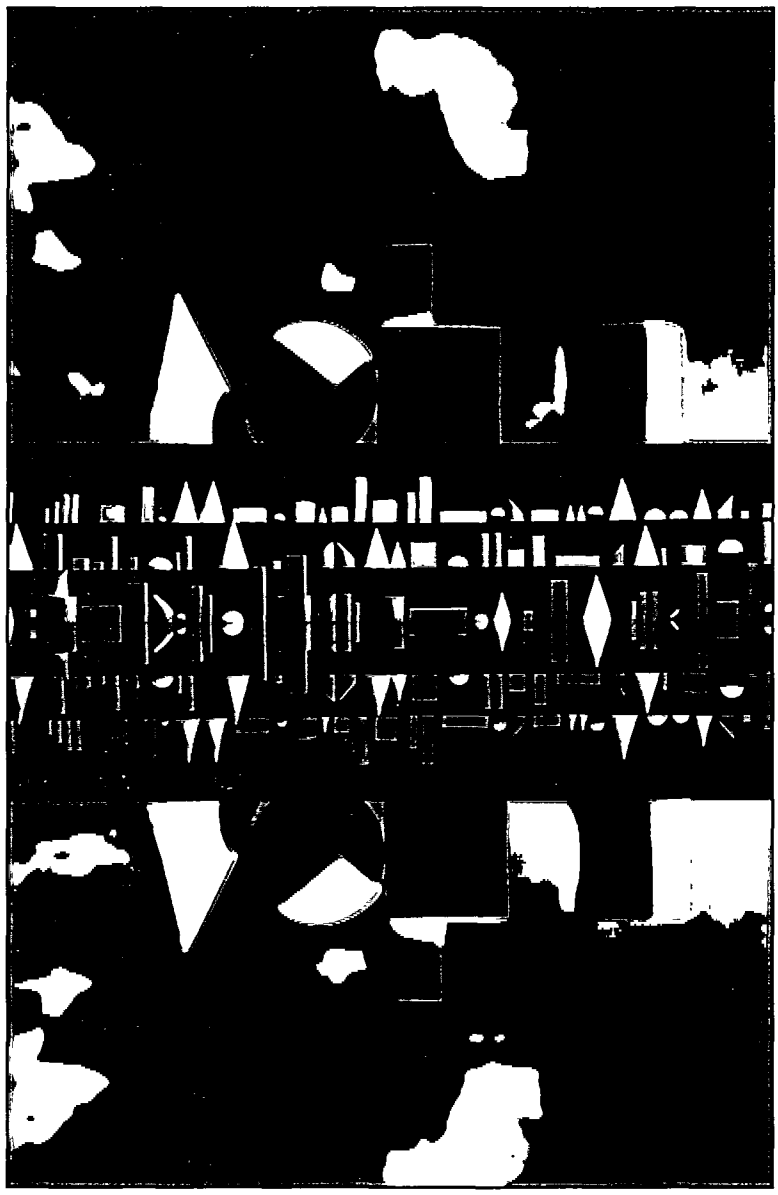
From "Future Perfect": Mass Customizing



By Stanley M. Davis

Mass customizing is more than an intriguing oxymoron. It's one of the most provocative new ideas in marketing and could instigate changes in the way companies organize and plan.

Our economy is undergoing a fundamental transformation, and it is essential to grasp the abstractions on which it is premised. . . . One basic abstraction of the new economy . . . is the simultaneous existence of mutually contradictory phenomena.

A clear drawback of the industrial-based paradigm, on which the notion of economies of scale is built, is that it requires us to operate under the constraints of an either/or bind. In this model, either goods and services are produced in small volumes, in which case they are customized but have high unit costs, or they are mass produced, in which case unit costs are brought way down but high volumes make customization impossible. In the economy of scale model, it is not possible to custom-tailor products and services and simultaneously have the voluminous, uninterrupted production runs that are necessary for low costs. You can have one or the other at the same time, but not both.

New models, therefore, have got to overcome this either/or dilemma and deal with the simultaneity of business opposites. The simultaneity condition says that we must accept the coexistence of mutually contradictory phenomena without trying to resolve the contradiction. In the either/or dichotomies of an industrial paradigm, . . . a shirt, for example, is either custom tailored or mass-produced. . . . However, new technologies will permit customized manufacture on a mass basis. Rather than being limited by the paradox, they seem to embrace and transcend it.

Let's begin with mass customizing shirt manufacture. Any shirts produced at one time and with the same specifications are parts of a single whole production run. Producing one custom-tailored shirt means the whole has only one part; the production run in a factory may mean the whole equals 5,000 identical parts. What if technology made it possible for every one of the 5,000 shirts to be customized while on the factory assembly line—that is to say, produced just as quickly as the 5,000 identical shirts, yet at no greater expense? Each shirt then is both a whole and a part of a whole at the same time.

The world of mass customizing is a world of paradox with very practical implications. Whether we are dealing with a product, a service, a market, or an organization, each is understood to be both part (customized) and whole (mass) simultaneously. New technologies are now coming on-stream that deal with infinitesimal parts of the wholes that interest us. They are able to get specific about parts that earlier technologies had to leave undifferentiated. In addition, they operate at such fast speeds that we may consider their treatment of parts simultaneous. Speed and specificity are the hallmarks of these new technologies, and the foundation for the mass customizing of products and services that follow. Speed and specificity enable us to see how the whole is actually present in each one of the parts.

For mass customizing of products, markets, and organizations to be possible, the technology must make it economically feasible in every case. One of the major propositions of this book is that the models we use for managing and organizing corporations have their antecedents in the product-market relationships that we call businesses, and that these, in turn, are premised on the new technologies. It is logical, therefore, that new technologies [for example, holography, parallel processing, customized chips, biotechnology and genetic engineering, customized catalysts, CAD/CAM, and expert systems] will display abilities that later find their way into business and organization models. . . .

[New] technologies make mass customizing a practical possibility, yet they are not sufficient by themselves. What is also needed is the perception of the mass customizing principle. In some businesses, this perception is sufficient without major new technologies. The new technologies do, however, facilitate the widespread application of mass customizing to many more products and services than might otherwise be the case. In this section we will look at mass customizing products and services, rather than at the specific enabling technologies.

Because I am 6'7" (2.02 meters), it is hard to get shirts that fit. American shirt makers give you long enough sleeves, but they fail to lengthen the body of the shirt proportionately. My solution is mass customization. Every three months a Hong Kong tailor visits the local motel in my neighborhood, and for the same price as the standardized store-bought variety, I buy made-to-measure shirts. They even have my initials on them instead of Yves St. Laurent's, at no extra cost. The waiting time is six weeks.

If you go to Hong Kong, you can have the shirts made in twenty-four hours. In Japan, 60 percent of men's suits are sold door-to-door. The salesmen, employed by department stores, carry ten sizes for fitting, and they customize by color, style, and material. To varying degrees, these are all examples of any time, any place mass customizing. But there is still a delivery delay.

Clothing manufacturers can approach mass customizing by the way they mix fabric, style, and color. One shirt maker, for example, may produce shirts in one fabric, with ten styles, and ten colors, while a second produces shirts in one fabric, one style, and one hundred colors. Both manufacturers generate one hundred stock-keeping units (SKUs); but, while the customers' perceived choice from the first company is ten, it is one hundred from the second company. When Ralph Lauren began, he offered basically one fabric (cotton interlock knit) in one style (short sleeve, one type of collar, logo) in a burst of shades. Later, scale enabled him to add a second fabric (pebble, or birdseye knit). Benetton follows the same logic.

Mass customizing does not always work, however; sometimes it runs into cultural barriers. In Italy, for example, a clothes manufacturer told his retailers that he could supply customized suits on a mass basis, by adding 10 percent to the price and a fifteen-day wait. In six months he sold only 250 suits that way, versus 200,000 the standardized way. His explanation for the failure is that Italians buy fashion and don't want to wait before they can wear their purchase. . . .

Eliminating the Wait

There is an increasing trend for manufacturers and distributors to mass customize their merchandize. As in clothing, some of the customizing has been going on for decades; what has been changed is the elimination of the wait. CAD/CAM, for example, makes possible instantaneous changes in the specifications, customized adjustments in garment cutting, without any machine downtime. The general message is, the more a company can deliver customized goods on a mass basis, relative

---

Stanley M. Davis, an author and corporate consultant, is president of Stanley M. Davis Associates of Boston. Future Perfect *has been published in 11 languages and was picked by Tom Peters as the business book of the decade.*
Future Perfect© *by Stanley M. Davis is published by Addison-Wesley, Reading, MA, 1987.*
Reprinted with permission.

to their competition, the greater is their competitive advantage. . . .

The Japanese housing industry has apparently learned the mass-customizing message much better than their U.S. counterparts. Mass-produced, factory-built houses are not highly esteemed in the U.S. The general sense of the public is that what you save on costs you lose in quality and in customization. If you are to buy a mass-produced house, your choices are limited to gross differences, such as the two- or three-bedroom model. The Japanese, however, have applied mass customizing to the housing business. Their effort began in the 1960s and has become quite sophisticated since then.

> *"The more a company can deliver customized goods on a mass basis, relative to their competition, the greater their competitive advantage...."*

The process begins by sitting down with a sales representative for a couple of hours and pretty much designing your own home on a computer screen. You choose from twenty thousand different standardized parts, like life-sized Lego blocks, and you can put those parts together pretty much as you want. Shall we add a foot to the length of the living room? No problem. A small addition to add a Jacuzzi in the left corner? Presto. You'd like the tea room on the other side of the house? Just press the button and the computer will make necessary adjustments in the plans and materials needed.

When the plans are finished, they are sent electronically to the factory, where they are cut from an assembly line almost one-third of a mile long. It will take less than one day for a crane and seven workers to get the roof and walls in place, and thirty to sixty days more for the finishing touches. In a two-story, three-bedroom house built this way just outside Tokyo, this included an electronic panel to warn you if the gas is leaking or the tub overflowing, and a dumbwaiter to pull drinks from the kitchen to the master bedroom at the touch of a button. The house also included a deck and small greenhouse. Cost: $110,000 plus the cost of the land. . . .

"Most U.S. contractors are really assemblers who build houses using ready-made materials and equipment," says Tadashi Konishi, manager of Misawa Homes's International Product Department. "The problem with being an assembler, however, is that customers have a hard time distinguishing you from the next company. The smaller builders in particular, would like to create an identity by bringing in Japanese technology and equipment." The largest prefab manufacturer in the U.S. turns out 2,000 units per year, a major Japanese manufacturer can produce 40,000 units. If the U.S. home builders don't turn to mass customizing, they may end up out of business before they ever see 2001 . . . .

Modularizing

The mass customizing of products can occur at various points along the line from design and fabrication to sale and delivery. This has been going on for quite a while, but generally without having been viewed as such. Modularization is one example. The parts are standardized, and the final product is customized at the end of the chain. This is point-of-sale customizing. The customer buys one manufacturer's turntable, another's amplifier, and speakers from a third. The final stereo system is tailored to one individual's specific needs, though the parts are not. The stereo can be placed on a modular set of furniture, and so on. You can buy a plain vanilla couch, for example, from the Swedish furniture company Ikea Svenska A. B., and then choose from a wide variety of fabrics and pillow styles. The result is a customized purchase for the cost of a mass-produced item. There is a very important lesson here, and one company captured its essence succinctly: "*Every buy is customized, every sale is standardized.*"

The core product of the industrial economy, the automobile, is treated very much this way. In the early days of the assembly line, the auto was a very standardized affair. After the introduction of the annual model change in the 1920s, product variations began to creep in more and more. To take the classic example, once different colors were available, customers began to choose the features they wanted. As the number of choices and options accelerated, fewer and fewer cars produced had identical mates. Of the first 850,000 Volkswagon Rabbits manufactured, less than 15,000 had an identical twin. All the others had some or several variations, giving them each a mass-produced uniqueness.

Although the decision to create any particular combination of characteristics lies with the manufacturer in most cases, the customer can also make the determination. In essence, customers can walk into any automobile showroom and order their own customized car that is mass produced and mass delivered. There is virtually no extra cost, and the waiting period is generally a matter of weeks, and the Japanese are working to get it down to a few days. (From the car company's perspective, the mass customizing is done by the dealers who place the order with the factory. The dealers' orders are a combination of individual customer orders and the

dealers' inventory based on local experience. The decision as to what cars to produce is therefore made at the end of the chain, in the delivery system.)

The Service Sector

Mass customizing will also be found in the service sector. . . . Rocky Aoki, founder of Benihana of Tokyo restaurants, has started a seafood chain that utilizes [a version of this] new concept. Serving an average of fifteen different fresh fish daily, customers can have their choice stir-fried (Cantonese, Szechwan, Shanghai, or Thai style), broiled (California, Japanese, or French style), steamed or poached (Chinese or Norwegian style), sauteed (Grecian, Parisienne, Florida Indian River, or Louisiana blackened style), char-grilled (Key West, Nouvelle Cuisine, or Roman style), or deep-fried (Tempura, Cajun, or Italian style).

The result, with an average inventory, an assembly-line kitchen, and an easy-to-read menu, is 285 different dinners to choose from—about one for every seat in the restaurant. . . .

Newspapers have long used zoned advertising and regional editions. . . . The technology exists for subscribers to select from a menu of syndicated columnists, cartoonists, and sections. . . .

In the new economy, information is the critical resource, and the floppy disk is the vehicle for using this resource to mass customize an endless number of products and services. The floppy itself is already a mass-produced commodity; the information any one floppy contains is what customizes it. And the customers have performed the final manufacturing and tailoring themselves. An example of mass customizing a service this way may be found in the greeting card. Here are the steps for making and sending your own greeting card, through the mail or electronically:

Equipment:
Personal Computer.
Colorgraphic Monitor.
Color Printer.
Software.
Communication Line.

Process:
Sign-on System.
Call-up Card Program.
Call-up Purpose Selection—Xmas, Birthday, etc.
Select Type—Humorous, Poetic, etc.
Select Cover—Various Forms.
Color Type.
Title—Mom, Son, etc.
Select Verse and Signature.
Transmit. . . .

Critic Ellen Goodman thinks that this mass-produced uniqueness is "the thoroughly modern illusion." Indeed, many of the applications do deal with trivia and a false sense of personalization. However, they also involve tens of millions of dollars. When Burger King advertised "Have it your way" they were trying to differentiate their commodity hamburger from the competition's by telling you that you can customize your order. There is a lesson here, however, that transcends the pickle on the bun. How do you customize a commodity? The answer is that *you standardize the commodity, and customize the services that surround it. . . .*

> *"The computerized assembly line can bring customized products within the reach of the average person."*

Alvin Toffler believes that the computerized assembly line can bring customized products within the reach of the average person; the economic fruits of democracy raised to the highest common denominator rather than to the lowest—and for houses and cars, as well as for clothing, hamburgers, and birthday cards.

If given the choice between a standardized and a customized product at the same price, which would you choose? Once again, the practical message for business is fairly apparent: Companies that can apply technology and marketing to produce mass customized goods gain an advantage over competitors that cannot. . . .

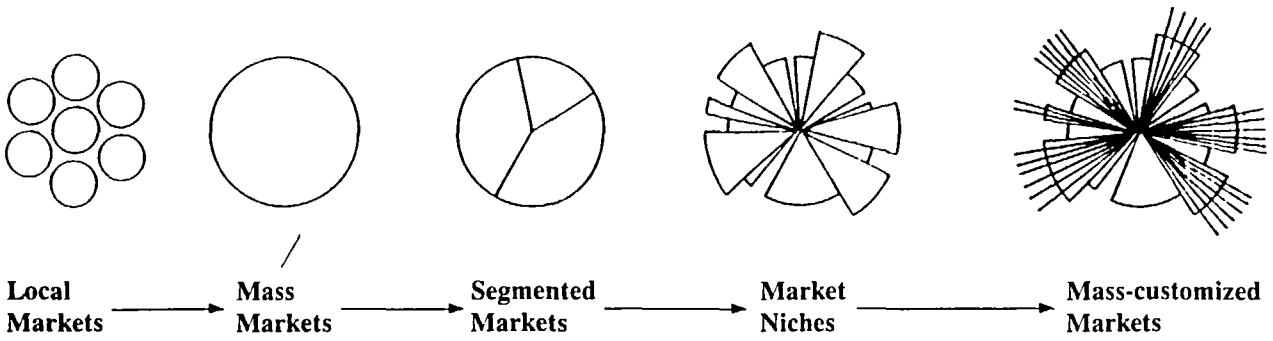
Customizing Markets

Industrial markets [evolved] from undifferentiated mass markets to increasing differentiation of the market parts. It was not until very late in the industrial economy that the marketing function formalized this differentiation into parts with the name "segmentation"—any of the parts into which something whole can be divided. . . .

The most simple of businesses today can generally identify different segments of its relevant market. Even in the most complex business corporations, however, segmentation schemes are limited. Most methods are limited to a division of the whole into only a few parts. . . .

Segmentation is not a very refined way to differentiate parts of a market. So a more refined scheme evolved, one that uses an apt term, "niches"—any of the parts into which a segment can be divided. . . .

EXHIBIT 1: Market Development



By the time markets have been segmented, and then niches have been carved out, the number of differentiated parts is considerable, and few companies will serve every niche in every segment. Although segmented and niched, however, the market has not yet quite reached its ultimate logic of internal differentiation. What is the final step, the unitary building block for the market whole in the new economy?

Units of One

It is the "individual" customer. Units of one, whether a consumer or a corporation. But these are not the single consumers and firms who were reached with customized goods and services in the limited, preindustrial markets. Rather, in the same way that segments and niches are reached on a mass basis, individuals can now be reached on a basis that is simultaneously mass and customized.

Mass customization of markets means that the same large number of customers can be reached as in the mass markets of the industrial economy, and simultaneously they can be treated individually as in the customized markets of pre-industrial economies. The progressive development of the market can be visualized in Exhibit 1, above. . . .

The ultimate logic of ever-finer differentiation of the market is markets of one; that is, meeting the tailored needs of individual customers and doing so on a mass basis. Again, computers are making this more and more of a reality. An example of this trend is found in the way that mass retailers are using transactional terminals to customize their offerings.

Customers have become used to seeing terminals in retail stores, but it is the salesperson who usually deals with them, entering and getting back information. Transactional terminals, however, conduct business directly with a customer, helping to close a sale. Merchandisers are experimenting with these machines in the mass-customized marketing of everything from paint and hair coloring to shoes, clothes, and eyeglasses.

Meeting Individual Needs

Whereas a mass-customized product is a one-of-a-kind manufacture on a large scale, the mass-customized market takes products of standardized manufacture and locates the one particular selection that is tailored to the individual's need. Each customer's individualized needs are satisfied with mass-produced goods, and the customizing occurs at instantaneous speed in the matching-up process.

Paints, for example, were rather variable in earlier times. Economies of scale called for standardized paint production in early industrial times. Henry Ford's famous remark, "You can have it in any color, as long as it's black," epitomizes this standardization. And the only reason the cars were all black, instead of pink, is because black was the fastest drying paint. When annual model changes came to the industry during the last quarter of the industrial period, customers could order a wide variety of colors.

Shortly after that, people could also buy custom-blended paint in the hardware store. This customization occurred because the final stage of customized manufacture was moved closer to the space of the customer—in the hardware store. The customer selected a color from a color sample sheet, the clerk added specified drops of different pigments to a basic stock and mixed them for a few minutes to produce the customized product. Industry leader Benjamin Moore & Co. has taken the process even further. They supply paint dealers with a computer that measures the light frequencies of a color sample and therefore allows for a mix to match perfectly. The result has been 20 percent more Moore sold in stores that have the machine.

Magic Mirror, by L. S. Ayres & Co. in the Midwest, is perhaps the most fantasy-like embodiment of mass customizing a market. Even women who love to shop

are limited in the number of clothes they can try on by the amount of time it takes to get into and out of each outfit. Speeding things up by looking at pictures or holding up a hanger doesn't do the trick. The solution is an electronic dressing room called Magic Mirror, where the customer sees a reflection of her own face, hands, and feet, and the computer creates the clothed rest of the picture, shaping the figure to conform to her own, and changing outfits as fast as the customer wants to. Final choices are generally made by . . . trying on the [selected outfits]. Ayres put the entire Liz Claiborne 1985 spring collection on the system in three stores and the brand's sales soared 700 percent in one week. . . .

What happens if you have 4,000 styles in your product line? Eyeglass retailer Cole National solves the problem by entering a customer's facial characteristics and favorite colors into its computer, thereby narrowing the choice to the few glasses a customer should try on. Cole expects to computerize some of its Eyeworks outlets in Sears and Montgomery Ward.

Compensating for Slow Growth

According to the Marketing Science Institute, because of current population trends, the real growth of retail sales is expected to be a very slow 2.3 percent through 1990. General merchandise stores (department stores and chains) are estimated to grow 2.4 percent, building materials and hardware stores 1.9 percent, specialty apparel and accessories 1.7 percent, and food, liquor, and drug outlets .8 percent. Moreover, a Touche Ross & Co. study calculates that there is 50 percent more retail selling space in the United States than is actually needed. With this combination of slow growth and overcapacity, retailers will be looking to increase their market share in order to survive. Mass customizing, along the lines described above, is likely to be a major instrument in that effort. Again, another key to the future lies in using new technologies to deliver mass-produced goods and services to individuals on a tailorized basis and mass scale simultaneously. . . . □

This article has been cited by:

1. Delisia Matthews, Lori Rothenberg, Sivasankari Gopalakrishnan. 2019. The impact of mass customization on fashion-innovative students: an assessment of need for uniqueness, self-identity, and perceived performance risk. *International Journal of Fashion Design, Technology and Education* **140**, 1-8. [Crossref]
2. Dhoha A. AlSaleh. 2019. The role of technology-based services in establishing brand equity within the private hospitals sector in Kuwait. *Journal of Transnational Management* **5**, 1-19. [Crossref]
3. Slavomir Bednar, Erwin Rauch. 2019. Modeling and application of configuration complexity scale: concept for customized production. *The International Journal of Advanced Manufacturing Technology* **100**:1-4, 485-501. [Crossref]
4. Dandan He, Zhongfu Li, Chunlin Wu, Xin Ning. 2018. An E-Commerce Platform for Industrialized Construction Procurement Based on BIM and Linked Data. *Sustainability* **10**:8, 2613. [Crossref]
5. (Jason) LiuGensheng, Gensheng (Jason) Liu, ZhangWeiyong, Weiyong Zhang, GuoChundong, Chundong Guo. 2018. Impacts of supply chain planning and integration on mass customization. *Journal of Manufacturing Technology Management* **29**:3, 608-628. [Abstract] [Full Text] [PDF]
6. Anne Margarian, Matthias Lankau. 2018. Anpassungs- und Gestaltungsfähigkeit regionaler Systeme beruflicher Weiterbildung. *Zeitschrift für Weiterbildungsforschung* **41**:1, 7-26. [Crossref]
7. Douglas Togni Custódio, Guilherme Luís Roehe Vaccaro, Fabiano Lima Nunes, Gabriel Vidor, Leonardo Dagnino Chiwiacowsky. 2018. Variant product configuration of industrial air handling units in a MTO environment. *The International Journal of Advanced Manufacturing Technology* **95**:1-4, 1025-1037. [Crossref]
8. Thierry Ellena, Helmy Mustafa, Aleksandar Subic, Toh Yen Pang. 2018. A design framework for the mass customisation of custom-fit bicycle helmet models. *International Journal of Industrial Ergonomics* **64**, 122-133. [Crossref]
9. BusseMaria, Maria Busse, SiebertRosemarie, Rosemarie Siebert. 2018. The role of consumers in food innovation processes. *European Journal of Innovation Management* **21**:1, 20-43. [Abstract] [Full Text] [PDF]
10. KalantariHassan Daronkola, Hassan Daronkola Kalantari, JohnsonLester, Lester Johnson. 2018. Australian customer willingness to pay and wait for mass-customised products. *Asia Pacific Journal of Marketing and Logistics* **30**:1, 106-120. [Abstract] [Full Text] [PDF]
11. Sandy Schuck, Peter Aubusson, Kevin Burden, Sue Brindley. Knowledge and Technology Challenging the Future 149-175. [Crossref]
12. Sunil Hwang, Eung-Kyo Suh. 2018. A Study on Supplier Involvement and Buyer Strategic Decisions. *Journal of Industrial Distribution & Business* **9**:4, 53. [Crossref]
13. Ali Raza, Lobna Haouari, Margherita Pero, Nabil Absi. Impacts of Industry 4.0 on the Specific Case of Mass Customization Through Modeling and Simulation Approach 217-234. [Crossref]
14. Songi Kim, Bongju Jeong. Mass Customization Capability Planning with Additive Manufacturing 184-192. [Crossref]
15. G. Pasetti Monizza, R. A. Rojas, E. Rauch, M. A. Ruiz Garcia, D. T. Matt. A Case Study in Learning Factories for Real-Time Reconfiguration of Assembly Systems Through Computational Design and Cyber-Physical Systems 227-237. [Crossref]
16. Hao Tieng, Chun-Fang Chen, Fan-Tien Cheng, Haw-Ching Yang. 2017. Automatic Virtual Metrology and Target Value Adjustment for Mass Customization. *IEEE Robotics and Automation Letters* **2**:2, 546-553. [Crossref]
17. Sheik Meeran, Semco Jahanbin, Paul Goodwin, Joao Quariguasi Frota Neto. 2017. When do changes in consumer preferences make forecasts from choice-based conjoint models unreliable?. *European Journal of Operational Research* **258**:2, 512-524. [Crossref]
18. Reinhold Decker, Christian Stummer. 2017. Marketing Management for Consumer Products in the Era of the Internet of Things. *Advances in Internet of Things* **07**:03, 47-70. [Crossref]
19. Gabriele Pasetti Monizza, Erwin Rauch, Dominik T. Matt. 2017. Parametric and Generative Design Techniques for Mass-Customization in Building Industry: A Case Study for Glued-Laminated Timber. *Procedia CIRP* **60**, 392-397. [Crossref]
20. Kjeld Nielsen, Thomas Ditlev Brunoe, Kim Noergaard Jensen, Ann-Louise Andersen. Utilization of Mass Customization in Construction and Building Industry 115-125. [Crossref]
21. Arun N. Nambiar. Chapter three Role of information systems in mass customization 37-54. [Crossref]
22. Dominik T. Matt, Erwin Rauch. Chapter two Designing assembly lines for mass customization production systems 15-36. [Crossref]
23. Arun N. Nambiar. Chapter twelve Sustainability issues in mass customized manufacturing 277-296. [Crossref]
24. Guoxiang Huang, Supapan Chaiprapat, Kriangkrai Waiyagan. 2016. Automated process planning and cost estimation under material quality uncertainty. *The International Journal of Advanced Manufacturing Technology* **86**:1-4, 323-335. [Crossref]
25. K Karthik, K Janardhan Reddy. 2016. Engineering Changes in Product Design - A Review. *IOP Conference Series: Materials Science and Engineering* **149**, 012001. [Crossref]

26. Fengyangzi Zhang, Guang Song. Can delivery speed affect sale in ecommerce: Evidence from household appliance 1-5. [Crossref]
27. Ruchi Mishra. 2016. A comparative evaluation of manufacturing flexibility adoption in SMEs and large firms in India. *Journal of Manufacturing Technology Management* **27**:5, 730-762. [Abstract] [Full Text] [PDF]
28. Shushu Wang, Rakshith Badarinath, El-Amine Lehtihet, Vittaldas Prabhu. Evaluation of Additive Manufacturing Processes in Fabrication of Personalized Robot 406-414. [Crossref]
29. Shabnam Rezapour, Ashkan Hassani, Reza Zanjirani Farahani. 2015. Concurrent design of product family and supply chain network considering quality and price. *Transportation Research Part E: Logistics and Transportation Review* **81**, 18-35. [Crossref]
30. Gabriel Vidor, Janine Fleith de Medeiros, Flavio Sanson Fogliatto, Mitchel M. Tseng. 2015. Critical characteristics for the implementation of mass-customized services. *European Business Review* **27**:5, 513-534. [Abstract] [Full Text] [PDF]
31. Ilona Skačkauskienė, Sigitas Davidavičius. 2015. The Features of the Concept of Mass Customization. *Verslas: Teorija ir Praktika* **16**:2, 132-139. [Crossref]
32. Rajkishore Nayak, Rajiv Padhye, Lijing Wang, Kaleshnath Chatterjee, Sheetal Gupta. 2015. The role of mass customisation in the apparel industry. *International Journal of Fashion Design, Technology and Education* **8**:2, 162-172. [Crossref]
33. Hamid Jafari, Anna Nyberg, Tone-Lise Osnes, Annika Schmitz. 2015. Customization in bicycle retailing. *Journal of Retailing and Consumer Services* **23**, 77-90. [Crossref]
34. Kasper Hallenborg. Intelligent Control of Material Handling Systems 1-43. [Crossref]
35. SeogJu chang. 2015. A Study On Customized Products and Services in Smart Environments. *Asia-Pacific Journal of Business Venturing and Entrepreneurship* **10**:1, 167-174. [Crossref]
36. Nilaish Nilaish. 2015. The Evaluation of Mass Customization's Key Benefits for Stamps. *SSRN Electronic Journal* . [Crossref]
37. Gabriel Vidor, Janine Fleith de Medeiros, Flávio Sanson Fogliatto. 2014. Definição de características críticas na implementação de serviços customizados em massa. *Production* **24**:4, 911-926. [Crossref]
38. Wei-Tsong Wang, Wen-Hung Chang. 2014. A study of virtual product consumption from the expectancy disconfirmation and symbolic consumption perspectives. *Information Systems Frontiers* **16**:5, 887-908. [Crossref]
39. Cor Verdouw, Adrie Beulens, Sjaak Wolfert. Towards Software Mass Customization for Business Collaboration 106-115. [Crossref]
40. Shin Liao, Ming-Jenn Wu, Chi-Yo Huang, Yu-Sheng Kao, Teng-Hsiang Lee. 2014. Evaluating and Enhancing Three-Dimensional Printing Service Providers for Rapid Prototyping Using the DEMATEL Based Network Process and VIKOR. *Mathematical Problems in Engineering* **2014**, 1-16. [Crossref]
41. Tong Shu, Shou Chen, Shouyang Wang, Kin Keung Lai. 2014. GBOM-oriented management of production disruption risk and optimization of supply chain construction. *Expert Systems with Applications* **41**:1, 59-68. [Crossref]
42. Scott Leavengood, Lyndall Bull. Innovation in the Global Forest Sector 377-404. [Crossref]
43. Urs Buehlmann, Al Schuler. Markets and Market Forces for Secondary Wood Products 77-98. [Crossref]
44. Afshin Mehrsai, Hamid Reza Karimi, Klaus-Dieter Thoben. 2013. Integration of supply networks for customization with modularity in cloud and make-to-upgrade strategy. *Systems Science & Control Engineering* **1**:1, 28-42. [Crossref]
45. Wei Liu, James Moultrie. Exploring innovative ways for companies to engage with customers through the internet in developing new products 136-141. [Crossref]
46. Tsai Chi Kuo. 2013. Mass customization and personalization software development: a case study eco-design product service system. *Journal of Intelligent Manufacturing* **24**:5, 1019-1031. [Crossref]
47. S. Mishra, S. Datta, S.S. Mahapatra. 2013. Grey-based and fuzzy TOPSIS decision-making approach for agility evaluation of mass customization systems. *Benchmarking: An International Journal* **20**:4, 440-462. [Abstract] [Full Text] [PDF]
48. Thomas Aichner, Paolo Coletti. 2013. Customers' online shopping preferences in mass customization. *Journal of Direct, Data and Digital Marketing Practice* **15**:1, 20-35. [Crossref]
49. Stelios Tsafarakis, Charalampos Saridakis, George Baltas, Nikolaos Matsatsinis. 2013. Hybrid particle swarm optimization with mutation for optimizing industrial product lines: An application to a mixed solution space considering both discrete and continuous design variables. *Industrial Marketing Management* **42**:4, 496-506. [Crossref]
50. Rubén De Juan-Marín, Víctor Matoses, Rubén Darío Franco. Digital Ecosystems Vision for Manufacturing Enterprise Interoperability 295-301. [Crossref]
51. Ayham A.M. Jaaron, Chris J. Backhouse. 2013. Systems Thinking for Service Delivery Design: A Real Time Mass Customisation Model. *IFAC Proceedings Volumes* **46**:9, 228-233. [Crossref]
52. Nico J. Vandaele, Catherine J. Decouttere. The Multiple Faces of Mass Customization: Product Design, Process Design and Supply Chain Design 270-277. [Crossref]
53. SungEuiCho. 2012. Factors affecting customer purchase intention on customized products or services in electronic commerce. *Journal of Korea Service Management Society* **13**:5, 151-176. [Crossref]

54. Gensheng Jason Liu, Rachna Shah, Emin Babakus. 2012. When to Mass Customize: The Impact of Environmental Uncertainty*. *Decision Sciences* **43**:5, 851-887. [Crossref]
55. Pei-Jou Kuo, David A. Cranage. 2012. Willingness to Pay for Customization: The Impact of Choice Variety and Specification Assistance. *International Journal of Hospitality & Tourism Administration* **13**:4, 313-327. [Crossref]
56. Flavio S. Fogliatto, Giovani J.C. da Silveira, Denis Borenstein. 2012. The mass customization decade: An updated review of the literature. *International Journal of Production Economics* **138**:1, 14-25. [Crossref]
57. Dejan Slobodan Aleksić, Dragan S. Janković, Leonid V. Stoimenov. 2012. A case study on the object-oriented framework for modeling product families with the dominant variation of the topology in the one-of-a-kind production. *The International Journal of Advanced Manufacturing Technology* **59**:1-4, 397-412. [Crossref]
58. Xia Wang, Zhi Min Xie, Xian Jun Guan. 2012. Partial Postponement Strategy: Application in Automobile Manufacturers. *Advanced Materials Research* **443-444**, 296-301. [Crossref]
59. P. K. Kannan, John Healey. Service Customization Research: A Review and Future Directions 297-324. [Crossref]
60. C.N. Verdouw, A.J.M. Beulens, J.H. Trienekens, T. Verwaart. 2010. Towards dynamic reference information models: Readiness for ICT mass customisation. *Computers in Industry* **61**:9, 833-844. [Crossref]
61. Der-Chiang Li, Fengming M. Chang, Sun-Cha Chang. 2010. The relationship between affecting factors and mass-customisation level: the case of a pigment company in Taiwan. *International Journal of Production Research* **48**:18, 5385-5395. [Crossref]
62. Y. Wang, J. Zheng, J. Liu, W. Wang, X. Zhang. Customized transportation service design for railway express delivery 150-154. [Crossref]
63. C. N. Verdouw, A. J.M. Beulens, J. H. Trienekens, T. Verwaart. 2010. Mastering demand and supply uncertainty with combined product and process configuration. *International Journal of Computer Integrated Manufacturing* **23**:6, 515-528. [Crossref]
64. Wen-Pai Wang. 2009. Toward developing agility evaluation of mass customization systems using 2-tuple linguistic computing. *Expert Systems with Applications* **36**:2, 3439-3447. [Crossref]
65. Y. X. Feng, B. Zheng, J. R. Tan, Z. Wei. 2009. An exploratory study of the general requirement representation model for product configuration in mass customization mode. *The International Journal of Advanced Manufacturing Technology* **40**:7-8, 785-796. [Crossref]
66. Lin Wang, Wee Keong Ng, Bing Song. Constraint Satisfaction Approach on Product Configuration with Cost Estimation 731-740. [Crossref]
67. Xu Hanchuan, Xu Xiaofei, Zhan Dechen. A Novel BOM Model Based on Product Identifier for Mass Customization 244-248. [Crossref]
68. Iris Tommelein, Glenn Ballard, Philip Kaminsky. Supply Chain Management for Lean Project Delivery 6-1-6-22. [Crossref]
69. Xiang Zhang, Rongqiu Chen, Yubo Ma. 2007. An empirical examination of response time, product variety and firm performance. *International Journal of Production Research* **45**:14, 3135-3150. [Crossref]
70. Andrew Kusiak, Mathew R. Smith, Zhe Song. 2007. Planning Product Configurations Based on Sales Data. *IEEE Transactions on Systems, Man and Cybernetics, Part C (Applications and Reviews)* **37**:4, 602-609. [Crossref]
71. Y. S. Fan, G. Q. Huang. 2007. Networked Manufacturing and Mass Customization in the ECommerce Era: the Chinese Perspective. *International Journal of Computer Integrated Manufacturing* **20**:2-3, 107-114. [Crossref]
72. Andrew Kusiak, Matthew Smith. 2007. Data mining in design of products and production systems. *Annual Reviews in Control* **31**:1, 147-156. [Crossref]
73. Melissa Petry Gerhardt, Flávio Sanson Fogliatto, Marcelo Nogueira Cortimiglia. 2007. Metodologia para o balanceamento de linhas de montagem multi-modelo em ambientes de customização em massa. *Gestão & Produção* **14**:2, 267-279. [Crossref]
74. Jue Chen, Yunhong Hao. Layout Design For Service Operation Of Mass Customization: A Case Of Chinese Restaurant 668-673. [Crossref]
75. Xiang Zhang, Rongqiu Chen. 2006. Forecast-driven or customer-order-driven? An empirical analysis of the Chinese automotive industry. *International Journal of Operations & Production Management* **26**:6, 668-688. [Abstract] [Full Text] [PDF]
76. Kaj A. Jørgensen. 2006. PRODUCT FAMILY MODELLING – ATTRIBUTES RATHER THAN MODULES. *IFAC Proceedings Volumes* **39**:3, 741-746. [Crossref]
77. Andrew Kusiak. Data mining in design of products and production systems 49-53. [Crossref]
78. Chen Jue, Hao Yun-hong. An Application of Process Layout Design Method to Service Operation of Mass Customization 1008-1013. [Crossref]
79. Kaj A. Jargensen. Product family modelling — Attributes rather than modules 697-702. [Crossref]
80. Andrew Kusiak. 2006. DATA MINING IN DESIGN OF PRODUCTS AND PRODUCTION SYSTEMS. *IFAC Proceedings Volumes* **39**:3, 49-53. [Crossref]

81. Wuyi Lu, Janet Efstathiou, Ernesto del Valle Lehne. Customer Service Level in a Lean Inventory under Mass Customization 233-250. [Crossref]
82. A. O. Aydin, A. Güngör *. 2005. Effective relational database approach to represent bills-of-materials. *International Journal of Production Research* **43**:6, 1143-1170. [Crossref]
83. A. E. Coronado, A. C. Lyons, D. F. Kehoe, J. Coleman. 2004. Enabling mass customization: extending build-to-order concepts to supply chains. *Production Planning & Control* **15**:4, 398-411. [Crossref]
84. Juan Diego Frutos, Denis Borenstein. 2003. Object-Oriented Model for Customer-Building Company Interaction in Mass Customization Environment. *Journal of Construction Engineering and Management* **129**:3, 302-313. [Crossref]
85. Giovani Da Silveira, Denis Borenstein, Flávio S Fogliatto. 2001. Mass customization: Literature review and research directions. *International Journal of Production Economics* **72**:1, 1-13. [Crossref]
86. Diana Twede, Robert H. Clarke, Jill A. Tait. 2000. Packaging postponement: a global packaging strategy. *Packaging Technology and Science* **13**:3, 105-115. [Crossref]
87. Diana Twede, Robert H. Clarke, Jill A. Tait. 2000. Packaging postponement: a global packaging strategy. *Packaging Technology and Science* **13**:3, 105-115. [Crossref]
88. Thorsten Blecker. Die Unternehmung ohne Grenzen aus der Sicht der Industrieökonomik (Market-Based View) 71-190. [Crossref]
89. Remko van Hoek. 1997. Postponed manufacturing: a case study in the food supply chain. *Supply Chain Management: An International Journal* **2**:2, 63-75. [Abstract] [Full Text] [PDF]
90. Kaj A. Jørgensen. Product Modeling on Multiple Abstraction Levels 63-84. [Crossref]