Survey Analysis: Digital Twin Expansion Plans Signal New Software Skills Investments Are Required

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Initiatives: Applications and Software Engineering Leaders

Survey results show companies are increasing the scale of digital twin deployment in association with newly acquired or custom-built applications. Application and software engineering leaders should leverage these recommendations to improve their chances of implementing digital twins at scale.

Overview

Key Findings

- The majority of respondents expect their organizations to significantly expand their use of digital twins in newly acquired or custom-built applications and software over the next three years.

- One in three respondents usually include digital twins in new applications and software.

- Most software engineering leaders have less than three years of digital twin experience.

Recommendations

Application and software engineering leaders investing in digital twins in association with newly acquired or custom-built applications and software should:

- Minimize future digital twin scaling issues by creating a plan to overcome common digital twin deployment challenges, such as data growth, portfolio management and security.
Future-proof all newly acquired or customer-built applications and software by including digital twin capabilities in the overall modernization strategy and making them a key evaluation criterion.

Drive overall digital twin team effectiveness by combining investment in diverse net new, digital-twin-specific technical skills with Gartner's proven software engineering team best practices.

**Strategic Planning Assumption(s)**

- By 2026, 25% of all newly acquired or custom-built applications will leverage digital twins.

- Through 2026, 50% of organizations will fail to fully achieve their multiyear digital twin deployment plans because they underestimated formidable digital twin technical and logistical challenges.

- By 2026, job postings for software engineering leaders with substantial digital twin proficiency will command 25% higher compensation than those without this requirement.

**Data Insights**

**Introduction**

This survey was deployed to understand the use and impact of various IT innovations in conjunction with newly acquired or custom-built applications. 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 — and 36 were from an external sample. For more details, see the Evidence section. Collectively, this research indicates companies are seeking to operationalize digital twins beyond niche applications and limited deployments.
The Majority of Respondents Expect Their Organizations to Significantly Expand Their Use of Digital Twins Over the Next Three Years

Context: From prior research we know companies have effectively used digital twins, often to improve the optimization of their equipment and operations (see Survey Analysis: Companies Heavily Use Digital Twins to Optimize Operations). But while adoption of digital twins has occurred throughout many companies and industries, deployment is likely still limited; that is, for proof of concept or limited use in production. Thus, one goal for this survey was to test our hypothesis regarding to what degree companies have deployed digital twins, ranging from not at all to full scale.

Hypothesis: To date, the majority of enterprises have only deployed digital twins to a limited degree across all their products, assets, equipment and processes, but the degree of adoption will increase over the next few years.

Question: To what scale have you deployed digital twins in your projects today (and in three years) across your targeted classes of products, assets, equipment or processes?

Finding: The survey findings indicate a majority of companies surveyed (56%) have not deployed or only have a limited deployment of digital twins. However, in three years a majority of companies (63%) plan to have deployed digital twins at medium to full scale (see Figure 1).
These results align with our earlier hypothesis regarding our perception of the currently limited scale of deployment as well as our speculation that within three years the scale of deployment will increase. The responses also align with our fairly low expectations for large- and full-scale (9% and 2%, respectively) digital twin deployments to date (11% combined). But we were a bit surprised at the fairly high anticipated levels of large- and full-scale (21% and 18%, respectively) digital twin deployments in three years (39% combined). If more than one-third of companies implementing digital twins did so at large- and full-scale in only three years, that would be a remarkable example of sustained investment and technical competency.
While we do expect many more companies will achieve large- and full-scale digital twin deployments in three years, we believe the formidable technical challenges associated with implementing digital twins at scale (for example, extraordinary growth in digital twin data, burgeoning cost of development and computing resources, IT/operational technology [OT] organizational integration challenges, effective governance, and security and digital twin portfolio management) will inhibit full-scale achievement. Thus, we believe that through 2026, 50% of organizations will fail to fully achieve their multiyear digital twin deployment plans because they underestimated formidable digital twin technical and logistical challenges. Regardless, we interpret the current nontrivial scale of digital twin deployment today — combined with decisive plans for an increase in scale in three years — to be a key leading indicator. We believe digital twin adoption over the next few years will evolve from a leading-edge, experimental innovation to a mainstream, more widely deployed innovation.

Recommendation

Application and software engineering leaders investing in digital twins in association with newly acquired or custom-built applications and software should:

- Increase their odds of successfully scaling up digital twins by planning how they will overcome common digital twin deployment challenges such as data growth, portfolio management and security (see What Should I Do To Ensure Digital Twin Success?).

One in Three Respondents Usually Include Digital Twins in New Applications and Software

Context: In previously published research (for example, What to Expect When You’re Expecting Digital Twins) we established a direct and significant impact for digital twins on various business applications. Commonly affected applications include, but are not limited to APM, CRM, ERP, EAM, FSM, SCM. In that research we further predicted, “By 2024, more than 25% of all new digital twins will be acquired as a bundled capability of new Internet of Things (IoT) native business applications.” Many of our client conversations focus on how to digital-twin-enable client applications, but to date, we have not yet acquired specific data to establish whether that trend is widespread.

Hypothesis: Digital twins are a desired capability for a significant proportion (albeit not yet a majority) of all newly acquired or custom-built business applications.

Question: How often do you include digital twin capabilities in your newly acquired or custom-built applications and software?
Finding: About one-fifth (22%) of the respondents indicated digital twins were not yet a required capability of newly acquired or custom-built applications, but a majority (77%) indicated digital twins were either “sometimes” or “usually” a required capability (see Figure 2).

Figure 2. Role of Digital Twins in New Applications and Software

<table>
<thead>
<tr>
<th>Role of Digital Twins in New Applications and Software</th>
<th>Respondent Involvement</th>
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<tbody>
<tr>
<td>Digital twins are always a required capability</td>
<td>2%</td>
</tr>
<tr>
<td>Digital twins usually a required capability</td>
<td>34%</td>
</tr>
<tr>
<td>Digital twins are sometimes a required capability</td>
<td>43%</td>
</tr>
<tr>
<td>Digital twins are never a required capability</td>
<td>22%</td>
</tr>
</tbody>
</table>

n = 65 respondents who have deployed digital twins in projects (excluding “unsure”)

Q. How often do you include digital twin capabilities in your newly acquired or custom-built applications and software?

Source: 2021 Gartner Application Innovation Implementation Survey

Analysis

A key take-away from these results is that demand for digital-twin-enabled applications appears to be increasing. Drivers for this increase include proven ROI, where digital twins are used to enhance traditional business applications (for example, APM, CRM, EAM) and software (modeling, visualization, simulation). Digital twins have been shown to deliver significant business benefits (for example, design improvement, remote monitoring, asset and process optimization, condition- and predictive-based maintenance, improved customer service) (see Why Machine Customers May Be Your Service Departments’ Best Advocates).
Another driver is that, as part of an application modernization strategy (likely including other factors such as a desire to move off of monolithic, legacy applications), some companies may find it easier to build or acquire new, native digital-twin-enabled business applications (for example, BIM, EAM, FSM) and software (production or system modeling and simulation). Companies will do this as an alternative to integrating digital twin technologies with legacy (that is, pre-IoT) business applications and software. The latter approach is difficult because it requires strong IoT device integration skills and the skills to develop new, IoT-enhanced workflows (see How Can Organizations Integrate IoT Digital Twins and Enterprise Applications?). Another driver is the increasing availability of COTS digital-twin-enabled applications. Examples include Bentley Systems’ AssetWise Digital Twin Services, GE Digital Predix Asset Performance Management, Lumada Manufacturing Insights and SAP Predictive Maintenance and Service.

**Recommendations**

Application and software engineering leaders who want to include digital twins in new applications and software should:

- To better support more data-driven business outcomes, begin including digital twin capabilities as a component of your application modernization strategy and a key evaluation criterion for newly acquired or custom-built applications and software.

- Ensure collaboration between IT and OT staff whenever implementing new, digital-twin-enabled business applications and software to help achieve a better ROI.

**Most Software Engineering Leaders Have Less Than Three Years of Digital Twin Experience**

**Context:** Companies worldwide have made initial investments in digital twins to improve business outcomes (see Tool: 50-Plus Digital Twin and IoT Cost Optimization Examples). But as companies seek to fully capitalize on such investments, applications and software engineering leaders are challenged to implement digital twin work at scale. Key challenges include aligning digital twin investments with digital business initiatives, enhancing R&D skills to address new digital twin competencies, and requisite organizational, budgeting and governance challenges associated with designing digital twins to support long-life (sometimes decades-long) physical assets. While we think software engineering leaders for digital twins have limited experience with digital-twin-related projects, we have not previously surveyed users to verify to what degree that perception is true.

**Hypothesis:** The majority of software engineering leaders for digital twin projects have limited digital twin experience, typically only one to three years.
Question: And, how many years of experience on digital twin projects do the software engineering leaders have in your organization?

Finding: A significant majority of software engineering leaders (72%) have three years or less of experience on digital twin projects (see Figure 3).

Figure 3. Software Engineering Leaders’ Digital Twin Experience

Analysis

While digital twins for extraordinarily complex and high-value assets (for example, space flight, industrial turbines) have been around for decades, only in the last few years have they become widely available for ubiquitous assets, equipment and processes (for example, escalators, industrial pumps and manufacturing). And industrial IoT platforms — a key enabling technology for digital twin development and deployment — only emerged within the last 10 years (see Magic Quadrant for Industrial IoT Platforms). Thus, given the fairly recent emergence of digital twins’ mainstream adoption, it’s no surprise that most software engineering leaders still only have three years or less of experience.
At the same time, companies indicate they will expand their use of digital twins over the next three years (see earlier survey finding). Thus, clients are also increasingly asking us what skills their software engineering leaders need to develop, deploy and support digital twins at scale. The implication of limited software engineering leader digital twin experience and the growing demand for more digital twins overall is that software engineering leaders will be challenged to succeed. Three key challenges include:

- Digital twin projects are relatively complex software products involving common challenges that every SWEL faces (for example, quality, testing, time to delivery, skills).
- Digital twin projects also involve technical challenges that are unique to digital twins (for example, IoT device provisioning, hybrid edge-to-cloud computing and new digital twin development tools).
- SWELs of digital twin project face unique challenges, such as budgeting digital twin R&D costs for long-life physical assets and overcoming traditional IT and OT organizational boundaries.

This “perfect storm” of challenges for SWELs of IoT projects will complicate things for companies seeking software engineering leaders who are qualified to help scale out their digital twin portfolios.

**Recommendations**

Application and software engineering leaders who want to increase the digital twin skill levels should:

- Leverage Gartner’s proven strategies to drive overall software engineering team effectiveness and increase the quality of digital twin software engineering projects (see Proven Strategies to Drive Software Engineering Team Effectiveness).
- Invest in diverse, net new, digital-twin-specific technical skills needed for digital twin projects (see Architect IoT Using the Gartner Reference Model).
- Adopt a digital twin “product” development approach that emphasizes a minimum viable product with incremental updates based on user feedback and evolving business needs (see What Should I Do to Ensure Digital Twin Success?).
- Invest in unique-to-digital-twin skills, such as long-term digital twin project budgeting and overcoming IT and OT organizational boundaries (see As IT and OT Converge, IT and Engineers Should Learn From Each Other).
Evidence

Gartner's Application Innovation Implementation Survey was conducted online from 20 July through 12 August 2021 to understand:

- Adoption of application innovations in support of newly acquired or custom-built applications and software
- Deployment of digital twins and the role of SWELs in digital twin software engineering
- Use of AI in application development

In total, 111 IT & 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 region (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. Note: the results of this study are representative of the respondent base and not necessarily the market as a whole.

* 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
The group represents a mix of industries and organization sizes, with the majority in North America and Western Europe.

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

### Acronym Key and Glossary Terms

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<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>APM</td>
<td>asset performance management</td>
</tr>
<tr>
<td>BIM</td>
<td>building information management</td>
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<tr>
<td>COTS</td>
<td>commercial off-the-shelf</td>
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<tr>
<td>CRM</td>
<td>customer relationship management</td>
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<tr>
<td>EAM</td>
<td>enterprise asset management</td>
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<td>ERP</td>
<td>enterprise resource planning</td>
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<td>FSM</td>
<td>field service management</td>
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<td>SCM</td>
<td>supply chain management</td>
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<tr>
<td>SWEL</td>
<td>software engineering leader</td>
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**What Should I Do To Ensure Digital Twin Success?**

**Tool: 50-Plus Digital Twin and IoT Cost Optimization Examples**

**Quick Answer: What Is a Digital Twin of an Organization?**

**Strengthen 4 Elements for Successful Management and Governance of Digital Twins**