

REVIEWS

Review:**Mass Customisation: The New Frontier in Business Competition**

by *B. Joseph Pine II*, 1993 (Boston, Harvard Business School Press)
US\$29.95, hardback, pp. xxi + 333.

1. Introduction

How should the success of manufacturing and service operations be measured? The criterion presumed to be paramount for many of the last one hundred years indicates that winners are low cost producers. In the recently released book *Mass Customisation: The New Frontier in Business Competition*, author Joseph Pine explains that the “American System” of mass production that superseded the craft mentality of European production was successful because of the innovative management ideas that were applied to producing standard products with a high degree of conformance to specifications. Rather than emphasising the technical achievements that were necessary to make mass production a reality, Pine argues that the conceptual foundations of the system of mass production, conceived by Henry Ford and his contemporaries and continually improved in the years that followed by managers and workers alike, formed the basis for the economic success of America. The markets that supported this model of production were large and homogeneous; they demanded standard products that could be delivered at low cost. That the Ford Model “T” was always black was less important to buyers than the success with which mass production techniques systematically reduced the unit price of these automobiles during a time when the relative wealth of individuals was rising.

2. Foundations of Mass Production

Many of the ideas that form the basis of manufacturing strategy in America developed within the context of this industrial renaissance. Abernathy and Utterback (1978) outlined a model of innovation in products and processes. Their model predicted a high degree of product design innovation in the earliest stages of new product introduction. It was during this period that the firm tweaked the features of the product to meet the preferences of a test market. Manufacturing used general purpose equipment, at a relatively high cost per unit, to produce the small volumes required during this introduction phase. As the life cycle of the product advanced, product innovation declined dramatically, and the focus of innovation was in the production process that was now engineered with special-purpose machines and methods to produce countless identical units at a very low unit cost. After the process stabilised, innovation in product and process was predicted to be very low, with improved efficiency and resulting lower unit cost the sole incentive for innovation. Successful and profitable products had long life

cycles that justified the development of machine tools and mechanised facilities dedicated to producing them.

This “efficiency” orientation was the basis for the development of the Product-Process Matrix, another key concept of manufacturing strategy.¹ The basis of this model is that failure to match the mix of products produced in a facility with the production technology results in very high opportunity costs. For example, highly mechanised continuous process facilities are most appropriate when a single product line is produced, such as sugar refining or petrochemical processing. At the opposite corner of the matrix, general purpose equipment is prescribed for job shops where a virtually infinite variety of products are possible, with small production lots to meet the custom specifications of the each order. Long runs of identical products were efficient and desirable, where material flowed at a constant rate. So desirable was this standardised production that designers of service delivery systems were urged to adopt a “production-line approach” to service, much as McDonald’s did in its early years (Levitt 1972). The logic of mass production, with its low cost strategy for profitability, could be applied to the developing service economy, where the customer sought standard services at low prices. Economies of scale formed the basis for competitive success.

It was generally assumed that the way to win orders in the marketplace was to produce products at low cost—products that met the requirements of large markets and that could be mass-produced by lean and efficient production technologies. The consequences of the mass-production approach are now legendary. To continue to succeed employing this strategy, lower and lower costs must be pursued constantly and the life cycle of products must be extended. This logic leads to a penchant for efficiency in domestic manufacturing plants and a push toward producing offshore in low wage locations. Rather than constantly refining the product to the changing tastes of market niches, mass-production prescribes the reduction of variety and resists customisation.

The author of *Mass Customisation* would concede that the mass production strategy remains appropriate for some segments of manufacturing and service industries. There are some segments of these industries where stable production systems are required to produce standard products in high volume and at low unit cost. In these industries, cost is the criterion upon which the firm “wins” an order from a customer; attempts to innovate are not rewarded.² But what occurs as customers become less and less homogenous? From Pine’s perspective in America, the marketplace is becoming more culturally diverse. The baby-boom is

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1. The product-process matrix is developed in two articles by Robert H. Hayes and Steven C. Wheelwright (1979a, 1979b).
 2. The term “order-winning criteria” is attributed to Terry Hill (1988). Hill argues that manufacturing can be measured on several criteria by customers. While “qualifiers” are criteria that enable a product to be included on a list of candidates for consideration, it is the “order-winning criterion” that the customer employs to choose from among the qualified products.

ageing and wealth distribution is increasingly uneven. Add to this image the globalisation of business, with most firms facing customers and competitors world-wide. The prospect of stable demand for standardised products begins to wane, as does the basis for mass production.

3. Mass Customisation: Origin of the Idea

The term “mass customisation” was first popularised in *Future Perfect* by Boston University Research Professor Stanley M. Davis (1987). Formerly on the faculty of the Harvard Business School and Columbia University, Davis is affiliated with the Human Resource Policy Institute at Boston University and has interests in futures research and environmental scanning. *Future Perfect* speculates on the future of business organisation, where customers’ needs must be met at any time, in any place, with a maximum value (defined by Davis as the ratio of information to mass). From these requirements he developed a description of the response: mass customising products and services to meet the customer’s time, place and information utility. Joseph Pine read Davis’ book while he was working in product development and strategic management for IBM Application Business Systems Division in Rochester, Minnesota.³ Awarded the opportunity to pursue a Master’s degree in technology management at the MIT Sloan School, he continued to refine the concept of mass customisation and its application within IBM and other industries. A generous man, Pine extends thanks liberally to his colleagues at IBM and MIT, and especially to Davis.

Many readers of *Mass Customisation* will find it more easily approachable than is Davis’ *Future Perfect*. Davis is a very broad thinker and effectively challenges some concepts that have grown to be widely accepted. In his Foreword to Pine’s book, Davis restates two of these assumptions which he believes to be critical to the mass customising paradigm. The first is the “parts-wholes” concept: Davis challenges the notion that the whole is less, more, or equal to the sum of its parts. Instead, he employs by analogy the DNA molecule that effectively holds the developmental instructions for each organism within each cell that comprises the organism. He states that the whole organisation of business resides within every employee and within each unit of production. Just as mass customisation must not be seen as an oxymoron, so must the whole and its parts be viewed holistically. The second concept Davis challenges is the “either-or” dichotomy. As an illustration, he describes how physicists concede that light behaves as both a wave and a particle, without attempting to resolve the dilemma. In similar fashion, Davis exhorts us not to think of cost *versus* quality or strategy *versus* operations,

3. Pine’s ideas regarding mass customisation were incorporated into the product design of IBM’s AS/400 mid-range computer. A discussion of the development of this machine in response to a segmented market can be found in Bauer, Collar and Tang (1992).

but to accept these contradictions without attempting to resolve them. From this perspective, providing customised products for small markets using the scale of mass production doesn't seem so dubious.

While these ideas are intriguing and attractive, and are convincingly applied to the idea of mass customisation, each should be scrutinised. Davis does have a tendency to use sleight of hand to brush through some ideas that he clearly believes to be true, but which have none the less escaped verification. For example, in both *Future Perfect* and the Foreword to *Mass Customisation* he states that "technologies are applied to create products and services for business, which then ultimately define our models of organisation". This is a bold statement considering that years of organisational research has not been able to conclusively establish the linkage between technology and organisational form.

4. Small Markets; Demanding Customers

Pine begins *Mass Customisation* with a chronicle of the success of the American system of mass production and the advances made in Japan, where a potential market, half the size of the American one, required the development of lean production systems that engaged fewer assets in work-in-process inventory and could produce smaller lots more efficiently. Japanese firms were first successful in domestic markets, and later sought to compete in global markets, armed with a system of production that was more efficient than the American one. The logic of the Japanese system was still, however, consistent with mass production: compete by high conformance, low cost standard products with long product life cycles.

The markets of the nineties are more fragmented, sophisticated and demanding. The low cost criterion, coupled with increasing conformance to quality specifications, is no longer sufficient for manufacturing success. Besides the competitive criterion of speed, production systems must support the proliferation of customised products (Schmenner 1988). The intelligent use of advanced manufacturing and information technology is the method by which the economics of the product-process matrix can be unravelled. Goldhar and Jelinek (1983) were among the first to articulate the strategic impact of flexible manufacturing systems. With the development of information-driven computer-controlled machines in highly automated environments, a wide variety of product options could be efficiently produced. At the Allen-Bradley electrical contactor facility in Milwaukee, Wisconsin, this vision was realised, with hundreds of varieties of contactors produced to customer order and shipped within 24 hours of order receipt. Goldhar and Jelinek (1983) described the competitive basis for this type of manufacturing as *economies of scope*, as opposed to the economies of scale that were the basis of mass production.

Competing on economies of scope implies a shortened life cycle for products and requires that organisations develop the ability to shorten the lead time required to introduce new products. Increased customisation will be required to satisfy individual customers and small market segments. Markets will be simultaneously fragmented and globalised and will require networked organisations and

sophisticated use of information technology. Business processes, not just manufacturing processes, will be re-engineered to meet the requirements of this new competitive environment.

Mass Customisation includes many examples where this market transformation has already occurred and documents successful responses by some firms. For example, between 1982 and 1990 the number of distinct models of automobile available in America from North American, Japanese and West European producers increased from 151 to 205. Within these models is an increasing number of customer-prescribed options. The entire process, from order entry in the showroom (or from your lounge room!) to delivery, including production, is heading toward mass customisation. Systems of flexible data processing and manufacturing are required to permit economic production and service within this industry while maintaining lean inventories and meeting the customer's requirement for quick response.

A more salient example of mass customisation that is common experience is in telecommunications. This technology continues to rely on an infrastructure that is able to efficiently deliver telephone services, but is now linked to messaging services and mobile networks, and includes call waiting, call forwarding, caller identification options, and even more service options that will be available within the next several years. Each customer is able to design an appropriate telephone service to meet his or her requirements. The technology that delivers this service must also change rapidly, with short product development cycles and a nose for new technologies that can be exploited to this purpose.

5. Developing a Strategy for Mass Customisation

Pine devotes two chapters to building his case for the transformation from a mass production to a mass customisation environment. The production function must shift from operational efficiency, which yields lower unit cost, to process efficiency, which ensures customer satisfaction. Continual incremental improvements by R & D replace the "breakthrough" mentality that expected to lead to products with long, stable demand patterns. Marketing success is measured by meeting customer needs rather than volume sales of standardised products. Accounting is charged primarily with providing information for decisions by managers rather than generating reports for external use. High or increasing market turbulence is the leading indicator managers must sense to signal the change to mass customisation, particularly in information services (Maital 1991). There are several approaches, according to Pine.

The first strategy for achieving through mass customisation is to move incrementally in a market that, at least currently, appears to be stable. Among the examples cited is the ever-present Toyota. The flexibility and responsiveness that were necessary business practices in the smaller Japanese domestic market provided a basis for Toyota to develop systems of production that were consistent with mass customisation. Having done so, they were then able to incite market turbulence for mass producers in Detroit by offering a range of product variety that

was very difficult to match using mass production systems. In the process, they developed the ability to bring new features and incremental improvements into automotive design in response to customer input. This could be accomplished quickly and without looking for “breakthrough” changes. Bally Engineered Structures, producers of walk-in cold rooms and related structures, used the incremental approach as well, but began by changing business processes rather than the manufacturing process. The firm had a modern production process in place that was unable to produce even standard products in a reasonable lead time. The Managing Director chose to leave production untouched and instead launched a program of incremental improvement in the management processes that were impeding success in mass production. When the organisational structure and systems were re-engineered, Bally invested in information technologies and some new production equipment to permit the production of customised products quickly. The functional “silos” that prevented marketing, production, and accounting, among others, from communicating in the past had been re-engineered to focus on the process of meeting customer requirements.

The second strategy is to transform the business—appropriate when the marketplace has already made mass production logic obsolete. Since many organisations appear incapable of fundamental change without the presence of a crisis, there are many examples that fit this strategy, including the Electronic Pager Division of Motorola. Faced with stifling price competition by Japanese firms, Motorola assembled a cross-functional team to develop an automated, computer-integrated line that could make customised pagers in lots as small as one. The team used every state-of-the art idea it could find to install the most effective production and business processes, backed by appropriate information technology. The new product and process could be produced in 29 million component variations, with an order entry to shipping lead time of less than two hours. Motorola didn’t have time to move incrementally.

The third strategy is to create a new business that has been designed specifically to provide variety at mass produced prices. Azimuth Corporation of St. Paul, Minnesota, developed a business that exploited the characteristics of a new type of film developed by 3M Corporation. They determined that the film could be used to produce signs, posters and banners of excellent quality in batches as small as one. Focusing on the small business market, they produce signs of a quality and price that was formerly possible only in very large batches. Azimuth’s lead times are quick and they have expanded the business through the use of laser printers and unique materials to serve their customers with stationery, business forms, nameplates, and other customised products.

6. The Value Chain: Identifying Opportunities for Mass Customisation

A simplified value chain of four stages is used to assist in classifying the approaches a firm might take to actually achieve mass customisation. The stages are Development, Production, Marketing and Delivery. A firm can meet customer requirements for variety by producing standardised products, but

customising the services that accompany them. While an airline seat is a standard product, Northwest Airlines plans to provide premium class customers with an interactive console that will provide a portfolio of news services, films, sports events, and shopping.

Rather than customising in the delivery function, you can focus on Development and Marketing to create new customisable products and services. Reebok's Pump is an obvious example. Another is office furniture that can be adjusted by individual users so easily that it can be adapted to meet changing requirements at various times of the day.

With point of delivery customisation, a portion of the production process is transferred to the delivery phase of the value chain. Traditionally, eyeglasses were produced in centralised factories where the orders from hundreds of optometrists were batched and then produced in large lots. New technologies permit firms to adjust standard lenses to custom specifications at the optometrist's shop in less than one hour.

Quick response through the whole value chain implies streamlining the entire value chain and integrating its phases with tighter linkages. Benetton is able to keep very lean stocks of knitwear by using a sophisticated information system to track sales. This data is specific to the individual retail store level and is used to direct production and distribution, avoid stockouts and discover emerging trends.

By far the richest way to achieve mass customisation is to modularise components so that end products and services can be easily produced from these parts. TWA Getaway Vacations is one example of modularity (Gillin 1990). With so many options, the primary barrier to providing customised tours was the difficulty of coördinating schedules while still managing costs. Using sophisticated information technology, TWA is now able to build vacation packages on the spot at "group tour" prices. Swatch watches use a common platform onto which a variety of components can be attached. National Bicycle Industrial of Japan builds "custom" bicycles to customer size using computer controlled fabricating equipment, adds pre-selected components, and silk-screens the customer's name on the frame, all within days of receiving a faxed order. This cut-to-fit modularity should be applicable to virtually all clothing, for example. Campbell's Soup varies recipes by region of the United States. The Farm Journal has responded to the increased specialisation in farming by producing a core publication fourteen times each year that has attachments—and advertising—that is customised in response to the size and type of farm to which it is sent.

7. Transforming the Mass Production Organisation

Having developed the case for mass customisation and uncovered a myriad of examples where it has been successfully demonstrated, the case becomes more murky. Pine develops the hypothesis that mass production relies on the occasional success of breakthrough inventions by R & D functions and that these inventions form the basis for the next generation of standardised, mass produced products. He states that "organisational forms suitable for mass production are

decidedly unsuitable for mass customisation” (Chapter 9, p.213). Organisations suited for mass production are “stilted hierarchies with deep functional separations, rigidly specialised resources (both workers and technology), and the separation of thinking and doing” (p.213). This is in contrast to the organisational form of mass customisation, which has none of these terrible features. In this argument, Pine is echoing Davis’ “whole-parts” principle. He sees within each customised unit of production or service the image of the organisation that produces and delivers it. He suggests that if the product is truly customised, then it must reflect an organisation of “flexibly specialised resources . . . and the integration of thinking and doing” (p.213). The product is now defined as the flow of ideas, processes and material that is purchased by an individual customer at some point in time. If we accept this definition of what a “product” embodies, then this definition should remain applicable to the products produced by mass production as well as mass customisation.

To formulate a response to this issue, we return to the product-process innovation model, where the product and process are developed somewhat simultaneously (Abernathy and Utterback 1978). In mass production, we are told, when the product life cycle is complete, the process is also scrapped. While Pine effectively builds the case for the learning organisation in mass customisation, the tenet that mass producing organisations do not and cannot have those features is not presented convincingly. For example, Pine himself is currently part of the IBM Advanced Business Institute in Palisades, New York, which would appear to be an R & D organisation. IBM is also cited throughout *Mass Customisation* as a firm that is converting to a mass customisation orientation. Why isn’t the development of new business processes centred in IBM’s constituent organisations rather than in an “invention” oriented facility? The three strategies outlined for achieving mass customisation do provide an escape from this dilemma. One could argue that a mass production organisation that is also a “learning” organisation, dynamically structured and combining thinking and doing, might be an “incremental mover” in disguise—a budding mass customiser.

A four cell matrix is developed, the Product-Process Change Matrix, to assist in building a theory of evolution from mass production to mass customisation (see Figure 1). The matrix proposes that firms are in one of four “states”, which are defined by the degree of product innovation demanded by the marketplace and the stability of the ideas that form the underpinnings of the production process. The mass production organisation has a stable product and a production technology that is essentially fixed. When the product life cycle expires, these organisations are briefly required to function as invention organisations and a new product with a new process is installed. Mass production organisations are described as not particularly agile at effectively managing these bursts of technological change.

Faced with shortening product life cycles, how is the mass production organisation to respond? Pine, with colleagues Boynton and Victor, indicates that moving directly from mass production to mass customisation is not possible.

Product Change	Dynamic	Mass Customisation	Invention
	Stable	Mass Production	Continuous Improvement
		Stable	Dynamic
		Process Change	

Source: Pine 1993, p.218, based upon Andrew C. Boynton and Bart Victor, 1991, Beyond flexibility: building and managing the dynamically stable organisation, *California Management Review*, 34, 1, 53–66.

Figure 1

The Product-Process Change Matrix

Rather, firms must first undergo a shift to an organisation designed for continuous process improvement, after which mass customisation can take place. To his credit, the endnotes admit that this hypothesis is the subject of current investigation. It is here that, perhaps, we expect too much from the author. The book has, until this point, been successful in illustrating the concept of mass customisation and the logic as to why it must occur in the face of increasing market turbulence. It has also presented and defended a technique for assessing “market turbulence” that is interesting in its own right. If we accept the tenets of the mass customisation idea, then transforming an organisation is the ultimate task. While these last chapters stand on ground that is far less firm than those that describe mass customisation, the author must be credited for admitting that these ideas are still under development and avoiding the temptation to stretch some anecdotal examples to the point of incredulity. Most impressively, he avoids the easy path taken by too many authors: the checklist (Get top management support! Be sure that you have a champion! . . .).

The prescription provided is consistent with the best of the Total Quality Management literature. Firms must shift their foci from products to markets, which must be targeted by creating cross-functional organisations within the firm that are charged with creating products to serve those customers. The cross-functional customer orientation forces linkages between silos that have developed

in bureaucratic organisations, referred to in *Mass Customisation* as “integrating” and “disaggregating” the value chain. Even with the mass customisation approach, shocks from new products and processes still occur that cannot be matched by a continuous improvement approach. Certainly, the mass customisation organisation is more adaptable than is the mass production system, but new dominant designs do emerge and they can reflect a reversal in the demand for customised products. For example, having spent his career with one of the largest proprietary systems developers in the world (IBM), Pine muses that programmers of the future might enforce standardisation on the industry, in the form of UNIX or something like it, rather than the unique systems that are developed on a variety of platforms today. Certainly, the market demanded a standard format for VCRs. To survive these shocks, firms may periodically foray into the pattern of invention, but the decoupling of process invention from products is retained. The organisational form that might emerge to accomplish this is network of organisations, each a source of process knowledge and experience that can be deployed to serve the market.

8. Implications for Australia

*Mass Customisation*⁴ arrives at a time when Australian managers are facing the pressures of business restructuring and new industrial relations. The size of the domestic population is often cited as an impediment to truly efficient manufacturing—consistent with the mass production logic of high volumes of standard products with constantly lower unit cost as the path to profits. As Australia looks for new markets in Asia and the Pacific, the outcome of the mass production paradigm will direct the transfer of productive capacity offshore where wage rates are lower. Pine requires that managers ask themselves if the marketplace they face is stable or increasingly turbulent and fragmented. If the latter is true, a leaner version of current organisation is not a sufficient response. Instead, Pine prescribes a shift toward continuous improvement of business processes and the development of a manufacturing system that excels at efficiently responding to small markets.

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4. Customising *Mass Customisation*: Pine laments that publishing technology does not yet permit the content and sequence of presentation of the book to be manufactured to meet the requirements of each reader. He makes an attempt in the Introduction, however, to provide alternate road maps through the chapters of the book.

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