



Response to the European Commission's call for contribution regarding Generative AI

1) What are the main components (i.e., inputs) necessary to build, train, deploy and distribute generative AI systems? Please explain the importance of these components

The main inputs needed to train and deploy generative AI models are (a) data, (b) computing resources, (c) employee expertise; and (d) interfaces, whether that is a platform with APIs, or applications or workflows to house the GenAI functionality. See Response to Question 2 for additional information.

2) What are the main barriers to entry and expansion for the provision, distribution or integration of generative AI systems and/or components, including AI models? Please indicate to which components they relate.

The GenAI space is rapidly evolving. The technical constraints of one year ago are not the constraints of today, and most likely these constraints will again be different one year from now. Accordingly, we believe it is still early to definitively assess what a barrier to entry may be. Three current areas of scarcity include (a) access to data, (b) GPUs (compute power) and (c) employee expertise.

a. Data

Data is needed to train generative AI models at various stages, including the initial training and fine-tuning, as well as the later refining of the model based on customer feedback. The type of data varies based on the type of the generative AI model. For example, a text-to-image model generates images using text prompts. Accordingly, to train a text-to-image model, the required dataset is image-text pairs.

The accuracy of an AI model is dependent on the amount of data it is trained upon. In addition, the more data an AI model has and the greater the diversity of that data, the less bias it will have. For those two reasons, it is critical to have policies in place that enable AI developers to have access to data. We understand IP and privacy laws can be in tension with this concept, and that balance must be examined as AI and data are regulated. For Adobe, we chose to build our first generative AI text to image model without scraping the web to minimize any IP issues, as our enterprise customers are quite interested in implementing a commercially safe model. In addition, when selecting datasets to use for training Firefly, we used curated, diverse datasets

comprised of licensed and public domain images that went through a human moderation process to minimize safety and bias issues. Since launching Firefly, other companies have released their own commercially safe generative AI models as well, due to customer interest. However, it is unclear whether limiting to safe datasets will ensure a level playing field with models trained on wider datasets, and we expect these approaches will evolve over the next year based on marketplace interest and developments in the law.

b. GPUs (Computing Resources)

The training and deployment of generative AI models also requires significant computing resources. Accelerator chips that are best suited for generative AI are those that are optimized for parallelized computing, which is the process of breaking down large tasks into smaller, independent tasks that can be executed simultaneously by multiple processors. The most popular accelerator chips currently are GPUs.

Although there were early reports of GPU shortages, there has been increased production in response to the rapid increase in demand. There also likely will be additional options as other companies introduce chips that are optimized for training or inference.

Entrants most likely would access computing resources via the public cloud providers. Doing so can reduce start-up costs while providing a means to scale as a model gains usage post-launch. As with any other commercially valuable space, the economic incentives for new entrants are strong and we would expect to see competition to grow and develop in the chip space.

c. Employee Expertise

The development and deployment of generative AI models also depends on employees with particularized expertise. Expertise with the entire generative AI stack is needed to both train and deploy generative AI. Researchers and engineers with the requisite expertise can be difficult to find given the newness of this field. Partnerships, mergers, and acquisitions are all strategies that companies can use to obtain the expertise necessary to remain competitive until the economic incentives of the marketplace create a change in workforce skills.

3) What are the main drivers of competition (i.e., the elements that make a company a successful player) for the provision, distribution or integration of generative AI systems and/or components, including AI models?

The generative AI industry is rapidly evolving; thus the drivers of competition are likely to change over time. Currently, some of the main drivers of competition for generative AI models are the

quality of output, speed of execution, fit for business purpose, ability to customize, price, extent to which it was designed to be commercially safe, and the provider's ethics, safety, and governance standards. There has been a rapid increase in the number of model providers, and it will only be seen over time whether large model providers will have an advantage over smaller targeted model providers and what the impact of open-source models will have on the market.

4) Which competition issues will likely emerge for the provision, distribution or integration of generative AI systems and/or components, including AI models? Please indicate to which components they relate.

We think that once the business models, legal issues, and technical advantages are more settled, it will be easier to understand what the competition issues will be. Currently it is unclear what particular aspects of AI systems will drive marketplace success. First mover advantages likely will accrue to the respective participants in chips, models, and platforms, but until a consumer or enterprise market has fully developed for the technology, it will be unclear what the winning strategy will be or whether the first mover advantages will prove durable. In addition, model architectures are rapidly changing (multi-modal architectures are now becoming the latest approach), and with the science and research still evolving, it is not yet clear what the winning technical approach will be. It is even possible that models themselves become a commodity due to open source and other competitive responses. Until we know how this plays out, it is difficult to state what the competition issues will be.

5) How will generative AI systems and/or components, including AI models likely be monetised, and which components will likely capture most of this monetization?

Businesses are still trying to determine optimal business models for monetizing generative AI. Generating content with AI models requires significant computation resources; as a result, it is unlikely that businesses will be able to provide free, unlimited access to generative AI on a long-term basis.

Adobe currently monetizes its generative AI through generative credits, through integration of generative AI into its existing products and services, and through the creation of entirely new products based on generative AI.

Relatedly, businesses are still trying to determine in which ways customers will prefer to access generative AI. Some customers may prefer interfacing directly with a standalone generative AI model that allows for the creation of content (e.g., images, videos, text) from a prompt. Alternatively, customers may prefer to use generative AI as features inside other applications. Adobe currently offers both a standalone generative AI model (available at <https://firefly.adobe.com/>) and

generative AI features inside other products (e.g., Generative Fill and Generative Expand in Adobe Photoshop, Generative Recolor in Adobe Illustrator, and Text Effects in Adobe Express).

6) Do open-source generative AI systems and/or components, including AI models compete effectively with proprietary AI generative systems and/or components? Please elaborate on your answer.

Open-source generative AI systems may compete with proprietary generative AI systems, depending on the customer's intended use, but it is not yet clear, how effectively. Given the rapid advancement in the generative AI space – including among open-source models – open-source generative AI models may become competitive for even more use-cases over time.

In addition, many generative AI systems rely on a pipeline of AI models to provide the full service to users and some of those generative AI model components likely will continue to be competitively offered under open-source licenses (e.g., encoders, decoders, multi-modal models, etc.).

7) What is the role of data and what are its relevant characteristics for the provision of generative AI systems and/or components, including AI models?

As discussed above, data is necessary for the training and fine-tuning of AI models. The quality and usability of Generative AI models are highly influenced by the quality and diversity of its training data. Relevant characteristics include the volume, safety, reliability, and applicability of the data to the desired use case. In addition, data must be labelled to be useful as training data.

Enterprises may prefer leveraging a tool for commercial purposes that is commercially safe. For those that do, generative AI providers will need to use one that does not include abusive, illegal, or harmful content, and will need to be cognizant of bias that may occur as a result of the training set and may also require that the training data be free of IP or brand issues.

One of the important issues that arises from AI's need for data is its implication on creators and copyright. Top of mind for the creative community is whether generative AI can be trained on the copyrighted or branded materials that exist on the internet without permission. Although generative AI promises numerous procompetitive innovations, it also raises significant competition concerns for content creators.

If a generative AI model is trained on images on the internet, the AI can learn to recreate new works in the exact same style as an original creator of those images. This creates the possibility for someone to misuse an AI tool to intentionally impersonate the style of an artist, and then use that AI-generated art to compete directly against them in the marketplace. This could pose serious

economic consequences for the artist whose original work was used to train that generative AI model in the first place.

For these reasons, Adobe supports legislation to create a new right to allow artists to protect themselves against people using AI to impersonate their style. Adobe believes such legislation is necessary in the age of generative AI – not only to support artists, but also to prevent confusion in the marketplace when AI tools are misused and cause economic harm to artists.

Specifically, legislation should cover AI-generated replicas of artistic works, in addition to other markers such as image, likeness, and voice. In addition, legislation should protect parties who can show economic or reputational harm, regardless of whether they are public personalities. This approach can also protect the public from deception when AI tools are intentionally misused in a way that causes deception and economic harm to artists.

8) What is the role of interoperability in the provision of generative AI systems and/or components, including AI models? Is the lack of interoperability between components a risk to effective competition?

Interoperability may be beneficial in certain circumstances, as it can increase customer choice and reduce switching barriers. Accordingly, as the generative AI industry evolves, such interoperability may arise naturally.

Adobe has historically fostered interoperability by providing open platforms and supporting consumer choice, and we expect that this will be our approach here as well. For example, there is a plug-in for Adobe Photoshop that allows customers to generate and edit images using Stable Diffusion and Dall-E 2 in lieu of Adobe Firefly.

9) Do the vertically integrated companies, which provide several components along the value chain of generative AI systems (including user facing applications and plug-ins), enjoy an advantage compared to other companies? Please elaborate on your answer.

The mere fact that a company is vertically integrated does not necessarily provide it advantages vis-à-vis more specialized providers. Many companies provide multiple components along the value chain of generative AI systems. Certainly, as the market develops it will be worthwhile to examine whether having a strong position at different levels in the vertical value chain provides an unfair advantage against competitors in those different layers, but it is difficult to tell right now if this will be an issue.

10) What is the rationale of the investments and/or acquisitions of large companies in small providers of generative AI systems and/or components, including AI models? How will they affect competition?

Investments are important to driving innovation and are beneficial to both companies and ultimately the consumer. Adobe invests in companies to encourage the success of ideas that may prove beneficial to our customers or to support companies that are providing products that fill gaps in our own portfolio. For GenAI, it may be difficult for a company the size of Adobe to create models of all the types that its customers may need, and bringing in talent, IP, and data may be the best way to serve our customers.

11) Do you expect the emergence of generative AI systems and/or components, including AI models to trigger the need to adapt EU legal antitrust concepts?

The antitrust laws are already suited to prevent or rectify anticompetitive conduct that could occur with regards to generative AI. Although the industry is young, the concerns articulated to date mirror those raised with regards to numerous other industries: the threat of predatory or exclusionary conduct. So that it may quickly address such conduct – and so that it does not unintentionally take action that impedes competition – Adobe encourages the Commission to gain subject matter expertise in the generative AI industry.

12) Do you expect the emergence of generative AI systems to trigger the need to adapt EU antitrust investigation tools and practices?

Although the current antitrust investigation tools and practices should prove sufficient if properly employed, the Commission's investigations may benefit from the increased use of technologists. Generative AI models and applications are advancing rapidly and rely on advancements in both the underlying hardware and software. A thorough understanding of the motivations, implications, and effects of conduct in this space will require substantive knowledge of the components. Conversations directly between technologists employed by the Commission and engineers, researchers, or other persons working in the industry could reduce any potential misunderstandings.

Otherwise, the Commission already has wide discretion to open an investigation to determine whether there has been a violation of competition laws. Through Requests for Information, the Commission can obtain detailed written and documentary information that is relevant to its investigation. To date, the Commission has used these powers to conduct thorough investigation into a variety of conducts in a broad range of complex industries. The type of anticompetitive conduct that regulators have identified as potentially likely to arise in the generative AI space is not

novel. What will be crucial, however, is determining whether any specific conduct is truly anticompetitive rather than procompetitive, especially in a space that is undergoing such rapid and dynamic evolution.