

Innovation, Sustainability and Complexity

A synopsis of the European Best Innovator Club annual meeting

The 2009 meeting of the European Best Innovator Club was held in Berlin, where winners of A.T. Kearney's annual Best Innovator competition met for two days to discuss innovation, sustainability and complexity. Participants examined how innovation is necessary to meet the sustainability challenge, how to manage complexity without stifling innovation, and how sustainability and complexity can be catalysts for innovation. This paper summarizes the insights generated by bringing together many of Europe's leading innovators.



Innovation, Sustainability and the "Triple Bottom Line"

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A.T. Kearney

Sustainability will be one of the most pressing global challenges for business and political leaders in the next 50 years. At A.T. Kearney we define sustainability as achieving the "triple bottom line" of economic success, social well-being and environmental protection. Even five years ago, the triple bottom line was viewed by most business leaders as a buzzword to be relegated to the Corporate Social Responsibility department. Today, almost every industry is dealing with the sustainability challenge at the CEO level.

Almost all industries are beginning to measure and manage their carbon footprints to meet new or soon-to-be-instituted restrictions on carbon emissions; the automotive industry faces a potential disruptive technology in

the form of electric cars; and the energy sector is grappling with both the threat and promise of renewable energy. There is a common denominator on all of these fronts: Companies are focusing on innovation to navigate a way forward, not just to meet these challenges, but also to transform the challenges into opportunities for business growth and competitive advantage.

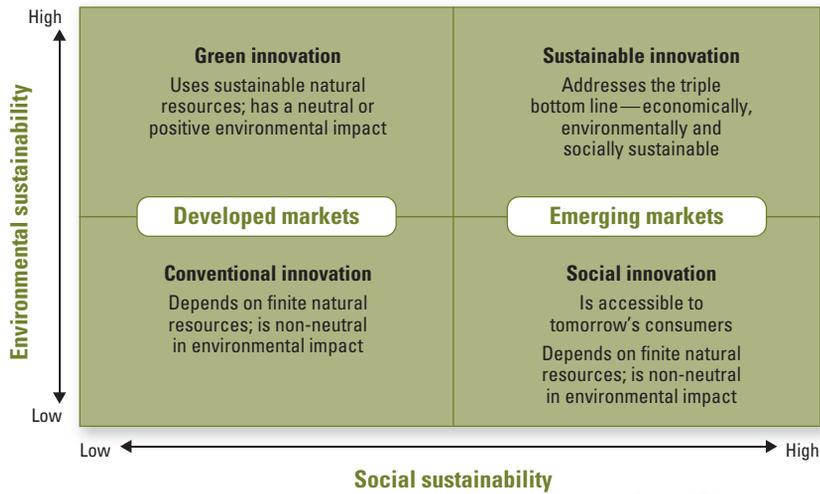
We have devised a "sustainable innovation matrix" based on the concept of the triple bottom line to help measure the sustainability of companies' innovation portfolios (see figure 1 on page 2). The basic question is: How much money should your company invest in each quadrant of the matrix? The answer can tell you whether your current innovation portfolio is more or less sustainable.

Let's look at the four quadrants:

Conventional innovation. This is innovation characterized by low environmental and social sustainability

A combined focus on innovation and complexity can maximize net profits, while a combined focus on innovation and sustainability can maximize the net impact on the company, the environment and society.

FIGURE 1: Sustainable innovation matrix



that focuses on consumers in developed markets, depends on finite natural resources, and is non-neutral in environmental impact. For example, in the automotive industry, dual-clutch transmissions are a conventional innovation that originated from the world of racecars and has improved the performance of traditional gasoline engines for well-off consumers in developed markets. While this has certainly been economically beneficial for select automobile manufacturers, it has not addressed the other two aspects of the triple bottom line: environment and society.

Green innovation. While these innovations are only accessible to consumers in developed markets, they are based on the use of sustainable natural resources and have a neutral or positive environmental impact. Tesla Motors' Roadster is a perfect example. It is an all-electric sports car produced by Tesla based in Silicon Valley, California. Since

its introduction in February 2008, Tesla has sold more than 700 electric roadsters priced at \$100,000 or more each to well-off customers in North America and Europe. It is an incredibly successful green innovation, yet its price makes it inaccessible to 99 percent of the world's population.

Social innovation. There are many potential ways to define social well-being—here we focus on whether or not the innovation is accessible to tomorrow's consumers in emerging markets. About 60 percent of the world's population earns less than \$8 per day, and this vast segment has been ignored by companies in the past. However, some companies are beginning to wake up. Procter & Gamble recently announced that it will add 1 billion new customers in the next five years by tapping customers in emerging markets; Tata is targeting lower-income consumers in India and other emerging markets with the

launch of its Nano, a car using a conventional gasoline engine that is priced at 100,000 Indian rupees, or approximately \$2,000.

Sustainable innovation. These innovations truly address the triple bottom line: They are economically, environmentally and socially sustainable. In the long term, there is no credible alternative to this type of innovation. If tomorrow's consumers in emerging markets develop the same consumption habits as today's consumers in developed markets, then we will need several more planets to provide the oil, store the waste and cope with the greenhouse gases that will be emitted.

Sustainable innovation, defined by these tough standards, is therefore the Holy Grail for policymakers and business leaders. It is the one possible chance to prevent or slow down global warming while lifting a large portion of the world's population above the poverty line. Examples of truly sustainable innovation are still few and far between—solar-powered netbooks and inexpensive mobile water purification systems are a few—yet the opportunity is vast for those companies courageous enough to invest. Indeed, the European Best Innovators that we surveyed said that more than 40 percent of their innovation budgets will be dedicated toward developing sustainable innovations within the next 10 years. This is a clear indication that leading innovators are embracing sustainability as a catalyst for change, and using innovation to help them meet the sustainability challenge.

Cradle-to-Cradle Design

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Imagine a world in which all the things we make, use and consume provide nutrition for nature and industry—a world in which growth is good and human activity generates a delightful, restorative ecological footprint.¹

While this may seem like heresy to many in the world of sustainable development, the destructive qualities of today's cradle-to-grave industrial system can be seen as the result of a fundamental design problem, not the inevitable outcome of consumption and economic activity. Indeed, good, principled design—based on the laws of nature—can transform the making and consumption of things into a regenerative force.

This new concept of design—known as cradle-to-cradle design—

goes beyond simply retrofitting industrial systems to reduce their harm. Conventional approaches to sustainability often make the efficient use of energy and materials the ultimate goal. While this is a useful transitional strategy, it tends to reduce negative impact without transforming harmful activity.

Cradle-to-cradle design, on the other hand, offers a framework in which the effective, regenerative cycles of nature provide models for wholly positive human designs. Within this framework we can create economies that purify air, land and water; that rely on solar energy and do not generate toxic waste; that use safe, healthful materials that replenish the earth or can be perpetually recycled, and that yield benefits that enhance all life.

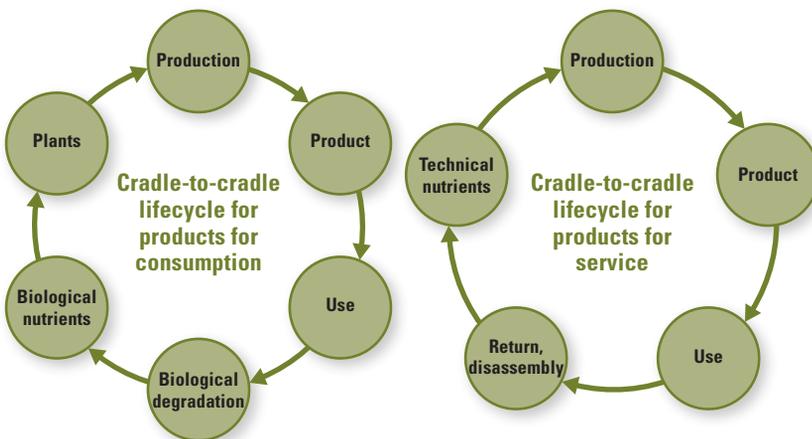
Over the past decade, the cradle-to-cradle framework has evolved steadily from theory to practice (see sidebar: *Sustainability at Trimo on page*

4). In the world of industry it is creating a new concept of materials and material flows. Just as in the natural world, in which one organism's "waste" cycles through an ecosystem to provide nourishment for other living things, cradle-to-cradle materials circulate in closed-loop cycles, providing nutrients for nature or industry. This model recognizes two areas, products for consumption and products for service (see figure 2).

Products for consumption. These include food and biodegradable products, from fibers and cosmetics to washing powders and even brake pads. These products, made of biological nutrients, are designed to support the growth of the biological systems they enter by being absorbed and processed by organisms and ecosystems. Biological resources such as plants can be renewed through agriculture, forestry or gardening, leading to future generations of products for consumption.

Products for service. These products, including electronic appliances or transportation vehicles, are chemically stable during use and get dismantled into technical nutrients after they have fulfilled their function. These nutrients are then completely recycled to make next-generation products. Tracking products and recovering their nutrients works through a service concept—the customer receives the right for a service (such as using a TV for a given time), but the materials the device is made of (the hundreds of chemicals in a TV) remain property of the producer or a recycler, or are part of a guaranteed take-back scheme.

FIGURE 2: Products for consumption and service



Source: Michael Braungart, EPEA Internationale Umweltforschung GmbH, Hamburg 2008

¹ Editor's note: Portions of this essay originally appeared in Worldwatch Institute's "State of the World 2004" report.

Cradle-to-cradle design in practice. Recovered biological and technical nutrients have already entered the marketplace. For example, the upholstery fabric Climatex Lifecycle is a blend of pesticide-residue-free wool and organically grown ramie, dyed and processed entirely with nontoxic chemicals. All of its product and process inputs are defined and selected for human and ecological safety within the biological metabolism. The result: The fabric trimmings can be made into felt and used by garden clubs as mulch for growing fruits and vegetables, returning the textile's biological nutrients to the soil.

Honeywell, meanwhile, is marketing a textile for the technical metabolism, a high-quality carpet yarn called

Zeftron Savant, which is made of perpetually recyclable nylon 6 fiber. Zeftron Savant is designed to be reclaimed and repolymerized—taken back to its constituent resins—to become new material for new carpets. In fact, Honeywell can retrieve old, conventional nylon 6 and transform it into Zeftron Savant, which is in effect “upcycling” rather than downcycling an industrial material. The nylon is rematerialized, not dematerialized—a true cradle-to-cradle product.

Transforming consumption. Cradle-to-cradle design empowers an industrial society to model its production processes on principles of nature, in which material flows are a central feature, while waste, avoidance, constriction and restriction are not. The cra-

dle-to-cradle strategy allows us to see our designs as delightful expressions of creativity, as life-support systems in harmony with energy flows, human souls and other living things. When that becomes the hallmark of productive economies, consumption will have been transformed.

Automotive Innovation: The Powertrain of the Future

STEPHAN KRUBASIK

A.T. Kearney

No other trend will reshape the automotive industry as radically as sustainable mobility and powertrain technologies. Hybrid vehicles, plug-in hybrids (electric vehicles with a combustion engine that serves as a range extender) and fully electric vehicles are about to attack the current dominance of pure combustion engines in the powertrain landscape (*see figure 3*). As with all major trends, powertrain innovation is not driven by a single aspect, but by a combination of multiple drivers of future development: customer demand, auto manufacturers' strategies, technology innovation and government regulation. The A.T. Kearney study, “Powertrain of the Future,” assesses the development of these four drivers in the next decade and examines the industry implications.²

Customer demand. From a customer's perspective, four factors are essential for choosing a powertrain: cost, functionality, comfort and image. Financially, we expect electrified power-

Sustainability at Trimo

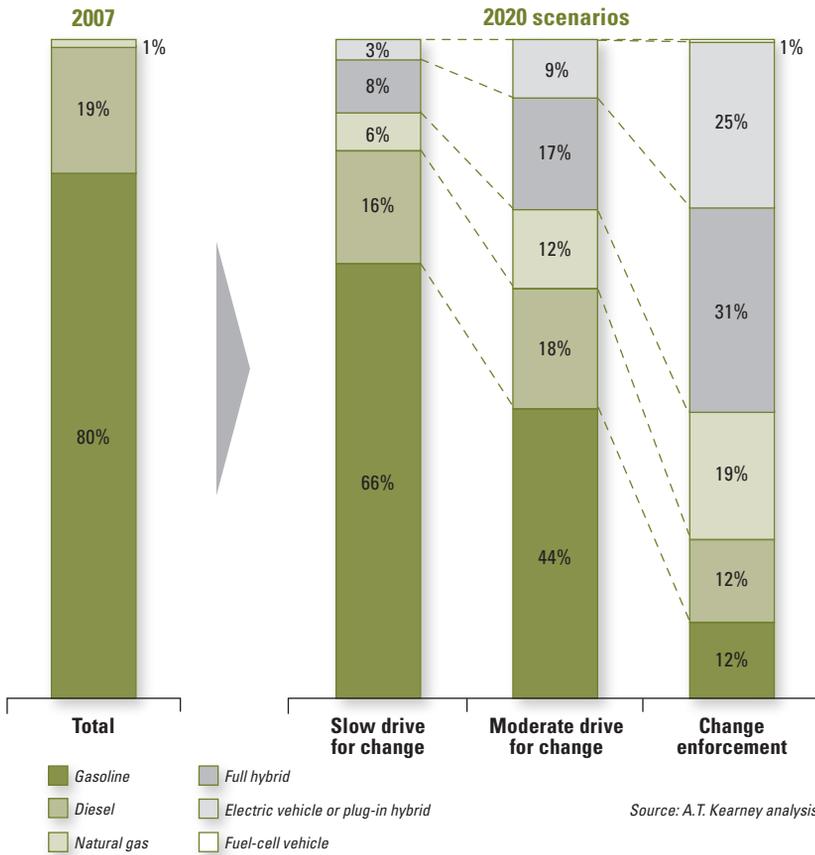
Trimo is a leading European manufacturer of prefabricated steel buildings, including the design, production and assembly of steel structures, facades and roofs. Its stated strategy is to add design, innovation and sustainability to otherwise standard products in order to create a complete solution for its customers.

Trimo defines sustainability as doing what is good for the economy, society and the environment. The company pursues economic sustainability by investing in innovation, its corporate culture and the capabilities of its people—investments which in some cases pay back only in the medium-to-long term. It pursues social sustainability by taking on projects with a positive impact on society. For example, in its Urban Crash Architecture Competition, students submit designs for an original urban installation that serves a public purpose; the winning design is built by Trimo at no cost to the public. Trimo aims for environmental sustainability by pursuing a positive environmental impact with its traditional products and developing new products that address the growing trend toward sustainability. For example, the company introduced a new roofing system that integrates solar panels directly into the roof surface, rather than mounting them separately atop the roof.

These examples demonstrate how a company can integrate sustainability into its corporate DNA, and by doing so strengthen its competitiveness.

² The study findings are available at www.atkearney.com.

FIGURE 3: The global powertrain landscape



trains to be fully competitive by 2020, as oil prices rise and battery costs fall, creating an advantage for electric vehicles of \$300 to \$600 per year. In addition, the “green” image of alternative engines will also gain in importance—environmental friendliness is already today one of the top five purchase criteria.

Auto manufacturers’ strategies. Powertrain has long been a major innovation area for the automotive industry and is a vital part of many automakers’ value propositions. Innovative combustion engines have

reduced fuel consumption significantly in the past and will improve by another 20 to 30 percent in the future. In addition, auto manufacturers have recognized the world’s sustainability push and are working toward introducing new electrified powertrains for hybrids and electric vehicles. By 2015 almost all manufacturers will have launched a broad range of hybrids and at least one electric model.

Innovation is not limited to new products: Business models related to electric vehicles, such as “pay-per-use,” will grow more prevalent. However, we

do not expect a radical shift in automakers’ portfolios: Model cycles of four-to-five years, limited developmental budgets and existing production plant structures and processes will slow down technological change.

Innovative technology. The battery is most critical for the technological development of hybrids and electric vehicles. Innovations in lithium-ion battery materials and control electronics will improve range, durability and costs tremendously toward 2020. Electric-vehicle ranges could reach more than 300 kilometers, and costs may be cut by 40 percent.

Government regulations. Governments around the world are pushing change with increasingly stringent emission limits and subsidy programs. The United States, for example, moved up its goal to develop an average 35-miles-per-gallon engine to 2016 (from 2020); China moved up its 2050 industry carbon-emissions target date to 2020. In many places, emission limits have been augmented with purchase-price subsidies for electric vehicles, ranging from about \$7,000 per car in France to more than \$14,000 per car in Japan.

The future is electric. In our baseline 2020 scenario (moderate drive for change in figure 3), we estimate a global production share of new electric and plug-in hybrid vehicles of 9 percent, and almost twice that amount for full hybrid vehicles. However, if oil prices rise significantly above \$200 per barrel and battery technology achieves a true cost breakthrough, hybrid and pure electric powertrains would power almost every newly produced vehicle.

Innovation and Complexity Management

OLIVER SCHEEL AND
JOSHUA HUBBERT

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Is increased complexity the inevitable result when companies focus on innovation? Not necessarily. By introducing systematic complexity management, companies can reduce complexity without limiting their ability to innovate. While this is not easy, success can generate significant economic benefits. A recent A.T. Kearney analysis estimates that systematic complexity management can lead to an average increase in EBIT (earnings before interest and taxes) of 3 to 5 percentage points.

The following guidelines demonstrate how to manage complexity systematically (see figure 4):

Understand the value of complexity for business success. Complexity can be either value-adding or value-destroying. Quite often, value-adding complexity is a real competitive advantage that should be actively and efficiently promoted. Value-destroying

complexity can push the customer away and send the company into chaos and confusion. Therefore, understanding the value of complexity for business success is the first step in every complexity-optimization program.

To do this, several questions must be answered: What complexity is required to serve different customer segments? Within customer segments, what value do customers place on variety? How can complexity be used to achieve competitive advantage? Finally and most important, how can customers' needs be translated into a product worth more to customers than the complexity it induces?

Create transparency into complexity drivers and costs. Many companies fail to understand the relationship between complexity and costs. The reason is that these connections often get lost in isolated, siloed departments and IT structures. It becomes nearly impossible to analyze the information flowing across the value chain.

The real cost of complexity can be determined through a pragmatic, activity-based cost calculation. This

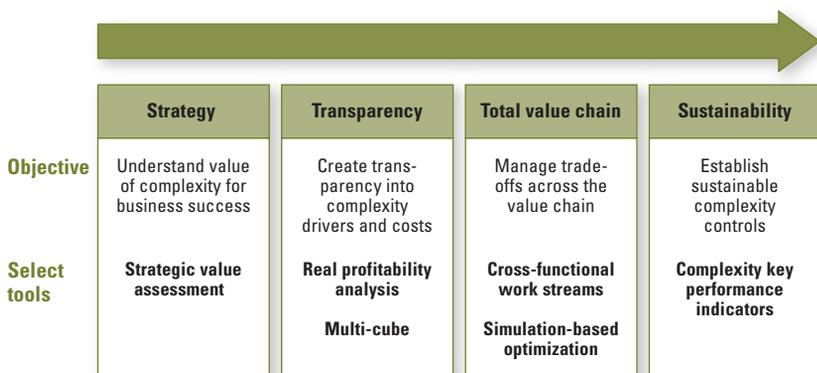
requires understanding the real contribution margin of each product—a difficult process, as product profit margins are often incorrectly assessed. For example, key costs related to the sales force or R&D may not be available by product or cluster, or the costs are allocated incorrectly.

Managing complexity and innovating are not mutually exclusive, but are both required to sustain profitable growth.

Additionally, the strategic value of all products should be assessed. Numerous factors need to be considered such as technology substitution options, customer loyalty, market size, share and growth. This analysis takes into account new products that haven't yet delivered the necessary contribution margin, aggressive pricing to increase a company's market share, and specific innovative offers used primarily for strategic positioning.

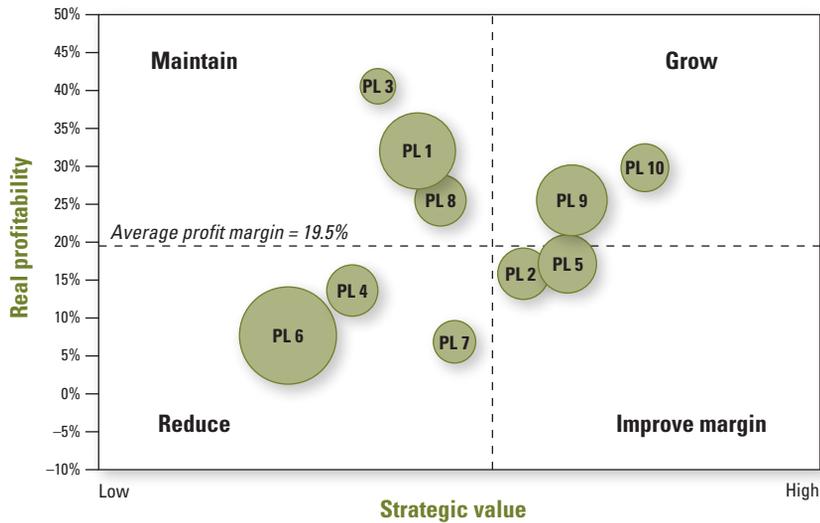
After these analyses are complete, a strategic value and real profitability matrix will help analyze the importance of all components of the portfolio—such as product groups, technologies

FIGURE 4: Manage complexity systematically



Source: A.T. Kearney analysis

FIGURE 5: Strategic value and real profitability matrix



Note: Size of bubble reflects sales
PL = product line

Source: A.T. Kearney analysis

and brands (see figure 5). The matrix pinpoints where to reduce complexity and where complexity could even be expanded.

Manage trade-offs across the value chain. Experts from across the value chain should be brought together to “simplify for value.” Joining together supply chain, production and purchasing on one hand, and R&D, marketing and sales on the other, is not a conflict-free process. Balancing various points of view and personal interests can pose a challenge. The key is for experts to consider openly and creatively how to achieve the best mix of innovation, complexity and profitability. Typical actions resulting from this process include variant elimination, selective re-pricing, increased part commonality and delayed customization.

As a first step, the strategic value and real profitability matrix illustrated in figure 5 can be used to analyze

all brands, market segments, products and stock-keeping units (SKUs). If the strategic value and profitability are too low for a product, the company can eliminate that variant and take steps to convert its customers to purchasing other, more profitable products. If, however, high strategic value is combined with an overly low real profitability, the company can increase its prices in order to induce customers to pay for the complexity. These measures address “above-the-skin” complexity, that is, complexity that is visible to customers.

Addressing “below-the-skin” complexity, such as component parts, raw materials or manufacturing processes, is just as vital. Strategies include part commonality and delayed customization—part commonality reduces supply chain costs and eliminates unnecessary R&D, while delaying customization until the end of the

value chain can minimize complexity costs while retaining product variety.

Such actions are not without risk, however. The changes need to be analyzed ahead of time, especially with regards to a “domino effect” that can occur when a change in one stage of the value chain triggers a positive or negative reaction in other areas. When trade-offs across the value chain are involved, companies must model the total value chain effect of the change.

A simulation-based optimization tool called the “multi-cube” can help model this domino effect and manage trade-offs across the value chain. The multi-cube pulls together detailed information from the respective modules of the current enterprise resource planning (ERP) system, and allows simulation of proposed changes in terms of:

Top line, portfolio mix. The effect of shifting customers to more profitable products or selective re-pricing.

Material costs. The effect of shifting to less expensive raw materials.

Operations costs. The effect of reducing variants on production lines and manufacturing facilities (such as which plants to retain or shut down).

Overhead costs. The effect on marketing, sales, R&D and other overhead costs.

Net working capital. The effect on inventory levels and warehousing capacities.

Establish sustainable complexity controls. The benefits of optimizing complexity cannot be sustained unless controls are introduced to prevent value-destroying complexity from creeping back in. Such controls typically include new key performance

indicators (KPIs), processes, and roles and responsibilities. These controls are integrated into the innovation processes for phasing in new products and the processes for phasing out products. For example, a phase-in KPI might define a threshold value of common parts; and a new product can only be introduced if it exceeds the threshold value. Similarly, a phase-out KPI might be net sales per product; the value below the minimum threshold triggers a decision in an annual review of whether or not to eliminate the product.

The bottom line: Systematic complexity management should be implemented throughout the entire innovation life cycle. Complexity management and innovation management are not mutually exclusive, but instead are complementary prerequisites for sustainable value creation (*see sidebar: Complexity Management at KSB*).

Complexity as an Innovation Driver: Harnessing Mass Customization

FRANK PILLER

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Mass producers have traditionally offered a limited number of standard products because the cost of complexity makes more tailored offerings too expensive. Of course, whenever customers are not getting exactly what they need, a business opportunity is created. Mass customization addresses this opportunity by leveraging complexity to drive rather than put the brakes on or constrain innovation.³

We define mass customization as the development, production, marketing and delivery of affordable goods and services with enough variety that nearly everyone finds exactly what they

want. But while companies such as Dell, BMW or MyMuesli appear to have cracked the code, reality has been harsh for others. Indeed, few firms are actually deploying mass customization beyond experimentation, and in many cases it has simply failed to deliver on its promises.

Consider Levi Strauss. The jeans maker was a pioneer in mass customization when it began offering tailored jeans in 1994, yet its exercise could not be scaled up to become a sustainable business unit. Tailored jeans were dropped in 2003 when the company entered a period of financial turmoil and never came back.

Despite such failures, our research found that mass customization can be broadly applied to most businesses. The key to profits is to see it not as a stand-alone business strategy that replaces today's production and distribution systems, but as a set of organizational capabilities that can supplement and enrich an existing system.

Let's first try to understand what it takes to mass customize a product. While specific answers are clearly industry or product-dependent, a decade of studying mass customization has led us to three fundamental capabilities needed for a firm to mass customize: develop a solution space, design a robust value chain and simplify product choices.

Develop a solution space. A company seeking to adopt mass customization needs to understand the idiosyncratic needs of its customers. This is in stark contrast to the approach of a mass producer that focuses on identifying "central tendencies" among its

Complexity Management at KSB

KSB is one of the world's leading suppliers of pumps and valves. In 2004, it started an initiative to manage the complexity of its business more systematically. Complexity at KSB then and now is driven by factors common to many global companies: The company has a diverse product range, and serves different customer segments in distinctly different regions. The challenge is how to maximize variability to meet customer requirements without increasing complexity.

Like many companies, KSB's first step was to reduce complexity by simplifying its product range and portfolio. It then implemented sustainable complexity controls, including its VARI.CO. database, which makes the cost of complexity more transparent. Lastly, a KSB EasySelect Configurator tool was created to enable its sales force to configure products to meet individual customer needs within a modular, predefined solution space.

KSB now plans to focus on avoiding complexity by harmonizing and standardizing processes. The results are already impressive: the company has increased overall sales, sales per employee and EBIT dramatically since the start of this program.

³ Editor's note: This article builds on the paper, "Cracking the Code of Mass Customization," by Fabrizio Salvador, Martin de Holan and Frank Piller. *MIT Sloan Management Review*, Spring 2009, p. 70-79.

customers' needs. Indeed, a mass customizer must identify the product attributes along which customer needs most diverge and then clearly define its solution space: what it is going to offer and the dimensions along which the offering can be configured to meet individual customer needs.

Design a robust value chain. It is crucial that increased variability in customers' requirements does not lead to significant deterioration in the firm's operations and supply chain. This can be achieved through a value chain design in which customized solutions can be delivered with near mass production efficiency and reliability.

A robust value chain depends on flexible automation and process modularity. Although this may sound like a contradiction in terms, automation today is no longer synonymous with rigidity. In the auto industry, for instance, robots and automation are compatible with previously unheard-of levels of versatility and customization. The BMW factory that produces the Mini enables customers to specify a variety of options unrivaled for compact cars. It does this by integrating individual mobile production cells, called MobiCells, with standardized robot units into existing facilities. In this way, current capacities can be adapted flexibly and quickly without extensive modifications to production areas.

Simplify product choices. Finally, the firm must be able to support

customers in identifying their own solutions, while minimizing complexity and burden of choice. When a customer is exposed to too many choices, the cognitive cost of evaluation can easily outweigh the increased utility of having more choices. This is called the paradox of choice: Having too many choices actually reduces value instead of increasing it. As such, offering more

Mass customization is a process rather than a destination. Small steps can produce big results, even if the organization remains far away from the ideal.

product choices can lead customers to postpone or suspend their purchases, and, even more troublesome, to classify the seller as difficult to deal with and hence undesirable.

Therefore, choice simplification is vital to navigating the company's product assortment. A key approach is assortment matching—having an IT system build the configuration for the

customer, who then only has to evaluate it. The system does so by matching the characteristics of an existing solution space, or set of options, with a model of the customers' needs. Online jeans retailer Zafu.com does this by asking customers to provide their body measurements and then recommending the best fitting pair of jeans out of an assortment of many major brands. From the customer's perspective, Zafu is offering something a lot like tailor-made jeans; from a fulfillment perspective, the company is merely matching standard inventory with individual needs.

Mass customization as a journey. Our experience with companies in numerous industries is that many managers reject mass customization on the basis that "it won't work in my business." This reaction results from a perception of mass customization as an ideal, unachievable state. However, we believe that pursuing it is akin to moving along a continuum whose limits are mass production and mass customization. When viewed this way, mass customization is a process rather than a destination. Small steps can produce big results, even if the organization remains far away from the ideal.

Because no firm can become a perfect mass customizer, the real question revolves around how developing a solution space, designing a robust value chain and simplifying choices can be improved rather than perfectly achieved.

About the European Best Innovator Club

The mission of the European Best Innovator Club is to build a unique and dynamic group of European thought leaders in the field of innovation management. The Club is open to former winners of A.T. Kearney's European Best Innovator competitions, and includes senior executives involved in innovation management, technology management and research and development from industries and organizations across Europe. Members meet annually in retreats designed to encourage networking and the exchange of experiences and ideas. Participants contemplate today's important issues and explore the latest trends and best practices in innovation management.

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