RACONTEUR

Future of Consumer Goods Manufacturing

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Autodesk is leading the way to the future of making, allowing manufacturers to meet growing market demands by delivering better products faster, at lower cost and with less waste. With a comprehensive design and manufacturing portfolio, Autodesk provides advanced technology that automates and connects workflows for end-to-end product development.

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Publication sponsored by
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Contents

This report explores how consumer goods manufacturers can harness the convergence of design and manufacturing, to unlock new levels of creativity and gain a competitive edge

SUSTAINABILITY

Future of sustainable packaging

Driven by consumer pressure, corporate sustainability has become much more than a buzzword with companies across industries forming comprehensive strategies that put environmental and ethical considerations at the top of the agenda

Finbarr Toesland

Traditional consumer packaging is extremely wasteful and contributes a great deal to landfills around the world. But the development of 3D printing, also called additive manufacturing, may allow for packaging to be created using less wasteful techniques and in far more sustainable ways than traditional production methods.

"With 3D printing, we are able to minimise or even eliminate excess material during the production process, thereby reducing the overall use of material. Also many materials used in 3D printing are made from sustainable sources – PLA [polylactic acid or polylactide], for example, is made from renewable feedstocks – and even enable us to reuse plastic waste," says Michael Storey, managing partner of Beckatt Solutions, specialists in additive manufacturing.

While additive manufacturing has been mostly used for tooling and prototyping, there is considerable scope for it to be applied in more ways in the packaging industry. Beyond just gaining the ability to create innovative new decorative designs that will differentiate packaging from competitors, 3D printing

enables countless new packaging designs to be created rapidly. For example, unique and personalised packaging for one-off events and specialised products can be produced quickly and cost effectively.

Sustainable by nature

"Many of the materials that we use in additive manufacturing are sustainable by nature and through recycling. Add to that the more widespread adoption of additive manufacturing in packaging manufacturing and we can easily envision a future where additive manufacturing plays a substantial role in sustainable packaging, so long as we continue to develop and produce sustainable additive manufacturing material," says Mr Storey.

With the sustainable packaging market forecast to reach $400 million by 2024, according to Zion Market Research, 3D printing can help ensure environmentally friendly packages are also attractive to consumers in ways that more traditionally printed products are not.

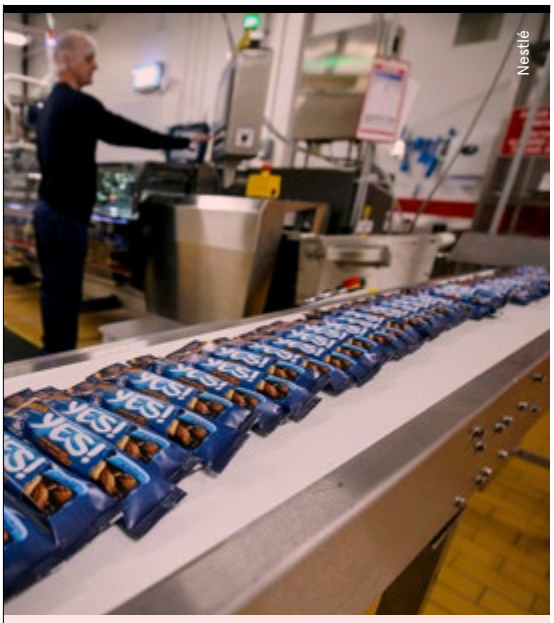
By removing the need to build expensive and time-consuming templates, manufacturers are likely to create a more complex product, but with even less material than more conventional processes. Manufacturers will need to hire talented staff who have the skills required to both design for and operate 3D printers, which are also relativity expensive, but the end-result will be a more sustainable operation.

"Additive manufacturing enables accessible high-value, low-volume products to be developed and manufactured anywhere in the world for businesses of all sizes, transforming the economics and workflow of production. From a sustainability standpoint, this can mean additive will enable manufacturing and packaging to happen closer to the source of consumption," Dávid Lakatos, chief product officer at Formlabs, a 3D-printing technology developer and manufacturer, concludes.

$400M

forecast value of the sustainable packaging market by 2024

Zion Market Research, 2018



Ensuring sustainability

Technical advances are enabling new innovations in packaging, reducing the need for companies to use wasteful materials in their product packaging. A team of packaging experts at confectionary giant Nestlé recently showed how they are able to make use a recyclable paper wrapper in a high-speed 'flow wrap cold seal' packaging line.

Previously, this process was only able to be used with plastic films and laminates, but Nestlé has achieved a world-first breakthrough with this new method. The company is on track to implement the recyclable paper wrapping in its 'YES!' range of fruit-based, and nut-based bars to make its packaging more sustainable and easier to recycle.

According to Nestlé, the recyclable wrapper will take a maximum of six months to degrade in a marine environment, far shorter than the up-to 450 years flow wraps takes to degrade.

Despite facing over 90 different challenges to modernizing and adapting their machines and conventional methods to be able to process the recyclable paper wrapper in this new way, Nestlé is now able to produce 300 bars per minute in the 'flow wrap cold seal' packaging process and significantly reduce the waste it creates compared to the old system.

> **We can easily envision a future where additive manufacturing plays a substantial role in sustainable packaging**
>
> **Michael Storey**
> Managing partner, Beckatt Solutions

Manufacturing creativity

Few industries have been left unaffected by startup enterprises making use of innovative technologies to change consumer expectations fundamentally

Finbarr Toesland

Faced with rising competition, companies need to ensure they are delivering innovative new products that exceed customer expectations, with new technologies playing a vital role in helping them achieve this goal.

From aerospace and automotive to consumer goods and construction, manufacturers across industries can benefit from generative design, a technology that has begun to show major potential for manufacturers, giving them the ability to generate multiple high-performing design alternatives quickly.

Generative design for manufacturing makes use of advanced artificial intelligence and cloud-computing resources to allow engineers or designers to explore computer generated design options. After setting a number of constraints and defined design aims, including materials and manufacturing methods, generative design software can swiftly reimagine a single idea and offer countless potential solutions.

In an age of heightened competition, generative design can be a truly transformative tool for manufacturers seeking to boost creativity and reduce time to market. One of the multiple manufacturing methods available with generative design software is 3D printing, a technology that can enable manufactures to create unique designs using less material.

40%

of leading manufacturers will use 3D printing by 2021

International Data Corporation, 2018

25%

of waste can be eliminated with 3D printing

International Data Corporation, 2018

Significant advantages

There are significant advantages for manufacturers that embrace 3D printing. According to the International Data Corporation, 40 per cent of the leading 2,000 manufacturers will use 3D printing by 2021, united with intelligent machine tools, to improve material usage, resulting in a waste reduction of at least 25 per cent.

As many conventional manufacturing limitations can be solved with generative design, designers will be free to move past previous restrictions and work with this exciting technology to construct creative designs that differentiate their products from rivals.

Sports apparel manufacturer Under Armour worked with leading software company Autodesk to develop the first commercially available 3D-printed sneaker, drawing on Autodesk's Fusion 360 and generative design software. Under Armour's UA Architech sneakers feature a unique interlocking lattice structure in the midsole that offers lightweight, cushioning support to athletes, even in high-intensity workouts.

When the UA Architech has weight pressed down on the midsole, its computer-generated shape allows for energy to be bounced back and for structural stability to be enhanced.

These intricate design elements go beyond aesthetic considerations and offer a best-of-breed structure that isn't just eye catching, but also provides flexibility and durability to wearers. Human designers simply couldn't design and perfect such a complex structure in the same way that Autodesk's software is able to create, but designers still play a vital part of the process by ensuring the design follows set parameters.

Mutual benefits

Benefits of generative design are evident for both manufacturers and consumers. A whole new range of products, which are able to meet customer requirements and needs more closely, are now capable of being produced thanks to the use of generative design. But manufacturers, too, can quickly create advanced products that minimise waste, and better tailor designs and functionality for their customer base.

Building innovative products is clearly a laborious process, even for highly experienced designers and engineers. As generative design enables engineers and designers to approach design issues from new angles and in more efficient ways, new ideas can be prototyped much faster.

The practical benefits of generative design allow engineers and designers to fix problems they were not able to solve on their own. The reduced waste and affordable cost of using generative design software is setting the stage for increased application of this exciting technology.

It's clear that manufacturers that do not embrace generative design will find themselves at a competitive disadvantage, with manufacturers harnessing these next-generation tools able to set themselves apart as they will be able to test out new product ideas and concepts with unprecedented speed.

Advanced generative design tools can produce an array of suitable products for designers by processing the answers of significant questions. These include what materials and manufacturing process should be used, what are the cost parameters, and what is the maximum weight?

As the collaboration between Autodesk and Under Armour illustrates, the answers to these questions will ensure the future of design will look radically different from the past.

> **In an age of heightened competition, generative design can be a truly transformative tool for manufacturers seeking to boost creativity and reduce time to market**

PERSONALISATION

How manufacturers can achieve built-in agility

Customers are demanding a personalised experience, but traditional operating models make it difficult and costly to scale production of such products, so with new technologies available, manufacturers must bake more agility into their business

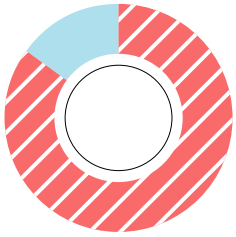
Ben Rossi

Agility has always been important, but has never been higher up the agenda for manufacturers. Consumers no longer accept that a product will be available soon. Customer expectations have changed and consumers want to feel they can have what they want, when they want it and in the format they expect.

Successful manufacturers understand the need for a good customer experience, but they risk losing this as they develop. The trouble is many evolve to be big more than they evolve to be smart. The result is a system constrained by immense supply chains and distribution networks, as well as fixed equipment and personnel costs that necessitate large production minimums. The transition from prototype to full scale in traditional manufacturing is a costly commitment and refinements are difficult to make.

Manufacturers are also held back by legacy systems and organisational structures. Many are countering this by building in agility through small, autonomous functions which they can swap out and replace as needed, making them leaner and more flexible by optimising the end-to-end orchestration of the business and individual functions.

"There are new ways to engage the customer, particularly when there is a complex supply chain between the manufacturer and the customer," says Graeme Wright, UK and Ireland chief technology officer for manufacturing at Fujitsu. "But having the right infrastructure to be agile and implement new ways of working is the key to delivering on this engagement."



81%

of organisations expect to compete based mainly on CX in 2019

Gartner, 2019

3D printing

Meanwhile, traditional norms around production minimums, supply chains and time to market are being upended by new additive manufacturing capabilities. "How products are conceived and designed can now link almost seamlessly with an individual customer experience, with hundreds of thousands of components produced every day to different customer specifications," says George Brasher, UK and Ireland managing director at HP.

Long gone are the days of just mass products; companies offering a more personalised customer experience are growing faster and achieving greater profitability. This level of diversity, agility and specificity in manufacturing is unprecedented and the line between prototyping and full-scale production is becoming less distinct. The design process can now be seamlessly integrated rather than precede a long procurement and manufacturing process, allowing companies confidently to modify production at scale.

Increasing return on investment will require a renewed focus among manufacturers on

improving customer satisfaction, reducing churn and increasing brand loyalty. Failing to respond to market changes, by not adapting fast enough if a competitor introduces a more popular variation of a product, for example, is sure to lose customers.

Incremental changes

To build agility into their existing business models, manufacturers need to focus on promoting incremental changes, whether on a brownfield production line, physical plant or around supervising IT and operational technology systems. Responding quickly to changing demands requires production lines that can be configured rapidly.

"The simplest way to do this is by introducing flexible robots on existing lines rather than fixed machines, changing manual adjusters, deploying smart sensors on to lines, and introducing manufacturing execution and manufacturing operations management systems," says Martin Walder, vice president of industry at Schneider Electric.

> **Those that survive and thrive in the future of manufacturing won't be the largest, the fastest or the strongest, they'll be the organisations that adapted best to change**

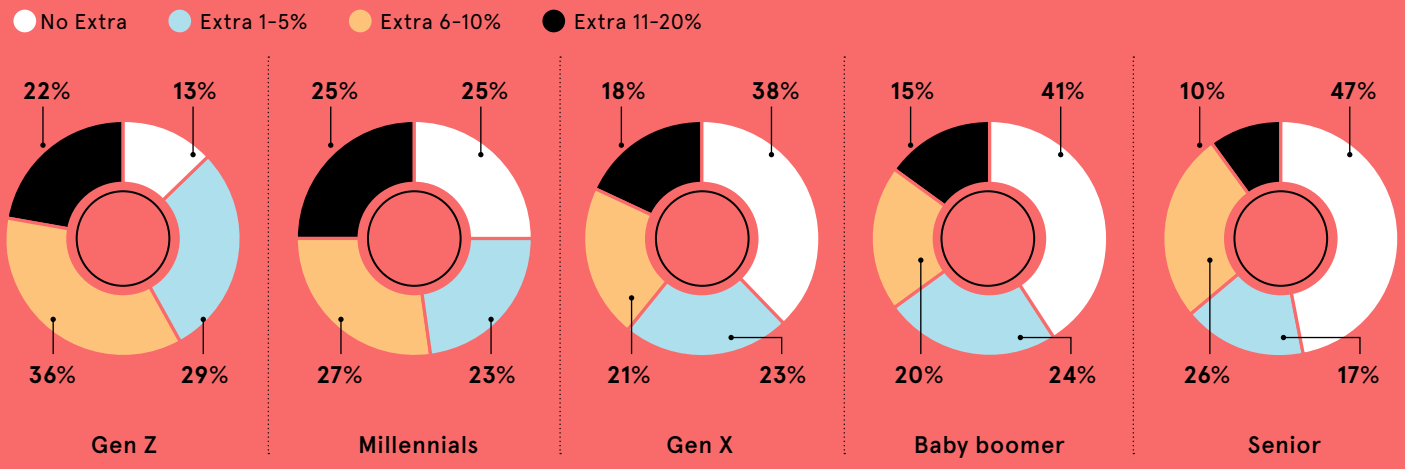
Agility has always been a differentiator in the manufacturing sector and that will only become more apparent as technology continues to move and evolve at a rapid pace. Those that survive and thrive in the future of manufacturing won't be the largest, the fastest or the strongest, they'll be the organisations that adapted best to change.

MANUFACTURING A GREENER FUTURE

The pressure is on for consumer goods manufacturers to meet the rising demand for sustainable products

1 SHOPPERS FAVOUR PRODUCTS THAT ARE SUSTAINABLE AND ARE WILLING TO PAY MORE FOR THEM

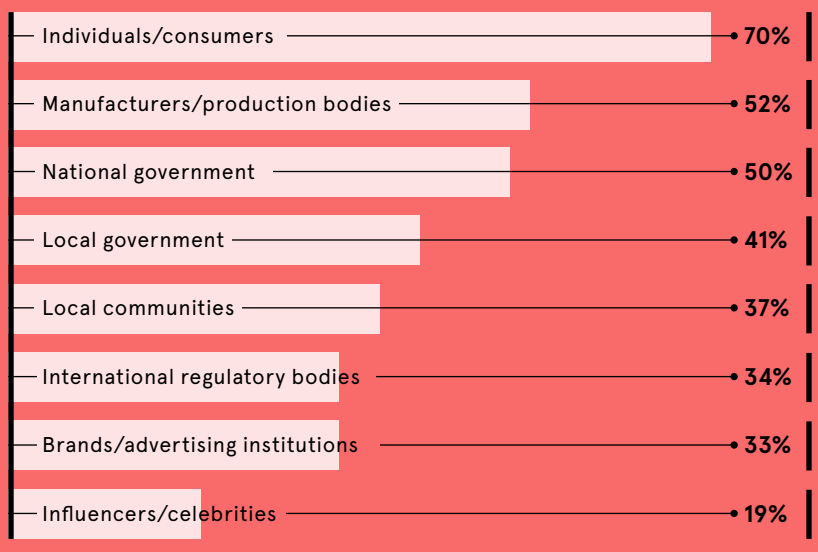
Consumer willingness to pay for sustainable products by generation in the United States



Deloitte, 2018

2 CONSUMERS FEEL MANUFACTURERS ARE LARGELY RESPONSIBLE FOR CHANGING OUR 'THROWAWAY' CULTURE

Where does responsibility lie for the future of the environment?



GlobalWebIndex, 2018

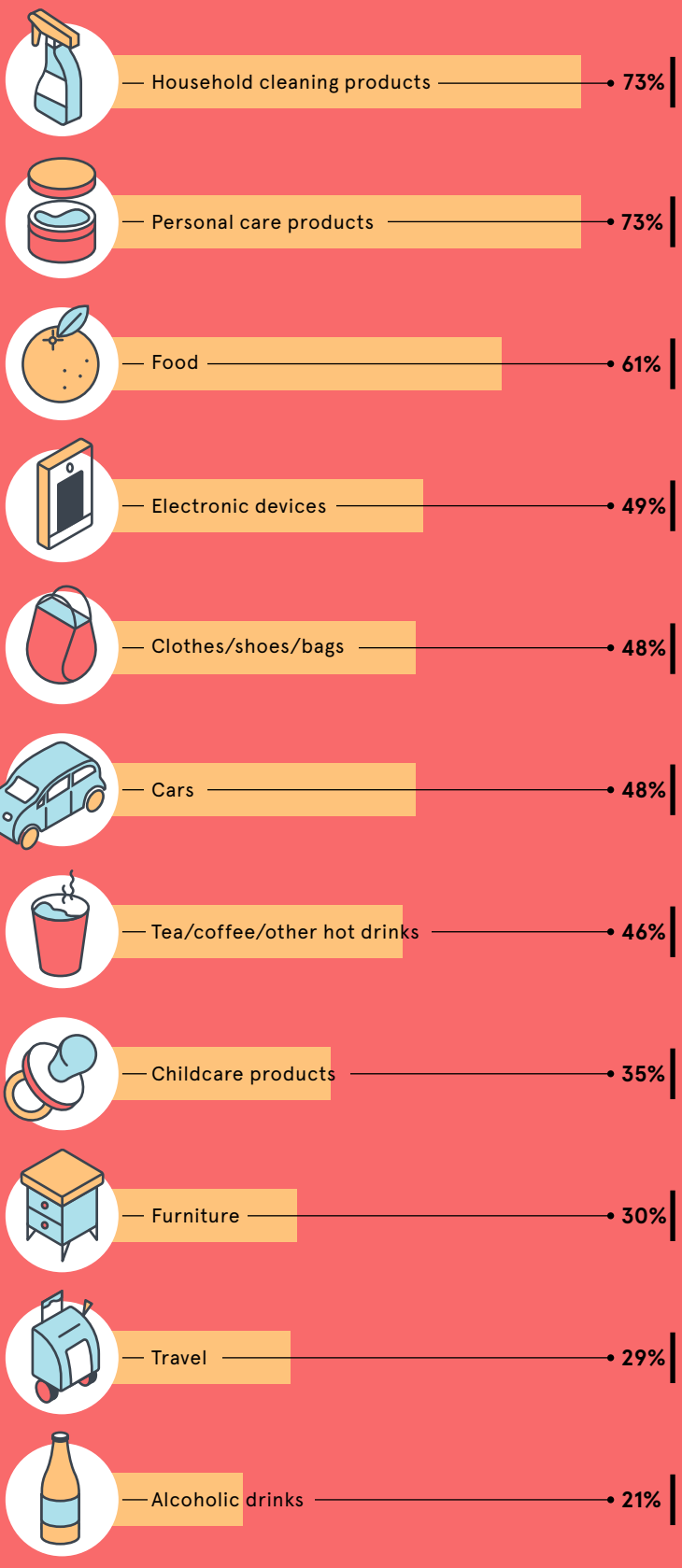
37%

of consumers look for products with environmentally friendly packaging

PwC, 2019

3 WITH THE VAST MAJORITY OF PRESSURE FALLING ON CONSUMER GOODS BRANDS

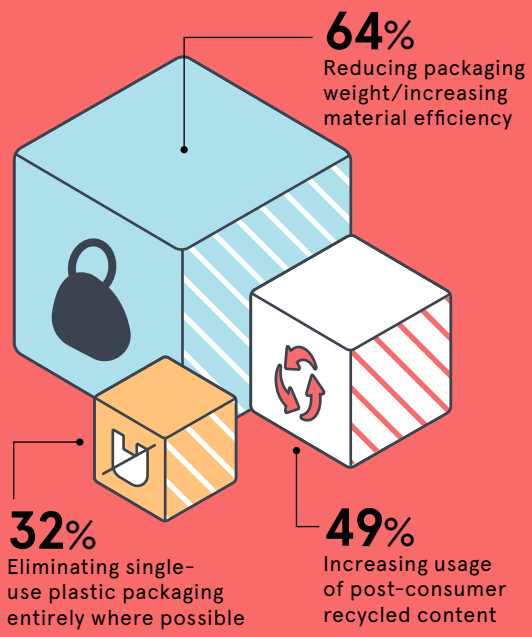
Products that consumers research to ensure they are eco-friendly



GlobalWebIndex, 2018

4 COMPANIES ARE BEGINNING TO TAKE ACTION, WITH THE ISSUE OF PLASTIC PACKAGING AT THE FOREFRONT

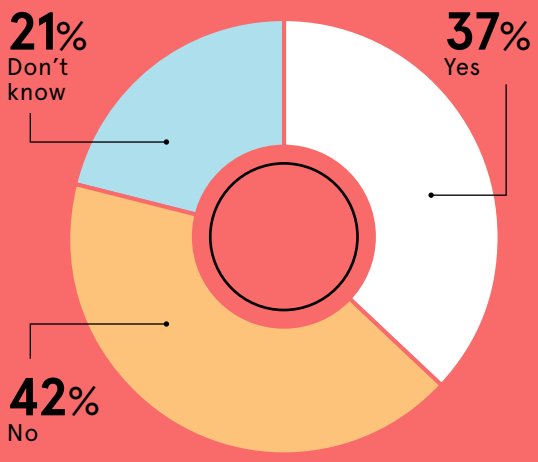
Actions companies are taking in response to consumer sentiment against plastic packaging



Packaging Digest, 2018

5 BUT THERE IS MORE TO BE DONE TO ACHIEVE THE SUSTAINABILITY GOAL

Companies that feel they have the appropriate staff for sustainable packing tasks



Packaging Digest, 2018


filadendron/Getty Images

CUSTOMER EXPERIENCE

From consumer to creator

Superior customer experience is now a central differentiator for companies looking to get ahead in a growing number of industries

Finbarr Toesland

There is a quantifiable bottom-line business benefit from giving consumers superb customer experience. A Forrester study found that leaders in customer experience achieved yearly revenue growth rates of 17 per cent compared with just 3 per cent recorded by those firms falling behind on customer service.

But in an extremely competitive business environment, when almost all companies are looking for innovative ways to stay ahead of the competition, how can enterprises truly separate themselves from rivals?

The continuing need for improved customer experience has seen mass personalisation of consumer goods, offering a far more individualised product. This unprecedented level of personalisation is seeing the consumer transition to creator and begin to design the products they desire.

Data insight

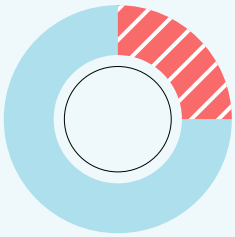
"Mass personalisation is being driven by a few things: the drive to provide the best possible customer experience is one, since this increases preference and can command a price premium, but it is also being driven by the increasing amounts of data and insight that manufacturers have about consumers, better understanding their wants and needs," says Tom Gray, innovation director at consulting firm Capgemini.

Exciting new manufacturing technologies, too, are playing an important role in enabling consumers to customise goods to their tastes. Countless consumer goods, from cars to trainers, can now be personalised, but for this approach to become commonplace in everyday life, both design and manufacturing processes must work in unison.

"Today's expectations simply change faster and are harder to achieve, but the advent of better simulation, 3D design, supply chain and manufacturing technologies means we can promise and deliver more than ever before," says Mr Andrew Hughes, principal analyst at LNS Research.

Manufacturers are responding to this changing consumer demand and, in the process, realising customers expect an excellent experience at every stage of the personalisation, not just in the final product. This holistic approach will ensure consumers are easily able to personalise their items and the entire journey is as simple as possible.

It will be vital for manufacturers to use the customer data they already have to provide a tailored experience for users and continually build on the customer profile, so they are able to suggest the most appropriate product personalisation options relevant to consumers' tastes and preferences.



25%

of organisations say personalisation is their top priority

Econsultancy, 2018

"Mass personalisation is a means to demonstrate and deliver on these changing expectations, and involves designers and marketers – the creators – understanding what's possible instead of just doing what is asked of them," says Mr Hughes. "By configuring to order and leaving design decisions until the consumer makes their order, the future of fast-moving consumer goods will be an amalgam of consumer and creator ideas delivered in previously unimagined personalised products."

Complexity

Unlimited personalisation with no guidance or frameworks, however, may overcomplicate the service and leave users unconfident of where to start or unable to navigate the myriad of options. Manufacturers, too, will find it unnecessarily complex to produce products that are customisable in every way possible, especially if only a very small percentage of consumers actually want this level of customisation.

"What design can do is help to pinpoint the elements of greatest value for customers to personalise and identify the sweet spot from a manufacturing point of view as to what is most efficient from a cost and speed point of view. Taken together, this creates a product and experience that maximise value on both sides, consumer and commercial," Mr Gray concludes.

Astro Studios

COMPETITIVE ADVANTAGE

Servitisation gives manufacturers breathing space to grow

With margins being squeezed in a challenging business environment, servitisation is providing much-needed relief to manufacturers as a model that enables them to design efficiencies into their supply chain and drive growth with new revenue streams

Ben Rossi

Offering value-added services alongside traditional products, known as servitisation, has helped manufacturers produce new revenue streams, slash costs, boost customer relationships and move ahead of competitors. It now makes up 15 per cent of Apple's revenue and more than half at Rolls-Royce. Boeing is looking to grow its services revenue from $8 billion to $50 billion in the next decade and in some cases servitisation programmes have evolved into entirely new companies, such as General Electric's launch of GE Digital.

The concept of value-added services is hardly new, but technology advances have multiplied the servitisation opportunity. In the aerospace sector, manufacturers are using the internet of things to add predictive maintenance capabilities. Chemicals companies are deploying consumption-driven replenishment and supply planning, and energy firms are developing managed asset maintenance programmes based on huge volumes of data.

It's not just technology that is driving this trend. Customers are hungry for service-oriented solutions, and servitisation provides a way for manufacturers to deliver differentiation from competitors with new services that address their specific pain points, while also reducing costs, lowering lead times and enabling better flexibility and responsiveness.

Relational mindset

"Manufacturers need to move from a transactional focus to a more relational mindset," says Rafi Billurcu, who leads Infosys Consulting's manufacturing practice in Europe. "This will require continuous nurturing of customer relationships, which itself may entail a shift in culture and organisation. For example, manufacturers need to ensure they have call centres and other customer touchpoints in place, make the necessary adjustments to information systems, accounting practices, and risk and compliance requirements."

Design and manufacturing processes are increasingly converging as manufacturers seek new efficiencies in their supply chain that help enable the best servitisation experience and allow them to build a longer-term relationship with their customers. End-users are more likely to develop a higher degree of trust with manufacturers that consistently provide a great quality of service, which discourages them from looking to the competition.

Servitisation is a gradual and incremental process. Many start with an aftermarket spares-and-repairs parts service before adding break-fix repair services, where they reactively deliver services. Eventually, they add annual maintenance contracts, which increases the amount of revenue flowing from each initial sale. To sell a profitable maintenance contract, the manufacturer has to know what the cost of maintaining the product or asset will be, so it is only a minor step to then selling the entire life cycle as a service.

Higher margins

This has made manufacturing a higher-margin business and enabled manufacturers to focus more on the outcome they are working towards with their customers, rather than simply exchanging money for a product. The

design of a product can also influence what it will cost to service it over its life cycle, which means industries with aftermarket service revenue streams are putting more thought into serviceability and reliability in product design.

"Servitisation will make it easier for customers to purchase products and assets in both consumer and industrial settings," says Antony Bourne, global industry director for industrial manufacturing at IFS.

"It will also help manufacturers differentiate themselves on the ability to help their customers reach their goals and intended outcomes. If one manufacturer sells only the product and another sells through servitisation, the servitised manufacturer will present a lower risk profile. Manufacturers will be able to sell based on their base of satisfied customers and the real-time performance of established equipment."

Servitisation is the new competitive battleground on which manufacturers win or lose their reputation. Those that make a success of it will be able to respond much faster to changing customer needs and will develop a greater understanding of how to deliver the value their customers crave. With customer expectations changing rapidly, gaining this kind of knowledge will be the difference between succeeding and failing in the years ahead.

> **Servitisation is the new competitive battleground on which manufacturers win or lose their reputation**

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