Hype Cycle for the Future of Applications, 2021

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Initiatives: Applications and Software Engineering Leaders; Enterprise Architecture and Technology Innovation Leaders; Software Engineering Technologies

> Composable applications will require a combination of technologies to meet the demands of increasingly sophisticated users. Applications and software engineering leaders should use this Hype Cycle to identify and prioritize innovations and technologies key to delivering the future of applications.

Analysis

What You Need to Know

Applications and software engineering leaders must leverage composable technology to adapt to the pace of business change. To deliver on digital transformation, organizations need applications that can be readily assembled, reassembled and extended. IT and professional developers are not the only drivers of technological innovations. Business technologists, such as citizen developers and citizen data scientists, deliver business automation through a variety of technologies. Our research shows that more than 55% of business technologists (non-IT employees) have supported more than four such automation initiatives in the past year (see the Evidence section).

Applications and software engineering leaders work endless hours delivering technology that is both robust and flexible to meet current and future demands. Yet users clamor for intuitive user experiences, more flexibility in where work is done and self-service intelligent analytics. New technology is forthcoming that will meet these demands without building a monolithic application.

The Hype Cycle

This Hype Cycle contains the main components for the design, architecture and delivery of future application experiences. In the "future of applications," applications and software engineering leaders can adapt and improve business application capabilities on demand.

To accomplish this, they will be assembling component business capabilities from flexible applications and technologies rather than buying a static solution or suite that only addresses a specific use case. Some composable building blocks will be delivered in the form of API-centric software as a service (SaaS) or other specialized applications. Some will be semiautonomous components of larger packaged applications. Others will still be created by organizations for internal use. This does not mean all applications will be delivered via headless SaaS with custom user interfaces (UI) (see Note 1). Many people will continue to consume packaged applications, the main difference being those applications will have far more flexible capabilities to interconnect and extend with others.

This Hype Cycle encompasses a broad variety of technologies and innovations. These enable applications and software leaders to be agile, and adapt and respond faster to deliver on new business opportunities. This Hype Cycle is heavier on technologies earlier in their life cycle as the promise of composable applications requires more than just simple configuration. More than ever, it is possible to deliver on that promise with new ways of integrating data, orchestrating workflows, developing applications and enhancing UIs. Fast movers to watch:

- API marketplaces, citizen integrator tools and digital twin all matured rapidly toward or through the Trough of Disillusionment.

- Composable ERP is rapidly moving up from a nascent technology toward the Peak of Inflated Expectations.

Notable changes from last year:

- Added mesh app and service architecture (MASA) and industry clouds

- Replaced composable enterprises with composable applications

- Removed API economy and hybrid application platforms

Figure 1. Hype Cycle for the Future of Applications, 2021
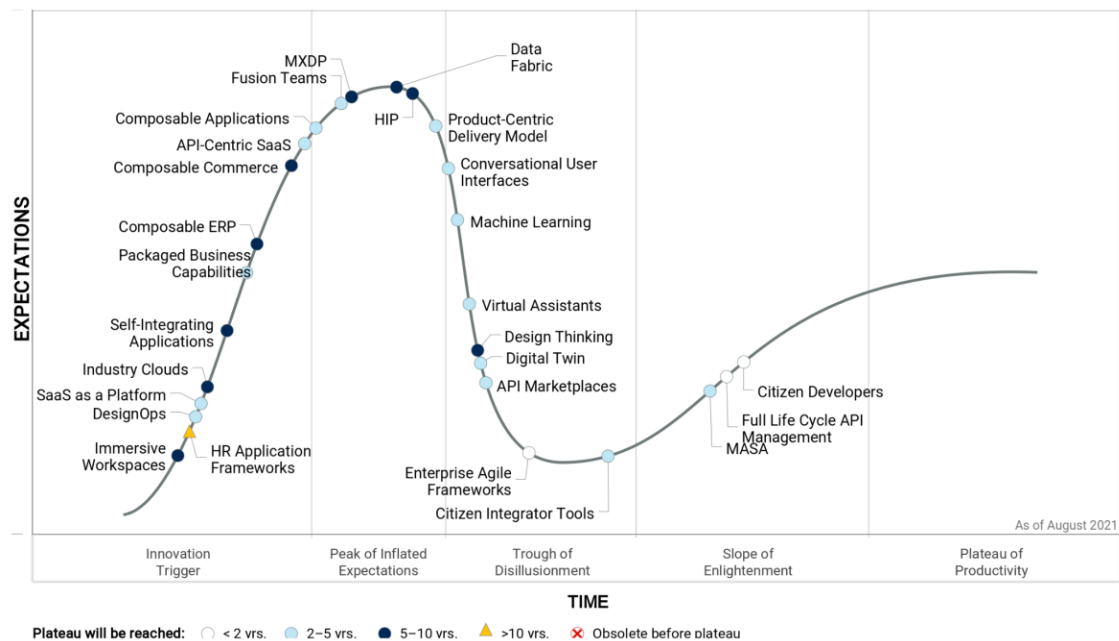
Source: Gartner (August 2021)

Downloadable graphic: Hype Cycle for the Future of Applications, 2021

The Priority Matrix

The Priority Matrix shows the relative impact of innovation profiles for the future of applications. It combines the potential benefit of the innovation on the vertical axis and the years-to-plateau rating on the horizontal axis. Applications and software engineering leaders can use this information for internal planning and the prioritization of emerging innovation profiles.

Most innovations for the future of applications have great potential with a transformational or high benefit. No transformational innovations are expected to become mainstream within two years; most are expected to be mainstream within two to five years. This means that there is still time to develop strategic plans and to evaluate the impacts of these technologies on your organization.

Of the transformational innovations, composable ERP and data fabric are two intriguing technologies worth closely tracking. ERP and the data it contains can have an outsized impact on what and how solutions are built. Modernization of core data and ERP technologies will provide outsized benefits, because currently, few companies will have the capability and discipline to fully execute. On the other hand, conversational UIs and ML are much more approachable technologies and can have an immediate impact without needing to reengineer the business.

Table 1: Priority Matrix for the Future of Applications, 2021

(Enlarged table in Appendix)

Benefit	Years to Mainstream Adoption			
	Less Than 2 Years	2 - 5 Years	5 - 10 Years	More Than 10 Years
Transformational		Composable Applications Conversational User Interfaces Digital Twin Fusion Teams Machine Learning Product-Centric Delivery Model Virtual Assistants	Composable Commerce Composable ERP Data Fabric Industry Clouds Self-Integrating Applications	
High	Citizen Developers Enterprise Agile Frameworks Full Life Cycle API Management	API-Centric SaaS DesignOps MASA Packaged Business Capabilities SaaS as a Platform	Design Thinking HIP Immersive Workspaces MXDP	HR Application Frameworks
Moderate		API Marketplaces Citizen Integrator Tools		
Low				

Source: Gartner (August 2021)

Off the Hype Cycle

The following innovation profiles were removed from the Hype Cycle this year:

■ Composable enterprises was removed to focus the Hype Cycle on technology innovations over organization design innovations.

■ API economy graduated off of the Hype Cycle, as it lives on in the Plateau of Productivity.

■ Hybrid application platform was removed as HIP and MASA are more concrete examples of the same concept.

On the Rise

Immersive Workspaces

Analysis By: Marty Resnick, Nolan Hart

Benefit Rating: High

Market Penetration: 1% to 5% of target audience

Maturity: Emerging

Definition

Immersive workspaces create collaborative work environments that convey a sense of real-world presence through the use of visual, auditory, haptic and other sensory elements. They principally employ virtual reality (VR), augmented reality (AR), and mixed reality (MR) technologies and techniques, but also utilize multiple displays delivered to users through head-mounted devices.

Why This Is Important

Immersive workspaces provide opportunities for deeper collaboration, engagement and connectedness within meeting solutions and telecommuting. They can facilitate more natural cooperation and coordination across a hybrid workforce. Immersive workspaces have the potential to transform knowledge sharing, onboarding, and training, and many other daily operations. Immersive technologies, multiple displays and sensory elements will drive these experiences.

Business Impact

- Immersive workspaces offer organizations opportunities to support work from home, reduce travel expenses by improving remote collaboration and increase productivity through design visualizations.

- Immersive workspaces fill the gaps that remote working causes, including: connectedness, collaboration, and engagement between remote and office workers.

- Providers of virtual meeting, conferencing and training solutions should look to add immersive workspace capabilities to their products.

Drivers

- Demand for immersive workspaces continues to increase, especially as organizations work from home and plan for a hybrid workforce going forward.

- Organizations want to reclaim the natural state interactions of colocation while reaping the benefits of hiring anywhere.

- VR, AR and MR in an immersive workspace allow collaborators to communicate naturally by displaying body language and other subtle visual cues that videoconferencing fails to capture.

- Current state deployments function as pilots and proofs of concept (POCs), but large enterprises are investigating new and innovative ways to enhance collaboration and communication through the use of immersive technologies.

- Immersive workspaces continue to appear and mature within VR platforms, such as Oculus, and the latest developments move toward an MR experience.

- MR-empowered, immersive workspaces possess the ability to create 3D virtual offices and desktops in a VR world.

- The ability to use MR to place digital objects (such as images of monitors) on walls in virtual representations of the physical world continues to emerge as the technology evolves. This will offer new collaboration, interactivity, visualization and productivity opportunities.

- The ability to utilize immersive workspaces to enable enhanced interaction with data in the form of immersive analytics will create additional market opportunities.

Obstacles

- Immersive technology is still in the early stages of development as products have moved from use by a few individuals to corporate adoption through teams and departments.

- Current products lack a refined user experience, with bulky hardware and frequent glitches.

- Currently, the use of 3D-enabled business applications in immersive workspaces is limited, and availability of these applications will need to grow to meet the true value of immersive workspaces.

- AR, MR and VR, and therefore the immersive workspace they enable, are not well-understood by the public (commercial and private).

- The industry must address the lack of user education and knowledge of how to use the tools and their potential benefits, and user concerns regarding privacy and security.

User Recommendations

- Look to use immersive workspaces to enhance engagement, communication and collaboration among members of an increasingly hybrid workforce and with business partners.

- Evaluate the market and experience virtual desktop applications through VR ecosystems, such as HTC's Vive and Facebook's Oculus, as well as MR ecosystems, such as Microsoft (HoloLens 2).

- Give employees the opportunity to test immersive technologies via pilots and POCs.

- Review unified communications vendors' roadmaps and plans for immersive workspaces.

- Start small with a POC based on a specified business outcome — VR conferencing, for example. Then, plan specific use cases for a wider rollout.

- Take into account the increased requirements for networks, hardware and software for successful implementation.

Sample Vendors

Cisco; Facebook; HTC; Igloo Vision; Microsoft; Spatial; vSpatial

Gartner Recommended Reading

Cool Vendors in Augmenting Human Experiences

Maverick* Research: Being Human 2040 — The Life of the Architected Human in a More-Than-Human World

Market Guide for Workstream Collaboration

Virtual Reality and Augmented Reality for Remote Workers

HR Application Frameworks

Analysis By: Sam Grinter

Benefit Rating: High

Market Penetration: Less than 1% of target audience

Maturity: Emerging

Definition

A progression from existing cloud HCM suites, an HR application framework is an approach for deploying multiple functional modules from multiple third-party vendors, relying on a seamless data flow and process orchestration. HR application frameworks comprise functional nodes supporting specific HR processes and catering to local requirements; subfunctional nodes, which consolidate other closely-related functions; and a central node, which unifies the data and user experience.

Why This Is Important

HR application frameworks are expected to become the dominant approach for deploying and managing HCM solutions. HR application frameworks deliver compelling advantages over cloud human capital management (HCM) suites. Although HR application frameworks are nascent and emerging, application leaders should begin shaping their HR technology strategies around this concept.

Business Impact

HR application frameworks deliver several advantages:

- **Data consolidation** — Supports improved system performance, reporting and planning, without the need for setting up and maintaining custom integrations

- **Access to innovation** — Organizations are not tied to the roadmap of one vendor, and may bring vendors in/out of their ecosystem as needs change

- **Extensibility/customization** — This architecture enables organizations to create an HR application ecosystem customized to their specific requirements

Drivers

Cloud HCM suites are the result of a more than 20-year journey by vendors from discrete functionality to a broad consolidation of HR functionality in a single integrated suite.

- However, functional gaps remain a challenge, and cloud HCM suites generally do not support the most cutting-edge HR processes or universal coverage of local compliance needs.

- A further constraint is that the current model cannot respond quickly to new challenges by turning on/off functionality provided by third-party vendors, because connections between applications are often delivered via custom integrations.

- During the next 10 years, Gartner expects cloud HCM suites to evolve and/or be replaced by the HR application frameworks.

Obstacles

- Cloud HCM suites are still the dominant deployment approach, and the initial intention at deployment at least was that they would serve a client for 10 or 20 years. The appetite to rip out and replace a cloud HCM suite with a HR application framework is low for most organizations. Most organizations yet to deploy a cloud HCM suite would still likely be better served by a cloud HCM suite, rather than an HR application framework, due to the comparable difference in market maturity.

- As HR applications frameworks mature, and as the limitations of cloud HCM suites become more widely understood and appreciated, the preferences of buyers will shift in favor of HR application frameworks.

User Recommendations

- Lobby HR technology vendors to invest in platforms to support some of the capabilities offered by HR application frameworks during the initial period. The is a nascent concept, and its suitability is limited only to early adopters. Examples of such capabilities include smoother integration with third-party applications, platform as a service (PaaS) and application marketplaces.

- Push for flexibility and scalability for license/user counts and functional modules to deliver greater business resilience when (re)negotiating terms and conditions of purchase.

- Demand quality assurances before committing to a deployment when engaging with an HR application framework vendor.

- Run a deployment as a pilot and/or in tandem with an existing cloud HCM suite to deliver redundant support of HR technology, at least initially.

Sample Vendors

ADP; BizMerlinHR; Zellis

Gartner Recommended Reading

The Future of Cloud HCM Suites

Innovation Insight for Packaged Business Capabilities and Their Role in the Future Composable Enterprise

Tech Providers 2025: How Product Managers Can Prepare for the Future of HCM Software

DesignOps

Analysis By: Brent Stewart

Benefit Rating: High

Market Penetration: 5% to 20% of target audience

Maturity: Adolescent

Definition

DesignOps is a set of operational practices that enables design team management and product-level delivery of design assets. The team management side focuses on strategic alignment to the business, operations for the central design function and career development. The product delivery side combines UX, product management and technology operations to enable efficient and DevOps-compatible plans, estimates and processes that increase quality, enable collaboration and feed ongoing innovation.

Why This Is Important

DesignOps introduces formalized approaches to governance, operations and people management. As a set of easy-to-use operational standards, DesignOps continues to gain in popularity as digital product companies (for example, Airbnb, Adobe and InVision) and agencies alike discover the tremendous value of a proven operational approach for UX team management and design delivery on product teams.

Business Impact

The growth of DesignOps is due, primarily, to the value it creates during the delivery of design assets. Here, DesignOps does not alter the core skills and activities of a UX team; rather, it reorganizes them in a way that supports ongoing feature enhancement and idea generation without interrupting the continuous workflow of development teams. DesignOps represents the first widespread implementation of operational methods and techniques created not only for designers, but also for developers.

Drivers

Modeled to be compatible with DevOps and agile practices, DesignOps structures and organizes design work to enable early and frequent feedback via collaboration between the user, the designer and the developer, as well as ongoing, iterative delivery of assets and design decisions to the development team. This allows product teams to run parallel tracks of work (dual-track agile) in which UX teams employ "continuous discovery" to understand the user, engage in research, explore various design directions, test possible solutions and document outcomes. It also allows them to progressively support early development activities such as tech design and story creation.

There are three key drivers behind DesignOps:

- **Innovation:** When coupled with DevOps, DesignOps leads to more innovative solutions. As a practice, DesignOps employs dual-track agile that sets aside ongoing tracks of work dedicated to new discovery, idea generation and design exploration. This work acts as a constant source of evidence-based, multidisciplinary innovation.

- **Speed:** DesignOps reduces the time to market for major updates and incremental feature enhancements alike. Due to the concepts of continuous discovery and continuous delivery, developers engage in tech design, architectural explorations and proofs of concept sooner than before, and with much deeper understanding of the overall vision.

- **Collaboration:** DesignOps increases communication and camaraderie between design and development teams. The design-development gap exists for many reasons, one of them being culture. DesignOps promotes multidisciplinary teams in workshop settings, design sprints or one-on-one "pairing and sharing" that promotes understanding, empathy and relationship building between these two crucially important groups.

Obstacles

To a large extent, the growth of DesignOps is inhibited by key gaps in planning, estimation and tracking knowledge:

- Few UX practitioners are educated in detailed planning and estimation using a common work breakdown structure (WBS).

- Few product managers are trained in UX planning, estimating and tracking.

- Popular enterprise agile planning (EAP) tools are not designed with UX practitioners, activities and deliverables in mind (though this is changing).

User Recommendations

Software engineering leaders should:

- Educate themselves about the practice of DesignOps

- Train their UX teams in the basics of agile

- Pilot the approach with a high-performing, multidisciplinary feature team

Following a successful pilot, application leaders and the pilot team members should

- Engage in a productwide rollout that involves training, updated product plans and the allocation of one or more persons to the role of design manager — essentially, a UX-focused product manager.

It should be noted that a successful rollout of DesignOps at the product level requires complete buy-in from product management, design and development teams, as well as robust logistical and administrative skills.

Gartner Recommended Reading

DesignOps: Organize, Collaborate and Innovate Product UX at Speed

Technology Insight for Digital Product Design Platforms

3 Key Practices to Enable Your Multiexperience Development Strategy

Software Engineering Technologies Primer for 2021

SaaS as a Platform

Analysis By: Paul Vincent, Fabrizio Biscotti, Yefim Natis

Benefit Rating: High

Market Penetration: 5% to 20% of target audience

Maturity: Emerging

Definition

SaaS as a platform (SSP) provides an integrated comprehensive business platform comprising a unified stack of SaaS-based packaged business capabilities, exposed as building blocks through APIs and/or event channels, and a low-code composition platform to facilitate new capabilities and experiences.

Why This Is Important

SaaS megavendors consume increasing proportions of IT budgets while providing both out-of-the-box business capabilities, and increasing extensibility for new and custom use cases for their customers. The combination of scalable SaaS business capabilities, information access via APIs, and low-code workflow and user interface tooling is increasingly popular among enterprises.

Business Impact

The SSP offerings are already disrupting the IT business: Salesforce attaining revenue of $13 billion faster than any other software company demonstrated the value of SSP. These SaaS offerings are already considered by many as a strategic platform. SSPs and their ecosystem partners are providing more packaged business and composition capabilities every year, displacing smaller specialized vendors across SaaS, PaaS and application development markets. This adoption curve is likely to grow.

Drivers

- SSP provides a unified business platform equating to a combination of SaaS+PaaS, including notably a composition capability through low-code application platform (LCAP) and integration PaaS (iPaaS) tooling. SaaS megavendors provide sets of business services or packaged business capabilities, along with a default user experience, API and/or event channel access to their services, and PaaS capabilities around application, data and user interface. The prime example is Salesforce, which has achieved No. 1 market status in customer relationship management as well as No. 2 status in application infrastructure and middleware services, and is therefore easily No. 1 in SSP.

- SSP vendors overlap, albeit incompletely, and are in increasing competition across their SaaS services. They may participate in specific markets through their ecosystem of partners rather than directly. Their approach to their PaaS services, like data, integration and user multiexperience, varies from customizable prebuilt services to complete frameworks and toolkits competing in those markets as separate offerings. The competitive nature of their SaaS drives the innovation and capabilities of their low-code development tooling, enabling enterprise users to consume new technologies as they are delivered by their SaaS providers through APIs.

- The wide-scale adoption of these SaaS solutions by business IT teams, together with the desire for differentiation on top of their commodity services, is driving the growth of the SSP model. Business leaders are less concerned with cloud infrastructure details/benefits of pro-code development, and more about application productivity and availability, making SSP a popular choice to extend SaaS investments into digital business initiatives. Customers are recognizing the value of a specific application ecosystem sharing data and services. Hype is low but increasing around SSPs as their adoption evolves from departmental to strategic and enterprise.

Obstacles

The strategic SSP concept, providing customers with an integrated (typically one vendor) solution for standard business capabilities (SaaS) and new differentiating service applications (enabled by developer tools like LCAP, business process automation, integration and design systems), provides a customer dilemma:

- Strategic SaaS vendor investment versus best-of-breed solution selection and integration.

- The platform components of SaaS vendors are often incomplete, such as around composability, component catalogs, real-time events and decision management.

- SaaS vendors themselves often have an incomplete portfolio, requiring multiple vendors across CRM, ITSM, ERP, financials, HR, etc., with associated higher costs.

- Hype is low but increasing around SSPs as their adoption moves from departmental to strategic and enterprise; there is still little recognition from CIOs as to their commitment to the SSP model.

User Recommendations

CIOs and IT leaders investigating the strategic selection of composable SaaS+PaaS platforms will likely already be a customer of some of them.

- Understand the implications of a single platform versus best-of-breed approach for applications and platforms. For many, the selection of a SSP will be to increase automation capabilities, yet multiple integration standards across SaaS will add problems.

- Ensure the SSP vendor being considered can demonstrate the desired characteristics of a unified SaaS+PaaS platform. Its SaaS services must be readily extendable to create new and custom applications via APIs, and its integration capabilities must be either strategic in scope or replaceable with a strategic integration solution.

- Beware of legacy vendors that provide SaaS on multiple underlying platforms and architectures with disparate API styles, which increase operational management costs and complexity of reuse.

- Be wary of high costs associated with menu-driven pricing for these platforms, and mitigate that through contract best practices.

Sample Vendors

Creatio; IngageApp; Microsoft; Oracle; Pegasystems; Salesforce; SAP; ServiceNow; Zoho

Gartner Recommended Reading

Emerging Technologies and Trends Impact Radar: 2021

Identify and Evaluate Your Next Low-Code Development Technologies

Industry Clouds

Analysis By: Gregor Petri

Benefit Rating: Transformational

Market Penetration: Less than 1% of target audience

Maturity: Embryonic

Definition

Industry clouds leverage underlying cloud services to offer business and technical capabilities that are specifically relevant to an identified vertical industry. Industry clouds aim to address the unique and evolving functional, regulatory or technical requirements and use cases of the addressed vertical industry and offer a whole product.

Why This Is Important

Cloud adoption has been growing at record pace, but total cloud spend currently makes up only about 10% of global enterprise IT spend. The majority of organizations use one or more cloud services in a variety of areas. But broader adoption within enterprises will require more vertical-targeted whole-product solutions that follow defined industry scenarios and process models, rather than technology-oriented solutions that enterprises have to largely configure and integrate themselves.

Business Impact

Industry clouds will have a lasting impact on cloud customers, blurring the lines between established cloud services such as infrastructure as a service (IaaS), platform as a service (PaaS) and SaaS, and also between cloud providers and cloud SIs and MSPs. The market is taking a classic page from Geoffrey Moore's "Crossing the Chasm," by creating whole-product offerings that cater directly to the established needs of vertical industry enterprises.

Drivers

- Industry clouds have the potential to cover the full functional breadth required for a specific industry, from top (with a suite of applications) to bottom (middleware and infrastructure). So far, organizations bought cloud services as either specific point solutions, in the form of somewhat siloed top to bottom SaaS applications, or as an alternative for a horizontal layer of their technology stack, in the form of IaaS or PaaS services.

- Today, industry clouds are largely being initiated and created by large cloud and software providers, although we see some industry enterprises considering creating an industry cloud as the basis for a manufacturing, food or pharma ecosystem.

- Enterprises can gain value from industry clouds through shared best practices and thought leadership offered through vertically specialized go-to-market and implementation teams; compliance of the infrastructure platform with industry-specific regulations, such as HIPAA or FedRAMP; analytical capabilities to mine the data from their existing applications; industry-specific functionality applications and collections of industry-specific functional building blocks available in industry cloud marketplaces; choosing a combination of the above as a (pre-)composed industry solution.

- Industry clouds create value for enterprises by bringing traditionally separate purchased solutions together in a preintegrated solution. This can simplify the sourcing, implementation and integration process, but enterprises need to realize that providers will initially build out their offering from the infrastructure, application or analytics solutions they historically offered. Leaders in this space are expected to leverage composable cloud and edge approaches to create more holistic and comprehensive industry offerings, which enterprises will be able to recompose to meet unique or special requirements.

Obstacles

- Industry clouds are at risk to follow the same path as community clouds, such as dedicated government clouds. These provided a walled garden where providers added specific vertical functionality, which often led to breaking the compatibility and upgradability with the cloud it was derived from. This left enterprises on a long-term unsupported or unsupportable fork or copy of the cloud of their choosing.

- Initially, industry clouds will cater to the needs of individual enterprises, but to reach their full potential, they will evolve into something best described as ecosystem clouds. Enterprises can leverage these ecosystems by participating in shared (business) processes, such as shared procurement, shared distribution, shared payment procession, and maybe even shared R&D and innovation. This is a step beyond the initial sharing of infrastructure and technology that clouds traditionally brought to the table.

User Recommendations

- Assess the industry-specific features promoted by cloud providers, and distinguish between real technology or functionality offerings versus marketing messages.

- Take into account that vendors choose different paths to add industry value: some focus on compliance with industry regulations, some on adding analytical capabilities to existing or partner-sourced functionality, others invest in building or acquiring specific functional building blocks. Longer term, we expect composability to play a significant role in creating more comprehensive and adaptable industry clouds.

- Select industry cloud offerings that satisfy both your IT/cloud requirements and your vertical industry end-user or line-of-business requirements

- Establish communications with current application and infrastructure providers about which industry cloud ecosystems they plan to support or envision to become part of in the future.

Sample Vendors

Amazon Web Services; Google; IBM; Infor; Microsoft; Oracle

Gartner Recommended Reading

7 Elements for Creating a Pragmatic Enterprise Cloud Strategy

Self-Integrating Applications

Analysis By: Keith Guttridge, Eric Thoo

Benefit Rating: Transformational

Market Penetration: Less than 1% of target audience

Maturity: Embryonic

Definition

Self-integrating applications will use a combination of automated service discovery, automated metadata extraction and mapping, automated process definition and automated dependency mapping to enable applications and services to integrate themselves into an existing application portfolio with minimal human interaction.

Why This Is Important

Integrating new applications and services into an application portfolio is complex and expensive. Gartner research shows that up to 65% of the cost of implementing a new ERP or CRM system is attributable to integration. The technology to enable applications to self-integrate exists in pockets, but no vendor has yet combined all the elements successfully. As applications develop the ability to discover and connect to each other, the amount of basic integration work will dramatically reduce.

Business Impact

- Improved agility, as the time to onboard applications and services is massively shortened.

- Cost savings of up to 65% when onboarding new applications and services.

- Reduced vendor lock-in, as platform migration becomes simpler.

- Greater ability to focus on differentiation and transformational initiatives, as the "keep the lights on" burden is dramatically reduced.

Drivers

- Cloud hyperscalers providing features such as service discovery, metadata extraction, intelligent document processing and natural language processing

- Automation/integration vendors providing features such as intelligent data mapping, metadata extraction, data fabric, next best action recommendations, process discovery and automated decisioning

- SaaS vendors providing features such as process automation, packaged integration processes, portfolio discovery and platform composability

- A new era in which intelligent application portfolio management is placed on top of augmented integration platforms, in order to be where the challenge is finally addressed

Obstacles

- Embedded integration features within SaaS being good enough to enable organizations to get started quickly, thus stalling investment in improving self-integration capabilities.

- A general lack of awareness of the availability of augmented integration technologies to enable self-integrating applications. Many organizations still view integration as a complex issue requiring specialist tools.

- The lack of a clear market leader that is looking to push this technology forward as the major application vendors look to protect their customer bases.

User Recommendations

Application leaders should:

- Ask their major application vendors about the interoperability of applications within their portfolios. This is the area where self-integrating applications are most likely to emerge first.

- Investigate integration vendors that have augmented artificial intelligence features to automate the process of onboarding applications and services into a portfolio.

- Manage their expectations. Self-integrating applications will provide just enough integration with the rest of the application portfolio to enable a new application to work efficiently.

Sample Vendors

Boomi; Informatica; Microsoft; Oracle; Salesforce; SAP; SnapLogic; Workato

Gartner Recommended Reading

Innovation Insight for Self-Integrating Applications

Data Fabrics Add Augmented Intelligence to Modernize Your Data Integration

Packaged Business Capabilities

Analysis By: Yefim Natis

Benefit Rating: High

Market Penetration: 1% to 5% of target audience

Maturity: Emerging

Definition

Packaged business capabilities (PBCs) are encapsulated software components that represent a well-defined business capability, recognizable as such by a business user and packaged for programmatic access. The definition does not specify the size, functional scope or internal architecture of the implementation, but PBCs are only as useful as they are modular, discoverable, autonomous and ready for composition (integration).

Why This Is Important

As the pandemic disruption forced organizations to seek increased business adaptability, many turned to the model of the composable business. PBCs are a foundational element of the composable application architecture. They act as the building blocks for composition and recomposition of application experiences. When combined with the democratized application composition tools, PBCs empower fast, safe and efficient application and business innovation by the business-IT fusion development teams.

Business Impact

- Adoption of PBCs improves the ability of organizations to involve business professionals in design of application experiences and to make changes to applications by way of recomposition instead of new coding.

- Composable applications, using PBC architecture, equip organizations to innovate faster, safer and smarter, which in turn delivers business resilience, efficiency and adaptability.

Drivers

- Increasing pace of business change, demanding faster, safer and more efficient application innovation.

- Increasing participation of business professionals in software engineering, requiring more business-oriented expression in software modeling, replacing or augmenting the traditional programmatic orientation.

- Increasing democratization of platform technologies, bringing more business professionals to application design work.

- Increasing orientation of vendor applications (SaaS) to API-first and API-only ("headless") design, leading organizations toward composition and integration instead of the basic customizations of vendor applications.

- Increasing sophistication of agile development practices and product-style application delivery demands more advanced modularity, autonomy, orchestration and discovery for application capabilities.

Obstacles

- Lack of clarity in understanding the fundamentals of composable application architecture, which leads to false starts or "composability-washing" initiatives that do not deliver the expected results.

- Lack of democratized composition tools, which leaves too much of the attempted composition initiatives with technology professionals, limiting the direct business professional participation. This in turn generates designs that are less reflective of the nuance of the required business change and compromise the delivery pace and quality of the outcomes.

- Lack of experience operating fusion teams, which reduces their effectiveness and compromises both technology and business aspects of the products.

- Cultural resistance to change, fear of the shifting business priorities and common familiarity bias — all form obstacles to rapid adoption of architecture of composability and the PBCs.

User Recommendations

- Prioritize expertise in API management, event brokering, integration, business-IT collaboration and democratized tooling to achieve preparedness for composable business applications experience.

- Reject any new monolithic solutions proposed by vendors or in-house developers, and plan to renovate or replace the old ones to enable their participation in composition.

- Accelerate product-style delivery of application capabilities, using agile and DevOps techniques over traditional methods.

- Prioritize democratized tools in support of development, integration (composition) and governance of composed application experiences.

- Give preference to vendor offerings that deliver API-first and API-only (headless) application services.

- Transform the IT organization to the role of a partner and strategic guide to business units, trusted to deliver efficient, safe and fast services to help advance organizations' business objectives.

Gartner Recommended Reading

Innovation Insight for Composable Modularity of Packaged Business Capabilities

Strategic Architecture Roadmap for Composable Enterprise Applications (Presentation)

Use Gartner's Reference Model to Deliver Intelligent Composable Business Applications

Kick-Start Your Composable Business Journey With 2 Key Strategies

How to Design Enterprise Applications That Are Composable by Default

Composable ERP

Analysis By: Denis Torii

Benefit Rating: Transformational

Market Penetration: 5% to 20% of target audience

Maturity: Emerging

Definition

Composable ERP is an adaptive technology strategy that enables the foundational administrative and operational digital capabilities for an enterprise to keep up with the pace of business change. It is not an off-the-shelf single product; rather, it defines a strategic technology framework where application and platform capabilities support dynamic and user-centric enterprise business capabilities.

Why This Is Important

ERP strategies are evolving from something more than just loosely coupled apps into a mesh of ERP applications, platforms and non-ERP vendors. The need to support a resilient and future-proof enterprise requires CIOs to adopt an ERP approach that merges dynamic business needs with application stability. Composable ERP is the approach that will transform existing ERP journeys into strategies that deliver on that promise.

Business Impact

Delivering business value is at the core of composable ERP. Ability to deliver value is changing radically, due to the influx of new technologies, mindsets and practices. Main focus changes are:

- Business outcomes — Shift of focus from how to why do it.

- Complexity — Accepting the complexity and working to manage ERP is a must. Trying to reduce the challenge through a single-vendor approach is a mistake.

- Customer value creation — How can the enterprise understand and keep up with customers' demands.

Drivers

Organizations are assessing what their composable business vision is, and need to rapidly create an ERP strategy to support them in enabling this composability. Main drivers for this journey are:

- **Agnostic integration strategies**: Composable ERP must leverage a hybrid integration approach to enable business value beyond the borders of monolithic ERP.

- **Faster achievement of business outcomes**: The days of five-year waterfall ERP implementations are over. More agile approaches to implementation are required to meet the rapidly changing digital world, which will result in quicker time to value.

- **Consistent data management**: Organizations are focusing more on getting quality data to enable AI and predictive analytics adoption in the near term. Data fabric and data literacy become the lifeblood of composable ERP.

- **Outcome-focused intelligence enablement**: AI and process automation are enabling more efficient business process execution leading to better business outcomes.

Obstacles

- Software vendors are still discovering the impacts and directions of this customer-led future state. Tactical roadblocks, like licensing models and out-of-the-box integration capabilities, are still barriers to a more open ecosystem.

- System integrators can't yet see where they can position themselves on this business value story. Most are still talking about agnostic digital transformation that translates into vendor-led technology modernization as opposed to a customer-centric composable enterprise story.

- Articulating business value hasn't always been a priority for IT initiatives. Therefore, the engagement between IT and the business to discuss an enterprise IT-enabled vision is not a trivial exercise for most.

User Recommendations

- Ensure business and IT work as a single unit to create this ERP strategy.

- Establish the scope of what ERP means — and should mean — for your organization by synchronizing capabilities with business plans and desired outcomes and experiences. Reimagine ERP to align with the emerging generation of applications, architectures and technologies. Avoid the temptation to adopt an old monolithic ERP mindset.

- Exploit the emerging technologies across all pace layers based on your organization's growth, transformation or optimization goals.

- Invest in enabling technologies along the core ERP journey. AI, low code/no code, integration capabilities, master data management and security discussions must all be part of the ERP strategy.

Gartner Recommended Reading

The Future of ERP Is Composable

Expert Insight Video: How to Launch a Composable ERP Strategy

Future of Applications: Delivering the Composable Enterprise

How to Design Enterprise Applications That Are Composable by Default

Composable Commerce

Analysis By: Jason Daigler, Sandy Shen, Mike Lowndes

Benefit Rating: Transformational

Market Penetration: 1% to 5% of target audience

Maturity: Emerging

Definition

Composable commerce is an architectural approach to digital commerce where customer experiences are constructed with packaged business capabilities (PBCs). It is a modular approach that requires loosely coupled application capabilities, which are used to compose new commerce functionality and experiences. This approach contrasts with a platform-centric approach in which monolithic commerce platforms are deployed to manage most aspects of the commerce customer experience.

Why This Is Important

Digital commerce solutions need to be flexible and nimble to quickly respond to ever-changing customer expectations. This need was exacerbated by the COVID-19 pandemic as many companies needed to respond quickly with new products, processes, delivery methods, and customer experiences. Composable commerce allows application changes and deployment to production in a more flexible manner, without working with a monolithic platform that includes many tightly coupled components that are not changed in every release.

Business Impact

Composable commerce will provide:

- Significant benefits to digital commerce teams in midsize, large and enterprise companies that want a more flexible architecture

- Greater ability to move quickly to respond to customer demand

- Less reliance on single vendors and the problems arising from large version upgrades for monolithic commerce platforms

- Better ability to swap out capabilities when new vendors emerge, expand to new channels more easily, and develop more innovative solutions

Drivers

Many of the individual components included in full digital commerce solutions — such as personalization engines, commerce search and content management — have been around for several years and sold and integrated independently. So the concept of using best-of-breed, individual applications to construct commerce experiences is not new. Composable commerce takes this concept a step further by offering granular functional components within the core commerce offering. Additionally, companies of all sizes, in almost all industries, are increasing investments in digital commerce, often in response to the changing customer demands driven by the COVID-19 pandemic.

Shifts toward composable commerce are often driven by:

- The need to allow fusion teams to work on and deploy individual components of the commerce tech stack without impacting other components. These commerce teams will be able to move more quickly and act more autonomously. They can control their own roadmaps, based on their own expertise in the module they are responsible for, and deploy their changes to production on their own schedule.

- The desire to move away from inflexible and slow-to-update, monolithic digital commerce platforms that power many aspects of the commerce customer journey, even if they are not purpose-built for those areas.

- The need to adopt a modular approach that provides more flexibility for digital commerce teams who want to swap out a piece of functionality for a different one from a best-of-breed or emerging vendor, or a solution that they develop themselves.

- The desire for better business-IT alignment when adopting product management best practices. With composable commerce, these fusion teams share common goals and metrics.

Obstacles

- Confusion abounds in the digital commerce market as vendors use terms like headless, microservices, and API-first. Many companies struggle to determine if the solutions they're purchasing are truly as modular and flexible as vendors claim.

- Companies with smaller development teams or fewer solution integration resources may be more comfortable with a larger commerce suite with a single business user admin console.

- Those who adopt composable commerce will need to have strong architectural, integration and API orchestration skills to be successful.

- Composable commerce is still in the early stages of evolution and adoption, and user-friendly integration tools, such as low-code application platforms (LCAPs), need to emerge before the approach becomes mainstream.

User Recommendations

Companies considering a composable commerce approach should:

- Evaluate the existing commerce tech stack and identify weaknesses that could benefit from composable commerce.

- Understand their own maturity because succeeding with composable commerce requires a digitally mature viewpoint, embracing processes such as digital product management and DevOps.

- Work with individual product teams who would own the modules in a composable commerce architecture to develop business cases that provide support for composable commerce solutions.

- Acknowledge the complexity that integration will play in composable commerce. Many individual components, today, are not well-integrated. Low-code or no-code integration generally does not exist between commerce PBCs today, especially if those PBCs come from separate vendors. Resources to build and maintain the integrations over time will be required and should be factored into project plans.

Sample Vendors

Algolia; Amplience; commercetools; Contentstack; Elastic Path; Kibo; Skava; Spryker; VTEX

Gartner Recommended Reading

API-Centric SaaS

Analysis By: Yefim Natis, Mark O'Neill, Anne Thomas

Benefit Rating: High

Market Penetration: 1% to 5% of target audience

Maturity: Emerging

Definition

API-centric ("headless") SaaS is a cloud application service that is offered primarily or entirely for programmatic access via APIs or event subscriptions. Some user experience may be provided, but the strategic intent for API-centric SaaS is to be used as a business capability, programmatically packaged for application composition, development and integration.

Why This Is Important

Increasingly, businesses seek a greater role in defining their digital experiences. API-centric SaaS enables customers to define their differentiated application experiences instead of being bound to the user experience packaged by the vendor. API-centric SaaS allows capabilities such as payments or mapping to be used within larger applications. Although as an application (SaaS), the API-centric SaaS is packaged for use in development platforms (PaaS), blurring the boundaries of SaaS and PaaS.

Business Impact

Business organizations that are equipped to capitalize on API-centric SaaS can create new application experiences for their employees and customers through composition of those prepackaged business capabilities, giving them an opportunity for faster, safer and more efficient business innovation. API-centric SaaS is also a base for fast-paced innovation by startups and other software vendors, contributing to the increasing pace of digital business change.

Drivers

- The patterns of software innovation have embraced integration and composition to a degree that application vendors that want to be included must offer their services, at least optionally, as libraries of API-enabled functional capabilities.

- The technology and skills for integration, including management of APIs and event streams, are widespread, allowing some leading businesses to package their business capabilities behind APIs for customers' and partners' customized use. API products serve that purpose.

- The demands for the depth of customization of applications in business organizations have evolved to the point that SaaS vendors must allow rearrangement of their business functionality by the customers. API SaaS serves that purpose.

- Increasing use of digital twin architecture in IoT application design serves as the early experience of utilizing API-packaged business capabilities, preparing organizations' skills and technologies for the use of the similarly designed and encapsulated API-centric SaaS.

- Many older applications are used as if "headless" by businesses accessing them via API and foregoing the vendor-defined user experiences. This prepares organizations' skills and technologies to include the API-centric SaaS capabilities into their application development experience.

- Business application design has become significantly partitioned into the back-end functionality with its APIs and the front-end multiexperience user interface, each side created using different tools and design expertise. Some business-oriented application vendors find it convenient to concentrate on the back-end data and business logic and leave the finalized user experience to separate teams, including the customer's own developers.

Obstacles

- API-centric SaaS is a relatively new phenomenon, when compared to the conventional SaaS offerings. There are not enough dedicated development tools or trained software engineering teams to assure the right balance of cost and value of adopting it.

- API-centric SaaS offers business capabilities, typically delivered as a collection of multiple APIs, but most leading marketplace technologies are designed to manage only the individual APIs, making the discovery and governance of such packaged business capabilities more difficult.

- Minimal or fully absent user interfaces packaged with an API-centric SaaS assume and require that the customer implement their own differentiated application and user experience. What is a welcome opportunity for innovation for some can be a burden to others, inhibiting the wide-spread adoption and API-centric SaaS.

User Recommendations

- Give preference to SaaS offerings that expose more of their business capabilities as API and/or event streams.

- Plan for gradual shift of development to composition and integration of API-centric packaged business capabilities.

- Ensure clean separation of the back-end business logic and the front-end user experience in all applications, to maximize future benefits of the composable application experiences.

- Avoid vendor applications that lock your organization into their user experience technology.

- Give preference to low-code and pro-code PaaS offerings that are well-equipped for access to external API and event marketplaces.

- Practice use of API marketplaces in preparation to greater adoption of API-centric SaaS and API products

- Watch for opportunities to experiment by offering some of your business capabilities as priced API products.

Sample Vendors

Algolia; Alloy; Clearbit; Cloudinary; Lob; MessageBird; Plaid; Strapi; Stripe; Twilio

Gartner Recommended Reading

Create API Portals That Drive API Adoption Among Internal and External Developer Communities

Kick-Start Your Composable Business Journey With 2 Key Strategies

Gartner's API Strategy Maturity Model

Top Trends in Cross-Industry Open APIs for Product Leaders at Banking TSPs for 2021

Choose the Right API Monetization and Pricing Model

Composable Applications

Analysis By: Yefim Natis

Benefit Rating: Transformational

Market Penetration: 1% to 5% of target audience

Maturity: Emerging

Definition

Composable applications use business-defined modularity to enable business-IT fusion teams to safely and rapidly compose and recompose application services in the moments of need. The modularity of applications that is suitable for fusion teams is expressed in business terms, is accessible programmatically, and maximizes autonomy and preparedness of its modules for governed orchestration and discovery.

Why This Is Important

Without a model for application design that supports safe, efficient and fast business change, modern organizations risk losing their market momentum and loyalty of their customers. Composable application architecture empowers such adaptable businesses. It resolves the agility constraints of monolithic applications by first partitioning them into self-contained business capabilities and then encapsulating the isolated capabilities using the microservices model of API-/event-based interfaces.

Business Impact

Composable business applications enable a better match of application experiences to a changing, operational context of the business. Composable business, founded on composable application technology and built with composable thinking throughout the organization, is well-positioned to recognize and exploit business opportunities, respond to unexpected disruptions, and meet customers' changing demands at their pace, retaining their loyalty.

Drivers

- In the continuously changing business context, demand for business adaptability directs organizations toward technology architecture that supports fast, safe and efficient application change.

- The demand for active participation of business decision makers in the design of their digital experiences promotes adoption of technology models that are accessible and useful to business experts, in addition to the technical professionals.

- Increasing number of vendors offering API-centric SaaS (also known as API products or "headless" SaaS) builds up a portfolio of available software-encapsulated business capabilities — the building blocks of composable business applications.

- Increasing mainstream use of low-code application, integration and automation platforms supports composition of applications using API products and other forms of packaged business capabilities, preparing organizations for composable business engineering.

- Fast-growing competence in mainstream organizations for management of broad collections of APIs and event streams creates a technology foundation for safe operation of a composable business technology environment.

Obstacles

- Limited experience of composable thinking and planning in most software engineering organizations complicates the design efforts and transition plans of seeking the benefits of a composable application architecture.

- Limited practice of business-IT collaboration for application design in some organizations delays the effectiveness of composable design that benefits from the complementary expert talents in multidisciplinary fusion teams.

- Most legacy applications can participate in composition via their APIs and event streams, but their architecture provides only minimal autonomy to simulated encapsulated business capabilities and therefore delivers limited enterprise agility, as compared to the native composable applications.

- Lack of development and platform tools dedicated to composable application architecture limits the early success with composition to the more-advanced design teams, capable of adapting precursor technologies to their objectives.

User Recommendations

- Build competence in API and event stream management to prepare to catalog, protect and administer access to the encapsulated business capability services — the building blocks of composable applications.

- Use low-code development and integration technologies to facilitate design collaboration of business and technology experts.

- Prioritize formation of business-IT fusion teams to support faster and more effective adaptive change of business applications.

- Build an investment case for composability by identifying opportunities that address urgent points of friction, hindering the organization's ability to achieve short-term business goals.

- Use API-centric SaaS, where available, to practice application composition.

- Catalog the outer APIs of older applications along with the accessible APIs of external applications to support the initial stages of composable applications.

Sample Vendors

Contentful; Treasury Prime; Snipcart; Twilio; Modularbank; Evervault; Claudinary

Gartner Recommended Reading

Strategic Architecture Roadmap for Composable Enterprise Applications (Presentation)

Use Gartner's Reference Model to Deliver Intelligent Composable Business Applications

Kick-Start Your Composable Business Journey With 2 Key Strategies

How to Design Enterprise Applications That Are Composable by Default

Redefine Your Business-IT Relationship Continuum to Deliver Greater Business Agility

Fusion Teams

Analysis By: Bill Swanton, Matthew Hotle

Benefit Rating: Transformational

Market Penetration: 20% to 50% of target audience

Maturity: Early mainstream

Definition

Fusion teams are multidisciplinary teams that blend technology and other types of domain expertise and are often designed to deliver products rather than projects. Fusion teams do not separate the technology work from the rest of the effort to create a complete product or service and often don't report to the IT department, but somewhere else, such as a business unit.

Why This Is Important

More professional software development will be done outside of IT as business becomes more digital. Business units building digital business want full control of all the people critical to that business and closer collaboration between business and technical professionals.

Business Impact

- The rise of fusion teams shows that the boundaries between IT and the rest of the business are blurring at an accelerated rate.

- Distributed, simultaneous initiatives with broad-based involvement yield better results than centralized, sequential digital business initiatives.

- Organizations with distributed delivery and risk-reducing tactics can transform their digital businesses 2.5 times faster than those running initiatives in one centrally managed IT team divorced from the legacy business.

Drivers

- Software companies, digital natives and builders of technology products have had engineering teams outside IT for years. Fusion teams are starting to emerge in more traditional organizations as more products and services have an online component, such as in digital business.

- Development of digital products for use by external customers drives fusion teams.

- Business unit needs control of all the resources for delivering a product, including the professional software development teams.

- Mixed teams of business people and technical people allow tight collaboration on the details of the product.

- Making the software development an integral part of the product development will allow software engineers to inject innovative ideas for the product.

Obstacles

- IT often has the perception that fusion teams are "shadow IT" and will deliver lower-quality products that do not follow IT guidelines.

- CIOs fear they will be stuck supporting this software or cleaning up after a data breach.

User Recommendations

- Accept that there will be fusion teams doing technology work outside of IT — the business units need to have full control of the resources to deliver their product or service.

- With control comes responsibility, so organizations should ensure that the CIO and other business leaders work together to build agile and effective governance frameworks for the work the fusion teams do.

- CIOs should focus on the human side of managing digital business risk and foster "digital judgment" in fusion team leaders. Digital judgment is the set of beliefs, mindsets and behaviors that leads to sound risk management among front line technology decision makers throughout the enterprise.

Gartner Recommended Reading

Fusion Teams: A New Model for Digital Delivery

Fusion Teams: Cross-Functional Collaboration for the Digital Era

Application Leaders: Master Composable Enterprise Thinking for Your Post-COVID-19 Reset

MXDP

Analysis By: Arun Batchu, Jim Scheibmeir, Van Baker, Adrian Leow

Benefit Rating: High

Market Penetration: 5% to 20% of target audience

Maturity: Emerging

Definition

A multiexperience development platform (MXDP) offers development teams an opinionated and integrated set of front-end development tools and "backends for frontends" services. Its purpose is to enable distributed and scalable development (both in teams and architecture) of fit-for-purpose apps across digital touchpoints and interaction modalities.

Why This Is Important

A MXDP unifies front-end application development activities across heterogenous types of apps so that the user experience (UX) across these apps is seamless, persistent and enjoyable. MXDPs ensure maximum reuse and accelerate development velocity.

Business Impact

- Delightful application user experiences that seamlessly and persistently span multiple devices and augment human senses (touch, vision, auditory).

- Simplified and composable construction of complex front-ends that speed-up application development and deployment.

- Smoother development experiences resulting in more engaged and loyal software engineers.

- Reduction of the number of development teams and personnel by allowing cross-platform development.

Drivers

- Need for consistent, seamless and distinctive application experiences that span an increasing number of end-user computing devices.

- Need for ambient (no-touch) experiences accelerated by the pandemic.

- Increased sophistication of multiexperience development platform technology.

- Increased demand for digitalization of industries using heavy machinery or operating in hazardous environments.

Obstacles

- Lack of portability of applications across MXDPs and vendor lock-in.

- Immaturity of immersive technologies.

- Inconsistent implementation of browser models across multiple devices and operating systems.

- Platform licensing costs, especially for consumer facing use cases.

- Learning curve for proprietary stack.

- Lack of and retention of trained personnel.

- Preference for open-source software stacks.

User Recommendations

- Guide teams to consider an MXDP as a supplement to open-source software stacks and low-code application platforms (LCAP).

- Drive innovation by having teams demonstrate the power of MXDPs to business and upper management stakeholders.

- Narrow down a consideration set by using Gartner's Critical Capabilities research for MXDPs.

- Use Gartner's Magic Quadrant research to pick a vendor that best matches the strategic vision and expectations of product execution.

- Evaluate licensing costs at scale, before increasing the impact of MXDPs.

- Develop plans for training and recruiting developers for the chosen MXDP.

- Mitigate lock-in risk by encouraging modularizing of applications and replacing them with open source stacks when appropriate.

- Utilize software engineering skills to extend the MXDP offerings with custom and reusable modules that citizen developers can utilize in no or low code development.

Sample Vendors

Appian; Builder.ai; GeneXus; HCL Software; Mendix; Neptune; Neutrinos; OutSystems; Pegasystems; Salesforce; SAP; ServiceNow; XOne

Gartner Recommended Reading

Technology Insight for Multiexperience Development Platforms

Magic Quadrant for Multiexperience Development Platforms

Critical Capabilities for Multiexperience Development Platform

Data Fabric

Analysis By: Ehtisham Zaidi, Robert Thanaraj, Mark Beyer

Benefit Rating: Transformational

Market Penetration: 1% to 5% of target audience

Maturity: Emerging

Definition

A data fabric is an emerging data management design for attaining flexible and reusable data integration pipelines, services and semantics. A data fabric supports various operational and analytics use cases delivered across multiple deployment and orchestration platforms. Data fabrics support a combination of different data integration styles and leverage active metadata, knowledge graphs, semantics and ML to automate and enhance data integration design and delivery.

Why This Is Important

A data fabric leverages both traditional and emerging technologies in enterprise architectural design and evolution. It is composable and supports flexibility, scalability and extensibility in an infrastructure used by humans or machines across multiple data and analytics use cases. It abstracts data management infrastructure to disintermediate any incumbent platforms, and enables data integration and delivery regardless of the number of on-premises or CSP-based data assets in use.

Business Impact

Organizations benefit as data fabric:

- Provides insights to data engineers and ultimately automates repeatable tasks in data integration, quality, data delivery, access enablement and more.

- Adds semantic knowledge for context and meaning, and provides enriched data models.

- Evolves into a self-learning model that recognizes similar data content regardless of form and structure, enabling broader connectivity to new assets.

- Monitors data assets on allocated resources for optimization and cost control.

Drivers

- A data fabric enables tracking, auditing, monitoring, reporting and evaluating data use and utilization, and data analysis for content, values, veracity of data assets in a business unit, department or organization. This results in a trusted asset capability.

- Demand for rapid comprehension and adaptation of new data assets has risen sharply and continues to accelerate — regardless of the deployed structure and format. The data fabric provides an operational model that permits use cases, users and developers to identify when data experience varies from the data expectations depicted in system designs.

- A shortage of data management professionals is increasing the demand for accurate and actively utilized metadata to make system design, data availability and data trust decisions.

- Catalogs alone are insufficient in assisting with data self-service. Data fabrics capitalize on machine learning to resolve what has been a primarily human labor effort using metadata to provide recommendations for integration design and delivery.

- Business delivery and management professionals find it difficult to identify adjacent, parallel and complementary data assets to expand their analytical models. Data fabrics have the capability to assist with graph data modeling capabilities (which is useful to preserve the context of the data along with its complex relationships), and allow the business to enrich the models with agreed upon semantics.

- Significant growth in demand and utilization of knowledge graphs of linked data as well as ML algorithms to provide actionable recommendations and insights to developers and consumers of data can be supported in a data fabric.

- Organizations have found that one or two approaches to data acquisition and integration are insufficient. Data fabrics provide capabilities to deliver integrated data through a broad range of combined data delivery styles including bulk/batch (ETL), data virtualization, message queues, use of APIs, microservices and more.

Obstacles

Data fabrics are just past the Peak of Inflated Expectations. The main challenges surrounding broad adoption are:

- Diversity of skills and platforms to build a data fabric present both technical and cultural barriers. It requires a shift from data management based upon analysis, requirements and design to one of discovery, response and recommendation.

- Intentional market hype by providers and services organizations purporting a data fabric delivery is adding to market cynicism.

- Misunderstanding and lack of knowledge in how to reconcile and manage a data fabric and a legacy data and analytics governance program that assumes all data is equal will lead to failure.

- Proprietary metadata restrictions will hamper the data fabric, which is wholly dependent upon acquiring metadata from a wide variety of data management platforms. Without metadata, the fabric requires analytic and machine learning capabilities to infer missing metadata, and while possible, will be error prone.

User Recommendations

Data and analytics leaders looking to modernize their data management with a data fabric should:

- Invest in an augmented data catalog that assists with creating a flexible data model. Enrich the model through semantics and ontologies for the business to understand and contribute to the catalog.

- Invest in data fabrics that can utilize knowledge graph constructs.

- Ensure subject matter expert support by selecting enabling technologies that allow them to enrich knowledge graphs with business semantics.

- Combine different data integration styles into your strategy (bulk/batch, message, virtualization, event, stream, replication and synchronization).

- Evaluate existing tools to determine the availability of three classes of metadata: design/run, administration/deployment and optimization/algorithmic metadata. Rate existing and candidate platforms and favor those that share the most metadata.

- Focus on a similar transparency and availability of metadata between PaaS and SaaS solutions.

Sample Vendors

Cambridge Semantics; Cinchy; CluedIn; Denodo; IBM; Informatica; Semantic Web Company; Stardog; Talend

Gartner Recommended Reading

Top Trends in Data and Analytics for 2021: Data Fabric Is the Foundation

What Is Data Fabric Design?

Top Trends in Data and Analytics for 2021: Data Fabric Is the Foundation

Emerging Technologies: Data Fabric Is the Future of Data Management

HIP

Analysis By: Massimo Pezzini

Benefit Rating: High

Market Penetration: 5% to 20% of target audience

Maturity: Adolescent

Definition

The hybrid integration platform (HIP) is an architectural framework that defines integration and governance capabilities and enables differently skilled personas to tackle multiple integration use cases across hybrid, multicloud setups. A HIP implementation typically consists of an assembly of diverse integration tools, from one or more providers, which are managed as a cohesive, federated and integrated whole, typically by an integration strategy empowerment team.

Why This Is Important

As organizations pursue digital and composable business initiatives, they find that the integration challenges they must address are growing in complexity and quantity. Cloud services, cloud data warehouses, ecosystems, mobile apps and Internet of Things (IoT) devices are new endpoints that they must integrate with traditional applications and data sources. The HIP helps software engineering leaders implement the integration and governance capabilities needed to integrate all their IT assets.

Business Impact

Each organization's HIP implementation will differ to reflect specific requirements. But in all cases, it will alleviate integration challenges by:

- Supporting centralized control and governance, while leveraging decentralized and collaborative integration delivery

- Improving business groups' self-sufficiency and agility by reducing their reliance on specialist integrators of limited availability

- Accelerating the time to value for integration-intensive business initiatives

Drivers

A HIP implementation typically consists of an assembly of on-premises and cloud-delivered Integration platforms, API management platforms, event brokers, metadata management tools and other use case-specific components, often from different providers. Despite the complexity of such a setup, a growing number of midsize and large organizations are implementing HIP-inspired platforms to:

- Enable a range of diverse integration personas to perform integration work in a self-service fashion. These personas include: integration specialists (professional integration developers), "ad hoc" integrators (application developers, SaaS administrators and business technologists who occasionally have to perform integration work), and citizen integrators (business users who want to automate personal or workgroup processes).

- Integrate a wide variety of endpoints residing in cloud environments, on-premises data centers, ecosystem partners, and mobile and IoT devices by leveraging APIs, events and batch mechanisms.

- Support a differentiated set of use cases, including, but not limited to, application, data, B2B, process, IoT, API and event integration; robotic process automation; and digital integration hub

- Deploy integration platform capabilities in a hybrid, multicloud scenario — that is, one featuring a combination of public and private clouds and on-premises data centers — and embed them in applications and edge systems.

Although not all organizations need to address all these requirements, almost all organizations will have to tackle some of them. Therefore, most midsize, large and global organizations will have to deploy at least a subset of the capabilities defined in the HIP framework.

Obstacles

Organizations will face key challenges when implementing an HIP-inspired platform:

- A growing number of providers have released integrated technology suites mirroring, at least in part, the HIP framework. In many instances, though, a HIP implementation requires the aggregation of multiple products from different providers — a daring technological deployment and skills-building effort for the less technically skilled organizations.

- Such a technology aggregation poses operational challenges. Use of a wide range of product-specific tools leads to suboptimal outcomes and skills duplication. However, implementing a single, cross-product "control plane" may require notable investments in technologies and skills.

- A HIP is often deployed to enable self-service integration by a variety of organizational units. To avoid chaotic duplication of efforts and high costs, software engineering leaders must define and enforce well-balanced governance policies.

User Recommendations

Software engineering leaders responsible for integration should:

- Modernize their strategy by implementing a HIP-inspired infrastructure to enable collaborative and decentralized integration delivery, carried out by a variety of personas and addressing diverse use cases.

- Implement a HIP, If they work for a large organization, by federating different vendors' products, instead of buying an out-of-the-box HIP. This will make it easier to maintain backward-compatibility with in-place integration platforms and mitigate the risk of single-vendor lock-in.

- Implement a HIP, If they work for a midsize organization, by adopting an iPaaS, whenever possible, to reduce the complexity of effort. Many iPaaSs provide a subset of the HIP framework capabilities that is generally sufficient for such organizations.

- Adopt a stepwise, initiative-by-initiative HIP implementation strategy, which is much easier to justify than a "big bang" approach and reduces complexity and risk.

Sample Vendors

Boomi; IBM; Informatica; Jitterbit; MuleSoft; Oracle; SAP; SnapLogic; Software AG; TIBCO Software

Gartner Recommended Reading

How to Deliver a Truly Hybrid Integration Platform in Steps

How to Justify Strategic Investments in Integration Technology

Product-Centric Delivery Model

Analysis By: Wan Fui Chan

Benefit Rating: Transformational

Market Penetration: 20% to 50% of target audience

Maturity: Early mainstream

Definition

A product-centric delivery model allows organizations to respond more rapidly to changing demands using agile methodologies. It also allows organizations to deliver incremental improvements to business outcomes with a focus on users and customer centricity.

Why This Is Important

Volatile, uncertain, complex and ambiguous (VUCA) headwinds in markets, requirements and technologies have resulted in organizations evolving from traditional, project-based frameworks. A product-centric delivery model allows organizations to navigate through turbulence and also to iterate, adapt and refine processes to deliver business benefits efficiently and frequently. A product-centric model can provide competitive advantage sought by many organizations.

Business Impact

Key benefits of a product-centric delivery model include:

- Stronger focus on incremental improvements to business outcomes

- Increased agility to respond to changing market demands and customer value prioritization

- Reduction of silos, and closer collaboration across the organization

- Minimum quality escapes through DevOps practices

- Flatter and more rapid decision making

Drivers

- Organizations' need to keep pace with market demands and increased volatility

- Desire to increase speed of improvements that currently take too long to implement and deliver

- Pressure to reduce loss of knowledge caused by continuous disbanding of teams to work on new projects

- Need to overcome inefficiencies caused by the silos between business, finance and IT

- Increasing necessity for continuous innovation

Obstacles

- Inertia from existing organizational culture

- Difficulty finding talent with necessary skills and open mindset

- Misconception that product-centric delivery models have no plans, documentations, milestones or budgets

- Walls between business and IT

- Lack of clear reasons or defined measurable benefits for transitioning

- Long time frames for transition

- Lack of senior management and organizational support, which leaves adoption in pockets across the organization

- Outmoded governance processes incentivizing control and risk aversion, rather than experimentation and innovation

User Recommendations

- Clearly identify and train product managers, product owners, business leaders and team members on agile and product management practices to create a baseline of understanding which dispels any myths and misconceptions.

- Utilize agile coaching to aid in the transformation and avoid the temptation to go it alone.

- Use iterative change management practices during the transition that allow for learning and adaptation.

- Establish a strong partnership with colleagues in the various business areas as you adopt this new delivery model; cross-functional collaboration is a prerequisite for success.

- Move to a product funding model that allows for dynamic teams and reallocation of resources based on business demand and changing market conditions.

- Establish clear goals and objectives for the transition anchored on business priorities.

Gartner Recommended Reading

Becoming Product-Centric Should Be an Evolution, Not a Top-Down Transformation

Overcome Objections and Sell the Benefits of Moving From Projects to Products and Agile

How to Use Product Roadmaps for Funding and Governance of Agile Product Delivery Teams

Avoid Agile Transformation Failure by Using Agile Coaches

Prepare Now for the Future of Digital Product Management

Sliding into the Trough

Conversational User Interfaces

Analysis By: Magnus Revang, Van Baker

Benefit Rating: Transformational

Market Penetration: 5% to 20% of target audience

Maturity: Adolescent

Definition

Conversational user interface (CUI) is a high-level design model in which user and machine interactions primarily occur in the user's spoken or written natural language. The sophistication of a CUI can vary from understanding just simple verbal utterances to handling complex multiturn interactions.

Why This Is Important

CUIs promise a shift in responsibility between the user and the interface. In traditional UIs, the user operates the technology and is largely responsible for the effects of using it. In a CUI, this responsibility shifts. The CUI is responsible for determining the user's intention and executing it, meaning the CUI has taken over some of the responsibility from the user. This makes CUIs the first widespread adoption of agent user interfaces for software, devices and the IoT.

Business Impact

The conceptual shift away from the user as the operator, toward the user conversing with an agent that will execute on a determined intention, has a greater impact on the enterprise than most realize. Training, onboarding, escalations, productivity, empowerment and responsibility all change with this new model and need to be embraced as part of CUI projects. Treat CUIs as transformative, and plan on CUIs becoming the dominant interaction model in the future.

Drivers

- The underlying technology supporting CUIs, either front ends delivered as part of software or custom-developed CUIs (like chatbots and virtual agents) built on top of conversational platforms, still needs to evolve until it reaches its potential. Vendor and technology choice are tactical for the foreseeable future. Voice will also arrive as a strong modality.

- Users increasingly expect to be able to hold conversations and ask natural language questions of applications they use.

Obstacles

- Developing a good CUI requires much more effort than similar instructional GUIs. More intelligence has to be built into the conversation to deal with different kinds of users, different modalities and different edge cases.

- A conversational UI will make predictions about the user's intent. These predictions will sometimes be wrong, so the designer of a CUI has to have deeper knowledge about potential consequences, and design defensively with nonreversible actions and keeping ambiguity in mind.

- CUIs will need to employ anthropomorphism for the foreseeable future, lending elements of human communication to make it easier for users. A lack of personality, fragmented tone of voice, poorly written dialogue and flows that do not align with the user's behavior are affecting user sentiment toward CUIs, labelling them simple and, in many cases, useless.

User Recommendations

- Prepare for CUIs to communicate with each other. Larger architectures connecting different use cases for CUIs, like virtual agents for customer service, HR, IT to front ends for enterprise software, business intelligence tools, etc., will be a central challenge for organizations in the next three to five years. This will lead to a variety of architectural models entering the market, such as CUI-to-CUI communication and specialist tooling.

- Prepare for new roles in the enterprise. Dialogue designer, AI trainer, digital coach, humanizer and AI interaction designer are all titles Gartner is seeing in the market to support the creation of conversational experiences.

Machine Learning

Analysis By: Farhan Choudhary, Carlie Idoine, Shubhangi Vashisth

Benefit Rating: Transformational

Market Penetration: 5% to 20% of target audience

Maturity: Adolescent

Definition

Machine learning is an AI discipline that solves business problems by utilizing statistical models to extract knowledge and patterns from data. There are three major approaches that relate to the types of observation provided. These are supervised learning, where observations contain input/output pairs (also known as "labeled data"); unsupervised learning (where labels are omitted); and reinforcement learning (where evaluations are given of how good or bad a situation is).

Why This Is Important

According to Gartner's 2019 AI in Organizations survey, machine learning (ML) is the AI initiative for which more POCs and production systems are conducted. Over the past few years, ML has gained a lot of traction because it helps organizations to make better decisions at scale with the data they have. ML aims to eliminate traditional trial-and-error approaches based on static analysis of data, which is often inaccurate and unreliable, by generalizing knowledge from data.

Business Impact

Machine learning drives improvements and new solutions to business problems across a vast array of business, consumer and social scenarios like:

- Automation

- Price optimization

- Customer engagement

- Supply chain optimization

- Predictive maintenance

- Fraud detection

Machine learning impacts can be explicit or implicit. Explicit impacts result from machine learning initiatives. Implicit impacts result from products and solutions that you use without realizing they contain machine learning.

Drivers

- As organizations continue to adopt these technologies, we recently see focus on aspects that relate to ML explainability and operationalization. Augmentation and automation (of parts) of the ML development process improve productivity of data scientists and enable citizen data scientists in making ML pervasive across the enterprise.

- In addition, pretrained ML models are increasingly available through cloud service APIs, often focused on specific domains or industries.

- Data science and machine learning education is becoming a standard at many academic institutions, therefore fueling the supply of newer talent eager to venture into this space.

- There's always active research in the area of machine learning in different industries — manufacturing, healthcare, corporate legal, defense and intelligence. Thus, its applicability is far and wide.

- Newer learning techniques such as zero, one, few or end shot learning are emerging that take away the burden of having high volumes of quality training data for ML initiatives. This lowers the barrier to entry and experimentation for organizations.

- New frontiers are being explored in synthetic data, new algorithms (e.g., deep learning variations) and new types of learning. These include federated/collaborative, generative adversarial, transfer, adaptive and self-supervised learning, all aiming to broaden ML adoption.

Obstacles

- The triggers of its massive growth and adoption have been growing volumes of data, advancements in compute infrastructure and the complexities that conventional engineering approaches are unable to handle.

- Even though ML is one of the particularly popular AI initiatives in the last few years, it is not the only one. Organizations also tend to rely on other AI techniques such as rule-based engines, optimization techniques, physical models to achieve decision augmentation or automation.

- A significant portion of ML models at an organization doesn't make it into production, therefore adding to technical debt and risks mistrust in the initiative, often delaying value realization from ML at organizations.

- The application of ML is often oversimplified as just model development but it's not so. Several dependencies which are overlooked, such as data quality, security, legal compliance, ethical and fair use of data, serving infrastructure, and so forth, have to be considered in ML initiatives.

User Recommendations

- Build up and extend descriptive analysis toward predictive and prescriptive insights, which can be excellent candidates for machine learning.

- Assemble a (virtual) team that prioritizes machine learning use cases, and establish a governance process to progress the most valuable use cases through to production.

- Utilize packaged applications if you find one that suits your use case requirements. These often can provide superb cost-time-risk trade-offs and significantly lower the skills barrier.

- Explicitly manage MLOps and ModelOps for deploying, integrating and monitoring analytical, ML and AI models.

- Adjust your data management and information governance strategies to enable your ML team. Data is your unique competitive differentiator, and adequate data quality, such as the representativeness of historical data for current market conditions, is critical for the success of ML.

Sample Vendors

Amazon Web Services (AWS); Databricks; Dataiku; DataRobot; Domino; Google Cloud Vertex AI; H2O.ai; Microsoft Azure; SAS; TIBCO Software

Gartner Recommended Reading

Magic Quadrant for Data Science and Machine Learning Platforms

Critical Capabilities for Data Science and Machine Learning Platforms

Toolkit: RFP for Data Science and Machine Learning Platforms

3 Types of Machine Learning for the Enterprise

Understanding MLOps to Operationalize Machine Learning Projects

Virtual Assistants

Analysis By: Van Baker

Benefit Rating: Transformational

Market Penetration: 5% to 20% of target audience

Maturity: Adolescent

Definition

Virtual assistants (VAs) help users with tasks previously handled by humans. VAs use semantic and deep learning models, natural language processing, prediction models, recommendations and personalization to interact with people via voice or text conversations. Increasingly, they also automate processes and workflows. VAs learn from user behaviors, build data models, and recommend and complete actions to support VA users. VAs can be deployed in simple as well as complex use cases.

Why This Is Important

Conversational interactions are inherently appealing to both customers and members of the workforce. The ability to converse with applications to retrieve information or accomplish transactions is a natural extension of human-to-human interactions to human-to-machine interactions. A well implemented virtual assistant is always available, cannot be distracted, and can be very efficient in assisting humans in accomplishing tasks and retrieving necessary information.

Business Impact

VAs, RPA, event brokers and other technologies are automating the enterprise. VAs use contextual multiturn conversations to drive business workflows. Integration with enterprise applications enhances the handling of complex tasks by VAs. Consumer VAs led to enterprise VAs embedded in SaaS platforms. Business channels such as websites, mobile apps and messaging are commonplace. Voice-based VAs are becoming the focus of conversational AI providers. Additionally, use of VAs can expand hours of operation and improve customer response time.

Drivers

- Customer expectation for access to customer service anytime, anywhere. This is especially true for online e-commerce businesses that have seen extreme growth in response to the pandemic.

- Consumer expectation for access to product information anytime, anywhere. E-commerce is a 24/7 business and consumers expect to get their answers whenever they engage.

- Employee access to information on a real-time basis via conversational queries, resulting in enhanced productivity because of increased use of business-critical information.

- Increasing demand for technology that is easy to understand and interact with. While this is true for all workers, it is especially needed by remote workers in the enterprise.

- A strong desire by businesses to automate business workflows and processes wherever automation can deliver value to the business.

- The ability to initiate communication with your workforce in response to event triggered conditions or transactions. This facilitates more timely response to changing business conditions by removing the need for workers to initiate transactions.

- The ability of conversational AI platforms to deliver more complex transaction capabilities spanning multiple users and business processes.

- Improved access to the business across multiple channels addressing the preferences of particular customer segments, allowing them to select their channel and modality of choice.

- Improving capability for conversational AI platforms to use natural language generation. This allows the virtual assistants to initiate interaction with customers and employees rather than just reacting to user requests.

- VA tools are becoming available that enable the automatic ingestion of unstructured and structured data to enhance and improve the language models.

- Enabling technologies are making creation of VAs easier such as low-code tools, automated identification of intents and entities, and the use of APIs for complex integrations.

Obstacles

- Poor or inadequate language models for the use case that is deployed. The virtual assistants need to be able to respond to an extraordinary variety of users' questions. They should also be able to handle off-topic questions to some degree.

- Inadequate conversational AI platforms that do not have the capabilities needed to deliver virtual assistants. Many platforms lack the ability to handle complex transactions, context switching, multi-intent utterances, strong integration, process automation and other functionality needed for virtual assistance level capabilities.

- A design approach that oversimplifies use cases for virtual assistants. Many dialogue designs assume consistency in the way that people ask questions or do transactions that do not exist. This often leads to successful pilot development efforts that fail upon deployment.

- The need for ongoing continual retraining of the language models is often overlooked or ignored leading to poor performance over time.

User Recommendations

- Assess the continual rapid evolution of the technologies that support the creation and deployment of virtual assistants. These technologies are evolving at a very rapid pace that is not expected to slow in the near term.

- Deliver significant levels of integration and business process automation in conjunction with virtual assistant conversational capability as the platforms in the market are becoming increasingly sophisticated. Many conversation AI platforms include workflow automation capabilities as part of their offering.

- Evaluate that VAs will have voice and text capabilities with voice becoming the dominant modality.

- Define a chatbot strategy at the enterprise level and decouple the technical decisions from it.

- Pick your core services by favoring modular technical solutions that allow the same.

Gartner Recommended Reading

When Should I Use Embedded Conversational Assistants?

Making Sense of the Chatbot and Conversational AI Platform Market

Craft a Chatbot Initiative Based on Your Business Requirements and Solution Complexity

Roles and Responsibilities for Scaling Chatbot Initiatives

Solution Criteria for Enterprise Conversational AI Platforms

Design Thinking

Analysis By: Gene Phifer

Benefit Rating: High

Market Penetration: 20% to 50% of target audience

Maturity: Early mainstream

Definition

Design thinking is a multidisciplinary process used to improve the design of digital and analog products and services. It starts with empathy for users and the gathering of insight about their needs and motivations. These are then developed using an iterative, experimental approach. Deep customer insight, combined with a creative process, is ideal for digital innovation and digital product development. Design thinking helps to design high-value solutions and improve their usability.

Why This Is Important

Design thinking is a proven methodology applied to a broad range of business problems, but typically used to enhance usability and user experience (UX) of analog and digital products/services. UX is a key element of total experience, impacting both employee experience and customer experience. Leading organizations regularly practice design thinking on new, digital projects/products. Design thinking can also link to lean startup and agile methodologies, further enhancing application development.

Business Impact

Design thinking can be a crucial element for UX, which is critical for both employee experience (EX) and customer experience (CX). Higher levels of usability ensure that digital solutions are accessed and used by the end-user community. Usability also impacts CX key performance indicators (KPIs) like customer satisfaction, Net Promoter Score and customer effort score, and financial KPIs like customer retention, conversion, revenue and market share.

Drivers

- The growing importance of digital engagement with customers and employees has forced enterprises to take design seriously. Design teams, centers of excellence (COEs), user-centered design, usability testing, usability labs and skilled designers are but a few of the efforts made by enterprise IT to improve design. While these generally work well, a methodology for improving design as part of the development effort is needed. This is where design thinking comes in.

- Design thinking impacts UX, and UX impacts CX and EX (the two significant investment areas for enterprises). The relationship between UX, CX and EX is encapsulated in the concept of total experience, which is an emerging focus area for enterprises.

Obstacles

- Design thinking is a structured methodology, and as such, follows a specific set of steps. However, some developers may be unwilling to spend the necessary time at the design stage.

- Some experience in design and training in design thinking will ensure smooth application of design thinking. Fortunately, a high-end developer with years of design thinking experience isn't required; some basic training in design and design thinking is adequate. However, the relationship between the designer and the developer is important. The designer-developer pairing is a best-practice model for implementing design in projects and products, and for making design thinking work effectively.

- Design thinking has historically been accomplished by a group of people in the same location, frequently a dedicated space. With COVID-19, these gatherings are not possible and design thinking is forced into a remote-only model. This can be challenging, especially for steps like ideation and prototyping.

User Recommendations

- Identify opportunities for the application of design thinking to improve usability, especially in new digital projects and product development.

- Build cross-functional teams, drawing from business units and the IT department. Train them in the process of design thinking and give them time to practice it.

- Start simply and on a small scale in most cases. Take on more complex projects progressively as your experience grows. Eventually, consider building design COEs.

- Evolve your design thinking approaches to support the contactless world of COVID-19 and the post-COVID-19 era by supporting remote design thinking workshops. The key elements are: (1) a collection of digital collaboration tools; (2) electronic conference rooms; (3) multiscreen capabilities for individual WFH workers; and (4) application of DesignOps.

- Evaluate new tools for remote design thinking workshops to facilitate remote workers.

Sample Vendors

Accenture; frog; IBM; IDEO; Oracle; Pegasystems; Salesforce; SAP

Digital Twin

Analysis By: Alfonso Velosa, Marc Halpern, Benoit Lheureux

Benefit Rating: Transformational

Market Penetration: 1% to 5% of target audience

Maturity: Emerging

Definition

A digital twin is a virtual representation of an entity such as an asset, person, organization or process. The three types of digital twins are discrete, composite and organizational. Digital twin elements include the model, data, unique one-to-one association and monitorability. Digital twins are created in enabling platforms, such as analytics or simulation solutions, IoT platforms, or CRM applications.

Why This Is Important

Enterprises are using digital twins to create virtual representations of previously opaque entities or activities for process, cost or other business improvements. For instance, improved patient outcomes due to visibility of the entire patient across the siloed systems, or reductions in unplanned outages by monitoring the equipment state are now possible. Technology providers see digital twins and associated information products and services driving new customer outcomes and revenue streams.

Business Impact

- Digital twins enable business to enrich decisions — for example, to lower maintenance costs, increase asset uptime and improve performance.

- For OEMs, digital twins contribute to differentiation, new service models and obtaining customer data.

- Digital twins of people contribute to improved health monitoring, employee safety and customer transactions.

- Digital twins will help drive new business models, such as product as a service, as well as new data monetization approaches.

Drivers

- Enterprises are accelerating their adoption of digital twins to support a broad variety of business outcomes: reducing cost structure through improved remote monitoring of assets; optimization of equipment and processes by aligning asset digital twins into a range of solutions, such as predictive analytics and field service management; product differentiation via stakeholder visualization and control of assets, as well as new customer monetization strategies via digital-twin-enabled services.

- Asset-intensive industries, such as oil and gas, have leveraged lessons from their extensive digital history toward using digital twins to improve business operations.

- Military equipment and service companies on a global basis have seen a consolidated push toward using digital twins and model-based system engineering from the national ministries or departments of defense.

- Leading-edge enterprises are implementing digital twins to model IT organizations, financial exchanges, and processes such as purchase order approvals and fulfillment — for cost optimization and process improvement purposes.

- Consortia such as the Digital Twin Consortium and the National Digital Twin Programme at the Centre for Digital Built Britain contribute to digital twin visibility and business cases.

- Technology providers have woken up to the potential ways they can serve their customers and drive new revenue models using their digital-twin-enabling product portfolios.

- Improvements in models of all types employ analytics, visualization and simulation capabilities to understand, predict and automate business actions.

Obstacles

- Enterprises lack clear business objectives for digital twins. They lack consensus on the scope, structure, process or teams to start developing business-focused digital twins.

- Few enterprises have the fusion teams of skilled business, finance, and technology people and the collaboration between these people.

- These fusion teams must conceive, create and maintain the core models that are synchronized to the real entities, yet few enterprises have the budgets to do so.

- Digital twins challenge most enterprises technically due to the blend of operational and information technologies needed to develop and maintain them.

- While consortium and standards bodies are emerging, they are all generally immature, with many vendors pushing proprietary formats. We lack standards for a broad range of digital twin integration, evolution and other technical issues.

- Few vendors have a viable go-to-market strategy to build a digital twin business, creating market confusion and excess hype.

User Recommendations

- Work with business leaders to establish realistic expectations for how digital twins can support business outcomes and establish KPIs to measure success.

- Engage the business unit to identify champions, get budget support and co-create the digital twin strategy.

- Avoid digital twin projects that lack a business sponsor and objective, as they will waste resources and undermine adoption.

- Identify IT gaps and build a roadmap to drive IT organization learning opportunities, its investment plan for internal skills, and partner selection strategy.

- Build an IT digital twins technology roadmap to mitigate the hype around proprietary vendor approaches. Incorporate best practices for software asset development and management, security and privacy, and integration.

- Assess the use cases and architectural and technical implications of composite and organizational digital twins.

- Develop a long-term governance strategy.

Sample Vendors

Amazon; AVEVA; Cognite; Cosmo Tech; GE Digital; Microsoft; Thynkli; Voovio; XMPro

Gartner Recommended Reading

Use 4 Building Blocks for Successful Digital Twin Design

What Should I Do to Ensure Digital Twin Success?

What Data and Analytics Leaders Need to Know and Do About Digital Twins

Essential Product Management Practices to Monetize Data and Analytics Assets

API Marketplaces

Analysis By: Mark O'Neill

Benefit Rating: Moderate

Market Penetration: 5% to 20% of target audience

Maturity: Emerging

Definition

An API marketplace is a platform for API providers to publish and market APIs. They range from API directories to API portals provided by a single API provider to commercial marketplaces. Consumers, mainly developers, use API marketplaces to discover APIs and (in some cases) purchase access to APIs. Although public API marketplaces are better-known, a growing number of organizations are deploying internal or private API marketplaces.

Why This Is Important

API marketplaces empower organizations to share APIs. External API marketplaces allow organizations to share APIs with a community of developers, including facilitating an ecosystem by enabling partners to implement solutions using their APIs. Internal API marketplaces address a different use case, which is to help developers discover and share APIs between teams.

Business Impact

For API providers, registering APIs in API marketplaces can increase developer visibility and consumer mind share, to drive API usage and, by extension, business impact. The API marketplace provider may take a share of the revenue for APIs sourced through the marketplace, but this can be considered a cost of sale. An API marketplace can also facilitate ecosystem creation and is a critical enabler of composable business.

Drivers

- Use of APIs is growing; according to the infrastructure and security vendor CloudFlare, in 2020, API traffic grew 300% faster than web traffic, reaching 50% of HTTP traffic. This demonstrates the need for API marketplaces to discover APIs from the large amount of APIs available.

- The number of APIs within an organization is also climbing, driving the need for developers to find which APIs and services are available.

- Composable business, including composable commerce, relies on the use of API marketplaces to share APIs and packaged business capabilities.

- Increased use of low-code platforms, iPaaS, RPA and analytics tooling enables more citizen development, using APIs which may be sourced from API marketplaces.

- New open-source platforms such as Backstage, from Spotify, are driving the creation of internal API marketplaces as part of larger developer hubs.

Obstacles

- Public API marketplaces which provide a public directory of APIs have generally had disappointing results, because developers are more likely to go to API providers directly to sign up for APIs. This has resulted in API marketplaces approaching the Trough of Disillusionment. However, internal API marketplaces have had more success, since they enable developers to share APIs across multiple teams.

- API portals provided as part of API management platforms are typically basic in nature, resulting in significant customization work to create an API marketplaces based on such an API portal.

User Recommendations

API providers:

- Manage senior business stakeholders' expectations by ensuring they are aware that outcomes from placing APIs in public API marketplaces are often disappointing.

- Examine billing terms to understand what goes to the marketplace provider when considering commercial API marketplaces. Since your APIs may be side-by-side with competing APIs, think carefully about differentiation.

- Establish a commercial model upfront (e.g., through registration fees and/or revenue share) and a clear governance process for onboarding third-party APIs if you plan to build your own API marketplace.

API consumers:

- Ensure that you use APIs from trusted marketplaces and trusted API providers, examining usage agreements, licensing and billing terms carefully. In general, ensure that you are governing your organization's usage of third-party APIs.

- Investigate if subscribing to an API directly from the API provider offers better pricing or usage terms than consuming the API through a marketplace.

Sample Vendors

Achieve Internet; Backstage; Constellant; Cortex; Effx; ProgrammableWeb (Salesforce); Pronovix; RapidAPI; Roadie

Gartner Recommended Reading

How to Derive Value From APIs Using API Marketplaces

Create API Portals That Drive API Adoption Among Internal and External Developer Communities

Choose the Right API Monetization and Pricing Model

To Create a Successful API-Based Ecosystem, Look Before You Leap

Enterprise Agile Frameworks

Analysis By: Mike West

Benefit Rating: High

Market Penetration: More than 50% of target audience

Maturity: Early mainstream

Definition

Enterprise agile frameworks are a collection of one or more methodologies and associated principles, such as lean and systems thinking.It is structured in a way to enable the delivery of large, complex agile initiatives. They may be top-down, bottom-up or a combination. They are increasingly implemented by organizations scaling up to address enterprise initiatives for complex software or cyber-physical product releases.

Why This Is Important

Enterprise agile frameworks provide organizations with structures, processes and practices that enable delivery of complex products. They can be used to implement, upgrade, migrate and enhance enterprise software and cloud solutions. Their purpose is to make the management and coordination of complex agile releases and evolving solutions not only feasible, but routine and sustainable.

Business Impact

Enterprise agile frameworks (EAFs) provide organizations with:

- Formal approaches for managing the work and deliverables of multiple teams.

- Structures, processes and practices that enable delivery of complex products.

- The ability to manage development of cyber-physical systems.

- Portfolio management discipline for allocating resources and tracking financial benefits.

EAFs also make possible agile configuration, integration, delivery and ongoing management of ERP and other complex corporate solutions.

Drivers

- Trust in agile development has grown across industries and geographies.

- The proportion of those doing most or all in agile has grown to exceed the percentage doing some agile development.

- Organizations have discovered that it is possible to align multiple teams to the same development initiative, but scrum of scrums is not practical for most.

- Consistent practices have become necessary to manage some of the challenges of complex agile development, such as cross-team dependencies.

- Many organizations now require formal governance to manage these complex, multiteam initiatives.

- Regulatory compliance issues increase the need to manage not just development, but the communications around the process.

- Financial expectations of organizations undertaking large-scale development require formal policy, process and practices.

Obstacles

- EAFs require experienced agile scrum teams that have attained predictable and productive velocity with high software quality.

- It requires incorporation of additional practices from extreme programming (XP) and other methods to enhance team productivity.

- It requires DevOps practices and a pipeline (or platform) in operation to deliver production-ready releases.

- It requires support for implementation at the CIO level or above with adequate funds to ensure training, coaching and facilitation of planning processes.

- It requires an internal customer with a need to scale to implement a complex system across many teams of developers.

- It can take as long as three-to-four years for most organizations to mature their agile capability and culture to be ready to scale.

- Not every organization will need to scale across multiple teams or require an enterprise agile framework. Some organizations will adopt more than one framework.

User Recommendations

As an application or software engineering leader scaling agile, you should:

- Drive the framework selection process by using evaluation criteria based on the solutions you will build, rather than a framework's popularity.

- Deliver positive outcomes in the selection process by shortlisting only frameworks that are compatible with your organization's culture, maturity and stakeholder needs. There is no single approach to scaling agile development that suits all organizations.

- Enable successful implementation by selecting a framework with sufficient training, consulting and support in your geography. Training and related consulting services for enterprise agile frameworks are still evolving.

- Ensure success in scaling by building agile team capabilities, engaging leadership around outcome-based value propositions and utilizing a team of change agents to seed and scale implementation.

Gartner Recommended Reading

Adapt Spotify's Chapters and Guilds for Better Business Outcomes

10 Essential Practices for Success in Implementing the Scaled Agile Framework (SAFe)

Bust Silos, Focus on Customers and Enhance Business Outcomes Through Value Streams

Market Guide for Enterprise Agile Frameworks

Citizen Integrator Tools

Analysis By: Massimo Pezzini, Tim Faith

Benefit Rating: Moderate

Market Penetration: 5% to 20% of target audience

Maturity: Early mainstream

Definition

Citizen integrator tools are typically cloud-hosted services providing very intuitive, no-code integration process development tools. This way expert business users with minimal IT skills can handle relatively simple application, data and process integration tasks (or "automations") by themselves. Citizen integrator tools also provide a rich set of packaged integration processes (PIPs) that business users can rapidly configure and run with no assistance from integration specialists.

Why This Is Important

Organizations must address a growing amount of integration challenges in shorter and shorter timeframes, which implies having at their disposal several "integrators" equipped with high productivity tools.

Citizen integrator tools enable business users with minimal IT skills to perform self-service integration work, thus increasing the organization's overall delivery capacity. However their ungoverned proliferation can lead to security and compliance risks and duplicated costs.

Business Impact

Citizen integrator tools enable business users to automate tasks currently integrated via slow and error-prone manual methods. Integration specialists or ad hoc integrators (developers, SaaS administrators), also use these tools to quickly sort out simple tasks instead of using more powerful, but expensive and complex tools. Therefore, citizen integrator tools contribute to improving organizations' efficiency, productivity, agility and innovation by reducing the relevant integration costs.

Drivers

- Citizen integrator tools may help deliver business value faster, reduce integration costs and support tactical or strategic digital initiatives. These outcomes are achieved by enabling rapid, pervasive integration by a wide range of employees within (and potentially also outside) the organization. However they are available in many forms, which address different markets and needs: PIPs — At times called "recipes," these are prepackaged and configurable sets of integration flows, available stand-alone (at times for free), as embedded capabilities in SaaS or as add-ons to integration platforms. As such buyers are typically application owners or SaaS administrators. Integration software as a service (iSaaS) — Cloud services that enable users to implement brand new PIPs and to deploy, run and customize existing ones. They are typically sold to individual business users or work teams. Integration platform as a service (iPaaS) — These are targeted to professional integrators, but several iPaaS provide an iSaaS-like development environment and/or make available collections of configurable PIPs atop their platform.

- iSaaS tools have achieved notable traction in the consumer and SMB markets, thanks to their very low cost of entry, intuitive user experience, low skills demand and their rich set of PIPs. However, they have failed to penetrate other segments due to their lack of enterprise capabilities and services (for example, consulting).

- PIPs and iPaaS providing citizen-integrator-oriented capabilities are becoming more and more popular in midsize, large and global organizations. The growing use of AI, ML, NLP and chatbots in iPaaS offerings to facilitate integration development is augmenting their appeal for citizen integrators, thus further favoring adoption.

Obstacles

- Business users are increasingly technology savvy and often driven by time-to-market pressures, especially in the post-pandemic era that requires fast reaction to sudden changes in the business environment. This will increasingly urge them to adopt cloud citizen integrator tools, rather than wait for their IT colleagues to methodically perform integration work for them. However, this will create a few challenges: If not framed in a proper governance model, citizen integrator tools adoption by business users will inevitably lead to security, compliance, management and governance issues.

- Although some central IT departments will adopt a positive attitude and proactively address these challenges, others will try to stop business users from leveraging these tools to prevent these risks. In addition, excessive expectations for ultra-easy, super-fast integration and the simplistic nature of some citizen integrator tools may still lead to disappointment, thus hindering their more widespread adoption.

User Recommendations

Software engineering leaders responsible for integration should:

- Engage with business teams to understand their automation needs and identify to what extent citizen integrator tools can improve their responsiveness and productivity.

- Approve, certify and support a set of citizen integrator tools that meet these needs and make them available to internal users in a self-service way. This will help to prevent the uncontrolled proliferation of similar tools and maintain a degree of centralized governance and monitoring.

- Beware when selecting citizen integrator tools that: some tools are rather simplistic and lowest-common-denominator in nature; and PIPs provided by SaaS vendors may have been designed for a professional IT developer audience.

- Give preference to providers that can support both "professional" and citizen integrator requirements when selecting an iPaaS.

- Frame citizen integrator tools, including those embedded in SaaS applications, in your hybrid integration platform (HIP) strategies.

Sample Vendors

Adeptia; Celonis (Integromat); elastic.io; IFTTT; Microsoft; Quickbase; Tray.io; Workato; Zapier

Gartner Recommended Reading

Accelerate Your Integration Delivery by Using Packaged Integration Processes

The Applications of the Future Will Be Founded on Democratized, Self-Service Integration

Quick Answer: When to Use (or Not Use) Embedded Integration Features Provided by Your SaaS Vendor

MASA

Analysis By: Anne Thomas

Benefit Rating: High

Market Penetration: 5% to 20% of target audience

Maturity: Early mainstream

Definition

Mesh app and service architecture (MASA) is a composition-based application architecture that enables application delivery teams to respond rapidly to changing business demands and support multiple experiences. A MASA application is implemented as a mesh of distributed, loosely coupled, autonomous and shareable components, including multiple fit-for-purpose apps supporting unique experiences and composable multigrained back-end services. Apps and services communicate via mediated APIs.

Why This Is Important

MASA describes the foundation for modern business application architecture. It enables multiexperience applications. It supports agility and rapid delivery of new capabilities. It is a technical architecture that enables composability. It facilitates incremental modernization of legacy applications while providing mechanisms that ensure security and robust operations.

Business Impact

MASA enables organizations to respond rapidly to opportunities and disruptions through extension and recomposition. It enables multiexperience. It enables cloud-native architectures. MASA is an architecture for individual applications, as well as a strategy for modernizing the application portfolio. It provides an evolutionary approach that enables development teams to iteratively modernize their applications in direct response to business priorities.

Drivers

The initial impetus to shift to MASA was to enable existing applications to add support for mobile experiences. But MASA enables many other critical application capabilities, such as:

- Multiple experiences for different types of devices and modalities, such as voice, touch, wearables and immersive technologies.

- Distinct, optimized experiences for the different personas that use an application.

- Rapid response to disruptive events and changing business priorities via composition of existing services and creation of new experiences.

- Greater flexibility through loose coupling of components.

- Improved application performance, scalability, security and resilience through intelligent mediation.

Obstacles

- The biggest obstacle to MASA is the extensive technical debt embedded in existing application portfolios.

- MASA requires application functionality to be encapsulated and exposed via APIs. Those legacy applications must be modernized and refactored to convert the embedded business logic into composable services.

- The architecture enables iterative modernization, but it will take years (perhaps decades) to modernize the entire application portfolio.

- MASA also requires an investment in API mediation and multiexperience technologies.

User Recommendations

Software engineering leaders responsible for architecture and infrastructure:

- Ensure that development teams have competence in user experience design, service-oriented architecture, API design and domain-driven design.

- Task your architects with updating existing technical architectures, governance mechanisms and success metrics to align them with using a MASA approach to modernize application delivery.

- Analyze your business's digital transformation roadmap and identify and prioritize applications to modernize to support those needs.

- Encapsulate data and functionality in existing applications and expose them via APIs to enable composition.

- Mediate API traffic to apply governance, performance and security policies.

- Take a pragmatic approach to creating services: encapsulate, extend or refactor existing applications or build new services.

- Determine appropriate service granularity based on your objectives. Don't presume that all services within MASA must be microservices.

Gartner Recommended Reading

Adopt a Mesh App and Service Architecture to Power Your Digital Business

3 Key Practices to Enable Your Multiexperience Development Strategy

Leading Teams to Success with Microservices Architecture

Mediated APIs: An Essential Application Architecture for Digital Business

How to Apply Design and Architecture to Multiexperience Application Development

Accelerate Digital Transformation With an API-Centric (Headless) Architecture for Enterprise Applications

Full Life Cycle API Management

Analysis By: Shameen Pillai

Benefit Rating: High

Market Penetration: More than 50% of target audience

Maturity: Early mainstream

Definition

Full life cycle API management involves the planning, design, implementation, testing, publication, operation, consumption, versioning and retirement of APIs. API management tools enable API ecosystems and publishing APIs that securely operate and collect analytics for monitoring and business value reporting. These capabilities are typically packaged as a combination of developer portal, API gateway, API design, development and testing tools as well as policy management and analytics.

Why This Is Important

APIs are widely used and accepted as the primary choice to connect systems, applications and things to build modern composable software architectures. The use of APIs as digital products monetized directly or indirectly is also on the rise. Advancing digital transformation initiatives across the world have emphasized the need for creation, management, operations and security of APIs and made full life cycle API management an essential foundational capability every organization must have.

Business Impact

Full life cycle API management provides the framework and tools necessary to manage and govern APIs that are foundational elements of multiexperience applications, composable architectures and key enablers of digital transformations. It enables the creation of API products, which may be directly or indirectly monetized, while its security features serve to protect organizations from the business impact of API breaches.

Drivers

- Organizations are facing an explosion of APIs, stemming from the need to connect systems, devices and other businesses. Use of APIs in internal, external, B2B, private and public sharing of data is driving up the need to manage and govern APIs using full life cycle API management.

- APIs that package data, services and insights are increasingly being treated as products that are monetized (directly or indirectly) and enable platform business models. Full life cycle API management provides the tooling to treat APIs as products.

- Digital transformation drives increased use of APIs, which in turn increases the demand for API management.

- APIs provide the foundational elements required for growth acceleration and business resilience.

- Developer mind share for APIs is growing. Newer approaches to event-based APIs, design innovations and modeling approaches such as GraphQL, are driving interest, experimentation and growth in full life cycle API management.

- Cloud adoption and cloud-native architectural approaches to computing (including serverless computing) are increasing the use of APIs in software engineering architectures, especially in the context of microservices, service mesh and serverless.

- Regulated, industry-specific initiatives such as open banking and connected healthcare, along with nonregulated, opportunistic approaches in other industries are increasing the demand for full life cycle API management.

Obstacles

- Lack of commitment to adequate organizational governance processes hinders adoption of full life cycle API management. This can be due to lack of skills or know-how, or due to too much focus on bureaucratic approaches rather than federated and automated governance approaches.

- Lack of strategic focus on business value (quantifiable business growth or operational efficiencies) and too much focus on technical use cases can disengage business users and sponsors. This is particularly apparent in cases where API programs fail to deliver promised return on investment.

- Traditional, single-gateway approaches to API management do not fit well to a modern, distributed application environment.

- Partial or full set of API management capabilities provided by vendors in other markets such as application development, integration platforms, security solutions, B2B offerings, etc., can create confusion and potentially shrink the market opportunities.

User Recommendations

- Use full life cycle API management to power your API strategy that addresses both technical and business requirements for APIs. Select offerings that have the ability to address needs well beyond the first year.

- Treat APIs as products managed by API product managers in a federated API platform team.

- Choose a functionally broad API management solution that supports modern API trends, including microservices, multigateway and multicloud architectures. Ensure that the chosen solution covers the entire API life cycle, not just the runtime or operational aspects.

- Use full life cycle API management to enable governance of all APIs (not just APIs you produce), including third-party (private or public) APIs you consume.

- Question full life cycle API management vendors on their support for automation of API validation and other capabilities, as well as their support for a modern, low-footprint API gateway.

Sample Vendors

Axway; Google; IBM; Kong; Microsoft; MuleSoft; Software AG

Gartner Recommended Reading

Magic Quadrant for Full Life Cycle API Management

The Evolving Role of the API Product Manager in Digital Product Management

How to Use KPIs to Measure the Business Value of APIs

API Security: What You Need to Do to Protect Your APIs

Top 10 Things Software Engineering Leaders Need to Know About APIs

Citizen Developers

Analysis By: Jason Wong

Benefit Rating: High

Market Penetration: 20% to 50% of target audience

Maturity: Early mainstream

Definition

Citizen developers are employees not in the IT organization who create or extend application capabilities, mainly for internal consumption by teams or workgroups. They can use development tools and runtime environments sanctioned (or at least not actively forbidden) by corporate IT or the business units. A citizen developer is not a title, role or professional developer in the business unit, but rather a persona taken on by an employee.

Why This Is Important

Citizen development is part of the business-IT continuum and the democratization of technology trends. Business leaders are increasingly owning their departmental applications, as well as building an increasing number of applications themselves. The COVID-19 pandemic and remote working have accelerated the need for greater business agility and putting better tools in the hands of employees so they can more rapidly solve their problems with new apps and automation.

Business Impact

The long-term strategic impact of citizen development is enabling self-service business innovation within business units. Citizen developers are often aided by IT in some aspects of co-creation or technical support. They can generate new ideas leading to greater business agility, as well as increased workforce efficacy and efficiency. Citizen development hackathons are a great way to promote and foster citizen development, while enhancing digital dexterity across the enterprise.

Drivers

- According to a 2021 Gartner survey on Reimagining Technology Work, 41% of respondents can be classified as business technologists. These are employees who don't report into an enterprise or business unit IT function yet they use tools to produce some technology output, such as analytics reports, apps or automation. (Note: Some of these business technologists are professional developers, such as software engineers, working in a business unit like marketing, or research and development. These professionals are not citizen developers, but do work with citizen developers.)

- Employees have easier access to more tools than ever before, and it's only increasing. A citizen developer is not a full-time professional developer, nor a specific role, but rather a persona of a business technologist using these tools. They may have some job responsibility to develop a solution, or simply choose to engage in development activities to achieve some business outcome for the greater good. Gartner's 2021 Hyperautomation Survey found that business technologists working on business-driven automation initiatives use on average 2.7 tools (out of 21 tools shown).

- Citizen developers feel more empowered by powerful low-code development tools and "no code" tools that specifically cater to them. Many vendors now provide robust low-code development platforms making it easier for citizen developers to develop their own applications — even applications that once required professional development skills, such as building mobile apps or using AI automation services like chatbots.

- Citizen developers may also take on other citizen personas depending on their skills, ambition and scope of work. Gartner often sees citizen data scientist, citizen integrator and citizen automator personas in the digital workplace. Over time, some of these citizen developers have become part of fusion teams including business and IT collaboration and development.

Obstacles

■ IT leaders often have a negative view of development outside of IT and label it as "shadow IT." Citizen development is not shadow IT. IT's resistance to recognizing business technologists' work and embracing citizen development results in missed opportunities to drive toward business and IT alignment.

■ IT leaders also often fear losing control on account of increasing citizen development activities, making their teams less relevant or burdening IT with unmaintainable apps. However, the risks of citizen development are typically outweighed by the benefits. Risks to IT can be better managed by directly addressing inadequate tooling and disorganized support for a citizen development community, which are key factors leading to poor outcomes and risky apps.

User Recommendations

■ Engage nonprofessional business technologists more actively to enlist and enable them to become citizen developers. Ignoring or attempting to prevent citizen development often carries more risks and limits enterprise innovation.

■ Mitigate shadow IT risks by working with business unit leaders to enlist citizen developers to establish trust and define safe activity zones.

■ Enable self-governing citizen development practices by fostering a community of practice (CoP) across business units and with IT.

■ Improve outcomes for citizen-developed apps by joint (business and IT) selection of the right tools and enabling technologies.

Gartner Recommended Reading
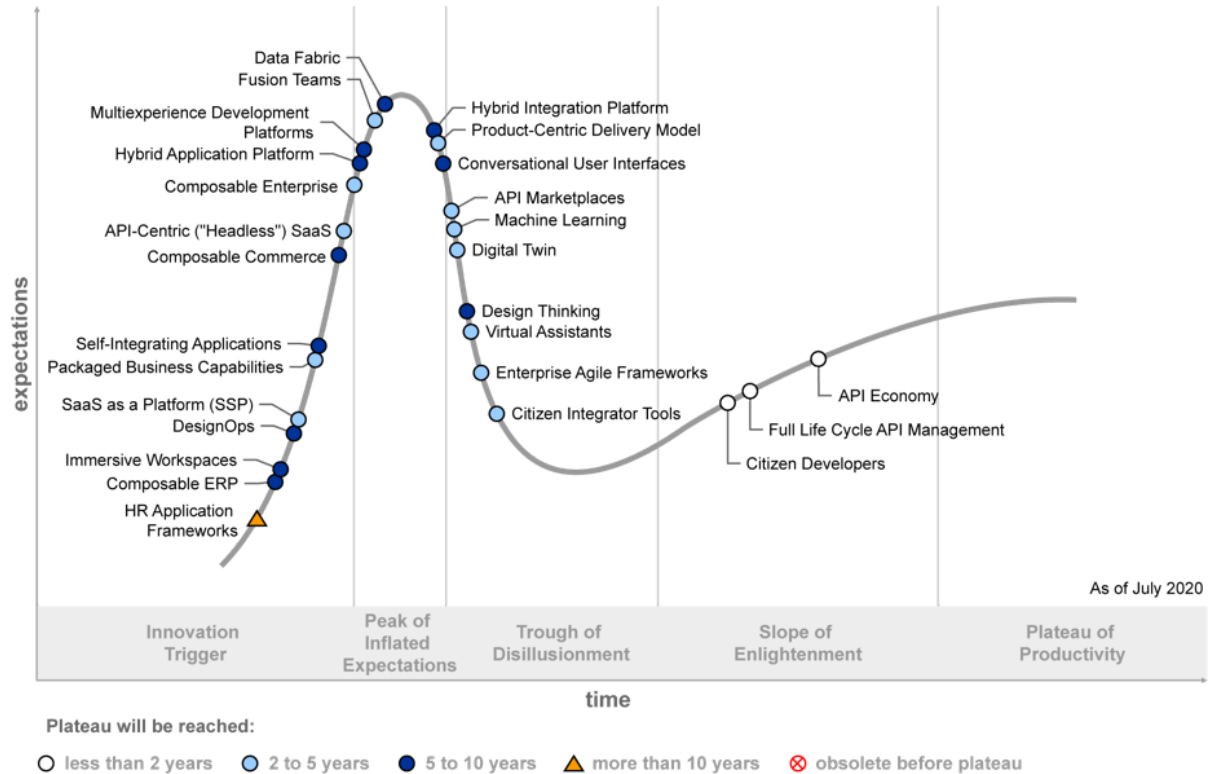
How to Define and Guide Citizen Development Practices

Platform-Enabled Citizen Development (BP)

Democratize and Distribute Technology Work Across the Entire Enterprise to Accelerate Digital Business

Appendixes

Figure 2. Hype Cycle for the Future of Applications, 2020

Source: Gartner (July 2020)

Table 2: Hype Cycle Phases

(Enlarged table in Appendix)

Phase ↓	Definition ↓
Innovation Trigger	A breakthrough, public demonstration, product launch or other event generates significant media and industry interest.
Peak of Inflated Expectations	During this phase of overenthusiasm and unrealistic projections, a flurry of well-publicized activity by technology leaders results in some successes, but more failures, as the innovation is pushed to its limits. The only enterprises making money are conference organizers and content publishers.
Trough of Disillusionment	Because the innovation does not live up to its overinflated expectations, it rapidly becomes unfashionable. Media interest wanes, except for a few cautionary tales.
Slope of Enlightenment	Focused experimentation and solid hard work by an increasingly diverse range of organizations lead to a true understanding of the innovation's applicability, risks and benefits. Commercial off-the-shelf methodologies and tools ease the development process.
Plateau of Productivity	The real-world benefits of the innovation are demonstrated and accepted. Tools and methodologies are increasingly stable as they enter their second and third generations. Growing numbers of organizations feel comfortable with the reduced level of risk; the rapid growth phase of adoption begins. Approximately 20% of the technology's target audience has adopted or is adopting the technology as it enters this phase.
Years to Mainstream Adoption	The time required for the innovation to reach the Plateau of Productivity.

Source: Gartner (August 2021)

Table 3: Benefit Ratings

Benefit Rating ↓	Definition ↓
Transformational	Enables new ways of doing business across industries that will result in major shifts in industry dynamics
High	Enables new ways of performing horizontal or vertical processes that will result in significantly increased revenue or cost savings for an enterprise
Moderate	Provides incremental improvements to established processes that will result in increased revenue or cost savings for an enterprise
Low	Slightly improves processes (for example, improved user experience) that will be difficult to translate into increased revenue or cost savings

Source: Gartner (August 2021)

Table 4: Maturity Levels

(Enlarged table in Appendix)

Maturity Levels ↓	Status ↓	Products/Vendors ↓
Embryonic	In labs	None
Emerging	Commercialization by vendors Pilots and deployments by industry leaders	First generation High price Much customization
Adolescent	Maturing technology capabilities and process understanding Uptake beyond early adopters	Second generation Less customization
Early mainstream	Proven technology Vendors, technology and adoption rapidly evolving	Third generation More out-of-box methodologies
Mature mainstream	Robust technology Not much evolution in vendors or technology	Several dominant vendors
Legacy	Not appropriate for new developments Cost of migration constrains replacement	Maintenance revenue focus
Obsolete	Rarely used	Used/resale market only

Source: Gartner (August 2021)

Evidence

The 2020 Gartner Digital Friction Survey was conducted in January 2020 among nearly 5,000 employees across functions, levels, industries and geographies. The survey assessed the analytic and technology activities in employees' jobs and the level of unnecessary effort they exerted when using and building analytic and technology solutions.

The 2021 Gartner Reimagining Technology Work Survey was conducted via an online panel in March 2021 among over 6,000 employees across functions, levels, industries and geographies. The survey examined the extent to which employees outside of IT were involved in customizing and building analytics or technology solutions, the types of activities they performed, the teams and structures they worked in, and the types of support they received, among others.

The 2021 Gartner Hyperautomation Survey was conducted online during March 2021 among 558 business technologists from North America (n = 226), Europe (n = 146), LATAM (n = 78) and APAC (n = 108).

To be qualified to answer, the survey respondents would need to:

- Have created, built or coded analytics or technology capabilities on their own or with input from others in the last 12 months

- Have used, in the same time period, at least one of the tools to produce analytics or technology capabilities for work; 21 tools were considered under four categories: application development tools, automation tools, integration tools, and data science and AI tools

Results of this study do not represent global findings or the market as a whole, but reflect sentiment of the respondents and companies surveyed.

Note 1: Meaning of "Headless"

"A 'headless' or API-centric approach has emerged as an alternate method to implement the UI and integrations for these types of applications or combinations of them. The API-centric approach involves using APIs provided by the enterprise applications to implement the optimal customer experiences and integrations. The term 'headless' comes from the idea that you are no longer using the UI capabilities of the enterprise application to build the client UI." (As quoted from Accelerate Digital Transformation With an API-Centric (Headless) Architecture for Enterprise Applications)

Document Revision History

Hype Cycle for the Future of Applications, 2020 - 27 July 2020

Hype Cycle for Advanced Future of Applications, 2019 - 5 August 2019

Recommended by the Authors

Some documents may not be available as part of your current Gartner subscription.

Understanding Gartner's Hype Cycles

Create Your Own Hype Cycle With Gartner's Hype Cycle Builder

Future of Applications: Delivering the Composable Enterprise

2021 Strategic Roadmap For The Composable Future Of Applications

Apply the Principles Behind the Future of Applications to Digital Commerce

Strategic Architecture Roadmap for Composable Enterprise Applications (Presentation)

Gartner

Table 1: Priority Matrix for the Future of Applications, 2021

Benefit	Years to Mainstream Adoption			
	Less Than 2 Years	2 - 5 Years	5 - 10 Years	More Than 10 Years
Transformational		Composable Applications Conversational User Interfaces Digital Twin Fusion Teams Machine Learning Product-Centric Delivery Model Virtual Assistants	Composable Commerce Composable ERP Data Fabric Industry Clouds Self-Integrating Applications	
High	Citizen Developers Enterprise Agile Frameworks Full Life Cycle API Management	API-Centric SaaS DesignOps MASA Packaged Business Capabilities SaaS as a Platform	Design Thinking HIP Immersive Workspaces MXDP	HR Application Frameworks
Moderate		API Marketplaces Citizen Integrator Tools		
Low				

Source: Gartner (August 2021)

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