Mass Customisation - A new religion for manufacturers?

A new faith?

Increasingly companies are providing more and more variety in their products and services to attract and retain customers. This trend appears to apply to all industries. Our early findings from a survey of UK manufacturing companies show that typically they have increased the product variety they provide to customers by 20% over the past five years. How are they doing this and is it cost effective? In many cases companies are *pushing* an increased variety of products into the market to increase customer choice and grow their market share. This is *high variety manufacturing* and has been practised for a number of years, notably by Japanese consumer electronic companies and companies like SMH, the company who produces the Swatch watch. However an increasing number of companies are adopting another approach. They are increasing their ability to provide customised products quickly and cost effectively, responding to customers *pulling* their requirements. These companies are practising *Mass Customisation* (Figure 1). Mass Customisation can be defined as the provision of customised products and services using stable business processes, at a cost and fulfilment time similar to standard, or mass produced, products. Providing customisation itself is nothing new, many specialist companies have been doing it for years. Craft producers are experts at meeting customer demands *exactly.* However they do it for a price and in a timescale significantly greater than mass produced equivalents. The traditional made-to-measure Savile Row suit embodying quality and individuality in a high cost package is a good example. What a Mass Customiser does is to provide this customisation on a *mass* basis, but doing so in a way that enables costs and timescales to be on a par with mass production - giving customers Savile Row individuality and quality but at off-the-peg price and availability.

Belief in the possibility

Although the term 'Mass Customisation' was only coined in 1987 (by Stan Davis more as a provocation than as an observation), it reflected a trend which had already begun, albeit slowly. The possibility of Mass Customisation becoming a reality has been created by the convergence of three main industry drives:

Business process focus

Information technology

Customer focus

In conventional Mass Production, low costs are achieved primarily through economies of scale, resulting in little variety, as typified by Henry Ford's original view on customer choice: 'Any colour as long as it's black'. In contrast Mass Customisation achieves low cost primarily through economies of scope, i.e. the application of a single process to produce a greater variety of products or services more cheaply and more quickly. Therefore Mass Customisation creates variety and customisation through flexibility and quick responsiveness. The use of programmes such as JIT, TQM and BPR in the 1980s and 1990s has made companies focus both on their business processes and their customers. The optimisation of business processes to make them run faster, at lower cost and with higher quality output, has also allowed them to become more flexible. The focus on customers brought about particularly by TQM and BPR, has improved the understanding of customer wants and needs in both the product design and order fulfilment processes. Continual feedback is sought through customer satisfaction surveys. It is sobering to think that whilst this customer focus seems implicit today, in the early nineteen eighties in the West, it was rare. The firm bedrock created by process optimisation and customer focus is a strong foundation for the effective deployment of information technology. One of the reasons that the CIM (Computer Integrated Manufacturing) drive of the mid 1980s foundered was that this bedrock was not in place and so companies attempted to computerise poor business processes and then wondered at the disappointing benefits they gained.

The first apostles

During the mid to late 1980s a number of pioneering companies seized the opportunities provided by the convergence of processes, technology and customer focus to implement new business strategies which we can

see today were the earliest examples of Mass Customisation.

In the mid 1980's, Motorola responded to the entry into their market of significantly cheaper pager products from Japanese companies by transforming both the design and the manufacture of its pagers. They had previously assembled products in Puerto Rico and the Pacific Rim but, although manufacturing costs were reduced, the process could not respond quickly enough to customer requirements. The result of their transformation was that by 1987 they were manufacturing new pagers, redesigned with a much lower parts count, on a highly automated production line, producing in batches as small as 1. Reconfigurable work flow paths were made possible by a computer control system that tracked the available capacity of the entire manufacturing plant. Retailers used laptop computers to help customers specify their pager and then transmitted the order direct to the factory. Unique bills of materials were generated and the order sent to the factory floor for fabrication. The result was a pager with over 29 million variations, sold at a highly competitive price.

In a small factory in Kokubu, Japan, National Bicycle Industrial Co. (Panasonic) produces around 50-60 personalised bicycles a day through a flexible manufacturing system which combines JIT, robots, CAD/CAM and the skills of craftsmen. In an appointed showroom the customer is measured, their preferences recorded, and the order is faxed to the factory - with all the paint finishes, frame sizes and component choices, there are over 11 million possible combinations. Using a mix of automation and manual assembly, the bicycle is manufactured in around five working days. In the market place these bicycles retail at prices between that of a mass produced machine and a hand-built product. The system caused a sensation when it was launched in 1987, and rival firms felt virtually obliged to follow suit. As a small part of a larger organisation which sells 700,000 bicycles a year, overall volumes have been increased through the enhanced perception of the customised products and Panasonic have clearly distinguished themselves from the competition, with the added cost benefits of only making to order in the Kokubu factory. Interestingly Panasonic feel the need to mention in their marketing literature that a craftsman is still required: *"Our custom order bicycles are not completely computer-made. Detailed checks of the bicycle and its painting are carefully performed by veteran craftsmen."* This may be required to help address a Japanese consumer perception that craftsman-built is better than machine-built.

Searching for UK disciples

Are we seeing examples of Mass Customisation in the UK? Yes, we believe so. IBM is engaged in a study of Mass Customisation activity in UK manufacturing to better understand the main challenges involved. There are two good examples of UK manufacturing operations that have adopted this approach: One example is Raleigh Industries, whose Special Products Division is providing high-end mountain bikes in their Dyna-Tech range customised to buyers requirements. They are using cellular assembly approaches to create a customised order made up by the customer using a menu attached to the Dyna-Tech brochure. Over 15,000 combinations are provided. This service was launched at the beginning of 1995 and was a successful response to competition from cheaper imports by service differentiation. Another example is close to home. The IBM manufacturing plant at Greenock in Scotland. This plant manufactures Personal Computers for Europe, Middle East and Africa and uses a build to order approach. Customisation is offered on all its PCs with order placement and tracking enabled by an electronic system linked to dealers and based on Lotus Notes. Orders can be fulfilled to any address within Europe within 10 days. This new system was piloted late in 1992 and quickly rolled out, yielding major inventory savings in a market where product lifecycles are commonly less than six months. This replaced a traditional 'high variety push' approach which had led to high inventories. Both Raleigh and IBM primarily use 'combinatorial assembly' to provide customisation and thus are heavily dependent on supply chains which are international (i.e. Shimano bike components from Japan and computer chipsets from the USA) and thus create significant challenges in forecasting and parts supply. These are but two examples of a number of UK companies embracing customisation as a weapon in competitiveness.

A broad church

There are a number of ways of providing a customers with high choice on a mass basis as shown in Figure 2. The most competitive (and most challenging) for a manufacturing company is to be capable of providing 'Core Mass Customisation', as it will have both the direct understanding of its customers and their requirements and the ability to fulfil them. In providing mass customisation, there are many shades of customisation 'ability'. Two parameters are very relevant here. Both relate to the variation which can be offered to the customer The

nature and degree of variation. Firstly, what is the nature of the variation offered? The easiest to provide will be a cosmetic one, offering a number of colours, a different surface finish or material. This is fairly standard in many industries, including the automotive. The next rung up the ladder is the offering of functional options, which can be specified by the customer, again this is common across industry. At the top is customisation of the core of the product, where the customer can modify these core elements - Panasonic Bicycle is a good example of this where the bicycle frame is robotically cut and welded in the factory to the customer's size. Core customisation on a mass basis is much less common in industry. Turning to the degree of variation offered, are we talking about a few tens or hundreds of variations or a few million? The absolute number is not the issue here, what is the issue for a company truly looking to become a mass customiser is how do we bring our capabilities in line with what customers want? If they want tailor-made colours, how can we paint cars like that using our normal paint-processes and not by making them a 'special'. If they want a motor specified with their keyway, their mounting holes and in a different colour and labelling, how can we do that in the same time as standard motors? These are questions for those companies who believe in the faith of mass customisation. So how do we judge whether a company is a mass customiser or not? I am often asked this question of a particular company that is attempting to provide customisation. The answer I often give is 'To a degree'. Looking at the world in black and white is all very well if you want to simplify things, but it's not particularly useful. The same goes for trying to identify companies as Mass Customisers or not. I prefer to view Mass Customisation as a broad church, with followers sharing one faith but with varying degrees of adherence. Of course the journey to total mass customisation never ends, for how can it? The nature of customer demand is forever changing and mass customisers have to grow and adapt their capabilities to ensure that they are meeting this demand. To help companies determine how far along this endless journey to mass customisation they are, a basic signpost is shown in Figure 3.

Fundamental doctrines

So how does a manufacturing company move towards Mass Customisation? It does so by focusing on the three elements I mentioned at the beginning of this article, namely: Focusing on the customer, improving business processes and utilising information technology. Companies must understand who their customers are and what they want. (This is much more difficult than it sounds). They must then align their business processes to their customers' needs, from designing their products to fulfilling orders. They must make these processes faster, cheaper and high quality. They must make their products and processes flexible and modular, so that customers needs can be met by selecting and operating individual pieces of each product and process module as required. This is major work requiring the creation of a culture and organisation of teamworking and the use of information technology to integrate business processes to provide speed and flexibility. Encompassing order taking and configuration; modular design with three dimensional computer aided design and product data management; dynamic scheduling and order tracking of automated and manual production modules; with powerful use of customer database 'warehouses' to maximise understanding of customers wants and opportunities. Companies that have completed much of this work through the use of programmes such as TQM, JIT, World Class, Lean Production and BPR will be well placed to embrace Mass Customisation. For those that haven't, Mass Customisation will remain as an unachievable theory.

Manufacturing challenges to the faith

One of the major issues that face manufacturing companies attempting to move to Mass Customisation is the method by which they will design and manufacture customisable products. There are three approaches which can be taken:

Combinatorial Assembly

In-house processing

Information Content customisation

Assembling different combinations of parts and components to meet a customer-specified product is a common method of providing customisation. However as the level of customisation is increased, the management of the parts supply chain to provide this increased variety and order unpredictability becomes a major challenge. I call this problem the *supply chain explosion*. Customer orders need to be met 'instantly', yet the variety mix cannot easily be forecast, so suppliers need to be capable of responding 'instantly' to demand

for their parts (i.e. they need to become mass customised), for manufacturers cannot economically hold stock of all the parts they might require. The supply chain becomes a major inhibitor. The solution to this is to *implode* the supply chain by shortening it and reducing the number of suppliers involved. Both the IBM Greenock and Raleigh Industries use combinatorial assembly as a key part of their customisation and face this challenge.

In-house processing is based on the use of machining, cutting, painting etc. to convert common materials to customer specifications. This approach is much more amenable to mass customisation, lending itself to the use of data-driven technology such as CIM for program download to automated equipment. A good example of this method is a US company called Ross Operating Valve who produce specialist valves for industry. Using specialist personnel to design the product with customers and then exploiting their CAD/CAM and automated machine tool capabilities, one-of-a-kind valves can be produced in as little as 72 hours, which is one hundredth of the time of traditional competitors and at one tenth the cost. Panasonic Bicycle also use this approach in the CNC cutting of its bicycle frames to size.

Information content customisation is potentially the most ideal approach to mass customisation as material management issues become minor. The software content of the product becomes the customisable element and can be customised and downloaded into a common hardware platform. This is increasingly becoming applicable for many products such as Personal Computers, Mobile Phones, Pagers and Home Entertainment Systems.

A final judgement

So, to return to my first question: How are companies providing increased variety and is it cost effective? Some companies are simply pushing higher variety into the market. If their product design is modular and if they read the market well (so they don't get left with unsold inventories), that approach may be cost effective - we will better understand this when we complete our survey. But other companies are using the emerging concept of mass customisation to provide tailored products to meet individual customer demand. The indications from the companies that have adopted this approach is that it can indeed be cost effective as premium pricing can be charged if competitors cannot yet provide this service and this can be a powerful way for companies to differentiate themselves. But is it cheaper than mass production? Theory says it should be possible, we need more case studies before this can be validated. But of course this may not be the most important question to ask. For if you can make a better mousetrap - and what could be better than one tailored for the mice in *my* house - the world will beat a path to your door, and they'll probably pay a bit extra for it too.

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