

THE UK'S INNOVATION FUTURE

August 2021

Foreword



At the forefront of innovation, we must always ask: how are science and technology best harnessed to deliver productivity, prosperity and public good?

This has never been truer than in 2021, which will be a transformational year. As the world finally turns a corner on the Covid-19 pandemic, countries are turning their attention to future global challenges, from combatting climate change and protecting the environment to tackling inequality and adapting to demographic change.

Catalysing innovation is a large part of the answer to those challenges. Governments must set out a clear vision, devise long-term strategies to facilitate cross-sector, cross-border collaboration and ensure access to the talent and finance that industry and academia require to thrive.

With its new Innovation Strategy, the UK has put forward such a vision, one rightly focused on key strategic technologies in which the country already plays a leading global role. Semiconductor IP is undoubtedly one of these, with many billions of devices in use today built on UK-developed technology.

The focus must now be on successful implementation of the strategy. As Chief of Innovation at one of the UK's most innovative businesses, I'm proud of the manifesto Imagination Technologies has put forward – ten recommendations that we believe the UK should follow to unlock its full innovative potential.

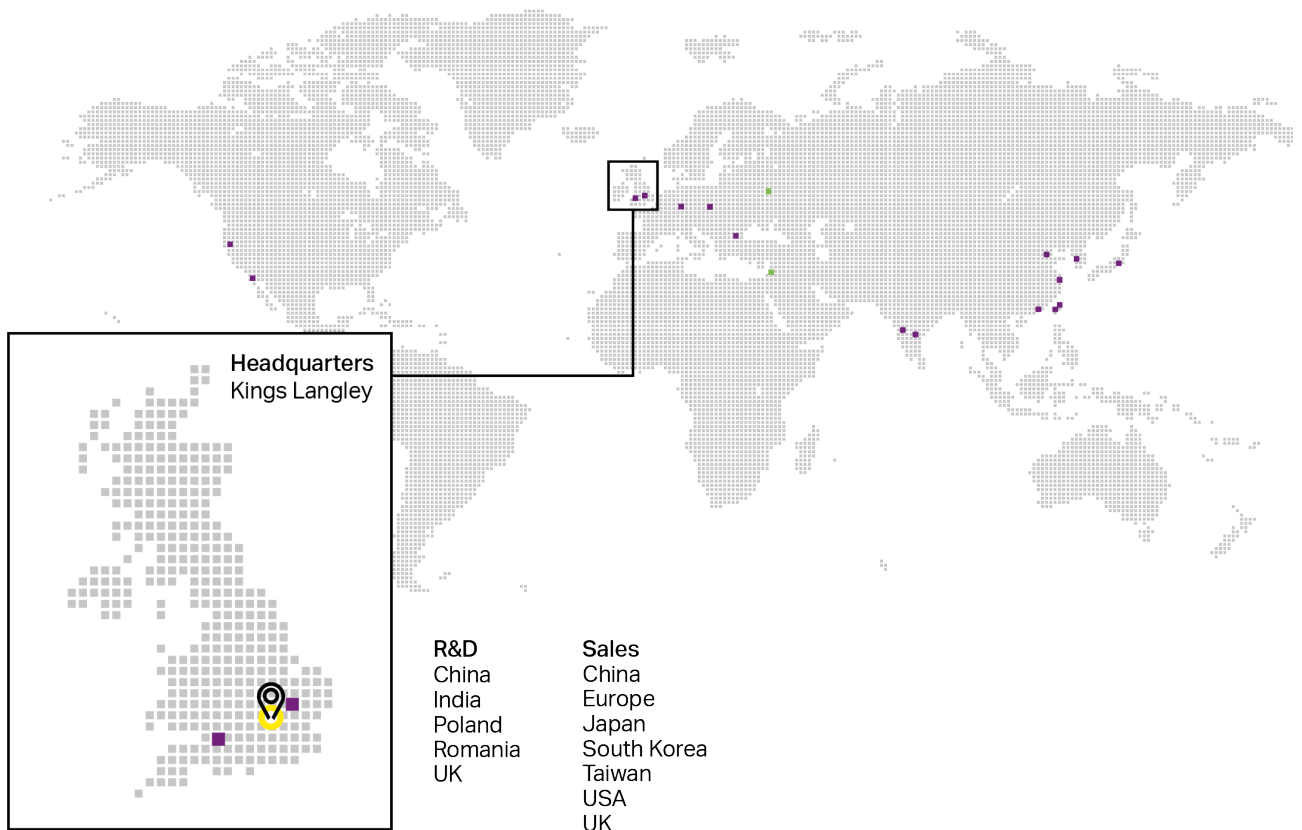
We are optimistic about the UK's future trajectory. With support from the Innovation Strategy and the Chancellor's Plan for Growth, we are confident in our ability to continue creating world-leading technology that will help the UK respond to the challenges of tomorrow.

Tim Mamtora,
Chief of Innovation at Imagination Technologies

About Imagination Technologies

Founded in 1985 and headquartered in Hertfordshire, Imagination Technologies is a leading British technology business that develops highly advanced intellectual property (IP) for use in semiconductors. Our IP creates considerable value in the electronic systems value chain, ultimately improving the user experience in many different consumer electronic devices, including games consoles, mobile phones, cars and computers.

Our IP is licensed to some of the world's leading companies, and we look forward to significant growth in the coming years as technologies including artificial intelligence and autonomous vehicles increase demand for advanced IP.



Imagination Technologies: innovation is in our DNA

As a leading British technology business, innovation is at the heart of Imagination's success. As one of the world's preeminent designers of the IP used in cutting-edge semiconductors, which in turn power all kinds of advanced technologies, we need to constantly innovate to stay ahead of the competition and ensure our IP is capable of the heavy lifting our customers – including leading carmakers and technology firms – require. That means investing heavily, and on an ongoing basis, in the research and development (R&D) and skilled talent that are the key ingredients in effective innovation. Over 700 of Imagination's 850 staff are directly engaged in R&D activity, with the majority of these based in the UK.

You don't need to take our word for it. When it comes to patent applications, a key indicator of how much we invest in innovation, Imagination ranks among the top businesses in the UK, both in terms of patent applications filed and granted at the UK Intellectual Property Office (UK-IPO) and the European Patent Office (EPO). For example, in 2020, Imagination was the 12th most prolific patent filer from all applicants worldwide at the UK-IPO, ahead of other major British technology companies including Arm, Ocado and Cirrus Logic, and was the 11th highest in terms of patents granted at the UK-IPO. This is only possible thanks to our high rate of investment in R&D relative to our revenues compared to the wider technology industry. Our commitment to innovation and global markets has also been recognised through numerous awards over the years, including multiple Queen's Awards for International Trade, Technical Achievement and Innovation.

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And we don't just innovate ourselves. Through the licensing of our IP to our customers, Imagination unlocks innovation and economic growth in a range of sectors and applications, including automotive, gaming, the Internet of Things (IoT), virtual and augmented reality (VR/AR), artificial intelligence and mobile devices. Our IP is the basis for small, power-efficient yet cutting-edge chips that underpin devices used by billions of people across the world, from the latest cars and phones to the most advanced gaming consoles. Moreover, our business model – based on royalties received when companies create products using our technologies – means we only succeed when our customers succeed, encouraging us to work in partnership with our customers to ensure our technology is well and truly suited to their needs.

Last but not least, beyond our core business activities we support innovation through a number of programmes and initiatives. These include the recently launched IMG Labs and our successful University Programme, which provides students and teachers at leading British and international universities with hardware, software and high-quality teaching materials.¹ We also collaborate with PhD students and postdocs on future technologies and participate in initiatives such as the "AI4ME" programme, led by the BBC and the universities of Surrey and Lancaster, which seeks to leverage the power of AI to create personalised media experiences.²

1 For more information visit <https://university.imgtec.com/>

2 For more information visit <https://ai4me.surrey.ac.uk/>

Case study – IMG Labs

In March 2021 Imagination Technologies announced IMG Labs, a specialist division tasked with developing breakthrough innovations fundamental to new, advanced semiconductor products.

IMG Labs' mission is to understand and accelerate future trends in the semiconductor industry, translating these into new licensable technologies that will enable world-leading products for Imagination's partners. IMG Labs' initial focus will be on AI, GPU, heterogeneous compute and ray tracing technologies.

A key part of IMG Labs will be Strategic Technology Research, a cross-functional, horizon-scanning initiative that will seek to anticipate trends and identify disruptive innovations for more detailed investigation, from pushing the boundaries in GPU design to exploring potential applications of neural network acceleration in cars and data centres.

With the launch of IMG Labs, Imagination is doubling down on what it does best – investing in core R&D for new technologies that will shape the future of the British and global economy. Our aim is for IMG Labs to play a significant role in producing cutting-edge solutions and supporting innovation across the UK in the years to come.



Semiconductors: a strategic industry ripe for UK leadership

Although their importance has never been in doubt, the severe global semiconductor shortages that arose during the Covid-19 pandemic have demonstrated like never before the strategic role played by microchips in today's increasingly digitised and globalised economy. From cars, data centres and laptops to phones, televisions and washing machines, semiconductors are the technological fuel behind much of our modern, connected lives. The critical importance of semiconductors will only become more evident in the years to come, with chips – particularly those at the cutting-edge – set to feature at the heart of next generation technologies, such as electric and autonomous vehicles, virtual reality headsets, artificial intelligence applications and smart sensors.

Governments across the world are taking note. The European Union, the US, China, Japan and others have all announced recent measures to strengthen their respective domestic semiconductor industries through investment, incentives, public-private partnerships and other measures. For example, President Biden has committed over \$50 billion to US semiconductor production and undertaken a review of the sector's supply chains, while the EU has put forward bold plans to capture 20% of global market share in advanced chips. In Asia, the Japanese government has identified driving growth in the sector as a "national project", while semiconductors featured prominently in China's \$1.4 trillion six-year plan to secure technological leadership.



Semiconductors: a strategic industry ripe for UK leadership

But where does Britain sit in this picture? While Asia, and, to a lesser extent, the United States, are seen as world leaders in the semiconductor industry, it is an underacknowledged fact that the UK plays an important role in the global semiconductor supply chain. Although its overall global market share may be relatively low, the UK is home to several leading producers of semiconductor IP, including Imagination Technologies, Arm, Alphawave and Graphcore, whose designs collectively underpin billions of devices and applications globally. This concentration of excellence – combined with the country's renowned universities, impressive research base and rich talent pool – offers the UK a rare opportunity to secure a leading role in the global semiconductor industry, should it choose to seize it.

"These chips, these wafers — it's all infrastructure. We need to build the infrastructure of today and not repair the one of yesterday."

Joe Biden, President of the United States

The government appears ready to do so. In its recently published Innovation Strategy, the Department for Business, Energy and Industrial Strategy (BEIS) identifies semiconductors as a key strategic priority for the UK, noting the UK's existing leadership in semiconductor design and the importance of building upon this in the next wave of technological development.³ The strategy also confirms that the government is carrying out a review to explore how public support for the sector could augment UK technological capabilities.

³ <https://www.gov.uk/government/publications/uk-innovation-strategy-leading-the-future-by-creating-it>

Semiconductors: a strategic industry ripe for UK leadership

"Today, we produce 10 percent of what is needed in the world in Europe in terms of semiconductors. We will double it in the next 10 years."

Thierry Breton, European Commissioner for Internal Market

Imagination strongly supports the government's stated intention to get behind the semiconductor industry. But while it is right for the UK to take a more strategic approach to the sector, the focus should be on chip innovation rather than manufacturing. Although a certain level of domestic production would provide the UK with an emergency buffer against severe supply chain disruption, ultimately it will continue to rely on the scale and efficiency made possible by global supply chains. Instead, it should double down on its comparative advantage in semiconductor design and innovation – exemplified by firms like Imagination – by providing the sector with the vision and targeted support it needs to reach the next level.

In practice this should include measures to increase R&D investment in the sector, be it through direct public funding for semiconductor research – including through the existing Compound Semiconductor Applications Catapult – or greater incentives for firms to invest themselves, for example through a new R&D tax credit targeted at advanced technologies or intellectual property. The government should also reflect the sector's importance in its policy programme, both by developing a bespoke strategy for the sector's growth and incorporating it into its wider agenda.



Innovation: the key ingredient in the race for global tech leadership

In addition to helping the UK secure a leading role in the global semiconductor industry, innovation will determine whether the country prevails – or ultimately lags behind – in the global race for tech leadership. As noted in the government’s recent Integrated Review of Security, Defence, Development and Foreign Policy, success in this race will largely shape the UK’s ability to provide its citizens with a prosperous, sustainable and stable future.⁴

It goes without saying that the UK is already a highly-innovative and entrepreneurial country, thanks to its deeply-rooted culture of invention and scientific discovery, world-leading universities, advanced technology companies and – perhaps most importantly – the vibrant ecosystem that brings them all together. According to the Global Innovation Index (GII) – published by Cornell University, INSEAD and the World Intellectual Property Organisation (WIPO) – the UK ranks fourth globally in terms of innovation, performing particularly strongly with regard to the quality of its universities, access to and use of ICT technologies, and government digital capabilities.⁵

However, it cannot afford to rest on its laurels. More than in most areas, preserving a comparative advantage in innovation is highly dependent on maintaining a favourable environment and ensuring the existence of a continued stream of investment. In addition to strengths, the GII identifies a number of weaknesses that risk undermining the UK’s innovation excellence, including relatively low levels of public funding for education (ranking 44th) and low overall levels of capital investment (117th). Without addressing these and other weaknesses while also building on its core strengths, the UK could fall behind its competitors in Europe, North America and Asia.



⁴ <https://www.gov.uk/government/publications/global-britain-in-a-competitive-age-the-integrated-review-of-security-defence-development-and-foreign-policy>

⁵ <https://www.globalinnovationindex.org/gii-2020-report>

Innovation: the key ingredient in the race for global tech leadership

Fortunately, the UK government has recently begun to put innovation at the heart of its overall economic plan. Imagination welcomes key parts of this emerging agenda, including the R&D roadmap and the commitment to invest 2.4% of GDP in R&D by 2027, the new DARPA-inspired Advanced Research & Invention Agency (ARIA) and its emphasis on investment in high-risk, high-reward projects, and the recently published Innovation Strategy, which sets out the strategic technologies and missions the government sees as integral to innovation. In particular, we strongly support plans to establish the International IP Service to help British businesses navigate the highly complex global IP landscape.

For this set of initiatives to succeed, Imagination believes that the government needs to take a more strategic and long-term approach to nurturing innovation in key technologies and sectors – including but not limited to the semiconductor industry – than it has in the past. Too often, successive British governments have put forward new strategies and institutions – from the Industrial Strategy and Industrial Strategy Council to the Regional Development Agencies (RDAs) – and then replaced or abolished these just as businesses had started familiarising themselves with them. This uncertainty hampers the ability of government and businesses to work together towards maximising the UK's innovative potential.

The current government's sizeable parliamentary majority provides it with an excellent opportunity to pursue an ambitious, coordinated and long-term approach to supporting innovation, ideally with a degree of cross-party consensus to lock in even greater longevity. But supporting innovation alone is not enough. It is just as important to avoid undermining it through policies that restrict or disincentivise trade, investment, immigration and business creation – all of which are fundamental ingredients of the innovation mix.

Striking the right balance will not be easy. But the UK's future prosperity and competitiveness depend on it.

Ten recommendations for a more innovative UK

At Imagination, we believe there are ten things the UK should do to unlock its full innovative potential.

1.

Provide an overarching vision and build on existing strengths: although industry has a leading role to play in enabling innovation, an overarching vision from government can help ensure that this activity is directed towards a common purpose. This vision should be based on a realistic assessment of the UK's strengths and weaknesses, and seek to channel support towards areas where the UK already has a competitive advantage.

2.

Recognise and reinforce the UK's existing excellence in semiconductor design: one clear area of existing strength is in semiconductors, with the recent global shortages demonstrating as never before the centrality of chips in modern supply chains. Through enabling innovation in other sectors, the semiconductor sector is also a powerful illustration of the importance of wider innovation "ecosystems". The UK should build on its existing excellence in semiconductor design to become a true global industry leader, ensuring it captures the economic benefits of this rapidly growing sector while reducing its exposure to future supply chain disruption.

3.

Leverage investment: unlocking the UK's full innovative potential requires leveraging the power of private investment to drive technological advancement and provide businesses with the resources to scale. Government should seek to remove unnecessary regulatory barriers to domestic investment while maximising the UK's attractiveness to foreign investors and businesses.

4.

Fund the future: government should use public funding and procurement to drive innovation in areas where private investment is either absent or insufficient, particularly when it comes to high-risk investment in pre-commercialisation and early-stage technologies. Public investment should avoid crowding out or duplicating private investment, and focus on promoting national capabilities rather than national champions.

5.

Place innovation at the heart of trade policy: by increasing competition, facilitating technology transfer and expanding access to global markets, international trade enables innovation. The government should use trade policy to encourage the open and fair licensing of technology and widen access to global supply chains, while challenging unfair market practices abroad that disadvantage UK innovators.

Ten principles for a more innovative UK

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Maintain a healthy talent pipeline: without access to the right talent, innovation in the UK will be held back. Government must ensure that businesses, universities and the public sector have access to the skills they need by investing in domestic training and education, while making it easy for talented individuals to migrate to the UK. Careers in STEM should be promoted to pave the way for future innovators.

7

Incentivise innovation through the tax system: the tax system should raise sufficient revenues to meet spending needs while also incentivising innovation through mechanisms such as rebates, investment allowances and competitive rates. Equally, it is crucial that taxation does not disincentive innovation or drive it abroad by being overly punitive or complex.

8

Ensure a competitive listings environment: as more high-growth technology companies choose to go public, the UK should do all it can to take advantage. A competitive listings regime will attract more global innovators to list in the UK and encourage more innovative British companies to stay put, benefiting the wider economy.

9

Innovate for the greater good: innovation will be instrumental in addressing many of the interrelated challenges facing the UK, from levelling up the regions and achieving net zero to remaining competitive on the global stage. Both businesses and government should have these challenges front of mind as they invest in new technologies and R&D.

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Exchange best practice: innovation is most effective when it is disseminated as widely as possible. British businesses and government should draw on best practice from around the world when it comes to innovation and innovation policy respectively, while sharing their own ideas and expertise with trusted partners.



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