

Unlocking the power of AI

Organisations need machine learning operations to scale their AI capabilities



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Imagine your organisation is on one side of a door, and on the other lies vast opportunities for growth. Machine learning operations (MLOps) is the key to opening that door and connecting your operations with the possibilities of tomorrow.

As artificial intelligence (AI) has grown more advanced, so too has organisations' ambition to embrace these innovative technologies. Given their expanding aspirations, the puzzle for organisations is how they can scale AI to achieve the best outcome. The answer is that organisations must adopt and implement MLOps.

MLOps is a set of practices that aims to develop, deploy and maintain machine-learning models in production, reliably and efficiently.¹

MLOps encompasses a set of processes and practises essential to the deployment and management of machine learning (ML). Without sufficient MLOps capabilities, organisations can struggle to realise the potential of AI. Indeed, many organisations still need to catch up to their target AI maturity and have yet to implement ML meaningfully because of a lack of expertise, investment and infrastructure.

To explore this topic, Deloitte surveyed professionals who are knowledgeable or responsible for data, analytics and AI within their organisations. This AI-mature demographic allowed us to gauge the perception of leadership and other knowledgeable groups on the state of AI within their organisations and the challenges they face in implementing ML. This unique sample reveals how organisations want to scale AI solutions, what is required and what technologies are being used now and planned for the future.

About this survey

Deloitte surveyed 621 key decision-makers from the fields of AI, analytics and data between May and September 2022. Industries included consumer, energy, resources and industrials, financial services, life sciences and health care, government and public services, media, telecommunications and technology. Seven countries were represented: Australia, Canada, Germany, Japan, South Africa, the UK and the US. Respondents came from the following job roles: C-Suite (for example, CTOs, CIOs, CDOs), heads of units or departments, directors or vice presidents and other specialised technical functions (for example, data architects, data engineers, data scientists, ML architects, ML engineers).

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The survey identified specific barriers an organisation must navigate to develop AI effectively, demonstrating that organisations must invest in and implement MLOps to harness the power and potential of AI.

MLOps is a cross-functional capability involving several departments cooperating to deliver value and leverage data. Collaboration occurs across all aspects of an organisation, including business product owners, data engineering, data science, IT and infrastructure, with a common goal of generating value from data-led analytical solutions.

Organisations are struggling to scale AI to reach their target level of maturity

Organisations are looking to grow their level of AI maturity quickly. By 2025, AI and ML are estimated to drive US\$4.4 trillion in business value,² with the MLOps market expected to expand to US\$4 billion.³ This desire is widespread within our sample, with 92 per cent of respondents setting a target to be industry-leading or market-leading within the next three years.

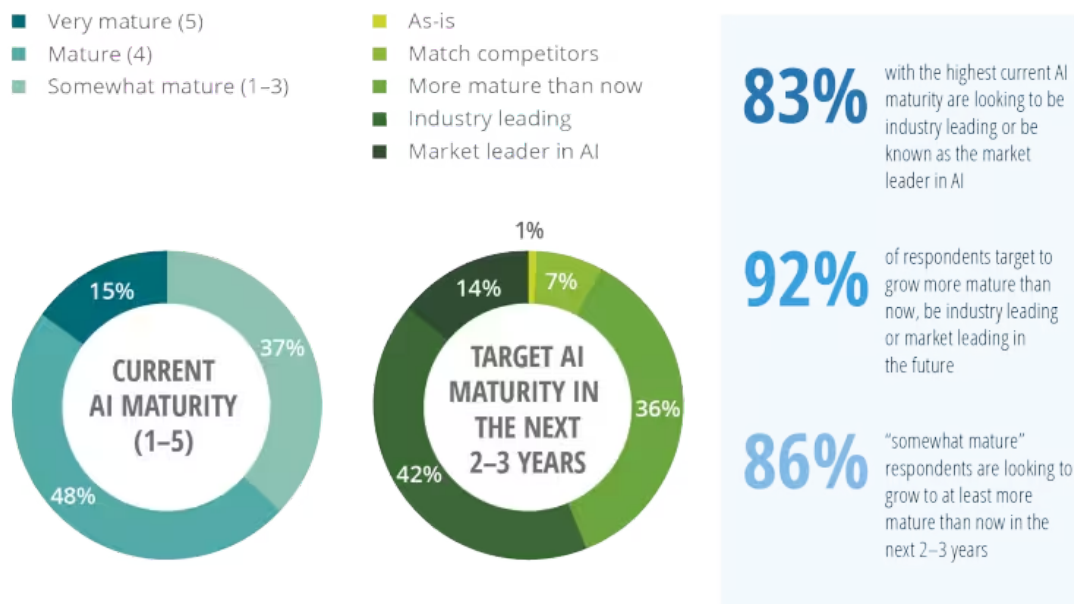
The organisation's ambitions are matched by their intention to increase their AI activities. The average number of AI activities undertaken by organisations in our sample is rapidly advancing from eight at present to ten in 2024. Moreover, 31 per cent of respondent organisations indicated that they planned to undertake more than 11 AI-related initiatives within the next three years.

However, while many organisations desire to be industry-leading or market-leading in AI, the data shows that this will require significant improvement from their current state. Only 15 per cent of organisations currently rate their AI maturity as very mature (figure 1).

FIGURE 1

High growth ambitions for AI maturity

Questions asked: How mature would you rate your organisation in terms of its AI maturity level from 1 (lowest) to 5 (highest)? How mature do you want to be in the next 2–3 years?



Source: Deloitte analysis.

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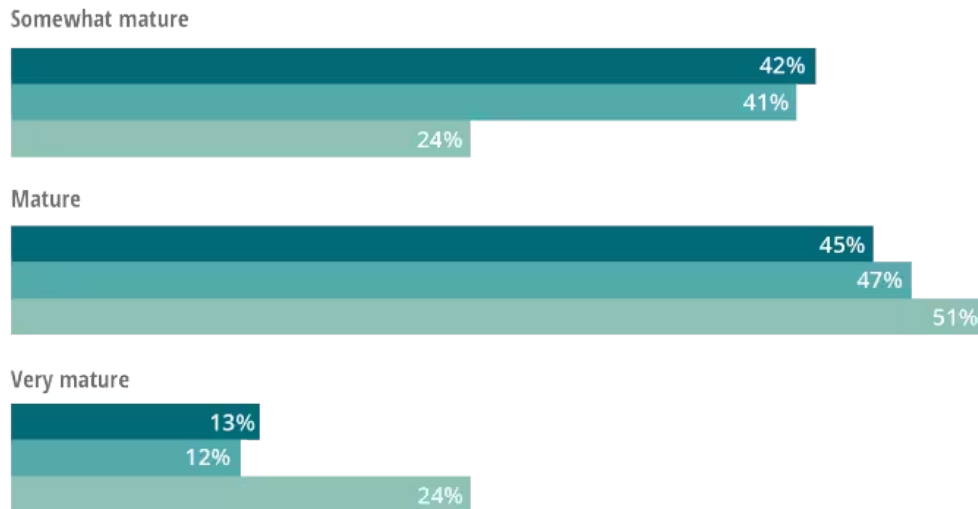
For this increase in AI maturity to occur, organisations must ensure they are prepared to negotiate complex barriers and implement adequate MLOps processes and tools. We also see a variation in the perception of an organisation’s current AI maturity between the C-suite and more technical roles (figure 2).

FIGURE 2

C-suite are the most ambitious about current AI maturity

Question asked: How mature would you rate your organisation in terms of AI?

■ Highly technical roles ■ Head of business unit/department/director/VP ■ C-suite



Source: Deloitte analysis.

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Comparing the responses of the current AI maturity of respondents' organisations indicates the C-suite to be more optimistic in their AI-maturity perception than those in highly technical or business leadership positions. Those in highly technical roles are the least likely to view their organisation as mature or very mature. This highlights the need to form a unified perspective on the level of AI maturity at an organisational level and educate senior leaders on MLOps. The C-suite must find the right balance between ambition and understanding the reality of the organisation's current state.

The critical importance of MLOps

If organisations are to scale AI and reach their target maturity, there are several barriers to overcome. Productionalisation is one issue – organisations can no longer rely on manual processes to bring ML to life.⁴ Instead, they need an automated, efficient and scalable approach. MLOps has emerged as a response to this problem and the growing complexity and diversity of ML systems. It is an essential requirement for organisations utilising AI, automating processes and operations and accelerating the ML model's life cycle.

The fundamental principle behind MLOps is consistency, and a repeatable approach for AI-solution builds. MLOps capability creates the end-to-end pipeline and architecture that helps data scientists, ML engineers and other developers experiment and rapidly deploy models in production. It creates a culture of software engineering and continuous integration and continuous delivery (CI/CD) principles to help organisations scale AI solutions into production. The robust model governance framework defined by MLOps capability ensures confidence around the models in production and their impact on customers.

The AI landscape is fast-moving. As the next generation of AI comes to the fore, the importance of MLOps is heightened. Only organisations with advanced MLOps capability can take advantage of the most sought-after AI algorithms. The data shows organisations' strong motivation to explore more complex approaches to AI, such as deep-learning techniques like reinforcement learning and generative models, to realise previously untapped sources of value. Of the sample, 41 per cent plan to use generative models next year and 42 per cent plan to use reinforcement learning. As new techniques and algorithms emerge, so do potential use cases and value for organisations.

Our research identified several barriers organisations must navigate to scale AI. Overcoming these challenges will ultimately allow organisations to grow their AI capabilities.

Mastering data transformation and management

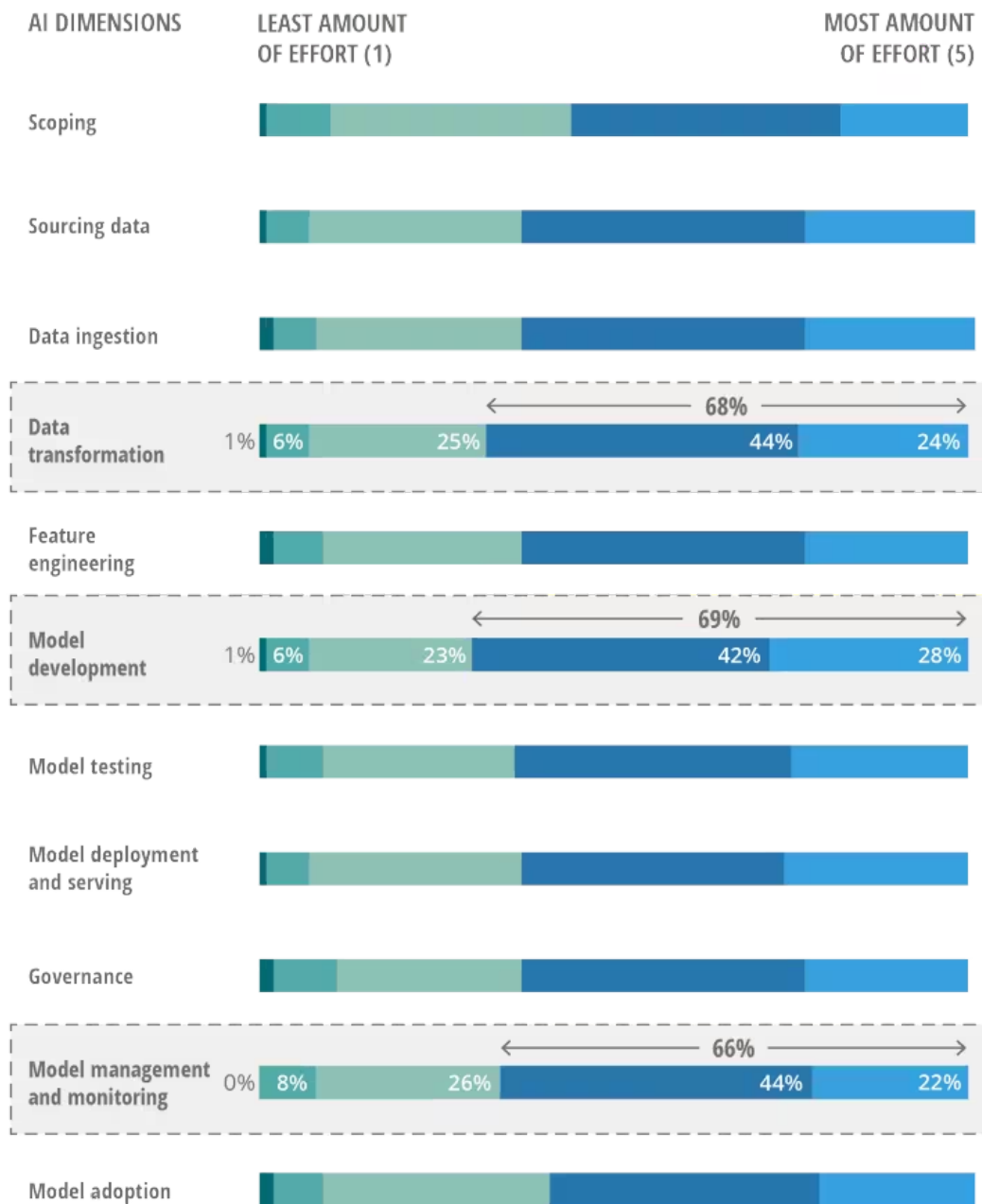
Data transformation is a critical aspect of ML. To fully deploy ML, data needs to be in the correct form. ML requires large amounts of data to be effective, and it is time-consuming to collect, manage and store. Indeed, the majority of respondents indicated that the AI dimensions requiring the most effort are model development, data transformation and model management and monitoring (figure 3).

FIGURE 3

Effort spent on AI productionalisation

Question asked: Within the time selected above, how much effort is spent on the following?
Please rank from 1 (least amount of effort spent) to 5 (most amount of effort spent).

■ (1) Least amount of effort ■ (2) ■ (3) ■ (4) ■ (5) Most amount of effort



Source: Deloitte analysis.

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AI models require high-quality data that are well-governed and properly transformed, which can be challenging in practice. Often well-established businesses, like those in the financial services industry, have significant amounts of data stored in legacy formats. This makes it difficult to integrate and use in modern ML models.

For example, traditional forms of enterprise data in databases, files and systems with unstructured text are difficult to utilise.⁵ Data used for ML models is complex and messy in some organisations, with missing values, outliers and other anomalies. Data transformation involves cleaning and pre-processing this data, which can be time consuming.

The potentially sensitive nature of data can compound this problem, as organisations must take extra steps to ensure that their data governance is adequate. Where data is sensitive, organisations need to balance the need for performance with security and confidentiality. Model development, training and maintenance also require effort and are time-consuming for large data sets or complex models. Monitoring model performance is a critical but time-consuming step to evaluate accuracy and reliability continuously.

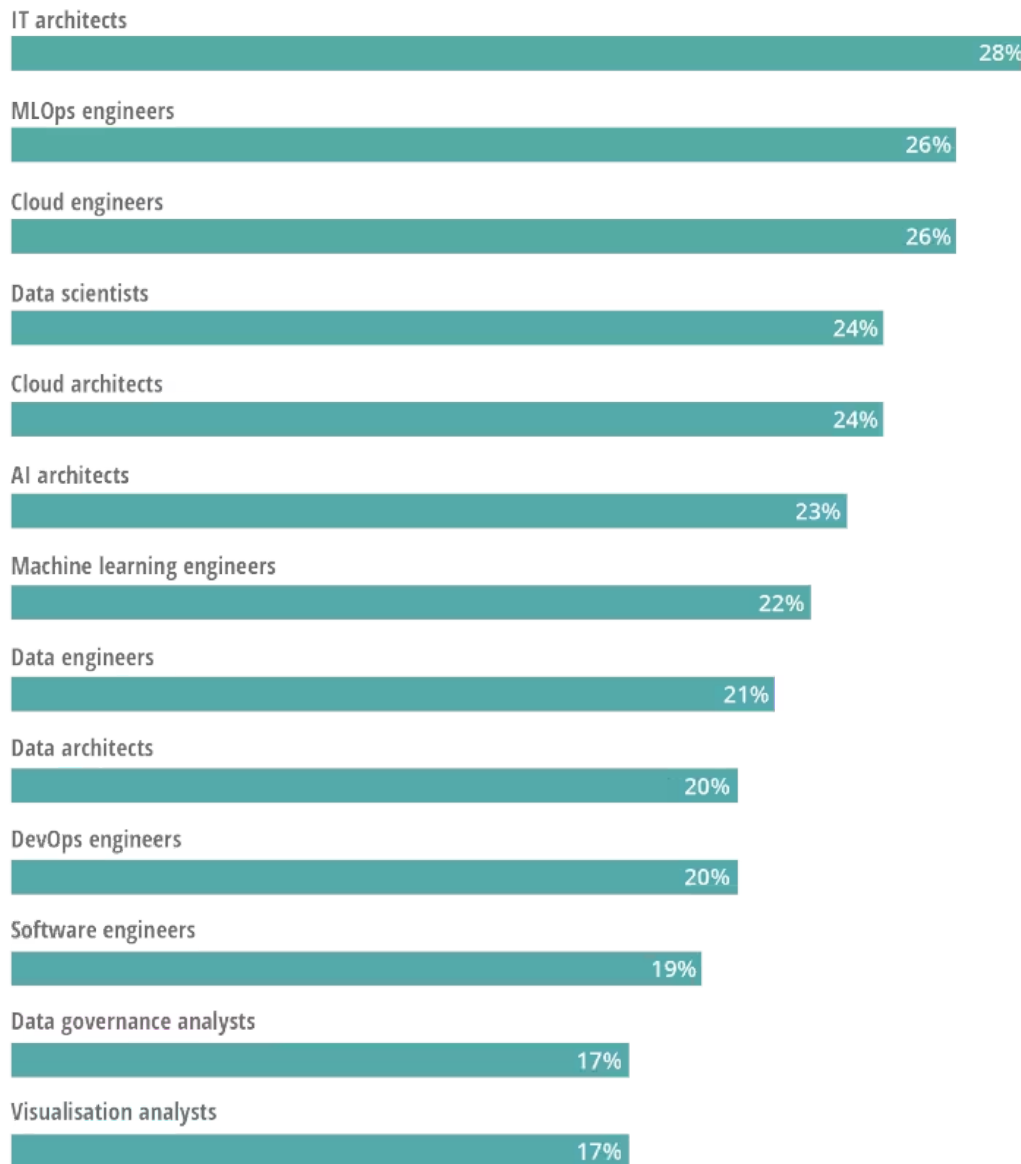
Organisations need expertise to engineer the solution and supporting culture

MLOps is a new field, and many organisations lack staff with the necessary skill sets (figure 4). Demand for technical talent will likely persist in the next five years with demand for MLOps engineers and IT architects across industries expected to be particularly high.

FIGURE 4

There is a demand for a range of roles

Question asked: What skillsets are you currently missing and when are you looking to hire these?



Source: Deloitte analysis.

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Our data shows that 26 per cent of organisations are missing MLOps engineers and 28 per cent need more IT architects. This demonstrates a gap in the technical skill sets required to develop MLOps to scale AI capabilities.

Organisations must recognise the specialist skills required. Business buy-in was identified as an obstacle to reaching an organisation's target AI-maturity rate. Yet, 85 per cent of survey respondents who saw this as an obstacle did not select budgetary challenges as an obstacle.

This suggests the buy-in issues that respondent organisations are facing are predominantly non-financial. It also indicates that the top-performing, highest-revenue AI-mature organisations have a strong culture around MLOps, and a shared understanding of the success and value it can bring.

A cultural shift is required among business leaders to redesign business practices to incorporate MLOps capability across all aspects of business operations, not just single-use cases. Understanding the value of MLOps must stretch across those in technical and leadership roles.

C-suite leaders should recognise the unlimited potential for augmenting human capabilities with ML through developing MLOps. Leaders should focus on scaling AI to achieve greater maturity levels to harness the vast potential for business and customer applications. A highly skilled and collaborative workforce is essential to unlocking the possibilities.

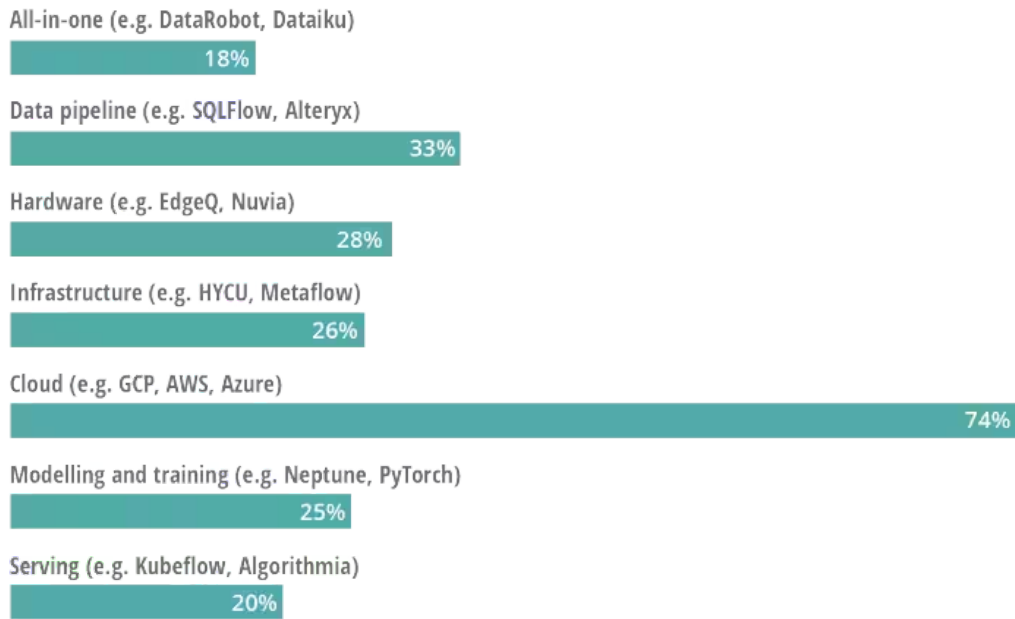
Lack of investment hampering MLOps technologies in organisations without proper infrastructure

Many technologies are available to organisations who want to invest in MLOps capability. Despite the wide usage of cloud services among organisations (figure 5), implementing other technologies like all-in-one and other specialist MLOps platforms are also being explored. However, they still lag behind the rate of adoption required, given most respondents focus on AI.

FIGURE 5

Implementation of all-in-one and serving platforms yet to be explored

Question asked: What technologies are you using?



Source: Deloitte analysis.

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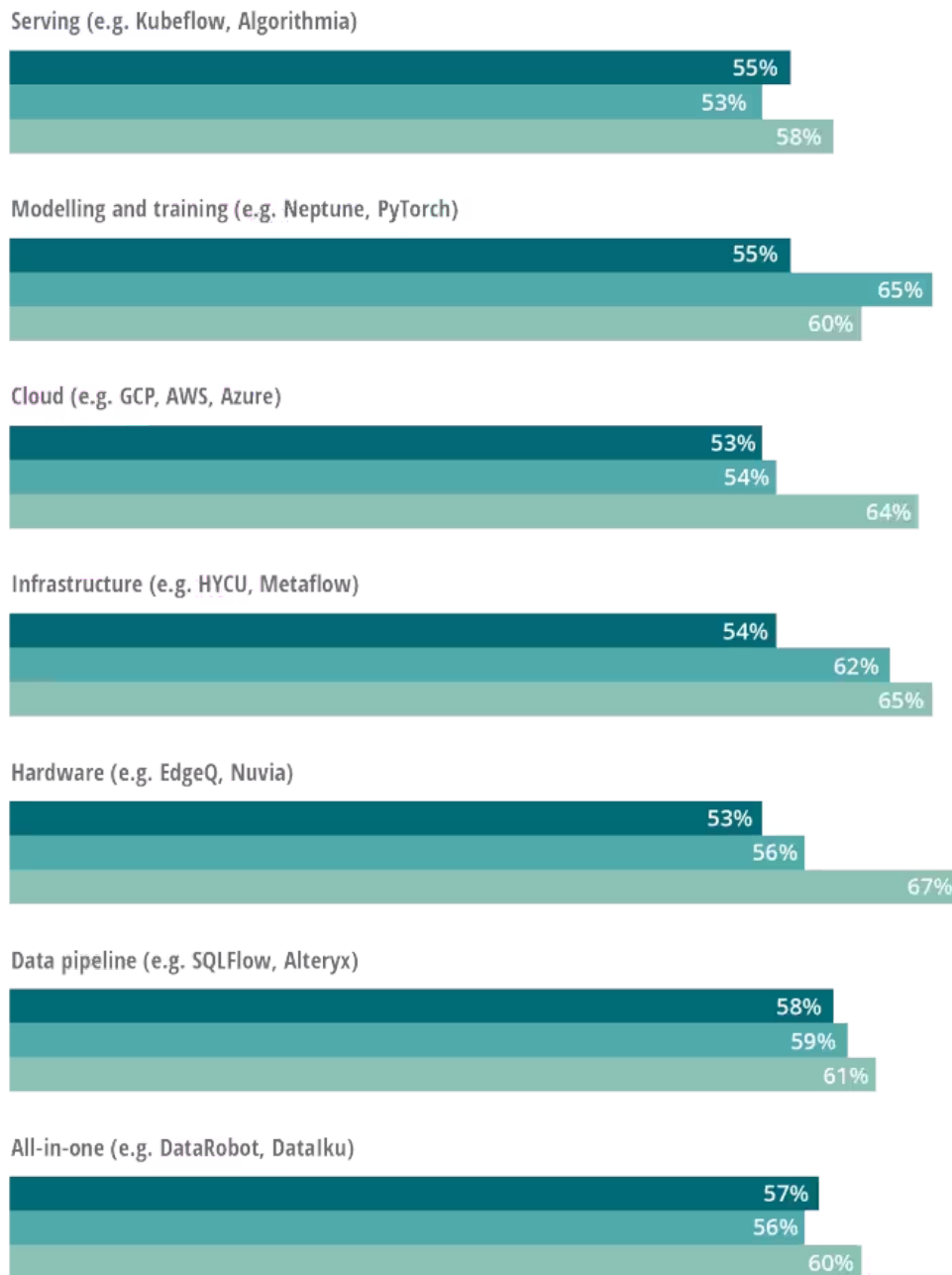
Most respondents continue to invest in cloud-native MLOps technologies, as cloud is already embedded with MLOps capabilities in place. However, we see a shift towards investing in specialised MLOps technologies (figure 6).

FIGURE 6

Plans to invest in a wide range of technologies

Question asked: What technologies are you looking to invest in the next 1–3 years?

■ Highly technical roles ■ Head of business/department/director/VP ■ C-Suite (e.g. CTO, CIO, CDO)



Source: Deloitte analysis.

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Organisations are overwhelmingly planning to invest further in a wide range of technology in the near future. The survey saw deviations between positions suggesting that leadership respondents are more ambitious with their investment time frames. C-suite executives are 14 per cent more likely than those in highly

technical roles to plan to invest in MLOps hardware in the next three years. This highlights the necessity of aligning investment priorities across roles.

MLOps requirements are increasing as AI and ML advance

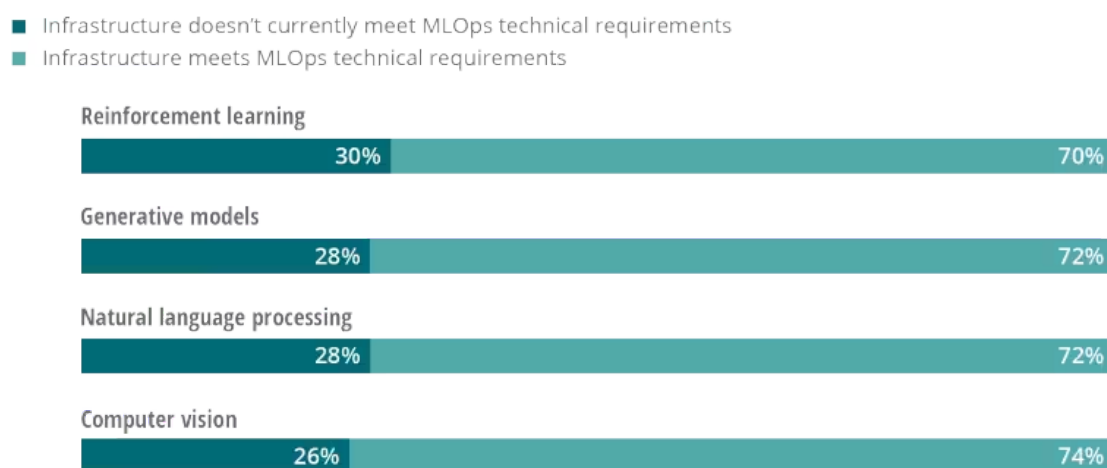
The most sought-after AI algorithms that respondents plan to use in the next year are deep-learning techniques such as reinforcement learning and generative models. This greater complexity in AI technology usage demands increasingly complex infrastructure capabilities.

Despite strong ambition and optimism, organisations must simultaneously ensure that their infrastructure – and current MLOps capabilities – can handle this evolution. Of the respondents planning to use newer algorithms in the next year, on average, 28 per cent stated their ML infrastructure doesn't currently meet their technical requirements (figure 7). Appropriate investment and evolution of the infrastructure and MLOps capability are needed to address this lag.

FIGURE 7

Organisations need to ensure their infrastructure and MLOps practices can handle next-gen AI

Questions asked: Does your current infrastructure meet your MLOps technical requirements?
What AI technologies are you currently using or planning to use?



Source: Deloitte analysis.

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However, most respondents ranked legacy technology infrastructure as one of the top three challenges, behind data and technical limits, and high investment costs.

This was particularly noticeable in the technology, media and telecom (TMT) industry, which has the highest current use of next-gen AI at 51 per cent so this is a widespread barrier across all sectors (figure 8). Transitioning out of a legacy system can be costly and time-consuming, but it is needed to evolve into a more AI-mature organisation.

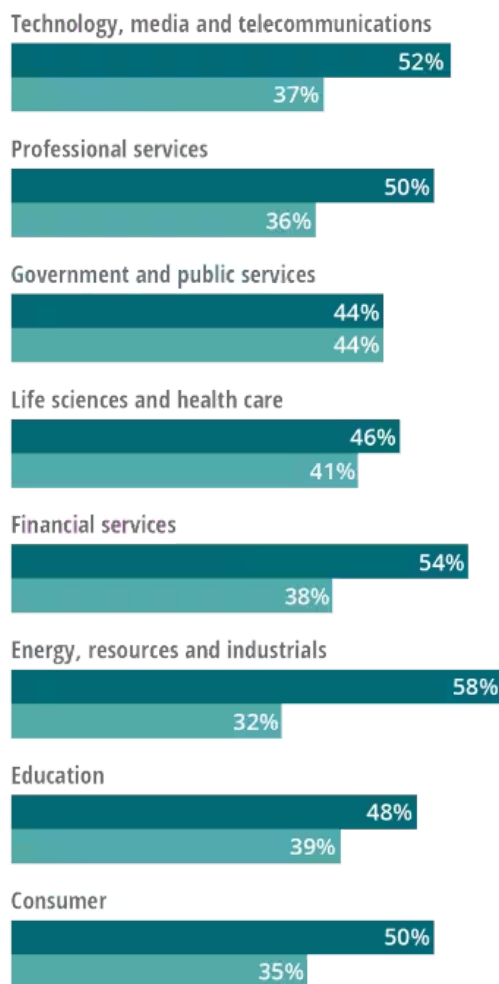
FIGURE 8

Industry breakdown for AI technology use

Question asked: What AI technologies are you currently using or planning to use?

■ Currently using
■ Planning to use in next year

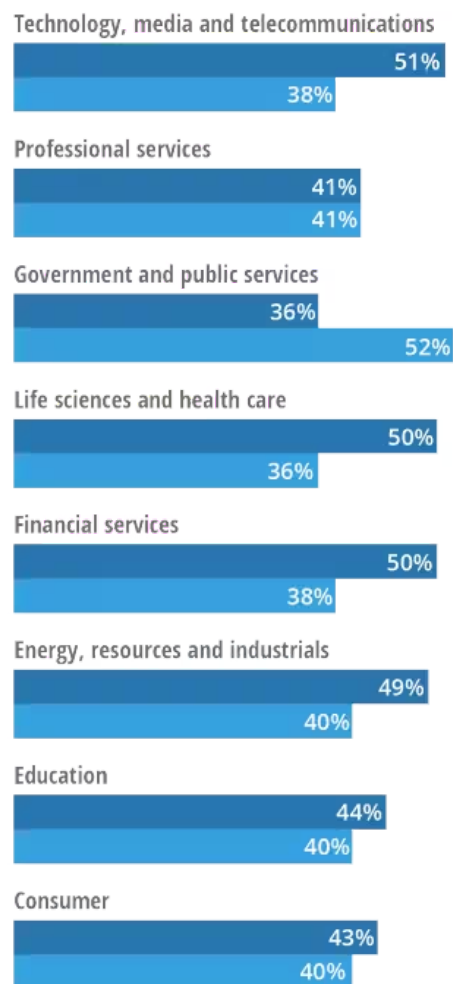
CLASSICAL ML



Classical ML = Supervised/unsupervised classical machine learning and forecasting

■ Currently using
■ Planning to use in next year

NEXT GEN AI



Next-gen AI = Generative models, natural language processing, computer vision and reinforcement learning

Source: Deloitte analysis.

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This is significant because organisations fail to recognise the critical importance of having the necessary infrastructure to not only deploy AI but also to prevent an AI system failure. A system failure can have significant consequences. Although 73 per cent of respondents say the material impact of an AI system failing is important, 27 per cent acknowledge their current AI infrastructure does not meet the required MLOps demands.

The sector most affected by this is government and public services. A significant 36 per cent from this sector say their current infrastructure does not meet their current MLOps technical requirements – the highest proportion of responses.

In financial services, two in three large organisations (>US\$5 billion) report their current infrastructure does not meet requirements. Large financial services organisations must update their ML infrastructure to prevent a system failure that could have material consequences and reputation damage. Yet, the advantages and growth opportunities from MLOps are for every organisation, regardless of size.

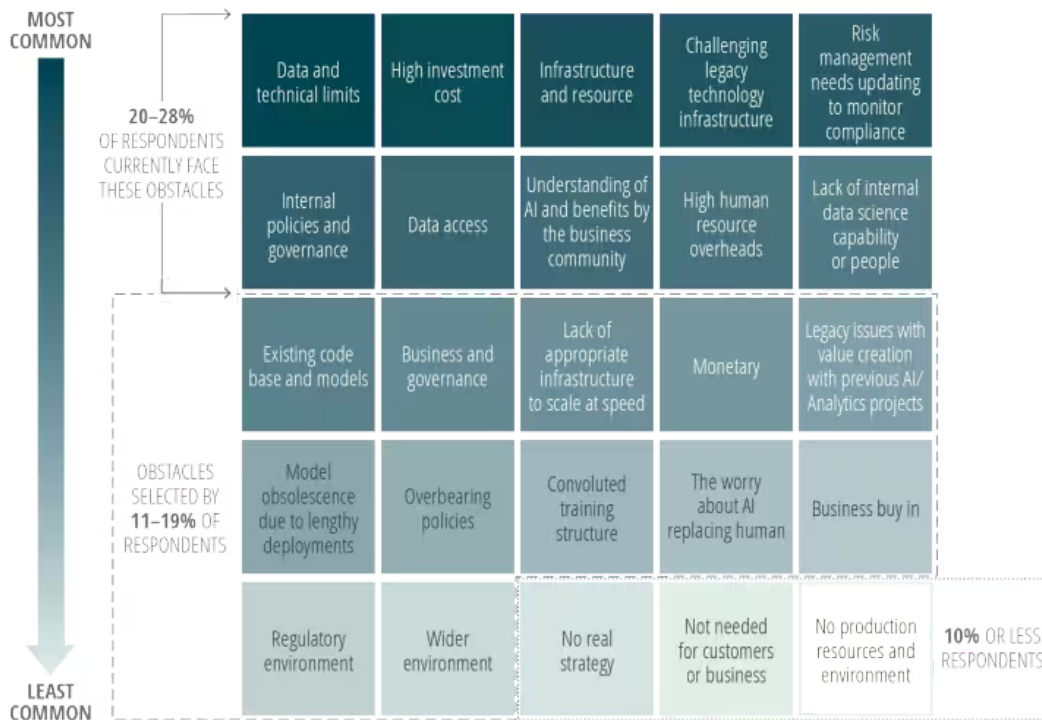
Do not underestimate the regulatory environment

The regulations around AI and ML are rapidly evolving, and business leaders need to be aware of the importance of compliance. The survey found that one of the least commonly selected and lowest ranked obstacles to achieving AI-maturity target state among respondents was the regulatory environment – it was the seventh lowest ranked obstacle when measured by weighted average (figure 9).

FIGURE 9

Challenges organisations face are fairly distributed across technical, resource and business obstacles

Questions asked: What are your obstacles to achieve your AI maturity target state?
Please rank the top 5 obstacles your organisation is facing out of all the ones you have selected above?



Source: Deloitte analysis.

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This suggests that organisations are far more concerned with technical costs and resource-related challenges than the regulatory environment and do not see this obstacle as significant when it comes to reaching their target AI-maturity state. However, with the shifting regulatory landscape – including the proposed EU AI Act, the UK National AI strategy and the Data Protection and Digital Information Bill – any MLOps strategy must recognise the importance of the regulatory environment.

This fosters trustworthy AI, embeds governance and trust at all stages and ensures MLOPs capability deploys ethical and fair AI to mitigate risk. The regulatory landscape is a crucial part of strategic decision-making for compliance and to prevent regulation from potentially stifling innovation.

Managing the regulatory environment through an MLOps framework has the potential to spark new use cases while putting in place safeguards for consumers,

society and organisations. Robust regulatory adherence can be streamlined using MLOps and increase confidence and reduce risks for investors.

Opportunities from investing in MLOps and scaling AI capabilities

It is difficult to overstate the gains available from investing in MLOps. The benefits of the investment in MLOps capabilities are reflected in all aspects, from improving employee productivity and providing better products and services to reducing production time and costs and, ultimately, a financial return on investment (ROI). Organisations that implement and enforce MLOps are twice as likely to achieve their goals.⁶

One of the most substantial gains of implementing MLOps capability is that it forms the backbone that allows organisations to utilise the most recent ML technologies. In many ways, organisations are restricted only by their imagination – technological advancements have the potential to radically redesign how we work and create knowledge. MLOps is essential to unlocking its power.

MLOps capability can also reduce the ethical and regulatory concerns surrounding the use of ML. One of the biggest challenges that surround ML is the lack of explainability. By utilising explainable ML tools and monitoring ML models, MLOps tools can help determine the reason a specific output has been generated and reduce the ‘black box effect’. This is important for cases where bias has arisen in the data. MLOps capability can help to determine how a specific outcome has been generated, allowing the system to be amended accordingly and embeds governance.

Significantly, MLOps capability can prevent system failures by being able to triage and find a solution immediately. Most of the sample indicated how important an AI system failure would be, yet they do not have infrastructure that meets the required MLOps demands. MLOps is essential to preventing systems failure – given the potential magnitude of a failure, it is clear how important it is to take every step to mitigate them.

The data also suggests that AI can aid workers in their roles and increase efficiency. Of those surveyed, 69 per cent report that employee productivity is enhanced. Organisations willing to invest the resources to implement a robust MLOps framework with a trained workforce will enjoy a future not constrained but open to the possibilities of the next generation of AI technologies.

MLOps capability can also improve the customer experience while creating new growth opportunities. Data revealed that 66 per cent of respondents suggested relationships with clients and customers are strengthened and 70 per cent reported gains from MLOps through newly created or enhanced existing products and services.

These advantages ultimately manifest in a significant ROI. The average ROI from investment in MLOps technology is 28 per cent in the sample but can reach as high as 149 per cent. Notably, there was no significant variance in ROI uptake from MLOps technologies between respondents from lower-revenue and higher-revenue organisations, highlighting the importance of MLOps investment, regardless of annual revenue.

In addition, respondents from lower-revenue organisations reported a higher percentage of shorter-term ROI realization than higher-revenue respondents. Almost half of the responses from the US\$250 million or less categories answered that their organisation realised ROI uptake within two years. Given the scalability of MLOps systems, it is probable that once an organisation has implemented MLOps for one use, future use cases will see faster ROI.

Conclusion

AI is developing rapidly, and emerging technologies will be harnessed by ambitious organisations ready to scale their AI capabilities and meet the challenge with MLOps. Organisations should aim to develop the greatest possible MLOps capability by overcoming key barriers of data transformation, lagging infrastructure and lack of investment.

Organisations must also recognise the importance of the regulatory environment, with MLOps minimising risk and consequently boosting the confidence of consumers and investors. ML expertise and talent are vital to benefit from the many gains, but organisations must act now. MLOps holds the key to unlocking the enormous potential of AI and leading organisations into future growth.

+ Endnotes

1. Deloitte, [The part of MLOps less talked about: Successful operationalisation of machine](#)

[learning at scale requires more than just technology](#), accessed 3 April 2023. [View in Article](#)

2. Bergur Thormundssen, “[Business value created by artificial intelligence \(AI\) technology worldwide from 2017 to 2025 \(in trillion US dollars\), by type](#),” Statista, 17 May 2022. [View in Article](#)
3. Deloitte Dbriefs Webcast, “Designing emotionally intelligent human experiences,” Deloitte, 9 January 2020. [View in Article](#)
4. Deloitte Insights, [Tech Trends 2023: The technology forces shaping tomorrow](#), accessed 3 April 2023. [View in Article](#)
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Cover image by: **Mark Milward**

About the Deloitte AI Institute

The Deloitte AI Institute helps organisations connect all the different dimensions of the robust, highly dynamic and rapidly evolving AI ecosystem. The AI Institute leads conversations on applied AI innovation across industries, using cutting-edge insights to promote human-machine collaboration in the Age of With™. The Deloitte AI Institute aims to promote dialogue about and development of artificial intelligence, stimulate innovation, and examine challenges to AI implementation and ways to address them. The AI Institute collaborates with an ecosystem composed of academic research groups, startups, entrepreneurs, innovators, mature AI product leaders and AI visionaries to explore key areas of artificial intelligence including risks, policies, ethics, future of work and talent, and applied AI use cases. Combined with Deloitte’s deep knowledge and experience in artificial intelligence applications, the institute helps make sense of this complex ecosystem

and, as a result, delivers impactful perspectives to help organisations succeed by making informed AI decisions.

To dive deeper into the survey related data and insights, reach out to the [AI Institute](#).



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