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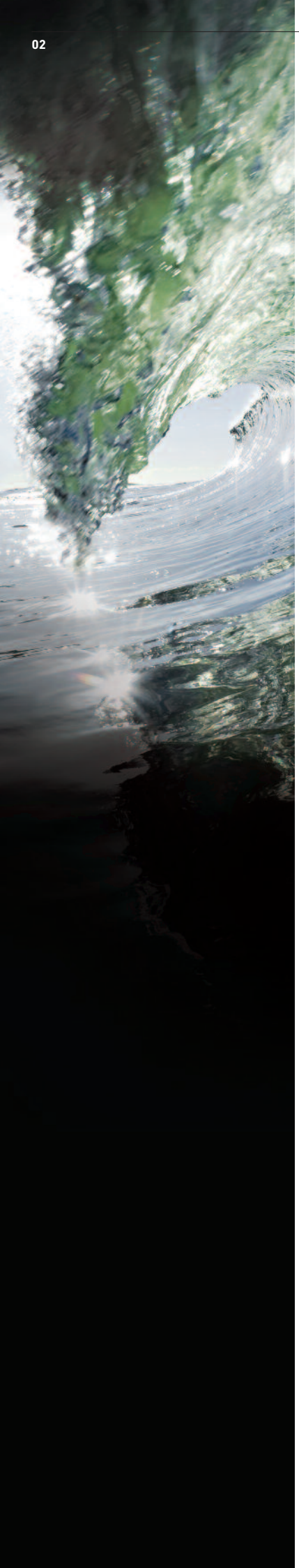
Standards that create the outstanding

Riding the next wave

3D printing



Riding the next wave

3D printing

Introduction

We are on the verge of the next wave of computing, and it will have immense consequences for business by the end of the decade. In this era of ubiquitous computing there are technology trends that are going to contribute and take advantage of the proliferation of data. They are going to be disruptive in some lines of business, promising major benefits but also creating some notable risks.

The fourth, and last, of our ***Next wave*** whitepaper series examines 3D printing, its process, the benefits and the huge potential for business.

3D printing

Otherwise known as additive manufacturing, three dimensional printing is on the verge of becoming a significant force in parts of the business world. It has been used in niche areas since the 1990s, but the recent launch of consumer 3D printers shows that the cost of equipment is falling sharply and will prompt many more businesses to think about how it could work in their markets. Over the next few years it is going to affect how certain products are manufactured, the relationship with the customer, the supply chain, the distribution of staff and the development of prototypes and plans.

The computerised craftsman

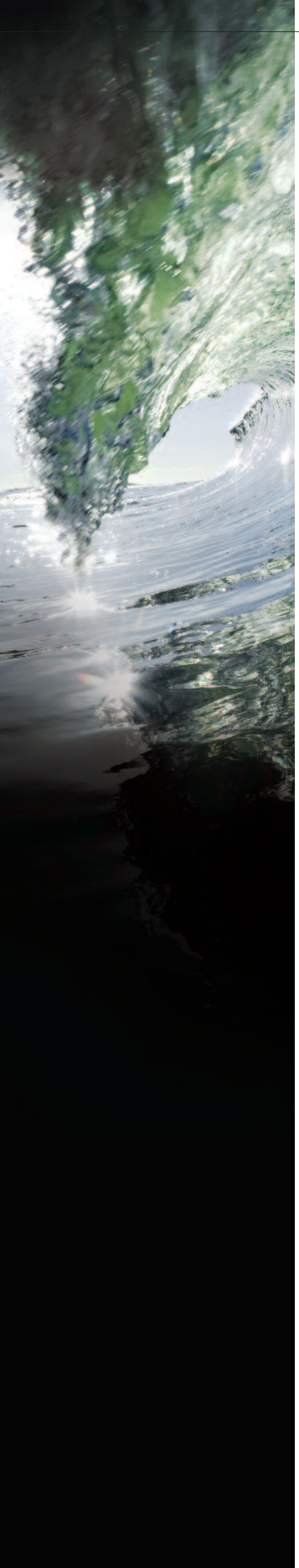
3D printing's big selling point is the ability to design and create products, or even a single product, to highly specific demands, making production the domain of a computerised craftsmen rather than an assembly line. This promises to create value in new areas and Wohlers Associates, a consulting company in this field, forecasts that the value of products and services in 3D printing will rise from $2.2bn in 2012 to approaching $6bn in 2017[1].

It is still early days for 3D printing, but there is growing confidence in its capabilities. Companies who want to maximise its business potential will have to look carefully at how it could work within their markets and develop a new blend of skills.

The process

Production begins with a 3D model of the object, usually created on computer aided design (CAD) or animation modelling software and exported as an STL (STereoLithography) file, which is then sliced into thin layers by the 3D printing software.

There are different techniques for building objects in layers of raw material.



Sometimes they are laid down as a powder then laser sintered together; sometimes a mechanism similar to an inkjet sprays plastic which is set by ultraviolet light; and sometimes a laser traces out a layer in a pool of liquid plastic, setting the layer which then sinks for the next to be imposed on top of it. The most commonly used raw materials are refined plastics, although gypsum-based materials, some metals and ceramics are also suitable.

With the growing sophistication of 3D printers, it is possible to produce complex constructions that can do exactly what the customer requires. This will provide an alternative to traditional production methods.

Advantages

There is scope for 3D printing to be offered as a specialised service, and for larger companies to take it on in-house. In both cases there are many benefits in store, as the technology turns the economics of production on its head[2]:

Rapid prototyping

One of the big advantages is the ability to produce a prototype of a product or component at high speed and low cost. When development involves a lot of trial and error, this can be more economical than relying on skilled labour.

Customisation

It is possible to create a product to very precise specifications, which would not be commercially feasible in conventional manufacturing. This can be for individuals or organisations, and can be used in producing final products or components, and even machinery. The broad economic benefits will be immense, providing support for companies that struggle to find parts for their own plant, enabling the construction of machines for new processes, and opening up a new industry with the potential for significant growth. It has also become valuable within the healthcare industry, offering the ability to match a product to personal characteristics including orthodontics, eyeglasses and the manufacture of prosthetics.

Reduced labour costs

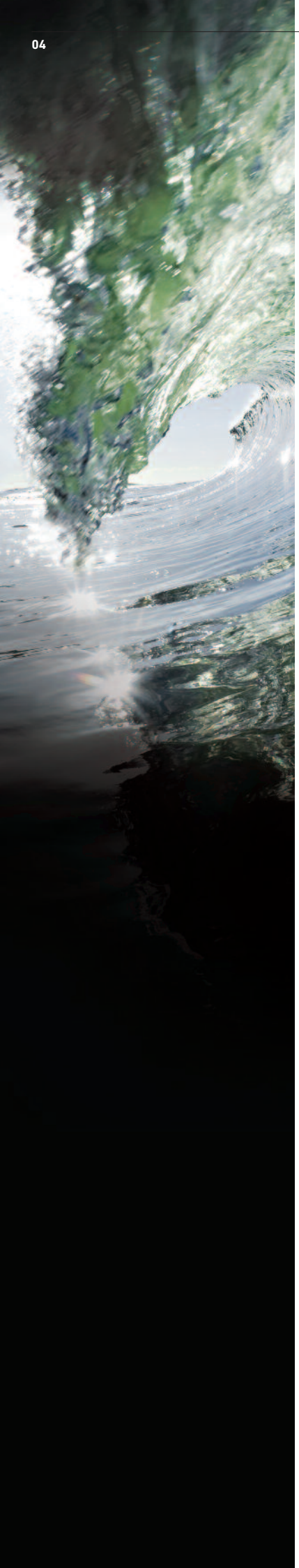
A 3D printer can take on tasks that currently require skilled or semi-skilled workers. It needs a capital investment in the IT and machinery, but over the medium to long term it will provide considerable savings.

Local economic growth

By contrast, 3D printing makes it possible to shift some productive capacity back to local markets. In most cases using a service overseas would nullify the advantages of the technology. This would benefit the UK economy by bringing some manufacturing jobs back from overseas.

Reduced inventories

More products could be made to meet short term changes in demand rather than being held in stock, cutting down storage costs and reducing the risks in producing for an unpredictable market. This would have to be partly offset against the need for stocks of raw material for printing.



Reduced transport costs
More products can be made closer to the points at which they are used. Again, this would have to be offset against the need to transport raw material, but the costs for this are generally cheaper and the overall effect would be to rationalise the process.

Green benefits
The overall reduction in transporting materials would reduce the carbon footprint of production.

Increasing product diversity
A manufacturing company could add new products to its range without having to invest as heavily in new equipment or go through a lengthy retooling process. The flexibility in production offered by 3D printing can support innovation and help companies to exploit new opportunities in their markets.

Design flexibility
Even for bespoke products, there is scope for using a design again or amending it slightly to meet a new set of demands. The fact that the design for a product is retained within a CAD file makes it possible to reproduce it, or use it as a template for a partly customised product, in a different part of the world. This removes the cost of shipping the product or sending an expert to the new production site. There is scope for companies that run 3D printers to specialise in some areas and develop a market for their designs.

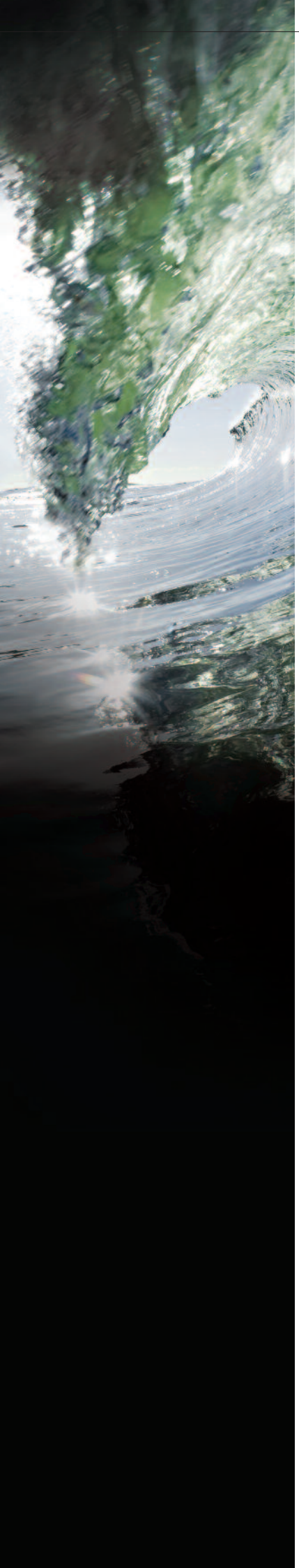
The business potential

The change in the manufacturing process opens up a new way of doing business. There is a big opening for service providers in 3D printing who will be able to offer designs that act as a template for consumers and business clients to customise, and who will then manufacture the products to order.

Some industries will be better suited to this than others; it depends on whether the raw materials are suited to the process and the economics of the industry. The most welcoming are those that have strong niches for bespoke or small-run products that are sold at premium prices. It comes back to the distinction between the work of a computerised craftsman and something that is mass produced.

On the consumer side, one of the prime markets is likely to be in clothing. Tailors and dressmakers have remained busy in the era of mass production; there is always a market for unique clothes and home decorations. Consumers who appreciate the style of tailored clothes, or have an eye for something different, will be eager to have a hand in designing products for themselves, albeit with the support of a professional who can create the CAD model.

There are questions about what type of fabrics could be used. At the moment nylon and other polymers, not often associated with high value clothes, provide the main options for 3D printing. But advances in textiles are likely to produce more attractive options using a computer and 3D printer to make the garment.



This could be particularly important for sports goods, as serious competitors want shoes and clothing moulded to the shape of their own bodies. Even more attractive is the market for bespoke sports equipment, and a demand for custom-built bicycles holds great promise.

There's similar potential in designer eyeglasses and the less expensive end of the jewellery market, and in making furniture and interior accessories. In these cases the consumer could feed their own ideas into what they want, working from a template to create a completely bespoke product, at a higher cost.

As techniques for using metal advance, it will even be possible to produce components for cars, motorcycles and boats to individual specifications. This is unlikely to challenge the mass production car industry, but there is an established demand for customised cars and it will open a niche for those with the money to create their own vehicle.

Products made from plastics and rubber are also likely to be significant. These can include consumer products such as specialised kitchen equipment and toys, or business products such as mouldings and storage units.

On the industrial side, 3D printing is likely to play a big role in providing machinery and components with bespoke designs, or which are in short supply in local markets. There is also scope in the supply of building materials, especially if a building has unusual architecture.

There are other areas in which the technology has a potential that will depend on whether it can harness the raw materials. For example, there has been speculation that it could be used to produce pharmaceuticals on demand in hospitals, and that it could be used in the wood and paper industries. In the former case it would respond to the highly personalised nature of medical care, but in both cases it is likely to take some years to develop.

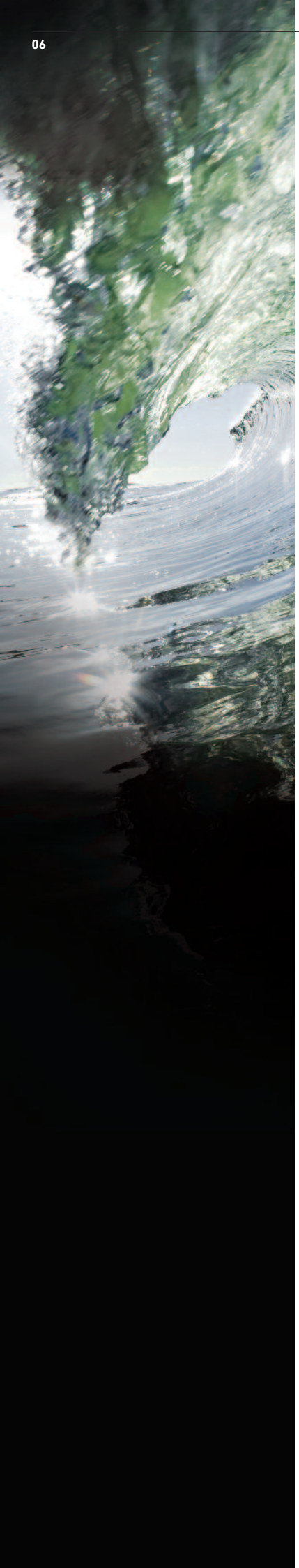
On a smaller scale, 3D printing is likely to be widely used in modelling, helping developers to visualise multi-million pound projects such as buildings, yachts and landscape developments. It will also appeal to artists who see the potential in a new method of creativity.

Challenges

The development of the technology is not going to be a smooth journey. Exploring the best use of raw materials will be a painful process, and new standards in the use of 3D printing and business practices will be adopted.

Recent press reports have raised concerns over 3D printers being used for the illegal manufacture of weapons. If these concerns grow, they will no doubt lead to calls for regulation.

The other big problem revolves around intellectual property. Manufacturers will be able to develop new products and claim IP rights more quickly, providing a big value generator. But the open architecture of the internet



makes it more difficult to control the sharing of IP, and the technology makes it easier to produce goods from others' designs. Gartner has identified this as a major issue for the next few years, predicting that by 2018 3D printing will lead to the loss of at least $100 billion (£62 billion) in IP around the world[3].

But these challenges will not prevent the spread of the technology. For some industries it will lead to immense changes in the supply chain and the way products are sold. Smaller production units serving local markets will become more important, and companies will spend more time dealing with customers to specify exactly what they want from a product. Factories churning out large volumes may remain viable for mass markets, but many firms could find it worthwhile to run both modes of production to serve different segments. The pattern will vary between industries and will take time to evolve, but 3D printing will open up lucrative new possibilities for several sectors of the UK economy.

Skills

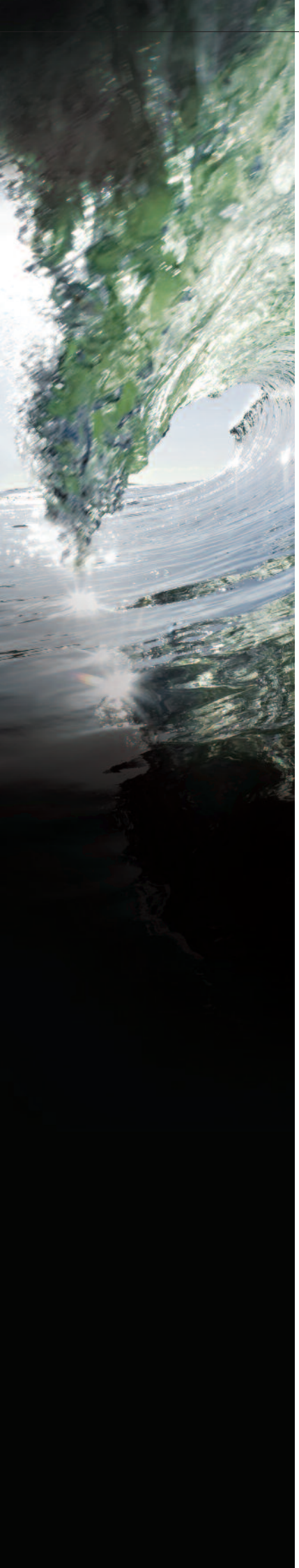
3D printing is going to shake up the skills mix in the affected industries. There will be a need for engineers and materials scientists to develop and refine 3D printing hardware and materials. There will also be demand for software programmers to develop the capabilities for different industries, and for engineers and technicians to install the machines and keep them in good working order. In the case of the software developers and technicians, the people already working in similar jobs should be able to pick up these skills with the relevant training.

The key factor, however, will be to ensure that the creative professionals are able to harness the technology. Designers in every field will have to get to grips with the relevant software and understand what the technology can and cannot do with the raw materials with which they work. This may seem to require a different mindset to their core talents, but there is a strong precedent in the way designers have made great use of technology in publishing, web design and advertising over the past 20 years.

Teaching in CAD design and 3D printing is beginning to edge into schools, suggesting that in a few years there will be a skilled cadre of professionals available. But the private sector can also play its part by supporting training opportunities for people who are already active on the creative side.

Conclusion

The technology is still evolving but already 3D printing is showing us the potential it can offer across sectors, from retail to healthcare, fashion to defence. It will completely transform manufacturing, blur the lines between customer and supplier, and enable growth in areas of the world that were previously depleted. Organisations should be exploring how 3D printing can work within their markets, so they can develop the skills to be able to ride this exciting and revolutionary wave of computing.



The business questions

There are big returns in ensuring your workforce is skilled and able to make use of 3D printing. Digital leaders should assess their state of readiness by asking themselves these questions:

Can you identify potential business benefits for 3D printing within your organisation? What are your capabilities for evaluating your business processes, identifying how they could be improved and managing the change?

Does your workforce have the core skills to implement the new technology? How can this be integrated into personal development plans?

Do your senior managers have the commercial awareness to take advantage of 3D printing's potential for rapid prototyping?

Are there parts of your business that could benefit from increased customisation and low volume production runs?

How well can the technology handle the raw materials for your products or equivalents?

Does your business have the processes in place to safeguard the quality of products using 3D printing?

Do your business processes include, or at least provide scope for, a dialogue with customers that would provide for direct customisation?

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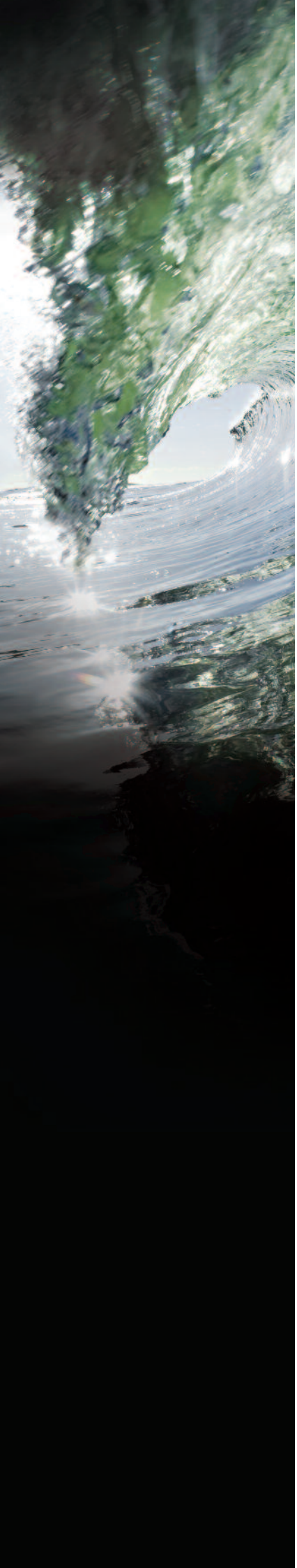

About the author

Mark Say is a business writer who has more than a decade of experience in covering information management and technology. He has been editor of *Government Computing* and *TechRadarPro*, written research papers for Kable and Ctrl-Shift, and works with BCS, The Chartered Institute for IT, on the relationship between IT and business issues.

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Riding the next wave is a series of four whitepapers: Ubiquitous computing; Cognitive computing; Augmented reality; and 3D printing.

They will be available to download, as they are published, from **bcs.org/nextwave**

With many thanks to our contributors:

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