Google's Economic Impact in the UK 2023

PUBLICFIRST

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PUBLICFIRST

Public First is a global strategic consultancy that works to help organisations better understand public opinion, analyse economic trends and craft new policy proposals.

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Contents

Executive Summary

2023 is a critical year for the development of AI. A new wave of generative AI tools and services looks set to transform how we work, communicate and find information. The UK is already one of the world's leading countries in AI, and given its research base and the strength of its wider tech industry, it has the potential to continue to thrive.

Google's mission is to organise the world's information and make it universally accessible and useful. This mission is more relevant than it's ever been, while AI is providing one of the most profound new opportunities to unlock the power of information. To ensure economic and societal growth, it's vital that everyone is given the opportunity to harness the benefits of technology. In this report, we look at how Google's innovations and products are helping British families, workers and businesses, and explore the massive potential of AI going forward.

Google's products have transformed how we access information. Google's original innovation - Search - revolutionised the search engine and made it easier for everyone to navigate the internet by judging the relevance of a website by the other links that point towards it. Google Maps has helped us explore the physical world without getting lost, while tools like Google Workspace - Docs, Sheets, Slides and Meet - has changed the way we worked, letting workers collaborate in real time on documents, and helped enable the current shift towards hybrid working.

For a number of years, AI has played a crucial role in many of Google's leading products:

Search uses AI to better understand the context behind queries. The technology also enables people to find information in different ways, such as with images or even by humming a tune.

Maps uses AI to provide up-to-date traffic information, and keep business hours up to date and accurate.

YouTube uses AI to automatically generate captions, and recommend relevant creators for you to watch.

In 2017, the company pioneered the Transformer machine learning model, which made it much easier to train ever larger machine learning models. This, in turn, led to the current wave of new generative AI applications that is transforming the wider tech industry.

This year, Google is adding more generative AI tools and other forms of AI to many of its core products, making it easier to research answers to nuanced questions with many possible solutions, help respond to emails quickly, create captivating presentations, build spreadsheets efficiently and have the tools to identify synthetically generated content.

In total, Public First estimates that these tools could s**ave the average worker in the UK over 100 hours a year**, which would be the single biggest improvement to worker productivity since the arrival of Google Search itself.

We all experience the value of Google everyday, but the wider value Google provides to other businesses and the UK economy can also be quantified. Google's products, platforms and tools, including Search, Maps, Workspace, Cloud, Play and Android, will **help provide an estimated £118 billion in economic activity in 2023 in the UK, supporting over 1 million businesses across the length and breadth of the country.** That's bigger than the entire economy of Manchester or Birmingham.

The Economic Impact of Google's Innovations

Consumer

Through investment, innovation and harnessing the latest technology, Google has continued to improve the experience and impact of its tools such as Search and Maps, helping families save money, time and make smarter choices.

1 In total, we estimate that Google services save the average household around £100 a year through reduced travel and entertainment costs.

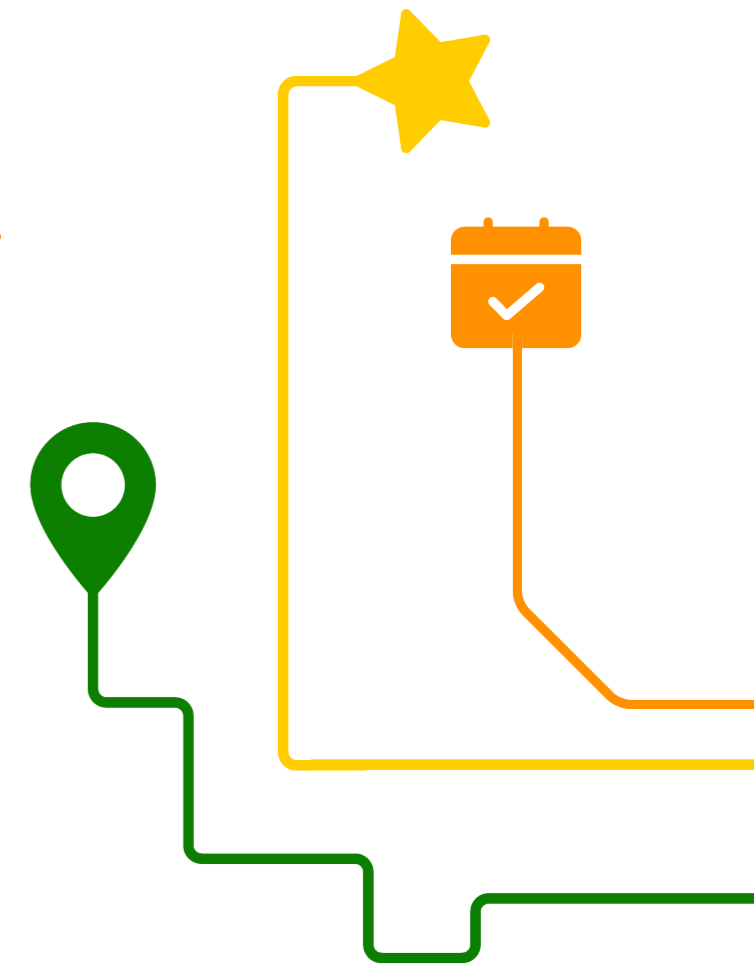🏠 **£100**/year

2 78% of users of Google Reviews say that they help them choose better products and services.

🛒 **78%**

3 Google tools have helped people in the UK to earn over £7 billion per year in secondary income online.

🪙 **£7bn**/year

Businesses

In the past, only the largest companies could afford to reach potential customers around the world. Today, Google's platforms, such as Google Ads, Google Business Profile, YouTube and Google Play, have made it far easier for businesses of all sizes in every corner of the country to reach customers at home or abroad.

4 Online search remains the second most important way businesses say that their customers find them, behind only word of mouth.

5 Two-thirds (65%) of Google Business Profile users agree that it helped them attract new customers.

65%

6 In total, we estimate that Android has saved developers in the UK over 1 million days, the equivalent of £300 million in reduced development costs.

£300m

7 Google Search and Ads are helping UK businesses to export over £20 billion worth of goods and services across the world. If this was a separate industry, it would be the UK's fifth largest source of exports behind mechanical power generators, oil, cars, and pharmaceuticals.

£20bn

Careers and Skills

Google's products and services have created new ways for people to learn new information or skills throughout their lives, making them some of the most essential tools for work today. At the same time, collaborative working platforms like Google Workspace have made it easier for us to adapt to more flexible forms of working.

8 Over seven million people in Britain have learned new digital skills through Google Search, creating a £26 billion improvement in productivity. That's a larger increase in human capital than produced annually by the entire Russell Group of universities.

£26bn
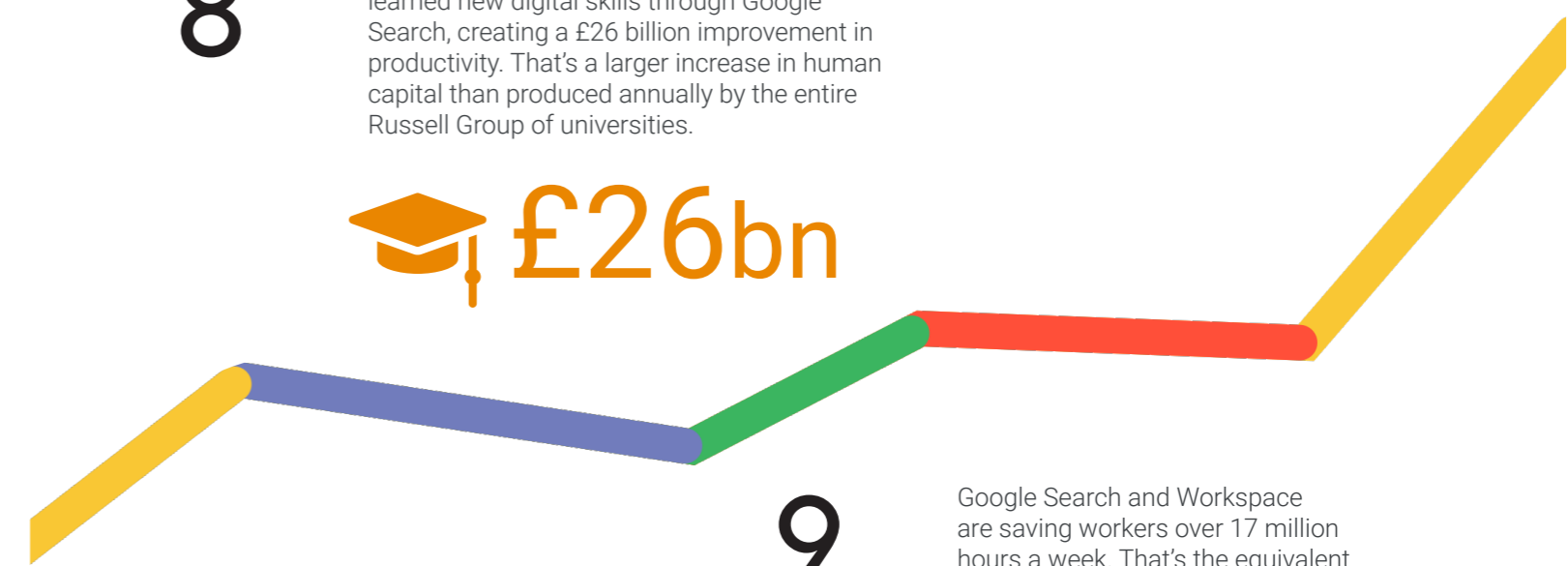
9 Google Search and Workspace are saving workers over 17 million hours a week. That's the equivalent of producing a £35 billion improvement in productivity for the British economy.

£35bn

10 Over half of Britons under 25 have recently used Google Search to help them apply for a new job.
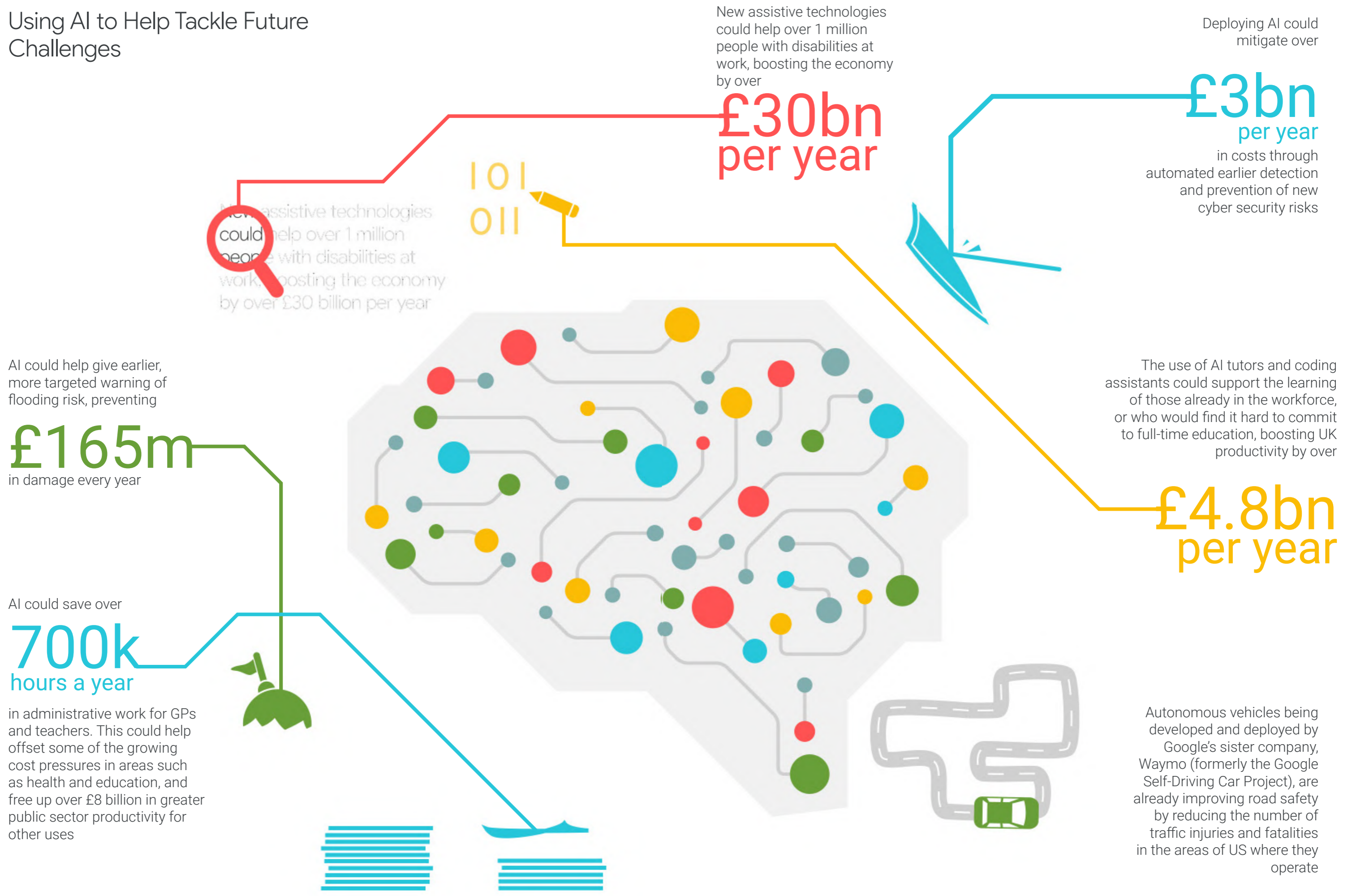
50%

11 Since 2015, Google has visited more than 500 locations across the UK and trained over 1 million people in digital skills.

1m

Using AI to Help Tackle Future Challenges

New assistive technologies could help over 1 million people with disabilities at work, boosting the economy by over

£30bn
per year

Deploying AI could mitigate over

£3bn
per year

in costs through automated earlier detection and prevention of new cyber security risks

New assistive technologies could help over 1 million people with disabilities at work, boosting the economy by over £30 billion per year

AI could help give earlier, more targeted warning of flooding risk, preventing

£165m
in damage every year

The use of AI tutors and coding assistants could support the learning of those already in the workforce, or who would find it hard to commit to full-time education, boosting UK productivity by over

£4.8bn
per year

AI could save over

700k
hours a year

in administrative work for GPs and teachers. This could help offset some of the growing cost pressures in areas such as health and education, and free up over £8 billion in greater public sector productivity for other uses

Autonomous vehicles being developed and deployed by Google's sister company, Waymo (formerly the Google Self-Driving Car Project), are already improving road safety by reducing the number of traffic injuries and fatalities in the areas of US where they operate

Google and its parent company, Alphabet, are one of the world's leading innovators in AI, pioneering many of the most significant advances in the field. This research goes beyond the products typically associated with Google.

Over the last five years, Alphabet has invested more than $145 billion globally in R&D. In 2021, the company published over 850 research papers in AI, while its TensorFlow library of open source machine learning tools has more than 200,000 users and over £13 billion in economic impact globally.

In the life sciences, Google DeepMind is helping to accelerate drug discovery through AlphaFold, its breakthrough in protein folding, while Waymo's team of engineers in the UK is helping to develop their autonomous driving technology.

In the next few years, the economic impact of AI is likely to grow even further, as the adoption of generative AI increases. In total, we estimate that these **tools could create over £400 billion in value for the UK economy by 2030**, the equivalent to an annual growth rate of 2.6%, or enough to end the recent growth stagnation. That is potentially a bigger boost to growth than the entire Personal Computer or Internet revolution.

In the second section of the report, we look at the potential of AI, digital technologies and better digital skills to help with societal challenges.

Powering the UK's AI Transformation

In order for the UK to fully take advantage of the economic potential from AI and remain internationally competitive, Google suggests government policy focuses on the following core areas:

- **Skills**. Two-thirds of UK employers currently report difficulty recruiting workers with digital skills. The UK should create a new National Skills Service. This could identify, offer and accredit accessible and valuable lifelong learning to help workers develop their careers and businesses to grow and increase their productivity.

- **Research and Development**. According to IPPR, the UK's share of global investment in research and development (R&D) has fallen by a fifth since 2014. The UK should increase the ambition of its target for public investment in R&D to consistently exceed the OECD average by 2030, while ensuring this funding is helping drive growth across regions with ring-fenced funding to support SMEs working on strategic technologies.

- **Pro-innovation regulation**. At the moment, there are too few structural incentives for regulators to take into account future potential benefits from new technologies. The UK should implement Innovation Impact Assessments to ensure that regulation supports innovation and doesn't become a barrier to growth.

- **Infrastructure**. To be a world leader in science and innovation, the UK needs to increase its large-scale computing capacity, and public access to it. As of November 2020, the UK only had 12 of the top 500 computer systems globally compared to 214 and 114 for China and the US respectively. The UK should establish a UK Research Cloud that democratises access to AI technology, computing power, datasets and collaboration tools to a network of researchers across industry and academia.

How we quantified Google's impact in the UK

In this paper, we used a range of different methods to quantify the economic impact and helpfulness of Google Search, YouTube, Android and other Google products:

Building on the precedent of previous Google impact reports from markets including the UK, the United States, and Europe, we used traditional economic modelling built upon third-party estimates of Google market size in the UK, and standard returns on investment (ROI) to measure the economic activity driven by Google's core products.

Working with independent providers Dynata, we conducted extensive polling of a representative sample of over 4,000 individuals representing every region in the UK.

At the same time, we polled 1,000 senior business leaders from small, medium and large businesses, representing a range of different industries.

To learn more about our modelling approach, please see the Methodology section in the report's appendix.

Public First is a member of the Market Research Society. The full tables for all the data used in this report is available to download from our website.

While Google commissioned this report, all information in this report is derived or estimated by Public First analysis using both non-Google proprietary and publicly available information. Google has not supplied any additional data, nor does it endorse any estimates made in the report. Where information has been obtained from third party sources and proprietary research, this is clearly referenced in the footnotes.

Foreword

AI is the most profound technology that humanity is working on today. It's a critical part of solving big societal challenges, from tackling climate change to developing new personalised medicines. That's why it's so inspiring that some of the early seeds of this extraordinary technology were sown right here in the UK. From British mathematician Alan Turing in the 1950s, to the team at Google DeepMind's work on protein folding today.

The UK is home to world-leading academic institutions, an enviable startup ecosystem and millions of businesses large and small using digital to drive growth. This country has an enormous opportunity for technology leadership. It's a hub for innovation that Google has been proud to call a home for over 20 years.

Google commissioned this economic impact report to delve into the potential that AI presents for the UK, as well as to understand in more detail how services like Google Search and Maps are creating tangible value up and down the country.

Based on their in-depth research, Public First has calculated that AI-powered innovation could create over £400 billion in economic value for the UK economy by 2030. That's not just a big number - it's an untapped potential that can benefit everyone across the UK: every sector, every industry, every aspect of our lives.

But for the opportunity of AI to be realised by everyone, we know we need to work together. There are three important ways that Google can help unlock the potential of tech in the UK:

Equipping the UK with tools and tech investment

Enabling everyone to develop the skills they need to harness technology

Engaging with the ecosystem to ensure a future that will benefit all

One of the ways that Google is equipping the UK is by putting AI-powered tools into the hands of people and businesses today. This report calculates that these tools and services will create £118 billion in economic value in the UK in 2023. Another way is by investing in Google's UK presence, for instance with the $1 billion purchase of the Central St Giles office, as well as a new development in King's Cross - providing capacity for up to 10,000 Google employees.

It's important that digital opportunities are open to everyone in the UK. That's why Google is focused on enabling everyone to develop the skills they need to harness technology. Google launched its digital skills programme in 2015 with teams visiting over 500 locations across the UK, from Glasgow to Port Talbot, Sunderland to St.Ives, offering free training to more than one million people, helping them grow their businesses and careers. Google Career Certificates are putting thousands of Brits on a path to highly paid tech jobs and Google for Startups delivers programmes to support startups across the UK.

Realising the potential of AI is not something one company can do alone, which is why we are focused on engaging with the ecosystem to ensure a future that will benefit all. From the Government, to academics, entrepreneurs and businesses, we all need to work together to fully maximise the opportunity. This includes developing access to compute capacity, realising ambitious R&D targets and developing a responsible, pro-innovation regulatory framework.

AI presents an enormous opportunity to enhance the lives and businesses of everyone across the UK - we are committed to working together to help see that potential delivered.

DKWeinstein

Debbie Weinstein

Vice President and Managing Director, Google UK & Ireland.

Introduction

The Importance of Innovation

It is easy to forget how much technology has changed in the last 25 years. In 1997, just 7% of the UK's population had access to the internet,[1] and for those who did, average speeds were around 2,000 times slower than today.[2] The only way to send text messages from your phone was limited to 160 characters, and each one cost the equivalent of 20p today. At work, you were as likely to receive a fax as an email. On TV, most people were limited to five channels, and if you wanted to watch a specific movie you didn't own, your best choice was to drive to a video rental store. Every photo you wanted to take cost around 50p a snap - and that is if you happened to have taken your dedicated camera out with you.

Together, the technological transformation created by the internet and smartphone has radically reduced the cost of creating and accessing information: making it possible for everyone to take near countless photos, access endless films or music, keep in constant touch with friends or family, or just look up a fact whenever you need it.

This has had a significant impact on the economy. Measuring all the different ways digital tech boosts growth is challenging: digital technology not only increases the productivity of individual workers, but often revolutionises the standard business model for many industries, making it hard to compare like for like. Even on conservative assumptions, however, we estimate that digital tech is responsible for 22% of the UK's growth since 1990,[3] while other estimates find that digital is responsible for over 60% of wider innovation.[4]

As important as its economic impact, has been the changes it has brought to our everyday lives. Many of the most important internet services, from search engines to online video, are often offered free of charge to the end user. While that makes them hard to measure using traditional economic statistics such as GDP or inflation, they are still valuable. When we asked people how much you would have to pay them to go back to the technologies of the mid 1990s, the average person said **over £200 a month**.

Google's Innovation

Ever since its official founding in 1998, Google has been one of the leading drivers of innovation in digital technology. From Search to Android, PageRank to the Transformer model, Google's innovation and technologies have played a key role in organising the world's information, and making it more accessible to everyone.

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1   https://ourworldindata.org/internet
2   Based on an average of 40 kbps in 1997 and Ofcom's estimated average home
        broadband speed of 80 mbps.
3   Public First based on Conference Board data
4   https://econpapers.repec.org/bookchap/eeegrochp/1-10.htm

Google's Key Innovations

PageRank was a groundbreaking algorithm developed by Google's co-founders, Larry Page and Sergey Brin, that ranked web pages based on the number and quality of links pointing to them, enabling the new **Google Search** to deliver more relevant and useful search results.

Online video streaming, exemplified by Google's **YouTube** platform, revolutionised the way people consume and share media content by allowing users to easily upload, store, and share videos with a global audience, democratising content creation and distribution.

Google Ads, then AdWords, introduced an innovative auction system for online advertising, allowing advertisers to compete for ad placements. This made it possible for businesses of all sizes to reach their target audience cost-effectively and efficiently.

Online productivity suites such as **Google Workspace - Docs, Sheets and Slides** - transformed the way people collaborate on documents, spreadsheets, and presentations, allowing real-time editing and sharing.

Threaded online email, as introduced by **Gmail**, transformed email communication by organising related messages into easily accessible conversations, while providing an order of magnitude more storage.

The open source **Android** operating system, provided a customisable and adaptable platform for mobile devices, and made sure every phone manufacturer could take advantage of the latest in mobile technology. Today, there are over 1,000 different companies that make devices that run on Android.

Having access to **Google Maps**, wherever you are, changed the way people travel and explore the world, making it easier for users to find locations, businesses, and directions without the need for physical maps or expensive sat nav systems.

Transformer, a machine learning architecture developed by Google, set the stage for almost all the generative AI activity we see today at Google and beyond, including the development of tools like Bard, Midjourney, GPT and Stable Diffusion.

Today, Google is at the forefront of developing new techniques and technologies based around AI.

If you have used Search, Maps or YouTube in the last few years, you have already used an AI powered Google product. AI is increasingly driving many of the new features introduced into Google services:

In **Search**, AI enables Google to better understand the context of the kind of information you are likely to be looking for, or let you search in different ways, such as through your camera or even humming a tune.

In **Maps**, AI provides up-to-date traffic information, and helps to always keep data such as business hours up to date.

On **YouTube**, AI helps automatically generate captions or recommend new and upcoming creators for you to watch.

In **Photos**, AI helps automatically categorise your pictures by who or what is in them, making it far easier to surface old memories.

In **Gmail**, AI helps power increasingly powerful autocomplete, while blocking nearly 10 million spam emails every minute.

In **Ads**, tools like Performance Max can help small and large businesses run a more efficient advertising campaign.

Google's Impact in the UK

The UK is one of Google's and its parent company Alphabet's most important engineering hubs, with 6,500 employees in the UK, $1 billion invested in its Central Saint Giles office and a new purpose built office development in King's Cross:

- UK-based engineers have worked on many of Google's core products including Search, Android, Google Cloud and Google Pixel. Google Business Profile, one of Google' most important tools to help businesses connect with customers, was largely developed in the UK. 79% of businesses in the UK told us that they found Google Business Profiles or Google Reviews a helpful way to connect with customers, and over 32 million businesses now use them globally.

- The UK is the home to Google DeepMind, leading on the research and development of Google's most capable and responsible general AI systems. From early success in learning Atari computer games to beating professional Go players, since its creation in 2010 DeepMind has achieved many significant advances in the field of AI. In the last few years, its model AlphaFold has demonstrated the ability to accurately predict 3D models of protein structures giving the potential to accelerate research in every field of biology.

- In 2022, Google opened a new Accessibility Discovery Centre, in association with The Royal National Institute of Blind People, the Royal National Institute for Deaf People and Everyone Can. It is intended to provide space for workshops for research and product development, and a space for collaborating, co-designing and learning with accessibility and disability communities.

In this report, Google commissioned us to explore and quantify the impact Google's products and innovation are having on families, workers and businesses in the UK.

In total, we estimate that Google's products, platforms and tools, including Search, Maps, Workspace, Cloud, Play and Android, will help provide an estimated £118 billion in economic activity in 2023, supporting over 1 million businesses across the UK.

In the first section of the report, we explore the impact Google's innovations are having now: making it easier for small businesses to connect with new customers worldwide, workers to learn new skills, or established companies to create new products and inform business decisions.

In the second section of the report, we look in depth at recent advances in AI, its potential to help reverse the UK's current growth stagnation and how it can help tackle many societal challenges, from the disability employment gap to providing earlier warnings of flooding.

Google's Impact per Region

£9.7bn
Scotland

£3.0bn
Northern Ireland

£13.1bn
North West

£10.2bn
West Midlands

£5.1bn
Wales

£9.9bn
South West

£4.2bn
North East

£9.6bn
Yorkshire & The Humber

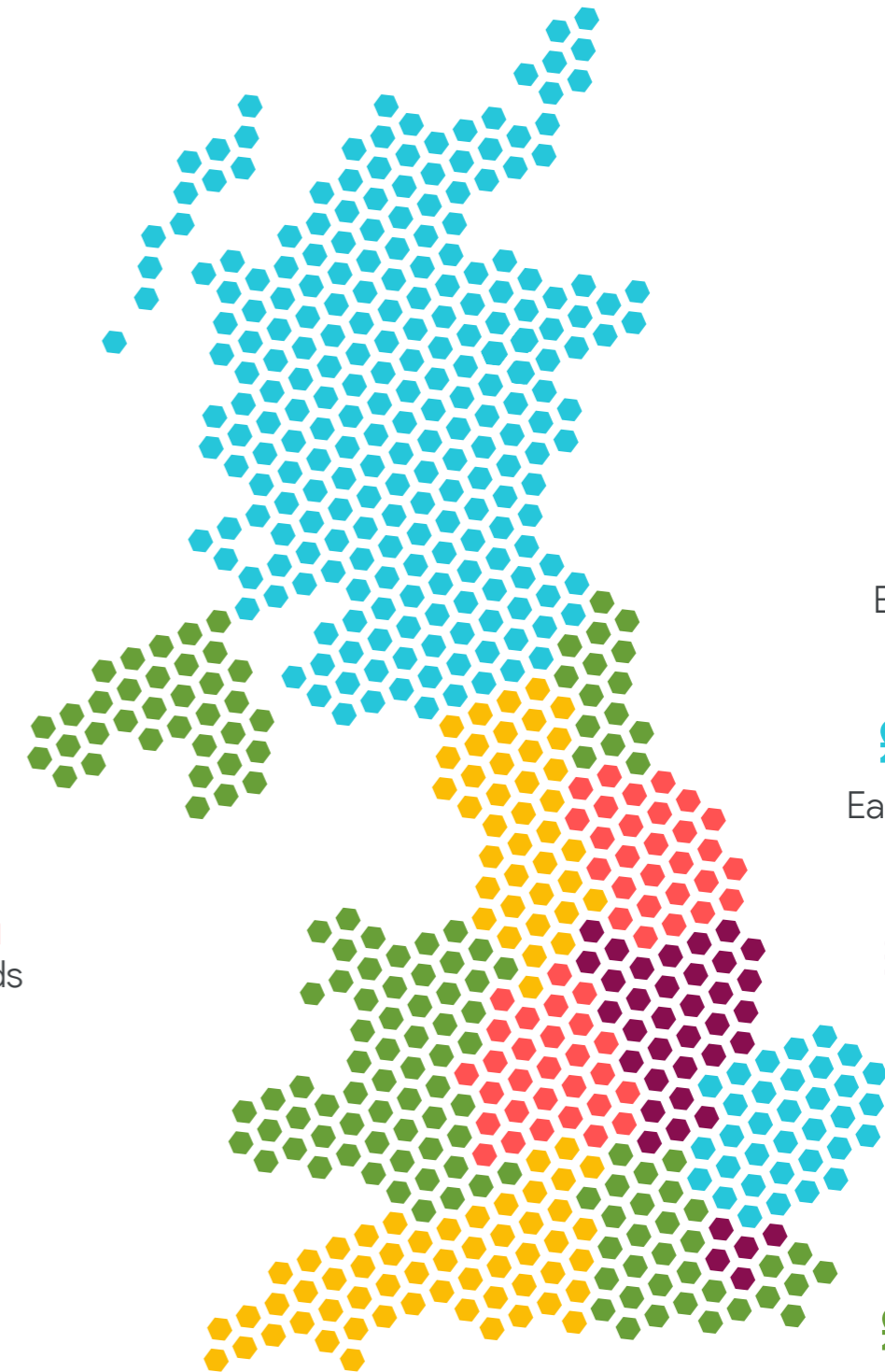**£8.5bn**
East Midlands

£10.8bn
East of England

£18.5bn
London

£15.4bn
South East

Consumers

> *"It would be wrong to claim you couldn't conduct internet searches before the invention of Google. You could. It's just that it didn't really work, and no one really cared."*

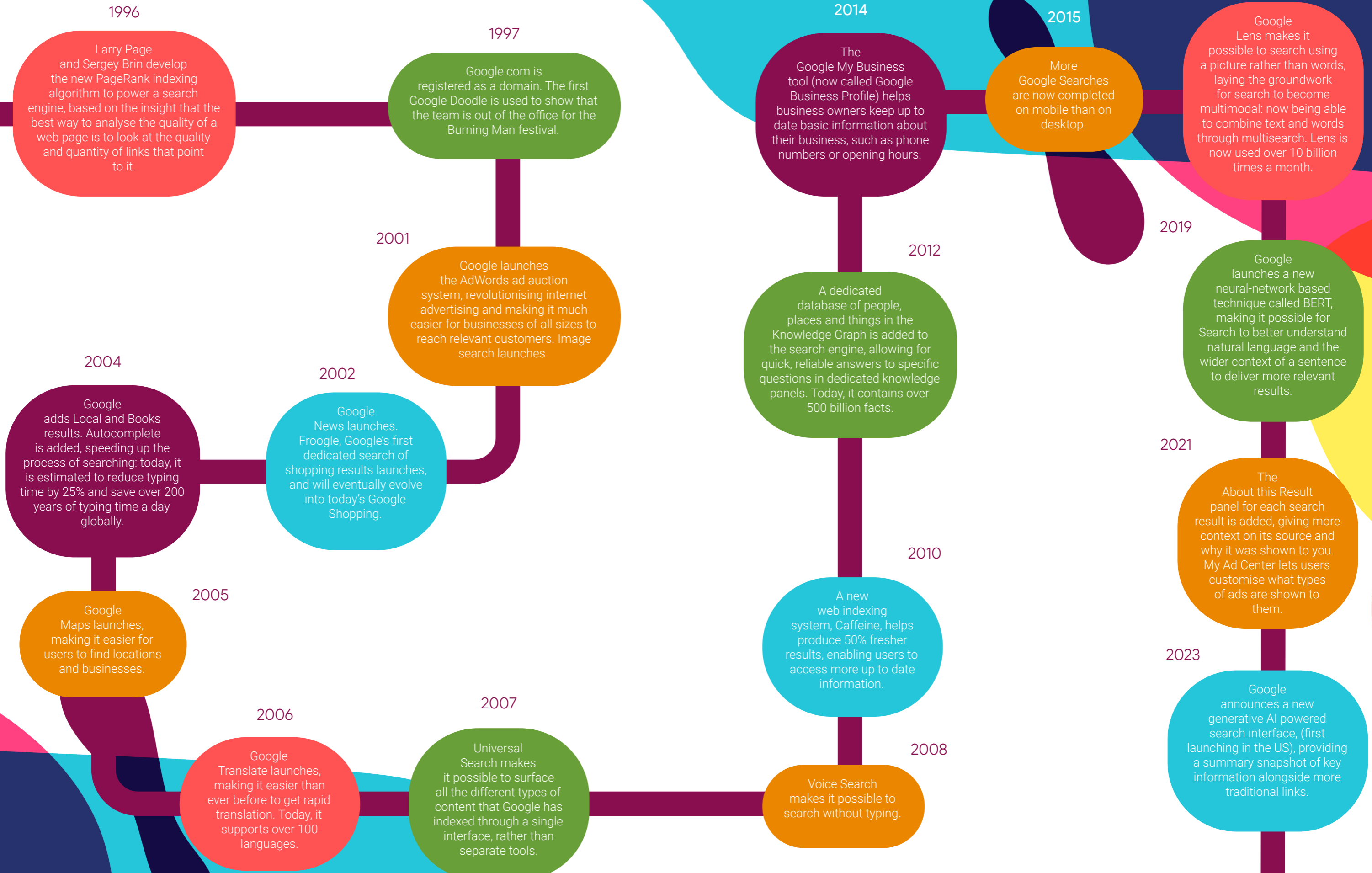**Chuck Klosterman, The Nineties**

Google's Innovation

In 1997, Google.com was registered for the first time as a domain. Started as a research project by two PhD students Larry Page and Sergey Brin the year before, by 2000 the search engine had already scaled to ten languages, indexing over 1 billion URLs. Google's first innovation, which saw it rapidly gain in popularity amongst early users, was PageRank: an algorithm that helped the search engine deliver far more relevant internet results.

Today, **the average person in Britain uses Google Search over five times a day**. Google Search helps us look up a fact, find a recipe online, compare prices, get holiday ideas, troubleshoot technical issues, learn more about history, stay up to date with the news, do basic maths, or figure out what to do next in our career. What we search for is just as varied and interesting as each of us individuals.

Small improvements add up. **Making the average process of finding a piece of information through search just one second quicker saves the UK over 2 million hours a year.** That's the equivalent of three average human lifespans.

When Google started, it had two buttons ("Google Search" and "I'm feeling lucky") and presented results 10 links at a time, from an index of 26 million pages. Over the last 25 years it has continued to iterate, adding features including image search, dedicated news results, shopping results, local search results, autocomplete, weather, translation, voice search, flight and hotel search, the Knowledge Graph database, instant sports results, job search and extreme weather forecasting. Under the hood, today's Google Search is more current, comprehensive and understands better the context of what you are likely to be looking for, allowing users to to get to relevant and trusted information quicker. In our polling, we saw that many people highly valued these features, with over 90% of the users of the automatic translation of other languages, knowledge panels, image search, built-in calculator, or flight search saying they found them helpful.

How Google Search has evolved through the years

1996

Larry Page and Sergey Brin develop the new PageRank indexing algorithm to power a search engine, based on the insight that the best way to analyse the quality of a web page is to look at the quality and quantity of links that point to it.

1997

Google.com is registered as a domain. The first Google Doodle is used to show that the team is out of the office for the Burning Man festival.

2001

Google launches the AdWords ad auction system, revolutionising internet advertising and making it much easier for businesses of all sizes to reach relevant customers. Image search launches.

2004

Google adds Local and Books results. Autocomplete is added, speeding up the process of searching: today, it is estimated to reduce typing time by 25% and save over 200 years of typing time a day globally.

2002

Google News launches. Froogle, Google's first dedicated search of shopping results launches, and will eventually evolve into today's Google Shopping.

2005

Google Maps launches, making it easier for users to find locations and businesses.

2006

Google Translate launches, making it easier than ever before to get rapid translation. Today, it supports over 100 languages.

2007

Universal Search makes it possible to surface all the different types of content that Google has indexed through a single interface, rather than separate tools.

2008

Voice Search makes it possible to search without typing.

2010

A new web indexing system, Caffeine, helps produce 50% fresher results, enabling users to access more up to date information.

2012

A dedicated database of people, places and things in the Knowledge Graph is added to the search engine, allowing for quick, reliable answers to specific questions in dedicated knowledge panels. Today, it contains over 500 billion facts.

2014

The Google My Business tool (now called Google Business Profile) helps business owners keep up to date basic information about their business, such as phone numbers or opening hours.

2015

More Google Searches are now completed on mobile than on desktop.

2017

Google Lens makes it possible to search using a picture rather than words, laying the groundwork for search to become multimodal: now being able to combine text and words through multisearch. Lens is now used over 10 billion times a month.

2019

Google launches a new neural-network based technique called BERT, making it possible for Search to better understand natural language and the wider context of a sentence to deliver more relevant results.

2021

The About this Result panel for each search result is added, giving more context on its source and why it was shown to you. My Ad Center lets users customise what types of ads are shown to them.

2023

Google announces a new generative AI powered search interface, (first launching in the US), providing a summary snapshot of key information alongside more traditional links.

Together, these improvements have helped keep Google Search relevant. 96% of Google Search users told us that it helped them find the information they were looking for.

81% of the respondents to our survey scored Google Search at an 8 or above, on a scale from 1 to 10, when asked how favourable an opinion they had of it as a service. When asked how they would describe it:

91%
would describe it as helpful

89%
would describe it as fast

85%
would describe it as reliable

Britons, overwhelmingly, actively choose Google Search as their preferred search engine rather than using it by default, with only 19% telling us they thought it would be difficult to find a different search engine to use. Instead, when we asked more about why they chose Google Search and how it compared to other search engines:

76%
said it was easier to use than other search engines

71%
said it gives more relevant results

69%
said it returns results faster

One way to quantify the total value created by Google Search is through a measure used by economists known as the consumer surplus. The consumer surplus of products that are offered for free looks at how much a product is worth to a user and how much you would have to compensate them to lose it. In 2023, our central estimate is that **Google Search alone creates a consumer surplus for the average adult worth £39 a month, or almost £500 a year.**

Case Study: The Independent Community News Network

Over the past 20 years, Google has collaborated closely with the news industry to support the creation of quality journalism in a digital age. Through Google News Showcase, the company offers a product experience and licensing programme for news publishers, while programmes like the Google News Initiative provide tools, training, and grant funding to help news organisations thrive.

Google News Showcase welcomed the Independent Community News Network (ICNN), representing the UK's independent local news sector, earlier this year. Through a partnership with Ping — the Public Interest News Gateway — Showcase licensing deals have been extended to 45 smaller independent news titles. By aggregating local community and public interest stories and distributing them to regional and national news desks, new revenue streams have been created for the independent sector.

"*This is a watershed moment for independent journalism in the UK and we are delighted to expand our relationship with Google to bring this partnership together. Google News Showcase is an extremely important initiative that highlights the value of local news*," said Matt Abbott, ICNN's deputy director. "*By partnering with Ping News, Google is not only helping the independent sector become more sustainable but is also lending credibility to it.*

Google's support of the Ping platform means regional and national publishers will soon be able to access rich multimedia content from every region of the UK on demand, from hundreds of professional independent community journalists."

The Importance of Learning

Whether it is at school, for our job, to help around the home, or just satisfy our curiosity, we all need to learn new things throughout our lives. **87% of people told us it was personally important to them to learn new things.** On average, they reported spending around two hours a week learning about a new topic or skill.

Today, the internet is one of the most important ways we learn. A majority told us that they had researched something on the internet purely out of curiosity in the last week - which is around three times the proportion who had read a nonfiction book.

In the last three months:

51%
of Google Search users have used it to learn about a personal hobby

49%
of Google Search users have used it to learn about history

43%
of Google Search users have used it to learn about living more healthily

41%
of Google Search users have used it to learn how to use a piece of software or an app

Bar chart — "Have used Google Search to learn about this":
- The news in your local area
- International news
- A medical issue
- Look up subject knowledge for your job
- A personal hobby
- History
- Politics
- Living healthier
- How to use a piece of software or app
- How to reduce your energy bill
- A new skill in your personal life
- A technical or digital skill for your job
- Science
- Soft skills for your job
- How to apply for a new job
- Budgeting skills
- A skill that will help you get a new job
- How to reduce your impact on the climate

X-axis: 0, 10%, 20%, 30%, 40%, 50%, 60%, 70%

What was the last thing you used Google Search to learn?

"How long it takes to defrost chicken"

"About the prices for a flight for a trip to Thailand"

"Crossword clue"

"9 month baby developmental milestones"

"Advice about my teenager"

"To find out when the first Manchester Gay Pride march was held"

"Breathing techniques for swimming with goggles"

"A bit of German vocab"

"What a major seventh chord is"

"A history matter"

"Energy prices and ways to cut back and save"

"A business telephone number and address"

"How to change a seal on my fridge"

"A follow-up on an item on the BBC news"

"Searched for part time jobs"

"A specific exercise - pull ups"

"A knitting pattern"

"How to replace an ignition coil on a car"

"About changing gears on bicycles"

"To check trains were running as its snowing"

"How feasible is the recent news about nuclear fission breakthrough"

"About climate change effect on the crab population"

"About how March used to be the 1st month"

"The age of David Attenborough"

Responses to open text question in consumer poll. Answers have been edited for spelling and grammar, but are otherwise unchanged

For more tactile skills, a picture - or even better, a video - is worth a thousand words. Many people find video an easier way to learn than pure text. In our polling, more people (26%) actually told us that they learned better through video than reading than the other way around (16%).

That has helped YouTube to become an increasingly important learning tool. In the last year:

63%
of YouTube users have used it to learn something new or enhance their knowledge on a topic

58%
of YouTube users have used it to get help with DIY tasks

51%
of YouTube users have used it to get help with cooking

39%
of YouTube users have used it to find commentary on the news or political events

Have used Youtube to learn about this

- Watch a music video
- Look for entertainment
- Learn something new
- Watch YouTube Shorts
- Get help with DIY tasks
- Get help with cooking
- Learn a new skill in your personal life
- Learn about health and wellbeing
- Learn about fitness
- Find commentary on the news
- Learn a skill for your job
- Watch a video game stream
- Learn budgeting skills
- Get help with make-up
- Replace a video streaming service
- Get help with CV and job applications

At schools, Google products are an increasingly important educational tool. Around half (49%) of parents of school-aged children told us that their child had used one of Search, Maps, YouTube or YouTube Kids to help with homework in the last year.

Around a third (35%) of parents of school-aged children said that their child had used Google Classroom - Google's online learning platform - for creating, distributing, and grading assignments at school. Of those:

79%
said that it helped with their child's learning

78%
said that their child found it easy to use

81%
said that their child found it convenient

Case Study: Gosforth Handyman

Handyman Andy MacLellan, known as Andy Mac, has been repairing and maintaining properties for years, tackling everything from loose floor tiles to full renovations. In 2016, he decided to start filming some of his projects and sharing them on YouTube — something that proved hugely popular with viewers.

"*Before YouTube, I was constantly asked by clients how to do various simple repair jobs,*" says Andy. "*Eventually I thought I'd just make videos explaining how I do them. It started with 'how to use a tape measure properly' and all grew from there.*"

Known online as the Gosforth Handyman, Andy now uses his channel to document a range of common DIY challenges and simple fixes. With over 230,000 subscribers and more than 36 million views, his videos have become a reference point for tradespeople and DIYers alike.

Andy's success on YouTube has allowed him to expand his business online and, alongside his wife, he now operates a media creation business, offering everything from articles and reviews to branded products on his website. He also now operates a second YouTube channel, the Small Business Toolbox.

Once you move on to university, Google's tools become even more important:

69%
of students told us that they used Google Search to help with studying, and 68% of those said that their education would have been significantly more difficult without it

50%
of students told us that they used Google Scholar to help with studying, and 65% of those said that their education would have been significantly more difficult without it

61%
of students told us that they used YouTube to help with studying, and 47% of those said that their education would have been significantly more difficult without it

Health

With busy lifestyles, it's easy for keeping healthy and physical exercise to drop to the bottom of the priority list. Sedentary lifestyles are one of the most significant contributors to poor health and illness in the UK: it is estimated that 1 in 6 deaths in the UK is associated with physical inactivity.[5]

Smartphones and wearable technology such as the Fitbit, Wear OS or Pixel Watch can make it easier to keep track of exactly how much exercise you are doing, and help nudge users to make better decisions. **In total, we estimate that Fitbit helped Britons walk an extra 500 billion steps in 2022.**

At the same time, platforms like YouTube can provide an alternative way for people to exercise and learn more about health for those who don't have the time or the money to go to a gym. There are over 8,000 channels in the YouTube fitness community[6], and in 2021, health-related YouTube videos received over two billion views.[7]

Only around 14% of the general public are currently members of a gym.[8] By contrast, in our polling we found that:

43%
of YouTube users have used it in the last year to learn about fitness

44%
of YouTube users have used it to learn about health and wellbeing issues

43%
of Google Search users have used it in the last month to learn how to live healthier lives

Case Study: Mr Bruff

Exam season is always one of the most daunting and isolating periods for secondary-school students — something that Andrew Bruff, an English teacher who grew up in a disadvantaged family, is well aware of. In 2011, after spending four hours creating a lesson that would potentially only be seen by one class, one time, "Mr Bruff" recorded a snippet of the lesson and uploaded it to YouTube.

Since that first snippet, Mr Bruff has produced dozens more revision videos for GCSE and A-Level students, offering tips on literary analysis, essay technique, and text summaries. The Mr Bruff channel has now had over 47 million views, with its success leading Andrew to publish and sell his own revision guides on his own website — alongside worksheets for common books, which are free for all.

"I passionately believe that the quality of your education should not depend on where you live, which school you attend, or how much money your parents have," he says. *"With YouTube, educational videos like mine are accessible to everyone."*

5   Physical activity: applying All Our Health, Office for Health Improvement & Disparities, 2022
6   Community Spotlight: Fitness, Youtube, 2020
7   https://www.forbes.com/sites/jamessomauroo/2023/01/25/youtube-health-showcases-uk-strategy-5-things-we-learned/?sh=1c1fa7bb2512
8   https://www.puregym.com/blog/uk-fitness-report-gym-statistics/

Helping Save Money

The last year has been a difficult one for many families. Around half of respondents told us that in response to the rise in the cost of living, they had reduced spending on eating out, cut back on heating or switched to cheaper brands. 27% had cancelled some monthly subscriptions, while 18% had chosen to work extra hours or find another source of income.

One of the most important uses of Google's tools in recent times has been helping families save money:

81%
of Google Search users told us that they had used it in the last year to compare options for buying a product or service

63%
of Google Search users told us that they had used it in the last year to find special deals or coupons

39%
of Google Search users have used it to learn how to reduce their energy bill

51%
of Google Search users told us that they had used it in the last year to find cost or energy saving tips

This was particularly important for many of those who have been hardest hit by recent price increases. The most vulnerable households were 56% more likely to tell us that they had used Google Search to find energy or cost saving tips, 27% more likely to use it to find special deals, and 33% more likely to have used it to find free entertainment options.

Beyond helping people find cheaper options, many Google services also directly help people save or earn money:

- Google is one of the most important providers of free internet services such as Search, YouTube, Maps or Drive, ensuring affordable options are available to all families. 93% of people in our poll said that it was important for major internet services to continue to be available free at the point of use.

- By replacing standalone individual devices, such as a camera, music player, sat nav, alarm clock, calculator and torch, owning an Android smartphone saves the average person over £250. With over 1000 different manufacturers, Android smartphones are available from prices as low as £100 - but still incorporate all the latest operating system and security features.

- Services such as Google Ads, YouTube and Google Workspace have enabled individuals to earn over £7bn per year in income from side hustles such as selling goods online, freelance work and content creation.

In total, we estimate that Google services save the average household around £100 a year through reduced travel and entertainment costs.

Increasing Consumer Power

In the past, often the only way to learn which businesses to trust and which to avoid was through word of mouth, specific guidebooks or a bad experience yourself. Today, the two-way nature of the internet makes it far easier for customers to give feedback, and ensure that good service gets rewarded.

As part of its Google Business Profile feature, found through Search or Maps, Google allows users to leave their own reviews and star ratings for companies they've tried.

In our polling, 81% of users told us that they found reviews and star ratings on Search or Maps helpful. Reviews clearly had a real impact on consumer choices, with a significant majority (78%) telling us that they would be likely to choose the business that had a higher star rating, if they otherwise looked similar.

In addition:

69%
of users said that it helps them choose better products or businesses

73%
of users said that it helps them avoid businesses with bad service

Businesses agreed that user reviews had had a real impact on how they operate. 46% of all businesses and 77% of larger businesses agree that online search engines have increased the importance of maintaining high levels of customer satisfaction.

Which is your favourite Google product - and why?[9]

"Google Translate, because I am sponsoring a Ukrainian refugee family."

Woman, 72, Scotland

"Google Search as I love learning new things and it's quicker and easier than the encyclopaedias from when I was younger."

Woman, 56, London

"Google Translate. My children often have Welsh homework that I don't understand, but Google translate always figures it out."

Woman, 29, Wales

"Google Maps. I love seeing how the streets have changed over the years with the ability to go back in time and see how it used to look like."

Woman, 59, South East

"Google Scholar. It has been the main source to find articles for my university degree."

Woman, 22, West Midlands

"Google Search. I use it probably daily just to look up things in everyday life. From who's in a film to how to cook something to what is this strange mark on my arm. It's all there and easy to use."

Woman, 39, South East

"Google Mail. I find I barely get spam compared to other platforms and it integrates well with other Google products."

Man, 30, Yorkshire and the Humber

"I am a big music fan so I like YouTube. I collect rare old vinyl and can listen to tracks that aren't on Spotify etc before I buy the original releases."

Man, 67, South West

"Calendar. Helps me keep track of work shifts and personal events and easily share them with family."

Man, 42, East of England

"Google Docs because it means my work is automatically saved in the cloud as I write it, so I don't have to worry about losing it."

Woman, 23, West Midlands

"Google Maps. I walk LOADS and am always using it when I'm out and just want to head off the beaten track. I'd never dare do it without Google Maps to help me."

Woman, 56, East of England

"Google Search. I genuinely use it every single day without fail, when I need to know something quickly. I do not know what I would do without it."

Woman, 22, South West

Workers & Skills

Learning at Work

For most jobs today, learning doesn't stop when you leave formal education. Continuing to build new skills is a crucial way to stay up to date and to progress in your career. One recent estimate suggests that the career value of a technical skill halves every 2.5 years,[10] reinforcing the need for retraining throughout your working life.

Google Search is one of the most important ways in which today's workers find training resources and information to help them learn new skills. In the last three months, over half of people who are employed and use Google Search told us that they had used it to look up subject knowledge for their job, and around a quarter to learn a skill that will help them get a new job.

Google Search is often particularly important for those who sought to learn new digital skills at work. Based on our polling, we estimate that:

2.7m
workers have used Google Search to help them learn basic digital skills

2.1m
workers have used Google Search to help them learn advanced word processing, spreadsheet or presentation software skills

2.6m
workers have used Google Search to help them learn design and other creative tools

700k
workers have used Google Search to help them learn programming

900k
have used Google Search to help them learn data science and analysis

In total, we estimate that over 7 million workers have used Google Search to help boost their basic, intermediate or advanced digital skills. **This improvement in digital skills, in turn, has increased the productivity of the UK economy by over £26 billion.** That's a larger increase in human capital than produced annually by the entire Russell Group of universities.

Beyond this, through its Digital Garage and Google Career Certificates programmes, Google has visited more than 500 locations in the UK over the last eight years and trained over 1 million people in the digital skills needed to thrive in the modern economy. Google's courses help workers and business owners to learn skills from digital advertising, to writing a CV, to how to grow a business.

10   Chief Learning Officer magazine, 'Skills aren't soft or hard — they're durable or perishable', Matthew J. Daniel, October 2020.

Case Study: Google's Digital Skills Training

Google Digital Garage was launched in 2015 and provides free digital skills training across live events, on-demand videos, and online broadcasts. The training is aimed at businesses and consumers, covering a wide range of topics — from building a digital marketing strategy to writing a CV or creating compelling online videos.

For those in need of more in-depth training, Google has developed six Google Career Certificates in high-growth in-demand careers. These are the equivalent of a Level 4 qualification and are available in: IT support, Project management, UX design, Data analytics and digital marketing, e-Commerce, and Cybersecurity.

Google has also provided 20,000 scholarships, partnering with the U.K. government through the Department for Work and Pensions, Camden Council, The Prince's Trust, and INCO Academy, and offered 1,000 SMEs up to 500 scholarships each through the Federation of Small Businesses. The certificates are recognised by industry experts and employers, including Google, BT, the BBC, John Lewis & Partners, and NatWest.

Across both programmes, Google has trained more than one million people and visited 500+ locations.

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Case Study: Kiddiwhizz

After struggling to potty-train her son, single mother Zoë Chapman wanted to help other parents in the same position — and created the Whizzer, a compact and leak-proof portable potty. During the pandemic, Zoë turned to Google's online 1-to-1 mentoring for support, and with the help of her mentor, set up a Google Business Profile, connected analytics to her website, and learned valuable digital skills to enhance her online presence.

After the launch of the Whizzer in April 2021, it quickly gained popularity through social media, live events, and word of mouth. In 2022, support from Google helped Zoë secure a £50,000 investment from two Dragons on the BBC show "Dragons' Den".

Zoë credits her Google Business Profile with helping potential customers find her, and prioritises using Google Ads to expand her reach. She highly recommends Google mentoring to fellow small-business owners, highlighting its accessibility, versatility, and the genuine willingness of trainers to assist.

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Case Study: Project Katalyst

After facing mental health issues during his Ph.D. programme, physics student Maxwell Buckmire-Monro shifted his aspirations from academia to the tech industry — but knew he'd need new skills to land his dream career. Recognising the potential of cloud computing, he joined Google Cloud's Katalyst programme for high-potential individuals, with a focus on groups that are traditionally underrepresented in tech.

Katalyst's focus on soft skills development helped Maxwell with CV writing and job-related queries — and the mentorship on offer also played a crucial role, providing him with guidance and support while improving his knowledge of Linux and Python, and their application in real-life scenarios. Group sessions, teamwork, and consulting experiences with industry professionals helped Maxwell overcome impostor syndrome and feel confident as an entry-level professional. Thanks to Project Katalyst's approach to having industry experts teach, as opposed to traditional educators, Maxwell was able to access key players in the tech industry, which helped him feel valued and confident in his abilities.

Upon completing the programme, Maxwell secured a fulfilling role as a data engineer at CTS, the largest dedicated Google Cloud Partner in Europe. He later completed two Google Cloud certifications — Professional Cloud Architecture and Data Engineering — helping him improve his employability. With newfound financial stability, Maxwell can afford private diagnosis and treatment for his ADHD, significantly improving his quality of life.

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Productivity and Collaboration

In the last few years, catalysed by the COVID-19 pandemic, digital technology has helped support a radical shift in working patterns. 44% of all businesses and 81% of larger businesses told us that they had invested in or started using digital technology to help enable more flexible working in the last few years.

When we asked remote or hybrid workers the benefits they had received from this shift:

67%	**66%**	**58%**	**49%**
said that they had saved time from commuting	said that they had saved money on commuting	said that they had experienced better work-life balance	said that they had found it less stressful

50% of remote or hybrid workers told us that if they were no longer able to work remotely, it would make their current job somewhat or much more difficult.

Online suites such as Google Workspace, including video calling tools such as Google Meet, have played a crucial role in making remote working possible, and making it easier for workers to collaborate and act with greater agility. A Forrester Consulting study estimated that the deployment of Google Workspace, including tools like Gmail, Drive, Calendar, Meet, Docs, Sheets and Slides had the potential to save employees between 15 minutes to two hours per week at work, in more efficient collaboration. **In our business poll, businesses that use Google Workspace were twice as likely to report their revenue growing over 5% a year.**

For many, Google Search is also an indispensable tool for their work. On average, workers told us that they use Google Search over four times a day for their job, on top of any personal searches. A quarter of workers told us that not having access to a search engine would have a major impact on their ability to do their job, with those on average saying that not having access to a Search engine would see their work take over 25% longer.

Together, we estimate that **Google Search and Workspace are saving workers over 17 million hours a week, the equivalent of producing a £35 billion improvement in productivity for the British economy.**

Businesses

Reinventing Advertising

The best type of advert is one that is relevant to you, telling you about a solution at just the moment when you have a problem. For a business, the most effective type of advertising is targeted at only the right customers - with enough feedback to let you know whether your messaging is working.

Before Google Ads, much of advertising online looked largely similar to the kind of traditional advertising you might see in a print magazine, without taking advantage of the power of the internet. Advertisers had limited control over who saw their ads, leading to wasted time for consumers and a waste of money for businesses. In John Wanamaker's famous phrase, "Half the money I spend on advertising is wasted; the trouble is I don't know which half." Without clear data, it was impossible to know whether your advertising was working or not. Large scale advertising campaigns required significant upfront investment, putting them out of reach of smaller businesses or start-ups who could not afford to take that kind of risk.

By contrast, Google Ads made it possible for advertisers to optimise their ad spend and reach only relevant audiences, often at the exact moment when they were looking for a specific solution. Working on an auction "pay-per-click" model, Google Ads ensured that businesses only had to pay for adverts that were working. This helped level the playing field, allowing businesses of all sizes to compete on equal terms - and for new businesses, who would otherwise find it impossible to reach the right customer base, to grow their business with advertising.

Today, 65% of larger businesses in the UK told us that paid search advertising was an important way they connect with customers. **On average, Google estimates that for every £1 a business spends on Google Ads, it receives £8 back in profit from Google Search and Ads.**[11]

Of those who used paid search advertising, 78% said it was important to their business, and 16% said it was so important that their business would not be able to operate without it**,** suggesting Search is enabling hundreds of thousands of new businesses.

60% of businesses who export agreed that **online search engines have made it easier for their global customers to find their business.**

The UK is one of the world's most advanced markets for e-commerce, with an increasing number of businesses now selling both in person and through the internet. In our polling, 47% of businesses told us that they now sell directly online and 28% through a third party. Over half (58%) of businesses who currently sell online only started selling online since 2015, and just under a third (29%) since the start of Covid-19. **Around half of larger businesses (46%) told us that Google Ads was an essential tool in allowing their business to sell online, ahead of any other online tool we tested.**

Case Study: Zest Car Rental

After experiencing unpredictable shifts in customer behaviour and an unprecedented amount of booking cancellations during the pandemic, UK-based car hire broker Zest Car Rental was eager to return its bookings and revenue to their impressive pre-Covid numbers.

To help, the company took a number of steps to improve its Google Ads performance — including consolidating campaigns, optimising for privacy, adopting new bidding strategies, and using AI to fuel growth.

By embracing industry best practices, Zest saw its ads shown to a wider, more relevant audience. As a result, new customer bookings grew by 124%, and revenue soared by 239% vs. 2019. Zest Car Rental is now equipped with the right tools to continue to expand internationally and grow its customer base through Google Ads.

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Communicating with Customers

In addition to paid advertising tools, there are the many free platforms Google offers for businesses to communicate and connect with customers, such as Search, Maps and Google Business Profile.

79% of Search users told us that they had used it recently to find a local shop or business, and in our business polling, we saw that online search remained the second most important way businesses say that their customers find them, only behind word of mouth. Over half of businesses (52%) agreed that online search engines have made it easier for local customers to find their business, and **just under a third of businesses (31%) said their company could not exist without customers from online search engines**.

On top of this, Google estimates that businesses receive an average of five clicks on their organic search results for every one click on their ads.
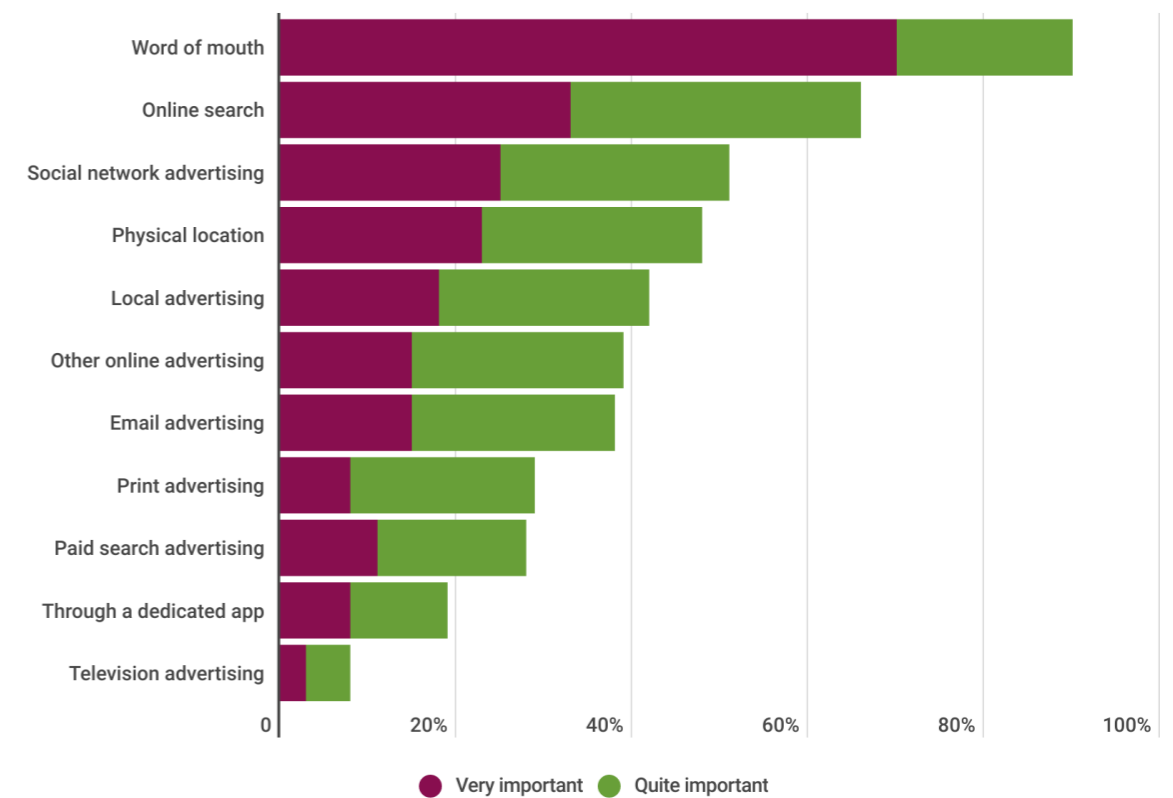
Search is just one of Google's tools that businesses use to connect with customers. In the business poll, Maps was also seen as important by over half of businesses, while many others also pointed to Google Ads and Google Business Profile.

Tool	Percentage
Google Search	74%
Google Maps	53%
Google Ads	26%
Google Business Profile / Google My Business	25%
Google Play store	13%
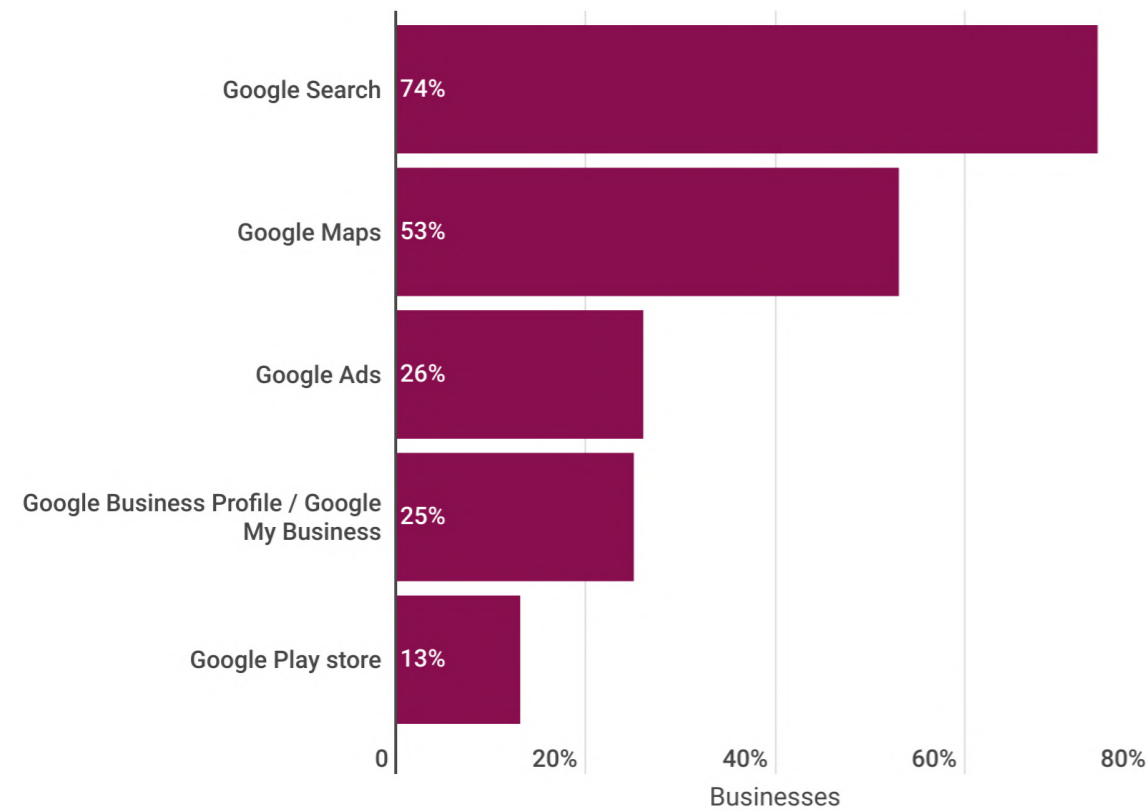
Businesses

79% of users of Google Business Profile told us that they found it a helpful way to connect with customers with:

65%
saying that it helped attract new customers

53%
saying that it helped increase sales

53%
saying that it helped demonstrate the quality of their service

Case Study: pam pam

After making its mark as the first women's-only sneaker store in the UK, pam pam wanted to expand its offering — including a curated product selection filled with stylish yet practical activewear for women. To help the business expand its reach online, co-directors Rio Holland and Bethany Heggarty turned to Google.

Setting up a Google Business Profile listing boosted the business's local ranking on Google, meaning shoppers were able to discover pam pam by typing in key terms like "trainers" and "activewear". At the same time, product images on the listing meant that shoppers could get a sneak preview of the sneakers' style before they even clicked through to the website. And for those who liked what they saw, integration with Google Maps made it easy to pop into the store and try the shoes on for size.

Building an online client base beyond pam pam's Brick Lane shop in London has helped the company's special releases to sell out entirely — sometimes within minutes. A prominent Google Business Profile and ranking on Search means increased global brand awareness, strengthening pam pam's market position as a reputable business. Going forward, pam pam's directors are investing online: in their website, on Google Ads, and into improving their online shopping experience for loyal customers around the world.

Consumers agreed that Google Maps was an important way they found local shops or businesses:

41%

of Google Maps users had used it in the last month to find a nearby restaurant, bar or cafe

38%

of Google Maps users had used it in the last month to check the opening hours of a local business

Similarly, YouTube is an important communications channel for many businesses. In recent Oxford Economics research:

75%

of SMBs with a YouTube channel agree that YouTube played a role in helping them grow their customer base by reaching new audiences

68%

of SMBs with a YouTube channel agree that YouTube played a role in helping them grow their revenue

65%

of SMBs who advertise on YouTube agree that YouTube ads have helped them grow sales

Cloud

Public cloud computing services like those offered by Google Cloud enable businesses to easily scale their computing resources up or down as their needs change, while taking advantage of the latest technology.

The flexibility enabled by cloud technologies generates significant savings for businesses. One report by Deloitte found that businesses have seen an average net return of up to £2.50 for every £1 invested in public cloud services such as Google Cloud. Some of the most successful Google Cloud customers saw returns of up to £10 for every £1 invested.[12]

In our business poll, Google Cloud customers told us that the most significant benefits they experienced were:

64%
said storing larger amounts of data

40%
said lower costs

23%
said improved carbon footprint

22%
said enhancing the security of their IT infrastructure

Beyond cost savings, the increased flexibility and economies of scale enabled by cloud solutions like those offered by Google Cloud can make it possible to significantly reduce energy usage and carbon emissions compared to traditional on-premises servers. Google data centres use 50% less energy compared to the typical data centre, and are powered by 100% renewable energy sources such as wind and solar power[13]. By moving computing workloads from on-premises services to the more energy efficient Google Cloud, Public First's modelling suggests that UK businesses could avoid **over 200,000 tonnes of CO2 emissions**.[14]

Case Study: The Egg Cafe

A fixture on Liverpool's restaurant scene for the past 30 years, The Egg café specialises in high-quality vegetarian food at a reasonable price. With an online social media presence already established, the Egg team wanted to improve their ranking on Google, focusing on the students and women under 35 that make up the core of their client demographic.

To generate awareness among potential customers, the Egg team created a free Google Business Profile, which gave the café greater visibility and a higher ranking for its website in an extremely cost-effective manner.

In one month, the company saw an increase of 67,000 direct Search queries for the café The Egg team has also seen growth in the number of people searching for directions to the café's location and the number of customer reviews on Google.

12   https://www2.deloitte.com/content/dam/Deloitte/es/Documents/tecnologia/Deloitte_ES_tecnologia_economic-and-so-cial-impacts-of-google-cloud.pdf
13   https://cloud.google.com/sustainability
14   Estimated emissions avoided are based on Public First's model and assumptions.

Case Study: Travis Perkins PLC

For builders' merchants, IT solutions and digital technologies can be key to increasing warehouse efficiencies — and for Stephen Harris, Director of Finance operations at Travis Perkins plc, modernisation is also key to achieving the company's net-zero targets.

To support a forward-looking strategy, Travis Perkins partnered with Google Cloud to build a unified, consistent, and meta-data-driven data warehouse. This allowed the group to access accurate information on stock levels and to act on data insights more quickly, empowering colleagues to work efficiently — and optimising sustainability in the process.

Using Google Cloud's online data warehouse BigQuery and data management tool Looker, Travis Perkins plc created a culture of data-driven decision-making throughout the company, improving productivity, increasing conversions, and reducing carbon emissions across its supply chain. The group has also implemented delivery efficiency reporting, leading to a 4% improvement in efficiency within months of adoption.

Creators

Every day, people in the UK will watch over two billion minutes of YouTube. Much of this content is created by independent creators, rather than large production companies. In the UK, the top 20 independent creators each have over 10 million followers. Whereas in the past distribution was often the hardest part of film and TV production, today anyone with a smartphone can broadcast to the world.

A recent survey by Oxford Economics found that:

80%

of creative entrepreneurs agree that YouTube provides an opportunity to create content and earn money that they wouldn't get from traditional media.

87%

of creative entrepreneurs agree that YouTube helps them export their content to international audiences they wouldn't otherwise have access to.

68%

of creative entrepreneurs agree that the revenue they receive from advertisements being placed on their YouTube content is an important source of income for them.

In total, Oxford Economics estimated that in 2021 Youtube's creative ecosystem contributed more than £1.4 billion to the UK's economy, and supported over 40,000 full time equivalent (FTE) jobs.

Developers

Google Play provides developers with a centralised distribution platform for their apps, making it easy to deploy apps or games to billions of users worldwide at once. More than 110 billion apps were downloaded from the platform in 2022 alone[15].

In total, in 2022 we estimate the Android App Economy generated over £9.9 billion in revenue for British developers, and supported over 457,000 jobs across the UK.[16] Alongside revenue generated from distributing apps through Google Play, developers also receive a significant income from contract work developing apps for businesses and brands.

Thanks to its free-to-use open-source model, Android has been widely adopted by the vast majority of Original Equipment Manufacturers (OEMs), with over 1000 companies building devices for Android globally. For developers, that can save significant time and costs from having to re-make their applications for a new operating system for every smartphone manufacturer. In total, we estimate that Android has saved developers in the UK over 1 million days - the equivalent of £300 million in reduced development costs.

15   https://www.statista.com/statistics/734332/google-play-app-installs-per-year/
16   Public First estimate

Using AI to Help Tackle Future Challenges

Case Study: Frobelles

As a six-year-old, Yvonne Ottley's daughter Alyssa loved playing mobile dress-up games, but struggled to find characters that looked like her. Wanting Alyssa to embrace her natural look with confidence, Yvonne suggested that they create their own together — despite not having any prior experience of creating online games

The result, Frobelles, launched on the Google Play store after a little over two years in development, allowing players to style the hair, clothes and accessories of three sisters — Coco, Kelli, and Krista — and swap finished looks on social media. Celebrating hair styles from Yvonne and Alyssa's African and Caribbean heritage, like updos, locs, and protective twists, Frobelles has received over 50,000 downloads on Google Play since launch.

Now the mother-daughter duo are planning an Afro-anime collection and adding male characters. "P*eople who think I am too young to have created things like this, well, I would say that's kind of their opinion*," says Alyssa, who also voices all of the game's characters. "*In my eyes, anything is possible*."

AI's Future Potential

Over the last 30 years, the internet has transformed the way we work, learn, play and communicate. In the next thirty years, AI looks set to have as significant an impact. Catalysed by new algorithms, advances in computing speeds and the immense amount of data available on the internet, the last decade has seen AI change from a focus of academic research to a significant driver of economic value. Recent advances in generative AI - allowing algorithms to fluently create text, images, or code - have seen the economic potential and interest in AI increase radically.

Google Trends ("AI", "UK")

● Interest over time
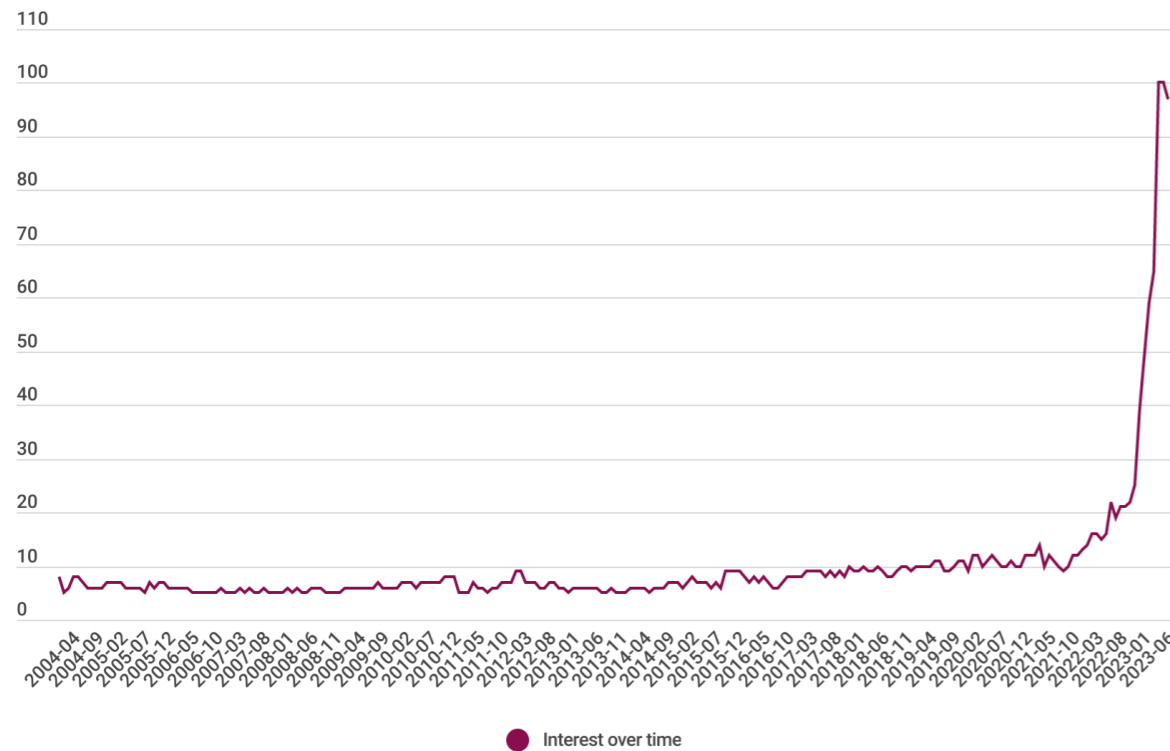
AI is already an active focus for many businesses, with those not already using it planning to to do so in the future. In our business polling:

49%
of larger businesses[17] were using AI to optimise existing processes or systems, and another 35% were planning to do so in the future

47%
of larger businesses were using AI to increase the productivity of their business or workforce, and another 35% were planning to do so in the future

34%
of larger businesses were using AI to analyse ways to increase energy efficiency or sustainability, and another 44% were planning to do so in the future

17   Defined as non SMEs, or businesses with more than 250 employees

	We already do this in my business	We don't do this in my business, but will in the future
Optimise existing processes or systems	49%	35%
Analyse internal data	51%	32%
Increase the productivity of your business or workforce	47%	35%
Help detect cyber threats	51%	31%
Reduce your business' costs	40%	41%
Automate existing processes or systems	50%	31%
Speed up research	43%	36%
Analyse ways to increase energy efficiency or sustainability	34%	44%
Increase your business' revenue	42%	35%
Develop new products and services	39%	38%
Help generate content	41%	35%
Automate or triage customer support (e.g. through chat bots)	35%	37%

● We already do this in my business   ● We don't do this in my business, but will in the future

Google and its parent company Alphabet have long been one of the world's leading innovators in AI, pioneering many of the leading advances in the field:

Google DeepMind: Acquired in 2014, London based Google DeepMind is a leading AI research company that has made groundbreaking achievements in reinforcement learning, deep learning, and neural networks. Google DeepMind's AI advancements have been applied to various applications, such as optimising energy consumption in data centres and advancing healthcare. In 2023, the company merged with Google AI's Google Brain division to lead the company's AI efforts as Google DeepMind.

The Transformer model. In the 2017 paper "Attention is All You Need" by Vaswani et al., Google researchers introduced the Transformer model. This breakthrough architecture addressed the limitations of previous models which struggled with long-range context and parallelisation, making it significantly easier to train larger deep learning models. Transformer models are at the heart of many of today's leading generative stable AI models, including Bard, Stable Diffusion, ChatGPT and MidJourney.

Waymo. Founded in 2009 as part of Google X's lab, Waymo is using AI to build The Waymo Driver, an autonomous driving system designed to make it safe and easy for people and things to get around. In October 2020, Waymo launched the world's first fully autonomous ride-hailing service, open to all members of the public in Phoenix, Arizona, and has since expanded its operations to Los Angeles and San Francisco in the US. In 2020, the company established a business entity in the UK, which is home to a team of AI and ML engineers, supporting its US operations.

Google's Advances in AI

2001

Google begins using machine learning to help with spell check at scale in Search.

2006

Google launches Google Translate.

2012

Google Research publishes the famous 'cat paper'. Using this large-scale neural network, it significantly improved the state of the art on a standard image classification test, leading to a 70 percent relative improvement in accuracy.

2014

DeepMind was acquired by Google in 2014 and became a wholly owned subsidiary of Alphabet Inc., after Google's restructuring in 2015.

2015

In November 2015, Google Research open-sourced an initial version of TensorFlow so that the rest of the machine learning community could benefit from it and we could all collaborate to jointly improve it.

Google developed AI in Google Photos to help you search for photos by what's in them.

2016

TensorFlow became the most popular machine learning project on GitHub,

Over 200 million people watched online as DeepMind's AlphaGo beat the world Go Champion, Lee Sedol.

2017

Google introduced Transformers in 2017, the grandparent of modern language models.

2018

Google introduces the BERT model to help improve the quality of Search. BERT was later succeeded in 2021 by the MUM model, which was one thousand times more powerful.

2020

DeepMind's AlphaFold was recognised as a solution to the 50-year "protein-folding problem". AlphaFold can accurately predict 3D models of protein structures and is accelerating research in nearly every field of biology.

2021

Google first demonstrates its conversational Large Language Model LaMDA at Google I/O

2022

Google Research introduced another Large Language Model PaLM. Google evaluated PaLM on hundreds of language understanding and generation tasks, and found that it achieves state-of-the-art performance across most tasks, by significant margins in many cases.

2023

Google introduces Bard - an experimental conversational AI service. Bard seeks to combine the breadth of the world's knowledge with the power, intelligence and creativity of our large language models. It draws on information from the web to provide fresh, high-quality responses.

The Economic Importance of AI

In the UK, as in many other advanced economies, the last few decades has seen slowing growth. If the UK had continued to grow at the same rate in the last fifteen years as it did the fifteen before, our total economy would be over 16% larger. That is the equivalent of an additional £5,000 per family, or over an additional £150 billion for public services.

● GVA Per Hour   ○ 1970 to 2007 trend
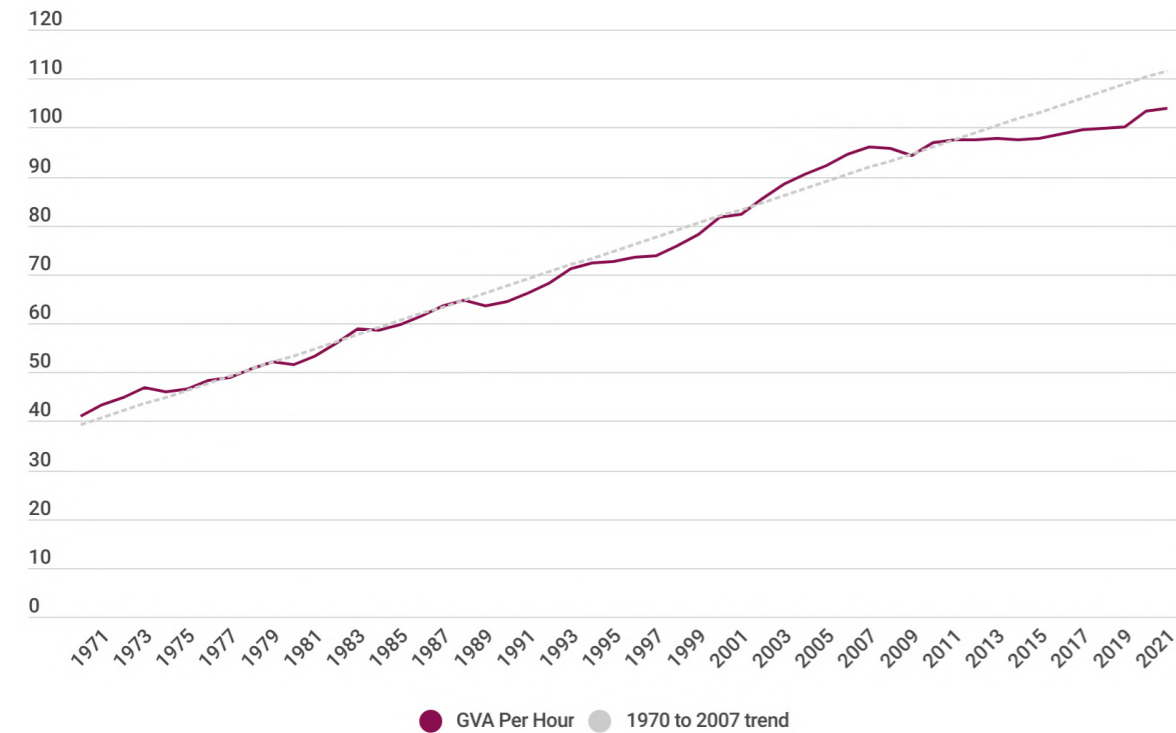
Just as the steam engine helped power the Industrial Revolution, or the Personal Computer (PC) spurred the past growth burst of the 1990s, today AI looks set to be the most significant driver of increased productivity in the 2020s and beyond.

The growing maturity of AI models (particularly generative AI models building on the Google-pioneered Transformer structure) means that they now look to be on the verge of diffusing widely through the economy, creating real economic impact. Generative AI models can help complement the productivity of individual workers, assisting with routine or administrative tasks, and enabling them to get more done faster.

In recent months, generative AI tools have been shown in experiments to be able to:

- significantly reduce the time taken for mid-level professional writing tasks, while increasing quality[18]
- increase the productivity of programmers by 55%[19]
- reduce the time for customer support agents to resolve cases by 14%[20]

In 2023, Google announced a wide range of new generative AI features, integrated across its core products. Search in the US will gain new abilities to summarise the results from a range of sources for more complicated queries, answer follow up questions or give custom product recommendations. Workspace will be able to produce the first draft of a document, email or slide deck, while Magic Editor in Photos will allow you to organically edit different aspects of a photo: such as where a relative is sat, or how overcast the sky is.

Building on Public First's AI model, we estimate that AI could create over £400 billion in value for the UK economy by 2030. That is equivalent to an annual growth rate of 2.6%, turning around the recent growth stagnation, and creating £200 billion in additional revenue for public services.

Alphabet continues to invest heavily in research, tools, and open data:

R&D. Over the last five years, Google's parent company, Alphabet, has invested more than $145 billion globally in R&D. In 2021, the company published over 850 research papers in AI, more than any other company, university, or organisation.

Tools. Google is one of the leading creators of AI tools. In 2015, Google released TensorFlow, an open-source machine learning framework that has become widely popular among AI researchers and developers. TensorFlow has become a critical tool for creating and deploying machine learning models, with more than 200,000 users and over £13 billion in economic impact globally.

Datasets. One of the most important barriers for smaller organisations is getting access to enough data to train more accurate models. Google has published over 90 open datasets for other researchers to learn from, including COVID-19 open data and open images.

18   https://economics.mit.edu/sites/default/files/inline-files/Noy_Zhang_1.pdf
19   https://github.blog/2022-09-07-research-quantifying-github-copilots-impact-on-developer-productivity-and-happiness/
20   https://www.nber.org/system/files/working_papers/w31161/w31161.pdf

Google's Recommendations to Power the UK's AI Transformation

The UK is already one of the world's leading countries in AI, with strengths in research, talent, finance and its wider tech ecosystem. According to Tortoise's Global AI Index, the UK is third behind the US and China.[21]
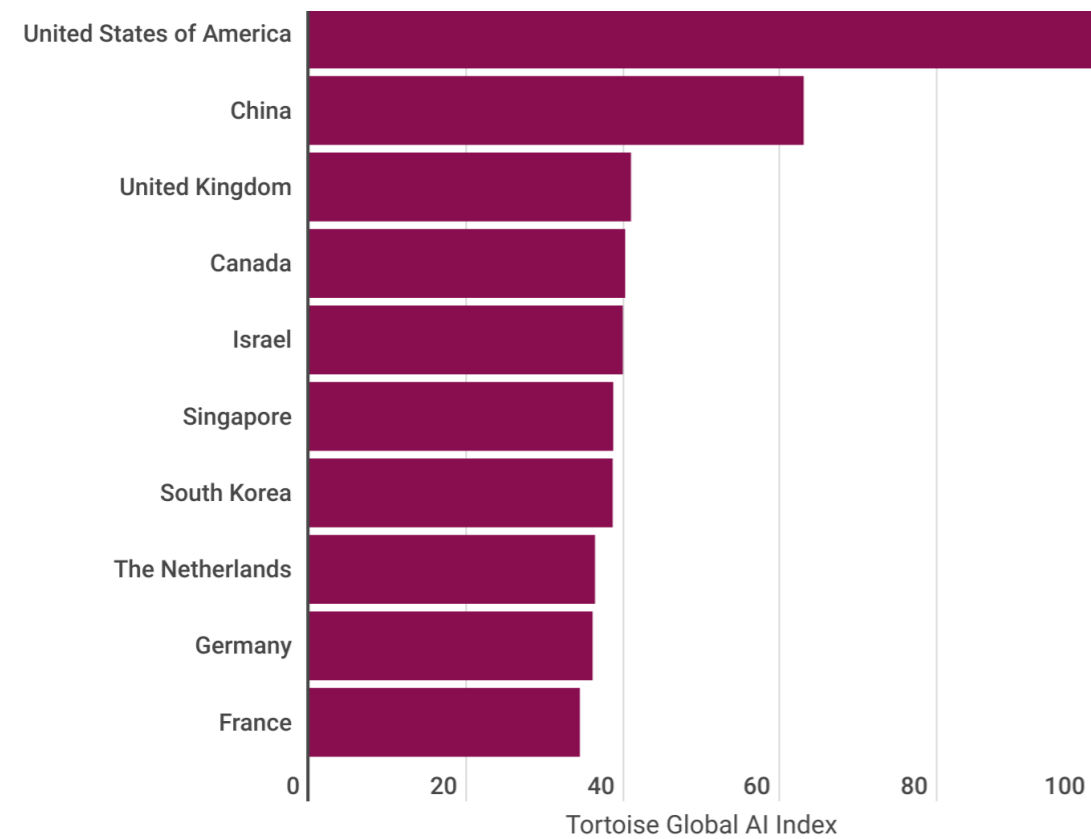
However, AI is an increasingly competitive area, and the UK can't afford to take its current position for granted, given the many other countries not far behind. In order for the UK to remain globally competitive and fully take advantage of the economic opportunities from AI, Google suggests government should focus on the following key areas:

Skills

As the nature of work evolves and new technology is adopted, the skills required to succeed in the workforce change. Employers are struggling to find employees with necessary skills - two-thirds of UK employers are having difficulty recruiting workers with digital skills.[22] Formal education is not meeting the demand for workplace-relevant skills, as 50% of employers think people are leaving education without sufficient digital skills[23].

The challenge of building digital capability is compounded by the need to keep pace with technology improvements and deployment. Recent research suggests that the half-life for technical skills is approximately 2.5 years.[24]

The UK should create **a new National Skills Service** that would establish a new platform and accreditation system for training and skills, for employers and workers which offers:

- Diagnostic tools to assess skills and recommend training to increase capability. This will help both employers and workers diagnose their skills gaps. These tools can also relate those gaps to relevant skills maps available for key sectors and areas of the country.

- Establish a standardised accreditation system that enables skills training to be understood, measured and communicated by employers and workers. Based on points, learning from the UCAS system, it should enable training to accumulate into specialisms and qualifications so people can start with 'micro-credits' and build up to more substantial qualifications - all would have immediate currency in the workplace and on professional network sites.

- Allow providers to be accredited to offer skills training ranging from 'micro-credits' to more substantial qualifications. This could be employers, Further Education and Higher Education institutions, trade unions and specialist training providers.

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21   https://www.tortoisemedia.com/intelligence/global-ai/

22   Chartered Institute for Personnel Development (CIPD), 'Learning and Skills and Work Survey 2021', May 2021.
23   Work Skills UK, 'Disconnected? Exploring the Digital Skills Gap', March 2021.
24   Chief Learning Officer magazine, 'Skills aren't soft or hard — they're durable or perishable', Matthew J. Daniel, October 2020.

Research and Development

R&D support needs to catch up to global competitors. According to IPPR, the UK's share of global investment in research and development (R&D) has fallen by a fifth since 2014.[25] The UK only places 11th in the OECD in terms of total R&D public investment as a percentage of GDP. The UK aims to invest 2.4% by 2027, yet the OECD previously recorded average is 3.1%.[26]

At the same time, innovation can be better nurtured beyond the South East. While the UK continues to produce some of the world's most cutting-edge technologies, this is focused in just a handful of institutions. In 2021, only Oxford and Cambridge published over 1000 top quality AI research publications. This contrasts with eight universities in the US.[27]

The UK **should set a target for public investment in R&D** to consistently exceed the OECD average by 2030. AI should be among its priorities for R&D, a point reinforced by the Future of Compute Review**.**[28] Such a public commitment and level of investment will instil confidence and attract investment to the UK.

To maximise impact, the R&D funding framework should be able to flex to consider the specific needs and circumstances of each region. A portion of the budget should be discretionary funding and a significant proportion allocated through the Small Business Research Initiative (SBRI) to benefit SME-led projects in strategically critical technologies like AI.

Regulation

The UK has an opportunity to chart a pro-innovation path for regulation. By developing a new approach, the UK can tackle the challenges that require a regulatory response, whilst facilitating the innovation that will underpin longer term growth and prosperity. This nuanced approach is important if the UK is to pursue a competitive advantage in attracting inward investment associated with agile regulation.

At the moment, there can be few structural incentives for regulators to take into account future potential benefits from new technologies.

The UK should implement **Innovation Impact Assessments** to ensure that new policies' impact on innovation are systematically assessed and addressed through a new institutionalised process that creates the right environment to unleash private capital and industrial growth.

This initiative could be supported by a panel of industry experts, business leaders, and leading academics from the UK's high growth sectors such as tech, finance, life sciences, and creative industries. The panel would provide an assessment of new policy and legislation's impact on innovation in the entire industry supply chain, i.e. impact on large corporations, investment firms, small and medium businesses, and research institutions to ensure a balanced view. By putting innovation-driven growth at the heart of policies and initiatives, the UK will be able to unlock potential and strive to be a global leader in sustainable growth and attracting inward investment.

Similarly, new policies should be subject to impact assessments for security and competitiveness. Just as major technology products undergo rigorous threat modelling from the design phase onward, policymakers could adopt a similar mindset that takes security into account at every step in the legislative or regulatory process in order to guarantee digital security for all.

Infrastructure

In fields such as scientific research, engineering, financial modelling and defence and national security, advanced computing is used to solve problems that would be impossible to solve with traditional computing methods. Advanced AI models need large amounts of computing power.

To be a world leader in science and innovation, the UK needs to increase its large-scale computing capacity, and public access to it. As of November 2020, the UK only had 12 of the top 500 computer systems globally compared to 214 and 114 for China and the US respectively.

The UK Government should establish a UK Research Cloud (UKRC) to increase access to cutting edge AI tools and high-end computational resources for researchers, academics, and government data scientists - as well as hosting large-scale government-held datasets in a secure cloud environment.. A national consortium could provide public cloud infrastructure and access to data, for all UK researchers and R&D operations - democratising access across different regions and contributing to the UK Government's growth agenda while strengthening collaboration between academic research hubs across the four nations. This would involve a partnership between universities, technology companies and the government and could significantly increase the UK's expertise in AI research.

A UK Research Cloud would

Enable researchers, academics, and government data scientists to keep pace of the rapid changes in technology

Enable participation and collaboration in further development of AI elements on a wide range of subjects

Provide UK institutions with direct access into the world of insight across AI

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25   https://www.ippr.org/files/2022-10/1666626317_science-or-stagnation-oct-22.pdf
26   OECD Main Science and Technology Indicators, Volume 2022 Issue 1, October 2022
27   OECD.AI (2023), visualisations powered by JSI using data from MAG, version of 31/12/2021, accessed on 8/3/2023,
        www.oecd.ai .[used top 10% in quality rankings]
28   Independent Review of The Future of Compute: Final report and recommendations

Solving Societal Challenges with AI

As important as the economic impact of AI, will be the new opportunities it creates to address societal challenges. In our polling, 53% of Britons told us that they were optimistic about the impact technology will have in the next twenty years, compared to only 15% who were pessimistic.

When we asked the public which societal challenges were likely to be positively addressed by technology in the next twenty years:

66%
said making it easier to develop new medicines and vaccines

62%
said making it easier for people with a disability to work

50%
said reducing the risk of cyber crime

49%
said growing the UK economy faster

AI could have a significant impact on many challenges we currently face. For example:

£4.8bn

AI could help equip everyone with the digital skills needed to make the most of the future economy. Around 35% of businesses today say that they find it difficult to find staff with good digital skills, while 39% of those out of work say their lack of digital skills is a barrier to them finding work. The use of AI tutors and coding assistants could make it easier for everyone to upgrade their digital skills, boosting UK productivity by over £4.8 billion a year.

700k
hours a year

AI could save over 700,000 hours a year in administrative work for GPs and teachers. Heavy workloads and excessive hours are one of the most significant factors leading people to leave the health or education workforce, exacerbating problems with staff shortages. Using AI could help offset some of the growing cost pressures in areas such as health and education, and free up over £8 billion in public sector resources for other uses.

1.7bn
hours a year

AI could free up 1.7 billion hours a year in reclaimed commute times. Autonomous vehicles could not only be much safer - preventing around 90%[29] of the approximate 1,500 traffic fatalities in the UK - but give us back vital time in the day to get more work done, increasing the size of the economy by over £13 billion[30] - or just have more down time to ourselves.

In the final section of this report, Google asked us to look at the wider potential impact of innovation and AI to address three specific challenges - increasing the accessibility of work, reducing the threat from cyber security and reducing the impact from climate change.

29   https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/ten-ways-autonomous-driving-could-re-define-the-automotive-world
30   Assuming that half of freed up time is used for work, and conservatively that work time in an autonomous vehicle is 33% as productive as at normal place of work.

1 - Increasing the Accessibility of Work

People living with a disability often face significant physical, social and economic barriers. In the UK, the disabled population is less likely to have degree qualifications, less likely to be employed, and more likely to report feeling lonely regularly than those who are not disabled.[31] Around 6% of the working-age population is currently not seeking or available for work due to long-term sickness, the highest rate in almost 18 years.[32]
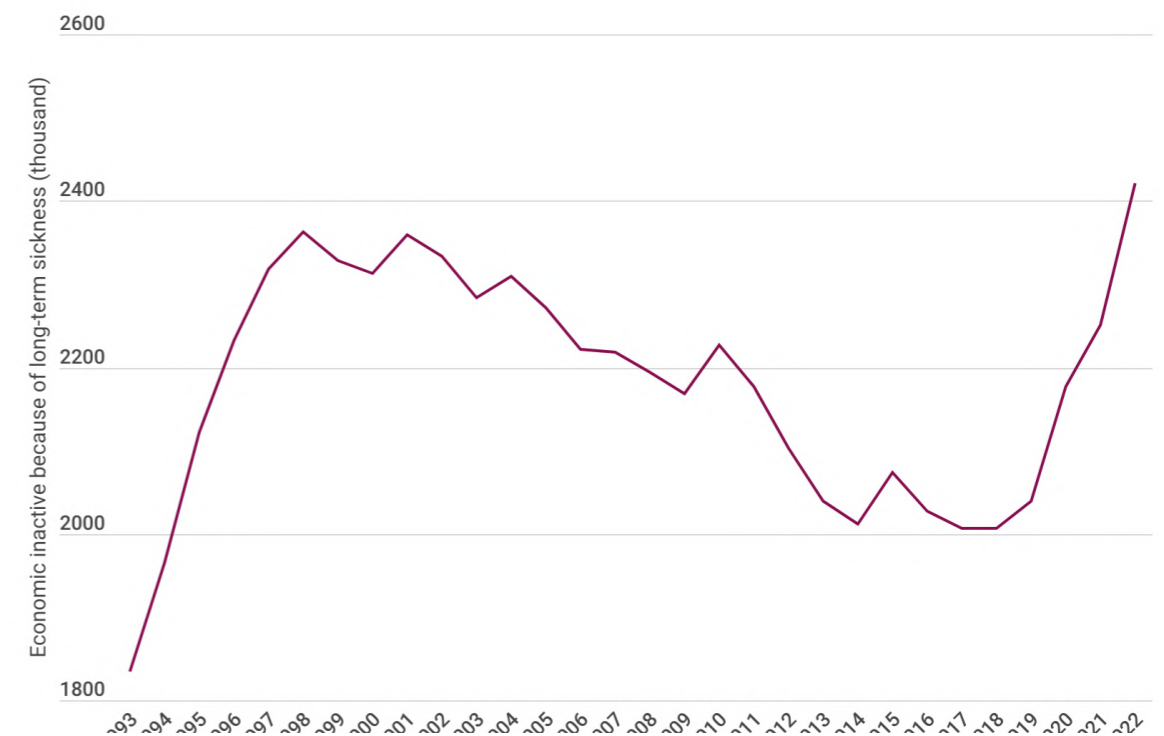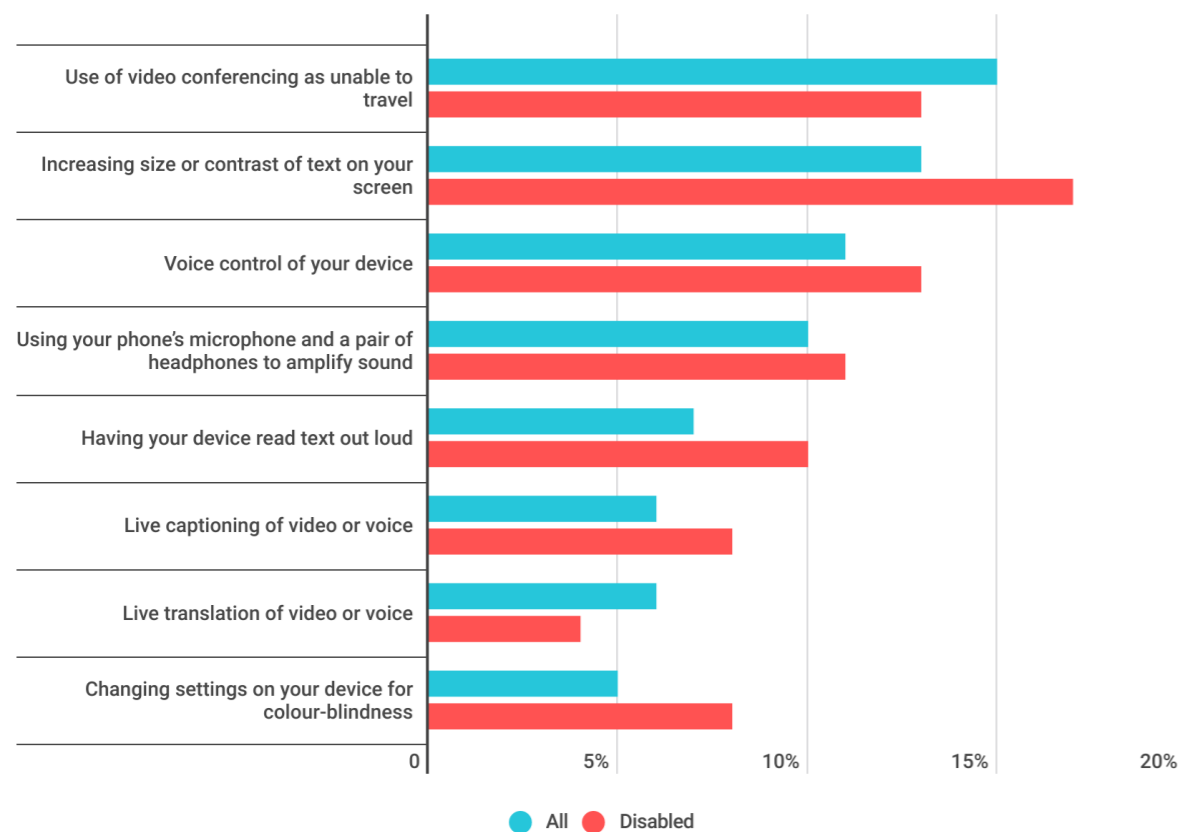

Digital technology can make it easier for people living with disabilities to stay connected. Google has been a significant contributor to this change, developing a range of tools and technologies that help to improve accessibility such as its Android Accessibility Suite, a collection of accessibility features built into the Android operating system. These features include screen readers, magnification tools, and alternative input methods, which make it easier for people with vision, hearing, or motor impairments to use Android devices. **In our polling, we found that 51% of Brits who reported a disability and have an Android phone say that they have used an accessibility feature in their personal life,** while 43% of workers reporting a disability in the UK with an Android phone say that they have used an accessibility feature for work.

Accessibility tools don't only benefit those with disabilities. For example, closed captions allow for better comprehension and understanding for people having a conversation in loud environments or when someone wants to learn a new language. In our polling we found that around half of Britons without a disability say that they **have used an accessibility feature on their phone or computer in their personal life (48%),** while 38% of British workers say that they have used it at work.

31   https://commonslibrary.parliament.uk/research-briefings/cbp-9602/
32   https://www.ft.com/content/74d34caa-e540-4ab8-ab11-be42d152abfc

Have you ever used and of the following accessibility features in your work on your mobile phone, tablet, or computer?

Chart categories (top to bottom):
- Use of video conferencing as unable to travel
- Increasing size or contrast of text on your screen
- Voice control of your device
- Using your phone's microphone and a pair of headphones to amplify sound
- Having your device read text out loud
- Live captioning of video or voice
- Live translation of video or voice
- Changing settings on your device for colour-blindness

X-axis: 0, 5%, 10%, 15%, 20%

Legend: ● All   ● Disabled

By enabling remote working, digital technology such as video calling or other work collaboration tools has already made it easier for many people who would not have the energy or health to travel to access work. In recent polling for Public First, 76% of those with a long-term health condition **agreed that the availability of hybrid or flexible working allows more people with long term disabilities to hold down jobs** and 79% said that it **gives disabled people more autonomy in the hours they work.**[33]

At the same time, an increasing range of assistive technologies are being created to cater to the unique needs of those with physical, cognitive, or sensory challenges. For instance, speech recognition software can convert spoken language into written text, allowing those with mobility impairments or dyslexia to communicate effectively in the workplace. Screen readers, which convert digital text into synthesised speech or braille output, enable individuals with visual impairments to access and navigate digital content with ease.

AI opens up new potential for digital tools to help people with disabilities communicate, collaborate and navigate the world. These technologies could help over a million unemployed or economically inactive people with disabilities to access work. If it could boost the employment of these people by over 50%, we estimate that it would grow the economy by over £30 billion a year.

Case Study: Project Relate

Millions of people have difficulty being understood when they speak. Project Relate, an Android app built on Google AI research, helps people with non-standard speech communicate more easily with others.

Built by engineers and scientists in Google's London office, the app was developed in collaboration with the Royal National Institute for Deaf People, the Royal National Institute of Blind People, and the charity Everyone Can.

Early testers of Project Relate describe how the app has helped them be better understood and build more meaningful connections. One user, Debra, shared how she went from having less than 10% of what she says being understood by people she's just met to having more than 90% of her speech understood. *"Relate has changed my life,"* Debra said.

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2 - Reducing the Threat from Cyber Security Risks

Criminals also attempt to harness digital technology to create new types of attack. DSIT's Cyber Security Breaches Survey found that 32% of UK businesses reported a cyber attack in the least year, with the most common attack vectors being phishing attacks (79%), others impersonating the organisation (31%) or viruses, spyware and malware (11%). Each breach with a negative outcome cost businesses nearly £4,000 on average.[34]

In our polling, many ordinary people told us that they were worried about digital security threats:

74%
said that they were worried about the hacking of their personal data

71%
said that they were worried about identity threat

71%
said that they were worried about online scams or phishing attempts

Fortunately, we saw that the majority of people believed they had the tools to help keep them safe:

78%
said that they were confident that they understood best practice in keeping their data secure

57%
said that they used two-factor authentication wherever possible

55%
said that they used different passwords on each website or app.

Similarly, around 86% of businesses told us that they were confident that their business followed best practice for keeping data secure, and 75% agreed that their business was fully prepared to defend themselves from cyber crime.

Around half of businesses told us that they had experienced some form of digital security threat in the past five years, with the most common forms being phishing emails (32%), payment fraud (15%) or data loss (12%).

New technology can help make it easier to stay safe, taking away some of the hassle, while saving time for individuals. While biometric technologies like fingerprint recognition have made some aspects of security easier, **we estimate that the average person still spends around ten hours a year managing their passwords.** New technologies such as passkeys, launched in 2023 across Google accounts, look to significantly reduce this time, and make it easier to follow best practice.

Looking forward, AI powers new tools to help keep businesses and individuals safe: advising people on how to follow best practice, while proactively identifying and countering new threats before they can cause harm. **In total, we estimate that the combination of better training and the greater use of AI could save over 30 million hours a year in lost time for consumers, and prevent over £2 billion in losses for businesses.**

34   https://www.gov.uk/government/statistics/cyber-security-breaches-survey-2023/cyber-security-breaches-survey-2023

3 - Helping Reduce the Impact of Climate Change

AI tools can help individuals, businesses and communities operate more efficiently, reducing their overall carbon footprint.

For individuals, AI-powered tools can help make it easier to make more sustainable choices, and reduce unnecessary energy consumption. According to the ONS, households account for about a quarter (26%) of total emissions in the UK.[35] By choosing more sustainable diets, using public transportation and reducing unnecessary energy usage, we can all help bring the UK closer to Net Zero.

For example:

- On average, Nest thermostats have proven energy savings of 10%-12% for heating and 15% for cooling.[36] In 2021, Nest thermostats helped customers save more than 21 billion kWh of energy use globally a year. That is enough energy to power the electricity of over seven million homes in the UK.

- Google Maps provides, on average, over 2 billion kilometres of public transport results per day, while its fuel-efficient routing option leverages Google's AI tools and insights from the U.S. Department of Energy's National Renewable Energy Laboratory and data from the European Environment Agency to optimise fuel-efficient route choices. Fuel-efficient routing is available in the UK, and across the U.S., Canada, Europe, and Egypt. It is already estimated to have helped avoid more than 1.2 million metric tons of CO2e globally through the end of 2022 —the equivalent of taking approximately 250,000 fuel-based cars off the road.[37]

For businesses, AI can help them better understand where in their value chain emissions arise from, and the most efficient ways to reduce them. BCG estimates, for example, that **by 2030, AI could help large businesses to reduce greenhouse gas emissions by 2.6 to 5.3 gigatons, or 5-10% of the global total.**[38]

Similarly, communities can use AI tools to help understand the best next steps to improve their own sustainability. Building on existing Google datasets - such as those that go into Google Maps or analysis traffic - **Google's Environmental Insights Explorer** allows cities to better understand the sources of emissions in their area from energy usage or transportation, map street-level air pollution data and quantify the future potential from rooftop solar panels.

35   https://www.ons.gov.uk/economy/environmentalaccounts/articles/climatechangeinsightsuk/august2022
36   Energy Savings from the Nest Learning Thermostat: Energy Bill Analysis Results, Nest Labs, February 2015
37   Google uses a high-quality ML prediction model based on a validated simulator from the National Renewable Energy Laboratory (NREL) to estimate the expected fuel or energy consumption for each route option when users request driving directions. First, Google identifies the route that consumes the least amount of fuel or energy. If this route is not already the fastest one and it offers meaningful energy and fuel savings with only a small increase in driving time, they then recommend it to the user. Google tracks all trips where users choose the fuel-efficient route instead of the fastest route or select it even when not the default option. To calculate avoided emissions, Google tallied the fuel usage from the chosen fuel-efficient routes and subtract it from the fuel consumption that would have occurred on the fastest route without eco-friendly routing and apply adjustments for the following factors: CO2e factors, fleet factors, well-to-wheels factors, and powertrain mismatch factors. Google then input the estimated avoided emissions into the EPA's Green-house Gas Equivalencies Calculator to calculate equivalent cars off the road for a year. For details about Google's initial calculation methodology, see their 2021 white paper, Google Maps Eco-Friendly Routing.
38   https://www.bcg.com/publications/2021/ai-to-reduce-carbon-emissions

As the climate changes, AI tools can also help offset some of the harm, helping individuals and communities to adapt. Google offers multiple AI driven tools for reducing the damage from climate change, including:

Google's **Tree Canopy Lab** combines AI and aerial imagery to help cities see their current tree canopy coverage and better plan future tree planting projects. This is likely to become more important as extreme temperatures and heat islands become more common in concrete dominated cities, leading to reduced air quality, dehydration and public health risks.

In London, for example, the Urban Heat Island can cause the city to be up to 10'C warmer than neighbouring rural areas, and previous heat waves led to a significant number of additional deaths among more vulnerable elderly people. The greater use of trees is estimated to be able to help reduce peak summer temperatures in heat islands by 1-5°C.

Google's global **FloodHub** platform uses AI to give hyperlocal and immediate alerts for areas at risk of flooding. This can be particularly important in emerging economies at high risk of flooding who lack existing early warning systems. In 2021, Google sent 115 million flood alert notifications to 23 million people over Search and Maps in flood prone areas in India and Bangladesh.

However, it can also create value for more developed economies too - and particularly so if climate change leads to greater flooding prevalence. According to the international EM-DAT database, the UK has suffered on average just under one major flood a year,[39] while the ONS reports that both average rainfall and the incidence of extreme weather events in the UK are increasing.[40] In 2023, Google announced that the FloodHub platform would be extended to 80 countries, including the UK.

Public First estimates that using AI and other digital technology to give more immediate and targeted alerts could reduce the damage to property, people and infrastructure created by climate change induced flooding by £165 million a year.

39   https://www.emdat.be/
40   https://www.ons.gov.uk/economy/environmentalaccounts/articles/climatechangeinsightsuk/august2022

Appendix: Methodology

Business Benefits

Google Ads

Following the precedent of past Google impact reports, we use third-party data to estimate the total size of the UK Google Ads market, combining PWC Global Entertainment & Media Outlook data on the total UK paid search market with other estimates of Google's market share.

Following the methodology of the US Google Economic Impact Report, we then scale this revenue by an assumed Return on Investment (ROI) factor of 8, from:

- Varian (2009) estimates that businesses make on average $2 for every $1 they spend on AdWords.
- Jansen and Spink (2009) estimate that businesses receive 5 clicks on their search results for every 1 click on their ads.
- Google estimates that search clicks are about 70% as valuable as ad clicks.
- Total ROI is then 2 * spend + 70% * 5 * 2 * spend − spend = 8 (spend).

This growth is similarly scaled by the ROI factor of 8 and divided by GDP.

More information on this methodology is available at https://economicimpact.google.com/methodology/

AdSense

In order to estimate total UK Adsense revenues, we combined:

- Google's published 2022 Network Revenue
- an assumption on Traffic Acquisition Costs as a % of Network Revenue, based on previous data
- the UK's share of non-video display spending and growth in overall market since 2022, derived from PWC Global Entertainment & Media Outlook data.

Cloud

In order to estimate the total productivity impact of Google Cloud in the UK we combine:

- Statista data on total public cloud revenue in the UK in 2023
- Ofcom data on Google Cloud's market share in the UK
- An assumption that every dollar invested in Cloud services by our users generates a net return

Android

We draw on:

- Deloitte (2022) data on the overall size of app store and contract revenue for the UK's app economy
- data.ai data on Google Play's share of app store revenue
- Statcounter data on Android's market share in the UK
- PPI data on the number of jobs supported in the UK by Android

To calculate the overall savings for developers we:

- Use AppBrain data to estimate total number of Android apps offered by UK developers
- Apply AlphaBeta estimates of average developer day time savings created by Android
- Multiple by third party data on average developer salary

Consumer Benefits

Consumer Surplus of Search

As part of our polling, we asked participants the following single discrete binary choice questions:

> "Imagine you had to choose between the following options. Would you prefer to keep access to Google Search or go without access to Google Search for one month and get paid £PRICE?"

The price offered was randomised between £1.25, £2.50, £5, £10, £20, £50, £100, £200 and £500. We then regressed the results of this poll to derive a demand curve and used this to calculate median consumer surplus per user.

Cost Savings

To estimate the average annual cost reductions from Google services we combined estimates on:

- reduced entertainment costs, based on the proportion of respondents in our consumer poll who told us they had used YouTube to replace a paid video streaming service
- reduced travel costs, based on estimated travel time savings through Google Maps

Our estimate of the one off cost savings from Android was based on polling data on the proportion of adults who would tell us they would have to buy the followings devices if they did not own a smartphone: camera, camcorder, torch, MP3 device, sat nav, GPS, landline phone, alarm clock, voice recorder, calendar, tuner, calculator and laptop.

Skills and Productivity

Digital Skills learned through Search

In order to do this, we:

- Undertook a review of estimates of the wage premiums associated with digital skills. Drawing on this, our calculations assumed:
  - A 6% wage premium from acquiring basic digital skills
  - A 15% wage premium from acquiring more advanced digital skills.
- Asked adults, through our consumer survey, whether they had used self-directed internet research to learn a range of digital skills from scratch (e.g. advanced spreadsheet skills, programming, computer aided design etc)

For those that had done so, we asked them whether Google played an important role in this self-directed research. This allowed us to estimate the share of adults in work that had exclusively used self-directed internet research, through Google, to learn digital skills.

Combining this with our estimates of the wage premium allowed us to arrive at a £30bn salary uplift across the whole economy.

AI

Potential Economic Impact of Generative AI

In order to do this, we:

- Drew on the US O*Net occupation database, which contains information on 17,000 different types of work task for around ~800 types of occupation
- Used a Large Language Model to classify each of the 17,000 tasks, and the likelihood that AI would be able to reduce the time taken to do each one by at least 50%
- Created a weighted measure of the importance of each task to each occupation, based on O*Net's data on their overall importance, frequency and relevance to each occupation
- Assessed the weighted proportion of tasks in each occupation that could be automated, aggregating this into broader economic categories based on their overall share of US employment and average wage bill
- Created our own crosswalk to convert the results from each occupation to the corresponding occupation for the UK

Based on the experience of previous General Purpose Technologies, we assumed that it would take between 10-20 years for the economic impact of generative AI to be fully felt across the economy

Cybersecurity

To assess the potential savings derived from AI cybersecurity, we first asked businesses questions on whether they had experienced a cyber attack as well as on their current utilization of AI-based cybersecurity solutions. From this we derived data points on the chance of a cyber attack and on the adoption of AI for businesses of varying employee size. .

Next, we drew on IBM's Cost of a Data Breach Report 2022 to obtain the average percentage savings achieved through the implementation of AI in cybersecurity practices. Additionally, we referred to the Cybersecurity Breaches Survey 2023 by the Department for Science, Innovation & Technology, for the average cost associated with cyber attacks.

By combining these data points with the Office for National Statistics (ONS) data on UK business demography, we constructed a model that estimated the potential savings that could be attained if non-adopters of AI cybersecurity were to implement such solutions. This analysis accounted for the variations observed across different business sizes and considered the overall composition of the UK's business landscape.

Potential from AI assistive technologies

To estimate the economic uplift from using teleconferencing and assistive technologies to help those with disabilities into work, we drew on ONS Annual Population Survey data on the number of people with disabilities not in work, split by main health condition. We assumed that teleconferencing and assistive technologies would be most appropriate for helping those with the following main conditions to work:

- Problems or disabilities connected with arms or hands
- Problems or disabilities connected with legs or feet
- Problems or disabilities connected with back or neck
- Difficulty in seeing
- Difficulty in hearing

This amounts to just over one million individuals in the UK. To calculate the economic gains from these individuals entering work, we assumed that the economic output per worker matched the average seen across the workforce, according to ONS data.

Reducing Flooding Risk

We estimated this based on:

- Data from the International Disaster Database on the average human and infrastructure costs of UK storm and flood disasters between 2000 and 2022, forecasted forward to 2030 as a baseline
- Using the methodology from Noy (2014) to estimate indirect costs on workforce productivity
- Using the average estimates from Pappenberg et al (2015) and De Groeve et al (2015) on potential from early warning systems to reduce overall flood damage