Survey Analysis: AI Adoption Spans Software Engineering and Organizational Boundaries

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Initiatives: Applications and Software Engineering Leaders

Survey results show increasing use of artificial intelligence and machine learning models in applications, but developers are just beginning to acquire ML skills. Software engineering leaders should plan for increasing use of AI and ML models, and encourage their developers to learn these skills.

Overview

Key Findings

For companies investing in artificial intelligence (AI) in support of newly acquired or custom-built applications and software:

- The majority of enterprises surveyed are using AI and machine learning (ML) models in their applications.

- The organizational structure for data science teams in the enterprise is not consistent, with teams reporting to a range of business units.

- Development teams are beginning to acquire ML skills, but most development teams are in the early stages of this skill acquisition.

Recommendations

For software engineering leaders investing in AI, in association with newly acquired or custom-built applications and software:

- Plan for increasing deployments of AI and ML models in the applications you are developing, and coordinate the management of ModelOps and DevOps pipelines with the data science teams in your enterprise.
- Ensure that a competent approach to ML is consistently applied by coordinating the building and management of AI and ML models with the data science teams, regardless of where they reside in the organization.

- Optimize the support and use of ML models built internally and models built using autoML services by accelerating the acquisition of ML skills among development teams.

**Strategic Planning Assumption**

By 2025, 70% of new, internally developed applications will incorporate AI- or ML-based models.

**Survey Objective**

This survey was deployed to understand the use and impact of AI and ML models in new, internally developed applications, the skill level of enterprise developers and where the data science teams report in the enterprises. It was conducted online from 20 July 2021 through 12 August 2021, with 111 respondents from Gartner’s ITL Research Circle — a Gartner-managed panel. Thirty-six were from an external sample. For more details, see the Methodology section.

**Data Insights**

Collectively, this research reveals that the use of AI and ML models in applications is growing rapidly, but the development resources needed to support these efforts are only just emerging. Additionally, data science resources are often deployed in different parts of the business from where the development teams reside, which complicates effective collaboration on software-embedded ML development.
The Majority of Enterprises Surveyed Are Using AI and ML Models in Their Application Development

**Context:** The Gartner 2021 CIO Survey revealed that AI/ML ranked as the top game-changer technology, with 25% of CIOs citing these combined. However, these technologies do not exist in isolation. The AI and ML models that are built must be deployed, and often these models can be implemented with API access that allows them to be incorporated into applications. One objective of the Application Innovation Implementation Survey was to determine the degree to which enterprises are incorporating AI and ML models in applications.

**Hypothesis:** Software engineering leaders and software engineers have only limited adoption of AI and ML models in application development, but are increasing their use of both.

**Question:** To what degree are software engineering teams in your organization incorporating AI and ML models into application and software development?

**Finding:** The use of AI and ML models in applications is more widespread than many would imagine, as noted in Figure 1 below. While 16% of organizations have no use of AI and ML during application development, 43% have moderate to extensive use, while another 41% of software engineering teams have limited use of these technologies.
Figure 1: Use of AI and ML in Application Development by Software Engineering Teams

**Use of AI and ML in Application Development by Software Engineering Teams**

<table>
<thead>
<tr>
<th>Percentage of Respondents</th>
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<tbody>
<tr>
<td>Extensive Use of AI and ML Models in the Applications We Develop</td>
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<tr>
<td>Moderate Use of AI and Machine Learning Models in the Applications We Develop</td>
</tr>
<tr>
<td>Limited Use of AI and Machine Learning Models in the Applications We Develop</td>
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<tr>
<td>No Use</td>
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43% of Organizations/Software Engineering Teams Make Moderate to Extensive Use of AI and ML Models in App Development

- n = 109 All respondents confident about adopting or using AI application innovations; Excluding “Unsure”
- Q. To what degree are software engineering teams in your organization Incorporating AI and ML models into application and software development?
- Source: Gartner 2021 Application Innovation Implementation Survey
- Note: Gartner’s IT & Business Leaders Research Circle members and External Sample
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**Analysis**

The results of the survey exceeded our expectations regarding the use of AI and ML by software engineering teams. We expected that, at this time, a smaller proportion of teams would be using AI and ML in their application development. The fact that 43% of enterprises had moderate to extensive use of AI and ML in application development was greater than we expected. The fact that 11% of enterprises have extensive use of AI and ML was even more surprising. A driver for increased adoption may be the availability of cloud-hosted AI and ML capabilities (e.g., facial recognition, Y and Z), which simplifies and accelerates adoption of this innovation even among software developers with limited subject matter expertise.

Our findings emphasize the importance and urgency of developing these skills in software engineering organizations. For software engineering leaders who have not yet begun to incorporate AI and ML models into their application development efforts, this should serve as a call to action. AI and ML will have demonstrable impacts on the way that businesses operate in the future and this fact should not be underestimated.
Recommendations

For software engineering leaders:

- Remain competitive by accelerating the use of AI and ML in your applications for well-understood AI and ML use cases, even if the applications make limited or no use of these technologies.
- Avoid confusion and duplication of effort by coordinating with data science teams in the enterprise to determine responsibilities and overlaps. This is critical to the success of these efforts.

Diverse Reporting Structures Will Challenge Both Development and Data Science Teams in the Use of AI and ML Models in Applications

- **Context:** We know that the chief data officer (CDO) is becoming more prevalent in organizations. It is often assumed that CDOs and their data science teams report to the CEO in the enterprise. In some organizations this is accurate, but there is now more variety in reporting structures with the recent influx of the CDO function in many enterprises.
- **Hypothesis:** Data scientists predominantly report to a CDO in an organization that parallels the CIO’s IT organization.
- **Question:** To whom do data scientists report within your organization?
- **Finding:** As shown in Figure 2, we found that 37% of data scientists report to central IT and 33% of data scientists actually report to a line of business. Only 29% of organizations surveyed had a central data science group, while 16% stated that they still don’t have data scientists in their enterprise.
Varying the reporting structure for data science teams makes it all the more challenging for software engineering leaders and data scientists to work together. The 37% of organizations in which the data scientists report into the CIO’s IT organization may find it easier to have the data science team and the development teams work in a coordinated fashion. However, the 63% of organizations in which the data science teams report elsewhere or don’t exist may find it more challenging. This is likely to be partially a result of the standing debate about centralized versus decentralized organizational assets (see Foundations of Making Organization Structure Decisions).

Software engineering leaders will either need to coordinate across functional areas of the business or take on the complete responsibilities for building and integrating AI and ML models into applications, if they have no data science assets in the organization. This can be accomplished to some degree through the use of off-the-shelf models and autoML services from cloud providers, but it will limit the range of models that can be used.
These environments will present greater challenges in terms of the integration needed between the ModelOps and DevOps pipelines, as these will be managed in two completely different organizations. In order to achieve desired business outcomes, software engineering and data science leaders will need to delineate the responsibilities of the two teams, despite having different reporting structures that may have conflicting priorities.

**Recommendations**

For software engineering leaders:

- Determine the responsibilities that overlap between data science teams and software engineering teams, and formalize the division and coordination of these responsibilities.

- Determine the degree to which you can address the full ModelOps pipeline in the software engineering organization if the enterprise lacks data science resources.

**Software Engineering Leaders Face Significant Challenges Incorporating AI and ML Models Into Applications Because They Lack the ML Skills Required to Do So**

- **Context:** Given the high interest in machine learning, increasing numbers of people are taking courses to learn the skills needed to create and deploy ML models. Software engineers are included in this group. However, as is the case with software engineers, the availability of ML professionals is seriously constrained.

- **Hypothesis:** Software engineers are acquiring more AI and ML skills in order to meet growing demand for those skills in development.

- **Question:** In your organization, what percentage of software engineers already have some machine learning skills or are acquiring them?

- **Finding:** Only 10% of organizations have 50% or more of their software engineers trained on ML skills. As reflected in Figure 3, almost 60% of organizations have either no software engineers or less than 10% of their software engineers trained in ML skills. This indicates a significant gap in skills needed for developing applications with ML or AI models incorporated into them.
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Figure 3: Percentage of Software Engineers Already Having or Acquiring Some Machine Learning Skills

**Percentage of Software Engineers Already Having or Acquiring Some Machine Learning Skills**

Percentage of Respondents

- None
- <10%
- 10% to <25%
- 25% to <50%
- 50% to <75%
- 75%+

More Than Three-Quarters of Organizations Have 25% or Fewer of Their Total Software Engineers Trained in Machine Learning

| 10% | 48% | 19% | 14% | 8% | 2% |

n = 105 All respondents; Excluding "Unsure"

Q: Finally, in your organization, what percentage of software engineers already have some machine learning skills or are acquiring it?

Source: Gartner 2021 Application Innovation Implementation Survey

Note: Gartner’s IT & Business Leaders Research Circle members and External Sample

Percentages may not add to sum due to rounding

Analysis

The use of AI and ML models in applications is, as noted previously in this survey analysis, growing rapidly and is already somewhat widespread. While software engineers do not have to be data scientists trained in building ML models using tooling such as TensorFlow, they do need to have some ML skills. Software engineers need to understand how models work and how to integrate them into applications, as well as how to detect when a model is not performing as expected. These skills will be needed to deploy and monitor models and their impact on application performance.
With the use of AI and ML growing — and a consensus that this technology will have an impact on business that is both substantial and profound — it is inevitable that application development will increasingly include integration, deployment and operationalization of AI and ML models in the software applications that drive the business. Just as software engineers use hosted services, components, modules, UI templates and other technologies to compose applications, they will also use AI and ML models. Enterprises will increasingly have portfolios of documented AI and ML models with their use, the data sources that drive them and their expected output ready to deploy in applications via an API call. As a result, software engineering leaders need to ensure their teams have the requisite ML skills to utilize and manage these assets. Currently, as noted, the skills fall short of what is needed in most enterprises.

Recommendations

For software engineering leaders:

- Identify the segments of your software engineering teams that have both the abilities and predisposition to learn ML skills. Consider creating a center of excellence or community of practice that spans data science and software engineering organizations.

- Provide the time and training resources needed for your software engineering teams to acquire these skills.

- Plan for widespread use of AI and ML models in the applications that you are building for the enterprise, and build the assets to manage these models in conjunction with data scientists in the business.

Evidence

Gartner’s Application Innovation Implementation Survey was conducted online from 20 July through 12 August to understand adoption of application innovations in support of newly acquired or custom-built applications and software. The survey focused on the deployment of digital twins, what role software engineering leaders have in digital twin software engineering, and use of AI in application development. In total, 111 IT and Business Leaders Research Circle members* participated. Seventy-five were from Gartner’s ITL Research Circle — a Gartner-managed panel — and 36 were from an external sample. Members from North America (41%), EMEA (41%), Asia/Pacific (10%) and Latin America (9%) responded to the survey.
The survey was developed collaboratively by a team of Gartner analysts and was reviewed, tested and administered by Gartner's Research Data and Analytics team.

*Gartner's IT & Business Leaders Research Circle members include leaders from application management, data and analytics, business process improvement, enterprise architecture and technology innovation, IT infrastructure and operations, program and portfolio management, security and risk management, sourcing and vendor relationships, strategic planning, product development and management, and software engineering. Members represent a mix of industries and organization sizes, with the majority in North America and Western Europe.

Note: The results of this study are representative of the respondent base and not necessarily the market as a whole.

For additional queries on the data or survey instrument, please contact Kanwarpreet.Oberoi@gartner.com

Acronym Key and Glossary Terms

| Artificial intelligence (AI) model operationalization (ModelOps) | AI ModelOps is primarily focused on the governance and life cycle management of all AI and decision models (including models based on machine learning, knowledge graphs, rules, optimization, linguistics and agents). |

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Quick Answer: How Will Artificial Intelligence and Machine Learning Expand Software Engineering Leaders' Responsibilities?

Innovation Insight for ModelOps