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OPEN STANDARDS FOR THE AI DEVELOPMENT ECOSYSTEM:

Enabling Integration, Innovation, Transparency, and Freedom of Choice

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In This White Paper

This white paper explores the benefits of open standards in the ecosystem for AI development tools and platforms. Based on the results of an IDC virtual focus group, it highlights the challenges developers face with fragmented tools and technologies and advocates for an open, unified AI development platform that follows open standards to streamline integration and enhance developer productivity. The paper also emphasizes how open standards in AI development enhance technology integration, innovation, transparency, and freedom of choice for developers. Finally, the paper introduces the Open Platform for Enterprise AI (OPEA) as a key initiative that promotes open, multi-provider GenAI systems.

Situation Overview

Focus Group:

Experts in AI development

Across the globe

AI-powered applications

To identify the challenges developers are facing with the increasing demand for AI-powered digital solutions, IDC conducted a virtual focus group for three days in June 2024 with experts in AI development that included developers, architects, engineers, and IT managers at small, medium, and large businesses from across the globe that are conducting business in a range of sectors (see Appendix).

All of the participants are actively developing and deploying AI-powered applications for use cases that include chatbots, fraud detection, supply chain optimization, predictive maintenance, and enterprise resource planning. To build these complex digital solutions, developers rely on dozens of tools, platforms, libraries, and frameworks ranging from large language models (LLMs), such as OpenAIs's GPT-4 and Meta's Llama-3, to accelerated computing SDKs, such as NVIDIA's CUDA and Intel's oneAPI (see Appendix).

The questions IDC asked during the focus group included:

- If you could wave a magic wand and have anything you want in the developer tools space (as it relates to intelligent applications), what would it be?
- What improvements would you like to see with respect to developer tools that specialize in the development of intelligent applications?

Overwhelmingly, the participants reported struggling to integrate the many different tools and technologies necessary to build AI-powered applications. To help overcome this obstacle, these professionals strongly support the emergence of a unified AI development platform based on open standards, which would facilitate the integration of disparate AI frameworks, libraries, and tools.

These experts are not looking for a single-vendor solution, and IDC's view is that no commercially available AI platform provides all of the capabilities that AI developers need (see *The Unified AI Platform, 2024: Integrating and Interoperating with Other Enterprise Systems* [IDC #US52254024, September 2024]). Rather, the participants in our focus group want to integrate their choice of tools and platforms into their work environment as necessary. In this context, while open source software is important for facilitating innovation and democratizing AI, open standards represent an equally if not more important force that empowers developers by facilitating integration and interoperability.

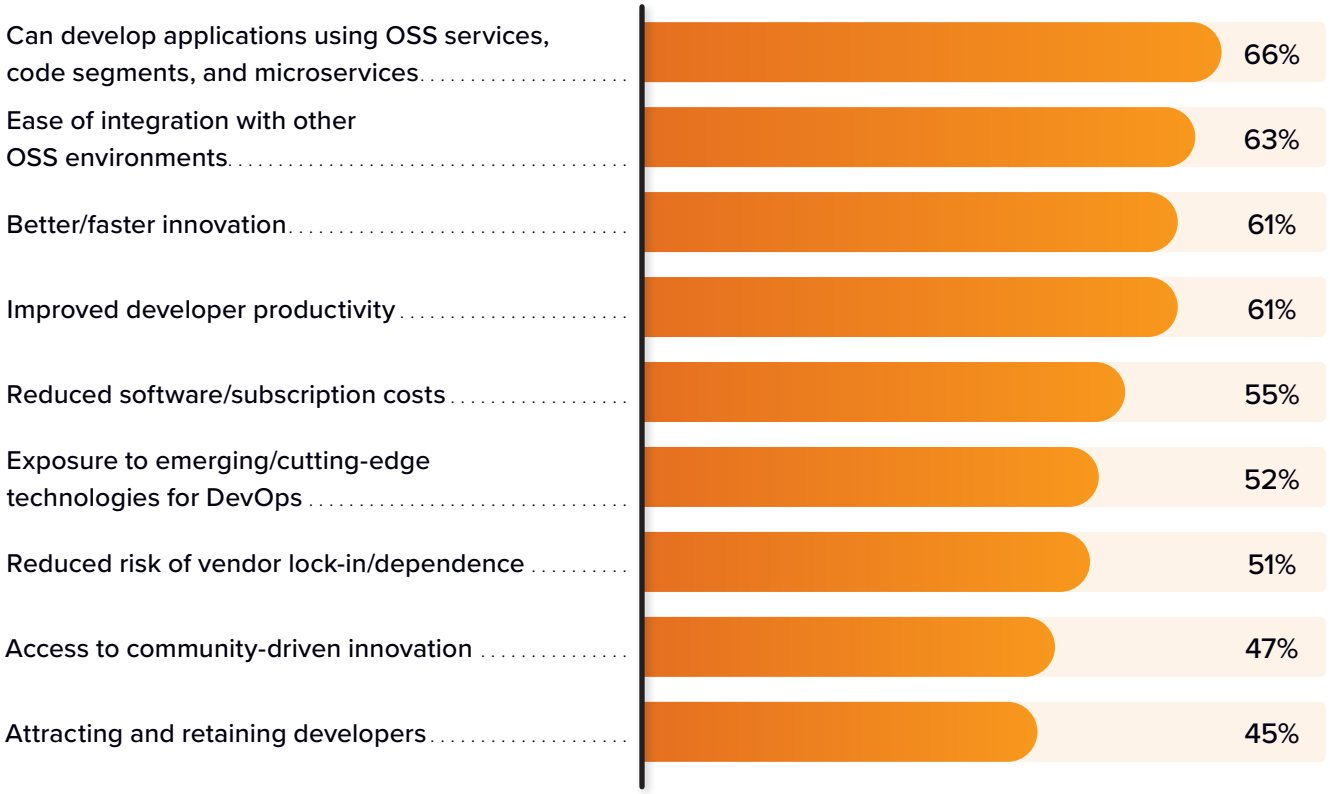
Open Source Software and Open Standards

Both open source software and open standards promote innovation, collaborative development, common ground, and an equitable playing field for developers and organizations to work together to solve critical technical challenges. Organizations of all sizes rely on open source software to create a stable foundation for building digital infrastructure and solutions. The share of companies using open source software has increased dramatically during the past five years, from about 84% in 2019 to 93% in 2024, according to IDC's *Open Source Software Use Survey* (2019–2024). Survey respondents point to a wide range of benefits resulting from their use of open source software, which provides access to components and code libraries they can use to jumpstart the development process and accelerate and improve their digital innovation initiatives (see **Figure 1,** next page).

FIGURE 1

Benefits of Open Source Software

What are the benefits your organization gets or expects it will get from using open source software?
(% of respondents)



n = 200 (all respondents); Source: IDC, *U.S. Open Source Software Use Survey,* June 2024

The enthusiasm for open source software among the experts in our focus group comes from its transformative potential for enabling innovation and transparency, which are essential to building intelligent applications. Even in organizations that lack an explicit preference for open source, developers see it as a natural choice for creating cutting-edge solutions.

Emmanuel H. emphasized how his organization leverages open source (as long as it maintains security and compliance standards):

> **We actively leverage open source tools, provided they meet our security and compliance standards. This approach allows us to benefit from community-driven innovation while maintaining high standards of security and performance."**

This statement underscores the dual advantage that open source offers: tapping into the rapid innovation of a global community while retaining stringent controls for security. Emmanuel's perspective highlights how open source allows developers to balance flexibility and safety, fostering a culture of innovation without compromising core operational requirements.

Open source software and open standards inherently promote transparency, flexibility, and customizability.

Leslie C. noted the importance of these values in the context of developing intelligent applications:

> **Due to the state of development in intelligent applications, we tend to be in favor of open source technologies, as we need the transparency, flexibility, and customizability."**

Leslie's emphasis on flexibility and customizability points to the open source ecosystem's ability to rapidly develop new tools, enabling specialized development that off-the-shelf proprietary solutions may not support. The value of open source software and open standards extends beyond technical characteristics to more business-focused benefits.

Christian M. pointed out how open source helps his company avoid vendor lock-in and reduce costs:

> **The majority of us are positive about open source technologies because we recognize the advantages, such as no/low license fees, transparency through insight into the source code, and interoperability through open standards."**

Christian's emphasis on transparency and interoperability demonstrates that open source is not merely a technical preference — it's a strategic decision that safeguards an organization's independence and operational sovereignty.

Despite the many benefits, some aspects of the open source ecosystem create inherent challenges for enterprise use. The decentralized nature of the ecosystem often makes integration complex, especially in environments where different components must work seamlessly together. The experts in our focus group pointed out that this lack of standardization often hinders developer productivity and complicates the integration of disparate open source technologies.

To mitigate these issues, Kevin T. touched on the need for greater collaboration and standardization in the open source community:

> **"If I could improve one thing about the open source community and the development of AI technologies, it would be to foster greater collaboration and standardization across projects. Standardization would enable different AI frameworks, libraries, and tools to work more seamlessly together. This would simplify integration efforts, reduce duplication of efforts, and make it easier for developers to combine components from different sources."**

Kevin's perspective highlights a crucial point of tension in open source development: The diversity that drives innovation can also create barriers to effective implementation. By advocating for more collaboration and standardization, Kevin points to the potential for greater interoperability, which could make it easier for developers to combine tools from multiple projects into cohesive solutions. This would streamline the development process and broaden the applicability of open source technologies in enterprise settings.

Open Standards for the AI Development Ecosystem

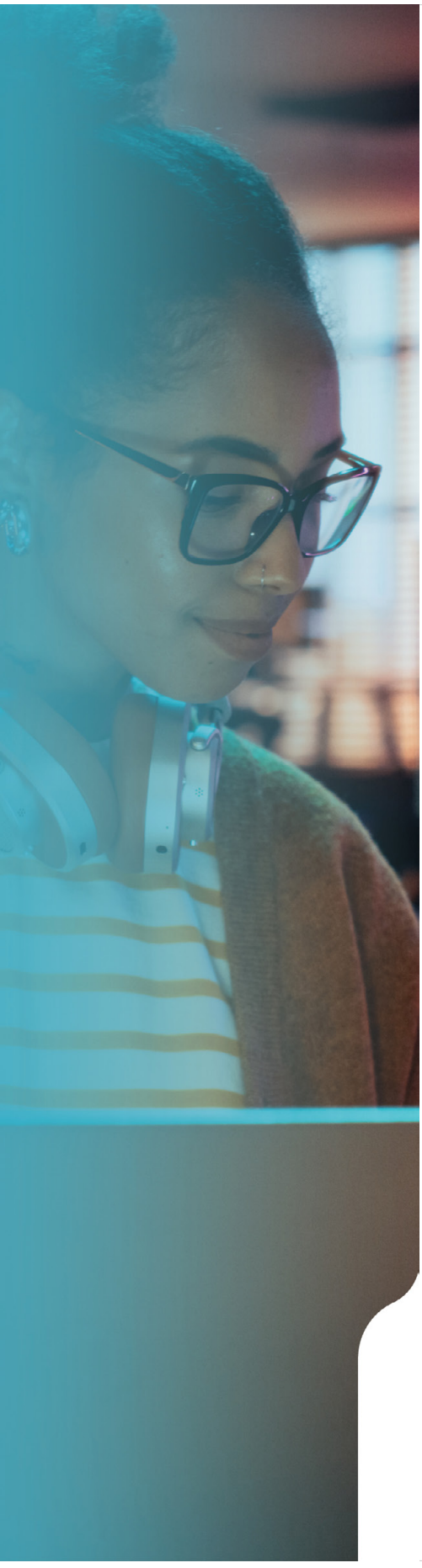
The need for interoperability between AI development tools highlights the value of open standards for this emerging ecosystem. Without access to a unified AI development platform based on open standards, the participants in our study are struggling to integrate the wide range of tools they need to build AI-powered digital solutions (see Appendix). These developers believe that open standards for AI models, frameworks, and tools would facilitate integration and streamline the developer experience.

The experts in our focus group mentioned several benefits they expect to accrue from a unified AI development platform with open standards, including:

- Rapid prototyping, testing, and iteration of new ideas
- Improved recruitment and retention of a diverse range of developers who bring new perspectives and expertise
- Enhanced collaboration among developers, researchers, and organizations to enable the development of more innovative solutions
- Fairness, transparency, and bias mitigation for GenAI models through governance tools and guardrails
- A lower risk of disruptions stemming from an individual vendor's changes to terms and licenses or discontinuation of support
- Increased ability to switch to better or more cost-effective solutions as they become available
- Reduced risk of dominance by a few vendors, which can limit the variety of available solutions and stifle innovation

Open standards have developed and thrived throughout the rise of the open source software movement, often behind the scenes, by establishing common definitions, guidelines, procedures, components, and operations for interoperable solutions to technical challenges. These initiatives have enabled the development of new ecosystems by providing a common understanding for distributed development projects and are often vital to the flourishing and survival of open and interoperable software solutions. By enabling interoperability, open standards have facilitated foundational technology platforms, such as the cell phone network (GSM, 4G, and 5G) and the internet (TCP/IP, HTTP, and HTML), while enabling vendors to compete with differentiating features, packaged solutions, and support and consulting services. For consumers, open standards help protect end users from vendor lock-in by increasing the choices available to them.

Because the development of open standards is a collaborative process involving multiple stakeholders who can identify and address potential vulnerabilities, standards-based solutions can be more transparent and secure than proprietary solutions. By supporting an open standard, tool vendors can create software that is compatible with other



best-of-breed tools, providing developers with more choice and flexibility and mitigating vendor lock-in. Open standards–based solutions can also make it easier for start-ups to participate in emerging ecosystems, such as AI development.

What Developers Want: The Benefits of an Open, Unified AI Development Platform

The participants of the focus group expressed a strong interest in a unified platform for AI development that would provide integrated access to the range of developer tools for AI. Respondents observed that an AI development platform would optimize the integration and performance of these tools.

This type of unified platform allows organizations to use best-of-breed solutions for AI development workstreams. The participants noted that the task of selecting developer tools and individually assembling an AI development platform is challenging, given the heterogeneity of contemporary developer technologies. The difficulty of selecting individual development technologies in combination with the speed of their emergence and their fragmentation across a multitude of vendors creates a unique challenge.

The focus group participants expressed frustration with the task of integrating and optimizing the wide range of AI development tools (see the Appendix for more information about the tools that experts in our study use).

An open, unified AI development platform would facilitate the integration of AI foundation models with tools for model training and development, data management and analysis tasks, and platforms for security, monitoring, and governance.

Kevin T. elaborated on this desire for an open AI development platform:

> **If I could envision the ideal developer tools in the space of intelligent applications, here's what I would imagine — Unified AI Development Platform: A comprehensive, unified platform that integrates all aspects of AI development from data preprocessing to model training, deployment, and monitoring. Seamless integration with popular frameworks (TensorFlow, PyTorch, etc.) and cloud services (AWS, Azure, GCP) for easy scalability and deployment.**
>
> **Automated machine learning (AutoML) superpowers: Advanced AutoML capabilities that automate the tedious aspects of machine learning, including feature engineering, hyperparameter tuning, and model selection. Intelligent suggestions and optimizations based on best practices and domain-specific knowledge."**

Kevin emphasized the importance of openness by highlighting the platform's "seamless integration" across multiple machine learning development frameworks and cloud infrastructures. This ability to integrate a plurality of developer tools enables developers to select best-in-class technologies from a diverse set of vendors. Kevin's comments underscore the importance of a fully managed, open infrastructure and software stack that provides developers with an integrated and optimized set of technologies for AI development.

Emmanuel H. added to Kevin T.'s comments by proposing an open development ecosystem that "integrates seamlessly across all major platforms, be it AWS, Azure, Google Cloud, or on-premises systems," in ways that "allow developers to switch between environments without any friction."

Here's how Emmanuel H. described the value proposition of an open, integrated development ecosystem:

> **This would enable us to deploy our AI models across diverse client environments effortlessly, improving our ability to provide customized solutions. Our developers would save significant time by not having to deal with compatibility issues, leading to faster delivery of projects and enhanced innovation. Even developers worldwide would experience a smoother, more integrated workflow, allowing them to focus on building and improving applications rather than troubleshooting platform compatibility issues.**

A unified, comprehensive AI development ecosystem would revolutionize the way we and the broader developer community build, deploy, and manage intelligent applications. By integrating seamless cross-platform compatibility, advanced debugging and monitoring tools, enhanced deployment and scalability options, robust security features, and generative AI enhancements, such an ecosystem would empower developers to create sophisticated AI solutions with unprecedented efficiency and ease. I'm pretty confident about that much, because this would not only accelerate innovation but also ensure that AI applications are more secure, scalable, and accessible to a broader range of industries and use cases, ultimately benefiting the entire technology landscape."

Emmanuel's remarks emphasize how an open AI platform would enhance developers' productivity by freeing them from compatibility concerns and thus empowering them to "create sophisticated solutions with unprecedented efficiency and ease." Furthermore, he highlights how an open standards–based AI development platform could make applications "secure, scalable, and accessible to a broader range of industries and use cases." Emmanuel's vision extends Kevin's by articulating the benefits of openness with respect to developer velocity, developer experience, innovation, security, and stability. He suggests that an open, unified AI platform would be transformative and have the potential to revolutionize AI and broader software development by addressing the fragmentation that developers face today.

Brandon T. underscores the importance of an open, unified AI development stack by commenting on the range of developer tools necessary to support AI development projects:

"I would love a seamless integration from data collection and preprocessing to model training, deployment and monitoring, automated workflow — tools that automate repetitive tasks such as data labeling and model selection reduce time for experimentation."

Brandon's comments highlight the importance of a platform that supports data acquisition and model-centric responsibilities, such as training and deployment. In particular, Brandon reinforces the value of developer tools that "automate repetitive tasks" specific to developer interactions with models. These remarks underscore how a unified AI development stack can streamline the AI development process.

Taranjeet S. highlights the value of open infrastructure, emphasizing compatibility across a wide range of technologies, languages, frameworks, and workflows:

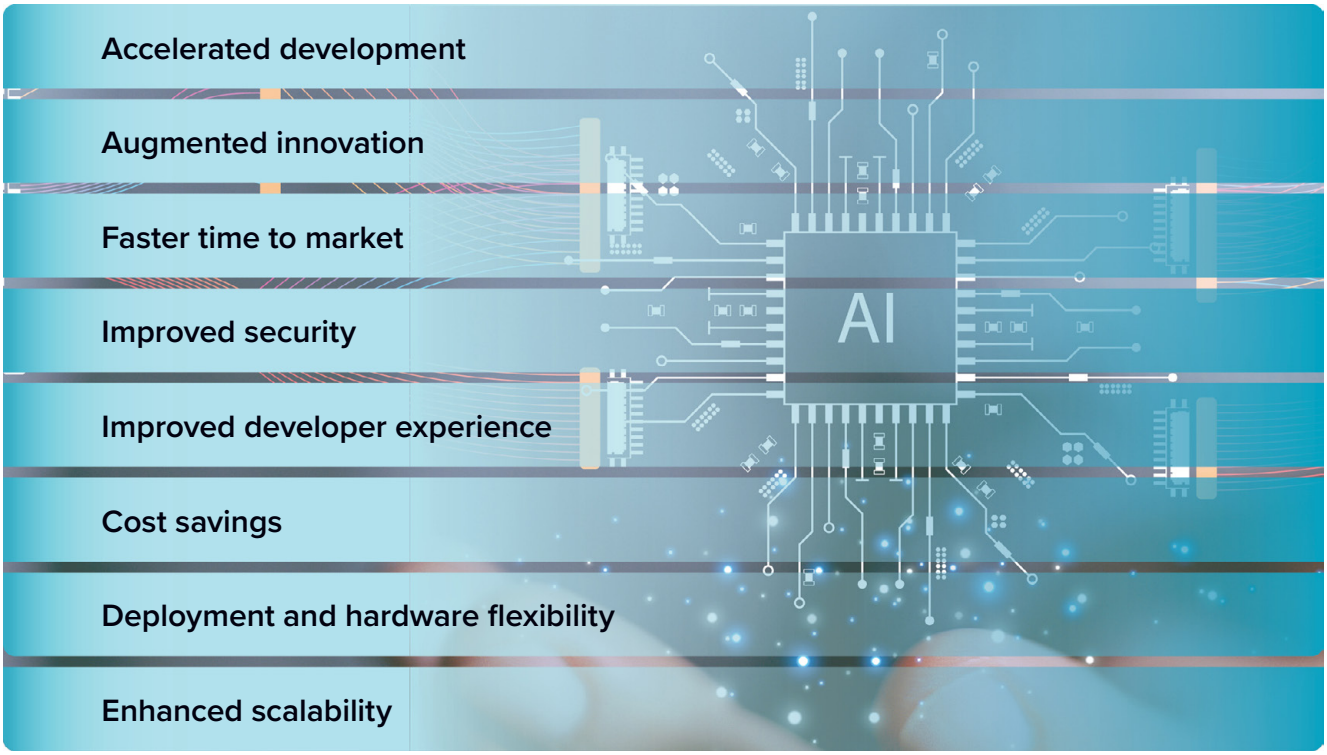
> **"I would like to have cross-platform and cross-hardware compatibility for multiple languages and framework support, seamless integration with existing workflows so that tasks can be automated easily, and scalable and cost-effective infrastructure to ensure flexible costing."**

Notably, Taranjeet emphasizes the importance of cross-hardware compatibility, pointing to the value of open infrastructures that work across CPUs, GPUs, and other specialized hardware. This open approach contributes to enhanced automation, scalability, and cost savings for developers and their organizations.

Figure 2 summarizes the benefits of a unified, open standards–based AI development platform that our focus group participants identified.

FIGURE 2

Benefits of a Unified, Open Standards–Based AI Development Platform



Source: IDC, 2024

Emerging Open Standards–Based Platforms for AI Development: The OPEA

The developers who participated in this study overwhelmingly expressed a desire for a unified AI development platform that integrates a plurality of discrete developer tools. This platform should support open, interoperable technologies to minimize vendor lock-in considerations, offer seamless integration and compatibility between and among software and infrastructure components, and include tools that multiple cloud platforms and on-premises infrastructures support. The tools should enable the automation of repetitive development tasks and address the variety of workstreams in machine learning development, such as data acquisition, data cleansing, model training, model inference, and the development and deployment of digital solutions that leverage foundation models.

The OPEA, which was founded in April 2024 as a Sandbox Project at the LF AI & Data Foundation with the mission of championing open, multi-provider GenAI systems, is developing one such AI platform. Designed as a multi-vendor, open standards–based initiative, the OPEA, which began with 15 initial members, including Intel, Hugging Face, and Red Hat, has grown to include 45 members in six months.

As of October 2024, the OPEA offers:

- A framework of microservice components that can combine to build GenAI solutions, including LLMs, data stores, vector databases, and prompt engines
- Blueprints for GenAI workflows, such as chat and retrieval-augmented generation, comprising bundles of microservices for capabilities including embedding, reranking, and guardrails
- An assessment guide for evaluating GenAI systems for performance, features, trustworthiness, and enterprise readiness

The OPEA's solutions can operate in many environments, from the public cloud to the AI PC, creating the potential for a truly interoperable AI platform, the importance of which the OPEA's members recognize:

As GenAI continues to advance, open source is playing a critical role in the standardization and democratization of the models, frameworks, platforms, and tools needed to help enterprises realize value from AI. Red Hat is excited about the potential for AI innovation for our customers through the Open Platform for Enterprise AI."

Steven Huels
VP and GM, AI Business Unit, Red Hat

While the OPEA project is an open platform with an Apache 2.0 license, it can integrate proprietary and open source components based on the user's preferences — a strategy the experts in our focus group support. The organization plans to add several more features this year, including open models for OPEA integration and OPEA-optimized compilers and toolchains. Although its development is not complete yet, the OPEA platform exemplifies the benefits of open standards that our focus group participants expressed.

Strategic Recommendations

The ecosystem for AI development tools and platforms is evolving rapidly as organizations increase their investments in GenAI-based solutions, with 25.9% of organizations having deployed GenAI solutions to production and an additional 37.6% investing significantly (*Future Enterprise Resiliency and Spending Survey Wave 7,* IDC, July 2024).

The survey respondents expect 33.5% of spending on AI development, data, and infrastructure through 2025 to go toward GenAI, compared to 37% for predictive AI and 29.5% for interpretive AI.

With this evolving ecosystem in mind, IDC offers the following strategic recommendations:

Adopt a Unified AI Development Platform Based on Open Standards

- Select core technologies with integration in mind by making interoperability a requirement when choosing core tools and platforms.

- In the case of technologies that need optimization, select interoperable tools that enable discrete technologies to function optimally together. Prioritize considerations such as security and performance when building optimizations and integrations.
- Develop a phased implementation roadmap by identifying key use cases, prioritizing critical areas, and ensuring minimal disruption to ongoing projects.
- Provide comprehensive training and support to ensure smooth adoption and effective use of the new development stack.

Foster the Open Ecosystem

- Develop policies that encourage employees to contribute to open source projects and use open source solutions.
- Create an Open Source Program Office to provide support for projects and help employees evaluate and select open source software.
- Establish an organizational policy on the use of open source software.
- Provide financial support to open source projects and maintainers through sponsorship programs.
- Commit to using and promoting open standards in all technology decisions and implementations.
- Participate in industry consortia and collaborative initiatives to influence and stay updated on emerging open standards.

Conclusion

Developers face significant challenges when integrating diverse tools and technologies for AI applications, highlighting the need for a unified AI development platform based on open standards.

The experts in our focus group, representing a range of technical roles, geographies, industry verticals, and organization sizes, independently expressed their desire for an open, integrated platform for AI development. Given that contemporary AI development often requires significant effort to ensure compatibility and optimization between and among discrete developer technologies, respondents agreed that this platform would empower developers to focus on higher-value development tasks that would drive innovation and accelerate time to market.

Open standards and open source software are crucial for fostering innovation, transparency, and interoperability, enabling developers to build more secure, scalable, and accessible AI solutions. Organizations that choose a unified AI development platform based on open standards will streamline the developer experience, accelerate innovation, and reduce vendor lock-in while maintaining access to the innovation that the open source ecosystem generates.

Appendix

FIGURE 3

Virtual Focus Group Participants

Name	Country	Role	Sector
Annie A.	U.S.	Software architect	Construction
Brandon T.	Singapore	SMB lead	Retail
Christian M.	Germany	Software architect	Manufacturing
Emmanuel H.	U.K.	Release manager	Systems integrator
Gaetano R.	Germany	DevOps engineer	Systems integrator
Ilya K.	U.S.	IT director	Education
Kevin T.	Singapore	Software manager	Financial services
Leslie C.	Singapore	Head of IT, full-stack developer	Systems integrator
Lithesh K.	India	Front-end developer	Software
Mark G.	U.S.	Software architect	Software
Paras W.	U.S.	Software architect	Software
Rajath S.	India	Full-stack developer	Financial services
Taranjeet S.	India	IT software manager	Systems integrator
Zhenhua Z.	U.S.	Test developer	Software

Source: IDC, 2024

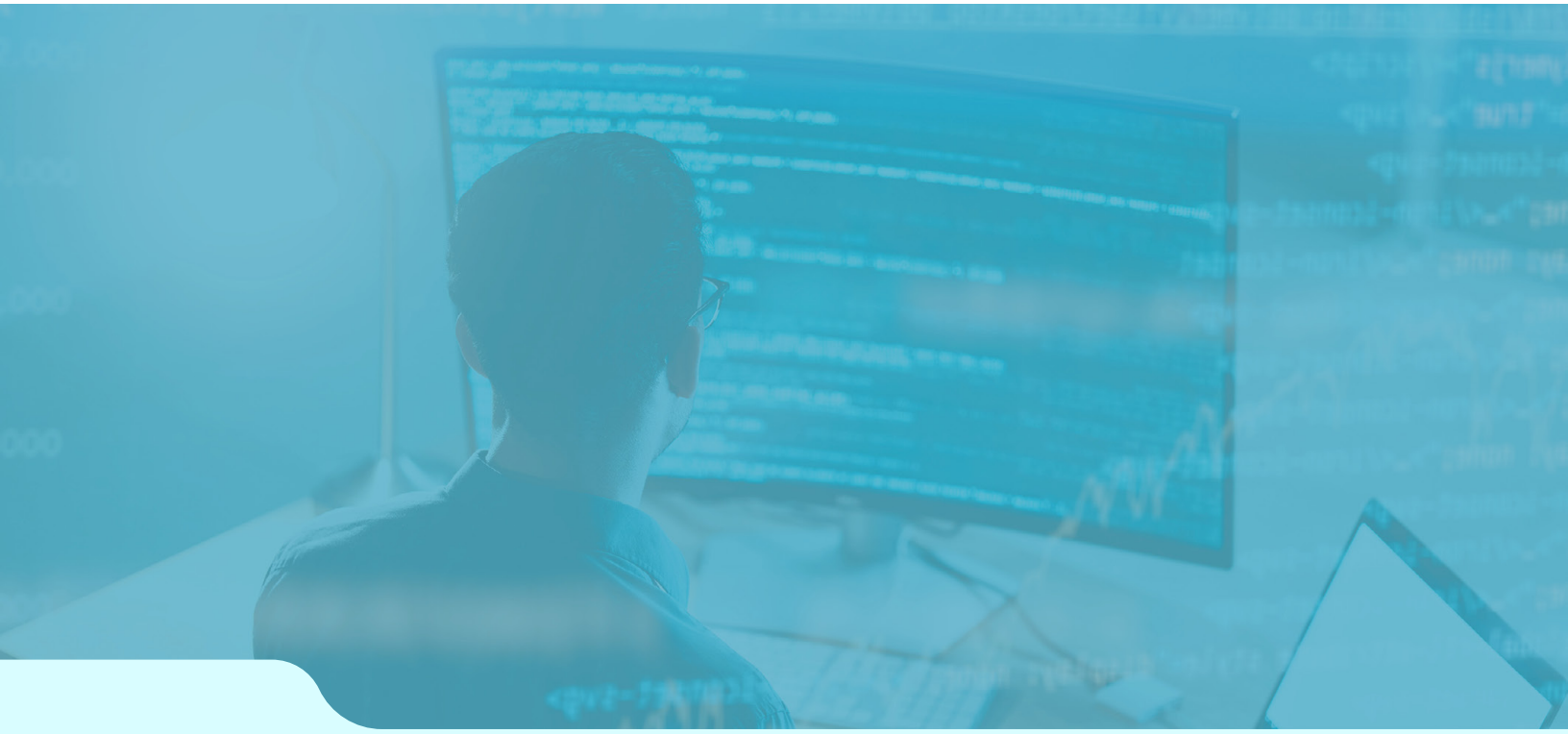
AI USE CASES

The participants in our focus group are actively developing and deploying AI-powered applications for a wide range of use cases, including fraud detection and prevention, supply chain optimization, predictive maintenance, and enterprise resource planning.

For example, Annie A. has used a combination of generative and traditional AI to build an application that helps users identify next steps in a multi-step activity.

Several participants in the study are actively building customer and employee chatbots. Mark G. has two projects: an onboarding chatbot integrated with Microsoft's Semantic Kernel and another using Microsoft's Document AI to extract pension data from PDFs. Taranjeet S. built a customer service chatbot with GPT-3 for intent recognition, which is integrated with a CRM for personalized responses. Many participants leveraged both traditional and generative AI for chatbot projects, such as Zhenhua Z., who used both approaches, which resulted in improvements.

Security analytics is another common AI use case. Christian M.'s organization uses machine learning to identify cyberthreats in real time. Emmanuel H. uses GPT-4 for security documentation and simulating cyberattacks, improving preparedness and freeing up resources for critical tasks.



AI DEVELOPER TOOLS

Participants use various tools to build new AI applications and integrate AI into existing ones. Tool integration is often challenging, particularly with tools not designed to work together. Participants cited the use of traditional and generative AI tools, open and proprietary solutions, and technologies from multiple vendors.

Coding Assistants

GitHub CoPilot was the most frequently mentioned AI coding assistant. Emmanuel H. highlighted the tool's ability to accelerate development through its code completion capabilities and code snippet suggestions. Other participants mentioned the Microsoft Azure Machine Learning coding assistant and the DeepSeekCoder open source coding assistant (Leslie C.).

Many developers use coding assistants for various tasks. Lithesh K. uses them for UI building and code refactoring, while Emmanuel H. uses them for refactoring, generating boilerplate, creating unit tests and code reviews, and accelerating development cycles. IDC's *GenAI Developer Survey* found that 90% of respondents used AI coding assistants to develop production-grade solutions in the past year (September 2024, IDC #US52577524).

Development Frameworks and Platforms

Participants use both proprietary and open source frameworks, with frequent mentions of Microsoft Azure ML, OpenAI GPT Builder, and TensorFlow. Emmanuel H. and Leslie C. also used LangChain, LlamaIndex, and Scikit-Learn. Other platforms include AWS Bedrock, GCP Vertex AI, PyTorch, and Microsoft Document Intelligence. According to IDC's *GenAI Developer Survey* (September 2024, IDC #US52578024), more than half of developers reported using a development framework that specializes in machine learning when interacting with a foundation model — the top response, ahead of foundation model APIs or an AI development platform.

Large Language Models

Participants reported using large language models, with OpenAI's GPT-4 being most common. Emmanuel H. uses it for threat detection and analysis. Other models cited include Meta's Llama-3, Google's Gemini 1.5 Pro, and Mistral AI's Mixtral 8x7B. According to IDC's *Open Source Software Use Survey,* open GenAI models represent more than half of currently deployed GenAI models, and organizations plan to use open models for more than 60% of GenAI use cases (August 2024, IDC #US52477724).

SDKs for Accelerated Compute

Kevin T. and Emmanuel H. use SDKs such as NVIDIA's CUDA for GPU acceleration, optimizing memory and workload performance. Emmanuel's organization also leverages Intel's oneAPI to optimize performance across CPUs and GPUs. Almost 70% of respondents to IDC's *Future Enterprise Resiliency and Spending Survey* (Wave 3, March 2024) have already deployed or are planning to deploy significant workloads using GPUs, DPUs, or FPGAs.

About the IDC Analysts

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Michele Rosen is research manager for IDC's Open GenAI, LLMs, and the Evolving Open Source Ecosystem practice. Dr. Rosen's research focuses on the open source ecosystem and the emerging role of open source communities in delivering and governing GenAI software and large language models (LLMs). Open source tools such as Jupyter, PyTorch, and TensorFlow have been integral to the development of generative AI, and open LLMs are beginning to play a significant role in fostering innovation and democratizing access to powerful natural language processing tools.

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Dr. Arnal Dayaratna is research vice president of Software Development at IDC. Arnal focuses on software developer demographics, trends in programming languages and other application development tools, and the intersection of these development environments and the many emerging technologies that are enabling and driving digital transformation. Arnal's research examines how the changing nature of software development relates to broader trends in the technology landscape.

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