can provide an outline of their requirements (but not firm orders) and the general production capacity plan can be created and checked. The need is to check that capacity (particularly manpower needs) is adequate for the seasonal variations.

Short term (0 to 2 months):

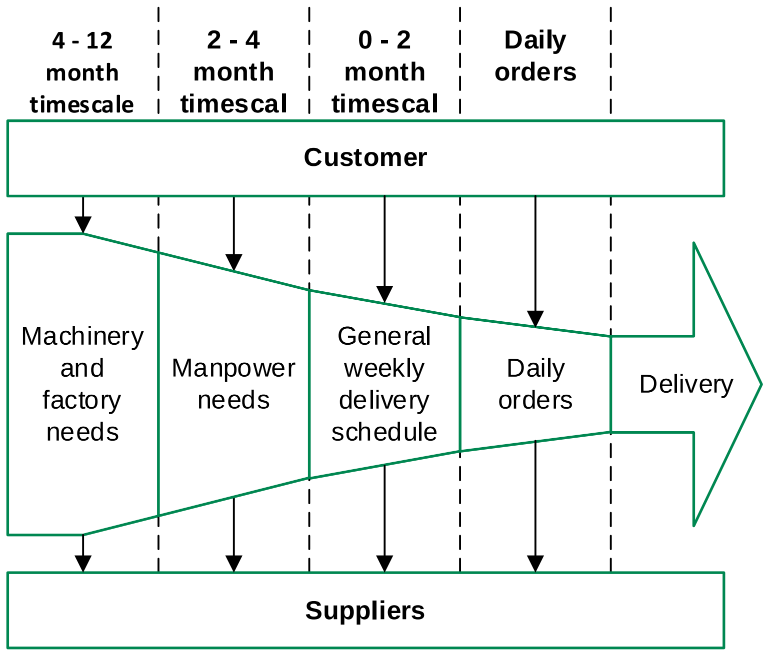
This is the scheduling horizon for general machine and people availability. At this level the schedule can remain flexible but action needs to be taken for manpower and some broad orders to major suppliers can be confirmed.

Daily:

Daily production can be scheduled by the following steps:

- Determine the factory production capacity at full activity (in squares per day).
- Determine the time taken for actually producing the window, this should be around 2 days for most factories.
- Work backwards from the delivery date to give the date for ‘seeding’ the order to the factory.
- Work backwards from the delivery date to give the date for ‘seeding’ the orders to external suppliers, e.g., glass or panels.
- Establish ‘check stations’ for collection of the products at the end of each day and determine where the product should be at the end of each day to make sure that it is completed at the right time for delivery.
- Accept and schedule orders to only 80% of the factory production capacity for delivery each day. The remaining 20% is the ‘buffer zone’ for emergency orders and remakes. After accepting the total number of orders then ‘close’ the day for production scheduling. No more work should be scheduled for production on this day.
- Colour code windows for day of delivery as they are cut on the first day after seeding.
- Check that all windows of the specified colour code are at the check station at the end of each day.

- Use the 'spare' 20% capacity for the rush jobs (colour code them as rush jobs to go straight through the factory system).
- Complete the delivery as required.



Funnelling in to the daily production but remaining flexible about the actual demands.

This system works simply and easily to prevent delays and achieve on-time delivery – the only extra requirement is the factory management and discipline necessary to keep to the colour schedule but nobody ever said life had to be easy!

Schedules built under this system work because they have inbuilt commitment, workers know the requirements and can clearly see what has to be done to achieve the schedule – visible management works.

2. Transfer batches (KANBAN)

Within this type of schedule there is a need to reduce the size of transfer batches as much as possible. Most manufacturers like to process product in batches because of Economic Batch Quantities (EBQ) and the size of the EBQ effectively determines the amount of WIP in the factory. How many fabricators cut or process in large batches and what does this do to the cost of work in progress? If you have lots of space for WIP e.g., toast racks, then you can be sure that they will fill up but you can also be sure that it will fill up with the wrong stock i.e., the stuff you can never move.

Simple scheduling and JIT encourage the use of small transfer batches to reduce WIP and does this by using the KANBAN concept. The KANBAN is simply a card or any other indicator that tells you:

- How many items are in the batch.
- The name and number of the item.
- Where it has come from.
- Where it is going to.

For window fabrication it can be a toast rack or a marked space on the factory floor.

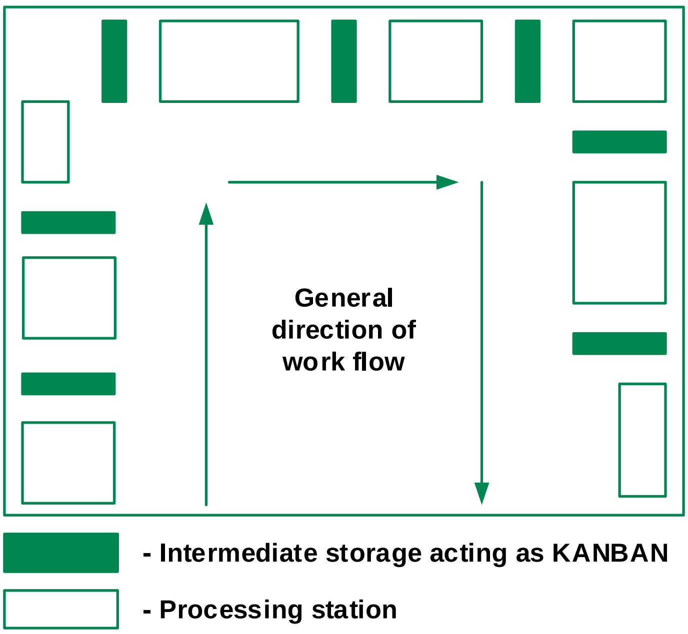
The space defines for the operator the amount of good work to process and when it is full then he does other work until the KANBAN space requires more product, he cannot and must not produce more product than this on the basis of 'just-in-case'.

Note: Work is also prioritised strictly on the colour code system.

The benefits of KANBAN are:

- They reduce the number of toast racks (provided that you insist that no work is produced if the toast rack in front of the station is full).
- They limit the spaces for WIP to hide.
- They speed the flow of work through the factory.
- They show scrap immediately.
- They control production in a highly visible manner.
- They reduce the transfer batch size.
- They quickly improve factory control and WIP reduction efforts.

KANBAN can also be used to reduce the size of the factory. If there is a lot of space in any factory, then it will fill up with WIP. It is also certain that the space will fill up with the wrong WIP such as rejects or stock that is not really needed. KANBAN prevent the build-up of WIP and can reduce the space needed.



Using toast racks as KANBAN controls or 'check points' for scheduling and production control will reduce WIP, clean out the factory and improve delivery reliability.

Window and Glazing Topics – Manufacturing strategy for window fabricators

Part 9: Waste – methods

1. What are waste activities?

Waste is 'the expenditure of resources that do not add value to the product at least equal to the cost of the resources expended'. This month we look at 'methods' waste in the production area and how this can be improved. This is often achieved not by doing things more efficiently but by not doing them at all. It is no good being extra-efficient at something that you don't need to be doing in the first place. Let's start to think about effectiveness rather than efficiency.

Reducing waste in any of its many forms translates immediately into real cost reductions in any industry and none more so than window fabrication. In manufacturing there is now an increasing focus on waste, particularly on non-value adding activities – these are exceptionally effective methods of cost management. The 7 wastes defined by Taiichi Ono (Toyota's Chief Engineer) are:

Overproduction

Making product with no current sales:

- Ties up capital.
- Uses space.
- Reduces delivery performance.
- Occupies bottleneck machines.

Waiting

Machines waiting for goods, maintenance, product or other action:

- Wastes time.
- Reduces throughput.
- Uses space for idle products.

Transportation

Moving products:

- Increases cycle time.
- Increases WIP.
- Creates waiting waste.

Process

Using inefficient processes:

- Increases cycle times.
- Increases WIP.

Stock

Stock definitely hides other wastes and:

- Ties up capital.
- Increases stock losses due to damage.
- Uses space.

Motion

Movement that does not create added value:

- Increases cycle time.
- Causes product damage.
- Wastes employee effort.
- Needs investment in space and machines.

Defects

Creates all the other wastes and adds unnecessary cost to the product.

2. The waste activities

To start to identify the waste activities it is useful to separate all the activities into those that add vale and those that add cost. The table below shows that only processing and assembling add vale and the rest of the common activities only add cost to the product. A quick 'walk-around' of most fabricators shows that they spend more time adding cost than adding value! The simplest route to improved profitability is to do less of the adding cost activities and more of the adding value activities. A necessary first step is to find areas or processes that waste resources, of any description, and then to eliminate or redesign the process to reduce the waste. Be ruthless.

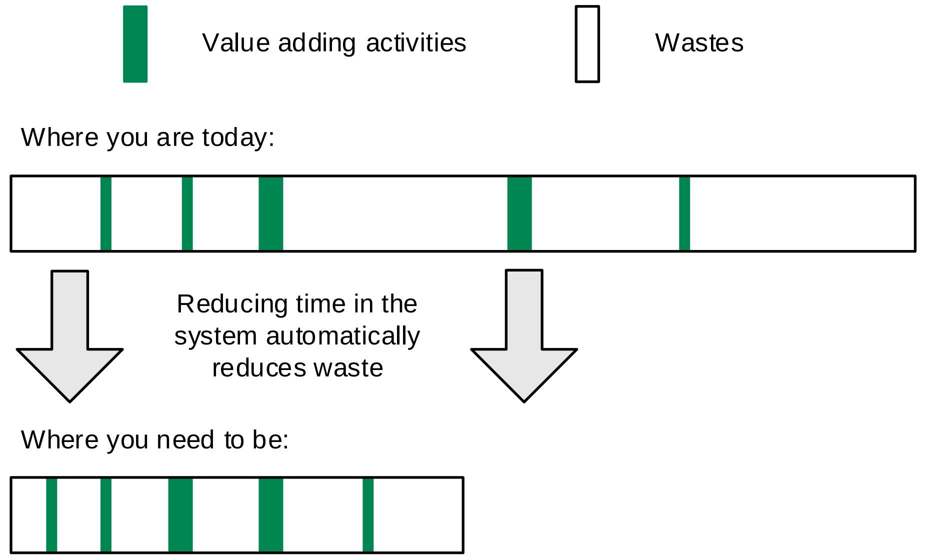
Activity	Adds value	Adds cost
Moving		✓
Storing/Waiting		✓
Processing	✓	
Over-production		✓
Counting		✓
Inspecting		✓
Scrapping		✓
Re-working		✓
Assembling	✓	
Sorting		✓

How much time do you spend on waste activities?

Classification of factory activities into value-adding processes and waste processes. Measuring the time spent on each of these processes in the production area gives a measure of the time wasted in the production area.

3. Quantify the waste activities

Quantifying the amount of waste is critical to success and a first estimate of the waste can be made by measuring the time in the manufacturing system and comparing this to the value-adding time. In many fabricators the material is only having real value added to it for less than 1% of the total time it spends in the system. The rest of the time it is WIP or inventory and in the new world, inventory is a liability rather than an asset. Complete the form for your own company and remember that reducing the time in the system not only has positive financial benefits but also makes scheduling and production management easier.



The cycle time flow chart

A cycle-time flow chart can be produced to monitor the time spent 'adding value' and the time spent 'adding cost'. This can be converted into a percentage of the total time the product is in the system. For window fabrication the ratio is rarely higher than 1% and a ratio of 0.25% is not uncommon.

The example above shows an 'adding value ratio' 8%.

Measurement	Time (Minutes)
Time order is in the order processing system	
Time order is in the production system	
Total cost adding time	= X
Actual time taken to process the order (Ignore waiting times and transport times)	Process 1
	Process 2
	Process 3
Actual time taken to produce the order (Ignore waiting times and transport times)	Process 1
	Process 2
	Process 3
	Process 4
	Process 5
Total value adding time	= Y
Adding value time / Adding cost time (%)	= X/Y(%)

Adding value or adding cost – the cycle-time flow chart

Use the Worksheet above to quickly calculate how much of the time you are adding value and how much of the time you are adding cost. Anything above 5% is very good. Anything above 10% and you probably haven't collected the information correctly! Reducing the cost-adding time will significantly improve process throughput and customer responsiveness. It will also release real cash back into the business.

4. Paperwork processes

A prime but often neglected target for methods waste reduction is the paperwork system of the company. Many companies have reached the stage where it takes less time to make the product than it does to complete the paperwork. If it takes 45 minutes to manufacture a window (real manufacturing time – not the time in the system) and it takes 60 minutes to process the order then the administration system must be redesigned to catch up with the production system. Is the real problem in the factory or in the office?

5. The greatest waste of all

This is the waste of not using all of the talent and ideas that are already in the company. We ignore our employees' ideas and treat them simply as a 'body for hire'. Truly the greatest waste of all. We have all seen signs in factories saying 'Stop Waste' or 'Eliminate Waste'. These treat workers as if they wouldn't stop waste if they saw it. The biggest problem is not that we don't stop waste but that we accept it as a normal part of the system and don't even think of it as waste. The signs should be changed to read 'Find Waste' to challenge all staff to find an area of wasted effort each week and to eliminate it on the spot. It is not actually that difficult if the emphasis is changed.

Window and Glazing Topics – Manufacturing strategy for window fabricators

Part 10: Waste – materials

1. The business reasons

Materials waste is estimated to cost UK industry at least £15 billion/year – or some 4.5% of total turnover for the average UK company. This cost can be reduced by at least 1% through simple tools and techniques to easily raise profits.

2. Waste costs real money

Waste costs real money that is coming directly off the company profits. A reduction in waste costs by 1% can be the equivalent of increasing sales by over 14%. Internal effort spent on minimising waste can produce benefits equivalent to substantially increased sales. Most fabricators would regard a sales increase of 14% as excellent yet the same benefits can be achieved totally internally and with no risk at all. The only risk is that the competition does it and you do not.

3. The true costs are hidden

There is a large difference between the visible and the true cost of waste. Direct costs are visible and include waste collection and disposal costs (despite the fact that they are visible these costs are still largely ignored by most companies). The largest portion of the total waste costs are indirect and hidden and we have even developed special code words to make waste appear inevitable and part of the operations. The hidden wastes include:

- Raw material costs.
- Energy consumption.
- Water consumption.
- Effluent generation.
- Packaging.
- Factory and office consumables.
- Wasted time and effort.

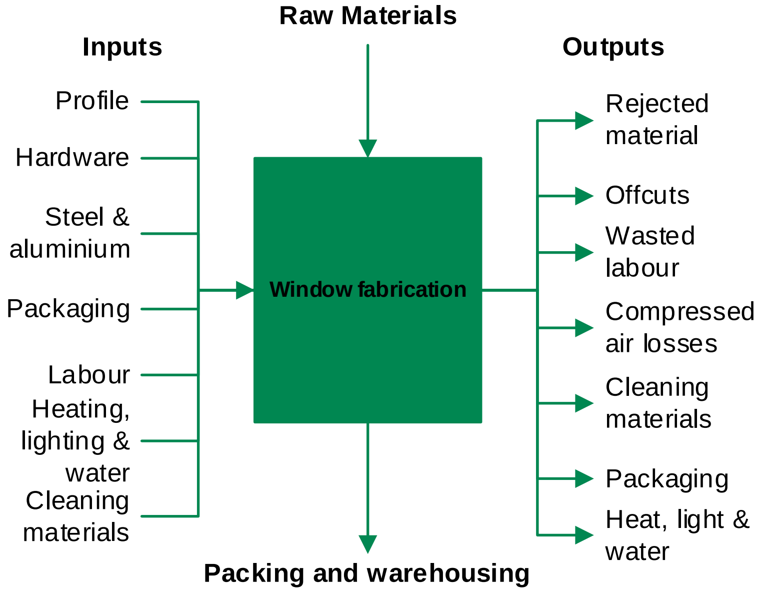
These costs are not recorded or are not shown as separate items. They exist even for efficient companies and arise whether you like it or not. They are also significant whether you like it or not. After performing simple assessments, many companies have found that their waste costs were more than 20 times higher than their initial estimates!

Reducing materials waste gives:

- Good investment returns and improved profits.
- Protects your image.
- Ensures meeting legal requirements.

4. Walk-around waste survey

The first step is to find some of the waste. Carry out a quick site waste survey to gain an overview of the processes and identify some no-cost or low-cost improvements to save money and reduce costs. After the survey is complete other methods can be used to find more hidden wastes. The survey should be carried out as soon as possible – waste is happening now and it is costing money now. Always look in the skips – it is an excellent starter for locating waste!



The process flow chart gives an overview of the wastes in the process.

Use a similar process flow-chart to record all the losses at each work station. The wastes may appear small but they are mostly avoidable and they add up to significant costs.

Waste tracking model		
Name:	Date:	Sheet: of
Process description:		
Supplier/input:		
Resource/ Material/Utility	Quantity Wasted	Monthly Cost (include purchase and disposal)
Rejected material		
Offcuts		
Wasted labour		
Compressed air		
Cleaning materials		
Packaging		
Heat, light & water		
Total		

The general waste tracking model for window fabrication

Use the waste tracking model to put some numbers and costs on the wastes identified from the process flow chart. Putting numbers on the costs will focus the mind on reducing the costs.

5. Simple no-cost and low-cost money saving ideas

Eliminate, reduce, re-use, recycle

In waste minimisation the waste 'hierarchy' is an important tool: first attempt to eliminate the source of waste, then reduce the amount, then re-use any waste that does arise, then recycle the waste and only when these have been eliminated should waste be disposed of. During the site survey always look for opportunities to eliminate the waste rather than simply accept it.

Materials management

- Avoid product damage by improving storage and handling techniques.
- Record materials content and track any variations.
- Find out where and why scrap is being generated.

Note: The more you get paid for recycled off-cuts the more you are wasting money. It cost a lot and now you are only getting a pittance for it!

Packaging

- Re-use any packaging if possible.
- Find ways to minimise packaging use with both suppliers and customers. Packaging is never free – it is always paid for.

Water

- Water is paid for twice – once when it is bought and once when it is disposed of. Reducing the amount bought reduces the amount disposed of.
- Repair all dripping taps and urinals and check for leaks in the water system.
- Make sure hot water is not above 60°C.
- Switch off hot water heaters before holidays.
- Check that the hot water control system is set properly and fit time switches on immersion heaters.
- Fit flush controls to urinal systems and trigger controls to hosepipes.

Utility management

- Implement no-cost and low-cost methods of improving energy efficiency.
- Monitor utility and packaging usage.
- Service compressors and reduce air leaks in the system.

Other measures

- Ensure machines are suitable for the process and are maintained regularly.
- Ensure employees are trained and understand the effects of their actions. Employees are vital to the success of waste segregation.
- Make measurements of the material used at each machine and any wastes.

Part 11: Supply chain

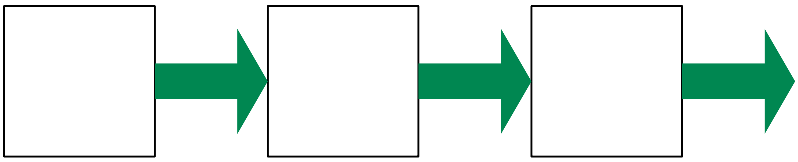
Suppliers are the key to effective manufacturing so why is it that they are treated as the enemy? Good supplier relationships need good customers as well as good suppliers.

1. The supply chain

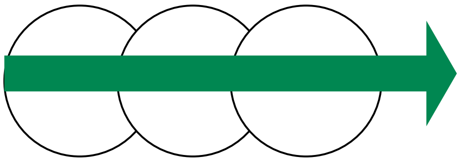
The conventional view of Just-In-Time was that it was simply asking suppliers to deliver smaller lots more often. Many companies did this and failed to gain any real benefit. Not a great surprise. They missed a real opportunity to improve the supply chain and develop a partnership with suppliers. Improving the supply chain means having a minimum number of totally reliable suppliers and then working with them on:

- Saving in materials costs.
- Reducing inventory levels.
- Achieving higher quality service.
- Reducing inspection & administration paperwork.
- Reducing the variability of supplied product.

Supplier development is about achieving these cost reductions and simultaneously improving reliability and response time. This requires supplier development and their eventual integration into the rapid production environment.



The conventional supply chain



The shorter integrated supply chain

Supply chain development

The traditional supply chain has distinct barriers between the suppliers and the customers, this leads to adversarial conditions. The integrated supply chain has overlapping at the customer / supplier interface and co-operation for mutual gain. This gives a reduction in the length of the supply chain and quicker reaction to customer demands.

Purchasing has traditionally been wary about supply chain integration because of concerns such as:

- Fear that single sourcing may give suppliers too much power over the company. In reality, this power was always there and the necessary mutual commitment between buyer and supplier can actually reduce the risk. The supplier is assured of business and the buyer is assured of the supplier's commitment. The adversarial element of the relationship is decreased and partnership increased. If a supplier loses a single sourced contract, then they lose the whole contract and not just a small part of the business. This is an incentive not to abuse the relationship.
- Fear that small lots delivered more frequently will increase transport costs. In practice, most suppliers are willing to absorb higher transport costs on the basis of a guaranteed level of business.

- Fears about the reduction of raw material inventories, with no buffer stock, a late delivery or defective lot can stop production. Many companies would rather hold excessive stock than be dependent on suppliers. This concern can be minimised by the JEDI approach, where JEDI is 'Just Enough Desirable Inventory'.

2. Supplier relations

Approaches to supplier relationships can either be co-operative or competitive. The co-operative approach is best if the supplier has significant technical resources that can contribute to new product development and can lower costs as a result of stability or economies of scale. For most fabricators this is the relationship with the systems supplier. The systems supplier has resources that the fabricator can use to improve their business. The competitive approach is appropriate when there are many suppliers of totally equivalent products or when important raw materials are in danger of having supply interrupted. Even in these cases the co-operative approach can prove better in terms of additional co-operation from the supplier with regard to delivery and quality.

3. The benefits

Developing supplier relationships and integrating suppliers into the company processes can save real money and improve operational effectiveness at the same time. Improving the supply chain needs time and effort but the rewards are worth it. Some of these are:

Purchasing

- Reduction in the number of suppliers and the difficulties of dealing with them.
- Improved global prices by volume ordering.
- Reduction in the number of purchase orders by using blanket orders to cover forecast quantities.
- Jointly targeted cost reductions on high volume items.
- Defined, clarified and mutually agreed delivery and quality standards.
- Greater flexibility in ordering and delivery of smaller lots more frequently.

Supplier Quality

- Minimum inspection on delivery.
- Quick feedback to supplier on performance.

Goods Inwards

- Frequent deliveries with no inspection on receipt.
- ABC rating of products for simple control based on strategic importance.

Stores

- Minimum stocks – shipped direct to shop floor to minimise handling.
- Buffers of minimum quantities of strategic stocks only.
- Packaging of product in KANBAN containers for immediate use.

Communication

- Improved understanding of each other's strengths and weaknesses.

Supplier development and integration can reduce the costs of purchased materials significantly through simple and direct actions but only if the adversarial relationship is replaced with one of mutual benefit.

4. Qualifying suppliers

The key to managing the supply chain is finding the right suppliers to integrate with and procedures are needed to select and evaluate suppliers. The formal evaluation must not be simply on ‘first time cost’ but also include quality, reliability, technology and stability.

Suppliers need to be qualified on the basis of the following information:

- What are the supplier’s financial and credit ratings and what is the current financial position?
- What are the current and projected levels of business?
- What credit terms are offered? How do these compare with other suppliers?
- Are the prices reasonable?
- How is production scheduled?
- Can they meet the future schedules?
- What are the cost implications of overdue deliveries against the schedule?
- How is special tooling purchased?
- Will they specify key contacts in design, production and finance to provide relevant information?
- What are the design and development procedures?
- Is the supplier certified externally to a quality standard?
- What are the supplier’s inspection procedures and controls?

5. Improving the relationship

Actions to improve the supplier relationship are:

- Start the process of developing the supplier base into a strategic strength. Encourage visits (at all levels of staff) to and from the supplier to understand strengths and weaknesses. Develop processes to minimise the weaknesses and exploit the strengths.
- Use suppliers to drastically reduce raw materials stocks. Investigate the use of ‘consignment stocks’ to reduce inventory costs.
- Discuss future materials requirements at a global level and use the increased purchasing volumes as a cost lever.
- Jointly target cost reduction areas. Find every possible cost reduction idea and implement it. If the current supplier doesn't want to do this, then find a new supplier.

6. Building supplier relationships

- Building supplier relationships is not a quick fix. It demands time and costs money but reduces costs in the long-term.
- Inform them and communicate with them.
- Obtain commitment to an open process of working.
- Get them to open up their organisation by asking questions and being open with them.
- Visit them and have them visit you – not just the purchasing staff but all the way down to the shop floor.
- Create a mutual understanding of the benefits of cooperation and working together.
- Negotiate and agree formal supply long-term agreements.
- Use ‘just-in-time’ to work with them not as a weapon.

- Teach them what you have learnt.

7. Not simply purchasing

Improving the supply chain changes the way purchasing works. Instead of chasing materials and processing repetitive orders purchasing can work on the real core functions of negotiating agreements, working with suppliers to improve operations and ensuring value for money purchasing.

Window and Glazing Topics – Manufacturing strategy for window fabricators

Part 12: Measurement

1. The old efficiency measures – doing things right

The traditional efficiency measures used in window fabrication are generally based on systems designed for a factory where direct labour and machine utilisation were the important factors. These measures such as:

- Direct labour utilisation (and other measures).
- Efficiency (however measured).
- Machine utilisation measurements.
- Materials usage measurements.
- Variances of all the above.

These measures are concerned with doing tasks faster or with less material/labour and do not ask if you should be doing the task or not. They do not consider that you can be the most efficient slide rule manufacturer in the world but that won't help you if the market has moved on to pocket calculators or computers. Efficiency measurements such as these have little relevance to the shop floor and are generally treated by the average worker as unapproachable and a mystery. They ‘cannot’ be improved so why try?

2. The new effectiveness measures – doing the right things

Performance measurements must be relevant to the manufacturing area. The measurements must drive and improve the production process and relate directly to survival in the market place.

The measures must share common characteristics and measurements meeting these criteria will drive a factory much more effectively than pure financial numbers. When these numbers are right then the financials will fall into place for both the short and long term.

Data collection should be done manually and the measurements should be recorded as the information is available on a blackboard or chart that is clearly visible to the factory staff. Ideally the production staff should collect and record the results to give them ownership of the numbers. Ownership and self-monitoring are powerful incentives to improvement. The public display of a measurement gives control, visibility and immediate feedback for the workforce.

3. Metrics for manufacturing

The choice of the measurements to be used depends on the areas selected for improvement and this should relate back to the Key Factors for Success (KFS) established as part of the manufacturing strategy, i.e., what is it you need to be good at to improve or maintain your business? If quality is a KFS of the business then include a measure of quality in the measurements. If customer satisfaction or service is important then include a measure for this in the system.

Some examples of measurements are:

Quality Measures

- Supplier performance: lead times, incoming goods quality, certification.
- Cost of quality or quality index.
- Customer satisfaction: Surveys, complaint recording, repeat sales.

Customer Time Measures

- Number of products (line items) delivered on schedule.
- Value of products delivered on schedule.

- Lead time reduction improvements.

Process Measures

- Total product processing (cycle) time.
- Total product distance travelled.
- Machine down times.
- Number of handling operations.
- Material availability.

Cost Measures

- Waste measures.
- Direct labour productivity: value of finished products divided by number of hours to make.
- WIP turns.
- Inventory turns.
- Reduction of non-value-added production steps.

These are just a few measurements that you could use. The important thing is to decide where you need to get better and then measure that area. Choose the measurements that control production effectiveness and use these until the concerns that they measure are under control, then move on to the next most important improvement areas.

Presentation at management level can use a 'management dashboard' (see box at right) presenting the measurements as on a car dashboard. Progress and achievements (non-financial) will be clear and unambiguous.

4. Characteristics of the new effectiveness measures.

1. They should be clearly communicated to the employees:

    'I will succeed if you tell me what you want me to do and where you want me to improve'.

2. They should be non-financial and used by all employees:

    'Tell me in terms I can understand'.

3. They should reflect the performance required at each location:

    Give me something that is relevant'.

4. They should vary with time to reflect changing goals in the organisation:

    'I've got that right so let's move on to the next priority'.

5. They should be simple and easy to use:

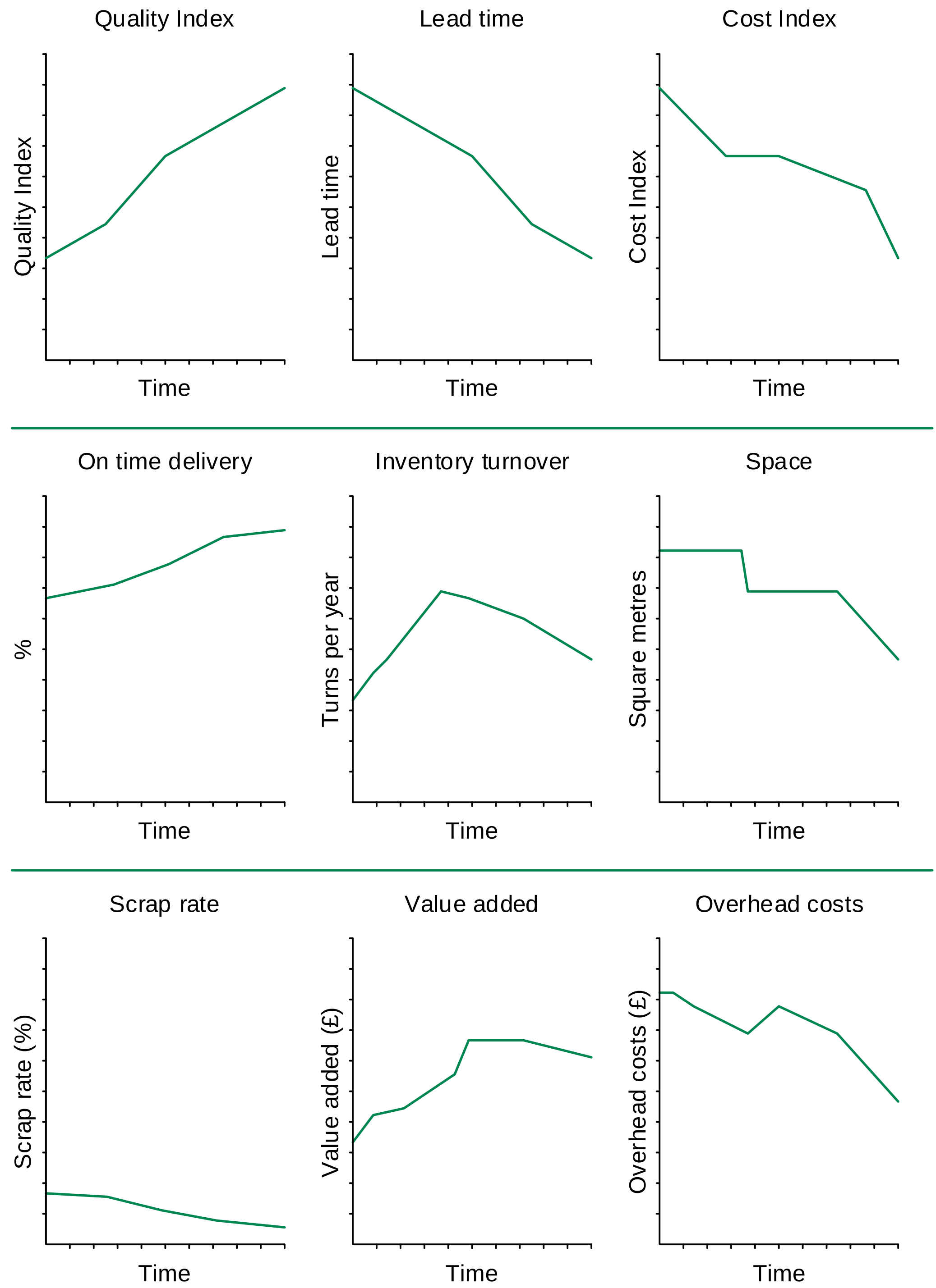
    'I understand that'.

6. They should be fast to give quick response and feedback:

    'Is today soon enough?'.

7. They should aim to teach rather than monitor and be designed for improvement rather than simple historic reporting:

    'OK, now I see where I can get better'.



Measurements displayed on the 'company dashboard' are easy to understand, can be changed rapidly and show progress (or lack of progress quickly). Limit the number of measures and change them as the objectives are achieved.

People all react in the same way, if a worker is told that quality is all important and is then measured according to his production output then what will he concentrate on improving?

People react in the way you inspect and not in the way you expect. People react in the way you audit and not in the way that you plaudit. Above all measure, display, analyse and act to improve the results

5. Changing the Measurements

The measurements used and progress made will show the improvements and automatically drive the factory to improve.

If good materials are purchased and the internal processes are in control then outgoing quality is automatically good. The measurement of quality can then be changed from outgoing quality to control of incoming quality. If quality is controlled at all levels, then it is possible to move on and treat customer responsiveness as the major priority. Focusing on flexibility and short lead times gives rapid customer order turn-around. Any company still worried about quality in 2021 will soon be outflanked by competitors using responsiveness and time as a competitive weapon.

Performance measurements must reflect the competitive priorities (as defined by the KFS) and the new competitive weapons are simple: reliable products (as distinct from products that simply conform to specification as they leave the factory) and quick dependable delivery. Only by reflecting these priorities in the measurements will companies survive.

Window and Glazing Topics – Manufacturing strategy for window fabricators

Part 13: The cost of quality

1. Logoland?

Many fabricators are interested in quality but this is sometimes only focused on gaining the various logos and approvals to improve customer acceptance of their product and services. This is not necessarily a bad thing but it is also possible to miss one of the biggest possible benefits of improved quality – that of actually reducing costs and improving profitability.

2. Quality costs or quality savings?

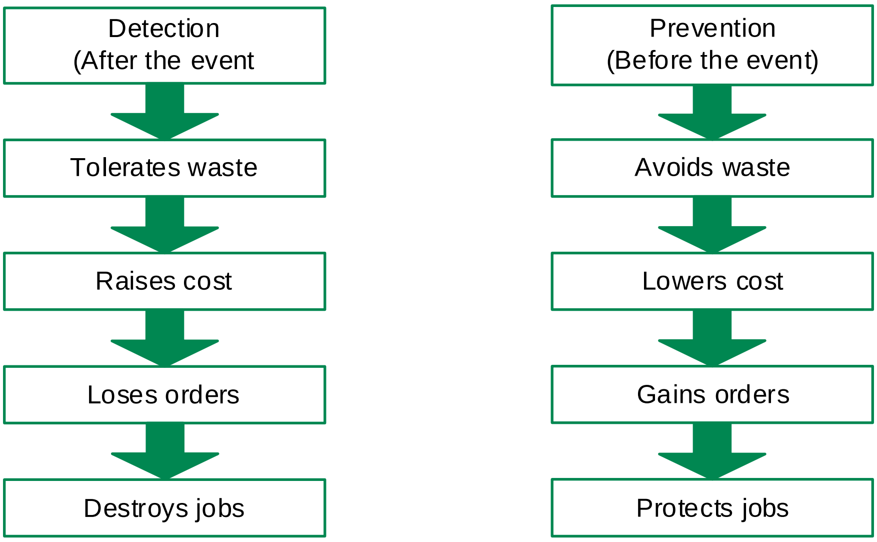
One of the basics of quality is that it is better (and cheaper) to prevent defects than to detect them after you have made them. If defects are prevented by an efficient quality system, then waste is reduced, costs are lowered and sales can either be increased by lowering prices or more profit can be generated by keeping prices constant. Quality should not be regarded as a method of gaining logos or as an abstract theory but as a vital tool in the management of your company.

The 'cost of quality' is not just the cost of gaining the logo and the effort to maintain it. It is the total cost of not getting the product 'right first time'. Quality costs are not always due to bad production but can also be created by initial specifications or customer expectations that are unrealistic with respect to production capabilities. The cost of poor quality for the avenge British business has been estimated at between 5 and 25% of turnover. At the average of 15% of turnover this could well be more than your profit! These costs are largely preventable and yet what have you done in the last 6 months to reduce them? Pause here for one second and think what it would be like if you could add half of this back on to your bottom line. This could be an increase of at least 50% in your profits. A simple calculation for your company will show the possible magnitude of the costs.

3. Prevention and detection

Prevention is always cheaper than detection and the different approaches (and inevitable end results) are shown below. In these terms it hardly makes sense to purchase cheap materials because the cost only returns via another route, and cheaper in the short term may be more expensive in the long term. This change of emphasis from failure and appraisal to prevention requires a change in ideas about quality control and the costs. At present, quality is often seen as a cost to the company but simply by changing the emphasis it can be seen as a gain to the company by increasing quality (and hence sales) whilst at the same time decreasing the overall product cost.

Detection versus prevention



Two approaches to quality

Would you prefer defect prevention or defect detection?

4. The real costs

It is general to divide quality costs into three separate areas i.e., prevention, appraisal and failure (PAF). For most companies 5% of quality costs are spent on prevention and 95% of quality costs are expended on failure and appraisal. These failure and prevention costs add nothing to the value of the product and are wasted money. Increasing the money spent on prevention can reduce the overall quality cost by between 30 and 50%. This could be the equivalent to adding approximately 50% to the profit figure, i.e., it is a very highly geared investment.

What sort of costs should we consider to be quality costs? A typical breakdown of quality costs would be:

Failure Costs:

- Internal – scrap material; labour overhead; sorting; selective production; and downtime.
- External – faults and complaints; investigations; interest on unpaid invoices; and product recall costs (transport, paperwork etc). When a single call-back costs at least £50 it doesn't take many to become a significant factor in the costs.
- Intangible – lost sales through bad reputation and production delays.

Appraisal Costs:

- Incoming, in-process and final inspection.
- Test equipment.
- Special checking.
- Overheads of general quality control.

Prevention Costs:

- Quality plans.
- Sourcing via quality suppliers.

- Design tolerances.
- Housekeeping.
- Packaging.
- Training of personnel in quality.

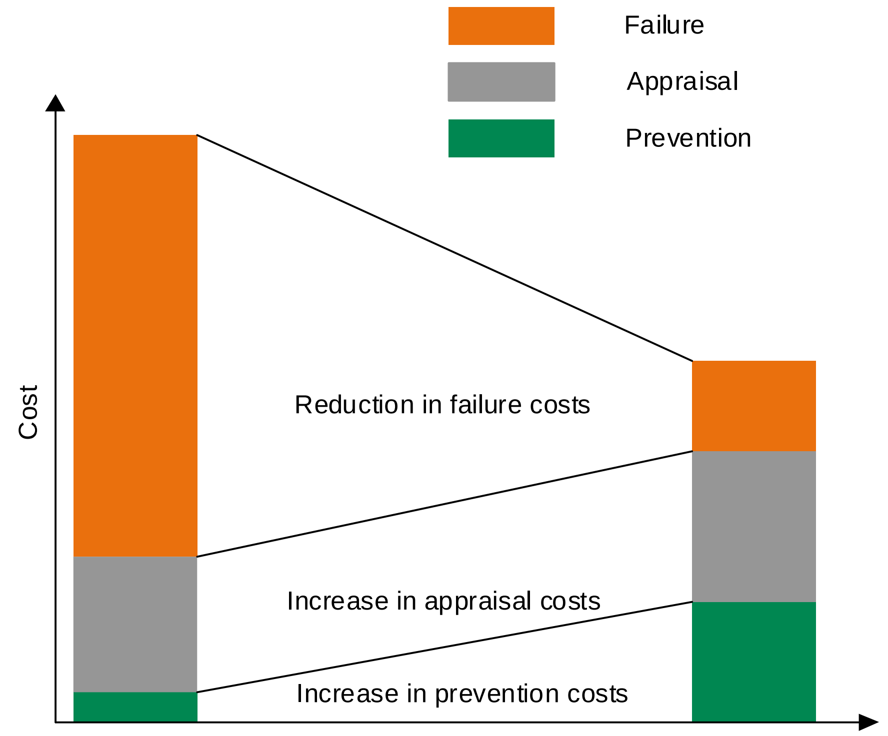
It is easy to see that the true cost of quality is far higher than the first thing you thought of, i.e., the cost of certification and inspection. Once the type of cost to be considered is recognised it is not surprising that quality costs can be a significant proportion of turnover. The next problem is to determine the actual quality costs and to begin to reduce them.

An initial recommendation is to make a start by collecting some initial costs for typical product lines and looking for possible ways to reduce or eliminate these. For a window manufacturer there are several areas to concentrate on:

- How much training have you carried out in quality?
- How much effort have you put into reducing the real causes of problems rather than simply fire-fighting?
- Are all profiles and ancillary products delivered on time and fit for use?
- What is the cost of inspection (at all stages)?
- What is the scrap/wastage rate in fabrication of a typical window and how could this be reduced?
- Are you performing operations that do not really need to be done, i.e., post-polishing?
- What are the call-back costs?
- How many credits have you given customers in the last 12 months?
- How much time is spent on reworking products?
- How many mistakes are due to office functions and how many are due to production functions?
- How many customers have you lost through poor quality?
- How much time do you spend sorting out problems that should never have happened in the first place?

Reducing costs by changing from detection to prevention could be one of the best investments that you ever make. Simple changes will start to save money quickly – all it takes is a change in perspective.

Quality, both in terms of your reputation and the total costs involved, may be the one thing that decides if you survive or not.



Transformation through changing the allocation of resources

Part 14: The hidden costs of inventory

1. Why worry about inventories?

The cost of inventory should be an area of constant concern to any business. Too much inventory not only eats up the working capital of a company and creates cash flow problems but it also needs additional space and people to manage it. Inventory is not passive or free, it actually costs money to have goods in the company and costs can be reduced by reducing the inventory levels. The opposite problem of too little inventory can cause production delays and poor customer service. Getting the balance right is essential and one knee-jerk but ultimately doomed response is to require Just-In-Time (JIT) deliveries from the major suppliers. A better response is to implement 'The return of the JEDI' where JEDI is 'Just Enough Desirable Inventory'.

2. The cost of inventory

The real cost of inventory is estimated to be 30% of the total inventory held and if you hold an inventory of £100,000 then the cost per year is around £30,000. Little wonder that many companies now see inventory reduction as a method of freeing up cash and reducing labour costs. JIT or JEDI production methods can reduce inventory but there are other practical things you can do to start an inventory reduction programme.

Stocktakes

Greatly reduced inventory means quick, easy and accurate stocktakes – in fact, if things are done properly, the inventory is so low and so stable that stocktakes are simply not necessary. Simply add a notional figure for stock held back into the accounts.

Think of all the effort and cost saved in the process of counting, reconciling and getting it wrong anyway.

The hidden costs of inventory:

Purchased goods:

- Purchasing costs.
- Freight costs.
- Inwards goods and inspection costs.
- Warehouse labour for storing, moving etc.

Manufactured goods:

- Manufacturing time/labour.
- Manufacturing materials.
- Time/labour for manufacturing order preparation.
- Inspection costs.

Additional general costs:

- Higher insurance.
- Increased space needed.
- Increased materials handling needed.
- Lower return on investment.
- Increased physical stocktaking (and increased risk of errors).
- Increased record keeping and accounting.

- Increased probability of loss, damage and deterioration.
- Increased probability of obsolescence.

Economic ordering

It is possible to balance the cost of placing an order against the cost of holding the inventory by using the formula:

Economic order quantity: $\dfrac{\text{Annual usage (£) x Cost of order}}{\text{Cost of holding material.}}$

Note: As purchasing reduces the 'cost of order' down to zero through blanket orders and call-offs then the economic order quantity also approaches zero and it is feasible to 'sell daily – make daily – buy daily'.

Inventory is not free

3. Improve the inventory accuracy

If you don't know how much you have or where it is, then it doesn't exist. A high inventory accuracy (a minimum of 95%) is an essential to starting any inventory reduction process. Inventory accuracy requires well-designed cycle counting systems. These can very rapidly pay for themselves by not only counting things but also identifying and solving inventory system problems. Don't just collect the numbers, analyse them and work to improve them. At the end of the inventory reduction process the stocktake process may well be redundant but at the start it is an essential tool.

4. Reduce the lead time

Long lead times automatically mean more inventories as Work-in-Progress (WIP) in the system. A former client had a 16-week lead time (for windows!) and had 16 weeks' worth of production on the factory floor at any one time – their main concern was to keep the saws going! The space used was enormous; orders regularly got 'lost' in the factory and close to £750,000 of cash was tied up as WIP. They didn't listen, they ran out of cash and they are no longer with us. Don't start to produce an order unless you intend to do something with it. Don't make anything for anybody, make them come and get it. Reduce your production lead times to a maximum of 2 days (it only takes about an hour to make a window so 2 days in the production system is actually excessive) and issue production orders only when needed on the shop floor.

5. Increase the speed of operation

Inventory levels often have little to do with the level of customer service that you claim or want to provide. They are more dependent on the time taken to replace the materials used and the supplier reliability. If it takes 4 weeks to replace an item, you need to reorder when are down to 4 weeks stock at minimum (JEDI) or you risk running out of materials. Purchase from reliable suppliers with short lead times and inventories can drop dramatically. Make lead times and their reliability a key factor in the purchasing process. Short lead times from reliable suppliers can save more money than reduced 'headline' prices from unreliable suppliers.

6. Eliminate process misalignment

Watch out for the 'economies of scale' argument. Buy in the same units that you sell in. If you sell tens of products per week then buy tens of the raw materials per week. Buying thousands of the raw materials to get 'economies of scale' is a recipe for disaster. It creates large quantities of inventory, slow stock movement, possible product obsolescence, possible product damage and it locks cash up as inventory. Large stocks also reduce your responsiveness to customer demand – you cannot introduce new products until the entire inventory is used up. Buy what you need to match the customer consumption rate.

7. Specialise and throw it out

Have you ever heard: ‘If we don't carry that item then the customer won't buy from us’, but where else can they go if no one else stocks it? What about ‘We keep the mis-measures and quality rejects; someone will buy them someday’ or ‘We paid too much for it to throw it away’ or ‘It is written off so it doesn’t owe us anything’. The simple fact is that the products will all still be sitting there: taking up space, clogging the system and confusing people: get rid of them. Sell them now to generate some real cash (however small) for the business.

8. Get rid of the stores area (and the store man)

Stores areas are great hiding places for inventory and other redundant parts and you actually pay the store man to hide it for you! Make the operators and supervisors who use the parts responsible for ordering the parts and storing them in the production area (which is where the materials should be anyway). When they know that if they run out of parts then they stop work and don’t get paid, they will order the right levels at the right times.

Devolve the responsibility to the people who suffer if the component isn’t there. They will really care about it.

Putting the products by the operators also means that there is no time spent going to the stores (a great day out), filling out the forms and having a chat on the way.

9. Replenish based on market demand

Forecasts are educated guesses and their accuracy gets worse as they extend into the future. Use the market demand (and your high inventory accuracy) to replace the inventory as customers are actually buying products. Forecasts are always wrong and will either cost you money as excess inventory or customer service through lack of product.

10. Summary

High inventory levels are not a necessity; they are a failure of management to actually manage and are a real cash drain on your business. An inventory reduction programme will pay for itself by releasing real cash into your business, releasing space for production and at the same time improving your responsiveness.

An inventory reduction programme will pay for itself many times over so what are you waiting for? There is no excuse not to start to reduce inventory today.

Part 15: Environmental management

1. Clean business = good business

Environmental management systems are rapidly becoming an important issue throughout manufacturing industry and the window industry (at all levels) is no exception. Many companies are under pressure from customers and consumers to prove their 'environmental credibility' and this means that they need to develop a credible Environmental Management System (EMS). These are external pressures but perhaps the most important reason for developing an EMS is that it can save money. Companies who have implemented an EMS have often not only improved their environmental performance but have also achieved substantial cost reductions.

An EMS with a strong emphasis on minimising waste and continual improvement will undoubtedly help a company to reduce costs.

A good EMS is not simply a paperwork exercise; it is a practical management tool and will help:

- Identify, assess and manage the environmental consequences of operations.
- Reduce waste and operating costs.
- Gain a competitive advantage.
- Establish and show a system for continual environmental improvement.
- Demonstrate compliance with legal obligations.
- Improve the public image.

2. Waste minimisation and EMS

Instead of the typical route of having an EMS focused on completing the paperwork it is possible to have an EMS focused on waste minimisation. This will produce cost reductions from reduced waste, scrap, rework and energy use.

The average UK window fabricator has a waste rate of over 15% – this is not simply the sawing waste which is all many people concentrate on, but is the overall waste generated in the factory from all types of waste processes. This waste increases operating costs and reduces capacity from the lost opportunity to produce saleable product.

Eliminating or reducing waste gives environmental benefits by reducing the use and waste of resources and reduces costs. Environmental management systems are a 'win-win' for most companies – if only they care to get involved.

3. EMS basics

An effective EMS includes:

- An assessment of the environmental aspects and impacts of the company's activities, products, processes and services.
- An environmental policy.
- An environmental improvement programme with objectives and targets.
- Identified roles and responsibilities for all employees.
- A training and awareness programme.
- Written procedures to control activities with a significant environmental impact.
- A controlled system of records.
- A programme of regular auditing.

- A formal review process for the EMS.

In many ways an EMS is similar to existing Quality Management Systems and these two Management systems can be easily integrated into one system that is easily managed. If you have BS EN ISO 9001 then you are probably 60% there in terms of getting an EMS up and running.

4. Approaches to EMS

An EMS can be developed to comply with the ISO 14001 model and for companies with BS EN ISO 9001 this is probably the easiest and most straightforward approach. It is also possible to follow the EC Eco-Management and Audit Scheme (EMAS) or even to develop an in-house EMS if you do not want to go for formal certification and recognition.

It is not necessary to get external recognition of an EMS to obtain many of the benefits but the formal approach increases the commitment to continual improvement and to identifying opportunities for ongoing improvements and cost savings. External recognition increases the credibility of an EMS with customers and suppliers and provided the EMS has been systematically and properly implemented then the actual certification process does not require much more effort.

5. Key factors for success

Gain senior management commitment

Strong senior management commitment is essential to ensuring the successful implementation and operation of an EMS.

The benefits and aims of the EMS should be explained to senior managers before starting the implementation process. Convincing senior managers will require a project plan and a detailed estimate of the potential costs and also the potential cost savings from adopting an EMS.

Build on existing systems

There will be links between existing quality management, health and safety management and other management systems.

These links should be reinforced and not re-invented. It is environmentally good to re-use so do it with procedures as well, e.g., document control procedures used in other management systems should be suitable for use in the EMS and should be adopted by the EMS for consistency and ease of development.

6. Getting certified

To be ready for certification to ISO 14001, the EMS should have been fully operational for at least three months and at least one Management Review should have been conducted. For initial registration, participants need to have a fully operational EMS with an audit programme already in place and started, and to produce an initial and validated Environmental Statement.

Many companies use the same certification body for their EMS as for their QMS. However, it is important to check that the certifier is accredited by the United Kingdom Accreditation Service (UKAS) for ISO 14001 certification. Check that the proposed certifier/verifier has relevant experience in the window industry.

Certifiers use a range of methods for certification. Be sure to understand the different stages of the proposed certification process and what the certifier will be looking for at each stage. Ask the chosen certifier to run through the process of certification.

Before the certifier visits the site for the first time, hold a meeting to ensure everyone knows about the certification and what it will entail.

An ‘Initial Review’ will help to gather the data that will give a ‘snapshot’ of the status with environmental issues. Regular reviews will help to quantify the savings made and maintain the momentum for implementing the EMS.

Formal certification of an EMS is a significant milestone but it is not the end of the journey. Every EMS needs continued attention to deliver further improvement and savings. Senior managers must appreciate this – otherwise the initial enthusiasm for the EMS may decline after certification is achieved.

7. What to do next

Implementing an EMS with a focus on waste minimisation and continual improvement will reduce costs and improve environmental performance. The practical steps in implementing an EMS are:

- Understand the main elements of an EMS to ISO 14001 and become familiar with the standard's requirements.
- Appoint someone to oversee the implementation and operation of the EMS.
- Develop an environmental policy.
- Identify the company's environmental aspects, evaluate their significance and draw up an Aspects Register.
- Identify legislative requirements and draw up a Register of Legislation.
- Set objectives and targets.
- Assign responsibility.
- Develop employee awareness and conduct training.
- Prepare procedures to deliver operational and document control.
- Implement a programme of regular monitoring and measurement of significant aspects, e.g., waste, water use and energy use.
- Develop an internal audit mechanism and timetable.
- Review progress and, if necessary, revise the policy, objectives and targets.

Window and Glazing Topics – Manufacturing strategy for window fabricators

Part 16: Continuous improvement

1. The basics

Many fabricators think of quality as a cost instead of thinking of it as a potential tool for cost reduction. The reality is that quality is a cost only if you let it be, it is only a cost if it is used simply as a badge to complete the set of ‘Logoland’ badges. Quality can be the most effective tool available for cost reduction but only if it is used rather than treated as an on-cost and then ignored.

Many fabricators have a Quality Management System to ISO 9001 or similar but how many have made recent changes to the system to reduce costs and save money? These are not the changes that are made for compliance with the standard, these are the changes to the system that are made to reduce the paperwork, to simplify the product and to reduce costs, this is about using the quality management system as a tool for continuous improvement and continuous cost reduction.

Continuous improvement is so important that when ISO 9001 was changed in 2000 it was modified to include continuous improvement as part of the new requirements. The current standard is explicit in requiring continuous improvement as an essential part of the quality management system.

The quality system that was first put into the company should have changed dramatically by now, especially if the system has been in existence for more than two years. Quality systems are not engraved in stone; the systems should change as your operations change and as the systems should act as a driving force for change instead of a sea anchor. Documenting the processes for the quality management makes redundant processes, complex systems and redundant paperwork very visible: if you are not using the system to remove processes, simplify systems and remove paperwork then the system simply isn’t working or you have the wrong system (or both).

Hands up those who haven’t changed their quality system recently.

The initial gains from continuous improvement can be spectacular and in most cases are essentially free. Not only that but using the quality system to lock the gains into place results in the gains being retained and achieved every year – these are not one time savings but permanent cost reductions to the operating base of the company.

Typical savings that can be made are shown in the table below:

Area/Activity	**Potential Savings**
Waste minimisation improvements	2 – 3% of turnover
Energy efficiency improvements	1 – 2% of turnover
Quality system improvements	5 – 6% of turnover
Business process improvements	5 – 6% of turnover
Total	**13 – 17% of turnover**
These are typical possible savings based on our experience for an average firm. Individual firms may differ depending on the exact situation.	

These savings are much greater than the profits of most fabricators – imagine doubling profits or reducing prices to increase business whilst still retaining good margins!

2. What is it about?

Continuous improvement is not about directly improving the features of the product; it is about improving the processes used to make the product. Controlling and improving the process always leads to improvements in the cost, reliability and control of the product.

Control of the process through continuous improvement automatically leads to control of the product; equally a lack of control of the process automatically leads to a lack of control of the product. End-of-line inspectors do not add to the control of the process and therefore do not add to the control of the product, they are after the event. If you have to have end-of-line inspectors then you do not have control of the process and are paying the inevitable price.

3. How do we do it?

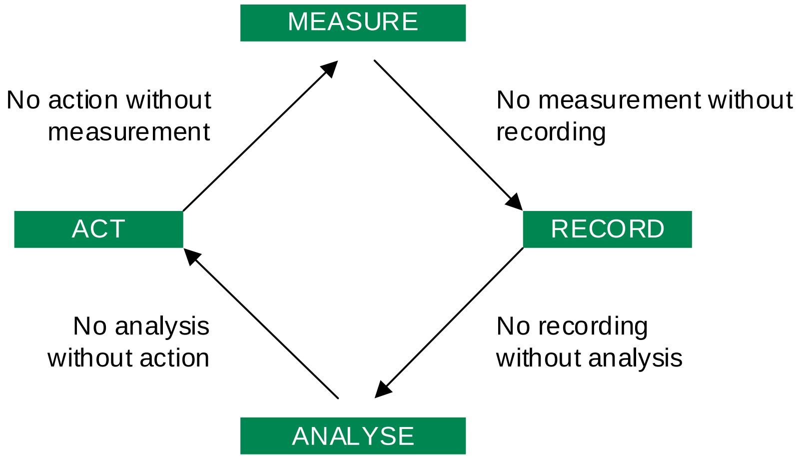
The first part of continuous improvement is to find out what to improve. This might seem basic but it is very important not to rush off and 'improve' the first thing you see or the first thing you think off.

One of the worst mistakes is 'coincidental correlation' where people think that because Event A happens before Event B then Event A must have caused Event B (this is often which is expressed in Latin as 'post hoc ergo propter hoc' or 'after this therefore because of this'). An example of this might be 'I took this cold remedy and after two days my cold got better, therefore the cold remedy cured me'; in reality the cold was going to get better in two days anyway. Don't let your only exercise be jumping to conclusions!

The secret to the decision about what to improve is information, information and more information. Information is not the same thing as data – data is simply numbers but information is power. Two of the best techniques for rapid analysis of data to provide information are:

- Simple graphs to show the trends in changing data – most people remember pictures better than they do words and graphs are simply pictures of data to show real information.
- Pareto analysis (the 80:20 rule) – Use the 80:20 rule and Pareto plots to sort data into easily handled information and to highlight areas for improvement.

Above all, continuous improvement relies on the Action Cycle (Measure, Record, Analyse and Act) shown below, follow this ruthlessly and you cannot go far wrong.



If you have no idea where to start then Cause and Effect Analysis (Fishbone Diagrams) will give you a range of ideas about where to start.

4. Two secrets

There are two simple secrets to continuous improvement:

- You have got to want to do it – Unless you actually want to improve then you will never improve the way you do things. This might seem self-evident but the majority of people don't really want to change things and would rather continue doing what they have always done. You (and the rest of the employees) have got to be prepared with the discomfort of changing the way you do things. Most 'managers' don't want to manage, a process that involves constant change, they want to administrate, a process that involves keep things constant for as long as possible. Real management and important changes always involve a discomfort factor that gets higher the more important the change.

- You've got to measure how you are doing both before and after the changes – Changes should always be tested and measured to assess their effectiveness before full roll out and those that do not deliver the results should be dropped. Not all changes will be a success but that is OK, do we expect every sales visit to result in an order? Fast failure and a quick recovery are better than a slow descent into chaos.

5. Change is the only constant

Some people get excited about 'quality' but in reality, it is pretty boring. The thing to get excited about is how you can use the existing quality system to increase profits. The opportunity and system are there – you simply have to use them.

To answer the question at the start of the article: Are we there yet?, the answer is simple: 'No', and the reason is also simple. Continuous improvement is not a destination, it is a process that never really ends, it is a constant effort to improve the business processes to reduce costs, save money and improve profitability – these are activities that can never end if you really want to survive.

Window and Glazing Topics – Manufacturing strategy for window fabricators

Part 17: The changing role of the production manager

The introduction of a Manufacturing Strategy, in any form, involves a major change in the role of the production manager and in the way he manages his people. The main areas of impact are:

1. Time for reaction

The time for reaction is always reduced by a reduction in inventory and increased throughput. When using effective production scheduling the control of work should be automatic. There should be little, if any, need for the production manager to be involved in the routine scheduling of work. There should be no crises over late or last-minute orders and the time-consuming progress chasing aspect of the job will disappear. The down side of this is that work in progress will be so low that a line stoppage will require an immediate solution before it threatens the whole production line - there is no inventory to act as a buffer and safety zone.

The increased variety that is likely to be required by the market reduces the reaction time even further. Many different products means that we must be able to move work around our production lines, or cells, very flexibly to keep up with rapid shifts in demand. If you can only produce white casement windows then you are in real trouble when you get an order for brown or woodgrain products.

The production manager of the future will spend less time planning and controlling the process and more time reacting and solving the causes of problems to give fault free production.

2. Management Methods

There is a need to increase employee involvement and responsibility to achieve the rewards of partnership. This obviously means that in many cases the company 'culture' must change quite radically and this naturally changes way a production manager manages.

Instead of ruling by order, power and threats the Production Manager must now convince and persuade. When we hire a pair of hands for our production line then we get a brain thrown in for free, it is up to us to use it! At times it appears that British manufacturing management thinks that production workers leave their brains at the factory gate. The reality is that they are thinking human beings who need convincing, persuading and responsible treatment to get the best out of them. In the company of the future the only way to communicate will be to listen.

If we expect our staff to accept responsibility then we must give them the power that goes with this. In many Japanese companies the line workers have both the power and the responsibility to stop the production line if there is a problem. This contrasts to the traditional British way of working where to stop the line was the ultimate sin. Power and responsibility are totally linked. If you doubt this, then consider how you would feel if your boss gave you responsibility but none of the power to back it up, how would you regard your boss if he had the power but none of the responsibility for success or failure? In the company of the future the only way to retain power will be to share it.

These two factors show that there is a necessary change from being a 'boss' to being a 'facilitator'. The facilitator who helps to get things done and who can be challenged to provide proof is a different person to our traditional role and this will be a difficult transition.

3. Quality

The production manager has always been directly responsible for the quality of the goods produced but in the factory of the future there will be no avoiding this responsibility. This greater responsibility for ensuring product quality during production will highlight a need for training in quality assurance.

Part 18: Things to do NOW!

1. Manufacturing

- Set out a full 'Manufacturing Strategy' to match and complement the Business Strategy.
- There are only two activities that add value to the product, the rest add waste and cost. Are you adding waste and not value? Walk around the factory and check where people are being efficient at wasting money. Don't make it efficient – eliminate it!
- Value adding and waste activities. Change manufacturing processes to remove waste and complexity.
- Use visual controls for performance measurement. Monitor quickly, display rapidly and improve constantly.
- Identify relevant performance measures – Display them (both targets and achievements).
- Identify the production bottlenecks or constraints and reduce these (preferably remove them) by strategic investments to give spare capacity.
- Embargo new machine purchases except at bottlenecks where they can improve throughput.
- Ensure that new equipment not only reduces direct labour but also does not increase indirect labour to support the machinery.
- Examine the use of many small cheap simple machines instead of complex and expensive machines.
- Make changing process settings without written approval a dismissible offence. If you think this is harsh then think how the MD would react if a process operator let the air out of his car tyres 'because I thought the car would run better'. Fiddling with process controls costs more in terms of scrap and wasted materials than you would ever believe. Stop it!
- Look at 'Lean Manufacturing' to reduce costs and inventory.
- Institute a '5S' programme to tidy and rationalise the factory.
- Use Total Productive Maintenance (TPM) for all machinery and particularly for bottleneck machines.
- Reduce layers of supervision to give direct and simple control.

2. Factory layouts

- Change the factory layout to decrease the need for product movements.
- Measure the distance travelled in producing the product and reduce by grouping product processes to give work cells.
- Measure the number of operations and total production time in minutes and reduce this (by combining operations) to give quicker flow and throughput.
- Get absolute physical parts control. This is where parts have no chance to do anything but follow a controlled path through the manufacturing process, people cannot make a decision where parts go next and the next move for parts is physically controlled and restricted.
- Introduce cell-based manufacturing to reduce line management.
- Identify the hiding places for WIP and reduce these (preferably remove them) to give clarity of work flow.

3. Incoming Goods/WIP/Inventory

- Reduce inventory (as stocks or WIP) in all areas. Stock is evil!
- Reduce stores to hold only essential stocks in priority order. Preferably get rid of them and hold the stock on the shop floor to be controlled by the operators as they need it.
- Reduce or eliminate all paperwork processes to give speedier response.
- Reduce or eliminate WIP at all stages to give pull-through of product rather than batching of production.
- Regard inventory wherever located as a cost rather than as an asset and continuously seek to reduce at all points of the production chain.
- Reduce supplier order quantities with forward orders for maximum discount and regular but smaller deliveries.
- Improve supplier delivery performance. Measure, monitor, score and tell them. Establish good relations to improve performance.

4. Quality costs

- Get rid of inspectors. Make operators responsible for their own work (they produced it in the first place) and the quality of that work.
- Establish plans to reduce the cost of quality.
- Remove Quality Control (after the event) and substitute Quality Assurance (before the event) by using SPC or other techniques.

5. Delivery of complete product

- Measure delivery schedule performance and improve in both line item and value terms.
- Constantly monitor schedule adherence.

6. Overheads

Energy usage

- What were the bills last month and what did you do about them?
- Investigate competitive pricing for energy supplies.
- Establish controls over energy usage.
- Carry out an energy audit. Contact Action Energy (0800 585 794) for free advice on how to reduce energy costs.
- Set up an energy management plan.

Compressed air usage

- Only about 5% of the energy used by a compressor becomes available to do work at the point of use and 40% of this is wasted through system leaks.
- A 3 mm hole in a 7-bar compressed air line costs about £1000 per year to feed. That hissing noise is costing real money. Reduce system leakage by up to 30% by simple management measures. Contact Action Energy (0800 585 794) for free advice on how to reduce these costs.
- Energy consumption varies as the square of pressure so increasing the supply pressure from 2 to 4 Bar requires four times as much energy.

Administration

- Reduce order process time by simplifying or using computer systems

- Use performance measurement recording for administration processes as well as for production.
- Look a Business Process Re-engineering (BPR) for all the business activities.

Waste

- Reduce materials and methods waste in every area.
- Carry out a waste survey/audit. Contact Envirowise (0800 585 794) for free advice on how to reduce waste.

Overheads

- Overheads are part of each manager's responsibility. Provide the manager with the incentive and the information to reduce the costs.
- Hold managers responsible for, and evaluate them on, the costs that are under their control. This includes overheads!

7. Accounting

- Materials represent between 45 and 80% of the product cost and there is a lot more to do than simply report the variances.
- Use accounts to provide real numbers, not simply those needed for the tax or VAT return.
- Produce detailed breakdowns of the product cost components. Identify the real cost of every finish, operation and special feature. Go for the big costs first.
- Justify every cost component or eliminate it!

8. Purchasing and suppliers

- Set up a 'Materials Team' (to include Sales, Purchasing, Production and Accounts) to ensure that all materials are used cost-effectively. A 1% reduction in purchasing spend has the same effect on profit as a 10% increase in sales volume!
- Provide the Materials Team with accounting information to allow them to do their job.
- Compare competitive products, strip them down and look for every cost saving – each one may be small but the total can be amazing.
- Set up 'measures of effective performance' for the Materials Team.
- Give purchasing the flexibility to get the best deal and get them involved with the Materials Team at the start to advise on the cost implications of every action.
- Communicate delivery & quality standards clearly to all suppliers.
- Use 'blanket' orders to reduce transaction costs.
- Use 'e-commerce' to reduce transaction costs.
- Get frequent deliveries with no inspection and buffer stocks for strategic items only.
- Check out the use of 'consignment' stock?
- Drastically reduce the number of suppliers and consider 'single sourcing'. Involve those that remain in the Materials Team.
- Jointly target cost reduction areas with the remaining suppliers. If they don't want to do this then use other suppliers.
- Develop your suppliers as part of the strategic strength.
- Get suppliers to package ready for production. Use returnable KANBAN containers and reduce packaging costs.

- Hold minimum stocks, carry out no inspection on delivery and ship direct to shop floor.
- Discuss all future requirements with suppliers at global level.

9. Sales

- Ruthlessly prune out ‘over-designed’ product features. Is the customer paying more for it or is it free? If a product feature adds cost or extra parts but justifies no extra margin then eliminate it.