

AI Foundation Models

Technical update report

16 April 2024

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1. Introduction

- 1.1 In May 2023 the CMA launched an initial review of AI Foundation Models (FMs). We launched this to help create an initial understanding of:
- how the markets created or impacted by the development of FMs and their use could evolve, and the scenarios that may emerge;
 - what opportunities and risks these scenarios could bring for competition and consumer protection; and
 - which principles could best guide the ongoing development of these markets so that the vibrant innovation that has characterised their emerging phase is sustained, and the resulting benefits continue to flow for people, businesses and the economy.
- 1.2 We published our initial report in September 2023, in which we proposed principles to guide the development and deployment of FMs to positive outcomes for competition and consumer protection.
- 1.3 Since the publication of our initial report, we have continued to monitor and review the development and deployment of FMs and the potential impacts on competition and consumer protection. We have also undertaken significant engagement, including in the UK, US and elsewhere.
- 1.4 Engagement has included a public call for submissions and feedback on our initial review; meeting with over 30 stakeholders for feedback on our initial report and proposed principles following publication (with additional presentations to and meetings with trade and industry bodies and business representatives); hosting a workshop with 45 civil society and academic attendees; engagement in the US with a range of stakeholders (including FM developers, deployers and civil society stakeholders); ongoing engagement with UK regulators, UK Government and international counterparts; and a final round of engagement with approximately 20 stakeholders in 2024 to discuss market updates since our initial report and the consumer experience.
- 1.5 Our engagement focused on:
- (a) Feedback on our initial report and the potential impacts on competition and consumer protection it identified;
 - (b) The proposed principles, how they have been received, and whether they have been reflected in companies' actions;

- (c) Further developments in the market and the impact they may have from a competition and consumer perspective;
- (d) How FM developers are accessing key inputs, such as compute, data and expertise, including through investments, mergers, acquisitions and partnerships; and
- (e) The role AI semiconductor chips play in the FM value chain.¹

- 1.6 We are grateful for the ongoing support by stakeholders in engaging with our AI FM review.
- 1.7 Following this extensive engagement and our ongoing monitoring of market developments since September 2023, this report:²
 - Provides an overview and discussion of key changes in the FM sector since the publication of our initial report ('Market landscape');
 - Outlines the feedback we received from stakeholders and relevant market developments that relate to each of our proposed principles ('The CMA's proposed AI principles');
 - Confirms final principles for guiding the market to positive outcomes for competition and consumer protection ('The CMA's confirmed AI principles');
 - Sets out risks to competition and consumer protection, including three key risks to fair, open and effective competition (reproduced below) that we see arising from current and potential developments in the FM sector, assessing how they would be mitigated by the CMA's principles and identifying the actions we are taking now, and are considering taking in the near future to seek to address these risks ('Risks to competition and consumer protection'); and
 - Outlines the next steps for the CMA's AI FM programme of work ('Next steps').

¹ We will publish a separate paper on this final topic in due course.

² This more detailed report accompanies the shorter update paper published on 11 April 2024: [AI Foundation Models: Update paper](#).

Three risks to fair, open and effective competition

1.8 The three key interlinked risks to fair, open and effective competition that we see arising from current and potential developments are set out below and discussed further in Chapter 5.

- 1. Firms that control critical inputs for developing FMs may restrict access to them to shield themselves from competition.**
- 2. Powerful incumbents could exploit their positions in consumer or business facing markets to distort choice in FM services and restrict competition in FM deployment.**
- 3. Partnerships involving key players could reinforce or extend existing positions of market power through the value chain.**

1.9 **We are concerned that the FM sector is developing in ways that risk negative market outcomes.**

1.10 In particular, the growing presence across the FM value chain of **a small number of incumbent technology firms, which already hold positions of market power in many of today's most important digital markets, could profoundly shape FM-related markets to the detriment of fair, open and effective competition, ultimately harming businesses and consumers, for example by reducing choice and quality, and by raising prices.**

1.11 We recognise that today's largest technology firms likely have an important role to play as FM-related markets evolve. These firms can contribute a huge wealth of resources and expertise and, in some cases, have themselves been drivers of innovation in this space.

1.12 However, the benefits flowing from FM technology for businesses and consumers, in terms of quality, choice, price and the very best innovations, are much more likely in a world where those firms are themselves subject to fair, open and effective competition, rather than one where they are simply able to leverage FMs to further entrench and extend existing positions of power in digital markets.

1.13 Further, diversity and choice underpin resilience in our economy and avoids over-dependence on a handful of major firms. This is a particularly critical concern considering the breadth of potential use cases for FMs and potentially impacted sectors such as finance, healthcare, education, defence, transport and retail. It is essential to preserve fully independent, competing offerings between different model developers. It is equally important to protect

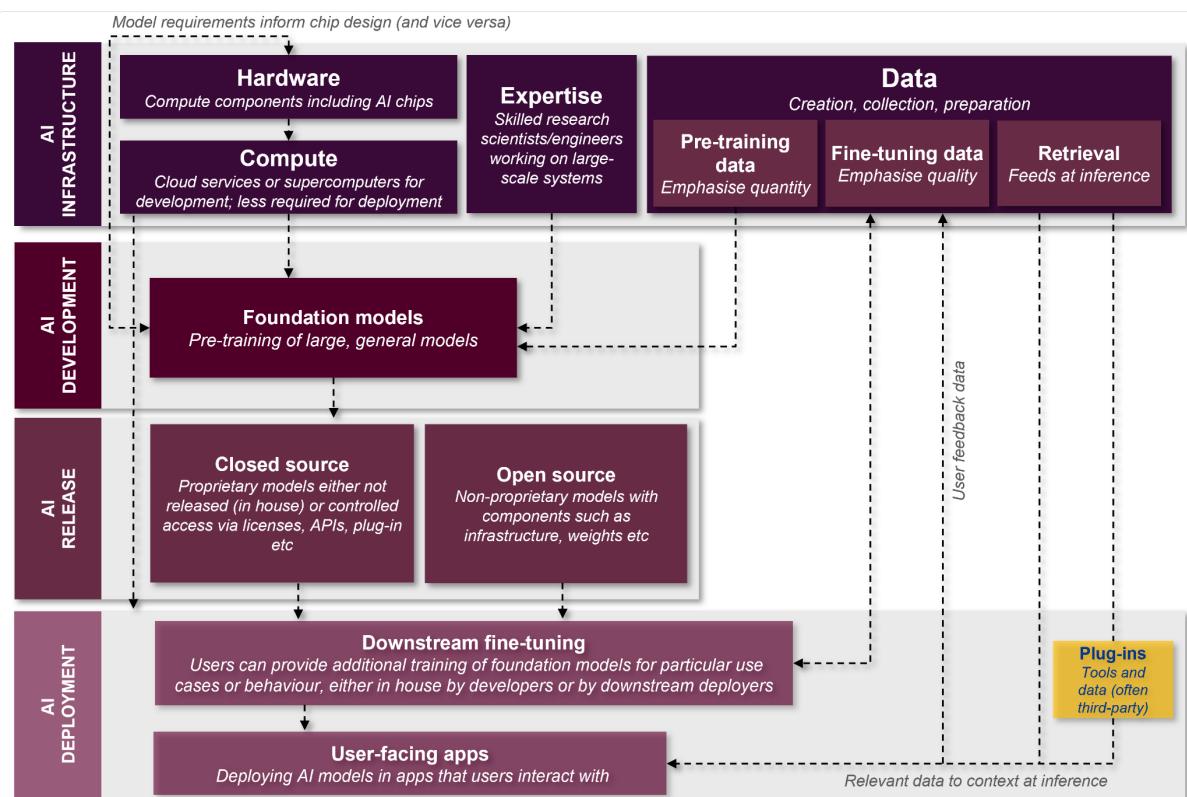
genuine diversity and choice in the deployment of models in any given use case. We think that means encouraging, protecting and preserving sharp-edged competition both from innovative independent players but also, importantly, between the largest incumbents.

- 1.14 We set out in this report the underlying principles we consider as necessary conditions to ensure fair, open and effective competition, to protect consumers, and to shape positive market outcomes. We also set out the action we are and will consider taking to address the risks we have identified and in light of these underlying principles.

2. Market landscape

- 2.1 Since our initial report in September 2023, there have been a range of developments across the FM sector, which we have monitored through reviewing publicly available information and engaging extensively with stakeholders.
- 2.2 This chapter outlines how the landscape has changed since September, including in relation to: (1) FM development; (2) key inputs for FM development; (3) model release, deployment and integration; (4) value chains (including partnerships); (5) regulatory developments; and (6) consumer understanding and attitudes towards AI.
- 2.3 Our work since the initial report has helped us better understand the complex FM value chain. Figure 1 below is based on a similar diagram in the initial report but updated to include hardware to the 'AI infrastructure' layer and separates 'AI release' from the 'deployment' layer.

Figure 1 – Overview of the FM value chain

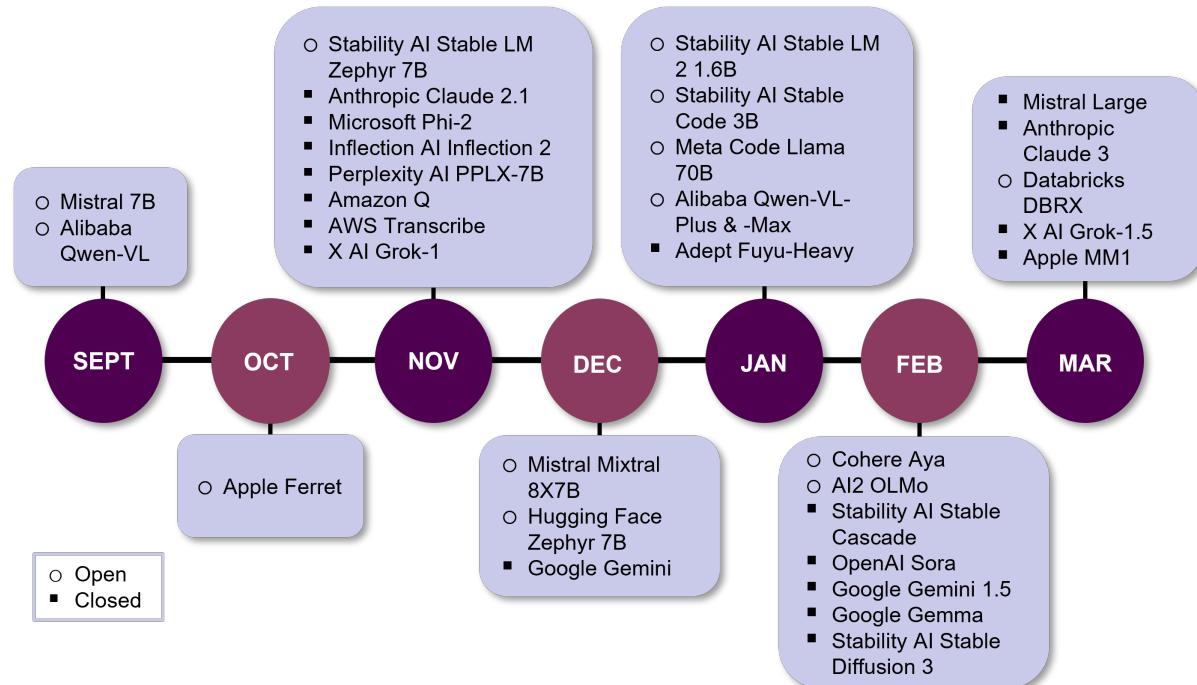


FM development

The number of FMs globally continues to increase

- 2.4 Many FMs were released between September 2023 and March 2024, ranging in size, modality, and capability. According to the Stanford Center for Research on Foundation Models (CRFM), over 120 FMs have been publicly released in this period, bringing the total number of known FMs globally to over 330.³ We have highlighted 31 FMs announced or released since September 2023 in Figure 2 below.⁴

Figure 2 – Selection of FM developments since September 2023



- 2.5 As set out in our initial report, FMs are generally made available on the spectrum of closed (eg proprietary, commercial, or internal-use models) to open-source (eg non-commercial models with weights and training recipes available to users).⁵ Fifty-two of the models identified by Stanford CRFM as released since September are open-source and 21 are closed (or limited).

³ This is a count of FMs that are in the public domain, there may be others that are private. Stanford CRFM (Accessed 08/04/2024) [Ecosystem Graphs for Foundation Models](#).

⁴ This is not an exhaustive list. These FMs have been highlighted due to factors such as model capability (eg performance relative to other models), modality (eg LLM or multimodal), or the prominent market status of the firm.

⁵ The closed-open spectrum is discussed further in the section on 'Diversity' in Chapter 3.

- 2.6 While GPT-4 is still widely regarded as a leading FM, as was the case upon publication of our initial report, other firms have recently released FMs with competitive capabilities. For example, Google claimed that Gemini Ultra outperforms GPT-4 against a number of benchmarks.⁶ Adept claimed Fuyu-Heavy was the third most capable multimodal LLM, at the time of release, after Gemini Ultra and GPT-4V (GPT-4 with vision).⁷ More recently, Anthropic released Claude 3, which it claimed outperforms GPT-4 and other highly capable Large Language Models (LLMs) across a range of benchmarks.⁸ However, there is press speculation that OpenAI will release a more capable model later this year.⁹

Firms are developing small but capable FMs

- 2.7 Our initial report primarily focused on LLMs. LLMs require large amounts of data, with some training data sets exceeding a terabyte.¹⁰ They also require large amounts of compute both for development and deployment. We outlined the push towards larger FMs, where increased numbers of parameters along with large volumes of inputs leads to improved model performance but we noted that there is also a trade-off between model size and costs of training.¹¹
- 2.8 Although models at the frontier continue to increase in size, we have heard from stakeholders that there is also a drive to develop smaller models (ie with a lower number of parameters) that exhibit extensive capabilities while requiring fewer resources to develop or deploy.¹² Stakeholders noted that this is driven in part by the costs of compute and because many deployment use cases do not require the full capability of the larger, general purpose FMs.
- 2.9 Examples of small FMs released recently include Google's Gemma 7B and Hugging Face's Zephyr 7B, which the firms claim match or outperform much larger FMs against some benchmarks.¹³ Another example is Microsoft's 'small language model' Phi-2 (with only 2.7 billion parameters). Phi-2 was developed using curated training data and Microsoft claims that the model outperforms Llama 2 70B against certain benchmarks eg those testing coding and

⁶ Google (2023) [Gemini: A Family of Highly Capable Multimodal Models](#)

⁷ Adept (2024) [Adept Fuyu-Heavy: A new multimodal model](#)

⁸ Anthropic (2024) [Introducing the next generation of Claude](#)

⁹ Business Insider (19/03/2024) [OpenAI Expected to Launch 'Better' GPT-5 for Chatbot Mid-Year](#)

¹⁰ Liu, Yang et al. (2024), '[Datasets for Large Language Models: A Comprehensive Survey](#)', arXiv, p4

¹¹ Competition and Markets Authority (2023), [AI Foundation Models: Initial Report](#), p44

¹² While there is not an agreed upon definition for 'small' FMs, in terms of parameter count, we have observed that FMs reported as being 'small' typically have less than ten billion parameters. As discussed in our initial report, methods for developing small FMs include quantisation, sparsification, distillation and pruning.

¹³ Google (2024) [Gemma: Google introduces new state-of-the-art open models](#). Tunstall, Lewis et al. (2023), '[Zephyr: Direct Distillation of LM Alignment](#)', arXiv, p1.

common sense reasoning.¹⁴ Another recently released, specialised, small FM is Microsoft's Orca-Math, a maths specific model created by fine-tuning the Mistral 7B model.¹⁵ While not all domain specific FMs are small (eg Bloomberg's finance specific BloombergGPT has 50 billion parameters),¹⁶ specialisation techniques such as fine-tuning or distillation can reduce the size of a model while enhancing its ability to perform specific tasks.¹⁷

- 2.10 Furthermore, firms are developing new model architectures to reduce the memory and compute requirements of FMs. For example, a class of transformer models called Sparse Mixture of Experts,¹⁸ such as Mistral's Mixtral 8x7B and Databricks' DBRX,¹⁹²⁰ allow developers to increase the number of parameters in a FM while minimising compute costs. Alternatives to the commonly employed transformer architecture²¹ have also emerged, such as Mamba²² and RWKV,²³ which further attempt to reduce the memory and compute requirements needed to build FMs. Developing methods to either reduce model size or reduce the compute cost associated with larger models remains an active area of research.

Firms are deploying smaller FMs on consumer devices

- 2.11 We also heard from stakeholders that the development of smaller FMs will enable, or is already enabling, deployment of FMs locally on consumer devices (ie without reliance on cloud infrastructure). We have also observed this trend in publicly reported materials. For example, Stability AI released several three billion parameter LLMs that are designed to operate on portable devices such as laptops. Stability AI claims these models are on a par with or

¹⁴ Microsoft (2023) [Phi-2: The surprising power of small language models](#)

¹⁵ Microsoft (2024) [Orca-Math: Demonstrating the potential of SLMs with model specialization](#)

¹⁶ Bloomberg (2023) [Introducing BloombergGPT, Bloomberg's 50-billion parameter large language model, purpose-built from scratch for finance](#)

¹⁷ Google (2024) [A three-step design pattern for specializing LLMs](#). Google (2023) [Distilling step-by-step: Outperforming larger language models with less training data and smaller model sizes](#).

¹⁸ Unlike traditional 'dense' models, Mixture of Experts models take a 'sparse' approach. Currently, the most capable models require a high parameter count, consequently requiring a high amount of compute. Mixture of Experts instead create multiple sub-expert models that are then activated for specific subtasks. This approach supports both efficient processing by breaking down complex tasks into simpler ones. Hugging Face (2023) [Mixture of Experts Explained](#).

¹⁹ Mistral (2023) [Mixtral of experts](#)

²⁰ Databricks (2024) [Introducing DBRX: A New State-of-the-Art Open LLM](#)

²¹ A transformer is a type of neural network that is used for natural language processing tasks. Transformers are able to learn long-range dependencies in text, which makes them well-suited for tasks such as machine translation and question answering.

²² Gu, Albert and Dao, Tri (2023), 'Mamba: Linear-Time Sequence Modeling with Selective State Spaces', arXiv

²³ Peng, Bo et al. (2023), 'RWKV: Reinventing RNNs for the Transformer Era', arXiv

better than some seven billion parameter models.²⁴ Google also specified that its Gemma 2B model is designed for on-device applications.²⁵

- 2.12 The ability for small FMs to be deployed on-device is further enabled by advances in hardware. Chip suppliers are announcing new specialised AI chips for personal computers (desktops and laptops), including CPUs and GPUs capable of accelerating AI, as well as AI-dedicated Neural Processing Units (NPUs).²⁶ Subsequently, PC suppliers have announced new ‘AI PCs’ powered by these AI specialised chips, touting their ability to support and accelerate FM-powered features such as Copilot on Windows.²⁷
- 2.13 Developing AI-specialised mobile chipsets powerful enough to run FMs is challenging. This is due to the compact size of smartphones and wearables relative to larger devices such as laptops. However, there were several announcements in 2023 that demonstrated FM-powered features on smartphones. For example, Qualcomm’s Snapdragon 8 Gen 3 mobile chipset supports optimised versions of Meta’s Llama 2 and Stable Diffusion on Android mobile devices.²⁸ More recently, Qualcomm released a library of pre-optimised FMs for deployment on-device.²⁹
- 2.14 Ultimately, there are two simultaneous developments that could enable on-device storage and inference of FMs: first, decreasing size of FMs and second, increasing prominence of specialised AI chips in consumer devices.³⁰ Reported benefits for users interacting with on-device FMs include: reduced latency (enabling real-time interaction), increased privacy and security, and the removal of reliance on an internet connection.³¹ FM developers and

²⁴ Stability AI (2023) [Introducing Stable LM Zephyr 3B: A New Addition to Stable LM, Bringing Powerful LLM Assistants to Edge Devices](#). Stability AI (2024) [Stable Code 3B: Coding on the Edge](#).

²⁵ Google (2024) [Gemma: Open Models Based on Gemini Research and Technology](#)

²⁶ Intel (2023) [Intel Core Ultra Ushers in the Age of the AI PC](#). AMD (2023) [AMD Extends Mobile PC Leadership with AMD Ryzen™ 8040 Series Processors and Makes Ryzen™ AI Software Widely Available, Advancing the AI PC Era](#). Nvidia (2024) [NVIDIA Brings Generative AI to Millions, With Tensor Core GPUs, LLMs, Tools for RTX PCs and Workstations](#).

²⁷ Lenovo (2023) [Lenovo Unlocks New AI PC Experiences with ThinkPad and IdeaPad Laptops Powered by Intel Core Ultra Processors](#). Dell (2024) [Dell Technologies Helps Organizations Create a Modern Workplace with New AI Experiences](#). HP (2024) [HP Unveils Industry’s Largest Portfolio of AI PCs](#). Microsoft (2024) [Advancing the new era of work with Copilot, Windows, and Surface](#).

²⁸ Qualcomm (2023) [Accelerating generative AI at the edge | Knowledge distillation & Quantization](#)

²⁹ Qualcomm (2024) [Qualcomm Continues to Bring the Generative AI Revolution to Devices and Empowers Developers with Qualcomm AI Hub](#)

³⁰ Qualcomm (2023) [Democratizing on-device generative AI with sub-10 billion parameter models](#)

³¹ Google (2023) [Gemini Nano now running on Pixel 8 Pro — the first smartphone with AI built in](#). Hewlett Packard Enterprise (Accessed 08/04/2024) [What is Edge AI?](#)

deployers may also benefit by eliminating the need for using cloud compute for inference and the cost this entails.^{32,33}

Open-source FMs remain an important force for competition and innovation

- 2.15 Since publication of our initial report, some of the most prominent models that have been released have been open-source, including Mistral's Mixtral 8x7b, Google's Gemma, Cohere's Aya, AI2's OLMo and Databricks' DBRX. Furthermore, Alibaba Cloud has launched Qwen-VL chat, based on their open-source Qwen-7B model.³⁴ Microsoft's Phi-2, originally only open-source for research purposes, has been released under broader open-source licenses for all deployers. Meta has also confirmed that it is currently training its Llama 3 model, the successor to its open-source models Llama and Llama 2.³⁵
- 2.16 We have also observed a number of FMs being released that have been built upon open-source FMs. For example, Abacus.AI launched Smaug-72B,³⁶ a fine-tuned version of the open-source Qwen-72B,³⁷ and claims that the model outperforms Qwen-72B as well as GPT-3.5 and Mistral Medium.³⁸ Furthermore, OLMo,³⁹ Aya⁴⁰ and DBRX⁴¹ are claimed to outperform Meta's open-source Llama 2 7B. Mixtral 8X7B, released in December, is also claimed to rival GPT-3.5's capability.⁴²

FMs being released can better process more and different types of data

- 2.17 As discussed in our initial report, knowledge augmentation techniques that draw on external knowledge sources (including the web) when generating a response can improve the accuracy and relevance of a FM's response.⁴³

³² While a single inference requires very little compute, as the model size and/or number of users increases, the compute required for inference also increases. Inference at scale can therefore require large amounts of compute.

³³ Financial Times (15/05/2023) [The race to bring generative AI to mobile devices](#)

³⁴ Bai, Jinze et al. (2023), '[Qwen-VL: A Versatile Vision-Language Model for Understanding, Localization, Text Reading, and Beyond](#)', arXiv

³⁵ The Verge (18/01/2024) [Meta's new goal is to build artificial general intelligence](#). See, also, social media posts from [Mark Zuckerberg](#), Meta's founder and Chief Executive Officer, and [Yann LeCun](#), its Chief AI Scientist.

³⁶ Hugging Face (2024) [abacusai/Smaug-72B-v0.1](#). Pal, Arka et al. (2024), '[Smaug: Fixing Failure Modes of Preference Optimisation with DPO-Positive](#)', arXiv.

³⁷ Hugging Face (Accessed 08/04/2024) [Qwen/Qwen-72B](#)

³⁸ Mistral (Accessed 08/04/2024) [Endpoints and Benchmarks](#)

³⁹ Groeneveld, Dirk et al. (2024), '[OLMo: Accelerating the Science of Language Models](#)', arXiv

⁴⁰ Cohere (2024) [Cohere For AI Launches Aya, an LLM Covering More Than 100 Languages](#)

⁴¹ Databricks (2024) [Introducing DBRX: A New State-of-the-Art Open LLM | Databricks](#)

⁴² InfoQ (23/01/2024) [Mistral AI's Open-Source Mixtral 8x7B Outperforms GPT-3.5](#)

⁴³ Guu, Kelvin et al. (2020), '[REALM: Retrieval-Augmented Language Model Pre-Training](#)', arXiv

Such techniques, known as retrieval-augmented generation (RAG), can incorporate both static and dynamic knowledge bases, and have reportedly become a key way to introduce domain and enterprise specific knowledge into FMs.⁴⁴ Examples of FM developers using RAG include xAI's Grok, which uses social media platform content from X (formerly Twitter) to inform its responses in real-time,⁴⁵ and Perplexity AI's 'Online LLMs', which use up-to-date information from the web when forming a response.⁴⁶

- 2.18 Another key trend we observed is the ability of newer FMs to process an increasing amount of data (or tokens) when producing an output. Several recently released FMs have longer context windows than predecessors, meaning an increased number of tokens can be input to the model for processing.⁴⁷ An increased context window can also enable FMs to check the surrounding data (tokens) relative to the main data, which helps to provide only relevant responses.⁴⁸
- 2.19 For example, Anthropic's Claude 3 has a context window length of 200 thousand tokens (approximately 150 thousand words), whereas Claude 2 had a 100 thousand token context window.⁴⁹ Google stated that its Gemini 1.5 Pro is available with a context window of up to one million tokens (over 700 thousand words or one hour of video).⁵⁰ One stakeholder told us that longer context windows may mean FMs require less fine-tuning in the future because the information required for a use case can 'fit' within the context window.
- 2.20 Finally, we have seen a trend towards the release of FMs with multimodal capabilities. These FMs can process prompts and outputs of various modalities (eg text, image, video, or audio) and include Google's Gemini,⁵¹ OpenAI's Sora,⁵² Apple's Ferret⁵³ and MM1,⁵⁴ and Adept's Fuyu-Heavy.⁵⁵ For example, OpenAI's Sora can be prompted with text, image or video. It can

⁴⁴ Menlo Ventures (2024) [The Modern AI Stack: Design Principles for the Future of Enterprise AI Architectures](#). Prompt Engineering Guide (2024) [Retrieval Augmented Generation \(RAG\)](#). IBM (2023) [What is retrieval-augmented generation?](#)

⁴⁵ "A unique and fundamental advantage of Grok is that it has real-time knowledge of the world via the X platform." xAI (2023) [Announcing Grok \(x.ai\)](#)

⁴⁶ Perplexity AI (2023) [Introducing PPLX Online LLMs](#)

⁴⁷ Google (2024) [What is a long context window? Google DeepMind engineers explain](#)

⁴⁸ TechTarget (2024) [Definition: Context Window](#)

⁴⁹ Anthropic (Accessed 08/04/2024) [Models overview](#)

⁵⁰ Google (2024) [Introducing Gemini 1.5, Google's next-generation AI model](#)

⁵¹ Google (2024) [Introducing Gemini 1.5, Google's next-generation AI model](#)

⁵² OpenAI (2024) [Sora: Creating video from text](#)

⁵³ You, Haoxuan et al. (2023), 'Ferret: Refer and Ground Anything Anywhere at Any Granularity', arXiv

⁵⁴ McKinzie, Brandon et al. (2024), 'MM1: Methods, Analysis & Insights from Multimodal LLM Pre-training', arXiv

⁵⁵ Adept (2024) [Adept Fuyu-Heavy: A new multimodal model](#)

therefore be used for image and video generation, as well as image and video editing.⁵⁶

Key inputs for FM development

2.21 FM development still hinges on availability of compute, data, and expertise – to which large technology companies typically have greater access.

FM developers are accessing data through partnerships, licensing deals and synthetic routes

2.22 Data at scale remains a key component for developing FMs. As well as developers looking to add volume to training data, in light of increasing intellectual property (IP) enforcement action,⁵⁷ there seems to be a trend for FM developers to ensure that they can lawfully access data for FM development. This could be through data partnerships, licensing deals or use of synthetic data. We explore these further below and in the ‘Access’ section of Chapter 3.

2.23 In our initial report, we noted examples of FM developers using proprietary sources such as academic journals, image repositories, coding companies and content websites to collate pre-training data.⁵⁸ We have since observed a variety of developments in the way that firms access proprietary data, including the following:

- OpenAI partnered with publishing house Axel Springer to give ChatGPT users access to real-time summaries of Axel Springer content, including otherwise paid content.⁵⁹ OpenAI is seeking to partner with organisations to either (1) produce open-source data sets for ‘anyone to use in AI model training’ or (2) access private data sets made up of the organisation’s data which can be used to train proprietary FMs, including OpenAI’s models. In the latter, the partner organisation can control the level of access to the data.⁶⁰

⁵⁶ OpenAI (2024) [Video generation models as world simulators](#)

⁵⁷ See, for instance: The New York Times (27/02/2024) [OpenAI Seeks to Dismiss Parts of The New York Times's Lawsuit](#)

⁵⁸ Agreements highlighted in the initial report include the agreement between Associated Press and Open AI to license news stories, and the 6-year license agreement between Open AI and Shutterstock to license images. AP News (13/07/2023) [ChatGPT-maker OpenAI signs deal with AP to license news stories](#). Shutterstock (2023) [Shutterstock Expands Partnership with OpenAI, Signs New Six-Year Agreement to Provide High-Quality Training Data](#).

⁵⁹ OpenAI (2023) [Partnership with Axel Springer to deepen beneficial use of AI in journalism](#)

⁶⁰ OpenAI (2023) [OpenAI Data Partnerships](#)

- Google's expanded partnership with Reddit now gives Google access to Reddit's Data API.⁶¹ Reports suggest the deal may enable Google to use Reddit content to train its AI models.⁶² Google has also partnered with Stack Overflow, a software developer Q&A site, to integrate Gemini on Google Cloud with Stack Overflow's coding knowledge base.⁶³
 - According to media reports, Apple is exploring multiyear deals worth at least \$50 million with news and publishing organisations to use their material in the development of generative AI systems.⁶⁴
- 2.24 Some firms developing AI-generated image tools (such as Adobe,⁶⁵ Getty Images⁶⁶ and Shutterstock)⁶⁷ have said that they are taking steps to ensure that the FMs they are developing or using are trained on licensed data. Meanwhile, Google,⁶⁸ Microsoft,⁶⁹ and Open AI⁷⁰ have, for some of their products, announced mechanisms aimed at enabling website owners to control whether their content is accessed by or used to train FMs.
- 2.25 Some firms, including Google,⁷¹ Microsoft,⁷² OpenAI,⁷³ Anthropic,⁷⁴ Shutterstock,⁷⁵ and Getty Images,⁷⁶ offer to indemnify customers against copyright claims arising from their use of these firms' FMs. Indemnification is discussed further in the 'Choice' section of Chapter 3.
- 2.26 In our initial report, we briefly considered the potential suitability of synthetic data⁷⁷ to supplement or replace human-generated data for pre-training, fine-
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⁶¹ Google (2024) [An expanded Partnership with Reddit](#)

⁶² Reuters (22/02/2024) [Exclusive: Reddit in AI content licensing deal with Google](#). Bloomberg Law (16/02/2024) [Reddit Is Said to Sign AI Content Licensing Deal Ahead of IPO](#).

⁶³ Stack Overflow (2024) [Stack Overflow and Google Cloud Announce Strategic Partnership to Bring Generative AI to Millions of Developers](#)

⁶⁴ The New York Times (22/12/2023) [Apple Explores A.I. Deals With News Publishers](#). The Verge (22/12/2023) [Apple reportedly wants to use the news to help train its AI models](#). Reuters (22/12/2023) [Apple explores AI deals with news publishers - New York Times](#).

⁶⁵ Adobe (Accessed 08/04/2024) [Firefly vs DALL·E 3](#)

⁶⁶ Getty Images (Accessed 08/04/2024) [Generative AI by Getty Images, powered by NVIDIA](#)

⁶⁷ Shutterstock (2023) [AI-generated Content on Shutterstock: Contributor FAQ](#)

⁶⁸ Google (2023) [An update on web publisher controls](#)

⁶⁹ Microsoft (2023) [Announcing new options for webmasters to control usage of their content in Bing Chat](#)

⁷⁰ OpenAI (Accessed 08/04/2024) [GPTBot - OpenAI API](#)

⁷¹ Google (2023) [Protecting customers with generative AI indemnification](#)

⁷² Microsoft (2023) [Microsoft announces new Copilot Copyright Commitment for customers](#)

⁷³ OpenAI (2023) [Business terms](#)

⁷⁴ Anthropic (2023) [Expanded legal protections and improvements to our API](#)

⁷⁵ Shutterstock (Accessed 08/04/2024) [Meet the first commercially safe AI image generator](#)

⁷⁶ Getty Images (Accessed 08/04/2024) [Generative AI by Getty Images, powered by NVIDIA](#)

⁷⁷ Synthetic data is data which has been generated artificially. It can be used for use cases such as pre-training, fine-tuning, and testing models. Examples include using data from simulations and using existing AI models to generate new data sets. Synthetic data is discussed in paragraphs 3.19 and 3.20 of the AI Foundation Models Initial Report: Competition and Markets Authority (2023), [AI Foundation Models: Initial Report](#), p32.

tuning, and testing models. We noted that there was uncertainty around using synthetic data as it had not been tested at scale and concerns regarding potential ‘model collapse’ (ie degradation of performance).

- 2.27 Several of the FMs released since then employed synthetic data in pre-training or fine-tuning, including Microsoft’s Phi-2,⁷⁸ Anthropic’s Claude 3,⁷⁹ and Google’s Gemma.⁸⁰ These market developments suggest that synthetic data might be an increasingly viable option to access data for FM training for certain purposes, and/or when used in combination with other sources. However, it remains to be seen the extent to which synthetic data will supplant other forms of data, and how costly or accessible it would be for market participants to acquire and generate at a sufficient quality.

FM developers predominantly access compute via the cloud, including through partnerships

- 2.28 As discussed above, there are ongoing efforts to reduce the compute required for FM development. Despite this, access to substantial compute remains critical for developing highly capable FMs. For example, Google reported that training Gemini Ultra involved a ‘large fleet’ of Google’s own TPUv4 accelerator chips across multiple data centres, which was significantly more compute than used to train its predecessors.⁸¹
- 2.29 FM developers continue to access compute mainly via Cloud Service Providers (CSPs), including both larger providers (such as Amazon, Microsoft, and Google) and smaller specialist AI cloud providers. Some stakeholders told us that partnerships remain one way of securing access to compute.

AI accelerator chip supply remains constrained, but the market is diversifying

- 2.30 Some FM developers continue to build their own clusters or supercomputers powered by AI accelerator chips. For example, in January, Meta revealed that it is growing its fleet of GPUs with an aim to operate ‘600,000 [Nvidia] H100

⁷⁸ “Our training data mixture contains synthetic datasets specifically created to teach the model common sense reasoning and general knowledge” Microsoft (2023) [Phi-2: The surprising power of small language models](#)

⁷⁹ “Claude 3 models are trained on a proprietary mix of publicly available information on the Internet as of August 2023, as well as non-public data from third parties, data provided by data labelling services and paid contractors, and data we generate internally.” Anthropic (2024), [‘The Claude 3 Model Family: Opus, Sonnet, Haiku’](#), Anthropic, p3

⁸⁰ “We finetune Gemma 2B and 7B with supervised fine-tuning (SFT) on a mix of text-only, English-only synthetic and human-generated prompt-response pairs...” Google Gemma Team, Google Deepmind (2024), [‘Gemma: Open Models Based on Gemini Research and Technology’](#), Google Deepmind, p4

⁸¹ Gemini Team, Google (2023), [‘Gemini: A Family of Highly Capable Multimodal Models’](#), arXiv, p4

[GPU] equivalents of compute' by the end of 2024.⁸² However, stakeholders told us about challenges they have faced in accessing state-of-the-art AI accelerator chips and reports in the media suggest long lead times of up to a year for Nvidia's H100 GPU.⁸³

- 2.31 Some stakeholders told us that constraints in manufacturing capacity are a reason for challenges and delays in accessing state-of-the-art AI accelerator chips, particularly for market leader Nvidia's AI-specialised GPUs. The CEO of OpenAI has commented publicly on his view that there is a scarcity of chips,⁸⁴ and media reports have speculated that he has been exploring the possibility of starting a new chip-making venture.⁸⁵
- 2.32 According to stakeholders, Nvidia's GPUs, such as the H100, continue to lead the market in AI accelerator chips.⁸⁶ However, since publication of our initial report, competitors have released, or announced the future release of chips, including Intel,⁸⁷ AMD,⁸⁸ Microsoft,⁸⁹ Google,⁹⁰ and Amazon.⁹¹ Some industry reports and stakeholders we spoke to suggested that these developments could increase competition in AI chips.⁹²
- 2.33 We will discuss this landscape further in a separate paper on AI accelerator chips, which we will publish in due course.

⁸² Data Center Dynamics (18/01/2024) [Meta to operate "600,000 H100 GPU equivalents of compute" by year-end](#)

⁸³ The Register (07/12/2023) [Dell APJ chief says the industry won't wait for Nvidia H100](#). Tom's Hardware (28/11/2023) [Nvidia sold half a million H100 AI GPUs in Q3 thanks to Meta, Facebook — lead times stretch up to 52 weeks: Report](#).

⁸⁴ Financial Times (12/11/2023) [OpenAI chief seeks new Microsoft funds to build 'superintelligence'](#)

⁸⁵ Reuters (06/10/2023) [Exclusive: ChatGPT-owner OpenAI is exploring making its own AI chips](#). The Wall Street Journal (08/02/2024) [Sam Altman Seeks Trillions of Dollars to Reshape Business of Chips and AI](#). Bloomberg UK (19/01/2024) [OpenAI CEO Sam Altman Looks to Raise Billions for Network of AI Chip Factories](#).

⁸⁶ Stakeholders told us that Nvidia's H100 GPU is currently the chip that is most widely used by FM developers. Nvidia has announced plans to release the H200 GPU and B100 GPU in 2024. NVIDIA (2023) [NVIDIA H200 Tensor Core GPU](#). WCCF Tech (13/11/2023) [Nvidia Blackwell B100 GPUs To More Than Double The Performance of Hopper H200 GPUs In 2024](#). The Register (02/01/2024) [2024 sure looks like an exciting year for datacenter silicon](#).

⁸⁷ CNBC (14/12/2023) [Intel unveils Gaudi3 AI chip to compete with Nvidia and AMD](#)

⁸⁸ AMD (2023) [AMD Delivers Leadership Portfolio of Data Center AI Solutions with AMD Instinct MI300 Series](#)

⁸⁹ Microsoft (2023) [With a systems approach to chips, Microsoft aims to tailor everything 'from silicon to service' to meet AI demand](#)

⁹⁰ Google (2023) [Introducing Cloud TPU v5p and AI Hypercomputer](#)

⁹¹ Amazon (2023) [AWS Unveils Next Generation AWS Designed Chips](#)

⁹² Tom's Hardware (16/12/2023) [AMD strikes back at Nvidia with new MI300X benchmarks](#). Tom's Hardware (15/12/2023) [Intel shows Gaudi3 AI accelerator, promising quadruple BF16 performance in 2024](#). The Register (02/01/2024) [2024 sure looks like an exciting year for datacenter silicon](#).

Demand for and investment in AI expertise remains high

- 2.34 Access to relevant expertise also remains important to FM development. There is significant competition between FM developers to attract skilled researchers. For example:
- OpenAI reportedly offered \$10 million pay packages, as well as greater access to compute resources, to attract researchers from Google.⁹³
 - Google reportedly gave senior AI researchers multi-million-dollar stock grants to compete with OpenAI's offers and retain staff.⁹⁴
 - Meta CEO Mark Zuckerberg described the importance of conveying the message that the firm was targeting 'artificial general intelligence' in terms of attracting talent, stating that 'a lot of the best researchers want to work on the more ambitious problems'.⁹⁵
- 2.35 Furthermore, during a short period of uncertainty around the future of OpenAI's leadership in November 2023, FM developers and deployers took the opportunity to offer jobs to OpenAI staff.⁹⁶ The battle for talent has been further demonstrated by Microsoft's recent appointment of the Inflection AI CEO (and other staff) to lead Microsoft's new consumer AI team.⁹⁷
- 2.36 There have also been significant investments in training for AI skills, both for FM development and for deploying and working with AI. For example, Microsoft stated that it will make a multi-million-pound investment in AI skills training in the UK, while Amazon has launched a series of free AI courses and scholarships for generative AI courses.⁹⁸ The UK Government has also announced £118 million to boost the AI skills base.⁹⁹

⁹³ The Information (10/11/2023) [OpenAI's New Weapon in Talent War With Google: \\$10 Million Pay Packages for Researchers](#)

⁹⁴ The Information (16/01/2024) [Google's Defense Against OpenAI Talent Grab: Special Stock](#)

⁹⁵ The Verge (18/01/2024) [Mark Zuckerberg's new goal is creating artificial general intelligence](#)

⁹⁶ TechCrunch (21/11/2023) [Chaos at OpenAI adds fuel to the AI talent poaching war](#)

⁹⁷ Inflection AI (2024) [The new Inflection: An important change to how we'll work](#)

⁹⁸ Microsoft (2023) [Our investment in AI infrastructure, skills and security to boost the UK's AI potential](#). Amazon (2023) [Amazon aims to provide free AI skills training to 2 million people by 2025 with its new 'AI Ready' commitment.](#)

⁹⁹ Department for Science, Innovation and Technology, Department for Business and Trade, UK Research and Innovation, British Council, and The Rt Hon Michelle Donelan MP (2023), [Britain to be made AI match-fit with £118 million skills package](#)

FM development continues to require large amounts of capital

- 2.37 Recent funding rounds highlight the continued need to raise large amounts of funding to support FM development. Examples of such funding developments include announcements from Open AI,¹⁰⁰ Mistral¹⁰¹ and Stability AI.¹⁰²

Model release, deployment and integration

Developers are releasing FMs on a range of platforms, often hosted by the largest technology firms

- 2.38 Methods of model release have developed further since our initial report. Models across the open to closed spectrum¹⁰³ can be accessed through various methods, including through a range of platforms. This is discussed further in the later section on our ‘Diversity’ principle, but several examples are set out in Figure 3 below. This emergence of platforms has, in part, motivated our depiction of ‘AI release’ as a separate layer in the FM value chain (Figure 1 above). Notably, several popular platforms have been launched by the largest CSPs (Amazon, Microsoft, and Google).

¹⁰⁰ Open AI announced a funding round which included a further \$10B investment by Microsoft. TechCrunch (23/01/2023) [Microsoft invests billions more dollars in OpenAI, extends partnership](#)

¹⁰¹ Funding round for ~ \$415M, including VC investment from Andreessen Horowitz and Lightspeed Venture Partners, as well as a later investment from Microsoft for \$16M. The New York Times (10/12/2023) [Mistral, French A.I. Start-Up, Is Valued at \\$2 Billion in Funding Round](#). TechCrunch (27/02/2024) [Microsoft made a \\$16M investment in Mistral AI](#).

¹⁰² Stability AI received \$50M in funding in the form of a convertible from Intel. Verdict (13/11/2023) [UK's Stability AI gets financial boost from Intel](#)

¹⁰³ See the section above entitled ‘The number of FMs globally continues to increase’.

Figure 3 – FM release platforms

Type	Platform	Selected models available
Paid-for development platforms	 Bedrock	<p>Both API and open-source access including:</p> <ul style="list-style-type: none"> • Anthropic's Claude 3 (and previous iterations) • Amazon's Titan (Text Express, Text Lite, Text Embeddings, Multimodal Embeddings, Image Generator) • Stability AI's Stable Diffusion XL 1.0 (and 0.8) • Meta's Llama 2 (13b and 70b) • Mistral's 7B and Mixtral 8x7B • Cohere's Command & Embed • AI21's Jurassic 2 Ultra (and Mid)¹⁰⁴
 Azure Machine Learning		<p>Both proprietary and open-source access including:</p> <ul style="list-style-type: none"> • Exclusive third party access to OpenAI models (GPT-3.5, GPT-3.5 Turbo, GPT-4, GPT-4 Turbo, DALL-E Preview, Whisper Preview, Text to Speech Preview)¹⁰⁵ • Open-source models and transformers models from Hugging Face • Access to curated models from partners such as Meta, Nvidia and Mistral¹⁰⁶
 Vertex AI		<p>Provides API access to Google models, including:</p> <ul style="list-style-type: none"> • Gemini 1.0 (Pro, Pro Vision, Ultra, Ultra Vision) • Gemini 1.5 (Pro – private preview) • PaLM 2, Codey, Imagen, MedLM¹⁰⁷ <p>The Vertex AI Model Garden provides access to 130+ FMs including:</p>

¹⁰⁴ Amazon (Accessed 08/04/2024) [Amazon Bedrock](#)

¹⁰⁵ Microsoft (2024) [Azure OpenAI Service models](#)

¹⁰⁶ Microsoft (2024) [Model Catalog and Collections - Azure Machine Learning](#)

¹⁰⁷ Google (Accessed 08/04/2024) [Model information | Vertex AI | Google Cloud](#)

	<ul style="list-style-type: none"> • Those developed by Google (Gemini, Imagen, Codey, Chirp) • Open-source models such as Gemma, Meta's Llama 2, TII's Falcon, Bert, T-5 FLAN, ViT, EfficientNet • Anthropic's Claude 3¹⁰⁸
	<p>Provides access to models, including:</p> <ul style="list-style-type: none"> • IBM Granite and Slate models • Meta's Llama 2, Google's T-5 FLAN • Elyza's Japanese-Llama-2 • EleutherAI GPT-NeoX-20B • Mosaic's MPT-7B-Instruct2 • BigScience mT0-XXL-13B • BigCode StarCoder-15.5B • Mistral's Mixtral 8x7B instruct¹⁰⁹
	<p>Allows users to build custom GPT models (no coding required) and share with other users. Premium service, only available to ChatGPT Plus, Team, and Enterprise users¹¹⁰</p>
Open platforms	 Hugging Face Provides open-source access for over 500,000 model versions (ie iterations of, or models adapted from, the FM) ¹¹¹
	<p>The exact number of FMs available on GitHub is unclear; however, there are over 8,000 open-source generative AI projects on the platform (this includes LLMs and open-source applications)¹¹²</p>
	<p>Provides access to hundreds of open-source models¹¹³</p>

¹⁰⁸ Google (Accessed 08/04/2024) [Model Garden | Google Cloud](#). Anthropic (2024) [Introducing the next generation of Claude](#).

¹⁰⁹ IBM (Accessed 08/04/2024) [Foundation Models in watsonx.ai](#)

¹¹⁰ OpenAI (2024) [Introducing the GPT Store](#)

¹¹¹ Hugging Face (Accessed 08/04/2024) [Models](#)

¹¹² GitHub (2023) [A developer's guide to open source LLMs and generative AI](#)

¹¹³ Kaggle (Accessed 08/04/2024) [Models](#)

There has been extensive FM integration in digital markets – often involving the largest technology firms – but wider adoption remains at the early stages

- 2.39 There has been a trend toward FM integration in commonly used digital products and services, often involving the largest technology firms. Stakeholders noted that many deployers are integrating models to improve operational efficiency and customer service. Examples of FM developers currently deploying AI in their services include the following:
- Google has integrated its Gemini model into several services, including Gemini for Google Workspace (which is available to individuals, smaller businesses, and larger enterprises – this was previously named Duet),¹¹⁴ and the Gemini chatbot.¹¹⁵
 - Microsoft has integrated FMs into several services under a single name, Copilot. Microsoft Copilot has been deployed across its products from Bing search to Office 365.¹¹⁶ Examples of the diverse use cases Microsoft has proposed for Copilot include chatbot functionality for personal users, drafting project proposals in Word for business users, and analysing Excel data for enterprise users.¹¹⁷
 - Meta has integrated FMs into a physical product, its Ray-Ban smart glasses. AI image generation (Imagine) and chatbots have been integrated into Meta's existing messaging apps (Messenger, WhatsApp, and Instagram currently only in the US).¹¹⁸
 - Amazon has released Amazon Q, a standalone 'AI-powered assistant',¹¹⁹ in preview and has also integrated Rufus, an AI-powered shopping assistant, into the Amazon shopping platform.¹²⁰ Some FM-powered services, such as Character.AI, have been integrated into Alexa.¹²¹
- 2.40 It is likely that integration will increase, and so FMs may be used to improve functionality of and user interaction with more traditional software or services. Stakeholders raised the potential for this to lead to the development of

¹¹⁴ Google (Accessed 08/04/2024) Bring your best ideas to life with Gemini for Google Workspace

¹¹⁵ Google (Accessed 08/04/2024) Gemini

¹¹⁶ Microsoft (Accessed 08/04/2024) Copilot

¹¹⁷ Microsoft (Accessed 08/04/2024) Reinvent productivity with Copilot for Microsoft 365

¹¹⁸ Meta (2023) What's New Across Our AI Experiences

¹¹⁹ Amazon (Accessed 08/04/2024) Amazon Q (Preview)

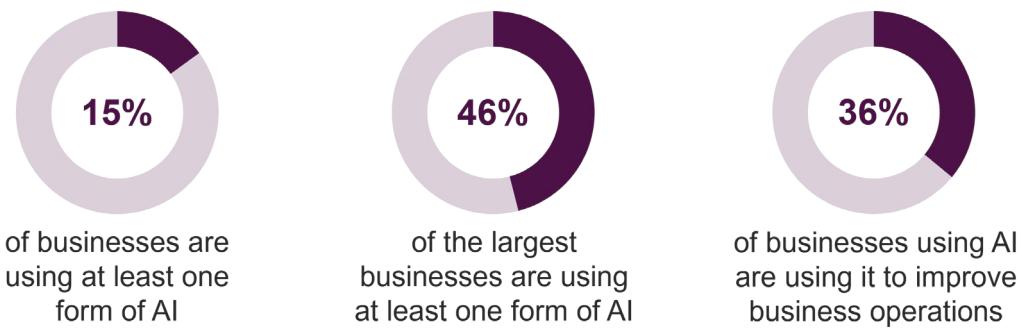
¹²⁰ Amazon (2024) Amazon announces Rufus, a new generative AI-powered conversational shopping experience

¹²¹ TechCrunch (09/01/2024) Amazon's Alexa gets new generative AI-powered experiences

autonomous AI in which AI systems take multiple steps and decisions, with limited human supervision, to complete complex tasks.¹²²

- 2.41 The extent of FM deployment in the wider economy, by contrast, remains at an earlier stage. Reports suggests that business adoption of FM services has been slow, and while companies are experimenting with these tools, many are yet to find valuable use cases, particularly given high usage costs as well as technical limitations such as hallucinations.¹²³
- 2.42 Recent survey results relating to UK businesses' use of AI from the ONS's 'Business insights and impact on the UK economy' survey¹²⁴ show that 15% of UK businesses are currently using at least one of the AI technologies asked about in the survey (which included FM services alongside other AI technologies), rising to 46% among the largest businesses (those with 250+ staff). Penetration of AI tends to increase with business size, and the level of adoption varies quite substantially across industries. The top reason businesses reported using AI is to improve business operations, followed by providing or personalising a product/service, followed by developing a new product/service or exploring a new market.¹²⁵

Figure 4 – Business use of AI¹²⁶



¹²² These kinds of more autonomous AI systems are also referred to as 'agentic systems' (see OpenAI (2023) [Practices for Governing Agentic AI Systems](#)), 'Agent AI' (see Microsoft (2024) [Agent AI - Microsoft Research: Overview](#)), or 'Agentic AI or AI Agents' (see Department for Science, Innovation and Technology (2024), [A pro-innovation approach to AI regulation: government response](#)).

¹²³ The Economist (29/02/2024) [How businesses are actually using generative AI](#). The Information (12/03/2024) [Amazon, Google Quietly Tamp Down Generative AI Expectations](#).

¹²⁴ Wave 98 of the survey, published in January 2024, included AI questions (responses relate to a reference period of November 2023). Office for National Statistics (2024), [Business insights and impact on the UK economy](#)

¹²⁵ Office for National Statistics (2024), [Business insights and impact on the UK economy](#)

¹²⁶ Office for National Statistics (2024), [Business insights and impact on the UK economy, Wave 98 \(published in February 2024, reference period of November 2023\)](#)

- 2.43 It remains to be seen how quickly and widely FM services will be adopted across the economy. Some observers have suggested that FM services will have widespread economic impact across a range of sectors. For example, a paper by Google-affiliated authors argues that AI has characteristics of a general-purpose technology, including broad applicability across a spectrum of economic activities.¹²⁷ In McKinsey's 2023 'State of AI' survey of businesses globally, three-quarters of respondents said they expect generative AI to cause significant or disruptive change in the nature of their industry's competition in the next three years. However, other commentators have expressed scepticism that many of the potential generative AI use cases will be profitable, given cost and hallucination issues, predicting a downturn in FM markets as a result.¹²⁸

Fine-tuning services

- 2.44 In addition to the fine-tuning tools available on FM development platforms, such as those offered by Microsoft, Amazon, and Google,¹²⁹ some firms, including OpenAI and Mosaic, provide fine-tuning services.¹³⁰ These services may be helpful for deployers and customers without the in-house technical resources to develop FMs, but who would like to take advantage of the broad capabilities of FMs whilst benefitting from a customised solution (which may involve a mix of models or access points, such as APIs).

¹²⁷ Ben-Ishai, Guy et al. (2024), '[AI and the Opportunity for Shared Prosperity: Lessons from the History of Technology and the Economy](#)', arXiv. Ellingrud, Kweilin et al. (2023), '[Generative AI and the future of work in America](#)', McKinsey Global Institute.

¹²⁸ Locus (2023) [Cory Doctorow: What Kind of Bubble is AI?](#), Where's Your Ed At (2024) [Have We Reached Peak AI?](#)

¹²⁹ Microsoft (2024) [Customize a model with Azure OpenAI Service](#). Amazon (Accessed 08/04/2024) [Fine-tune foundation models - Amazon SageMaker](#). Google (2024) [Overview of model tuning | Generative AI on Vertex AI](#).

¹³⁰ OpenAI (2024) [Introducing improvements to the fine-tuning API and expanding our custom models program](#). Mosaic (Accessed 08/04/2024) [Mosaic ML's finetuning services](#).

FM developers and deployers are exploring monetisation strategies

- 2.45 Since our initial report, we have observed wider monetisation of FMs and FM-powered services. For example:
- For enterprise customers, firms including Amazon,¹³¹ Anthropic,¹³² Google,¹³³ Microsoft,¹³⁴ Mistral AI,¹³⁵ OpenAI,¹³⁶ and Stability AI¹³⁷ provide a variety of paid tiers (monthly subscriptions, pay per number of tokens input and output used, pay as you go, credit-based systems).
 - For non-enterprise customers, the majority of services, such as those offered by Google, OpenAI, Anthropic, xAI and Microsoft, are either free, or up to \$20 per month for a subscription.¹³⁸
- 2.46 We have seen a trend in the monetisation of productivity software with AI integration, which is presented as a premium add-on; Microsoft's Copilot, for example, can be purchased as an add-on for existing Windows Home, Pro, or Enterprise users.¹³⁹
- 2.47 We have also observed increasing availability of paid API access directly from developers and through development platforms, such as Amazon Bedrock.
- 2.48 For example, via Amazon Bedrock, customers can access FMs including Anthropic's Claude 3, Cohere's Command, AI21's Jurassic-2, Meta's Llama 2, Stability AI's Stable Diffusion, Mistral's 8x7B, and Amazon's Titan.¹⁴⁰ Customers can also choose to pay for API access to some of these FMs directly from the developers, eg Anthropic, Mistral, and Stability AI.¹⁴¹

¹³¹ Amazon (Accessed 08/04/2024) [Amazon Transcribe Pricing](#). Amazon (Accessed 08/04/2024) [Generative AI Powered Assistant - Amazon Q Pricing](#). Amazon (Accessed 08/04/2024) [Build Generative AI Applications with Foundation Models - Amazon Bedrock Pricing](#).

¹³² Anthropic (Accessed 08/04/2024) [Model Pricing](#)

¹³³ Google (Accessed 08/04/2024) [Duet AI for Developers](#). Google (Accessed 08/04/2024) [Pricing | Vertex AI](#).

¹³⁴ Microsoft (Accessed 08/04/2024) [Microsoft Copilot for Microsoft 365](#). Microsoft (Accessed 08/04/2024) [Pricing - Translator | Microsoft Azure](#). Microsoft (Accessed 08/04/2024) [Pricing - Azure Machine Learning](#).

¹³⁵ Mistral (Accessed 08/04/2024) [Pricing and rate limits | Mistral AI Large Language Models](#)

¹³⁶ OpenAI (Accessed 08/04/2024) [ChatGPT Pricing](#). OpenAI (Accessed 08/04/2024) [Pricing](#).

¹³⁷ Stability AI (Accessed 08/04/2024) [Stability AI - Developer Platform](#). Stability AI (Accessed 08/04/2024) [Membership — Stability AI](#).

¹³⁸ Anthropic (2023) [Introducing Claude Pro](#). Google (2024) [Google Bard is now Gemini: How to try Ultra 1.0 and new mobile app](#). Microsoft (Accessed 08/04/2024) [Microsoft Copilot for Microsoft 365—Features and Plans](#).

OpenAI (Accessed 08/04/2024) [ChatGPT Pricing](#). X (Accessed 08/04/2024) [About X Premium](#).

¹³⁹ Microsoft (Accessed 08/04/2024) [Microsoft Copilot for Microsoft 365—Features and Plans](#)

¹⁴⁰ Amazon (Accessed 08/04/2024) [Build Generative AI Applications with Foundation Models - Amazon Bedrock](#)

¹⁴¹ Mistral (Accessed 08/04/2024) [Pricing and rate limits | Mistral AI Large Language Models](#). Stability AI (Accessed 08/04/2024) [Stability AI - Developer Platform](#). Anthropic (Accessed 08/04/2024) [Model Pricing](#).

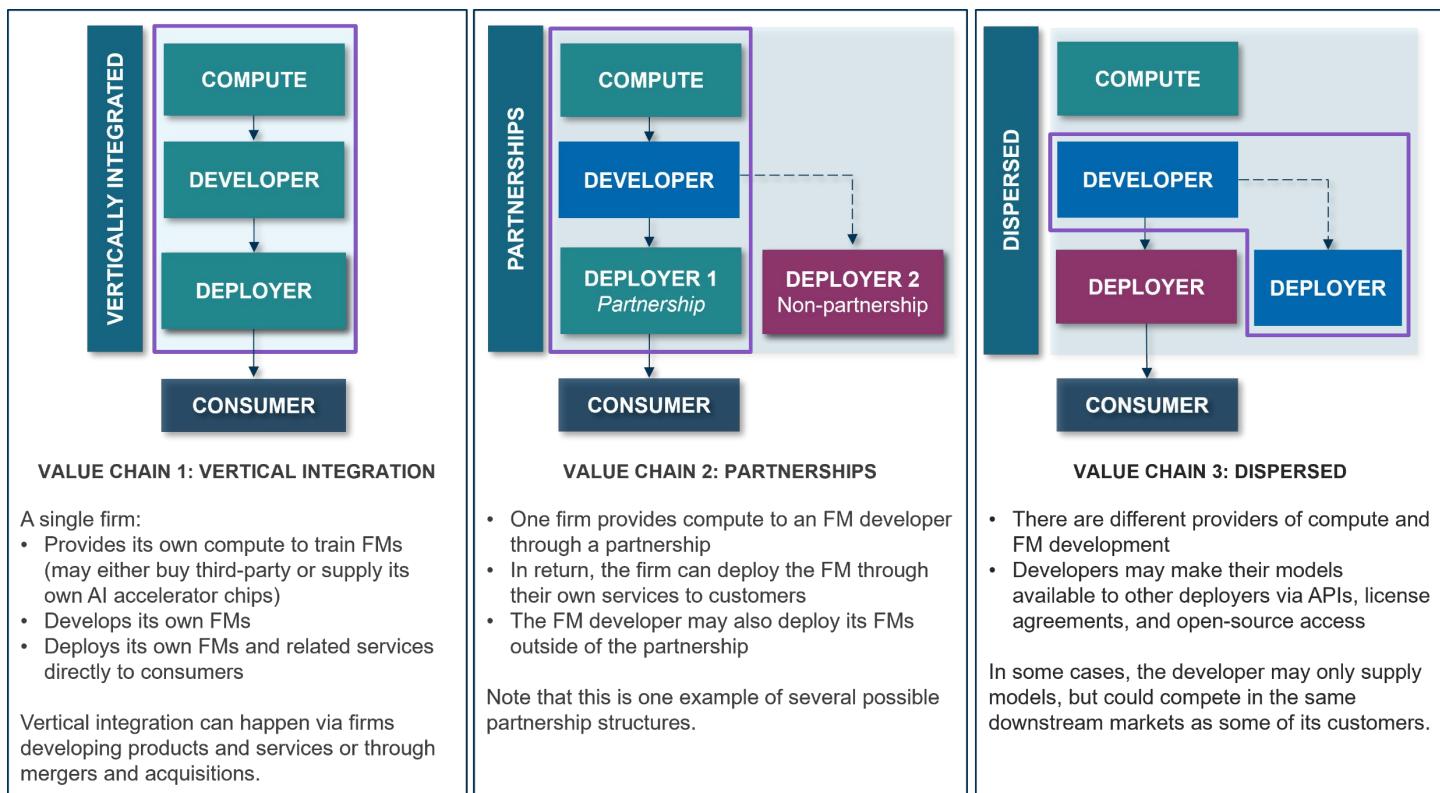
Value chains

2.49 We have developed our understanding of FM value chains, which are influenced by the nature of the FMs themselves and their compute requirements, among other factors. In some instances, firms are operating multiple types of value chain structures. We have seen examples of:

- Vertically integrated firms, where the same firm has a presence in FM inputs (such as compute or hardware), FM development, and FM deployment.
- Partnerships in the FM supply chain, such as between FM developers and CSPs.
- Dispersed value chains, where a range of firms operate at different levels of the value chain, for instance one firm providing compute, another developing FMs, and a separate firm deploying that model in their own products and services.

2.50 As part of the work on our principles, we have considered distinctions between our indicative value chains, and how they might impact the relevance and scope of particular principles.

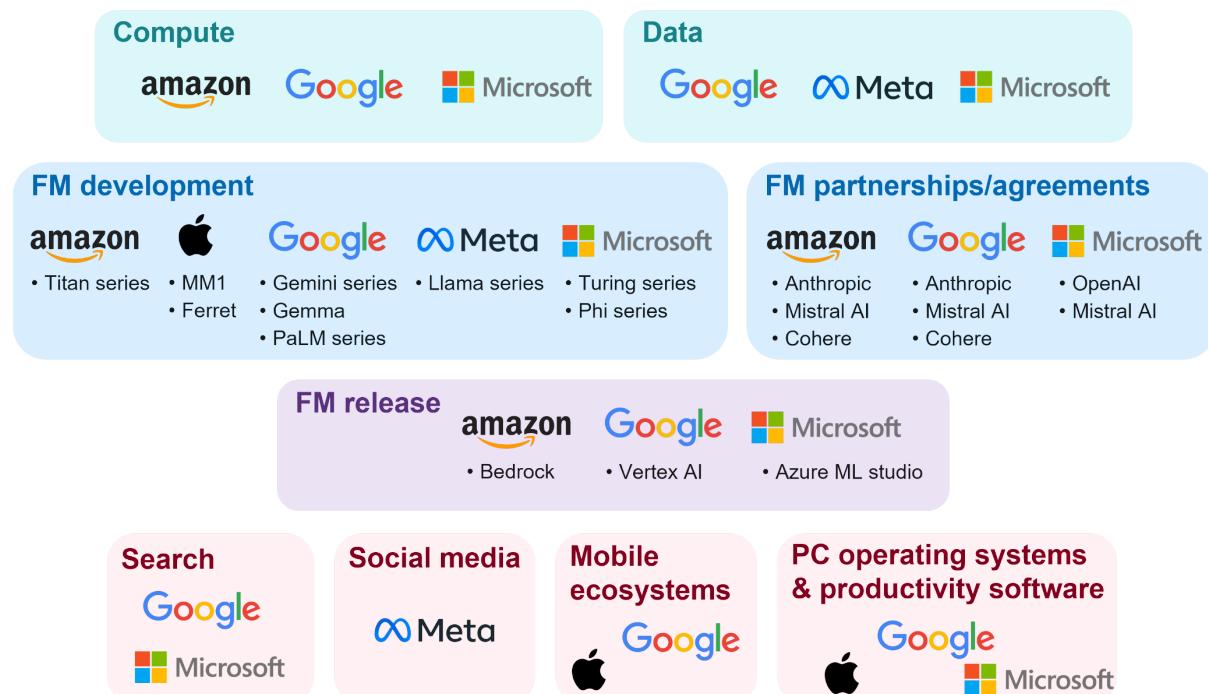
Figure 5 – Types of value chains



- 2.51 The largest and most established technology firms – many of whom already hold a strong position in related activities – are becoming increasingly active across multiple levels of the FM value chain, including in the upstream supply of critical inputs (such as data, compute and technical expertise), model development, and the downstream provision of products and services (such as apps and platforms) that allow businesses and/or consumers to access and deploy models.
- 2.52 This inter-connectedness is growing due to greater levels of vertical integration as well as through an increasing number of partnerships, investments and strategic agreements deepening the relationships between firms operating at different levels (see further discussion below).
- 2.53 Figure 6 below shows how Google, Amazon, Microsoft, Meta and Apple (sometimes referred to as the GAMMA firms) are active across different levels of the FM value chain to varying degrees, including through partnerships and agreements with FM developers.¹⁴² These firms often have strong positions in critical inputs for FM development – such as large data sets or AI compute infrastructure at significant scale – and/or key access points or routes to market for FM release and deployment.

¹⁴² Note this diagram is intended to be illustrative of the presence of GAMMA, rather than exhaustive. It includes references to the following partnerships and agreements: Microsoft (2023) [Microsoft and OpenAI extend partnership](#). Microsoft (2024) [Introducing Mistral-Large on Azure in partnership with Mistral AI](#). Google (2023) [Google Announces Expansion of AI Partnership with Anthropic](#). PYMNTS (13/12/2023) [Mistral AI Partners With Google Cloud to Distribute AI Solutions](#). Cohere (2022) [Cohere Is Available on the Google Cloud Marketplace](#). Amazon (2024) [Amazon completes \\$4B Anthropic investment to advance generative AI](#). Amazon (2024) [Amazon Bedrock adds Mistral AI models](#). Cohere (2023) [Cohere Brings its Enterprise AI Offering to Amazon Bedrock](#).

Figure 6 – Illustration of the presence of GAMMA firms across the FM value chain¹⁴³



¹⁴³ This figure is illustrative and non-exhaustive – it is not representative of all possible presence of these firms across the FM value chain nor all the FM-related markets in which they are active.

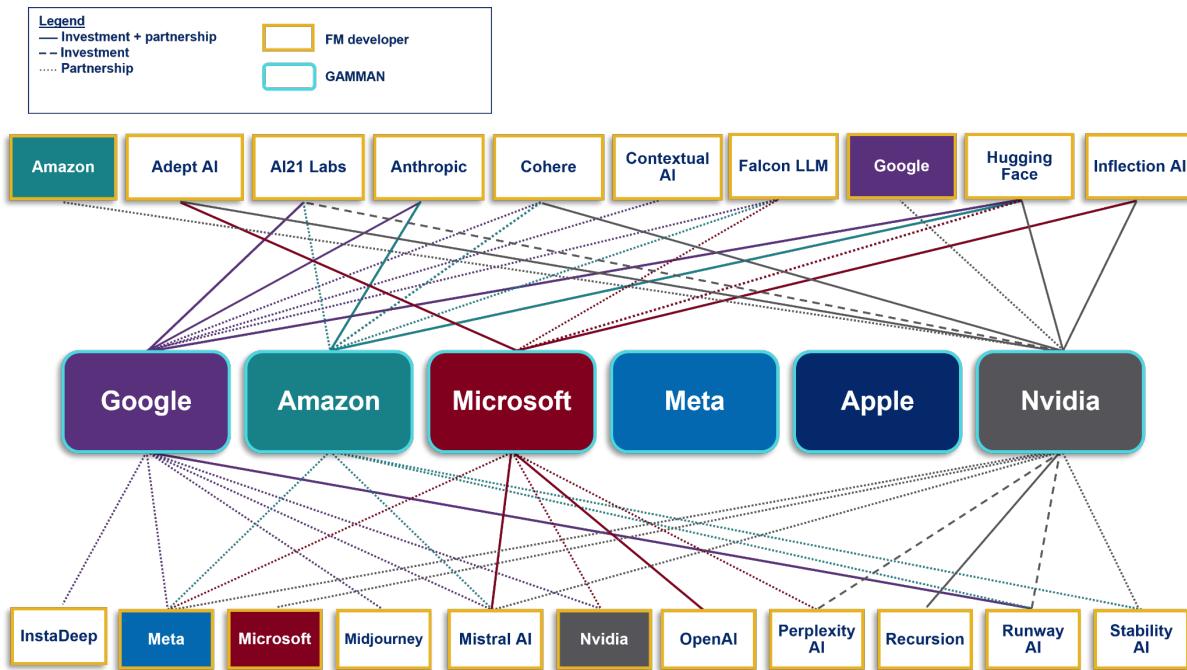
Partnerships and investments

- 2.54 One key market development is the continued proliferation of partnerships, investments and strategic agreements across the FM value chain.¹⁴⁴ We have been considering a range of these partnerships formed in recent years and in particular how FM developers access key inputs such as expertise, data, and compute.
- 2.55 Partnerships could bring significant benefits to the parties involved and lead to increased innovation and efficiencies. For example, they may allow FM developers to access scarce FM inputs, and bring their models to market faster and on a broader basis. On the other hand, partnerships could pose risks to competition in FM-related markets (see further Chapter 5 which considers this in more detail).
- 2.56 As part of our work in this area, we have been tracking some of the most significant partnerships we have observed based on publicly available information. The diagrams below non-exhaustively map out partnerships we have observed since 2019 between:
- (a) The GAMMA firms and Nvidia (which is the leading supplier of AI accelerator chips) – for brevity, we refer to this group below as ‘GAMMAN’ – given these are significant players in the FM supply chain; and
 - (b) FM developers, FM deployers or FM developer tool suppliers (together, ‘FM partners’)
- 2.57 In our mapping, we have considered a wide range of partnership arrangements, including but not limited to those which involve investments with or without an equity stake.
- 2.58 Based on our work to date, we make the following observations:
- We identified 90+ partnerships between GAMMAN firms and FM partners since 2019.
 - It appears that most of these partnerships did not involve an acquisition of a stake of 50% or more in the FM partner, though the detail of different partnership arrangements may vary.

¹⁴⁴ We will refer collectively to partnership, investments and strategic agreements as “partnerships”, unless otherwise indicated.

- We commonly observed interconnected relationships, where multiple GAMMAN firms have invested in or partnered with the same firm.¹⁴⁵

Figure 7 – Relationships between GAMMAN and FM developers¹⁴⁶

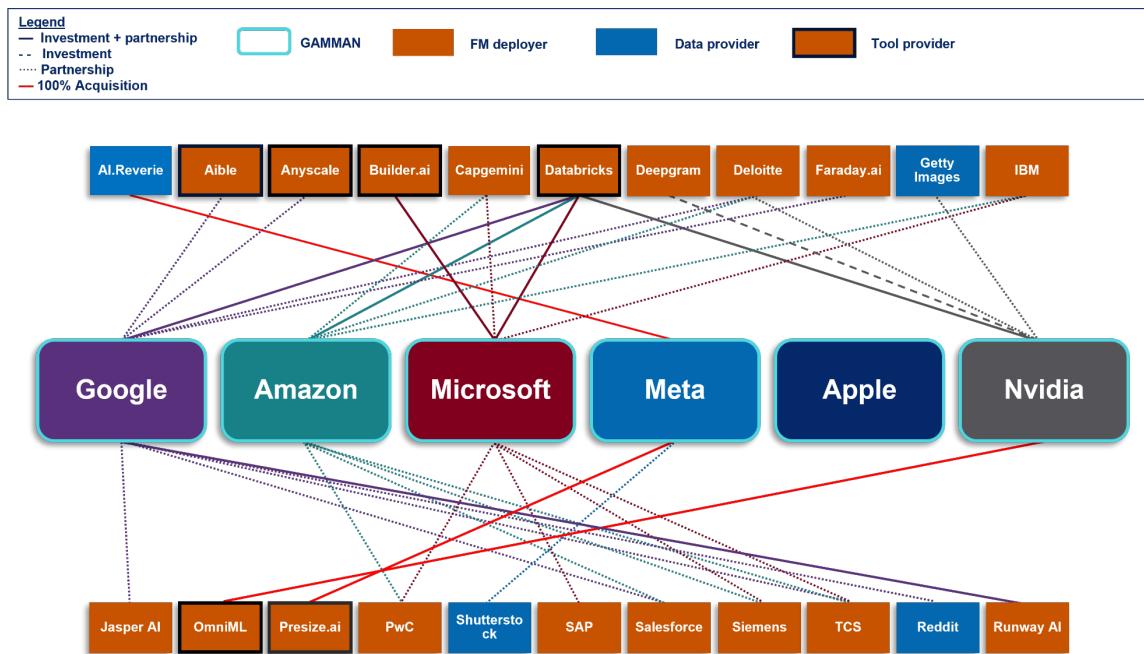


¹⁴⁵ See eg Bloomberg (29/06/2023) [AI Video Startup Runway Raises \\$141 Million From Google, NVIDIA](#). FT (29/06/2023) [Microsoft and Nvidia join \\$1.3bn fundraising for Inflection AI](#).

¹⁴⁶ Notes on the diagram:

- Relationships mapped here show a partnership and/or investment between a GAMMAN firm and a FM developer partner, where the relationship involves the latter's FM development (eg the GAMMAN firm supplying compute for FM development) or provision of FMs (eg for distribution on the GAMMAN partner's marketplace). That FM developer partner could also be a GAMMAN firm.
- The colour of the connecting arrows corresponds to the GAMMAN firm rather than the FM developer partner.
- All relationships indicated are based on public sources.
- ‘Partnerships’ cover any relationship that either of the firms themselves describe as a ‘partnership’ or ‘collaboration’ in public documents. This could involve a range of structures. An ‘investment’ refers to a cash investment, rather than eg provision of compute credits. A relationship between a GAMMAN firm and a FM developer partner can involve both an investment and a partnership. Note that none of these relationships are a 100% acquisition (ie in terms of an acquisition of the entire issued share capital of the target).
- This is a selection of the key partnerships and not exhaustive list of the partnerships which exist between GAMMAN firms and FM developers. Relationships could include partnerships that are anticipated but not yet completed.
- We understand that Apple has made several investments in AI, some of which involve neural network, deep and machine learning technologies. However, we cannot confirm whether they relate to FMs and therefore have not included them in our mapping.

Figure 8 – Relationships between GAMMAN and FM deployers/ data providers/ developer tool providers¹⁴⁷



There are a wide range of partnership structures

2.59 We observed a wide range of partnership structures in the mapping above between GAMMAN firms and FM partners.¹⁴⁸ We outline some of these structures below. For example:

- **Compute partnerships:** Partnerships may allow FM developers access to compute, including access to specialised supercomputing systems or chips (eg Microsoft and OpenAI, Amazon and Anthropic, Google and Anthropic)¹⁴⁹

¹⁴⁷ Notes on Figure 7 apply equally here, unless otherwise indicated. Relationships mapped here show a partnership and/or investment between a GAMMAN firm and a FM deployer partner, where the relationship involves the latter's (1) customer-facing, FM-powered service (2) provision of data or (3) developer tool for FM development or deployment.

¹⁴⁸ Where we refer to 'GAMMAN' firms in relation to these partnership structures, that means at least one of the GAMMAN firms entered into a particular partnership structure with a FM partner. It does not mean all the GAMMAN firms have done.

¹⁴⁹ Microsoft (2023) [Microsoft and OpenAI extend partnership](#). Anthropic (2023) [Expanding access to safer AI with Amazon](#). Anthropic (2023) [Anthropic Partners with Google Cloud](#).

- **Data partnerships:** Partnerships may allow one party to access data from the other party (eg Meta and Shutterstock, Google and Reddit)¹⁵⁰
- **Distribution partnerships:** These could take several forms:
 - **Distribution of FMs:** Some firms are building development platforms that offer a library of FMs. Partnerships may allow a GAMMAN firm to (1) add the partner's model(s) to their library or (2) provide access to the partner's model(s) via the GAMMAN firm's FM developer tools. Examples include Amazon and Cohere, Google and Mistral, Microsoft and Meta, Amazon and HuggingFace.¹⁵¹
 - **Distribution of tools:** GAMMAN firms may also add the partner's FM developer tool to its own platform or marketplace (eg Microsoft and Nvidia.)¹⁵²
 - **Distribution of FM infrastructure:** A GAMMAN firm may distribute a partner's AI infrastructure through its own cloud marketplace (eg Nvidia and Google,¹⁵³ Nvidia and AWS).¹⁵⁴
 - **Accelerator programme:** GAMMAN firms may create an accelerator programme for AI start-up partners (eg the Meta / Hugging Face / Scaleway start-up programme).¹⁵⁵ These may offer funding and compute resources, as well as coaching and networking opportunities.¹⁵⁶
- **Investments:** GAMMAN firms could be one of multiple investors in an FM partner, alongside other GAMMAN firms. Venture capital firms will also commonly participate in these funding rounds. Examples include funding

¹⁵⁰ PR Newswire (12/01/2023) [Shutterstock Expands Long-standing Relationship with Meta](#). Google (2024) [Google expands partnership with Reddit](#).

¹⁵¹ Amazon (2023) [Cohere brings language AI to Amazon SageMaker](#). Reuters (13/12/2023) [Google Cloud partners with Mistral AI on generative language models](#). Microsoft (2023) [Microsoft and Meta expand their AI partnership with Llama 2 on Azure and Windows](#). Amazon (Accessed 08/04/2024) [Hugging Face on Amazon SageMaker](#).

¹⁵² NVIDIA (2023) [NVIDIA Collaborates With Microsoft to Accelerate Enterprise-Ready Generative AI](#)

¹⁵³ NVIDIA (2023) [Google Cloud and NVIDIA Expand Partnership to Advance AI Computing, Software and Services](#)

¹⁵⁴ NVIDIA (2023) [NVIDIA BioNeMo Enables Generative AI for Drug Discovery on AWS](#)

¹⁵⁵ OpenAI (Accessed 08/04/2024) [OpenAI Startup Fund](#). Meta (2023) [Meta partners with Hugging Face & Scaleway to Support Open Source](#).

¹⁵⁶ See eg OpenAI's Startup Fund which offers "tech talks, office hours, social events, and conversations with leading practitioners, we'll explore the most important opportunities and challenges of building at the cutting edge of AI. In addition, participants will receive a \$1 million investment from the OpenAI Startup Fund and join our community of builders." OpenAI (2023) [Converge 2 · OpenAI Startup Fund](#).

rounds for Runway AI,¹⁵⁷ Cohere,¹⁵⁸ Adept,¹⁵⁹ Inflection¹⁶⁰ and HuggingFace.¹⁶¹ Investment may be a mixture of cash and compute credits.¹⁶²

- 2.60 Whilst we acknowledge the potential pro-competitive benefits partnerships can bring, we are vigilant against the possibility that incumbent firms may try to use partnerships and investments to quash competitive threats. See further Chapter 5, which considers this in more detail.

Regulatory developments

- 2.61 As noted in the initial report, the development of AI engages several other policy areas which are being considered by other regulators and governments around the world. Since the publication of our initial report, a number of regulators and governments, including the UK Government, have agreed principles or set out obligations to improve the safety of AI, including FMs, and the accountability of developers and deployers. Examples of key developments are set out in the table below. Our principles are intended to complement the UK Government's approach to AI and are focused on the development of economic markets that function well from a competition and consumer perspective, in line with our statutory remit. We are also monitoring key international developments since our initial report, including the White House Executive Order, the EU AI Act, and the Bletchley Declaration.

¹⁵⁷ Bloomberg (29/06/2023) [AI Video Startup Runway Raises \\$141 Million From Google, Nvidia](#)

¹⁵⁸ Reuters (08/06/2023) [AI startup Cohere raises funds from Nvidia, valued at \\$2.2 billion](#)

¹⁵⁹ Adept (2023) [Adept announces \\$350M of new capital](#)

¹⁶⁰ Inflection (2023) [Inflection AI announces \\$1.3 billion of funding led by current investors, Microsoft, and NVIDIA](#)

¹⁶¹ Reuters (24/08/2023) [AI startup Hugging Face valued at \\$4.5 bln in latest round of funding](#)

¹⁶² See eg TechCrunch (23/01/2023) [Microsoft invests billions more dollars in OpenAI, extends partnership](#). Tech Monitor (27/09/2023) [What the AWS Anthropic AI investment means for the cloud market](#).

Figure 9 – Key regulatory developments

Development	Detail
US Executive Order (30 October 2023)	The Executive Order directs federal agencies in the US to take measures to drive the safe, secure, and trustworthy development of AI, covering such areas as safety and security, privacy, civil and consumer rights while promoting innovation and competition. ¹⁶³
Hiroshima Process G7 voluntary AI Code of Conduct (30 October 2023)	A voluntary set of international guiding principles to promote safety and trustworthiness in advanced AI systems. The principles apply to all AI actors in the AI life cycle, including the design, development, deployment, and use of advanced AI systems. ¹⁶⁴
Bletchley Declaration (1 November 2023)	A policy paper signed by representatives from over 25 territories (including the US, EU, and China) which sets out shared objectives that AI should be ‘designed, developed, deployed, and used, in a manner that is safe, human-centric, trustworthy and responsible.’ ¹⁶⁵
UK Government response on its pro-innovation approach to AI regulation (6 February 2024)	The UK Government published a response to its consultation on its AI White Paper, building on areas such as the five cross-sectoral principles set out in the original White Paper. ¹⁶⁶ The Government has asked a number of regulators including the CMA to publish an update outlining their strategic approach to AI by 30 April 2024.
EU AI Act (13 March 2024)	Harmonised rules to ensure that AI systems in the EU ‘are safe and respect fundamental rights and EU values’ following a risk-based approach. ¹⁶⁷

Consumer understanding and attitudes towards AI

2.62 Despite its nascent stage, research shows significant numbers of people are exploring and experimenting with the technology. Research by CDEI found that over a third of the public claim to have used chatbots at least once a

¹⁶³ White House (2023), [FACT SHEET: President Biden Issues Executive Order on Safe, Secure, and Trustworthy Artificial Intelligence](#)

¹⁶⁴ European Commission (2023) [Hiroshima Process International Guiding Principles for Advanced AI system](#)

¹⁶⁵ Prime Minister’s Office, Foreign, Commonwealth and Development Office, and Department for Science, Innovation and Technology (2023) [AI Safety Summit 2023: The Bletchley Declaration](#)

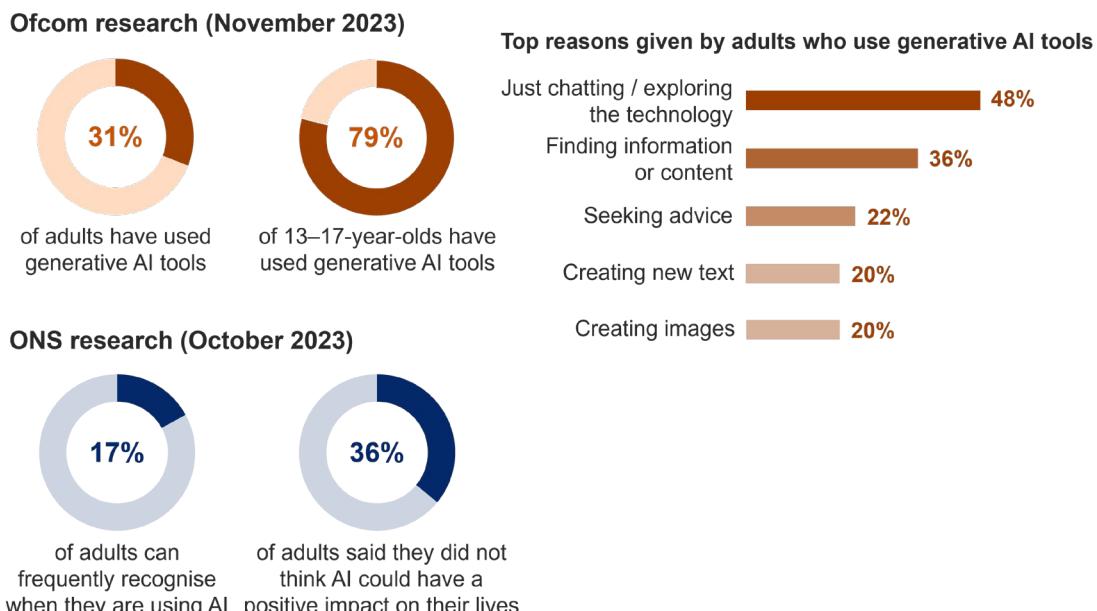
¹⁶⁶ Department for Science, Innovation and Technology (2024) [UK signals step change for regulators to strengthen AI leadership](#). The principles are safety, security and robustness, appropriate transparency and explainability, fairness, accountability and governance, and contestability and redress.

¹⁶⁷ Council of the EU (2023) [Artificial intelligence act: Council and Parliament strike a deal on the first rules for AI in the world](#). European Parliament (2024) [Artificial Intelligence Act: MEPs adopt landmark law](#).

month in their day-to-day lives and around a quarter report doing so for work purposes.¹⁶⁸

- 2.63 Research by Ofcom showed that 31% of adults and 79% of 13- to 17-year-olds have used a generative AI tool.¹⁶⁹ The most popular reason given by adults who have used generative AI tools is to chat or explore the technology (48%), followed by finding information or content (36%), seeking advice (22%), creating new text (20%), and creating images (20%).
- 2.64 However, among those who have never used this technology (69%), Ofcom reported that nearly one in four (24%) did not know what it was.¹⁷⁰ ONS research also found that only 17% of adults can frequently recognise when they are using AI, and that awareness decreases with age.¹⁷¹ A large proportion of the population has not used chatbots for either personal (44%) or professional (64%) purposes.¹⁷²

Figure 10 – Research on consumer understanding and attitudes towards AI^{173, 174}



¹⁶⁸ Centre for Data Ethics and Innovation and Department for Science, Innovation and Technology (2023) [Public attitudes to data and AI: Tracker survey \(Wave 3\)](#), section 6.2

¹⁶⁹ Ofcom (2023) [Online Nation 2023 Report](#). The most popular services for over 16s are ChatGPT and Google Bard (now Gemini), integrated services Snapchat MyAI and Bing Chat, and the image generators Dall-E, and Midjourney.

¹⁷⁰ Ofcom (2023), [Online Nation 2023 Report](#)

¹⁷¹ Office for National Statistics (2023), [Public awareness, opinions and expectations about artificial intelligence: July to October 2023](#), section 1 bullet 1. 55% of adults aged 70 or older reported they can hardly ever or never recognise AI use.

¹⁷² CDEI, 6 December 2023, [Public attitudes to data and AI: Tracker survey \(Wave 3\)](#), section 6.2

¹⁷³ Ofcom (2023) [Online Nation 2023 Report](#)

¹⁷⁴ Office for National Statistics (2023), [Public awareness, opinions and expectations about artificial intelligence: July to October 2023](#), under ‘Positive impacts of AI’

- 2.65 When asked by the ONS about the positive impacts of AI:
- 31% of adults reported that it would improve their access to healthcare;
 - 27% reported that it would improve their shopping experiences;
 - 25% reported that it would increase their access to learning or education;¹⁷⁵ and
 - 36% said they did not think AI could have a positive impact on their lives. Reasons for this included: distrust in AI, distrust in the companies developing AI, and concerns about insufficient monitoring and regulation.¹⁷⁶
- 2.66 Commonly reported negative impacts, according to the ONS research, included using personal data without consent (72%), making it difficult to tell whether news or information are fake (68%), and increased risk of cybercrime (60%).¹⁷⁷ Other surveys showed that individuals recognise that there are societal and individual benefits from AI but also risks of harms.¹⁷⁸
- 2.67 As the sector evolves, it seems likely that FMs will be deployed in more consumer-facing services. We are therefore undertaking consumer research jointly within the Digital Regulation Cooperation Forum (DRCF) to gain further insights into how consumers currently use FMs; what they understand about the accuracy and reliability of these models; how they choose them; and how FM outputs/advice affect consumer behaviour.

¹⁷⁵ Office for National Statistics (2023), [Public awareness, opinions and expectations about artificial intelligence: July to October 2023](#), under ‘Positive impacts of AI’

¹⁷⁶ Office for National Statistics (2023), [Public awareness, opinions and expectations about artificial intelligence: July to October 2023](#), under ‘Positive impacts of AI’

¹⁷⁷ Office for National Statistics (2023), [Public awareness, opinions and expectations about artificial intelligence: July to October 2023](#), under ‘Negative impacts of AI’

¹⁷⁸ Centre for Data Ethics and Innovation and Department for Science, Innovation and Technology (2023) [Public attitudes to data and AI: Tracker survey \(Wave 3\)](#), section 7.1. Ofcom (2023), [Online Nation 2023 Report](#), p32.

3. The CMA's proposed AI principles

- 3.1 In our initial report, we proposed a set of principles to guide the development and deployment of FMs in ways that promote competition and consumer protection. These are illustrated in Figure 11.

Figure 11 – Proposed principles from the initial report

ACCOUNTABILITY <i>FM developers and deployers are accountable for outputs provided to consumers</i>	ACCESS <i>Ongoing ready access to key inputs</i>	<ul style="list-style-type: none">Access to data, compute, expertise and capital without undue restrictions.Continuing effective challenge to early movers from new entrants.Successful FM developers do not gain an entrenched and disproportionate advantage by being the first to develop a FM, having economies of scale or benefitting from feedback loops.Powerful partnerships and integrated firms do not reduce others' ability to compete.
	DIVERSITY <i>Sustained diversity of business models, including both open and closed</i>	<ul style="list-style-type: none">Both open and closed source models push the frontier of new capabilities.Open-source models help reduce barriers to entry and expansion.
	CHOICE <i>Sufficient choice for businesses so they can decide how to use FMs</i>	<ul style="list-style-type: none">A range of deployment options, including in-house FM development, partnerships, APIs or plug-ins.
	FLEXIBILITY <i>Flexibility to switch or use multiple FMs according to need</i>	<ul style="list-style-type: none">Interoperability to support firms mixing and matching or deploying multiple FMs.Consumers can switch and/or use multiple services easily and are not locked into one provider or ecosystem.
	FAIR DEALING <i>No anti-competitive conduct, including anti-competitive self-preferencing, tying or bundling</i>	<ul style="list-style-type: none">Confidence that the best products and services will win out.No anti-competitive conduct, including anti-competitive self-preferencing, tying or bundling, especially from vertical integration.Competition can counteract any data feedback or first mover effects.
	TRANSPARENCY <i>Consumers and businesses are given information about the risks and limitations of FM-generated content so they can make informed choices</i>	<ul style="list-style-type: none">People and businesses are informed of FMs' use and limitations.Developers give deployers the information to allow them to manage their responsibilities to consumers.

Feedback on our approach to the proposed principles

- 3.2 We have engaged extensively with stakeholders on these principles. In light of stakeholder feedback, and market updates including those reviewed above, we have considered whether the proposed principles would achieve our aims of supporting competition and consumer protection.
- 3.3 Thinking about the principles overall, stakeholders provided the following feedback:
- There was strong support for the use of principles as a mechanism to help guide the market.

- Almost all stakeholders thought the CMA's proposed principles addressed the key inputs and uncertainties in AI development, deployment, and use.
- Some stakeholders sought greater clarity about the relevance of certain principles to specific levels of the supply chain and how they might function in practice. Some stakeholders thought there should be a clearer explanation of which principles might be more relevant to business-to-business activities versus consumer-facing activities.
- Some stakeholders were interested in the relationship between the principles and other parts of the CMA's work, including the CMA's anticipated new powers set out in the Digital Markets, Competition and Consumers Bill (DMCC Bill)¹⁷⁹ as well as how the CMA is working with other UK regulators, UK Government departments, and international counterparts.
- Some stakeholders also sought greater clarity on terminology, noting that the meaning of certain terms (eg 'interoperability', 'consumer', 'open' and 'closed') may differ based on the context, which can lead to confusion.

3.4 We discuss feedback from stakeholders on each of our proposed principles below.

Access

3.5 The proposed 'Access' principle refers to access to key inputs for FM development and deployment. These inputs can be highly specialised and, in some cases, subject to concentrated or otherwise restricted supply. Without ongoing, ready access to key inputs, firms may struggle to enter, expand, and innovate, which could negatively impact overall levels of competition in the market. Access to compute and data will also be key in ensuring FMs can be improved upon and adapted for particular use cases in deployment.

Figure 12 – Proposed 'Access' principles, September 2023

ACCESS <i>Ongoing ready access to key inputs</i>	<ul style="list-style-type: none"> • Access to data, compute, expertise and capital without undue restrictions. • Continuing effective challenge to early movers from new entrants. • Successful FM developers do not gain an entrenched and disproportionate advantage by being the first to develop a FM, having economies of scale or benefitting from feedback loops. • Powerful partnerships and integrated firms do not reduce others' ability to compete.
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¹⁷⁹ Competition and Markets Authority (2021), [Digital Markets Unit](#).

Access to data

- 3.6 Data remains a key input for training and developing FMs. We have heard that FM developers are exploring a range of data types to support FM training. This ranges from more readily accessible data, such as web-scraped data, to proprietary data that may only be available to certain firms (see Figure 13).
- 3.7 For example:
- **Publicly available data:** Web-scraped data and open-source data sets continue to be important for FM development. As outlined in our initial report, this type of data forms the bulk of the data used for pre-training FMs,¹⁸⁰ and some FMs only use this type of data at the pre-training stage.¹⁸¹
 - **Synthetic data:** Several recently released FMs used synthetic data¹⁸² in pre-training or fine-tuning (see 'Key inputs for FM development' section). We heard that benefits of using synthetic data may include constraining data creation costs and helping to address privacy/data protection and copyright concerns associated with proprietary or web-scraped data. However, one stakeholder highlighted that they are still learning how effective synthetic data could be and has not found a viable source at scale.
 - **Third party proprietary data:** There has been an increase in partnerships involving data, or agreements to licence data (see 'Key inputs for FM development' section). We heard concerns that large technology firms could use their existing strong positions in other markets and financial resources to secure access agreements to third party proprietary data sources that are not available to smaller firms, either due to their significant bargaining power or exclusivity agreements.
 - **First party proprietary data:** This is proprietary data possessed by firms active in FM development, which may be unavailable to their competitors. In the lead-up to our initial report, we heard that some firms were beginning to use their own proprietary data for both FM training and deployment. We understand that the use of first party proprietary data may be increasing, but views on the impact of this remain mixed. Some

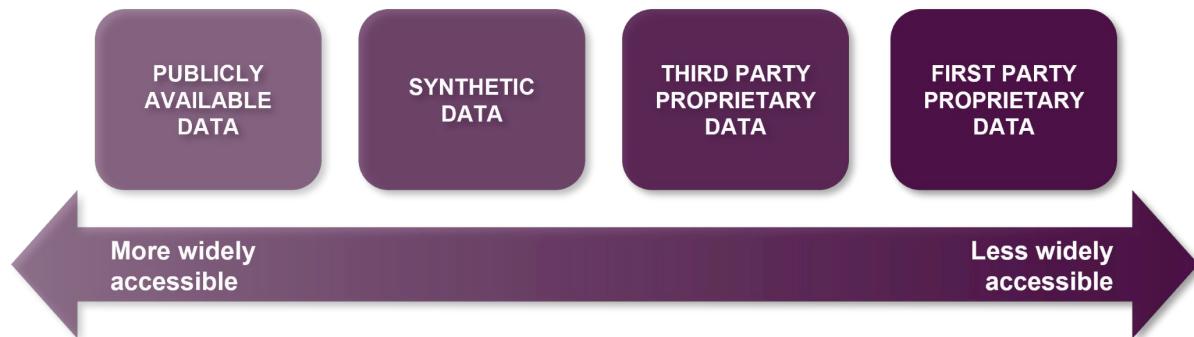
¹⁸⁰ Competition and Markets Authority (2023), [AI Foundation Models: Initial Report](#), p11

¹⁸¹ For example, Meta outline that Llama 2 was pretrained on publicly available online data sources. Meta (Accessed 08/04/2024) [Llama 2 FAQs](#)

¹⁸² Synthetic data is artificially generated data. Examples include using data from simulations, using existing AI models to generate new data sets, and artificially extending real data.

stakeholders stated that firms with an existing strong position in data-rich markets may have an advantage in obtaining data, but another noted that data of this nature is not considered as important for certain tasks (eg summarisation or analysis). If it can be used for FM development, this sort of proprietary data may be comparable in scale and significance to other categories of data set out above.¹⁸³

Figure 13 – Different types of data sets and their associated accessibility



Implications of web scraping for training and fine-tuning

- 3.8 As discussed above, many closed and open-source FMs have been trained on web-scraped data. If the ability to use web-scraped data is limited in future, this may serve to benefit those holding, or with the resources to purchase access to, proprietary data at scale. In light of unresolved legal questions across various jurisdictions about the use of web-scraped data, particularly in the areas of copyright and data protection, stakeholders questioned whether legal or regulatory responses will change what data is accessible to model developers. Imbalances may also emerge between early movers and later entrants in terms of the ability to have trained models on web-scraped data as more clarity emerges on the various legal debates relevant to this area. Developments in firms' abilities to use web-scraped data going forward could therefore impact the range of models available to deployers and users.

Data feedback loops

- 3.9 One stakeholder queried whether FMs may be able to learn from the feedback provided by a potentially large and differentiated population of users to craft responses for other users who might have similar preferences and

¹⁸³ For example, Meta's CEO has publicly stated that its stock of publicly shared images and videos is estimated to be greater than the Common Crawl data set. Fortune (02/02/2024) [Zuckerberg makes case for why Meta will beat Google at AI, and why it will cost tens of billions](#). The Common Crawl data set is a massive corpus of webpages and associated text, images, and metadata, which is freely available to the public: Common Crawl (Accessed 08/04/2024) [Open Repository of Web Crawl Data](#).

needs, much like recommender systems. If this is correct, feedback loops could become increasingly important. However, another stakeholder told us that they cannot currently retrain to incorporate this feedback, and that, even if they could, it would be very expensive to do so.¹⁸⁴

Access to compute

- 3.10 Access to compute remains key to developing and deploying FMs, especially for training the most generally capable models. When considering access to compute for FM development, one key reflection from stakeholders was that there is a limited supply of AI accelerator chips. We have also heard that access to compute may be a limiting factor for firms developing highly capable models, and that the cost of accessing accelerator chips may be constraining the research some FM developers are able to do. However, stakeholders also told us they are exploring alternative chips and/or ways of working to accommodate for available chip types. We have considered a variety of evidence relating to the role of AI accelerator chips in the FM value chain, and we will publish a separate paper on this subject in due course.

Development and deployment of smaller FMs may require less compute

- 3.11 Stakeholders also commented on industry trends that may have implications for access to compute. One such example relates to the size of FMs: smaller models typically require less compute for both development and deployment, especially if intended to be deployed on consumer devices. As discussed in the ‘Market landscape’ chapter, various stakeholders noted the benefits of smaller models, which include the reduced compute required.

Access to expertise

- 3.12 Stakeholders told us that it remains difficult to access appropriately skilled engineers in an increasingly competitive market. One stakeholder reflected that top AI engineers choose their employer based on its resources and therefore expertise is a function of other inputs (such as compute and data). Another stakeholder supported this argument, mentioning that compute resources are a factor in where leading talent would like to work. One stakeholder suggested that expertise varies across model modality (eg

¹⁸⁴ The CMA’s Initial Report outlined that user feedback data is not automatically fed back into the model and requires rigorous manual review. Competition and Markets Authority (2023), [AI Foundation Models: Initial Report](#), p31.

engineers may have bespoke skills for image generation versus LLMs) and so it would need to hire different experts depending on its activities.

- 3.13 Expertise may also pose a barrier to AI adoption within organisations more widely. A recent ONS survey found that the most-cited factor delaying UK businesses from adopting AI was their level of AI expertise.¹⁸⁵ We have heard about developments which may improve the supply of expertise within businesses; for example, Microsoft has launched a programme aimed at training one million people in the UK in AI skills.¹⁸⁶

Access to funding

- 3.14 Access to substantial funding remains essential to access the other key inputs needed to train FMs. This is particularly the case for some of the most generally capable models, which require key inputs at scale. We heard from stakeholders that venture capital is increasingly being spent on AI firms developing new models, and that partnerships remain important for FM developers to access funding. However, one stakeholder noted that access to finance is becoming more challenging for smaller firms.

Discussion

- 3.15 It remains the case that firms require ongoing, ready access to data, compute, expertise, and funding to enter, expand, and innovate in FM development. For example, the most highly capable models still require significant compute and there is a bottleneck in access to state-of-the-art AI accelerator chips. Restricted access may hamper efforts by new FM developers to enter and existing ones to innovate.¹⁸⁷ This could impact competition throughout the FM value chain.
- 3.16 There is currently a range of publicly available data to train FMs, and we understand that there is no single source of data regarded as a 'must-have'. FM developers appear to be seeking out alternatives to web-scraped data, exploring options along the different types of data sets (Figure 13). This includes first party proprietary data through to third party proprietary data that can be accessed through a licensing arrangement, as well as open-source data sets available online. Firms may also use data for different purposes,

¹⁸⁵ CMA analysis based on results from the following survey: Office for National Statistics (2024), [Business insights and impact on the UK economy](#), wave 98

¹⁸⁶ Microsoft (2023) [Microsoft to train 1 million people in UK with AI digital skills](#)

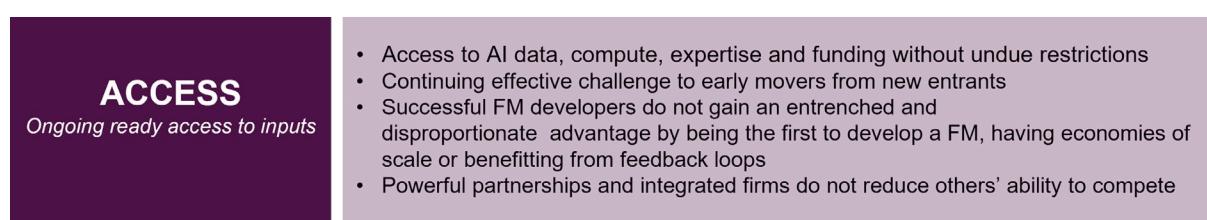
¹⁸⁷ We will publish a paper setting out evidence relating to AI accelerator chips in due course.

such as widely available large data sets for FM training, and specialised proprietary data sets for fine-tuning and deployment.

- 3.17 Notwithstanding this, certain data assets could become essential for developing competitive FMs and access to these assets may become restricted in a way that gives undue advantage to some firms. Likewise, access to proprietary data and data feedback loops could become a significant barrier to entry, such that advantages become entrenched and render markets incontestable, insulating firms from competition.
- 3.18 For competition to flourish, it is crucial that firms can access the key inputs they need to develop and deploy FMs. Ready access to inputs will help ensure that firms can enter the market and challenge incumbents, and help prevent established firms that have strong upstream positions in one or more critical inputs from leveraging that power through the value chain.
- 3.19 This principle is particularly relevant because there is a risk that, in future, access to inputs may be unduly restricted and incumbent firms may have the ability and incentive to use any existing market power to curb disruption or challenge to their existing position. For example, firms that control key inputs for building FMs, such as compute or data, may be the same firms facing potential disruption from AI in their core markets.

We would be concerned if firms that control critical inputs for developing FMs restricted access to them to shield themselves from competition, or if vertical integration or partnerships were used to reduce others' ability to compete. We consider this further in our discussion of risks to competition and consumer protection in Chapter 5 below.

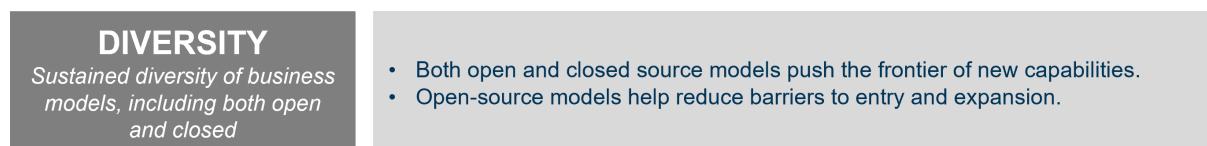
Figure 14 – Final ‘Access’ principle



Diversity and choice

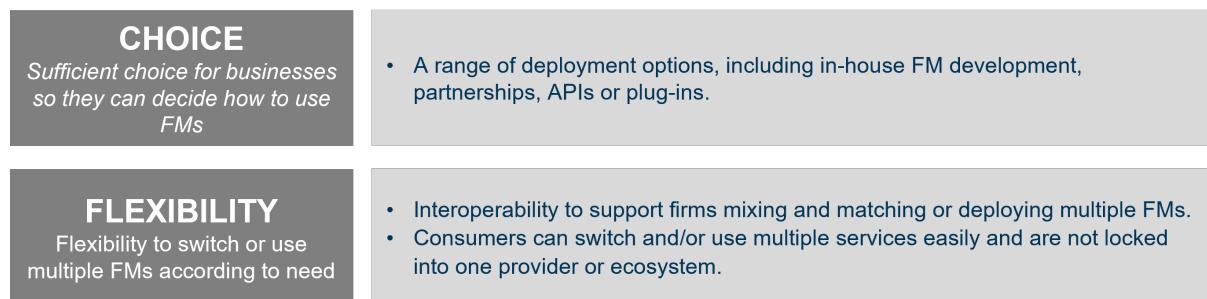
- 3.20 Our initial report proposed the principle of 'diversity'. In our view, a sustained diversity of models and options for accessing them would guide FM development and deployment to the best outcomes for competition and consumers. For example, genuine diversity in the range of model capabilities, open and closed source models, and business models would support a broad range of deployers to utilise FMs. This, in turn, would support a greater range of downstream services for consumers. A lack of diversity could mean that FM development becomes concentrated within a small group of firms. This may lead to reduced innovation and limit the spread of the benefits of the technology to businesses and consumers.

Figure 15 – Proposed 'Diversity' principle, September 2023



- 3.21 Linked to diversity, we thought the market would be more likely to facilitate positive outcomes for competition and consumers if users have a range of FM services to choose from and are not locked into one provider or ecosystem (ie have the ability to switch without undue restrictions). We therefore proposed two further principles: choice and flexibility.

Figure 16 – Proposed 'Choice' and 'Flexibility' principles, September 2023



- 3.22 Both principles sought to address the same underlying objective: choice in how to develop, release, and deploy FMs. We have therefore decided to combine the two principles into a single 'Choice' principle.
- 3.23 As explored below, these principles (choice and diversity) are intrinsically linked. Diversity is critical to allowing users (both business and consumers) to exercise choice, and choice is only meaningful with sustained diversity in the market (eg of model type and business models). We consider the diversity and choice principles below with this interrelationship in mind.

Diversity

Stakeholder feedback

3.24 As discussed above, a variety of new FMs have been released, both closed and open-source.¹⁸⁸ Some stakeholders told us that the current FM landscape contains a good diversity of model development and that, even though there is some consolidation taking place, diversity of model development is likely to continue.

Open-source FMs

3.25 Stakeholders were keen to clarify that closed and open-source FMs operate on a spectrum and have encouraged policymakers not to see them as a binary choice. Figure 17 below illustrates the gradient of ways in which models can be released.

Figure 17 – Openness of models and associated considerations¹⁸⁹

Considerations	A horizontal gradient from Fully Closed on the left to Fully Open on the right. The gradient is divided into six segments by vertical dashed lines. Each segment has a different shade of grey and a corresponding label: FULLY CLOSED (darkest), GRADUAL / STAGED RELEASE, HOSTED ACCESS, CLOUD-BASED / API ACCESS, DOWNLOADABLE, and FULLY OPEN (lightest). Above the gradient, there is a legend with two columns of text: 'Internal research only', 'High risk control', 'Low auditability', and 'Limited perspectives' in the first column; and 'Community research', 'Low risk control', 'High auditability', and 'Broader perspectives' in the second column.					
Level of access	FULLY CLOSED	GRADUAL / STAGED RELEASE	HOSTED ACCESS	CLOUD-BASED / API ACCESS	DOWNLOADABLE	FULLY OPEN
System (Developer)	PaLM (Google) Gopher (DeepMind) Imagen (Google) Make-A-Video (Meta)	GPT-2 (OpenAI) Stable Diffusion (Stability AI)	DALLE-2 (OpenAI) Midjourney (Midjourney)	GPT-3 (OpenAI)	OPT (Meta) Craiyon (craiyon)	BLOOM (BigScience) GPT-J (EleutherAI)

Source: Irene Solaiman (2023)

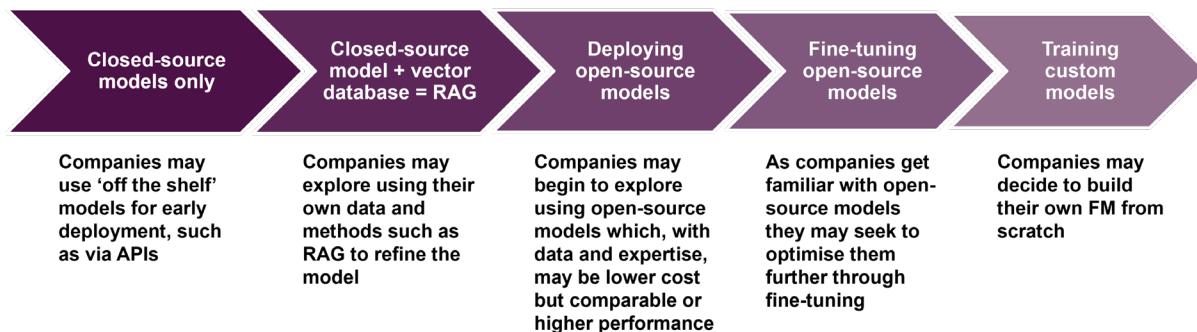
3.26 We heard that businesses may begin using proprietary models for prototyping and experimentation given their ‘off-the shelf’ availability. They might prefer to subsequently deploy open-source models or different models in production to maintain flexibility, potentially lower costs, and avoid dependencies on certain developers (eg should the developer decide to deprecate a specific model used in production). Figure 18 shows a

¹⁸⁸ See a selection of key model developments in Figure 2.

¹⁸⁹ This graphic is reproduced from Figure 1 in Solaiman, Irene (2023), [The Gradient of Generative AI Release: Methods and Considerations](#), arXiv, p4. In this paper, Solaiman proposed six levels of access from full closed to fully open viewed as an option along a gradient, noting that where a system falls on this gradient depends on what is being released including: access to the model itself; components that enable further risk analysis; and components that enable model replication.

hypothetical example of a business first accessing a FM through the proprietary API method, and then as the business continues to develop its AI capabilities, bringing more development in house.

Figure 18 – Potential business journey of AI deployment¹⁹⁰



Source: Menlo Ventures (2024)

3.27 Stakeholders also noted that open-source has allowed more users to interact with and build on existing models. Open-source capabilities can allow businesses to choose to deploy or refine those capabilities in-house and means they are not reliant on a third party for those capabilities. Possible benefits of open-source models noted during our stakeholder engagement include:

- Supporting transparency and safety by allowing users to review and critique the model (the importance of which is discussed in the 'Transparency' section below);
- Supporting access to FMs for users without existing access to the key inputs required to build a FM from scratch. This allows a broader range of developers (including university researchers) to use, build and deploy AI systems at a reduced cost, which may be beneficial for wider technological progress.

3.28 We are aware that, over time, firms may stop providing open-source access to new models (eg a firm may choose to release its earlier models as open-source, but then release its later ones as closed-source). One stakeholder reflected that open-source development is dependent on large technology companies continuing to make it available. We have observed firms making different decisions in terms of business models as they develop their products. For instance, Mistral AI launched its first models last year as open-

¹⁹⁰ Menlo Ventures (2024) [The Modern AI Stack: Design Principles for the Future of Enterprise AI Architectures](#)

source, but in 2024 released its newest models (Large, Medium and Small) under commercial paid licenses.¹⁹¹

- 3.29 We note that while open-source helps increase the diversity of models, many of the most capable open-source models have been developed by some of the most well-funded firms, as they have greater access to compute and other resources such as skilled expertise. Therefore, the open-source AI ecosystem may still be dependent on large technology firms¹⁹² or those with significant financial backing.¹⁹³

Discussion

Diversity in size and purpose of FMs

- 3.30 Stakeholders noted the increasing diversification of FMs across size, input and resource requirements, levels of performance, and specialisation.¹⁹⁴ We heard that this could allow deployers to choose which model to use depending on use-case, helping them select a highly capable large model where necessary, or a less capable or more specific model where appropriate (ie they may not require models at the frontier for all of their needs). This could avoid firms having to ‘overfit’ models that are much more capable, generalised or, often, expensive than they need – although the extent to which smaller or specialised models are being deployed in practice is currently unclear.
- 3.31 We are more likely to see positive outcomes if the market continues to sustain a range of FMs that meet differing business needs. Businesses should have meaningful choice and not be required to adopt models that ‘overfit’ what they need.

Options available for accessing and deploying FMs

- 3.32 Alongside the range of FMs available for businesses and consumers, there is a range of options for how they access and deploy FMs. For example, as shown in Figure 19, businesses can choose between different model sizes and functions and how they access models, from open-source API access, through to developing their own model. Some stakeholders reported using a

¹⁹¹ TechCrunch (26/02/2024) [Mistral AI releases new model to rival GPT-4 and its own chat assistant](#). Mistral (Accessed 08/04/2024) [Mistral technology: AI models](#).

¹⁹² For example, key open-source developments from large technology firms have been the releases of Meta’s Llama models and Google’s Gemma model.

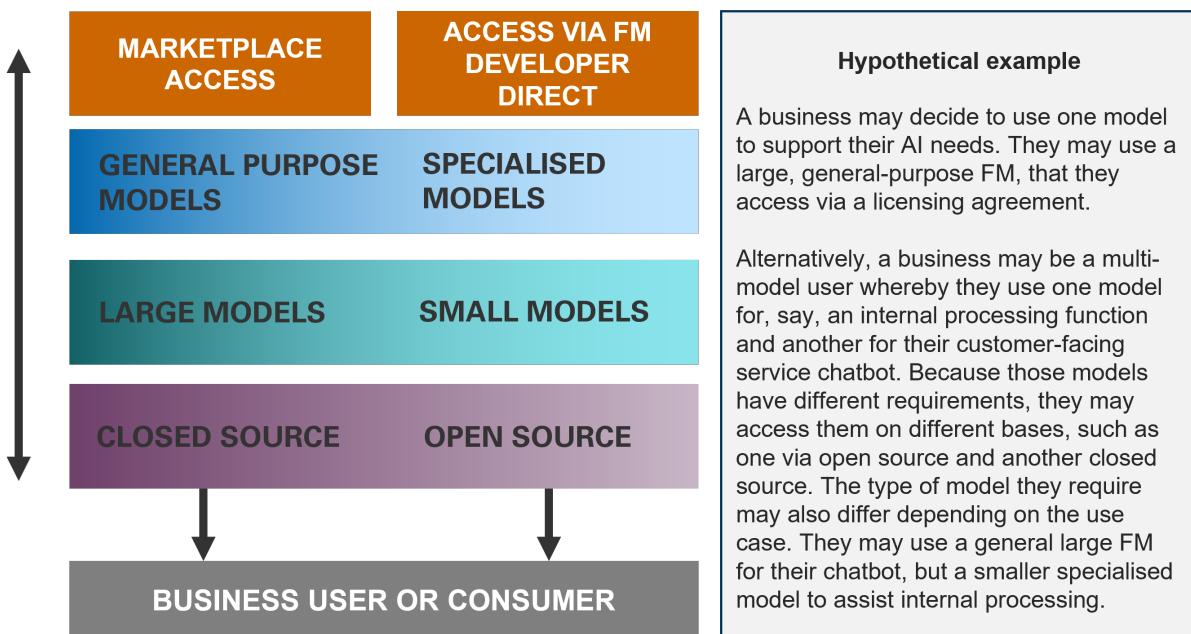
¹⁹³ For example, Mistral released Mistral AI’s 7B model as open-source, but we outline above the significant funding Mistral has received.

¹⁹⁴ See chapter 2, ‘FM Developments’, 2.4-2.20.

mix-and-match approach to model deployment in their tech stack. Depending on their requirements and financial constraints, this might include mixing the most capable models and less capable ones, or mixing closed- and open-source models.

- 3.33 What continues to be important is that consumers have range of options on how to deploy AI FMs across fully licensed model releases, plug-ins, or APIs.¹⁹⁵ We have seen an increase in API access to proprietary models directly from the developers¹⁹⁶ or via model marketplaces.¹⁹⁷ While APIs are beneficial for testing different models before use, and plug-ins can be a quicker and cheaper way to deploy models without fine-tuning,¹⁹⁸ they do offer limited flexibility and make downstream firms reliant on a third party supplier.¹⁹⁹ As such, to ensure choice for deployers to meet the needs of their specific use-cases, is important that different types of access points are not unnecessarily limited.²⁰⁰

Figure 19 – Representation of the options available for businesses and consumers



¹⁹⁵ Competition and Markets Authority (2023), [AI Foundation Models: Initial Report](#), p56

¹⁹⁶ OpenAI (2020) [OpenAI API](#). Mistral (Accessed 08/04/2024) [Mistral AI API \(0.0.1\)](#). Google (Accessed 08/04/2024) [Build with Gemini](#).

¹⁹⁷ Amazon (Accessed 08/04/2024) [Amazon Bedrock](#)

¹⁹⁸ Competition and Markets Authority (2023), [AI Foundation Models: Initial Report](#), p57

¹⁹⁹ Competition and Markets Authority (2023), [AI Foundation Models: Initial Report](#), p56

²⁰⁰ Competition and Markets Authority (2023), [AI Foundation Models: Initial Report](#), p56

Diversity in FM business models and how FMs are released

- 3.34 Models are currently available on both a free and paid-for basis. Business models are still developing, and some stakeholders reported they were still exploring their monetisation strategies. Open-source FMs are typically free of charge for other developers and deployers to adapt (some have restrictions depending on the number of users). However, there are concerns that open-source models could be closed in future (the ‘open first, closed later’ dynamic)²⁰¹ and result in lock-in or stifling future innovation due to a concentration of models within a small number of firms.
- 3.35 We have observed previously free open-source developers starting to offer both paid and free subscription models in certain circumstances. The Stability AI Membership, for example, allows self-hosted deployment of Stability AI’s models and commercial usage rights (depending on the tier of access).²⁰² Other models are available directly via agreements with developers, but there are other marketplace options such as Amazon Bedrock and Hugging Face with the price varying by model.²⁰³
- 3.36 Marketplace platforms currently support diversity of model access that is beneficial for deployers, giving them a broad range of models to choose from. For example, Amazon Bedrock provides access to both open- and closed-source models from AI21 Labs, Anthropic, Cohere, Meta, Mistral, and Stability AI.²⁰⁴ FM platforms or marketplaces are still relatively nascent features of the market but it is possible that in future these are established as mechanisms of control over FM distribution for the firms operating the platforms.
- 3.37 We expect business models to evolve and firms who develop the best FMs should be able to reap the rewards of their investment. However, we are more likely to see positive outcomes if the market sustains a range of business models over time and provides sufficient choice for consumers and businesses.

²⁰¹ Federal Trade Commission (2023), [Generative AI Raises Competition Concerns](#)

²⁰² Stability AI offers three tiers – Non-Commercial (for personal use and research), Professional (for customers with less than \$1 million in annual revenue, \$1 million in institutional funding, and 1 million monthly active users), and Enterprise (for companies larger than Professional). Stability AI (2023) [Introducing the Stability AI Membership](#). Stability AI (Accessed 08/04/2024) [Membership](#).

²⁰³ Amazon (Accessed 08/04/2024) [Amazon Bedrock](#)

²⁰⁴ Amazon (Accessed 08/04/2024) [Amazon Bedrock](#)

The role of open-source in the FM landscape

- 3.38 While this section has focused mostly on diversity of FMs, the open-source ecosystem also provides other services to support developers and deployers. For example, firms such as EleutherAI²⁰⁵ and HuggingFace,²⁰⁶ and tools and libraries such as TensorFlow,²⁰⁷ PyTorch²⁰⁸ and Keras²⁰⁹ sustain data sets and support training, inference and model evaluation. EleutherAI and HuggingFace publicly share their research so that developers and deployers can improve their skills. Further, EleutherAI,²¹⁰ HuggingFace²¹¹ and OpenCV²¹² provide opportunities for developers and deployers to engage and collaborate with each other, supporting the development of the FM ecosystem globally.²¹³
- 3.39 We have heard from stakeholders on the risks that disproportionate regulation might pose to diversity of FMs, and specifically to open-source models. As we noted earlier in this section, there are broader risks associated with both proprietary and open-source FMs. It will be important to ensure that there are effective risk mitigations in place for all FMs (both technical and policy mitigations), and that the governance ecosystem supports innovation and does not place a disproportionate burden on open-source FMs (see later section on ‘Transparency and accountability’).
- 3.40 Further, by sustaining an ecosystem of both open- and closed source models, accountability may become a feature that firms compete on and that helps sustain critical downstream use. For example, a developer might use an open-source model whose training data is transparent and documented to avoid potential IP infringements.
- 3.41 For competition to flourish to the benefit of consumers, it remains vital that there is sufficient diversity in the market in relation to the types of FMs being developed, how they are released to consumers and businesses, and the business models that firms employ.

²⁰⁵ EleutherAI (Accessed 08/04/2024) [Language Modeling](#)

²⁰⁶ Hugging Face (Accessed 08/04/2024) [Documentations](#)

²⁰⁷ TensorFlow (Accessed 08/04/2024) [Models & datasets](#)

²⁰⁸ PyTorch (Accessed 08/04/2024) [Ecosystem Tools](#)

²⁰⁹ Keras (Accessed 08/04/2024) [Keras 3 API documentation](#)

²¹⁰ EleutherAI (Accessed 08/04/2024) [Our Community](#)

²¹¹ Hugging Face (2021) [Join the Hugging Face Discord!](#)

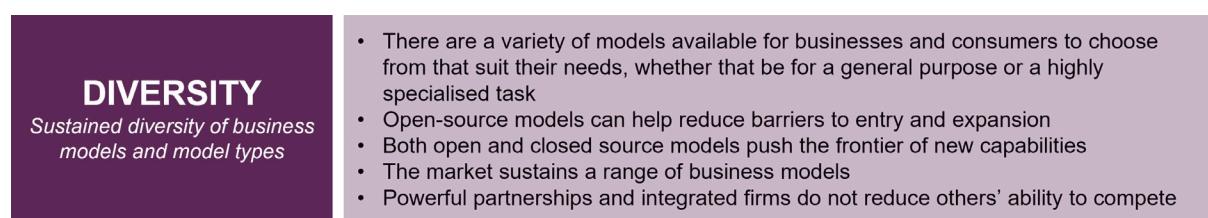
²¹² OpenCV (Accessed 08/04/2024) [OpenCV Forum](#)

²¹³ techUK (21/09/2023) [How AI is Increasing its capabilities with open-source foundation models](#). World Economic Forum (2023) [Why open-source is crucial for responsible AI development](#).

- 3.42 We have updated the principle to ensure it encapsulates the widest range of diversity that the market should sustain to support consumers and businesses with a range of FM requirements and use cases. This is in addition to the crucial role open-source models can play in supporting competition.

We would be concerned if we saw the market fail to sustain diversity of business models, routes to release models, or model types over time, including as a result of powerful partnerships or integrated firms steering the market away from diversity; or if FM developers and deployers with new approaches and business models were not able to effectively compete with incumbent firms. We consider this further in our discussion of risks to competition and consumer protection in Chapter 5 below.

Figure 20 – Final ‘Diversity’ principle



Choice

Stakeholder feedback²¹⁴

Switching between FMs being deployed or used

- 3.43 In the lead up to our initial report, some stakeholders told us that they found it relatively easy to switch between FMs. We noted in our initial report that it was uncertain whether, over time, it would remain easy and affordable to switch.²¹⁵
- 3.44 Since then, we have sought further feedback from stakeholders about their experience with switching and any potential barriers or difficulties associated with switching between FM developers. While most stakeholders reported that they had not switched providers, some raised the following as factors relevant to the decision or ability to switch:
- Some were concerned about the potential impact of vertical integration, exclusivity arrangements and the risk of customer lock-in (for example through exclusivity clauses or similar restrictions in contractual agreements), or technical barriers or friction.
 - We heard that leading or incumbent models could have an advantage, and that reliance by deployers on those models could lead to network effects and lock-in. One stakeholder suggested that the FM sector was already moving towards a concentration of power in the hands of a small number of players.
 - Anthropic,²¹⁶ Microsoft,²¹⁷ and Google²¹⁸ have all recently announced that they will indemnify generative AI customers over IP rights or copyright claims. We heard from stakeholders that the question of copyright and indemnification is an important factor for users when choosing their FMs. Some were concerned about the uncertainty around copyright and the potential impact that may have on uptake of the technology, FM training and rights-holders. Stakeholders were also clear that not all FM

²¹⁴ As explained above, we have decided to combine the ‘Choice’ and ‘Flexibility’ principles proposed in September 2023. As such, stakeholder feedback considered in this section relates to both of those proposed principles that are now contained in one overall ‘Choice’ principle.

²¹⁵ Competition and Markets Authority (2023), [AI Foundation Models: Initial Report](#), pp70-71

²¹⁶ Anthropic (2023) [Expanded legal protections and improvements to our API](#)

²¹⁷ Microsoft (2023) [Microsoft announces new Copilot Copyright Commitment for customers](#)

²¹⁸ Google (2023) [Shared fate: Protecting customers with generative AI indemnification](#)

developers would be able to indemnify or reach agreements with content providers.

- One stakeholder likened the costs of switching between FMs to those that consumers face when changing other hardware or software and said that these costs were not insurmountable or disproportionate to the benefits gained.

Interoperability between FMs and FM-powered services

3.45 In our initial report we said that the market was more likely to produce positive outcomes if FMs and the systems they use are interoperable with one another and the development of ecosystems did not unduly restrict choice or interoperability.

3.46 Stakeholders have since provided the following feedback on interoperability in AI FMs:

- One stakeholder was supportive of interoperability on the basis that it could make the deployment of FMs easier and reduce the effort currently required to make products work with one another. Another stakeholder noted that firms delaying roll-out of third party interoperability with new features, or simply not rolling out interoperability at all, could be damaging to competition.
- Some stakeholders queried whether interoperability was technically feasible or appropriate for base FMs given that they are developed on different architectures and data sets by different developers across a variety of markets.
- Some stakeholders suggested that interoperability between FMs would not be possible without further standardisation and alignment on technical standards, which were still in their infancy. It was stressed that it was vital the largest firms did not ‘set the rules of the game’ on standardisation as this would risk excluding challenger firms in future.
- One stakeholder said that interoperability could be possible for upstream tools for developing models.

Discussion

3.47 Without genuine and free choice for users in relation to how they access and deploy FMs, there is a risk that users cannot realise the benefits of diversity because they cannot easily switch or multi-home (due to difficulty or cost).

Integration

- 3.48 As FM services are deployed at scale and across business models and markets, they are increasingly accessed through or required to work within existing digital ecosystems. For example, consumer FM services are likely to be accessed through mobile ecosystems or via search engines, while FM services for businesses will need to work well with the productivity software stacks those businesses rely on. There is a risk that the players who control these ecosystems could “set the rules of the game” for FM deployment to restrict customer choice, giving their own FM services advantages in terms of accessibility, integration, and compatibility and creating artificial barriers to switching.

Switching costs

- 3.49 There will most likely be a certain degree of technical cost to switching between FMs, and fully eliminating this cost may not be possible. We acknowledge that switching will not always be without some cost. However, the ability to easily switch between services is vital to ensure that firms face robust competitive constraints, so that they do not gain an unassailable advantage, unduly raise prices or restrict innovation.
- 3.50 In future, ecosystems may become ‘sticky’ with customers remaining within one integrated ecosystem, particularly if products and services are not interoperable such that customers face real or perceived costs of switching.
- 3.51 We are less likely to see positive outcomes if unnecessary barriers are introduced by developers or deployers to impede switching and make it difficult for users to upload/download, extract and port their information to rival services. This includes ensuring contractual or technical restrictions are not used to limit or constrain multi-homing or switching.
- 3.52 We are also mindful that even in the absence of technical or contractual barriers to switching, customers may perceive that switching is too difficult or may be subject to other techniques, such as harmful choice architecture, that pushes consumers to choose a particular option or adds friction to switching decisions.²¹⁹ We therefore also expect FM developers and deployers to avoid harmful choice architecture or product design that might lead to customer lock-in.

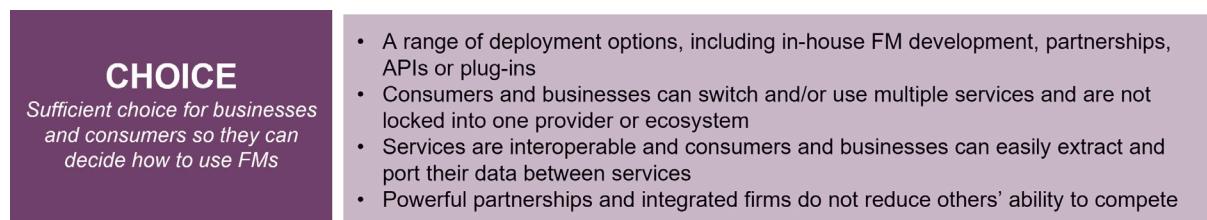
²¹⁹ The CMA’s discussion paper on online choice architecture explores how choice architecture practices can be harmful to competition and consumers: Competition and Markets Authority (2022), [Online Choice Architecture: How digital design can harm competition and consumers](#)

Interoperability

- 3.53 We understand some stakeholders' concerns that interoperability may be difficult to achieve between FMs, and that a certain level of standardisation would need to be reached across all products. We are aware of some voluntary interoperability formats and initiatives (such as ONNX),²²⁰ and note that the market may develop further standards as it matures. However, we are less likely to see positive outcomes if such standards are developed by a handful of incumbent firms and do not sufficiently represent the interests of the wider market.
- 3.54 We expect the best outcomes where there is a range of models to choose from – large, small, on-device, closed, open – and the ability to access them in a variety of ways – building in-house, partnerships, plug-ins, APIs. This includes being able to use one or many different products (multi-homing) and being able to switch between them without undue restrictions.
- 3.55 Our final 'Choice' principle reflects that the market is likely to achieve the best outcomes for competition and consumer protection if businesses and consumers can choose how they use FMs and switch between different options without being locked in to one provider or ecosystem. This can lead to more competition and therefore improved choice for consumers in FM-powered services, including both driving the development of more FM services and improving their quality.

We would be concerned if powerful incumbents exploited their positions in consumer or business facing markets to distort choice in FMs and FM services, including through vertical integration and partnerships. We consider this further in our discussion of risks to competition and consumer protection in Chapter 5 below.

Figure 21 – Final 'Choice' principle



²²⁰ 'ONNX is an open format built to represent machine learning models. ONNX defines a common set of operators - the building blocks of machine learning and deep learning models - and a common file format to enable AI developers to use models with a variety of frameworks, tools, runtimes, and compilers.' ONNX (Accessed 08/04/2024) [Open Neural Network Exchange](#).

Fair dealing

- 3.56 In our initial report, we said it was vital that businesses were not subject to anti-competitive conduct, including anti-competitive self-preferencing, tying or bundling, such that businesses could invest in FMs and FM services with confidence.

Figure 22 – Proposed 'Fair Dealing' principle, September 2023

FAIR DEALING <i>No anti-competitive conduct, including anti-competitive self- preferencing, tying or bundling</i>	<ul style="list-style-type: none">• Confidence that the best products and services will win out.• No anti-competitive conduct, including anti-competitive self-preferencing, tying or bundling, especially from vertical integration.• Competition can counteract any data feedback or first mover effects.
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Stakeholder feedback

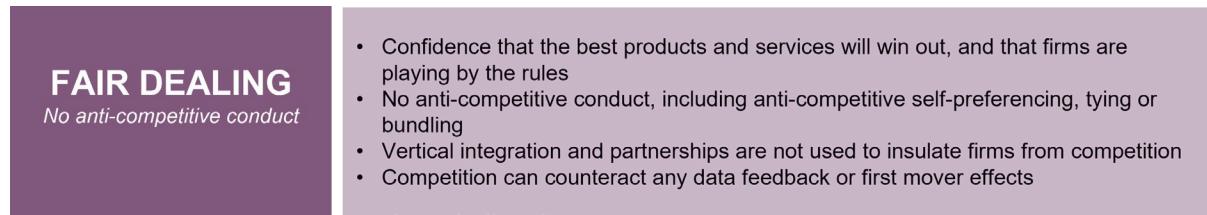
- 3.57 Feedback from stakeholders since our initial report has been supportive of this principle. Stakeholders agreed that the nature of FM-related markets means that there are risks of anti-competitive practices arising, and none suggested that the principle was inappropriate or in need of revision.

Discussion

- 3.58 It remains vital that businesses can invest in and develop FM products and services with the confidence that firms will not engage in anti-competitive conduct. The CMA will monitor these markets closely and act when necessary to protect competition.
- 3.59 We have updated our 'Fair Dealing' principle, which retains its original elements, but now also underscores that firms should play by the rules, and that vertical integration and partnerships should not be a means of insulating firms from competition. The best products and services should win out and not be restricted by anti-competitive self-preferencing, tying or bundling.

We would be concerned by instances of anti-competitive conduct such as anti-competitive self-preferencing, tying or bundling in FM-related markets, or if vertical integration and partnerships were used to insulate firms from competition. We consider this further in our discussion of risks to competition and consumer protection in Chapter 5 below.

Figure 23 – Final 'Fair Dealing' principle



Transparency and accountability

3.60 In our initial report we discussed that AI has the power to transform consumers' experience of products and services, but that there was a real risk that they would not use those services or have confidence in them if they were inaccurate or caused them harm. We therefore proposed that the market was more likely to trend towards positive outcomes if models were themselves reliable and accurate, if consumers had the right information about them to make informed decisions, and if there were mechanisms to determine the proper allocation of accountability and responsibility – our 'Transparency' and 'Accountability' principles.

Figure 24 – Proposed 'Transparency' and 'Accountability' principles, September 2023



3.61 Stakeholders told us that the principles were inextricably linked and, if implemented, could reinforce one another. For example, sufficient transparency could help ensure FM developers are held to account for the outputs provided to consumers. Whilst we will maintain two separate principles, underlying the importance of each principle in its own right, in the discussion below we will identify where they can assist one another to produce positive outcomes.

Transparency

Stakeholder feedback

Reliability and accuracy of model outputs

- 3.62 Stakeholders acknowledged that hallucinations – when FMs may produce inaccurate or misleading results – could create issues for output reliability and consumer trust. We heard that there is significant investment, both by individual firms and in the broader research community, to mitigate the risk of hallucinations.²²¹ Business practices include, for example, allowing the model’s output to cite a particular source in response to a query or, in the case of Gemini’s ‘Google it’ button, allowing users to verify the response. ChatGPT now utilises live web results and provides links to sources.²²² We were told that hallucination rates are being driven down, and firms are investing in ways to identify hallucinations. Nonetheless, there was recognition that challenges remain.
- 3.63 We also heard that context matters: hallucinations in a creative context which do not have significant consequences are of a different order to hallucinations in the context of travel recommendations, for instance. Stakeholders mentioned that hallucinations may lead to valuable insights in creative contexts.

Consumer awareness of FMs and their limitations

- 3.64 A number of stakeholders agreed that consumers should be informed when they are interacting with AI, and of its limitations. Other stakeholders thought that disclosures should not always be required. One stated that it would depend on the specific product, in particular whether it is otherwise obvious that the user is interacting with AI. Another stated that it should be judged on a case-by-case basis: if a customer knowingly signs up to an AI product, continual disclosures should not be required. This stakeholder also referred to

²²¹ For example, Kang, Haoqiang et al. (2023), ‘Ever: Mitigating Hallucination in Large Language Models through Real-Time Verification and Rectification’, arXiv, and Zhou, Yiyang et al. (2023), ‘Analysing and mitigation object hallucination in large-vision language models’, arXiv. Gordon, Andrew D. et al. (2023), ‘Co-audit: tools to help humans double-check AI-generated content’, arXiv. Liu, Michael Xieyang et al. (2023), ““What It Wants Me To Say”: Bridging the Abstraction Gap Between End-User Programmers and Code-Generating Large Language Models”, Microsoft Research. Amazon (2024) New tool, dataset help detect hallucinations in large language models. Zhang, Jiaxin et al. (2024), ‘SAC³: Reliable Hallucination Detection in Black-Box Language Models via Semantic-aware Cross-check Consistency’, arXiv.

²²² The Verge (27/09/2023) OpenAI enables Browse with Bing for live web results in ChatGPT

space limitations and said that too many disclosures may lead to a ‘clunky’ consumer experience.

- 3.65 Some stakeholders identified the challenges of consumer ‘over-trust’ in model outputs. One stakeholder thought this may require further amendments to user interfaces as well as investment in consumer and public education to improve awareness about appropriate uses of FMs. This stakeholder told us that matters are improving as the public is starting to become better informed about the limitations of LLMs, and that they are seeing increased consumer use of FAQs and training materials. Another stakeholder identified a need for greater research on model reliance and ‘over-trust’.
- 3.66 We discussed with stakeholders methods to identify AI-generated content and its provenance. Watermarking – a disclosure placed on content that informs the user of content that has been created using AI – is a technique often posited as a way of overcoming a lack of consumer awareness about AI.²²³ However, we have not observed any universal standard for watermarking,²²⁴ and research suggests that even when it is used there is a possibility that watermarks may be removed.²²⁵ One stakeholder highlighted the technical difficulties of finding a method to identify AI-generated content that cannot be removed. We consider watermarking further below.

Information available to deployers

- 3.67 We also discussed with stakeholders how far developers are transparent with deployers regarding model capability. We were told that deployers need information from developers to understand the reliability and safety of what they are deploying, and to comply with their legal obligations. One stakeholder identified relevant information as including model training methods, data sets used, and identified risks, mitigations and biases. Another stakeholder said there is an evolving debate about what information is passed down and that more guidance is needed about how this would happen.

²²³ Google (Accessed 08/04/2024) [SynthID - Google DeepMind](#). Hugging Face (2024) [AI Watermarking 101: Tools and Techniques](#).

²²⁴ Witness (2023) [Regulating Transparency in Audiovisual Generative AI: How Legislators Can Center Human Rights](#)

²²⁵ University of Maryland (2023) [Researchers Say Current AI Watermarks Are Trivial to Remove](#): note that this article also mentions the possibility of adding ('spoofing') watermarks. Saberi, Mehrdad et al. (2024), '[Robustness of AI-image Detectors: Fundamental Limits and Practical Attacks](#)', arXiv. MIT Technology Review (29/03/2024) [It's easy to tamper with watermarks from AI-generated text](#).

- 3.68 We heard that developers may be more willing to share some types of information than others for competitive reasons.²²⁶ We also heard that there are difficulties around creating a standard for transparency due to the fast-paced nature of the technology; current best practices such as model cards and data sheets are likely to evolve.
- 3.69 Some developers told us they provide model cards and system cards to deployers and that they receive feedback from users and developers about use cases. Another developer said that deployers should be responsible for understanding how AI is being used and subsequent risks before deployment. This developer acknowledged that service cards detailing a model's intended use cases, limitations, and best practices should be supplied to deployers.
- 3.70 One stakeholder told us that open-source FMs – in which the code, model weight, responsible use guide, and model card may be released alongside the model – might mitigate issues around transparency of model capabilities. EleutherAI has argued publicly that many claims about a FM's capabilities are unverifiable without open access to the weights.²²⁷

Discussion

Are model outputs reliable and accurate?

- 3.71 As indicated above, there appears to be significant investment and research by individual firms and the research community to minimise the incidence and severity of hallucinations. The evidence on progress in addressing hallucinations is mixed. Research into further tools to reduce the impact of hallucinations, such as Microsoft's research into co-auditing tools,²²⁸ is positive, but it is unclear whether robust methods to tackle hallucinations will emerge, or whether they will be adopted by all FM developers. We have also started to see tracking of the harms caused by AI, including hallucinations and deepfakes. We have observed two incident databases tracking these issues – the AI Incident Database, and the AI, Algorithmic, and Automation Incidents and Controversies Repository.²²⁹ We encourage developers to continue to work to reduce the incidence of hallucinations.

²²⁶ For example, we heard that there are strong incentives for transparency on performance and accuracy because of competitive pressures (eg requests from clients or investors). However, we heard that pressures of the same intensity do not (currently) exist for transparency on model weaknesses, labour used for FM development, and overviews of customers and deployed sectors.

²²⁷ EleutherAI (2023) [How the Foundation Model Transparency Index Distorts Transparency](#)

²²⁸ Gordon, Andrew D. et al. (2023), 'Co-audit: tools to help humans double-check AI-generated content', arXiv

²²⁹ AIID (Accessed 08/04/2024) [AI Incident Database](#). AIAAIC (Accessed 08/04/2024) [AIAAIC](#).

Are consumers aware of FM use and its limitations?

- 3.72 While there is unlikely to be a way to prevent hallucinations altogether, giving users a greater understanding of how FMs arrive at outputs, as well as providing a means to double-check outputs, could greatly lower the potential negative impact of hallucinations.
- 3.73 Our stakeholder engagement and research indicate that there are ongoing efforts to identify if content has been created or modified by AI and is misleading.²³⁰ This includes invisible watermarking in models which generate content and developing systems for identifying AI-generated content.²³¹ Open standards are also being developed by C2PA and are supported by several prominent tech firms, and disclosure mechanisms have been suggested.²³²
- 3.74 The lack of a universal standard for watermarking, and the possibility of removing or spoofing watermarks, is a concern; there is no consensus on best practices in this area. The inclusion of provisions relevant to watermarking within the AI Act and White House Executive Order could influence the development of industry standards.²³³
- 3.75 Several stakeholders are working on watermarking and content provenance tools (provenance tools detail the history of a piece of content, making them useful for the identification of AI-generated content – the C2PA standard is a prominent example),²³⁴ and the Partnership for AI is asking for more detailed

²³⁰ For example, Partnership on AI (2023) [Building a Glossary for Synthetic Media Transparency Methods, Part 1: Indirect Disclosure](#)

²³¹ Google (Accessed 08/04/2024) SynthID. Google (2024) [Google Labs: How to try ImageFX and MusicFX generative AI tools](#). Meta (2023) [Stable Signature: A new method for watermarking images created by open-source generative AI](#). Meta (2024) [Labeling AI-Generated Images on Facebook, Instagram and Threads](#).

TechCrunch (29/11/2023) [Amazon finally releases its own AI-powered image generator at AWS re:Invent 2023](#). Samsung (2024) [Samsung and Google Cloud Join Forces To Bring Generative AI to Samsung Galaxy S24 Series](#).

²³² C2PA (Accessed 08/04/2024) [Content Credentials : C2PA Technical Specification](#). C2PA (Accessed 08/04/2024) [Overview](#). The Verge (15/01/2024) [Here's OpenAI's big plan to combat election misinformation](#). Partnership on AI (Accessed 08/04/2024) [PAI's Responsible Practices for Synthetic Media](#). The Verge (06/02/2024) [OpenAI is adding new watermarks to DALL-E 3](#). The New York Times (08/02/2024) [Google Joins Effort to Help Spot Content Made With A.I.](#)

²³³ Provisional agreement announced by the European Council Press, 9 December 2023 – European Council (2023), [Artificial intelligence act: Council and Parliament strike a deal on the first rules for AI in the world](#). White House (2023), [FACT SHEET: President Biden Issues Executive Order on Safe, Secure, and Trustworthy Artificial Intelligence](#).

²³⁴ Google (Accessed 08/04/2024) SynthID. Google (2024) [Google Labs: How to try ImageFX and MusicFX generative AI tools](#). Meta (2023) [Stable Signature: A new method for watermarking images created by open-source generative AI](#). Meta (2024) [Labeling AI-Generated Images on Facebook, Instagram and Threads](#).

TechCrunch (29/11/2023) [Amazon finally releases its own AI-powered image generator at AWS re:Invent 2023](#). Samsung (2024) [Samsung and Google Cloud Join Forces To Bring Generative AI to Samsung Galaxy S24 Series](#). C2PA (Accessed 08/04/2024) [Content Credentials : C2PA Technical Specification](#). C2PA (Accessed 08/04/2024) [Overview](#). The Verge (15/01/2024) [Here's OpenAI's big plan to combat election misinformation](#).

provenance across tech firms. This indicates a positive direction of travel towards mitigating some of the uncertainties outlined in the initial report, particularly around consumers being able to understand and critically assess FM outputs. We expect FM developers and deployers to continue efforts to develop robust methods to ensure consumers can identify FM-generated content, particularly when it is shared widely online and divorced from its original context.

- 3.76 The Stanford Foundation Model Transparency Index (FMTI) seeks to assess the transparency of the FM ecosystem and help improve transparency over time. While we acknowledge that this is one measure of FM transparency and not definitive,²³⁵ the 2023 FMTI found that deployers of FMs generally scored well (an average of 85%) on transparency in user interfaces (ie making it clear to end users that they are interacting with a FM-powered chatbot).²³⁶
- 3.77 As outlined above, however, ONS research has found that only 17% of adults can frequently recognise when they are using AI, and that awareness decreases with age.²³⁷ Developers have also identified potential issues with consumer over-reliance on FM outputs even in the context of disclaimers.
- 3.78 Given this uncertainty and the nascent nature of the market, we think further research on consumer understanding of AI is necessary to ensure users meaningfully understand that they are engaging with AI and its limitations, in order to make effective choices. Along with DRCF partners, we are conducting further consumer research on consumers' understanding of generative AI. This research is considering how consumers are currently using FMs; what they understand about the factuality/reliability of these models; how they choose them; and how FM outputs/advice affect consumer behaviour.

Are deployers sufficiently informed of FM use and its limitations?

- 3.79 We consider that information about upstream inputs, such as data and training methods, are likely to be vital indicators of FM capabilities and risks.²³⁸ If deployers do not have visibility of how the FMs are created, their

Partnership on AI (Accessed 08/04/2024) [PAI's Responsible Practices for Synthetic Media](#). The Verge (06/02/2024) [OpenAI is adding new watermarks to DALL-E 3](#). The New York Times (08/02/2024) [Google Joins Effort to Help Spot Content Made With A.I.](#)

²³⁵ EleutherAI (2023) [How the Foundation Model Transparency Index Distorts Transparency](#) provides a critique

²³⁶ Bommasani, Rishi et al (2023), 'Stanford FM Transparency Index', arXiv, p42

²³⁷ Office for National Statistics (2023), [Public awareness, opinions and expectations about artificial intelligence](#), section 1 bullet 1. 55% of adults aged 70 or older reported they can hardly ever or never recognise AI use.

²³⁸ Bommasani, Rishi et al (2023), 'Stanford FM Transparency Index', arXiv, p1, 5, 32-33. Reinforced by Ada Lovelace Institute – without information on how a foundation model is trained (data, training methods, testing), it

data sets and how models might behave, they have no way of knowing the true scope of risk when they deploy the model in consumer-facing services. This applies to both closed and open-source models.²³⁹ It is therefore important that developers provide the right information to deployers so they can manage their responsibilities to consumers.

- 3.80 Our ‘Transparency’ principle has been updated to stress the importance of deployers clearly communicating necessary information to users of FM-based services to allow them to make informed choices, as well as making it clear when an FM-based service is being used.

We would be concerned if businesses and consumers did not receive the right information about FMs’ use and limitations, or if developers and deployers did not both play their part to ensure that businesses and consumers have the right information necessary to make informed choices.

We consider this further in our discussion of risks to competition and consumer protection in Chapter 5 below.

Figure 25 – Final ‘Transparency’ principle

TRANSPARENCY

Consumers and businesses have the right information about the risks and limitations of FMs

- People and businesses are informed of FMs’ use and limitations
- Developers give deployers the right information to allow them to manage their responsibilities to consumers
- Deployers provide the right information to users of FM-based services to allow them to make informed choices, including being clear when an FM-based service is being used

Accountability

Stakeholder feedback

- 3.81 Developers we spoke to pointed to the evolving regulatory landscape, including the US Executive Order and AI Summit. They pointed to measures they are already taking to reduce harms to consumers such as red teaming, and more general activities, such as developing internal systems to monitor trends and look for abuses and ways to prevent them, or contributing to the

would be difficult for a deployer to properly assess potential risks; datasheets and model cards thought to be crucial in terms of supply chain transparency. Brown, Ian (2023), ‘Allocating Accountability in AI Supply Chains: A UK-centred Regulatory Perspective’, Ada Lovelace Institute, p32, 61.

If training data is not available, there is no way to determine if models have been trained on personal, problematic, or copyrighted data. Trust in AI systems is dependent on data set transparency: Hardinges, Jack et al. (2023), ‘We Must Fix the Lack of Transparency Around the Data Used to Train Foundation Models’, arXiv.

²³⁹ Stanford CRFM (Accessed 08/04/2024) [Foundation Model Transparency Index](#)

development of industry safety standards. They also referred us to the role of industry bodies such as the Frontier Model Forum²⁴⁰ and the AI Alliance.²⁴¹ On the other hand, less than half of respondents to a McKinsey Global Survey on the current state of AI in 2023 said their organisations are mitigating the risk they consider most relevant: inaccuracy.²⁴²

- 3.82 Among stakeholders, there was common recognition of the ‘many hands’ issue²⁴³ and the shared responsibility of developers and deployers at different levels of the value chain. One stakeholder told us that the role of the deployer is to understand (1) how the AI is being used (2) what risks are created (3) what testing needs to be done (4) what the bar for accuracy should be (5) what level of human review may be required, and (6) which demographics are being served. The appropriate mitigations can then be introduced, including contracting back up the supply chain for aspects they do not directly control. The same stakeholder recognised that model developers also have a role to play as they control aspects that the deployer does not.
- 3.83 We were also told that end consumers who are ‘bad actors’ should also be held accountable where appropriate, and that, while developers and deployers may work hard to make models safe and beneficial, it is impossible to stop all bad actors who are intent on breaking the law. One stakeholder told us that, just as those who install malware or use the internet for fraud or to mislead consumers are subject to enforcement under the law, so should those that intentionally misuse or abuse FMs to harm others.
- 3.84 We also heard that incentives may not be aligned and will not develop naturally. The Ada Lovelace Institute, which has developed a conceptual framework to support the allocation of accountability in AI supply chains, has argued publicly that regulators should mandate the use of various transparency mechanisms that enable a flow of critical information, and redress.²⁴⁴ Another stakeholder said that standardised benchmarks are necessary for effective competition, but they are very hard and expensive to build, and firms may not have incentives to build and share them. This stakeholder suggested that there was a role for government and independent

²⁴⁰ OpenAI (2023) [Frontier Model Forum](#). This currently consists of Anthropic, Google, Microsoft, and OpenAI and is “focused on ensuring safe and responsible development of frontier AI models”.

²⁴¹ AI Alliance (Accessed 08/04/2024) [The AI Alliance](#), which describes itself as “an International Community of Leading Technology Developers, Researchers, and Adopters Collaborating Together to Advance Open, Safe, Responsible AI” launched in December 2023.

²⁴² McKinsey (2023) [The state of AI in 2023: Generative AI's breakout year](#)

²⁴³ Described at paragraphs 5.75 and 6.12 of the initial report. Competition and Markets Authority (2023), [AI Foundation Models: Initial Report](#), pp99, 106.

²⁴⁴ Brown, Ian (2023), ‘Allocating Accountability in AI Supply Chains: A UK-centred Regulatory Perspective’, Ada Lovelace Institute, p4

third parties. The Ada Lovelace Institute has also suggested a possible role for third party organisations to conduct independent certifications, audits and other processes to provide additional information about AI components, which would give assurances to the public, regulators and companies making use of them.²⁴⁵

- 3.85 We explored with stakeholders relevant differences between open and closed systems. One developer told us that closed model developers can build safety systems at different layers that work to mitigate harms and can monitor for harms. With open-source models, bad actors can more easily remove safety mitigations, fine-tune models for harmful use cases, and by their nature if run on a bad actor's own hardware cannot be monitored.
- 3.86 On the other hand, another stakeholder told us that open-source can promote accountability: while there is no direct ability to monitor use, the release of documentation about how the model operates opens it up to greater outside scrutiny. As a result, we were told users can better understand the model and report inappropriate output which will improve the model to improve future iterations.

Discussion

- 3.87 As set out in our initial report, if firms are not held properly accountable for their role within a supply chain, they may have a lower incentive to invest in strategies to reduce consumer harms arising from their use of FMs. The proper allocation of accountability and responsibility within a complex supply chain will incentivise firms to improve consumer outcomes, and consumers may more easily seek redress when things go wrong. In turn, that may lead to increased consumer confidence, trust and adoption.²⁴⁶
- 3.88 As described above, deployers need visibility about key elements of the FMs they use to assess the risks of using the model, including whether it risks misleading consumers or could be used to facilitate practices which mislead consumers. In this way, transparency within the supply chain supports accountability.
- 3.89 However, transparency alone is not sufficient. We would like to see firms at all levels of the supply chain embed effective mitigations and responsible practices, such as using high quality data for training or refinement; identifying

²⁴⁵ Brown, Ian (2023), '[Allocating Accountability in AI Supply Chains: A UK-centred Regulatory Perspective](#)', Ada Lovelace Institute, p28

²⁴⁶ Competition and Markets Authority (2023), [AI Foundation Models: Initial Report](#), p100, paragraph 5.76

model vulnerabilities through monitoring/evaluation techniques such as red teaming and human review; and continuous improvement by enabling users to flag problematic outputs, with a view to addressing them.

- 3.90 As a practical first step, developers and deployers should take proactive responsibility for what they control in the value chain and take positive action necessary to ensure consumers are adequately protected, including in the way they create sufficient transparency to enable others in the value chain to manage their accountability to protect consumers. All firms should take responsibility for ensuring they help foster the development of a competitive market that gains the trust and confidence of consumers and businesses.

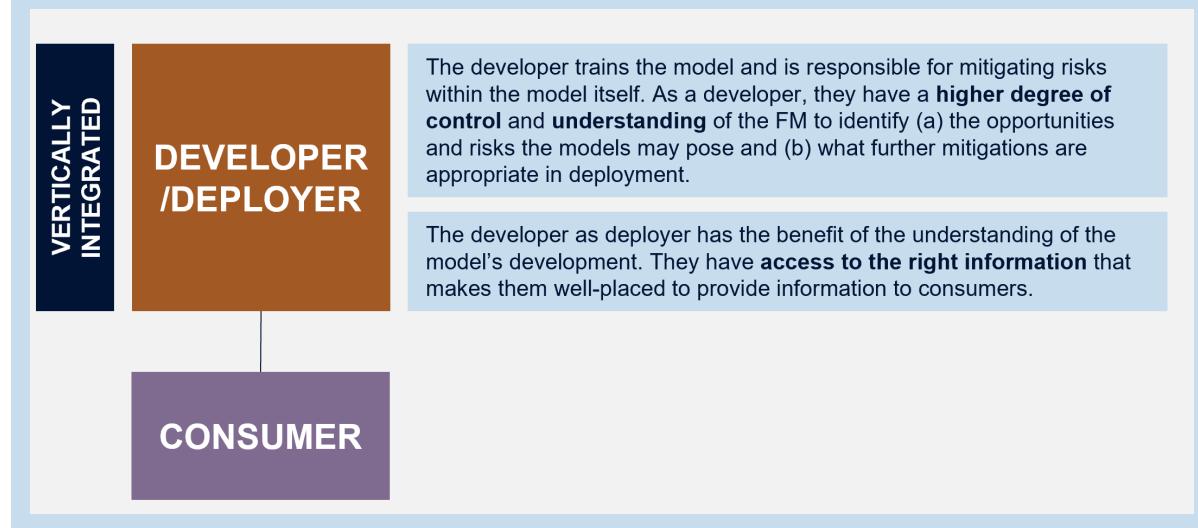
Figure 26 – Example of accountability for model outputs in different FM value chains

How accountability for model outputs and the flow of information can differ depending on the structure of the FM value chain

Based on the feedback received and research, we understand that accountability for the accuracy of model outputs and the flow of information between firms differs depending on the wider FM value chain and the relationships firms have with one another. Accountability is a complex issue, but below we set out three potential scenarios: vertical integration, API or license access and open-source.²⁴⁷ We emphasise that these examples are illustrative only: in practice, closed and open-source FMs operate on a spectrum (see Figure 13).

In Figure 27 (vertical integration), the developer has a high degree of control and understanding of the data and processes involved from development to ultimate deployment.

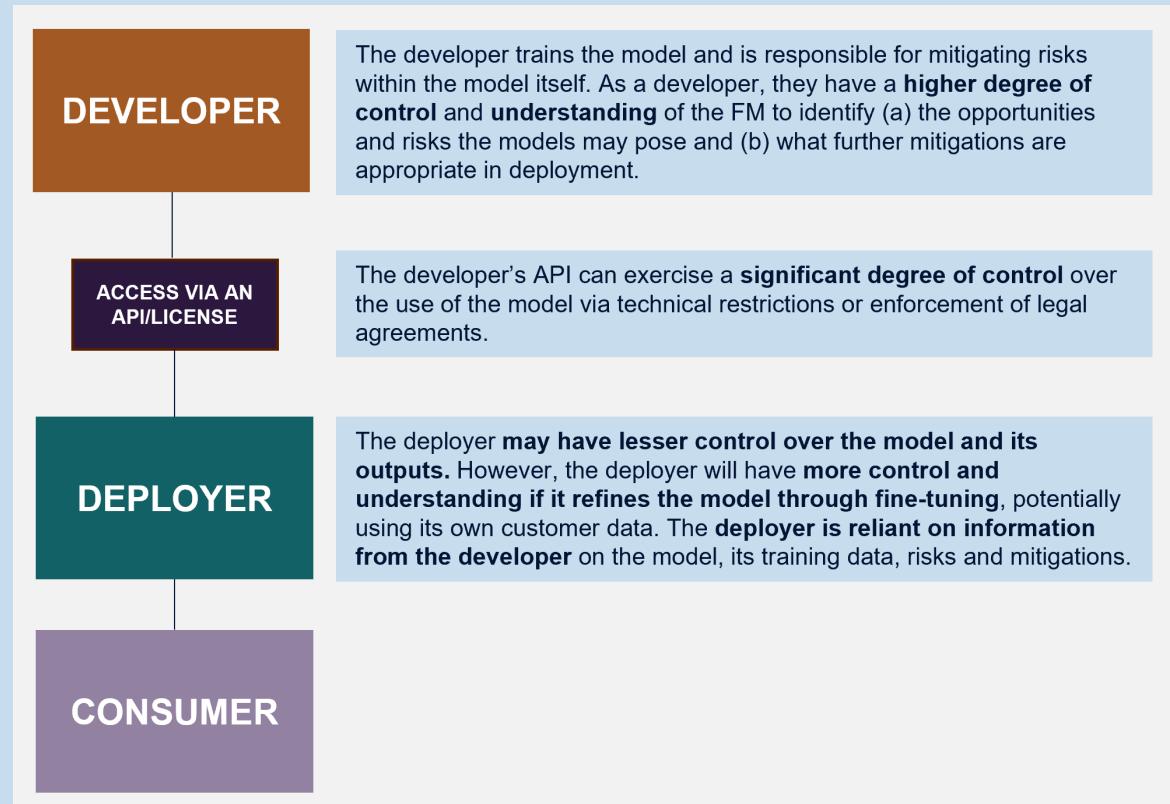
Figure 27 – Illustrative example of vertically integrated system which highlights the responsibilities of the deployer



²⁴⁷ These examples are similar to examples in Brown, Ian (2023), '[Allocating Accountability in AI Supply Chains: A UK-centred Regulatory Perspective](#)', Ada Lovelace Institute, pp25-28

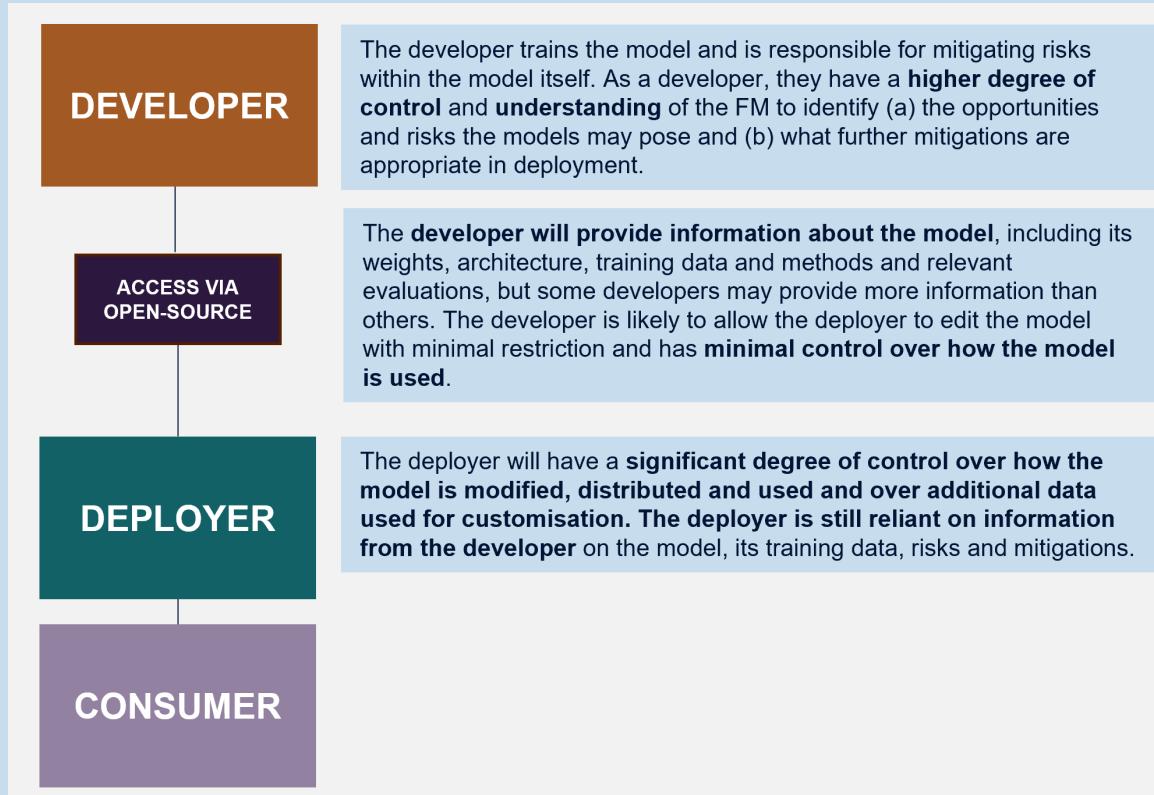
In Figure 28 (API/licensed model), the developer has control and understanding over the data and processes involved in the pre-training stage, and controls access via the API, but has less understanding and control over the data used by the deployer for fine-tuning, or of how the FM will operate in a particular business context. The deployer is dependent on the developer for information about pre-training.

Figure 28 – Illustrative example of an API or license access system, which highlights the shared responsibilities of the developer and deployer for the accuracy of model outputs



In Figure 29 (open-source), the primary developer has a high degree of control and understanding of the data and processes involved in pre-training which can be communicated as part of the model's release. The developer has limited control over the subsequent deployment of the model, including any modifications. The deployer of the model has an understanding and control of the subsequent deployment relating to any modifications or the introduction of new data.

Figure 29 – Illustrative example of an open-source model highlighting shared responsibilities of developer and deployer for the accuracy of the model's outputs

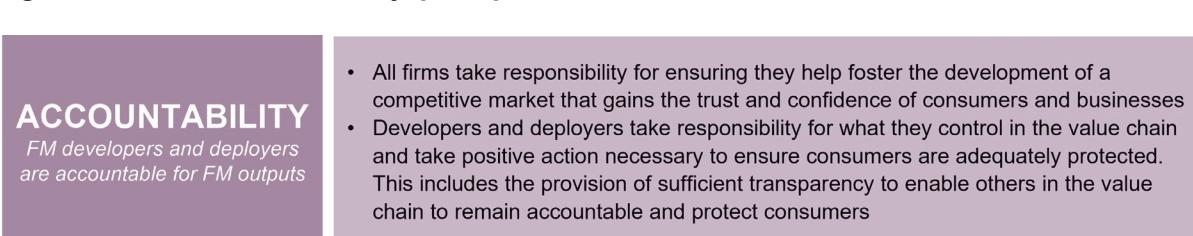


- 3.91 We confirm the accountability principle as set out in the initial report, with some amendment in light of stakeholder feedback. While we acknowledge that end users may also be accountable for their conduct, we consider that developers and deployers should take this possibility into account when designing their systems.
- 3.92 We urge firms at all levels of the supply chain to embed mitigations and responsible practices to reduce the risk of harm to businesses and consumers.
- 3.93 We have also made the connection between accountability and forms of transparency outlined above more explicit:
- Upstream developers have a responsibility to provide sufficient and accurate information about the model to enable downstream deployers to make informed assessments.
 - Downstream deployers need this information to ensure that they, in turn, provide the information users need to make informed decisions.
- 3.94 We also reiterate that, notwithstanding the helpful role wider accountability efforts can play, developers and deployers have specific legal obligations. For instance, firms across AI supply chains already have obligations under UK consumer law. Firms must take these obligations seriously and take proactive steps to build consumer law compliance into their products and business models.

We would be concerned if firms did not take responsibility for elements they control in the value chain, or did not take positive action necessary to ensure that consumers are adequately protected.

We consider this further in our discussion of risks to competition and consumer protection in Chapter 5 below.

Figure 30 – Final ‘Accountability’ principle



4. The CMA's confirmed AI principles

- 4.1 Taking into account the feedback received, we have updated our principles and confirm our final AI principles as follows.

Figure 31 – The CMA's AI principles

ACCESS <i>Ongoing ready access to inputs</i>	<ul style="list-style-type: none"> Access to AI data, compute, expertise and funding without undue restrictions Continuing effective challenge to early movers from new entrants Successful FM developers do not gain an entrenched and disproportionate advantage by being the first to develop a FM, having economies of scale or benefitting from feedback loops Powerful partnerships and integrated firms do not reduce others' ability to compete
DIVERSITY <i>Sustained diversity of business models and model types</i>	<ul style="list-style-type: none"> There are a variety of models available for businesses and consumers to choose from that suit their needs, whether that be for a general purpose or a highly specialised task Open-source models can help reduce barriers to entry and expansion Both open and closed source models push the frontier of new capabilities The market sustains a range of business models Powerful partnerships and integrated firms do not reduce others' ability to compete
CHOICE <i>Sufficient choice for businesses and consumers so they can decide how to use FMs</i>	<ul style="list-style-type: none"> A range of deployment options, including in-house FM development, partnerships, APIs or plug-ins Consumers and businesses can switch and/or use multiple services and are not locked into one provider or ecosystem Services are interoperable and consumers and businesses can easily extract and port their data between services Powerful partnerships and integrated firms do not reduce others' ability to compete
FAIR DEALING <i>No anti-competitive conduct</i>	<ul style="list-style-type: none"> Confidence that the best products and services will win out, and that firms are playing by the rules No anti-competitive conduct, including anti-competitive self-preferencing, tying or bundling Vertical integration and partnerships are not used to insulate firms from competition Competition can counteract any data feedback or first mover effects
TRANSPARENCY <i>Consumers and businesses have the right information about the risks and limitations of FMs</i>	<ul style="list-style-type: none"> People and businesses are informed of FMs' use and limitations Developers give deployers the right information to allow them to manage their responsibilities to consumers Deployers provide the right information to users of FM-based services to allow them to make informed choices, including being clear when an FM-based service is being used
ACCOUNTABILITY <i>FM developers and deployers are accountable for FM outputs</i>	<ul style="list-style-type: none"> All firms take responsibility for ensuring they help foster the development of a competitive market that gains the trust and confidence of consumers and businesses Developers and deployers take responsibility for what they control in the value chain and take positive action necessary to ensure consumers are adequately protected. This includes the provision of sufficient transparency to enable others in the value chain to remain accountable and protect consumers

- 4.2 The CMA's AI Principles are designed to help guide the FM sector towards positive outcomes for consumers, businesses, and the UK economy. The principles are intended to work together to achieve positive outcomes and should not be seen as operating in isolation. For example, accountability is

more likely to be achieved when there are a range of FM developers for businesses to choose from and which experience effective competitive constraint. That provides the right conditions for them to compete on the merits and improve model accuracy, reliability, and safety. Similarly, effective choice for consumers and businesses is likely to be achieved where there is a diversity of models and firms to choose from, along with sufficient transparency so those choices are informed.

- 4.3 Without fair, open and effective competition and strong consumer protection, underpinned by these principles, we see a real risk that the full potential of organisations or individuals to use AI to innovate and disrupt will not be realised, nor its benefits shared widely across society. That is why we have set out the underlying principles that we consider critical to safeguard those conditions. It is essential for competition agencies to work with market participants and other interested stakeholders to shape these positive outcomes.
- 4.4 **We urge firms to align their business practices with the principles, and to work with us to shape positive market outcomes. In this way, fair, open and effective competition can thrive, and consumers, businesses and wider society can reap the full benefits of this transformative technology.**

Fair, open and effective competition and consumer protection are key parts of the broader regulatory landscape in relation to AI

- 4.5 In the UK, the government recently published its response to the consultation on its AI White Paper including its own proposed cross-sectoral principles.²⁴⁸ In that response, the UK Government called on regulators to outline their strategic approach to AI by 30 April 2024. We will publish a separate response that will draw on the work we have done to date by the end of the month.
- 4.6 Our principles are intended to complement the UK Government's approach and are focused (per the CMA's remit) on the development of well-functioning economic markets that work well from a competition and consumer perspective. We are also monitoring key international developments since our

²⁴⁸ Department for Science, Innovation and Technology (2024), [Consultation outcome – a pro-innovation approach to AI regulation: government response](#)

initial report, including the White House Executive Order,²⁴⁹ the EU AI Act²⁵⁰ and the Bletchley Declaration.²⁵¹

- 4.7 Ongoing regulatory and policy debates on AI cover a range of areas such as safety, data protection and intellectual property which are not directly within the CMA's remit of competition and consumer protection. But we also have an important role to play in these broader debates to ensure the connections with competition and consumer protection concerns are recognised and understood. For example, in its response the consultation on its AI White Paper, the government acknowledged the benefits of open-source for innovation, transparency, and accountability but noted that there is a balance to strike to mitigate potential risks. We consider that there are risks associated with both proprietary and open-source models and that both need effective technical and policy mitigations to be put in place. For competition to flourish and consumer protection to be maintained, however, it remains vital that there is sufficient diversity of products, and we would be concerned if the market did not sustain a range of FMs, including open-source models, over time if that resulted in less choice for consumers and businesses.
- 4.8 In our conversations with government and our fellow regulators, we have been exploring and will continue to explore how future policy or regulatory interventions might impact fair, open and effective competition. We see a risk of chilling effects on competition if interventions are so burdensome that only larger firms can comply and raise barriers to entry for smaller firms or for those with disruptive business models. With this in mind, we fully endorse the House of Lords Communications and Digital Committee recommendation that 'market competition' should be an explicit policy objective of the UK Government's work on AI.²⁵² In line with our principles, any policy interventions should not come at the expense of diversity and choice which are also critical to resilience. We will also be particularly mindful of the risks any interventions might pose to effective consumer protection.
- 4.9 At the same time, wider policy or regulatory interventions and competition and consumer objectives can be mutually reinforcing as long as they are targeted

²⁴⁹ White House (2023), FACT SHEET: President Biden Issues Executive Order on Safe, Secure, and Trustworthy Artificial Intelligence

²⁵⁰ Provisional agreement announced by the European Council Press, 9 December 2023 - European Council (2023), Artificial intelligence act: Council and Parliament strike a deal on the first rules for AI in the world. MEPs adopted the AI Act on 13 March 2024 – European Parliament (2024), Artificial Intelligence Act: MEPs adopt landmark law.

²⁵¹ Prime Minister's Office, Foreign, Commonwealth and Development Office, and Department for Science, Innovation and Technology (2023) AI Safety Summit 2023: The Bletchley Declaration

²⁵² House of Lords Communication and Digital Committee (2024) Large language models and generative AI

and proportionate. Interventions that improve the safety, reliability and accountability of FMs can help foster consumer confidence and stimulate fair, open and effective competition in FM-related markets. Healthy competition can also help ensure that firms are incentivised to innovate on elements such as safety, accuracy and reliability.

- 4.10 In the next chapter, in light of the evidence set out in this report and our finalised AI principles, we set out risks to effective competition and consumer protection, including three key risks to fair, open and effective competition.²⁵³

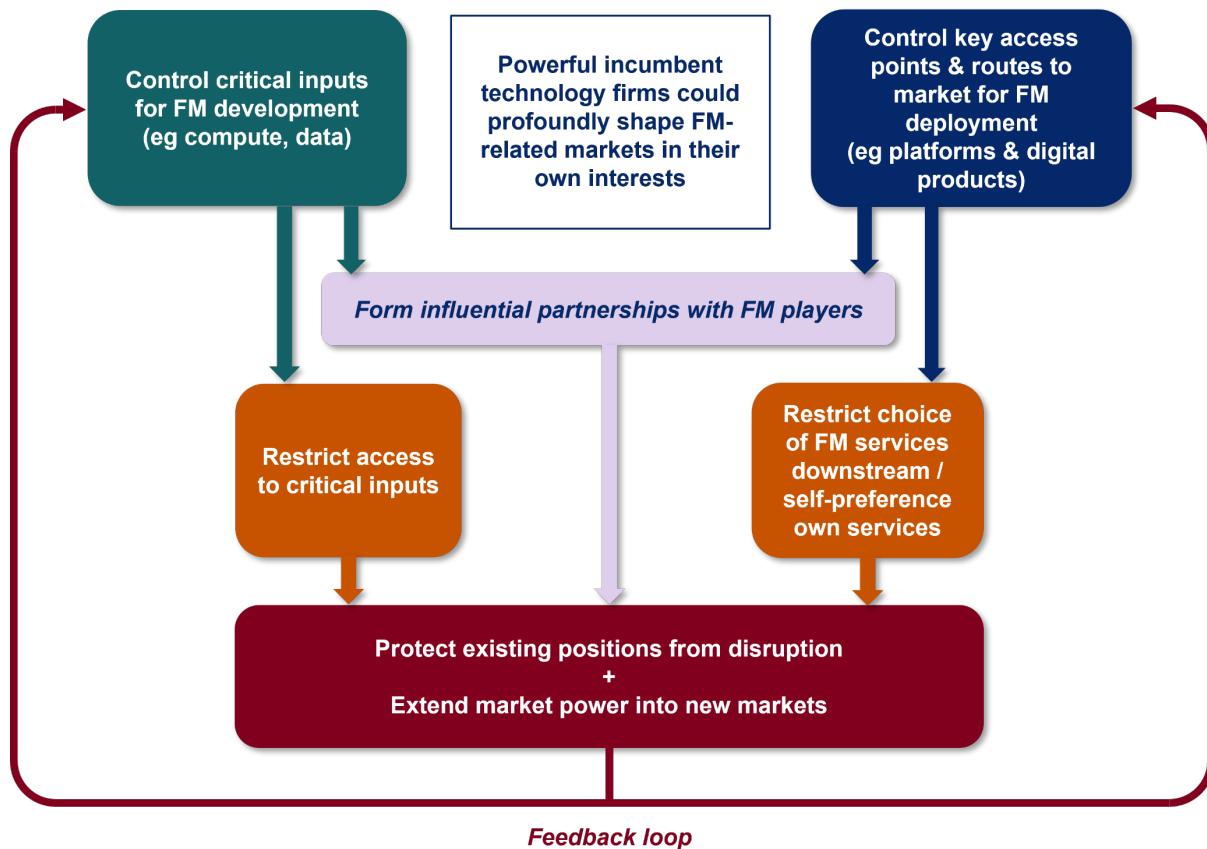
²⁵³ See also our shorter [update paper](#) published on 11 April 2024.

5. Risks to competition and consumer protection

We see three key risks for fair, open and effective competition

- 5.1 **We are concerned that the FM sector is developing in ways that risk negative market outcomes.** FMs, and AI more generally, have the potential to boost productivity in many sectors across the economy, to drive innovation in existing markets, and to allow entirely new products and services to be created. FM development so far has been characterised by rapid innovation, with several players pushing technological frontiers and competing intensely to attract investment and talent. However, some of the market trends and developments we have seen may put the sustainability of this competitive process at risk.
- 5.2 Our strongest concerns arise from the fact that a small number of the largest incumbent technology firms, who already have market power in many of today's most important digital markets, could profoundly shape the development of FM-related markets to the detriment of fair, open and effective competition and ultimately harm businesses and consumers, for example by reducing choice and quality, and by raising prices. Some of these firms have strong upstream positions in one or more critical inputs for FM development as well as control over key access points or routes to market for downstream FM deployment (either through their firm's own activities or through a network of partnerships and investments). This may pose a particular risk in enabling firms to leverage power through the value chain. At the same time, where firms have market power in other digital markets, this may be threatened by disruption and innovation from AI. This combination could mean that these incumbents have both the ability and incentive to shape the development of FM-related markets in their own interests, which could allow them both to protect existing market power and to extend it into new areas.

Figure 32 – Incumbent technology firms could shape FM-related markets in their own interests



5.3 Based on our work to date, we see the following three key interlinked risks to fair, open and effective competition:

1. Firms that control critical inputs for developing FMs may restrict access to them to shield themselves from competition.
2. Powerful incumbents could exploit their positions in consumer or business facing markets to distort choice in FM services and restrict competition in FM deployment.
3. Partnerships involving key players could reinforce or extend existing positions of market power through the value chain.

5.4 We consider each of these risks in turn below, assessing how they would be mitigated by the CMA's principles and identifying the actions we are taking now, and are considering taking in the near future to seek to address these risks.

- 1. Firms that control critical inputs for developing FMs may restrict access to them to shield themselves from competition**
- 5.5 Where firms control key inputs for developing FMs, such as compute, data or expertise, they could restrict access to them. They could do this to: (1) prevent other firms from building new, competitive FMs that might challenge their own (or their partners', where relevant); and/or (2) protect their position in related markets, by making it harder for potential rivals in those markets to develop or deploy capable FMs. For example, materially restricting access to key inputs such as compute, data or expertise would prevent challengers from building effective, competitive models. It might also reinforce incumbents' positions in related markets such as search and productivity software, by making it harder for potential rivals there to develop or deploy capable models that could provide the building blocks for a next generation competitive alternative, which could result in reduced choice and quality, as well as increased prices for downstream business customers and consumers.
- 5.6 To secure access to compute, we have seen some FM developers form partnerships with major cloud providers (discussed further below); meanwhile, only a handful of firms can rely on their own compute resources. These constraints are exacerbated in a context in which the availability of AI accelerator chips remains limited. We would be concerned if incumbent firms could use control over access to compute to shape FM-related markets in their own interests. In addition, we are increasingly seeing a battle for technical expertise where those with the deepest pockets may win out, making it challenging for non-partnered or non-vertically integrated firms to survive.
- 5.7 The CMA's '**Access**' principle reflects the fact that the market is more likely to flourish if there is ongoing ready access to data, compute and expertise, without undue restriction, and if powerful partnerships and integrated firms do not reduce others' ability to compete. The '**Access**' principle can help fair, open and effective competition to flourish for the benefit of businesses and consumers, by facilitating sufficient plurality in FMs, as set out under the '**Diversity**' principle. This includes diversity in the types of FMs being developed, how they are released to consumers and businesses, and the business models that firms may employ.
- 5.8 In light of the risk that access to critical inputs could be restricted or used to shape the development of FM-related markets in the interests of incumbent firms, which could also reduce diversity in FM development and deployment, we are:

- Examining the **conditions of competition in the provision of public cloud infrastructure services as part of our ongoing Cloud Market Investigation**. The CMA's independent group of panel experts appointed to conduct that market investigation is considering how the market for cloud services is operating in practice, including assessing the market positions of the main cloud service providers and the characteristics of customers. In addition to analysing a number of indicators, such as shares of supply and barriers to entry and expansion, the investigation will include a forward-looking assessment on the potential impact of FMs on how competition works in the provision of cloud services.
- Examining **Microsoft's partnership with OpenAI** to understand how it could affect competition in various parts of the ecosystem.
- Examining the competitive landscape in **AI accelerator chips** and the impact on the FM value chain as part of the next phase of work on our FMs initial review.

5.9 As well as using our current range of legal powers, we will take account of developments in FM-related markets as part of our consideration of which digital activities to prioritise for investigation under new powers anticipated in the Digital Markets, Competition and Consumers Bill. Areas of potential consideration could include those digital activities that are critical inputs for developing FMs such as compute, although we are yet to take any provisional decisions on which areas to prioritise for investigation, any designation would be subject to a prior investigation, and in considering compute we would take account of the findings of the Cloud Market Investigation.

2. Powerful incumbents could exploit their positions in consumer or business facing markets to distort choice in FM services and restrict competition in FM deployment

5.10 Businesses and consumers should be able to exercise free choice over which FM services they use. But their choice could be shaped by the existing digital products they use (such as mobile and other devices, search engines, or productivity software) and which FMs are or become integrated with those existing products. This is why firms that control such access points and routes to market could gain significant influence over FM deployment.²⁵⁴ Unchecked control over these access points and routes to market could result in reduced

²⁵⁴ FM platforms or marketplaces (such as Amazon's Bedrock or Google's Vertex AI) are still relatively nascent features of the market; it is possible that in future these are established as mechanisms of control over FM distribution for the firms operating the platforms.

choice, reduced quality, lower levels of innovation and higher prices in FM-powered products and services for business customers and consumers.

- 5.11 We have seen that incumbent firms are rapidly integrating FMs into their ecosystems of products and services. For example, Microsoft is deploying its own FMs and those of its partner OpenAI in the Copilot feature integrated in its productivity software (Microsoft Office), PC operating system (Windows) and search (Bing); Google is using its own FM for its Search Generative Experience. These integrations can bring benefits – such as innovation and efficiencies – to businesses and consumers. However, we are concerned about the possibility of restricting businesses' and consumers' ability to choose alternatives and making it harder for rival FMs or downstream applications to compete.
- 5.12 In terms of FM development, firms controlling important routes to market may be able to give their own FM services or those of their partners an advantage, through pre-installation, technical bundling, accessibility, integration, and compatibility.
- 5.13 In terms of FM deployment, if firms deploying FMs within their products and services gain access to particular leading FMs on exclusive or advantageous terms (for example, through partnerships), this could entrench their positions and impede challenge from rival FM deployers or allow them to extend any market power into new markets. In some cases, this may become exacerbated by feedback loops. For example, if a firm's exclusive or advantageous access to an FM allows it to strengthen its position within a digital domain that generates rich data sets, this could lead it to have greater access to data required for building or improving FMs. For fair, open and effective competition to flourish for the benefit of businesses and consumers, it is vital that there is sufficient diversity in the market. As set out in the CMA's '**Diversity**' principle, this includes the plurality in the types of FMs being developed, how they are released to consumers and businesses, and the business models that firms may employ.
- 5.14 For businesses and consumers to enjoy the full benefits of a diversity of FMs and FM services, the CMA's '**Choice**' principle sets out that businesses and consumers should be able to choose how they use FMs and switch between different options without being locked into one provider or ecosystem. The '**Fair Dealing**' principle emphasises that the best products should win out and not be restricted by anti-competitive bundling, tying or self-preferencing. Together, these principles help ensure that businesses and consumers can freely and fairly choose the best products and services for their particular use case. They are not forced to settle for inferior FMs because they are locked into one provider or ecosystem. Nor are they pushed into using inferior

complements with their desired FM through anti-competitive bundling, tying or self-preferencing.

- 5.15 In light of the risk that choice in FM services and competition in downstream deployment could be restricted, we will take account of developments in FM-related markets as part of our consideration of which digital activities to prioritise for investigation under new powers anticipated in the Digital Markets, Competition and Consumers Bill. Areas of potential consideration could include those digital activities that are critical access points or routes to market for FM deployment, such as mobile ecosystems, search, and productivity software, although we are yet to take any provisional decisions on which areas to prioritise for investigation and any designation would be subject to a prior investigation.

3. Partnerships involving key players could reinforce or extend existing positions of market power through the value chain

- 5.16 In addition to the increasing levels of vertical integration in the FM value chain, we are also seeing a proliferation of partnerships and strategic investments in the FM value chain by the GAMMA firms, as well as Nvidia, the leading supplier of AI accelerator chips. The GAMMA firms are also making strategic hires of key talent in the sector. The positions of these firms in relation to key inputs for FM development and/or access points or routes to market for FM deployment may give them significant leverage when agreeing partnerships with FM developers and deployers.
- 5.17 As shown in Figure 7 in Chapter 2 above, we have identified an interconnected web of over 90 partnerships involving the GAMMA firms and Nvidia.
- 5.18 We are aware that such partnerships typically form part of the development and investment ecosystem in the technology space – and indeed may be an essential ingredient for the success of independent developers. We understand that they can potentially bring pro-competitive benefits. And each partnership must be assessed on its individual facts and merits.
- 5.19 However, we are also vigilant against the possibility that incumbent firms may try to use partnerships and investments to quash competitive threats, even where it is uncertain whether those threats will materialise. In this context it is notable that not all such partnerships and investments will fall within the scope of merger control rules and some may have been structured to seek to avoid them. We consider it important that competition agencies are suitably equipped to take action where these arrangements give rise to competition concerns.

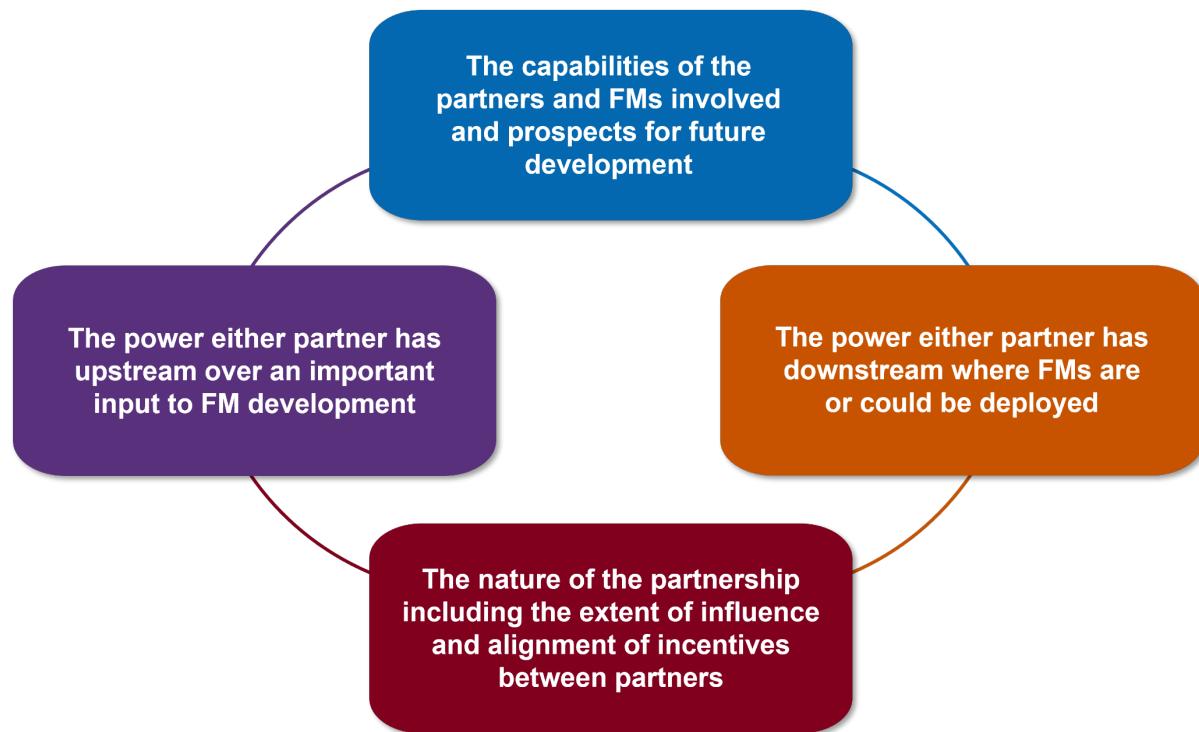
- 5.20 In this context, we believe the application of our principles are essential to safeguard fair, open and effective competition. The CMA's '**Access**', '**Diversity**' and '**Choice**' principles stipulate that powerful partnerships and integrated firms should not reduce others' ability to compete or steer markets away from a sustained diversity of business models and model types. Our '**Fair Dealing**' principle makes it clear that vertical integration and partnerships should not be used to insulate firms from competition.
- 5.21 In light of the risks arising from strategic partnerships and investments, we are:
- **Monitoring current and emerging partnerships closely**, especially where they relate to important inputs and involve firms with strong positions in their respective markets and FMs with leading capabilities. We will carefully consider current and future investments in, and partnerships with, leading FM developers and assess whether they could give rise to negative outcomes for competition and consumers.
 - **Stepping up our use of merger control** to examine whether such arrangements fall within the current rules and, if so, whether they give rise to competition concerns. It may be that some arrangements falling outside the rules are problematic even if not ultimately remediable through merger control. Equally some arrangements may not give rise to competition concerns. We consider it is appropriate to step up our review more generally so that we can start to identify more clearly and coherently which types of partnerships fall within the merger rules and the circumstances in which they may give rise to competition concerns. That will also be of benefit to the businesses involved.
 - As one example of that, we are **currently examining Microsoft's partnership with OpenAI**²⁵⁵ to understand how it could affect competition in various parts of the ecosystem. More generally, we will consider the application of UK merger control to other partnerships and arrangements in this sector in line with the approach outlined above.
- 5.22 We have set out below some indicative factors which may drive greater concern, with a focus on partnerships that involve some of these features:²⁵⁶

²⁵⁵ Competition and Markets Authority (2023), [CMA seeks views on Microsoft's partnership with OpenAI](#)

²⁵⁶ These are indicative factors which are likely to evolve as we gain more experience from our review of current and future arrangements.

- Either party has existing power upstream over an input critical to model development;
- Some or all of the models involved are highly capable, with significant future potential;
- Either partner has existing power in downstream markets where models are, or could be, deployed;
- Either party gains influence over the other's development of models and/or deployment downstream, particularly where there is information exchange and scope for incentive alignment between the firms.

Figure 33 – Factors the CMA may consider when assessing the potential impact of partnerships



The market may also develop ‘winner-takes-all’ dynamics

5.23 The scale of the threat posed by the three key risks we set out above will also be influenced by structural features present in the FM sector. For instance, if FM-related markets are characterised by high returns to scale of data, high levels of personalisation, or network effects, markets could tip to a single provider or small number of providers, and market power could become entrenched. This could prevent entry or expansion by firms that could offer superior technology or a more attractive customer proposition. Such structural features may not be present in all FM-related products and services, but some

domains in which FMs are being deployed already exhibit these sorts of features.²⁵⁷

- 5.24 It is therefore important that competition agencies closely monitor developments in the FM sector, including firms' approaches to monetising FMs, the ways in which they are integrating FMs into existing digital products and services, and how they are developing and commercialising entirely new FM-powered products and services. Monitoring such developments will inform our understanding of the structural features of FM-related markets and how these are evolving over time, and will inform the urgency of any action needed to preserve competition, including through our anticipated powers under the Digital Markets, Competition and Consumers Bill.

AI and consumer protection

- 5.25 While FMs may benefit consumers by providing higher quality, lower priced and potentially more personalised products and services, they also have significant scope to facilitate unfair consumer practices. Firms could do this deliberately through existing unfair practices such as subscription traps, hidden advertising, or fake reviews, or could develop new ways of acting unfairly towards consumers. Or it could be inadvertent, due to hallucinations or flaws in the technology that produce outputs that mislead consumers and prevent them from making informed choices. We are building our understanding of how consumer protection issues might map on to AI-based products and services, and we are undertaking joint research with fellow Digital Regulation Cooperation Forum (DRCF) members to explore consumers' understanding and use of FM services.
- 5.26 One means of addressing the risks to consumers posed by AI is through preventative steps. Our '**transparency**' and '**accountability**' principles make it clear that if consumers and businesses have sufficient information on the benefits and risks of AI products, and if every firm in the value chain takes responsibility for what they control, we are more likely to see positive outcomes for consumers. We will also consider issuing proactive guidance to firms on how to comply with consumer law in AI-related markets if we see uncertainty or particular issues that need clarification.
- 5.27 Prevention of consumer harm is not just in the consumer interest – it is also in the interest of business. If consumers lack trust and confidence in AI and AI-driven services, they are less likely to use them and benefit from what they

²⁵⁷ Competition and Markets Authority (2020), [Online platforms and digital advertising market study final report](#). Competition and Markets Authority (2022), [Mobile ecosystems market study final report](#).

offer, and the innovative and disruptive benefits of organisations or individuals using AI may not reach its full potential. We have already seen concerning arguments made by businesses that they are not responsible for the outputs of AI-powered tools used on their websites,²⁵⁸ and similar developments in future could damage consumer trust in AI-related markets.

- 5.28 If unfair practices in AI-powered markets emerge, we can also tackle them through enforcement action. The Digital Markets, Competition and Consumers Bill anticipates new powers for the CMA directly to enforce consumer protection law against infringing firms and envisages significant penalties for non-compliance. These penalties may be up to 10% of a firm's worldwide turnover. We are ready to use these new powers to raise standards in the market and, if necessary, to tackle firms that do not play by the rules through enforcement action.

²⁵⁸ BBC (22/02/2024) [Airline held liable for its chatbot giving passenger bad advice - what this means for travellers](#)

6. Next steps

We will continue to examine the impact of FMs on competition and consumer protection

- 6.1 In addition to the actions set out above to mitigate the risks AI may pose for competition and consumer protection, we will continue our dedicated programme of work to consider the impact of FMs on markets throughout 2024, including:
 - A forthcoming paper on AI accelerator chips, which will consider their role in the FM value chain;
 - Joint research in the DRCF on consumers' understanding and use of FM services, and participation in the [DRCF AI and Digital Hub](#) pilot due for launch in Spring 2024; and
 - A joint statement with the ICO on the interaction between competition, consumer protection and data protection in FMs.
- 6.2 We will publish a further update on our work in **Autumn 2024**.