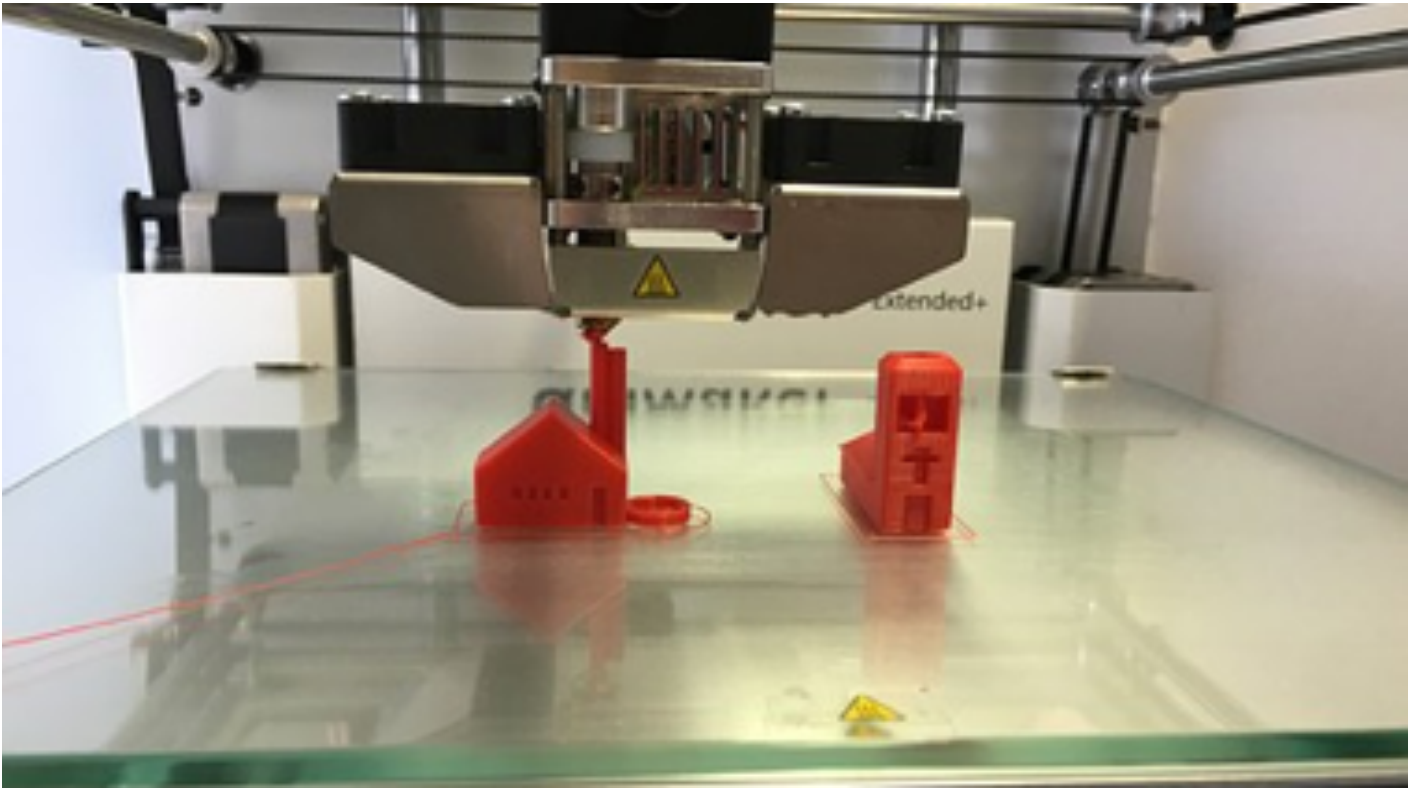


# 3D PRINTING IN THE HIGHLANDS AND ISLANDS

Executive Summary



---

## 3D PRINTING IN THE HIGHLANDS AND ISLANDS

---

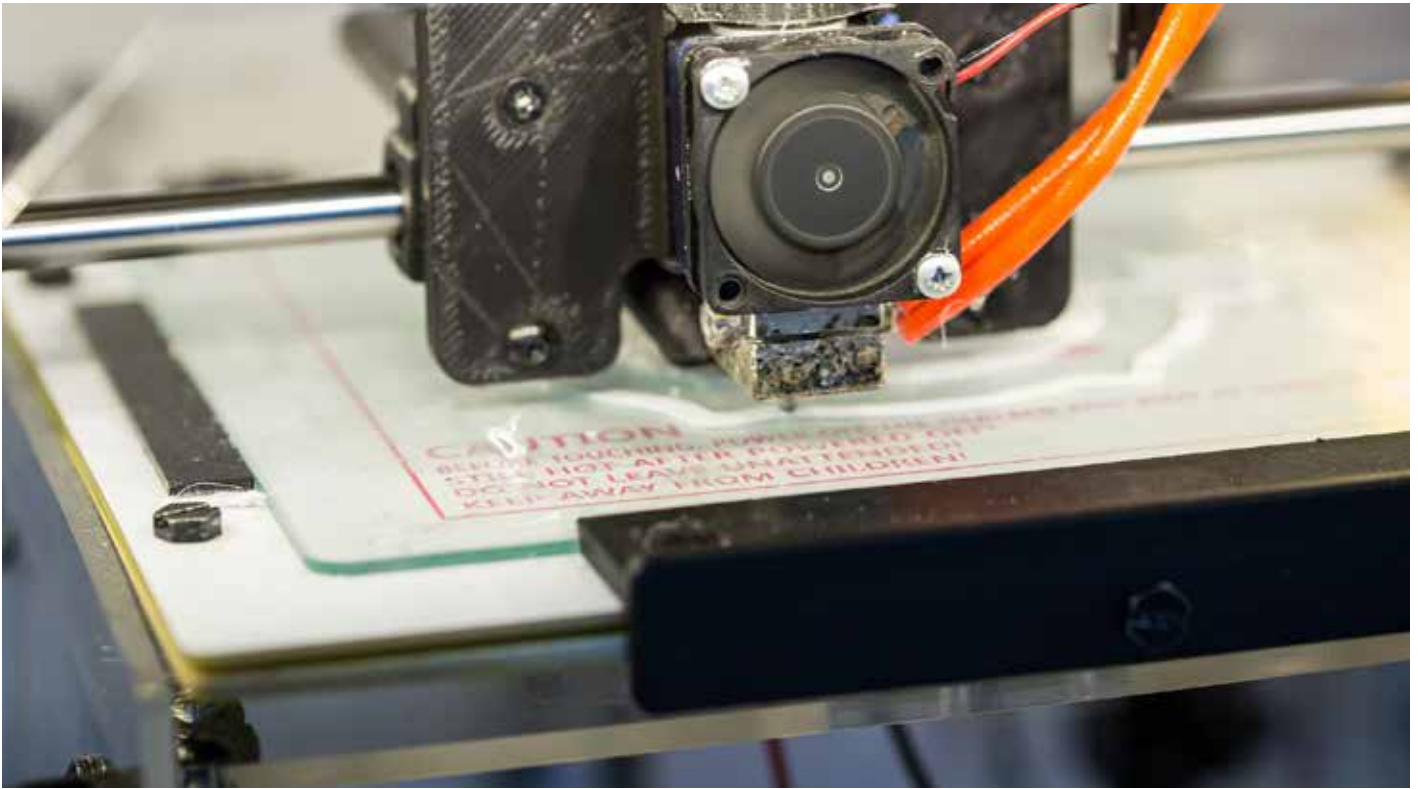
# INTRODUCTION

---

Highlands and Islands Enterprise (HIE) commissioned Frontline Consultants Ltd (Frontline), in partnership with Loughborough University, to undertake exploratory research to investigate the potential of Three-Dimensional (3D) printing in the Highlands and Islands. The study sought to consider the global trends in 3D printing; applications for manufacturing in the Highlands and Islands; barriers to adoption and support needs; and the disruptive effects and implications of non-adoption.

The approach included a mix of desk research and extensive consultation across a range of public and private sector stakeholders and businesses through face-to-face and telephone interviews. Stakeholders included representatives from industry leadership groups, publicly funded organisations, education and the third sector. A series of case studies were also developed to highlight current initiatives using 3D printing and supporting technologies.

“3D printing has the potential to revolutionise the way in which we work and live.”



## GLOBAL TRENDS IN 3D PRINTING

---

3D printing is increasingly used as a synonym for additive manufacturing - technologies that build 3D objects by adding layer-upon-layer of material. While 3D printing technology has existed since the early 1980s, it is only in recent years that it has seen its most rapid rate of growth with the global market value increasing from \$2.3bn in 2012 to \$6.1bn in 2016. This market growth is in line with the increasingly accessible price of industrial 3D printers, the growth of the consumer 3D printing market and the increasing use of 3D printing in production. While the rate of growth has slowed, the market for 3D printing is expected to see steady growth through to 2023 across all sectors.

Some industries wish to stay at the cutting-edge of 3D innovation, for example; the aerospace industry's adoption of 3D printing solutions is projected to increase from \$723m in 2015 to \$3.45bn in 2023, a 19% CAGR (Forbes, 2015). Businesses and consumers are now able to 3D print objects to a higher specification, with a wider range of materials, more quickly and cheaply than ever before. 3D printers can cost anything from £300 to over £1m, with many low-cost options now available.

3D printing has and will continue to create extensive new opportunities for prototyping and mass customisation. It has already led to an increase in global take-up of the technology, particularly in automotive, aerospace and life and medical science sectors. There has also been a trend in the 'DIY maker movement' where individuals and small and medium enterprises (SMEs) are testing the potential of 3D printers to support hobbies and enable in-house development, particularly since the cost has substantially decreased. While still a long way to go, from the trends identified, 3D printing has the potential to revolutionise the way in which we work and live.



Prosthetic hand made with 3D printing technology

---

### 3D PRINTING IN THE HIGHLANDS AND ISLANDS

---

## APPLICATIONS FOR MANUFACTURING IN THE HIGHLANDS AND ISLANDS

---

3D printing provides opportunities for businesses to create bespoke, one-off, model or finished products on-site, without having to involve any external third party or to be constrained by a minimum order requirement. It can offer a source of competitive advantage to businesses in the areas of rapid prototyping, manufacture of simple components, small batch production and bespoke product customisation and personalisation. It offers advantages to rural businesses by stripping layers out of the product supply chain and removing the need for time consuming and costly deliveries.

While there is limited evidence of 3D printing technology being currently employed in the Highlands and Islands economy, research suggests that the greatest sectoral areas of opportunity include life sciences and health, energy and creative industries, alongside the cross-sectoral opportunities presented by high value manufacturing. The table opposite summarises the applications, benefits and challenges. Some of the greatest and recurring challenges are access to technology, skills and cost which are exacerbated for small businesses and rural communities.

“ Given the savings in logistics, 3D printing is likely to be particularly advantageous for businesses in remote and rural areas. ”

## SECTORAL OPPORTUNITIES, BENEFITS AND CHALLENGES

SECTOR	APPLICATION	POTENTIAL BENEFIT	CHALLENGE
Life sciences and health	<ul style="list-style-type: none"> <li>Surgery, rehabilitation and prosthetics developing lattices and stents used in hip and joint replacements and maxillofacial projects.</li> <li>Printing medicines and printing bio-organic circuitry e.g. digestible circuitry.</li> <li>Medical support drones to deliver care packages.</li> </ul>	<ul style="list-style-type: none"> <li>Improved performance and durability.</li> <li>Cost savings aligned to reduce over-ordering, less repeat surgeries, better fit to patient.</li> <li>Direct point of care application and personal medicine.</li> <li>Medicine tracking.</li> <li>Deliver the right kinds of medicines to points of military need or humanitarian intervention.</li> </ul>	<ul style="list-style-type: none"> <li>Health and care markets were described as “very risk averse to change”.</li> <li>Regulatory constraints aligned to personalised medicine.</li> <li>Access to quality printers to support specialist output.</li> <li>Drone regulation.</li> <li>Regulating onsite manufacture.</li> </ul>
Energy including oil and gas	<ul style="list-style-type: none"> <li>High precision and high value low volume components. Single unit components.</li> <li>Maintain parts offshore reducing costs and time (viewed as long term).</li> </ul>	<ul style="list-style-type: none"> <li>Production of single piece components – very cost-effective approach given current market developments in printing metals; bespoke and fully customised design.</li> </ul>	<ul style="list-style-type: none"> <li>Still too expensive compared to traditional methods for majority of components.</li> </ul>
Creative industries	<ul style="list-style-type: none"> <li>Prototyping to speed up design times and to deliver bespoke end-products.</li> <li>Sculpture mock ups.</li> </ul>	<ul style="list-style-type: none"> <li>Bespoke customisation; personalisation; more cost effective and less time consuming than traditional materials.</li> </ul>	<ul style="list-style-type: none"> <li>Knowledge and skills to create the 3D modelling drawing (CAD); access to technology that is capable of a quality product.</li> </ul>
Food and Drink (packaging and design)	<ul style="list-style-type: none"> <li>Greatest opportunity aligned to design of innovative packaging, bottling and canning of products.</li> </ul>	<ul style="list-style-type: none"> <li>Market differentiation.</li> </ul>	<ul style="list-style-type: none"> <li>3D printed food accepted as still more of a fad – when aligned to actual food.</li> <li>Still too expensive to become a regular approach.</li> </ul>
Tourism	<ul style="list-style-type: none"> <li>Personalised models of tourist attractions either as souvenirs or interpretative aids.</li> </ul>	<ul style="list-style-type: none"> <li>Personalised souvenirs.</li> <li>Improved visualisation of attraction.</li> </ul>	<ul style="list-style-type: none"> <li>Knowledge and skills to create the 3D modelling drawing (CAD).</li> <li>Access to technology locally.</li> </ul>



Vulcan concrete printer (2018) and a 3D printed office in Dubai

### 3D PRINTING IN THE HIGHLANDS AND ISLANDS

## BARRIERS, DISRUPTIVE EFFECTS, RISKS OF NON-ADOPTION AND SUPPORT NEEDS

3D printing is a highly disruptive technology, with potential implications for the time it takes businesses to get a product to market, how businesses choose to segment their client market, how businesses organise their logistics, and for the long term economic viability of supply chain businesses. The growing usage of 3D printing technology has the potential to lead to several significant market transformations, including increased customer desire for, and expectation of, bespoke products; the removal of layers from the supply chain (including potential local supplier companies); and the re-localisation of product manufacturing around communities.

Over the coming years, this will have a major, positive, disruptive impact on the Highlands and Islands, particularly in remote and rural communities. However, there is some potential for negative disruptive effects, and businesses slow to adapt and adopt risk being left behind in terms of competitiveness, skills and knowledge.

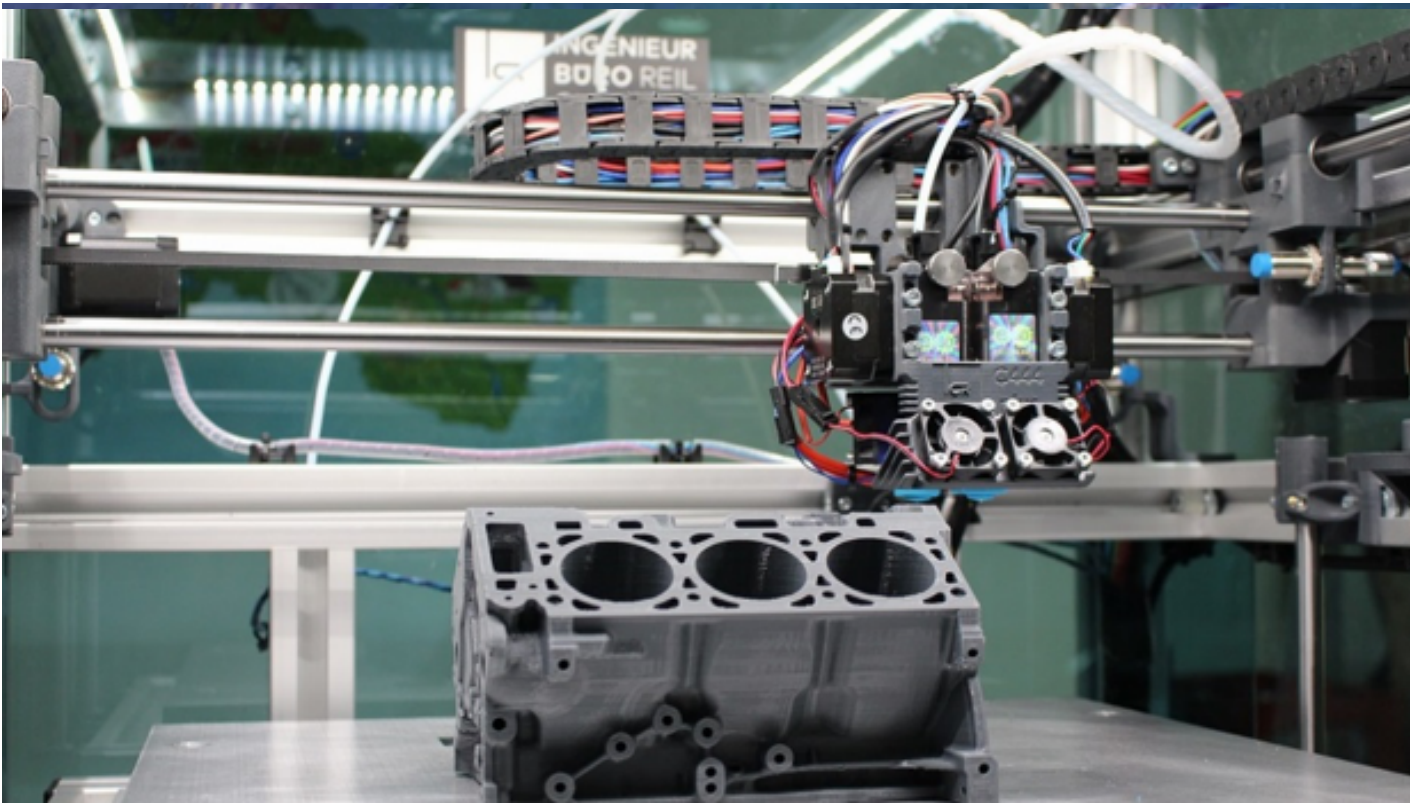
While some of these changes may take time to materialise, particularly in the life science sector, the region could obtain a significant competitive advantage by preparing for these now through supporting awareness raising, sharing exemplar practice and encouraging industry leaderships and champions.

While there are significant opportunities across the Highlands and Islands, lack of skills, low levels of awareness and understanding of 3D printing and high cost were identified as the top three barriers restricting uptake. Other factors include access to printers and materials and a lack of understanding of digital tools and modelling software.

There are a number of interventions that have taken place in the Highlands and Islands and elsewhere to help address challenges such as FabBus, a mobile fabrication unit developed in Germany; I2P Labs, a network of product innovation support centres in South Africa; and Project Nautilus, a community project in Tarbet, Isle of Harris to help young people develop skills in engineering, design, science and technology. In addition, there is a considerable amount of R&D and skills development utilising 3D printing and associate technologies currently being undertaken in academic institutions across Scotland and the availability of 3D manufacturing facilities and training provision is expanding.

Based on the evidence from the consultations and international good practice review, the types of support identified to help businesses in the Highlands and Islands to fully exploit the potential benefits of 3D printing included the following themes:

- raising awareness and encouraging uptake
- developing the local skills base
- developing the necessary infrastructure



### 3D PRINTING IN THE HIGHLANDS AND ISLANDS

## RECOMMENDATIONS

3D printing is a rapidly growing technology which has the potential to have 'game changing' implications for several sectors of the economy and has the potential to substantially increase the competitiveness of businesses, particularly in rural and remote rural communities. If businesses in the Highlands and Islands adopt this technology to its fullest level, the region has the potential to become one of the most innovative and productive manufacturing regions in Europe. Non-adoption is likely to leave businesses at a competitive disadvantage.

Collaborative effort is critical in supporting businesses to realise the benefits of this technology. A triple helix approach involving the public sector, academia and industry will be fundamental to this. Actions that could support the effective uptake of 3D printing in the Highlands and Islands should align with the strategic priorities outlined in the Scottish Manufacturing Action Plan and include:

- **ensuring access to the appropriate infrastructure** – this could include creating a shared facility showcasing the latest and most advanced 3D printing technology that can be accessed by businesses for new product development, by schools, colleges and universities for research and education purposes and for government agencies for showcasing purposes. This should be supported by the provision of a network of mobile or permanent spaces across the region for the demonstration and shared use of 3D printing technologies to help foster an inclusive approach. An innovation voucher type scheme may also help offset costs for businesses wishing to expand into this area.
- **facilitating knowledge sharing** - promoting and disseminating good practice would increase businesses awareness of the benefits of 3D printing. Establishing a community of 3D printer users in the region (including people who use 3D printers for research and educational purposes, people using the technology in different sectors of the economy and hobbyists) who meet regularly to discuss the challenges that they are facing and to share experiences, insights and discoveries would help businesses to make greater use of 3D printing expertise.
- **supporting skills development** – this may include supporting the development of 3D printing skills at school level by providing 3D printers to schools and training teachers in how to use them, and by working with STEM Ambassadors to raise awareness} of the career opportunities open to individuals with a 3D printing skill set. Introducing accredited qualifications and increasing work-based learning courses in 3D printing and CAD file design would help to ensure that the region produces enough graduates and training opportunities in these areas to meet the future skills demands of the area's employers.

**FOR MORE INFORMATION CONTACT:**

**T:** +44 (0) 1463 245 245

**E:** [hieresearch@hient.co.uk](mailto:hieresearch@hient.co.uk)

Highlands and Islands Enterprise  
An Lòchran  
10 Inverness Campus  
Inverness  
IV2 5NA

[hie.co.uk](http://hie.co.uk)



Highlands and Islands Enterprise  
Iomairt na Gàidhealtachd 's nan Eilean