3D Printing: The Future of Product Design Today
Introduction

3D printing is just one of the technologies impacting design today, and the capabilities it brings to the product design process cannot be underestimated. Early adopters are already experiencing huge value benefits and the future of product design will most certainly be interlinked with what this technology can bring.

To evolve their design and manufacturing strategies, many industry sectors are already using 3D printing solutions in the market. PwC estimates 67.7% of manufacturers are already using 3D printing. Of these, 28.9% are experimenting to determine how 3D printing can be optimally integrated into their production processes and 24.6% are using 3D printing for prototyping.1 It is also worth noting that 75% of industrial manufacturing CEO’s say they will make changes to increase R&D and innovation capacity.

Compared to traditional manufacturing and prototyping methods, 3D printing offers the potential for high degrees of customisation, reduced costs for complex designs, and lower overhead costs for short-run parts and products. The industry has been growing in excess of 20% annually and is widely expected to accelerate in the years ahead.1

Analyst Cristina Colón, Goldman Sachs

67.7% of manufacturers are already using 3D printing.
The advantages of 3D printing over other manufacturing technologies is leading to profound changes in the way many things are designed, developed, produced, and supported. Companies can more rapidly respond to market and customer demands, fix design flaws and counter competitive evolution.  

3D printing also brings a new skill set for the way we will design in the future and is impacting not only manufacturing and product design strategies, but is being integrated into the way students learn and develop across multiple subjects. This document will explore the myriad of ways that the product design and development process can benefit from the opportunities that 3D printing brings today and will bring in the future. It will also look at how 3D printing will shape product design in four key ways; driving efficiency, enhancing quality, reducing costs and guiding the designers of the future.

Driving the efficiency of design

3D printing has been a key contributor to the success of rapid prototyping (RP) in the last 30 years. However its value is not just accelerating the RP process.  

3D printing can play an invaluable role at each stage of product design process – leading to better designs through the development of products with enhanced quality, performance and manufacturability. It also reduces barriers to testing concepts which can cultivate an increase in designers’ entrepreneurial behaviour.

Supporting the design cycle

3D printing can enhance the product design process at each stage

**Envision | Plan**  
3D printing enables prototypes to be produced at this early ideation stage, enabling the designer to interact with their design in 3D form much earlier in the creative process.

**Design | Develop**  
3D printing enables faster design and development due to a reduction in the time required between new design iterations.

**Test | Release**  
Early feedback identifies design flaws and early changes save money. 3D printing provides a highly cost efficient means of producing numerous designs, enabling immediate feedback.

This report will look at how 3D printing will shape product design in four key ways:

- **Driving efficiency**
- **Enhancing quality**
- **Reducing costs**
- **Guiding the designers of the future**
A vital element of any product design process is the design brief. Without defining the expected goals and attributes of a proposed product, things can easily go wrong – leading to unexpected and unwelcome outcomes in the remaining stages of the product design and development process.

In contrast to the provision of verbal, written or drawn briefs that can often be open to misinterpretation, a brief in the form of a 3D model enables each contributor to the process to fully understand what is expected of the intended finished product. It not only describes the specifications but displays them and presents the often complex relations between design, materials and manufacturing that will need to be taken into consideration. A 3D brief can ultimately bring efficiency to the overall process.

3D printing is also capable of revolutionising the full design process. Accurate and cost-effective concept models can now be developed in hours rather than weeks with 3D printing opening up new ways of producing designs.

3D technology can also enable transformative changes to existing product development and design processes. It can easily and cheaply redesign products and include more design and review cycles during the development phase to increase manufacturing innovation and further aid efficiency during later stages.

3D printing has the capability of not only printing very complex parts, but also printing completely integrated part combinations as a single finished product. It enables users to print more complex designed parts than could ever be done by traditional moulding processes.

When we examine sustainable design and manufacturing, we view 3D printing as bringing a tremendously positive impact. The technology has not yet evolved to replace full manufacturing processes, but in its current nascent form it does cut down on prototyping, waste, opening the door for more sustainable business practices across a range of industries.

Chat Reynders, Chairman and CEO Reynders, McVeigh Capital Management

Those from all areas of art and design including product designers, fine artists, jewellery and textile designers, as well as architectural model-makers and engineers benefit greatly from 3D technology. Whether it’s speeding up the development of what they’re working on, opening up the possibility of creating new forms, or providing a whole new toolset to push ideas even further, it’s clear to me that the benefits of using 3D technology are broad and inclusive. 

Alastair Hamer - Head of Additive Manufacturing, Royal College of Art

Driving Efficiencies

3D printing can lead to better designs and products can now be developed in hours rather than weeks.

3D briefs not only describe detailed specifications but display them and present the often complex relations between design, materials and manufacturing.

3D printing provides the ability to easily and cheaply redesign products and include more design and review cycles during development.
Emerging technologies [such as 3D printing] are not just changing what’s being made or how fast it’s being developed, they’re also changing who is capable of making it. The ambitious entrepreneur who understands an audience—the young mother who has an idea for improving products for her baby, or the coffee fanatic who can see the future of specialised brewing—are enabled to move their ideas from mind to reality, from napkin sketch to use by an appreciative audience.

Jonathan Follett, Principal at Involution Studios.

3D printing is also an enabler of an improved product design review process. Being able to share printed pre-prototype models to determine market and customer approval, explore innovative thinking and test more frequently to avoid rejection further down the line is invaluable.

The following diagram (3) by Deloitte illustrates the differences between traditional product design and development, rapid prototyping, and digitally optimal design. The digitally optimal design path highlights how the use of 3D printing (referred to in the diagram as Additive Manufacturing) in production as well as within product design and development can open up entirely new avenues for the entire process. This enables the delivery of components that may have been previously impossible or impractical to produce using traditional manufacturing and design methods.

3D printing enhances the ways designers and manufacturers develop their offerings, enabling them to prove and perfect designs with agile but precise testing, and deliver high quality prototypes. It also allows designers to focus on designing for performance with less regard for traditional limitations of design for assembly or manufacturing.

The prospect of 3D printing enhancing the quality of a product’s design stems from the fact that it enables companies to repeat more prototypes within a pre-existing budget; this can lead to more testing, which will more likely yield better product designs.

3D technologies help to transcend potential barriers to collaboration to not only improve efficiencies but also the quality of design. Physical objects are universally understandable and can supercede geographical and language barriers. This further opens up the opportunity for design enhancements - when users can send prototypes as CAD files to be printed anywhere, it enables stakeholders to collaborate on concepts and designs more efficiently.

“3D printing enables an important part of our day to day work. Today, our department can develop physical prototypes practically overnight and create geometries and shapes that couldn’t be developed any other way. For the students, being able to design something without constraints is truly liberating and this naturally enables creativity and innovation to flourish. The benefits of faster turnaround times and multiple iterations speak for themselves - 3D printing is truly a boundary-shifting technology which allows us to continually improve our work and services.”

Dr. Billy Wu, Dyson School of Design Engineering Imperial College London

Enhancing the quality of design

Although many companies may be at stage one of this journey today, involving 3D printing throughout the product design and development process can ultimately yield greater results compared to traditional methods in the areas of innovation, performance and quality.
Reducing the cost of design

3D printers have the potential to expand the manufacturing industry, shift distribution locally, and implement on-demand production, reducing unnecessary inventories and shipping costs. This technology will permit mass customisation and print different products while reducing cost and recycling the excess of materials. Product weight can be reduced, and fewer tools will be needed because 3D printers could replace some of them.

Julio Vial, Research Manager of IDC’s Imaging, Printing and Document Solutions research

Driving efficiencies often result in cost reductions. Using 3D printing to support the efficiency of product design and development can drive substantial cost savings through the production of inexpensive prototypes, reduced change orders as well as insourcing elements of the design process, which in turn helps protect intellectual property.

The reduction in cost of testing a product design can also encourage information on what works to emerge more quickly than in traditional manufacturing practices.

Creating accurate design documentations, the evaluation of the manufacturability of products and the direct savings realised during the product design process itself also contribute to overall manufacturing cost reductions.

One of the most significant cost savings can be found through the increased level of collaboration in the design process, which is facilitated by 3D printing. This can enable products to be developed and designed more effectively, which can lead to a significant reduction in expensive errors further down the product development cycle.

Beyond design, products will also have the possibility of a longer life-span, where in the future, product parts will increasingly be replaced by 3D printing. This will safeguard the entire product from being thrown away and replaced each time it malfunctions.

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Designing in 3D printing meant that it took me three days to turn around my thesis project. Doing this using traditional methods would have taken me three weeks. It’s quite important that the University has invested in this technology as I feel that it has given me an extra level of employability in the future.

Student, The University of Nottingham.

The future of product design is naturally in the hands of the next generation of designers. Where and how much 3D printing is embraced by the education sector is therefore an imperative factor for the continued success of its application to the product design process. As 3D printing technologies help reduce design constraints and kindle new capabilities, many designers in and out of organisations will become increasingly entrepreneurial and experimental - encouraging early adoption is key.

In education, 3D printing fits perfectly within the science, technology, engineering, architecture and mathematics (STEM) curriculum. Schools across Europe are already installing 3D printers to educate students on how to use computer-aided design (CAD) software to create ‘products’ - with the technology allowing students to apply practical skills in a proactive and fun way. However, the objective is not only to teach how to perform 3D printing, but to also instil higher levels of creativity and flexibility in the design and manufacturing process.

While in the past, Computer Aided Design (CAD) was traditionally being taught in isolation to other design disciplines, today, nearly all taught Product Design programmes in Europe view CAD as an integrative element in the curriculum. Most universities now have dedicated CAD facilities to teach the use of software as an essential tool in the design process. At the same time, workshop facilities have evolved where education institutions offer a hybrid suite of facilities for conventional manufacturing and dedicated spaces for digital fabrication systems. 3D printers have become an attractive option for universities as they offer a cost effective means to realise prototyping needs for students. They are able to turn virtual models into physical parts quickly and affordably, allowing them to test and optimise their designs. This cyclic, iterative process enables students to learn in a visual and intuitive way about the design options and to inform them about the limits of digital manufacturing. Some of the key challenges in the future include having mastery of the software as well as being familiar with processes associated with the 3D printing hardware. It may be that in the future, ‘3D Printer Engineers’ will emerge as a distinct functional skill set, though inventive amateurs and hobbyists are likely to continuously surprise and push these skilled professionals.

Designers of the Future

Schools across Europe are already installing 3D printers to educate students on how to use computer-aided design (CAD) software.

3D technology allows students to apply practical skills in a proactive and fun way.

3D printing not only helps to convey the students’ design vision, but also challenges them to be more creative.
3D printing has the potential to revolutionise design with the invaluable benefits it brings to the product design process. The wider economic implications of 3D printing are also significant: McKinsey Global Institute research suggests it could have an impact on the global economy of up to $550 billion a year by 2025.18

Innovative product design relies on emerging technologies to meet and exceed the demands of its users and customers. 3D printing has already been proved by early adopters to be a technology that can achieve the following four things:

1. Save time in the development cycle and time to market by accelerating the development process
2. Enhance the final product’s quality and design
3. Reduce costs – through the development cycle such as through new design alternatives with less investment in set-up, tooling, and machine changeover
4. Inspire the designers of the future

3D printing is ultimately a transformative technology for businesses, accelerating product development by enabling faster and more productive design iterations and more flexible production. Those that adopt 3D technology as an additional tool in their product design toolbox are set to reap great rewards.

Moving from a product design process which doesn’t integrate 3D printing to digitally optimal design, should help designers take greater control of production. Many companies are now exploring how to integrate 3D printing into their design process over the next few years, opening up a new world of possibilities.

To understand how 3D printing can revolutionise your design capabilities and processes, please talk to your local Canon 3D representative who will be happy to work with you to discuss how you could get started.

Conclusion

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Appendix

7. Alastair Hamer - Head of Additive Manufacturing, Royal College of Art
9. 3D printing transforms organisations, Gartner, February 7, 2014
13. http://d27n205l7rookf.cloudfront.net/wp-content/uploads/2015/07/DUP_708-Figure2.jpg
Contact Information

For more information please visit,

www.canon-europe.com/for_work/business-products/3d-printers