



State of Digital Integration 2019

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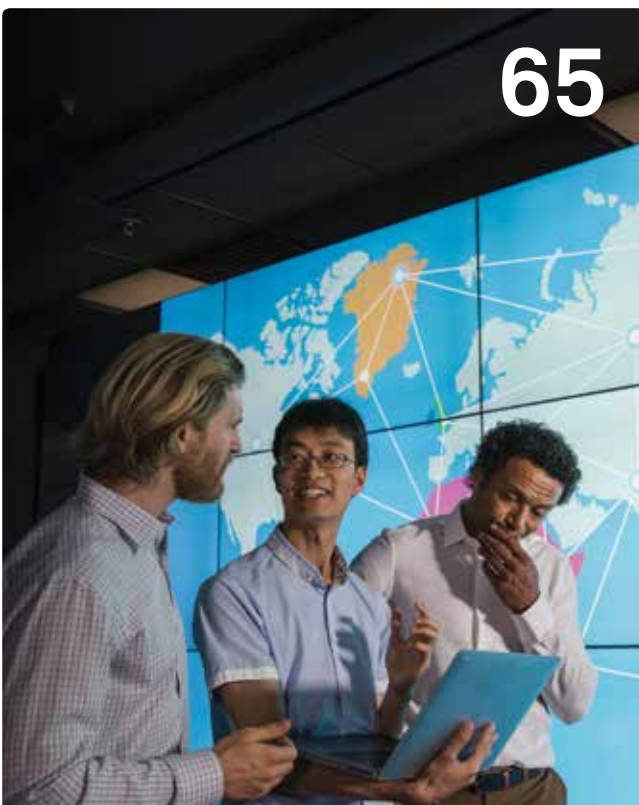
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Foreword



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Digital business has changed the benchmark for technology-led business disruption. Digital Transformation offers businesses endless opportunities but the change required to transform is continuous and needs a holistic approach. Successful **digital businesses** are those that progress with agility on their **enterprise digital journey** where the ultimate goal is to deliver differentiated customer and digital experiences. Enterprise digital journeyⁱ involves transformation on multiple dimensions including optimizing value streams, while building cloud-native architectures with AI-infused into all solutions. It also involves people and culture changes that adopt modern ways of working and new models of delivering applications and business capabilities.

Fundamental to an accelerated enterprise digital journey are **modern digital business platforms**. These platforms are the foundation for capabilities such as Artificial Intelligence, single view of data and any-to-any Integration. Consumable apps and business capabilities are then composed on top of these platforms. Whether connecting with partners to create a business ecosystem, or connecting to a machine to make IoT possible, Integration plays a major role. For example, HSBC has built an Open Banking API platform that opens their core banking capability to any innovation partner, thereby improving the experience for their customersⁱⁱ. JCB has created an IoT platform that could connect to any machine, to proactively monitor and manage themⁱⁱⁱ.

Central to these modern digital business platforms is Integration and in the context of digital business, we refer to it as Digital Integration. There have been several related technology disruptions in the past such as workflow automation, e-business, service-oriented technology and business intelligence but none match the scale and scope of Digital Integration. **Digital Integration** is the new architecture that seamlessly brings together multiple technologies to enable composition of smart applications and business capabilities and orchestrates a seamless value stream across the ecosystem in a boundary-less world.

As enterprises go through their **Digital Transformation journey**, awareness of where they stand in various facets of Digital Integration capability is crucial. Given the breadth and complexity of the Digital Integration landscape, from APIs to Cloud, it is also important to have a clear roadmap that is contextual to your industry or organization. The **State of Digital Integration 2019** is our cross-industry research report to create a valuable resource that will guide enterprises to be the best in their Digital Integration capability and accelerate their Digital Transformation journeys. The information in this report is based on a rich set of experiences and inputs from various customers and partners. I hope you will find this report useful as a reference guide to implement your Digital Integration strategy.

Preface



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I often say that modern enterprises have randomly evolved into a complex mesh of business capabilities that no human can comprehend. While that is said with humor, there is truth to it. Not many in large enterprises can map how their business capabilities are coming together. If enterprise cartography was a real discipline, it would be the toughest of all to master. Hundreds of legacy applications, databases, and processes have been integrated over decades. Adding to that are Digital Transformation initiatives that have brought in new entities such as Internet of Things, marketplaces, mobile apps, etc., thereby making **Digital Integration** critical to success.

During the research for this report, **State of Digital Integration 2019**, which surveyed our clients, we found that 90% of them believe Digital Integration is a Top 5 Priority and the success of Digital Transformation depends on it. It is also good to see that many of them are already running Digital Integration initiatives. Often, these initiatives seem siloed as they don't focus on the synergies brought by Digital Integration as an enterprise-wide strategic capability. It is my belief that a strategic view of Digital Integration is a must if you are to achieve success in your Digital Transformation journey. Also, it is essential to look at partner integration as well as legacy systems Integration from the lens of the end-to-end value stream, instead of seeing them as separate initiatives. All the entities participating in a value stream should come together seamlessly, similar to how an orchestra brings the various instruments and musicians together to create a memorable performance.

As we move into the post digital era, the importance of Digital Integration will only increase. Whether it is infusing Automation into every corner of an enterprise or in using Blockchain to build truly distributed trust-based ecosystems, Digital Integration will play a major role. APIs will be the first-class citizen of an enterprise landscape, similar to people and other physical resources like factories, offices and retail spaces. In such an API-first generation, new models of delivery shall evolve that are decentralized, agile and distributed.

So is there a single recipe for Digital Integration success? Not really. Strategies need to bring enterprise and industry-specific context into Digital Integration initiatives, making each effort unique.

This report, "State of Digital Integration 2019" is an attempt to distil the factors that contribute to Digital Integration success. It is based on our experience and that of our partners and customers. Within this report, you will find the guiding compass to create your unique Integration journey—and in the process avoid the many pitfalls that can dampen the impact of your Digital Transformation investments.

I thank the team that has researched and created this report. I am confident that you will find it just as interesting as we found researching it.

The Ubiquitous Integration



Integration, the Holy Grail of business success and the magic fuel for innovation, has become more important than ever. It now defines the success of Digital Transformation.

The quest for business integration has been around for centuries—business partners have signed complex contracts to integrate and share capabilities, assets, knowledge and markets. Over the last few decades, with the adoption of Information Technology, Integration has acquired a distinctly technological flavor. The gains that technology achieves largely remain the same, but with infinitely superior and more measurable results.

Over the last two decades, Integration has steadily moved from legacy application integration to the use of modern APIs, microservices and Integration Platforms as a Service (iPaaS) to become ubiquitous. It now

plays a key role in the success of modern digital business (see Figure 1).

Today, Integration has become the backbone of organizations, stitching together a fabric of business that is innovative and goes well beyond traditional organizational boundaries. Lufthansa’s effort to meet customer needs provides a fine example of what Integration can achieve. The airline’s open APIs offer access to its flight schedules, flight status, airport and aircraft details. These APIs have enabled businesses like Uber to innovate. Using real-time data on flight delays, Uber is able to suggest changes in ride bookings to its customers flying Lufthansa^{iv}.

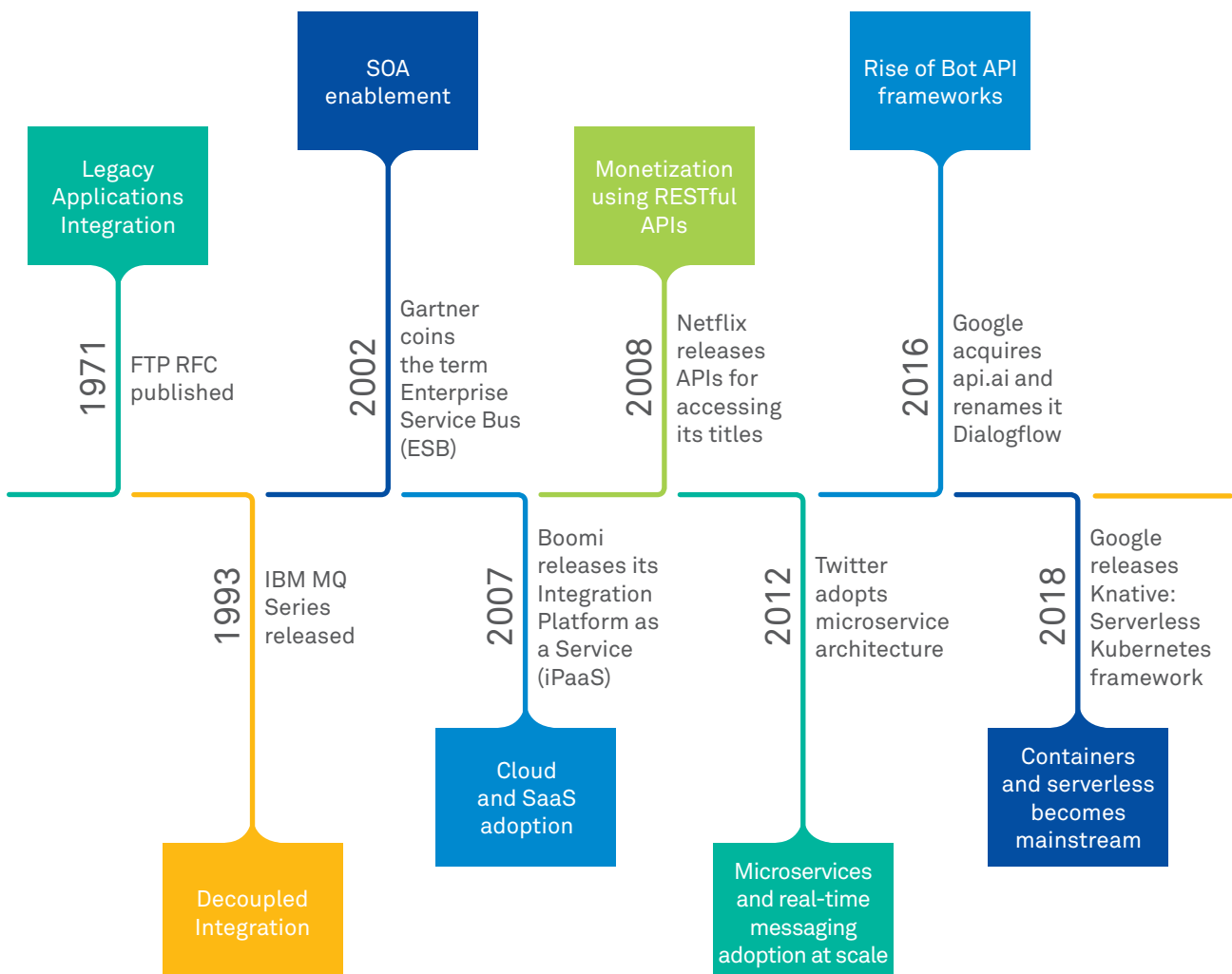


Figure 1: Evolution to Digital Integration

Rethinking Integration for Digital Transformation

Over the last decade, the success of business industries has been tied to differentiation offered in Customer Experience (CX). Delivering differentiated CX has led to Digital Transformation initiatives across organizations. Delivering the best possible CX is 20% about UI and usability, while 80% is about how people, devices, systems, partners, employees and geographic locations are seamlessly integrated. Successful integration is what makes Digital Transformation successful. To deliver such transformation and to provide experience, organizations have adopted SaaS and cloud applications, which have been the #1 trigger for moving Integration center stage. Integration has now become the backbone of providing business partners, suppliers, collaborators,

customers and regulators with access to business applications and data—across channels (web, mobile, partner, voice and more)—in a bid to realize the best possible experience, and simpler and faster business processes.

However, these ambitions can only be achieved through Digital Transformation in concert with the ubiquitous connectivity that is making the dream of real-time business come true. The onus is on enterprises to take up the challenge to seamlessly integrate their internal and external applications and processes across the ecosystem (see Figure 2).

The example of a modern airline like Lufthansa can be extended to provide an understanding of the complex scenarios in which Integration can achieve extraordinary results. The businesses of modern airlines extends well beyond moving

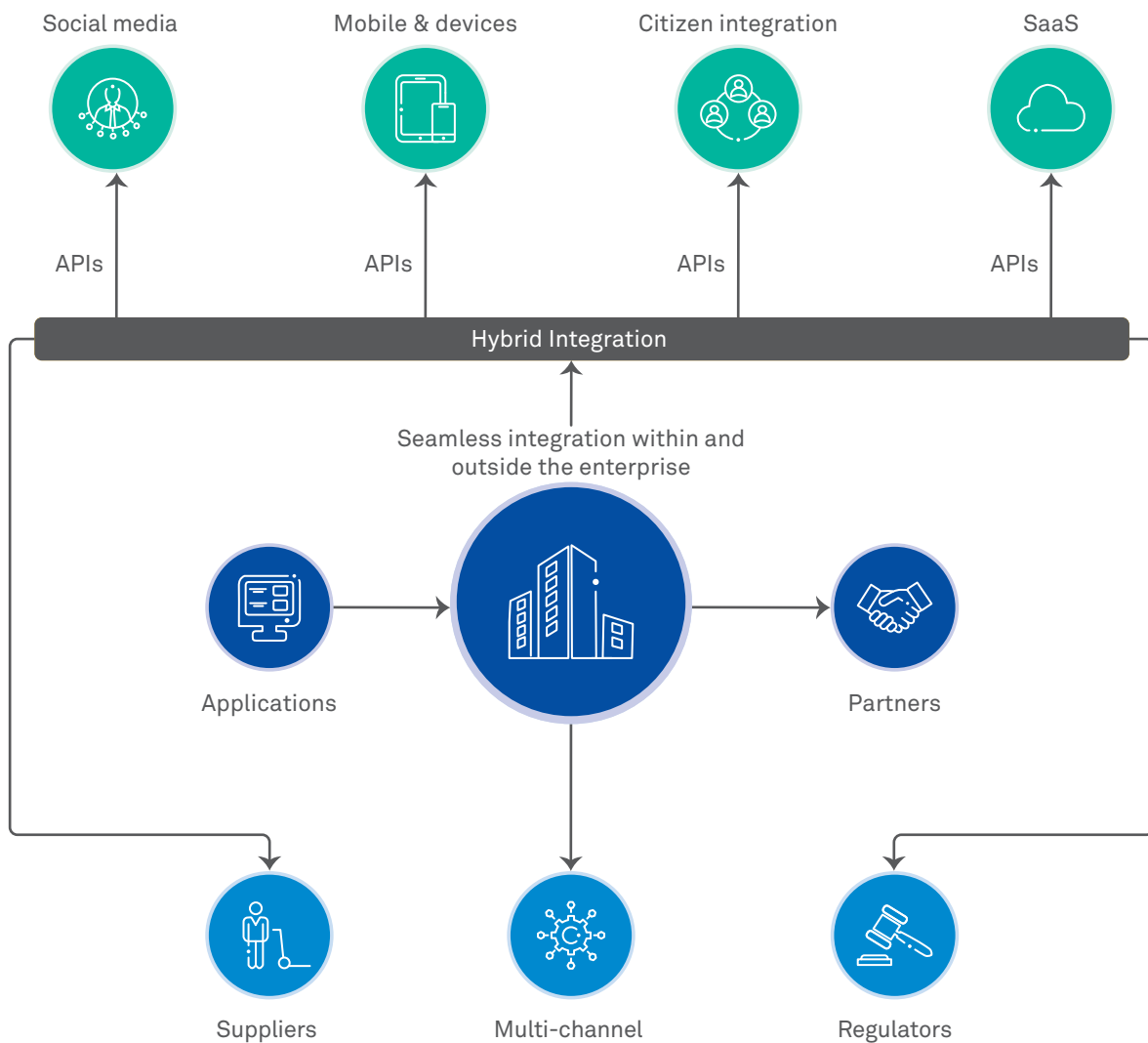


Figure 2: Digital Integration for Digital Transformation

passengers safely from Point A to Point B. Airlines are in a highly competitive environment where they must also partner with hotels for co-branded rooms, airport concierge services, cellphone rentals, visa processing services, loyalty programs, packaged tours and event managers in order to provide a better travel experience and, as importantly, add to revenue streams. Doing this requires access to complex data in a variety of formats and structures that are typically used within the various systems of the airline, and by its partners. This data must be acquired, transformed and integrated with the airline's industry-specific systems. The goal is to accurately complete transactions in real time across channels and devices. On top of this is the mega challenge of empowering users to design their own business processes for a truly satisfying customer experience. The secret to accomplish this lies in well-designed and flawless integration.

Digital Integration is a strategic imperative

Digital Integration is the outcome of rethinking Integration in the context of Digital Transformation. It's not difficult to see why organizations are bringing a laser focus to Digital Integration strategy. Such strategy should support the key initiatives of an organization to establish it as a digital business leader.

The strategy should enable the applications to benefit from an integration reference architecture that is lightweight, scalable and distributed. It should provide a catalog of integration patterns that help in the implementation. The strategy should also provide guidance on choosing the right products based on integration needs.

Implementing Digital Integration requires a hybrid strategy with platforms that provide agile practices for the "integration of everything." These platforms are typically used in "As a Service" models. They are referred to as Integration Platform as a Service (iPaaS) with API management and IoT capabilities that deliver Hybrid Integration for Digital Transformation.

No Digital Integration is complete without APIs, a simple vendor-agnostic means of providing multi-channel integration. They allow easy partner collaboration for innovation and for the monetization of new capabilities. Alongside APIs,

No Digital Integration is complete without APIs. They provide a simple vendor-agnostic means of multi-channel integration allowing easy partner collaboration for innovation and monetization. Through the use of APIs and Hybrid Cloud Integration, the barriers for information flow are broken, thereby enabling seamless integration across applications, partners and devices.

microservices architecture helps in simplifying and modernizing applications through a modular, manageable and scalable approach propelling organizations forward in their digital journey.

While microservices have helped simplify and modernize legacy applications, APIs have helped in differentiation. Every organization exposing APIs is now a technology company using APIs to productize and offer their business capabilities. APIs have enabled them to be composable to realize a business process not just within but globally across organizations.

Digital Integration strategy has been the backbone of initiatives across industries such as Open Banking, Connected Car, Smart Airports and others. Through the use of APIs and Hybrid Integration, the barriers for information flow are broken thereby enabling collaboration across applications, partners and devices.

Chart an end-to-end strategy that goes beyond technology

Organizations should build their Digital Integration strategy top down, aligned with their overall business and IT strategy to enable the realization of business objectives. A good Integration strategy will utilize value stream analysis to identify Integration opportunities and then cover people, processes, technology and domain knowledge to support the strategy. The strategy should define a roadmap towards becoming a genuinely digitally integrated organization.

What will this report cover?

To meet the needs of executives, architects, Integration managers and stakeholders in Integration projects who grapple with the shifting demands of IT, we have researched and documented the State of Digital Integration 2019. We begin with the insights from our team of Integration experts and practitioners in the areas and technologies that turn Digital Integration into a powerful path to real-time operational and business capabilities. We cover various Digital Integration domains such as Application Integration, API Integration, Cloud Integration, IoT Integration and Partner Integration.

The report then delves into Integration from an industry perspective. This covers key industries that include Banking, Retail, Manufacturing, Airports and Healthcare.

Once the reader is familiar with the emerging Integration landscape, the report provides a window into the enterprise journey to modern Integration. Here, the report aims to create a meta understanding of the various facets that go into the successful execution of an Integration strategy through delivery, operations, people, skills, organizational factors, governance, competency centers, DevOps, monitoring, etc.

The report concludes with how we see the future of Digital Integration. It is interesting to see—and attempt to predict—how emerging technologies will impact and shape the Integration practice and its outcomes. Here, we discuss technologies such as Blockchain and Citizen Integration that are bound to shape the Digital Integration of tomorrow.



Facets of Digital Integration

- State of Application Integration
- State of API Integration
- State of Cloud Integration
- State of IoT Integration
- State of Business Partner Integration



The journey to Digital Integration complements an enterprise's digital journey, and such a journey cannot be linear. The journey goes through several parallel paths, building capabilities across the varied dimensions of Digital Integration.

Wipro's Enterprise Digital Journey framework defines five dimensions of modernization along which organizations transform and build capabilities in their Digital Transformation journey (see Figure 3). The dimensions involve modernization of the entire organizational

landscape through platforms, architecture change, culture, people and the models of work. Such a journey is supported by digital platforms and accelerated by process transformation to deliver a differentiated customer experience.

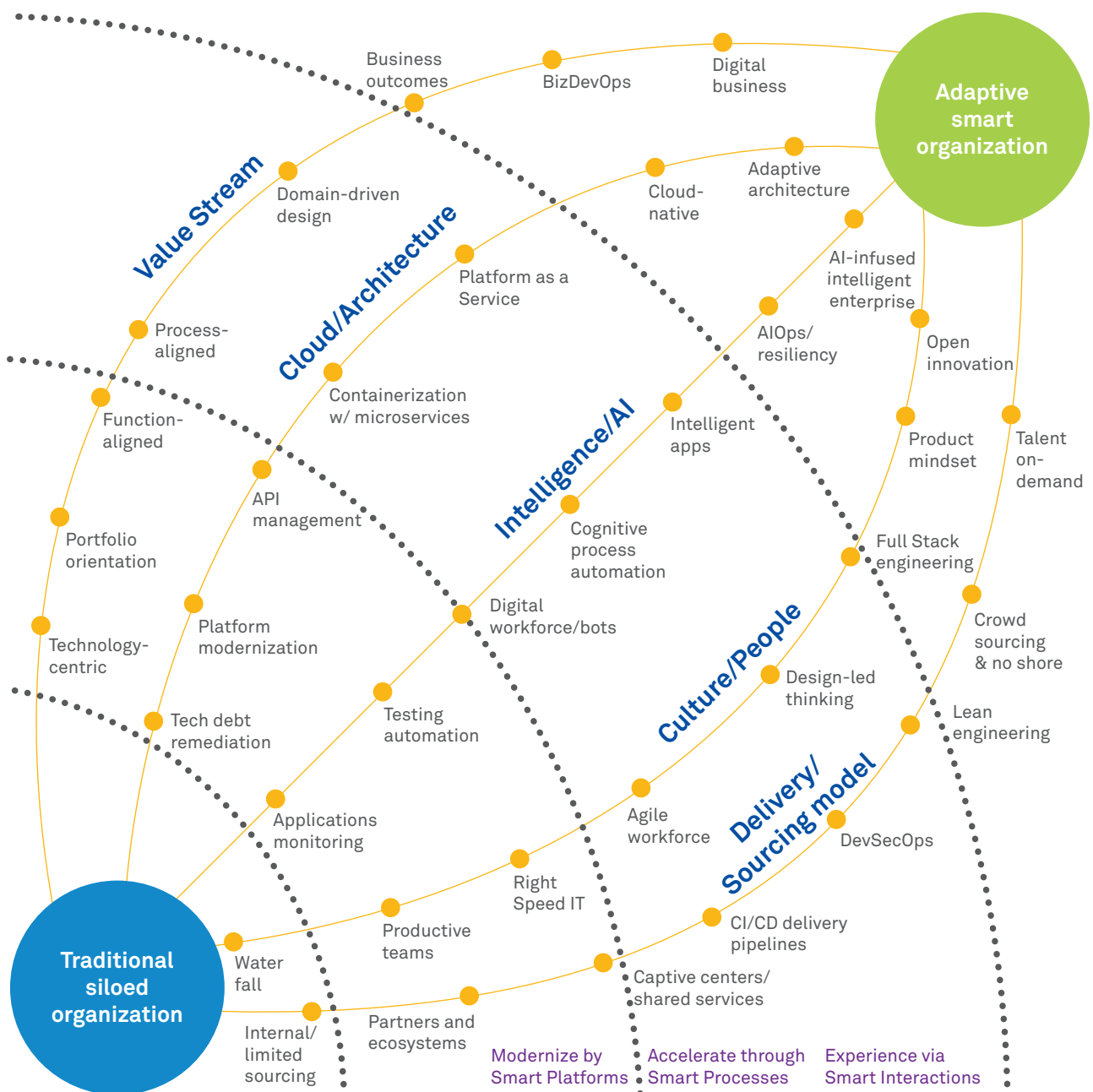


Figure 3: Enterprise Digital Journey framework

In most organizations, IT continues to operate as a project order taker. Teams across the business often work in silos, building new capabilities from scratch or buying quick fixes when issues arise. As a result, projects are often delivered inefficiently, due to duplicated efforts or unnecessary spend. To keep up with the speed of digital transformation, organizations need to change the way they operate and shift IT from a tactical function to a strategic business partner.

To fuel this shift, IT needs to change how its building blocks are created. IT should encourage teams to build assets in widely consumable ways versus one-off efforts. Then, it should drive teams toward a default mindset that what they need from IT may already exist and can be self-served in an enterprise marketplace of IT assets. By aligning development teams with this new mindset, a strong bank of reusable, externalizable API building blocks will grow into a powerful application network, allowing CIOs to decentralize IT and empower the business to move faster.



» **Ross Mason,**
Founder, MuleSoft



The five dimensions of an Enterprise Digital Journey framework are explained and summarized here (see Figure 4):



Value stream

is a dimension that represents alignment to business goals and seamless collaboration across business and IT. Value stream maps helps in identifying and building the Integration capabilities needed for the business.

Cloud/architecture

helps adoption of Next Gen technology and movement to cloud. In the Digital Integration journey, cloud-based architectures are making hybrid Cloud Integration the norm for Application Integration and helping organizations realize the goal of Integration of Everything.



Intelligence/AI

brings cognition into data engineering and process architecture. Automation based on Machine Learning is improving the development and management of Integration.

Culture/people

which is self-organizing and continually improving is another dimension of the Enterprise Digital Journey framework. New ways of working such as crowdsourcing are building faster and more innovative integrations.



Delivery/sourcing models

consisting of multi-skilled teams and the use of DevOps. Rise of non-proprietary skills are making Integration development more open and widespread than before.

Figure 4: Five dimensions of an Enterprise Digital Journey framework

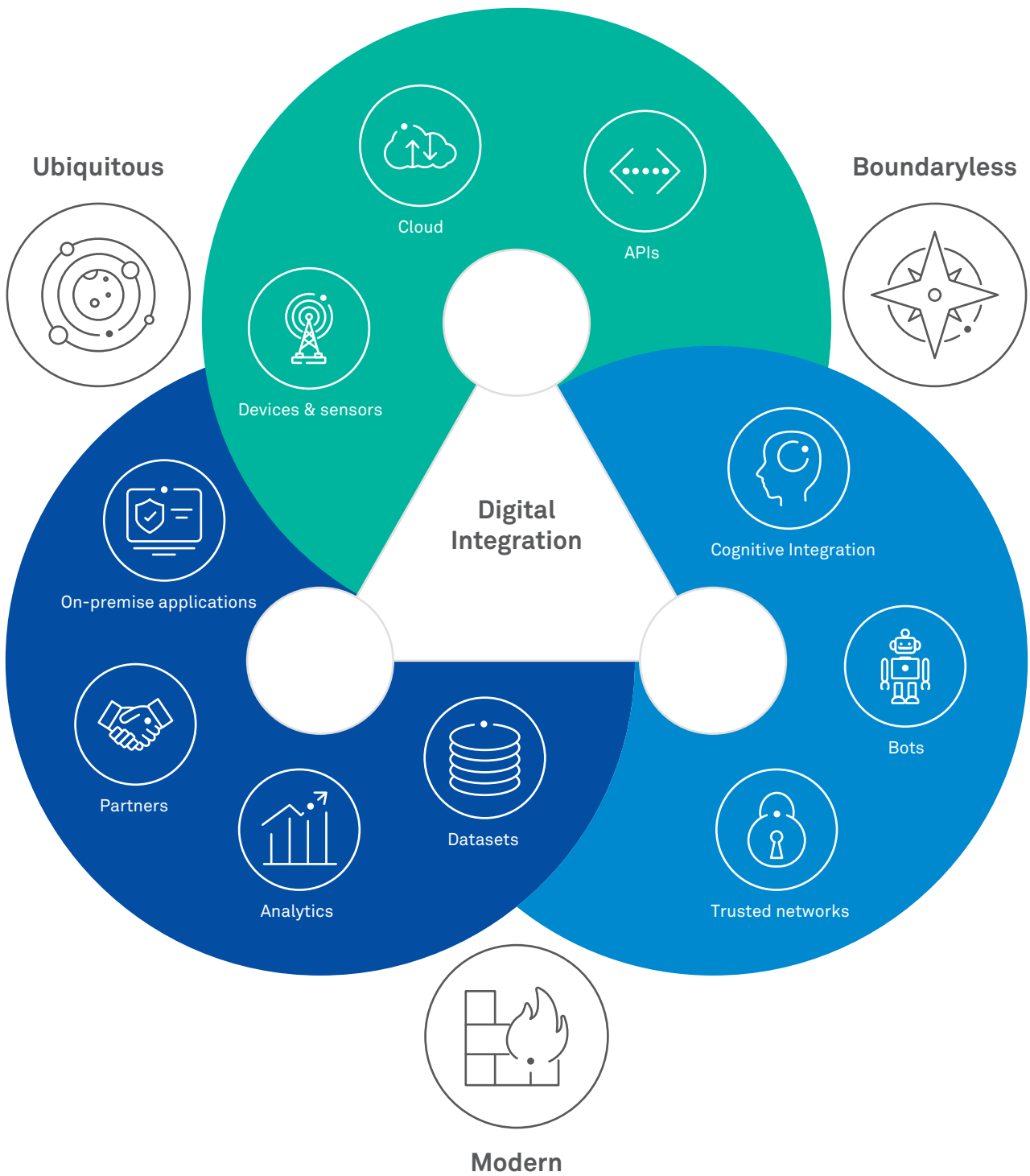


Figure 5: Facets of Digital Integration

Value streams play a key role in defining API and Integration strategies, and drive architecture across Application Integration, Hybrid Cloud, IoT and B2B Partner Integration. Our observations of trends, success strategies, best practices are covered in the report in the sections that follow. Commonly observed challenges too are covered.

The dimensions identified help implement a modern, ubiquitous and boundaryless Digital Integration covering - Application, API, Cloud, IoT and Business Partner Integration (see Figure 5).

State of Application Integration

Applications are how digital businesses are experienced by users. Effective integration of applications is what results in successful outcomes. Today, transformation in modern applications, such as adoption of microservices architecture and container platforms, is driving Application Integration strategies, demanding more than what was traditionally scoped for.

As application architectures evolved and newer business models emerged, Application Integration strategy has had to respond and keep pace. Modern applications are always connected to enable real-time experiences to consumers. Application architectures are agile and are adopting microservices architecture. Polyglot development, where multiple programming languages and technologies are used to build these services is now becoming a common practice. As a result, the key capabilities of a modern Integration strategy have evolved to:

- Support a variety of application endpoints, user personas and Integration styles that can seamlessly connect modern and legacy applications

- Keep pace with the tempo of the development ecosystem where applications are now rolled out in hours and days instead of months
- Enable differentiation and agility as the primary goals as opposed to standardization, consistency and reuse which ESB-based architectures focused on
- Support newer Integration requirements for microservices-based applications
- Operate at Internet-scale with resilience and in real time, delivering serverless and cloud-native applications

You need to proactively plan, build, manage and scale your application ecosystem. Or put simply, you need to 'own' integration not only within your enterprise but look beyond to the ecosystem of apps used by your customers and partners. It is key to enterprise agility and fluid business workflow. It's foundational for Digital Transformation. And for large enterprises, it's a prerequisite for connecting back-office systems that deliver business outcomes. In a world where business processes span hundreds or even thousands of applications inside and outside your enterprise, you must be on top of your ecosystem to ensure that your apps work together. If your apps aren't integrating, your data isn't working for you. Companies that realize that—and there are more and more each day—are experiencing tremendous growth.



» **Mark Geene,**
CEO and Co-Founder, Cloud Elements



The race to modernize is on

It is evident from our survey results that most organizations, across industries, are well on their way to modernizing their Integration strategy

and platforms. More than half the respondents said that they have already executed or are currently executing a modernization program while more than a third said they would commence modernization in the next 12 months (see Chart 1).

Q If you are considering modernizing your Integration architecture and platform(s) as part of your Digital Integration strategy, what are your plans towards it?

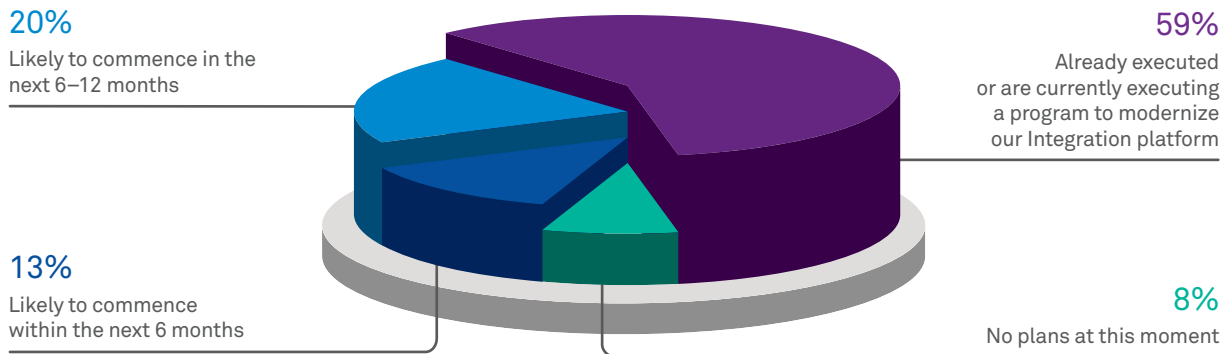


Chart 1

The desired target state looks different for different organizations

Organizations look at their desired future state depending on a variety of factors such as the industries and the geographies they operate in.

For example, organizations in the Retail and Financial Services industries, with their IT landscape dominated by custom-built applications, are gradually modernizing to microservices-based architecture. These microservices are connected through API gateways. As this architecture rolls out across their enterprise and legacy applications are retired, these organizations can envision a future where ESB-style platforms will give way to API-oriented integrations. API gateways will,

soon, become the cornerstones of the Integration architecture for these industries.

On the other hand, industries such as Utilities or Airports that rely on COTS and packaged applications might still find ESB-style platforms—either on-premises or delivered as a Service—fit their needs well.

Our survey results show that a majority of the respondents believe that ESB will co-exist with modern Cloud Integration platforms designed for microservices architecture, as part of hybrid Integration architecture. This was followed by the belief that ESB will go away as applications are re-architected and modernized into a microservices-based architecture. A reasonably large number of respondents felt that ESB will be modernized (re-factored) and deployed on a cloud platform (see Chart 2).

Q As your applications modernize and you adopt modern Integration platforms and architectures, how do you see the future of your existing ESB platform in your organization?

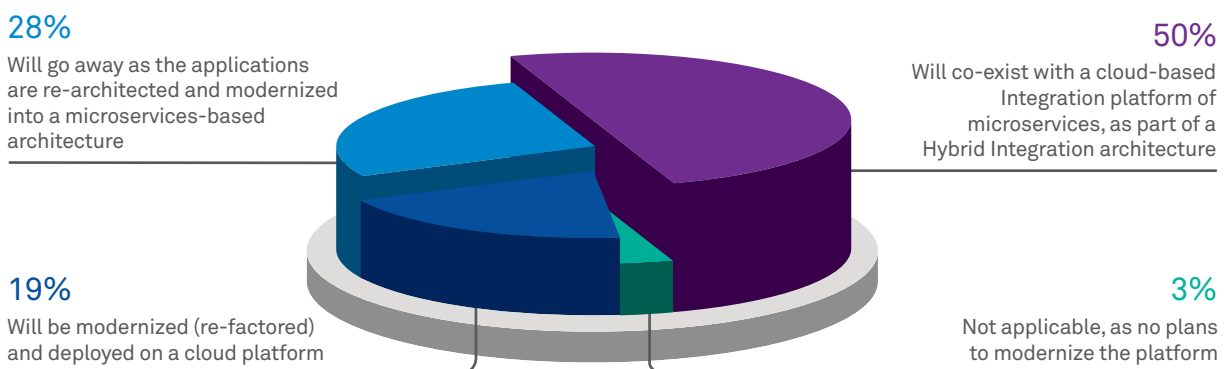


Chart 2

Say “hello” to convergence

In the past, different styles of Integration and technology stacks were used based on Integration needs, such as Remote Procedure Call (RPC) - styled integration, data integration, batch integration, event-driven integration and more. In the near future, we will see the breaking down of existing barriers between the different styles of Integration. Organizations will move

towards a more unified approach to unify data, applications, and processes. More than half the survey respondents said that they had planned convergence or it is already underway (see Chart 3).

This means we will not only need platforms that support different Integration styles but implies change in organization structures, processes and practices in enterprise IT departments and service providers.

Q As part of your Integration strategy, do you plan to unify the application and data Integration platforms including people, processes, and technology?

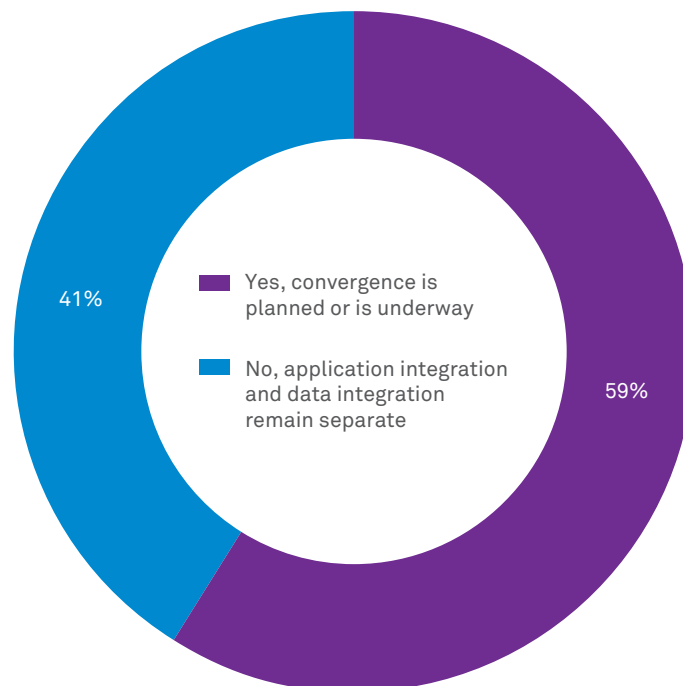


Chart 3

Strategies for Pervasive Integration

A digital enterprise has Integration requirements across multiple levels of complexity and abstraction. In addition to the Integration specialists who need powerful low-level connectivity, orchestration and rich data transformation features, there are application developers who are building modern, cloud-native applications that require tools to stitch microservices together. And there are digital teams that need to quickly compose APIs out of existing backend services or other APIs. An organization's Integration strategy, then, needs to recognize these diverse requirements and provide the guidelines, technologies and tools that are

appropriate for each of those roles and use cases (for the emerging role of a new breed of Citizen Integrators, see “Future of Digital Integration” in this report).

When we asked our survey respondents about the Integration capabilities that they feel are important to developing Application microservices, over 45% indicated the need to mediate API calls between microservices and another 25% said the availability of a Message Bus to allow reliable, event-driven interactions between microservices was important (see Chart 4). These are the kinds of requirements that the Integration strategy should address.

Q What new Integration capabilities do you see as important in microservices architecture?



Chart 4

Getting ready for cloud-native Integration

Our survey indicates that more than three-fourths of respondents want to develop cloud-native Integration services (see Chart 2) following microservices architecture. These microservices always work with each other by orchestrating themselves to deliver larger business capability, hence integration is native to them. To make sure they work well together, organizations must develop newer Integration capabilities that are native to the platforms where the services are deployed.

The library of Integration patterns and Integration service design best practices and principles will need an update too. While most of the general microservices-related design principles and best practices remain applicable when implementing Integration microservices, specific areas such as task coordination, service and API composition, handling of distributed transactions, strategy towards transaction rollbacks and compensating actions, etc., need particular attention. Technologies such as Service Mesh, which can simplify the integration needs of microservices in cloud-native platforms, can be adopted.

Building capabilities to deliver real-time enterprise

Delivering superior customer experience and deriving business value from IoT initiatives have a common foundational capability. Both need technologies and architectures to connect to sources of events and data streams, ingest fast-moving data, combine it with other enterprise assets, correlate them to derive useful intelligence, and deliver it to the right stakeholders at the right time. Another factor driving this evolution is the growing popularity of a shared message backbone for communication and interaction between microservices.

The existing on-premises hub-and-spoke based systems are being augmented with distributed, cloud-native platforms that can scale to process millions of messages per second and with peer-to-peer messaging platforms that are more appropriate for connecting IoT devices with each other. Technology capabilities—such as In-Memory Data Grids, Event Stream Processing, Function as a Service and Complex Event Processing capabilities—are being created to derive and deliver intelligence from the messages and events.

We asked survey respondents about the level of adoption of these technologies within their enterprises. 55% of respondents said that their enterprises are exiting hub-and-spoke platforms and have adopted cloud-native, distributed platforms like Kafka. 65% of respondents said

that their enterprise have adopted Event Processing technologies (see Chart 5). If we consider only respondents from Financial Services, Retail and Transportation industries, this number goes up to almost 85%.

Q What is the level of adoption of technologies such as distributed platforms, Messaging as a Service and Event Processing in your enterprise?

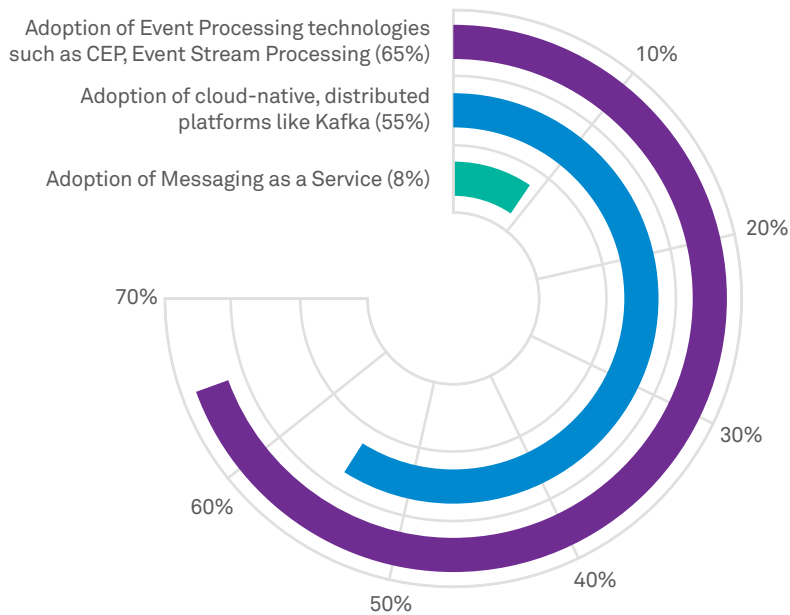


Chart 5

In addition to the technology, effective Governance practices and Management and Monitoring tooling are key to the successful adoption of Event-based interactions between and within applications.

that they have the tools to handle Event Queue Failures, including Dead Letter Queues, Retry/Republish, etc., while more than half of them also reported monitoring of Event-level KPIs and metrics (see Chart 6). Only about a third of the respondents had mechanisms and processes in place to manage the structure and semantics of all their enterprise-level Business Events.

We asked survey respondents to tell us about their Event Governance, Monitoring and Management capabilities. A large number said

Q If you have adopted or are adopting Event-driven architecture, indicate the capabilities of Event architecture in your organization.

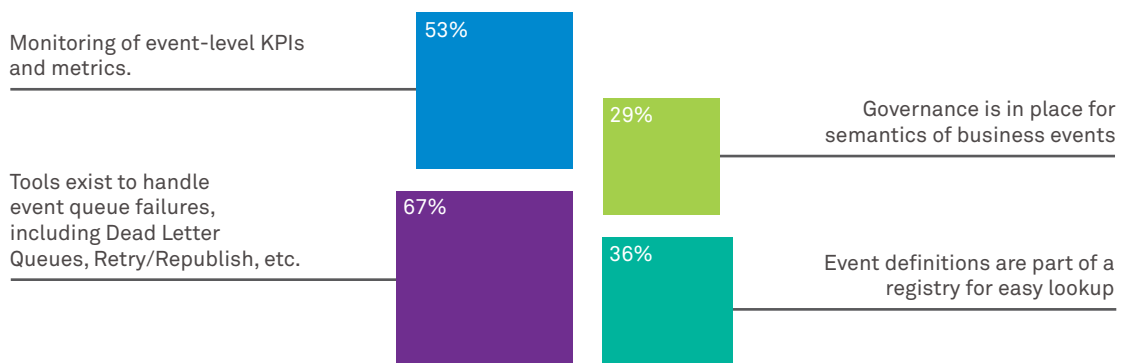


Chart 6

Strategizing your Application Integration

As enterprises formulate and progress with their modern Application Integration strategy, the following should be key considerations:

- Prepare to set the stage for long-term Integration strategies that evolve and add more Application Integration capabilities over time. Be sure that different Application Integration needs are sufficiently addressed. This would mean the capabilities have to be modular and also replaceable—preferably with a microservices approach using APIs.
- While platforms play an important part of Application Integration strategy, focus on patterns, practices and developer productivity enablers rather than focusing on vendor products.
- As the strategy evolves, look for opportunities to combine Integration styles for a more converged approach using shared capabilities.
- Address ever-growing microservices adoption and related Integration needs in the context of various digital initiatives. Cloud-native Integration capabilities using Service Mesh and other microservices-based Integration capabilities have to be explored.
- Loose coupling and real-time Integration are always an important part of a responsive organization's vision for Integration. Make event architectures such as event brokers, Event Sourcing and Serverless Architecture a key part of your Integration strategy.

Disruption is a reality in nearly every industry. Initiatives like Digital Transformation and creation of digital services are increasingly being pursued to prepare for this disruption. Technology plays a critical role in delivering digital services. Companies now must be technology-focused, even software-driven, using software to create new value. They are expected to deliver on a multitude of new and different business objectives, from big data, APIs, Internet of Things (IoT) initiatives to omni-channel experiences. In addition, the software needs to work across multiple business functions, business models, engagement channels, and stakeholder ecosystems—in an environment of accelerating change and innovation.

Application and data integration are key capabilities in realizing these different business objectives and delivering competitive services. The move to cloud applications and hybrid cloud IT environments, adoption of DevOps and microservices, the shift to more event-driven systems, drive demand for modern application architectures. Integration is increasingly important because delivering services on a near continual basis is becoming critical. The expectations of continuous innovation and faster outcomes create challenges for traditional Integration approaches like centralized ESBs. There is a better way to address these requirements and challenges: An Agile Integration approach that combines agile methods and practices with cloud-native, distributed, lightweight, API-centric technologies to rapidly integrate applications and data and deliver adaptive solutions.



» **Ken Johnson,**
Senior Director, Product Management,
Red Hat Middleware, Red Hat



State of API Integration

What's the quickest way to compound the value of technology?

Answer: Run an effective program to integrate APIs into the business. By sharing data and functionality with internal and external partners, APIs are fast-tracking collaboration and innovation and allowing IT to create composable organizations.

On 7 February, 2000, the IDG Demo 2000 conference witnessed a historic moment. Salesforce.com opened a powerful new window to collaboration by launching the world's first Application Programming Interface (API)^v. Since then APIs have proliferated into every digital

business and have become an important channel for value creation. As of 2015, Salesforce.com was generating 50% of its revenue through APIs. Expedia.com generates 90% and eBay 60% of its revenue, thanks to APIs^{vi}.

The relentless march to the cloud will continue. However, most organizations have so far lacked a coherent, long-term cloud strategy. More often than not, new cloud services get deployed reactively. It results in cloud deployments that are messy and often dependent on point-to-point integrations. In a cloud-native era, vendor lock-in and traditional point-to-point integrations leave enterprises with tightly coupled and fragile architectures that prevent organizations from being adaptable.

In today's digital world, its clear organizations need to build for change. We'll see more organizations start to look inwards to modernize their core so they can compete in today's cloudy world. Organizations will need to modernize legacy systems, so they can co-exist with cloud infrastructure and applications. This is best achieved through an application network underpinned by APIs, which are language-agnostic and can decouple on-premises system data from system-specific complexity. As a result, we'll see APIs increasingly become an intermediary between legacy systems and the cloud.



» **Ross Mason,**
Founder, MuleSoft



There is an API for it

These impressive API statistics are only the tip of the iceberg. For every public API that is offered by a business, we estimate that there are 50–100 internal APIs in use. An internal study at Wipro revealed that on an average each of our employees use about 2,000 APIs every day. These APIs work in a variety of ways, from authenticating a user to showing up alerts on mobile phones,

querying data from a CRM system, or even initiating transactions into ERP systems. There is an API for everything.

But this is not by sheer chance. APIs are built on open standards, making them highly interoperable and they use HTTP, the underlying foundation of the web. Most importantly, successful APIs are always mapped to value streams (much more than a data conduit).

Versatility of APIs

While APIs have evolved and have been adopted across industries at differing times and pace, the reasons for adoption have been the same.

Our survey showed that the top reasons for adopting APIs were that they provide value to the end customer, were central to the Digital Integration strategy and improve organizational efficiency (see Chart 7).

Q What are the key drivers for your organization to use and build APIs?

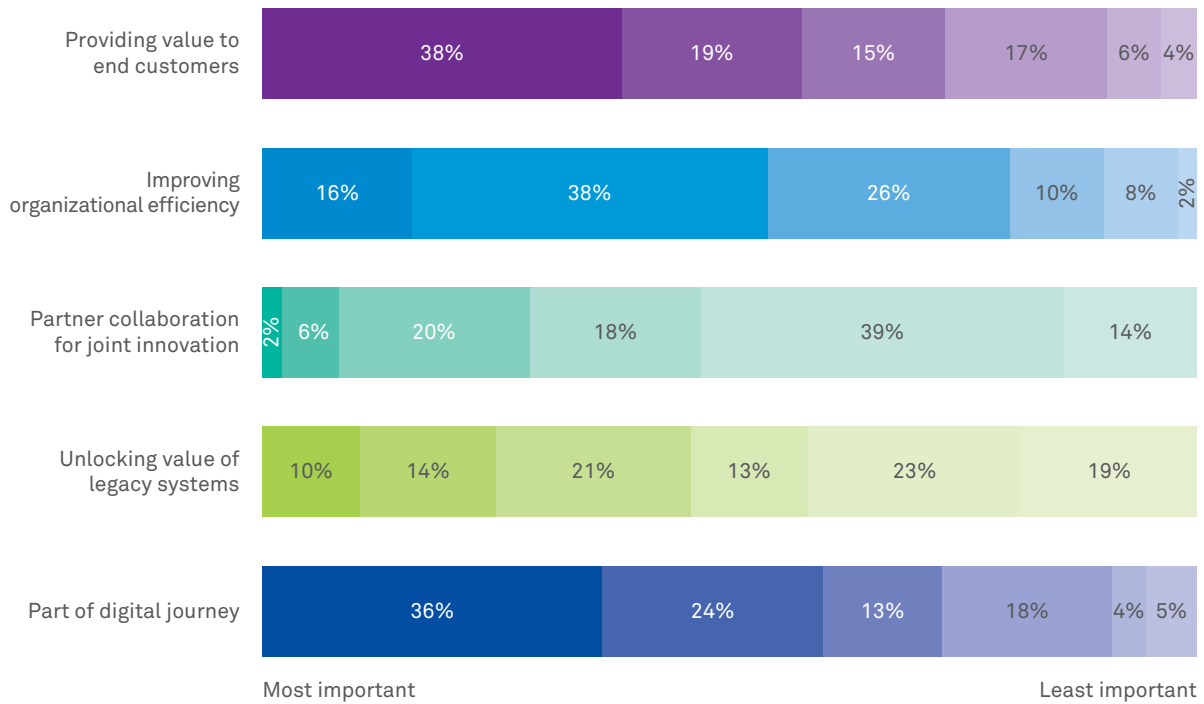


Chart 7

The dominance of APIs

The influence of APIs has spread to all aspects of Integration, from application to application (A2A) integration to data integration, partner integration

and device integration. APIs have not just assumed the role of SOAP-based web services in the current Integration landscape but they do a lot more (see Chart 8).

Q Based on usage, APIs can be classified into different categories. How do you see your API portfolio currently distributed?

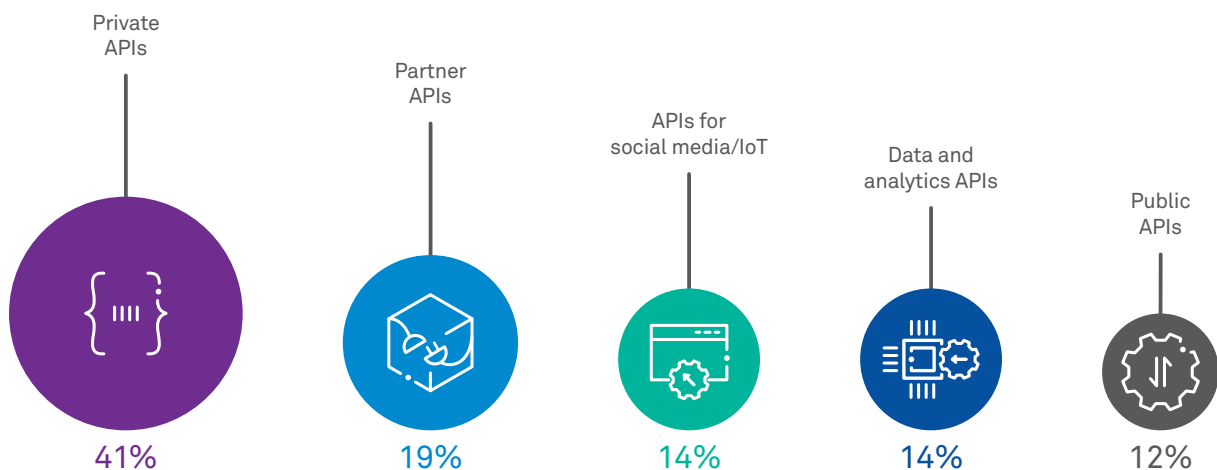


Chart 8

Value stream alignment is key to API success

Across industries and domains, we have seen effective APIs are always aligned to business value streams. In other words, most effective

APIs are the ones that integrate the systems such that value is created for the customer or the business. A majority of the survey respondents agree that API Integration programs are critically or very critically aligned to business value streams (see Chart 9).

Q How is API Integration aligned with your business value streams?

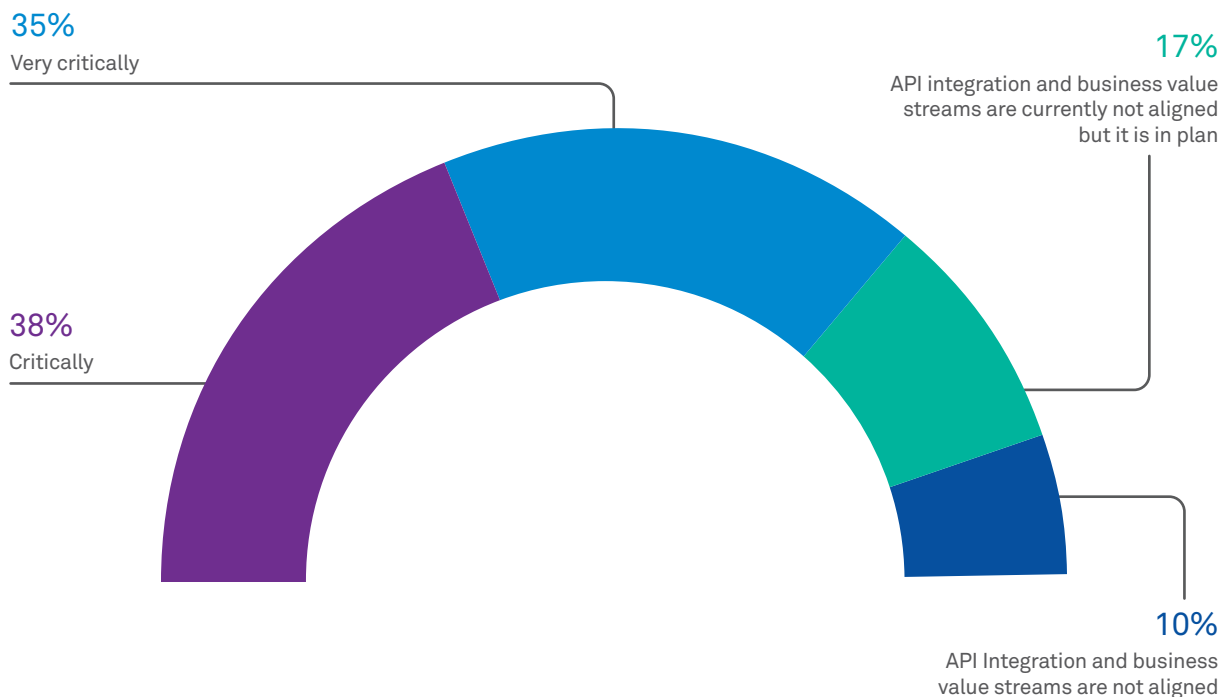


Chart 9

Any company can build APIs and expose them for use. But to achieve success with APIs requires a real focused effort with scalable and secure API management and experienced API implementers. Many companies take significant initial missteps with their API approach due to inexperience and lack of understanding of what challenges a successful API program brings in terms of volumes, security exposures, partner ecosystems and the like. It takes effective technology and experience to avoid wasted effort and costly re-engineering.



» Ken Parmelee,
Director, IBM Cloud Pak for Integration, IBM



Challenges around API implementation

When APIs are part of core business value streams, things can get very complex. The challenges span from security to versioning,

proliferation, duplication and legacy connectivity. Our survey results showed that the top challenges enterprises faced were around governance of APIs, implementing adequate security, integration with legacy applications and choosing the right tools and frameworks (see Chart 10).

Q What were the challenges that your organization saw or has overcome when implementing an API program?

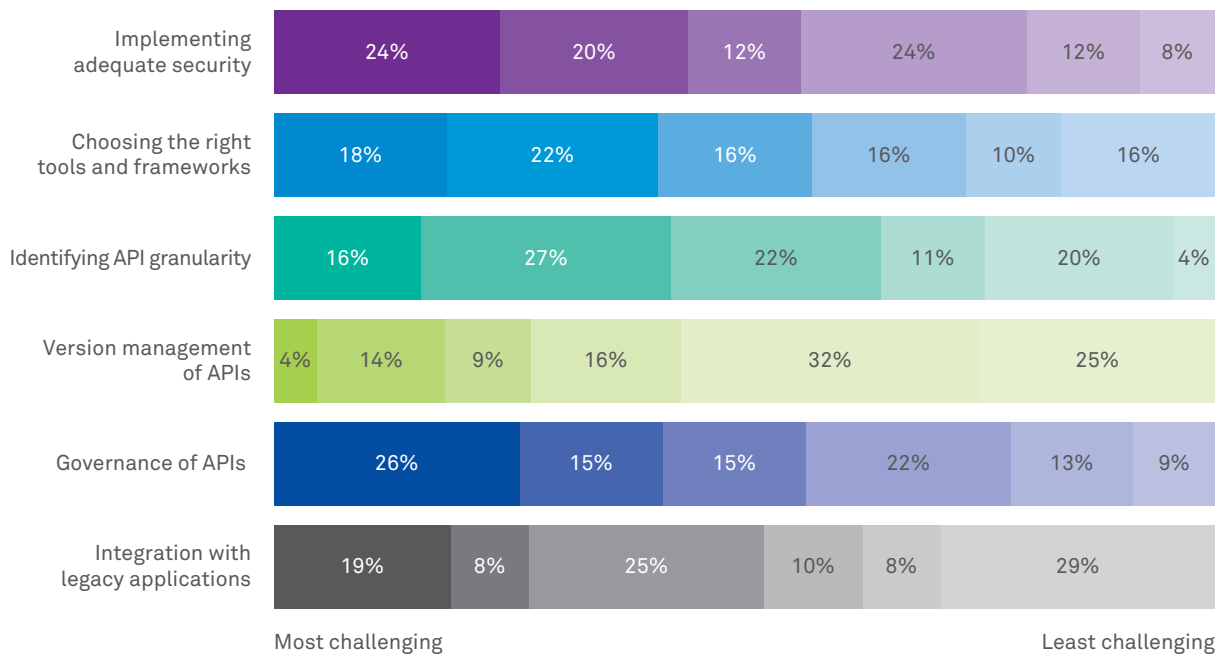


Chart 10

REST is the king, SOAP is still relevant, JSON rules

APIs, once rooted in SOAP-based web services are evolving, with JSON-based RESTful services becoming more popular; their lightweight data interchange format make them easily readable and are language-agnostic. Not surprisingly, of the top 10 most popular APIs in the world^{vii}, nine use JSON^{viii}. Our survey shows that organizations

are predominantly using REST for exchanging data (see Chart 11).

API technologies are rapidly changing with the emergence of languages such as GraphQL to handle the challenge of API duplication and proliferation (also known as “API sprawl”). It provides query-like features on top of the existing API to help API consumers write customizable data elements while keeping the background API layer intact.

Q What are the key mechanisms you use or are planning to use for exchanging data?

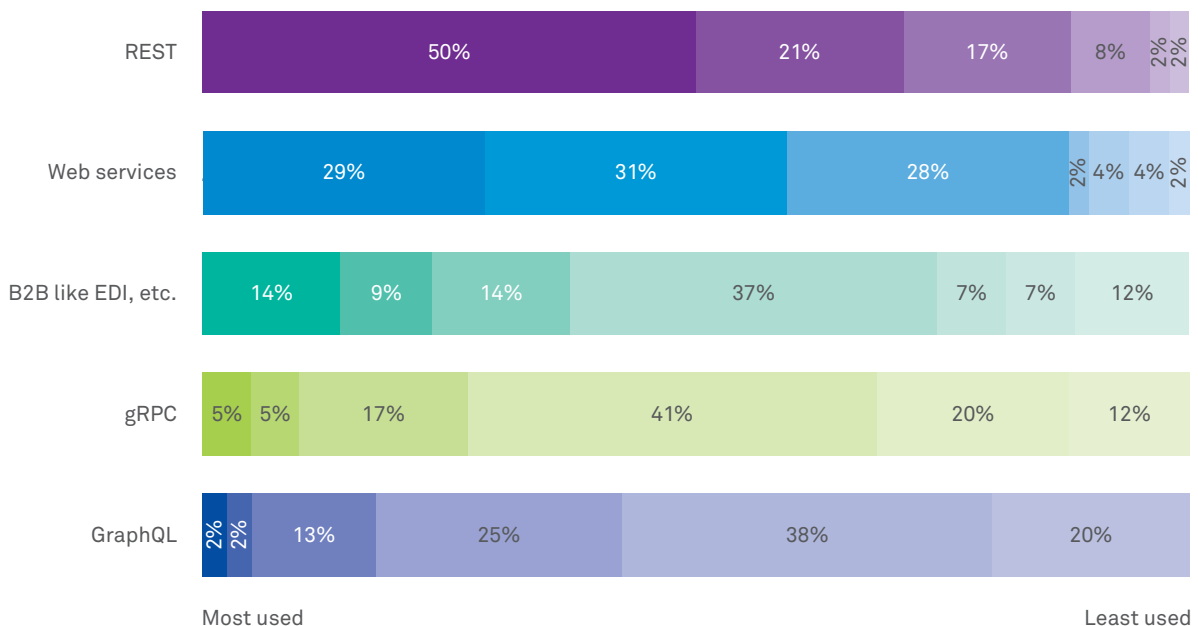


Chart 11

Platforms and tools simplify API development at scale

In the context of APIs, API Management (APIM) platforms are frequently discussed in the context of securing and managing APIs at scale.

APIs have gone beyond their initial use cases to Digital Integration use cases. A wide variety of platforms and tools are being used to go beyond APIM. The survey results show that API Development platforms are the most popular, followed by API Management platforms and API design tools like Swagger (see Chart 12).

Q What are the various tools you use in your API lifecycle?

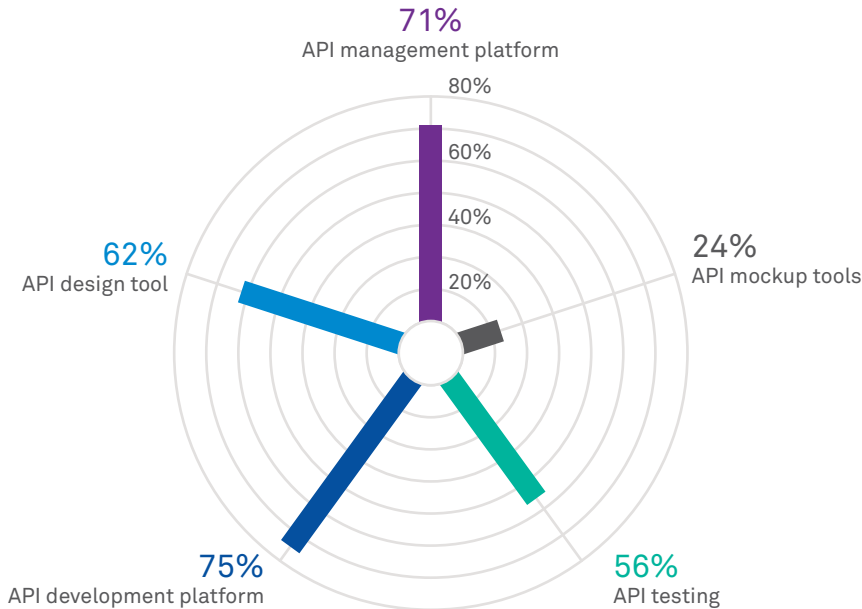


Chart 12

Road to standardized data models

When using APIs for integration (both external and internal), interoperability concerns go beyond technology. Data models used by APIs determine the interoperability. But until industry-wide open consortiums (like Banking Industry Architecture Network (BIAN)^{ix} and TM Forum) or product

companies and developer communities (like schema.org) define industry-standard data models by joining hands and build platforms to collaborate and innovate, the pain of interoperability isn't about to go away. Our survey results show that organizations across domains are showing an inclination to adopt these models (see Chart 13).

Q How are you modelling or planning to model your API(s)?

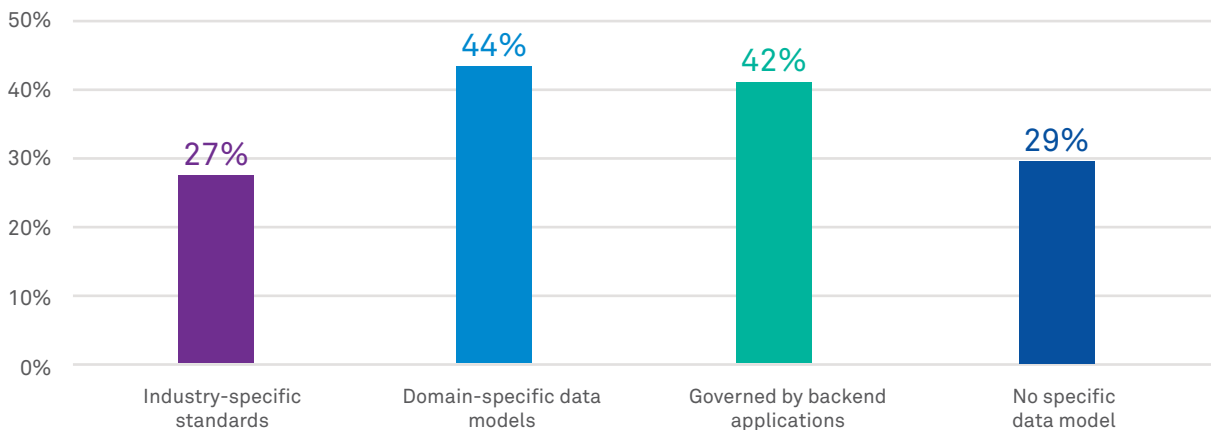


Chart 13

Tackling API proliferation

As observed from the survey results, API governance is the top-most challenge (see Chart 10), and that is because of API sprawl. Organizational structures, communication challenges and Not invented here (NIH)^x syndrome often compound this challenge. A lack of domain alignment and API taxonomies further add to it. Our survey results show that

most enterprises do understand this issue, and they are investing in API governance products to provide runtime and design time governance through central and federated structures (see Chart 14). It must be remembered that a product or a group of products is only one dimension of the solution. The aim should be to continuously train people and instill a product building mindset, and supplement the process with data available from API management platforms.

Q What is the mechanism you use to manage your APIs?

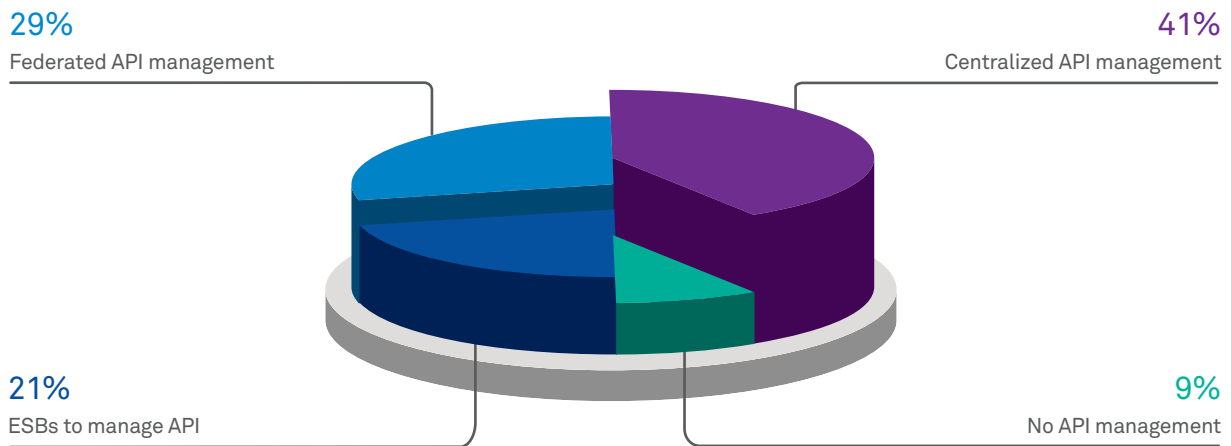


Chart 14

Importance of KPIs for API success

Given the cross-enterprise and cross-ecosystem scope of API programs, it is important to define the KPIs that are good indicators of success. These KPIs often include speed of implementation, type of users, invocations,

monetary outcomes, etc. Some of the key metrics that survey respondents used to measure the success of their APIs included “improved business KPIs in the value stream” and “the number of subscribers and usage of the API.” A surprisingly larger number did not have any defined measurement criteria (see Chart 15).

Q What are the success factors of an API program?

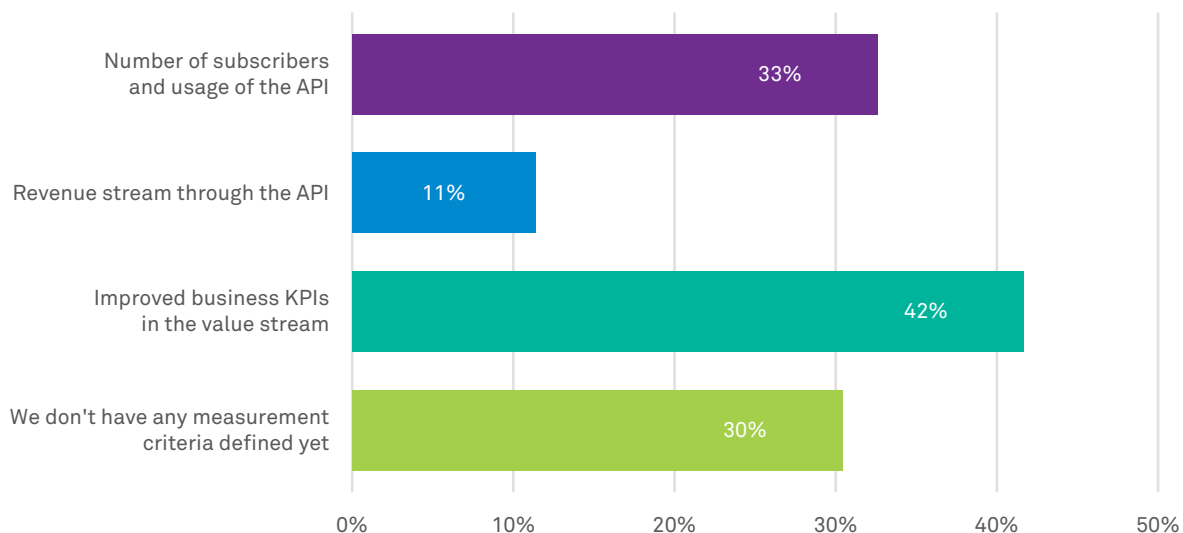


Chart 15

Build better APIs—cheaper, faster and more efficient

A digital organization's success is fueled by multiple intertwined technologies, and by the integration of platforms, systems, and people. In short, it must integrate everything. APIs are one of the most efficient ways to achieve this state. Enterprises therefore need to invest time and money on factors that build successful APIs. The factors for successful API Integration include alignment of APIs to value stream maps, cloud-native architectures to realize APIs, and

Organizations should align their APIs to value stream maps, adopt cloud-native architectures and use Artificial Intelligence for a successful API Integration.

the use of Artificial Intelligence (AI) to manage operations. This shortlist of technical factors must be augmented with a product building and continuous learning mindset coupled with strong domain knowledge. That is the simple recipe for improving outcomes of API Integration programs.

Hybrid, API-centric integration is everywhere. With the growth of cloud services, containers, SaaS, and IoT, the sheer number of APIs and digital endpoints is growing into the billions. In fact, the research suggest that by the end of next year, nearly half of the time and cost of building digital platforms would be on some form of integration. As the trend continues, the CIO's job won't be to 'code' services as much as it will be to 'assemble' them, and doing so at scale. Thus, WSO2 is betting that ALL Development will eventually become a form of Integration, and that a key to a company's competitive advantage will be its digital agility. This is the philosophy behind the 'composable' enterprise.

Our big bets for Integration in 2019 and beyond include:

- API-centric development will become the enabler for line-of-business apps
- Published APIs will become increasingly aggregated, federated and re-marketed
- Real-time, streaming, and push APIs will become ubiquitous
- Traditional middleware will slowly disappear, sedimenting into code+ infrastructure
- Enterprise Integration teams and development teams will tend to merge

Technically, we're seeing developers taking on integration challenges with new cloud-native programming languages like ballerina.io that are ideal for coding integration logic right into microservices themselves. And organizationally, we're also seeing "integration-agile" methodologies emerging, where the same agile techniques for developers are being applied to Integration teams.



» Ken Oestreich,
VP Marketing, WSO2 Inc.



State of Cloud Integration

Cloud is rewriting the rules of Digital Integration as businesses around the world turn the page in their Digital Transformation story with new Cloud Integration architectures, platforms and operating models.

Going by a recent Forbes prediction, 83% of enterprise workloads will move to the cloud by 2020^{xi}, making it safe to say that cloud adoption is reaching critical mass. We are already seeing the metamorphosis of enterprise application and data landscapes, making integration a challenge owing to concerns on data security and latency. Here are some of the questions that businesses are asking as they script their Cloud Integration story:

- As applications and data cross the traditional trust boundaries from on-premise into the cloud, how do we allay security risks during the Integration?
- Many enterprises choose to take the SaaS-first route to the cloud, resulting in a number of enterprise applications being replaced by their SaaS equivalents. Their sheer numbers and lack of standardized data models makes it hard to integrate with existing systems. How do we handle this?
- Since the Integration landscape is distributed across cloud and on-premise, where do we host the Integration platforms? Should they be cloud-centric or continue to run on-premise?
- How do we handle issues such as network latency and the cost of data transfers? Is optimizing data transfers a reliable enough way?

Most IT leaders agree that Cloud Integration makes digital business possible by bringing together complex elements of an enterprise landscape across platforms. As information flows

smoothly across departments and stakeholders, it enables a more efficient model of business. In this section we explore various Cloud Integration options and the current state of the art.

The hybrid future of Cloud Integration

A majority of businesses are moving to the multi-cloud, hybrid Integration strategies for their A2A, B2B and API Integration needs. Enterprises will still need to have critical data sensitive applications on-premise to comply with strict regulatory requirements. This is why we will continue to see on-premise Integration solutions alongside native Cloud Integration solutions, but with a clear momentum towards cloud adoption. In response to our survey on Cloud Integration methodologies, 80% of the respondents said that they were looking at bringing together on-premise and cloud capabilities in hybrid architecture (see Chart 16).

Q As per your cloud strategy, where do you see your Integration platforms to be hosted?

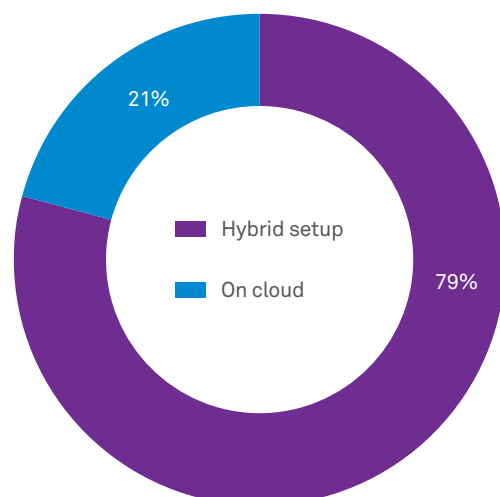


Chart 16

Below are the key factors we observed that influence hybrid Cloud Integration strategy.

- **Modernizing the core while leveraging existing investments:** Businesses are deriving value from the strategic technology investments around middleware deployed in-house while integrating them securely with existing on-premise applications and other cloud-based solutions.
- **Cost benefit:** Flexible pricing offerings such as packaged or a la carte pricing is giving customers the flexibility of as a service models and helping them to choose the most cost-effective, yet powerful solution.
- **Citizen Integration:** Citizen Integrators are empowered business users who can accomplish Integration tasks like on-boarding, order fulfillment, order-to-cash, and data synchronization. This helps reduce the workload of the IT team while enabling these functional analysts to easily configure and create Integration flows and reduce time to market.
- **Support for multiple Integration styles:** The Cloud Integration scenarios now support A2A, B2B, API, IoT, mobile and social Integration, each of which enables the business to function with greater efficacy.

Different paths to Cloud Integration

While the trend indicates that cloud adoption is a must for every enterprise, not every business finds the same path to the cloud. This choice is influenced by drivers specific to both the enterprise and its industry. Some of the drivers that determine the path to Cloud Integration are the level of cloud adoption within an enterprise including SaaS and hyperscale providers, the level of capability of existing Integration platforms, and the state of other Digital Transformation initiatives. Here are the three major paths that businesses take to get on the cloud:

- **Custom-built Cloud Integration:** Enterprises with strong technical capabilities chose this path by bringing best-of-breed cloud technologies either via open source or commercial products. While this option gives the most flexibility, its complexity means that it is not meant for every company.
- **Extending Enterprise Service Bus (ESB):** Many enterprises chose to leverage their existing Integration platforms like the ESB. They often use the updated platforms from the same vendor to handle Cloud Integration-specific requirements. However, flexibility to change, time to change, cost of implementations/ upgrades and cost of maintenance can become major challenges in this setup.

There are several common drivers we see when Dell Boomi customers are looking to harness the power of the cloud—all of which are about accelerating an organization's ability to succeed and thrive in the new digital economy. Most importantly, it's about the imperative need for businesses to connect people, processes and things. When global workforces, applications, and data are integrated, silos are eliminated. The value of operating in the seams truly unlocks transformation and the art of the possible becomes even more real.

Real transformation comes when everyone—from executives, to HR and finance, to sales and marketing, to employees, to partners and suppliers—gets the right data at the right time so they can take the right actions to get the right results.

Many organizations also realize that by getting rid of the pain of legacy infrastructure and migrating to cloud applications, they are better prepared for modernization. Armed with the right tools and technologies, organizations enjoy accelerated business outcomes.

Using an Integration Platform as a Service (iPaaS), organizations can quickly build a digital foundation to link all of their systems, data, applications, processes and people—including customers, partners and colleagues—anytime, anywhere, and on any device. Businesses that get this right, grow faster.



» **Chris McNabb,**
Chief Executive Officer, Dell Boomi



- Integration Platform as a Service (iPaaS):**
 With a hybrid Integration capability and containerized solutions, the iPaaS provides the service and data virtualization layer with out-of-the-box connectors and components. A low code platform is used for building the Integration flows. It offers support for various Integration styles and is easy to deploy.

When asked about the key considerations around selecting or building a Cloud Integration platform, over 75% of businesses said that they prefer a low code platform and a platform that supports various hybrid Integration scenarios (see Chart 17). This makes iPaaS a preferred choice for cloud and hybrid Integration.

Q What are the key considerations when building a Cloud Integration platform?

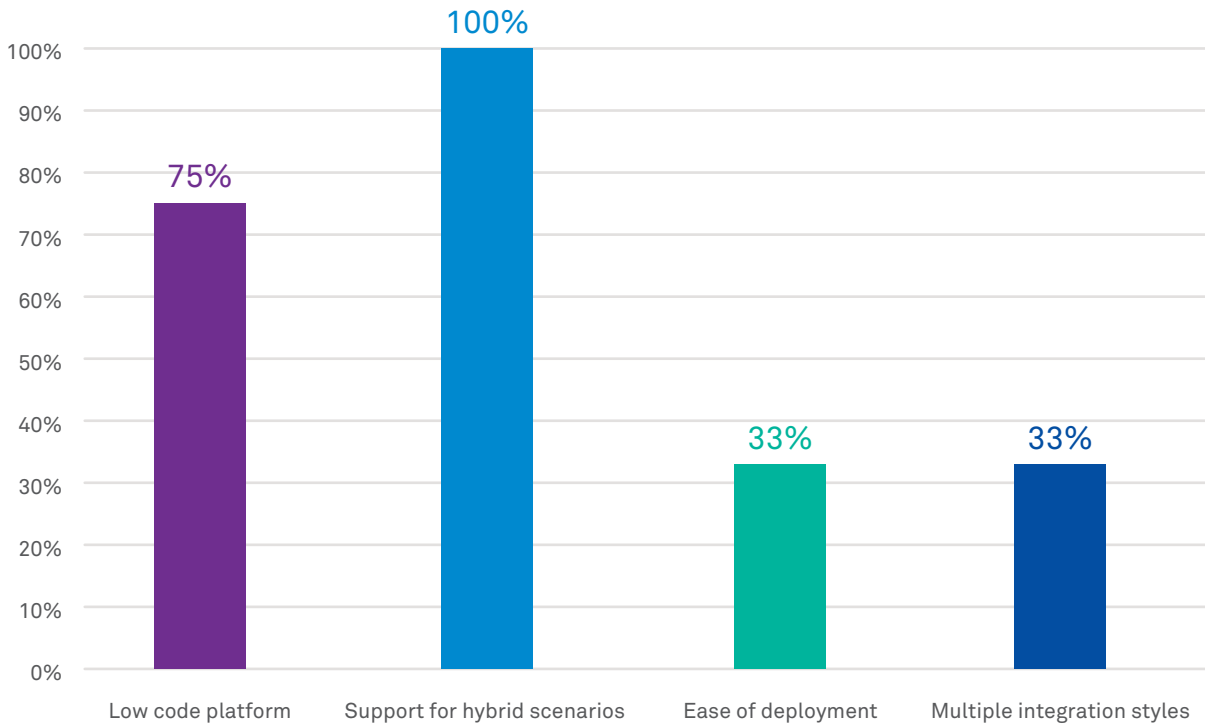


Chart 17

Integration Platform as a Service (iPaaS)

iPaaS is a low code platform with in-built connectors supporting various Integration styles across a hybrid network, and provides as a service-consumption based pricing. It provides other benefits too, such as versatile programming models, cross-organization governance and visibility, and better operational efficacy in addition to stronger security.

Security and data optimization challenges: How iPaaS can help

When we asked about the key challenges they see with Cloud Integration and adoption, over 70% of respondents voted for security and data privacy. This is easily the primary challenge that needs to be overcome for more widespread Cloud Integration adoption (see Chart 18).

The data also shows that businesses want to optimize data transfers while having complete visibility into end-to-end data-flows. This is especially true in the world of high volume and high velocity data, where data processing is distributed across cloud and on-premise systems. Businesses are seeking to address the challenges around latency in such a hybrid cloud scenario with efficient orchestration of data-flows, proactive problem detection and preventive maintenance.

Platform vendors are responding by providing in-built security controls, security certifications, compliance with regulatory requirements and support for security protocols. This addresses Identity and Access Management, Application Security, Data, Platform, and Infrastructure Security in a distributed setup. iPaaS platforms also support batch/real-time data processing, in-memory processing and partner with other vendors to optimize big data.

Q What are the key challenges that you have seen or overcome for Cloud Integration adoption?

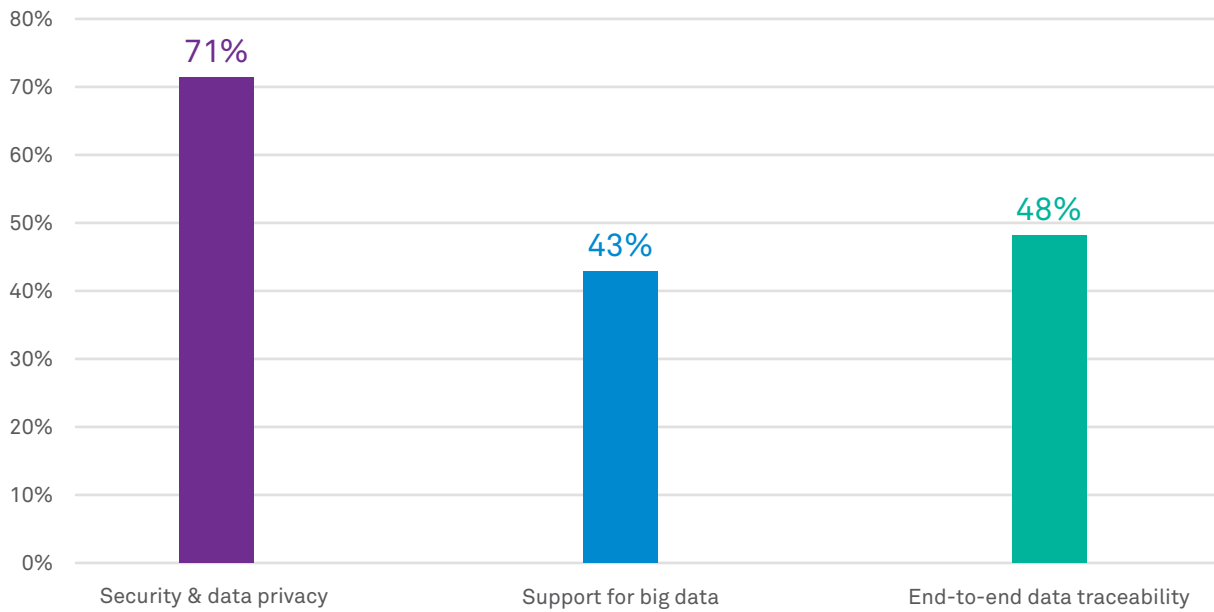


Chart 18

Beyond iPaaS

When it comes to adopting an iPaaS platform, what are businesses losing sleep over? We asked them about the activities that consume the most time and effort, with a view to understanding how cloud adoption efficiency could be upped. The answer was unanimous: the need of the hour is to bring together Integration platform runtimes, tools, frameworks and supporting services (e.g. DevOps, templates, accelerators, configuration services, monitoring) to cut down the time to enable a secure hybrid Integration platform (see Chart 19).

The next frontier of the iPaaS is Digital Integration as-a-Service—a set of tools and frameworks that augments an iPaaS with capabilities for Service Management, DevOps, Monitoring and Integration Service Reuse. It helps organizations go to market faster by reducing the time taken to perform routine tasks after an iPaaS is procured or subscribed to.

Q Which of the following activities consume most efforts while adopting an iPaaS platform?

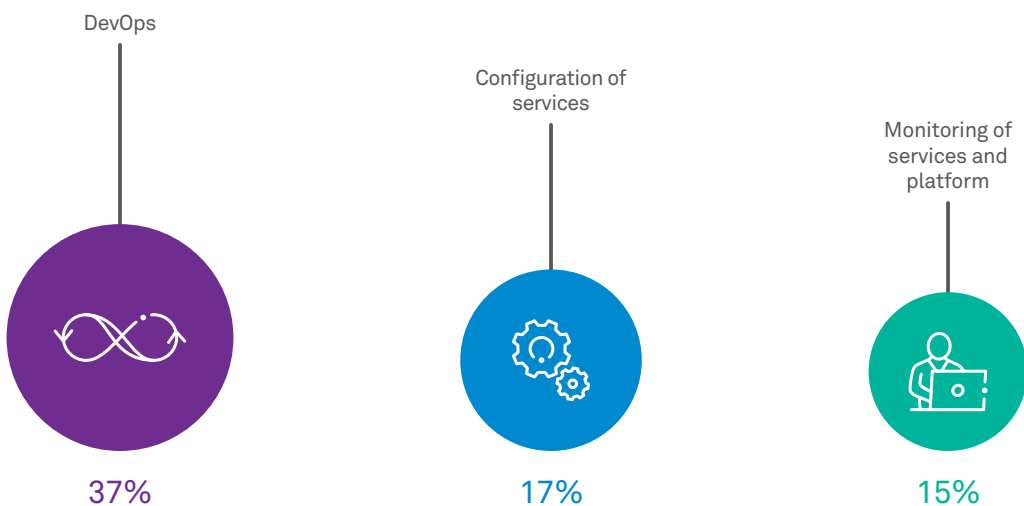


Chart 19

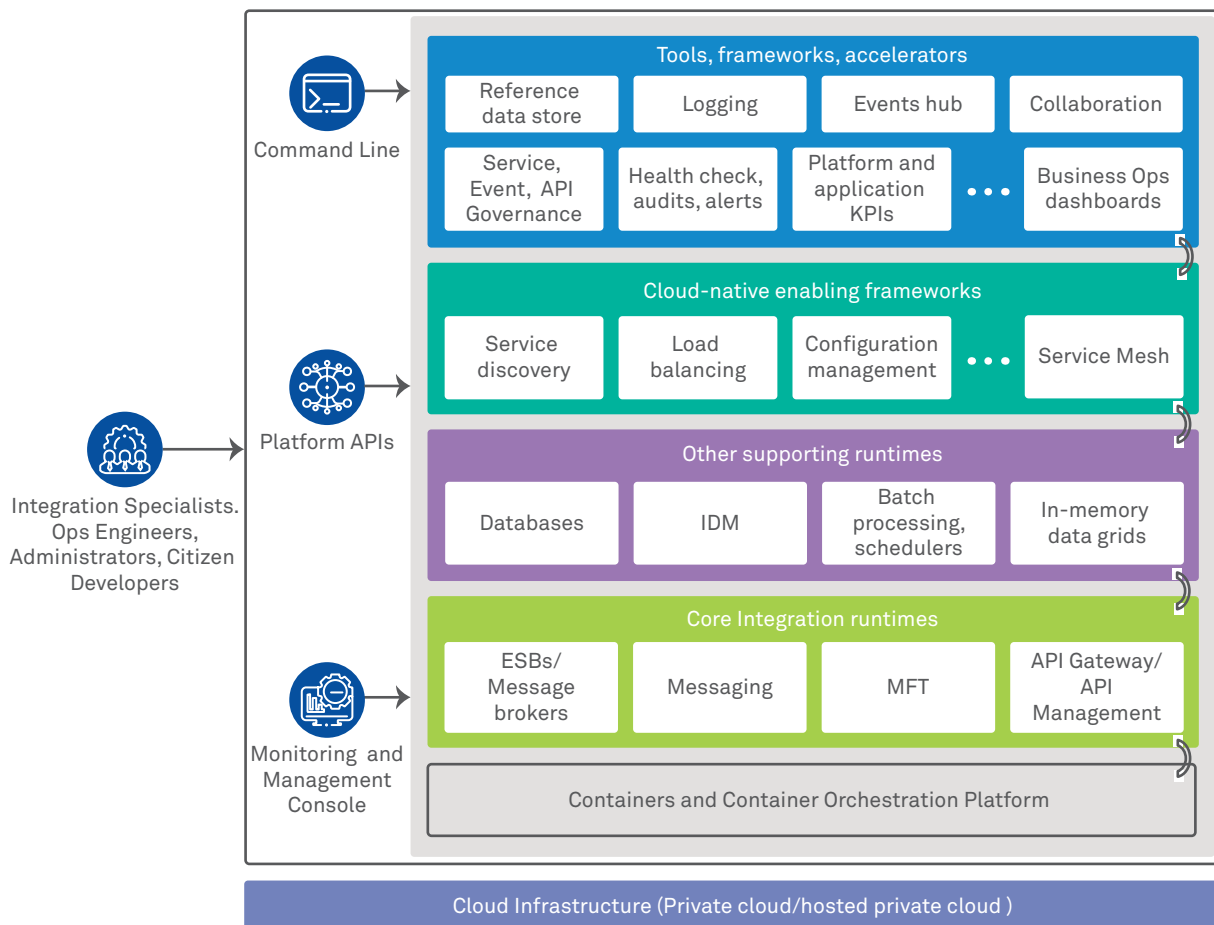


Figure 6: Snapshot of Digital Integration as a Service

The next frontier of iPaaS is Digital Integration as a Service. Here is a snapshot, on how we can bring together architecture, platform supporting services, and tools and processes that transform enterprises to deliver the capabilities (see Figure 6).

Digital Integration as a Service is a set of tools and frameworks that augments an iPaaS with capabilities for Service Management, DevOps, Monitoring and Integration Service Reuse. It helps organizations go to market faster by reducing the time taken to perform routine tasks such as those mentioned above, after an iPaaS is procured or subscribed to.

Future focus: What should cloud-savvy enterprises do?

With legacy systems not going away any time soon, the growth in cloud application endpoints is pushing the trend towards hybrid architecture. Enterprises should have a long-term strategy and

set up their Integration architecture supporting hybrid scenarios with both on-premise and cloud.

With iPaaS emerging as a preferred choice, organizations should look at adopting it as a lightweight Integration platform to meet their Cloud Integration needs with an optimized cost. While it may seem daunting, many organizations have found it best to bet on adopting a multi-product, “best-of-breed” strategy by choosing the right mix of iPaaS, SaaS, ESB and API-based integration depending on the business scenario, use cases and current investment. Organizations also need to have tools and practices in place that can provide developer flexibility, lifecycle management, end-to-end monitoring, security, scalability and governance. As a final step beyond iPaaS, organizations could look at adopting Digital Integration as a Service, an overarching solution framework that can help achieve the desired end-state by streamlining some of the activities that consume most time (e.g. DevOps, configuration, monitoring, etc.)

State of IoT Integration

Precise and effective Internet of Things (IoT) Integration is central to outcomes such as connected digital enterprises, smart factories, smart cities, smart oilfields, smart health, smart utilities and more.

Within the last few years the Internet of Things (IoT) has quickly evolved into a growth enabler. Machines, appliances, assets, infrastructure, and people are being connected to applications, making the vision of a software-defined world possible. As IoT becomes more sophisticated, it is giving way to specialized disciplines such as the Industrial Internet of Things (IIoT) and the Medical Internet of Things (MIoT), each with its own nuanced requirements.

There could be 200 billion connected devices by 2020 (up from 15 billion in 2015)^{xii}. Studies suggest that by 2025, IoT could be a USD6.2 trillion market^{xiii}. The business of integrating these devices into existing systems presents a new challenge. The rewards of getting it right include the ability of businesses to drive proactive actions, better communication, faster decision making, developing new business models, etc.

Water and gas utilities provide an excellent example of the complexities that must be mastered before IoT Integration can unlock new possibilities. Typically, the infrastructure of these utilities is vulnerable to slow and imperceptible damage. IoT changes that. Fleets of drones and sensors replace the armies of inspection crews, providing 24X7 surveillance. The data from IoT platforms is captured for analysis by analytics engines. The insights are then combined with the relevant systems to trigger appropriate action. This requires sophisticated IoT Integration capabilities.

We believe that the upside around IoT Integration is likely to be exceeded by several magnitudes, starting in 2020, as 5G comes into play. With 5G offering network slicing, low latency and never-before QoS, IoT adoption will multiply and Integration will be even more important to enable next-level business transformation.



What is driving IoT adoption?

There are diverse reasons for the adoption of IoT. Our survey results showed that the top three reasons for the adoption of IoT were to create a connected ecosystem which is the foundation for Digital Transformation, to build smart supply

chains (with track and trace capabilities and the capacity to protect the business from counterfeit products), and for proactive and predictive maintenance that brings down operating costs and ensures higher customer/user satisfaction by reducing down time (see Chart 20).

Q What are the top uses of IoT that are important in your Digital Transformation journey?

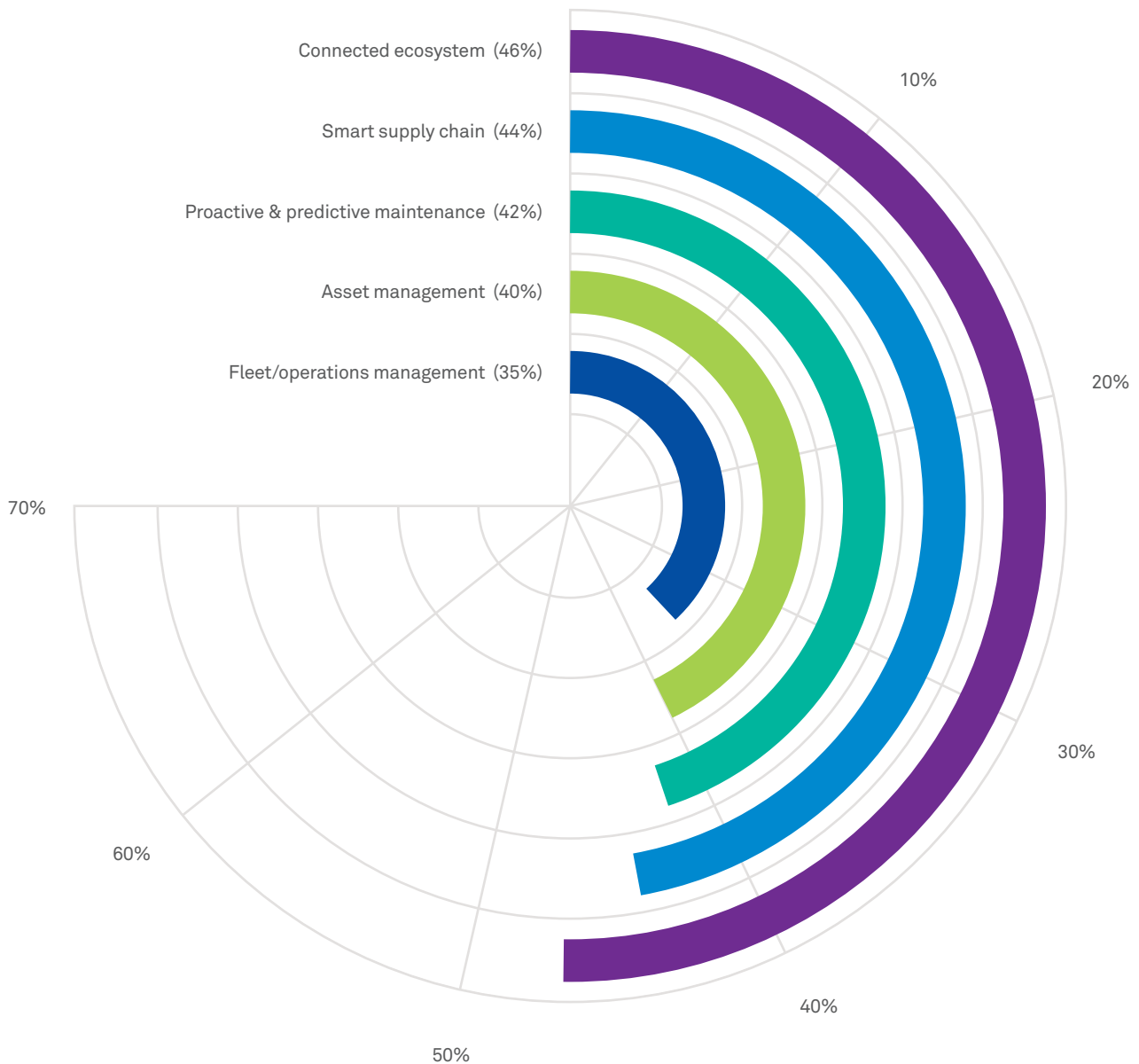


Chart 20

Integration is key to IoT success

Integration is central to how IoT is successfully leveraged by businesses. Creating a seamlessly connected ecosystem of devices, things, people, process and IT applications across infrastructure and geography is going to demand unforeseen skills and expertise. This is because such

Integration needs to connect everything, and must function in a diverse ecosystem of platforms, operating systems, networks, protocols, energy constraints and data sources/formats. Without doubt, there are few other environments that present such a large and complex number of integration points as well (see Figure 7).

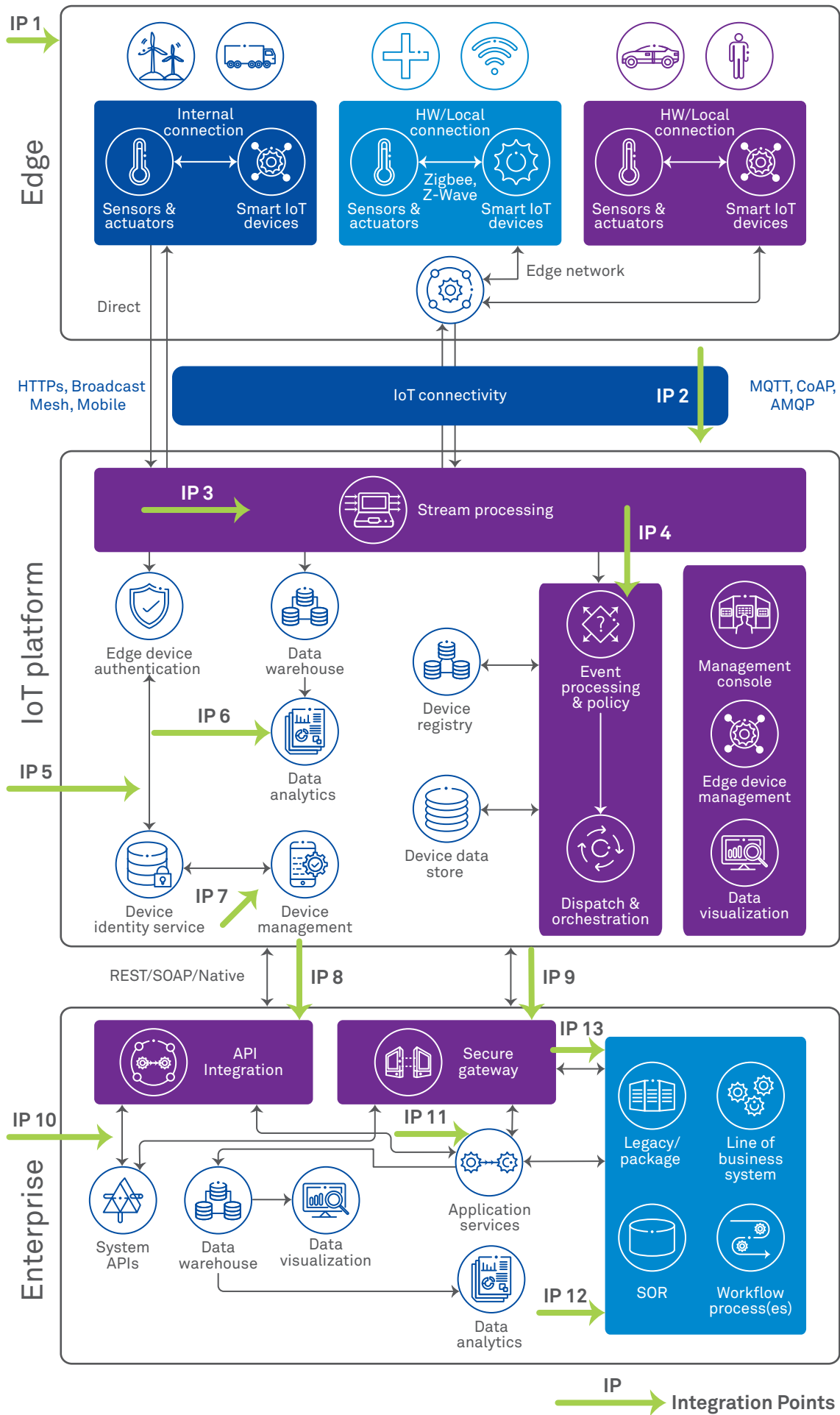


Figure 7: A synopsis of integration points in an IoT landscape

Heterogeneity and diversity of devices adds complexity to IoT Integration

IoT presents a new set of Integration challenges. The survey results show that connecting devices and sensors to gateways is the #1 challenge. This is followed by the challenge of connecting the IoT platform with the enterprise applications and IoT platform to application APIs (see Chart 21). These are natural outcomes of the fact that enterprises have invested in integrating internal systems or integrating across industry-specific

assets. This is their area of comfort. Suddenly, businesses are faced with a challenge of having to integrate with an external environment made up of heterogeneous devices and applications of different size, firmware, capacity, and capability to exchange data and encryption standards, security requirements, etc. They have to think of diversified protocols (AMQP, CoAP, MQTT, HTTPs, etc.) and data formats (JSON, XML, custom wire) with the many constrains that determine integration (such as low energy, bandwidth). Amidst this is the challenge of dealing with analytics at multiple points and the growing security concerns at various integration points.

Q In the context of IoT Integration, what are the most challenging integration points?

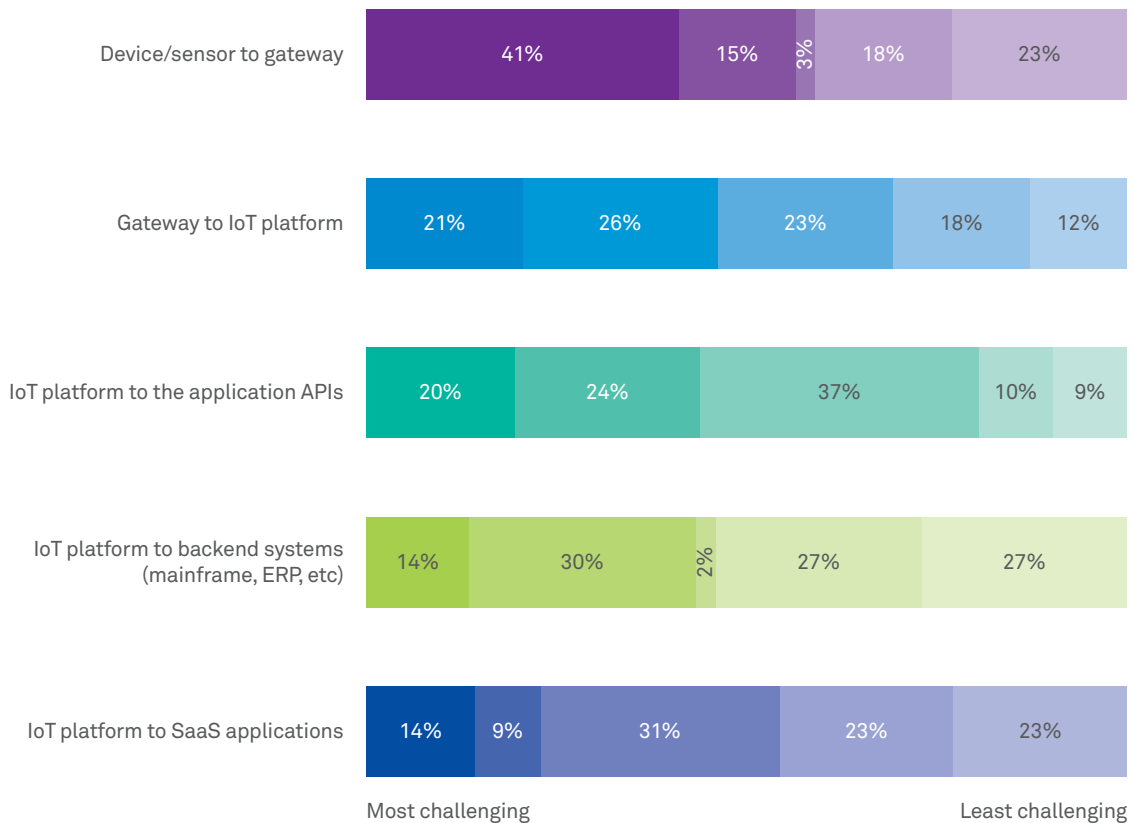


Chart 21

Strategy for effective IoT Integration

The complexity of IoT Integration and the challenges presented by it are strong reasons for approaching IoT Integration differently from traditional Integration. What are the differentiated capabilities that such an Integration strategy needs to bring in order to be effective? We asked our respondents to tell us the most desired enterprise capabilities that would be needed to ensure better ROI. Real-time integration of sensor data was the

most wanted capability, followed by the ability to integrate heterogeneous devices and reliability of the integration (see Chart 22). Organizations should start by assessing the capabilities of their existing Integration platforms, identify gaps and take steps to re-architect and modernize the platform. The platform should also be able to orchestrate and choreograph cross-enterprise workflows, integrate and transform bi-directional data and provide actionable insights in a secure manner through seamless integration across devices and applications.

Q Based on the use cases for IoT, what are the most important capabilities or requirements that should be addressed as part of your IoT Integration platform/architecture?

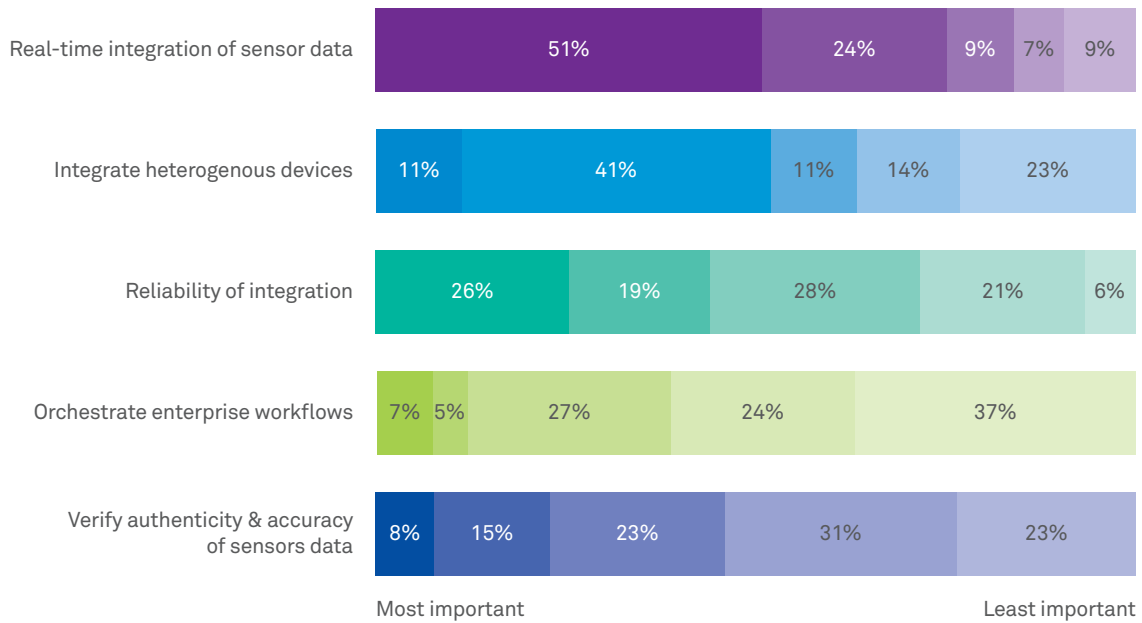


Chart 22

Internet of Things to Web of Things

Our survey results indicate that lightweight IoT protocols (AMQP, MQTT, TR-069) continue to be used and supported by sophisticated integration products for high-speed messaging. HTTP/S usage, supported by multi-factored security schemes, is rising in popularity and is ahead of all other protocols to connect gateways with IoT platforms (see Chart 23).

The rise of HTTP/S usage can be attributed to its simplicity and the omnipresence of the web. Banking on this trend, W3C^{xiii} is currently working on Web of Things standards. Mozilla has released an implementation of its Web Things gateway based on web protocols^{xiv}.

Q Which of the following protocols do you use for sensors or small/constrained devices while interacting with a gateway or an IoT platform?

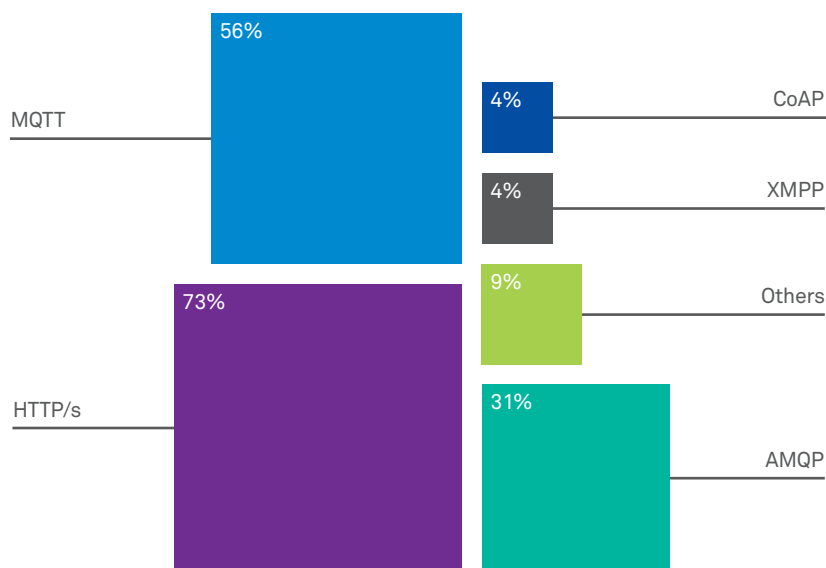


Chart 23

Simplifying IoT Integration and the case for APIs

With the growth in data, organizations are showing a marked preference for an API-based approach for data collection and processing. This is followed by Event Streaming to process

growing data loads along with streaming analytics and the use of Messaging Middleware to pass data between applications (see Chart 24). APIs and Event Streaming make applications more efficient, responsive and relevant for a specific event and help the organization in evangelization.

Q What are the preferred data processing and mediation approaches for IoT Integration in your enterprise?

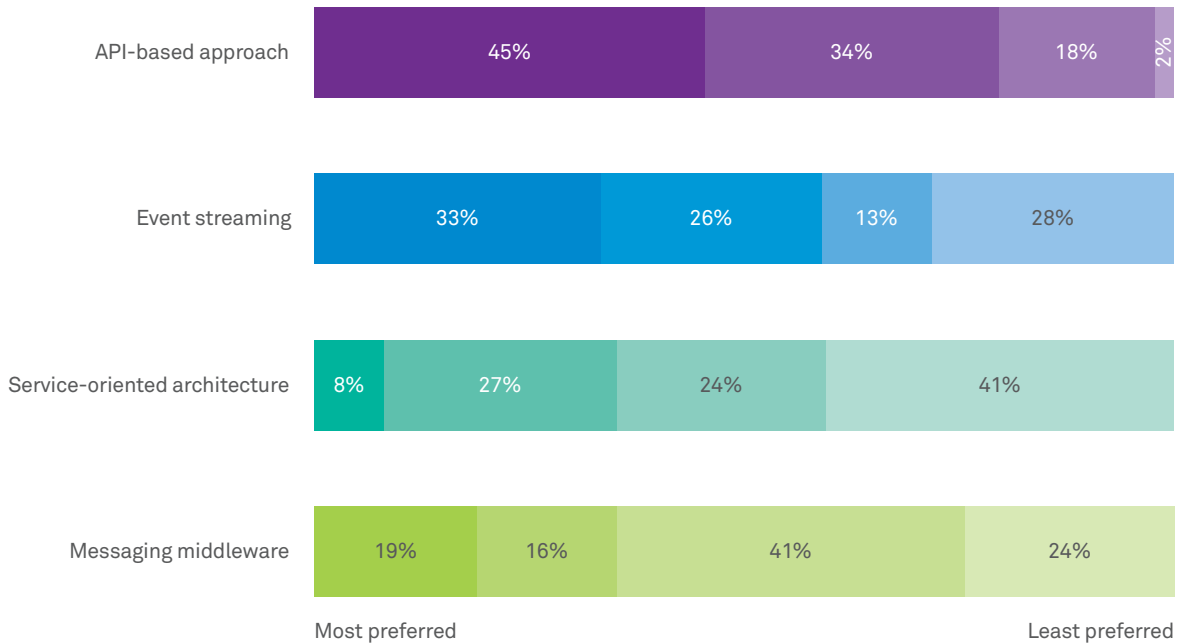


Chart 24

Edge computing moves to the center

The exponential growth in the number of IoT devices is leading to a higher volume of highly distributed data across billions of nodes, resulting in increased latency and stress in the ecosystem.

With Digital Transformation initiatives sweeping across industries, edge computing is gaining traction. Edge computing offers low-latency and highly available computing infrastructure closer to edge infrastructure such as things, machines, factories, and points of sale. With analytics available at the edge, many important tasks can be offloaded from the IoT platform to the edge, improving data privacy, security and latency.

Edge locations have several constraints. These constraints play a major role on the compute approach chosen. Some organizations are embedding edge capabilities within the devices and a few of them are doing it at the gateway. A number of organizations are also exploring serverless edge computing, given its simplicity.

To gain a better understanding of how organizations view these issues, we asked respondents to tell us how edge computing would impact IoT Integration. The response was as expected; most felt that edge computing simplifies Integration as the edges can handle device-specific protocols and translate it to standard open protocols like HTTP. This was followed by respondents saying that edge brings down latency in Integration as it offers responses avoiding latency to cloud and edge makes Integration more reliable as it acts as an intermediate buffer (see Chart 25).

Edge computing brings low-latency and highly available computing infrastructure with deep insights closer to the things enabling efficient IoT integration.

Q Are you planning to adopt edge computing? If yes, how do you see it impacting IoT Integration?

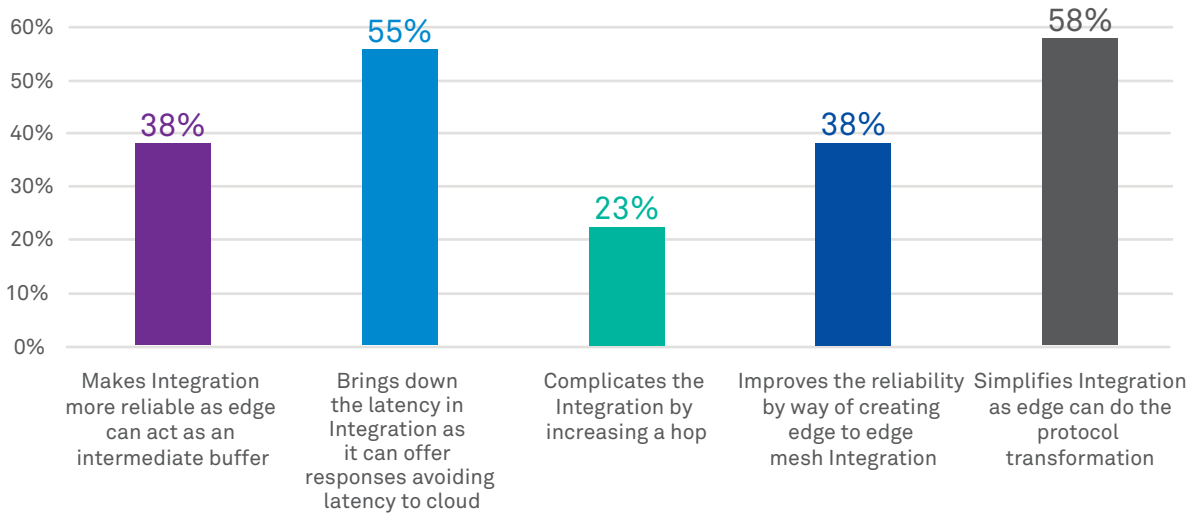


Chart 25

You don't need me to tell you that IoT is changing the world - it is inexorably and clearly changing not only how we interact with technology, but how technology interacts with us. Whether we're pushing the boundaries of production line efficiencies, creating new and innovative products for customers, reducing the numbers of car accidents, or managing wind farms to maximize power output (to name a few examples), IoT is making the world a better place.

As IoT converges OT (Operational Technology) with IT, integration becomes a crucial part of any IoT project and, for the majority, more than half the budget is typically dedicated to this area.

Bi-directional integration technologies make it easier than ever to combine device data with your enterprise data. You can leverage pre-built connectors and recipes to accelerate your integration tasks to enrich IoT device data with contextual data from cloud-based and on-premises systems such as ERP, CRM, and order and service management systems. You can automate your business processes to trigger event-driven actions based on IoT events, for example, to inform a service technician when a critical machine status has been detected or predicted.

A strong implementation partner can help guide you around strategic hurdles, and choosing the right IoT platform, as opposed to building your own, can enable you to avoid the technological issues, delivering immediate value while providing the flexibility to iterate and innovate continuously.

Ultimately, any IoT project needs a clear business case first, and my recommendation to any organization starting on their IoT journey is to: Think big, start small and move fast.



» Dr. Jürgen Krämer,
General Manager, IoT & Analytics, Software AG



Integration of Everything

As organizations step up their plans to connect everything, from back to front, it is time for Enterprise Integration Platforms to evolve and use low code to natively handle IoT Integration—to a point where they are able to deliver the Integration of Everything.

The rise of connected products and connected business models are bringing IoT to the center of business processes, making elements such as resiliency, low-latency, security, and concurrency important. It is therefore the right time to examine and adopt cloud-native architecture patterns to create a truly resilient and real-time enterprise.

State of Business Partner Integration

In the age of digital, business partnerships are becoming complex. They now involve not just the exchange of business documents, which is the traditional function of business partner Integration, but are also meant to forge collaborative paths to success. In the modern world of digital and business disruption, business partner Integration is the Digital Integration of optimized and automated business processes that could extend beyond the boundaries of the organization. Business partner Integration platforms are evolving, designed to meet these new demands.

Modern businesses are sprawling entities with multiple partnerships across industries and geographies. Their value streams are complex and involve manufacturers, producers, customers, suppliers, distributors, logistics providers, financial institutions, regulators, legal entities,

support services, etc. Integrating these diverse partners effectively into their digital systems is the secret of their success. These organizations are outpacing traditional companies that have been in business for decades, setting examples that others can emulate.

With the modern application transcending the traditional boundaries of an enterprise, partners are a part of an organization's technical landscape and an important asset to delivering value for their customers. B2B Integration brings this network of partners into an organization's logical architecture and allows it to multiply its ability to deliver services that are not traditionally a part of its core business model.

The line between applications, devices and partners has blurred significantly as the deployment models become less relevant and the main driver is the collective value delivered. Of course, with the emphasis on the quality and reach of the service provided, the importance of its reliability has also increased. The move toward microservices-based architectures is an important trend catering to these needs and B2B Integration will need to find ways to benefit from these rather than follow the traditional hub-and-spoke model.

The partner is an application and the services it provides are just APIs into the partner's ability to enhance the experience for your customers. That is why B2B Integration will also increasingly be API-led in the near future. API management for partner interfaces provides the additional layer of trust and security demanded by B2B Integration. It also makes it easier for an organization to gauge partner maturity based on the quality of exposure of their APIs. A multi-function iPaaS with integrated B2B, API Management, Hybrid Integration and IoT capabilities allows an enterprise to rapidly on-board new partners, enable partner self-service and enhance the collaboration between the enterprise and its partners.



» Rupinder Singh,
General Manager, Integration & API, Software AG



Top-notch business partner Integration gives organizations a definite edge. They become more competitive, sharply differentiated and are able to fuel growth through higher levels of service and their responsiveness to customers.

Collaboration for seamless value chain

The survey results of the State of Digital Integration 2019 show that business partner Integration has matured. It has emerged as a collaboration platform providing insights and analysis of connected digital business value chains spanning multiple partners. These platforms are making organizations agile, with the flexibility to quickly run business processes for new products and markets when required.

Business partner Integration has matured, emerging as a collaboration platform providing insights and analysis of connected digital business value chains spanning multiple partners. These platforms are making organizations agile, with the flexibility to quickly run business processes for new products and markets when required.

In a bid to respond to changing business conditions, organizations have started viewing business partner Integration as a path to profitable business growth, driven by Digital Integration throughout the business value chain (see Chart 26).

Q In the journey towards digitalization and Digital Integration, how do you perceive the role of the business partner Integration platform?

39%

Collaborative platform providing insights of connected digital supply chain data

34%

Business document exchange with limited digital visibility

27%

Generating profitable business growth



Chart 26

Demand for domain-specific Integration

As Digital Transformation demands more responsiveness and a focused customer experience, our survey respondents said that they want their Business Partner Integration platform to be domain-specific. They want it to address their industry and business needs. The next most important ask from the B2B Integration platform is for solutions that are specific to the business (see Chart 27).

For example, an automobile manufacturer will want a platform that can integrate its industry/domain-specific partners who are not necessarily confined to a single community (for e.g. supply chain, logistics, customs, distributors, recruitment agencies, financing institutions). The automobile manufacturer can then manage the communities by assigning community-specific processes with reusable rules. Internally, the organization would want a platform that integrates business-specific processes such as sales, invoicing, payments and reconciliation.

Q How much of industry focus would you expect from the Business Partner Integration solution?

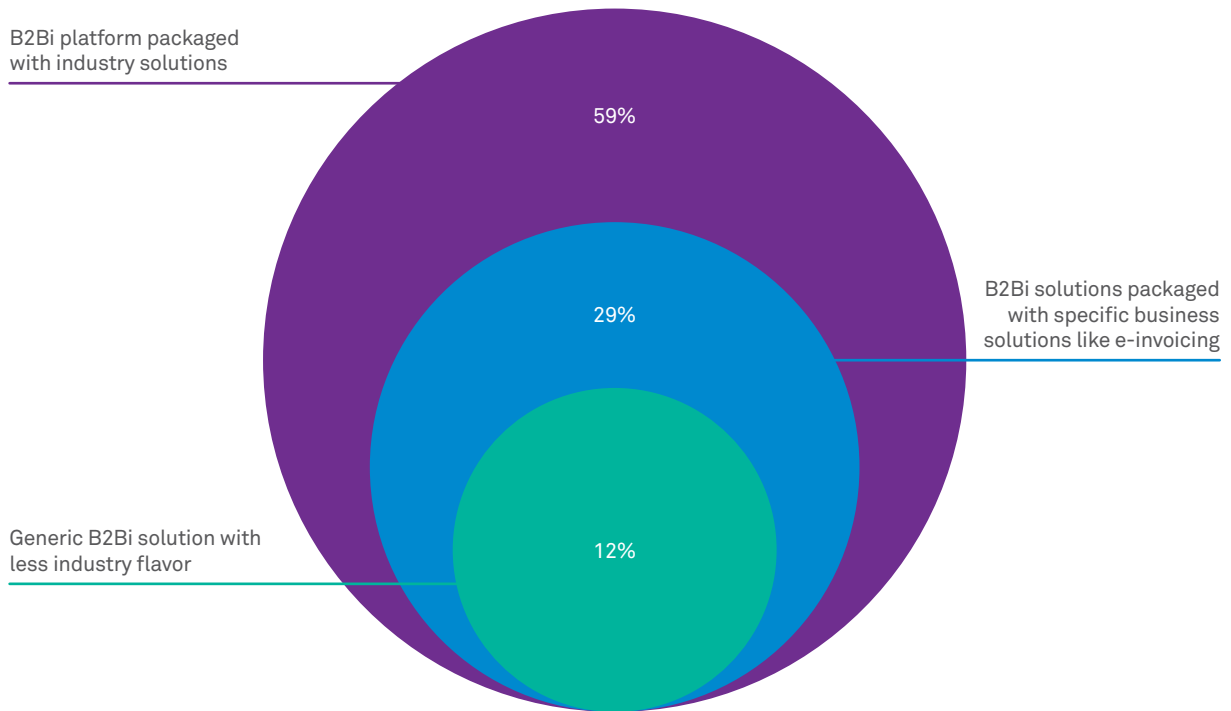


Chart 27

APIs: Transforming Business Partner Integration

With evolution, business partner Integration platforms have adopted web services and APIs into their landscape. Service Oriented Architecture (SOA) and web services have added more reusability into business partner Integration, with the result that organizations are able to respond faster to their business needs.

APIs have begun to play a major role in Business Partner Integration. Our survey results showed

that a majority of the organizations were adopting APIs in two different ways:

1. for operational activities like new business partner on-boarding, leveraging self-service from business partners, providing insights and visibility into business partner transactions and
2. for core Business Partner Integration to exchange business documents with business partners (see Chart 28)

Q How do you leverage APIs for Business Partner Integration in your digital journey?

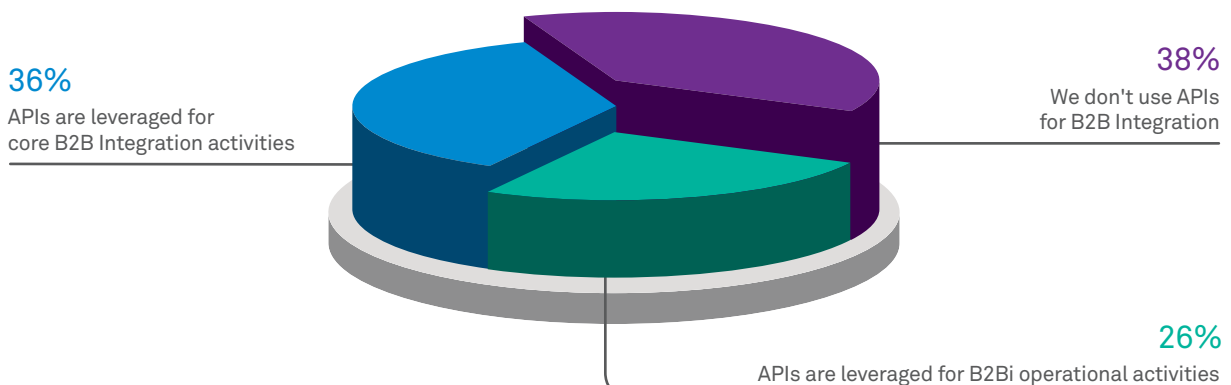


Chart 28

B2B Integration requirements for digital applications are driving companies to focus on providing transformations as services to applications. By implementing new interaction layer APIs to work with existing EDI integrations companies can simplify integration with their partners and extend the value of their existing EDI integrations. This approach can allow for self-service on-boarding of partners to these services through the APIs reducing the complexity.



» Ken Parmelee,
Director, IBM Cloud Pak for Integration



Desired capabilities of Business Partner Integration platforms

APIs allow businesses to integrate new mobile and SaaS applications with traditional business partner Integration standards and applications. API-led business partner Integration enhances the value of existing systems. It opens the doors to convenience and innovation without compromising the control and security of enterprise data. Take

the example of new business partner on-boarding. It has always been a time-consuming process, hindering time-to-market. API-led self-service has stepped in to address the problem, reducing on-boarding time and lowering time to market. Our survey results support this. Respondents said they want their business partner Integration platforms to monitor and analyze business activities, followed by API management capabilities and partner collaboration/self-service features (see Chart 29).

Q What would be the additional capabilities that you would want in your business partner Integration/MFT platform to support your organization's digital initiatives?

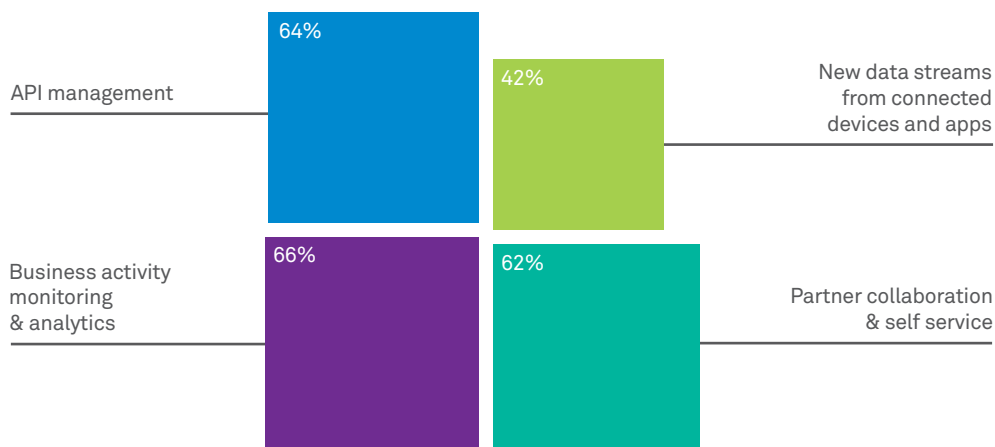


Chart 29

Key initiatives in Business Partner Integration

Drivers of modernization and the forces of digital disruption are setting the stage for organizations to adopt a set of key initiatives for partner integration. These initiatives include:

- **Global Business Partner Community Management**

Business partner Integration stitches together partners that are spread across multiple

domains/communities such as customers, suppliers, financial institutions, and government organizations. Managing each partner community, via the Integration platform, is vital.

- **Business Process Integration and Automation**

Business partner Integration extends business process outside the boundaries of the organization to the business partners. Exchanging business documents in accordance with policies and industry standards will involve certain business rules and processes to be followed. For example, an invoice that has an

amount above a certain value might need to go through an approval or matching process. This requires using rules and profiles between partners that can be automated. A peripheral system runs these processes, preventing the core system from becoming overloaded—leading to an improvement in efficiency and productivity.

• **SaaS adoption**

Our survey shows that organizations prefer a hybrid model of deployment for their business partner Integration with an on-premises component or agent enabling the integration of enterprise applications with the business partner Integration platform on cloud. The trend will be for organizations to steadily move towards a Managed Services model (see Chart 30).

• **Blockchain adoption**

A typical business partner Integration platform is designed to exchange and manage a large variety and volume of documents (contracts, orders, approvals, invoices, notices, etc.). Our survey results show that organizations want to leverage Blockchain in their platforms primarily to enhance the visibility and authenticity of business documents (see Chart 31). In addition, the results show that organizations are keen to use Blockchain, which provides immutable trust within networks, to enable greater collaboration. For example, a shipment notice from a retailer will ensure that a fleet of trucks can be kept ready by the logistics partner, without worrying about the authenticity of the order.

Q What kind of deployment do you prefer for your Business Partner Integration infrastructure?

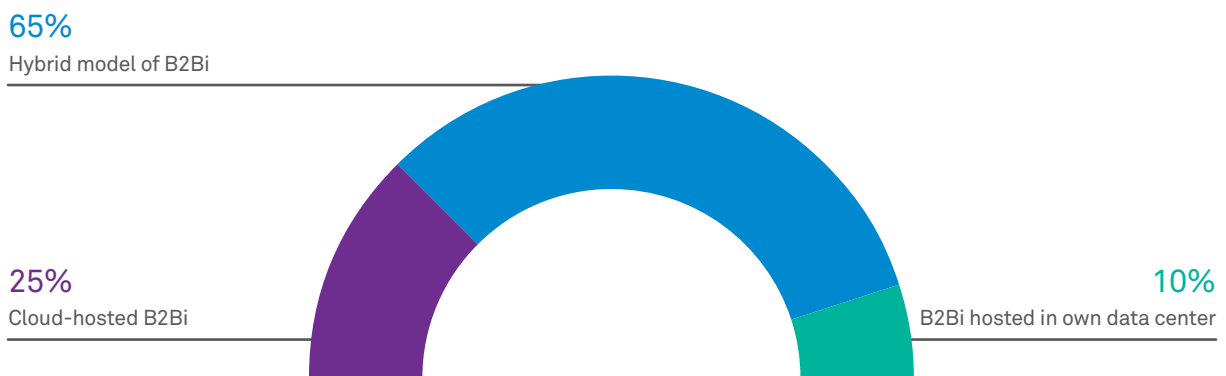


Chart 30

Q How do you foresee Blockchain providing value in B2B Integration?

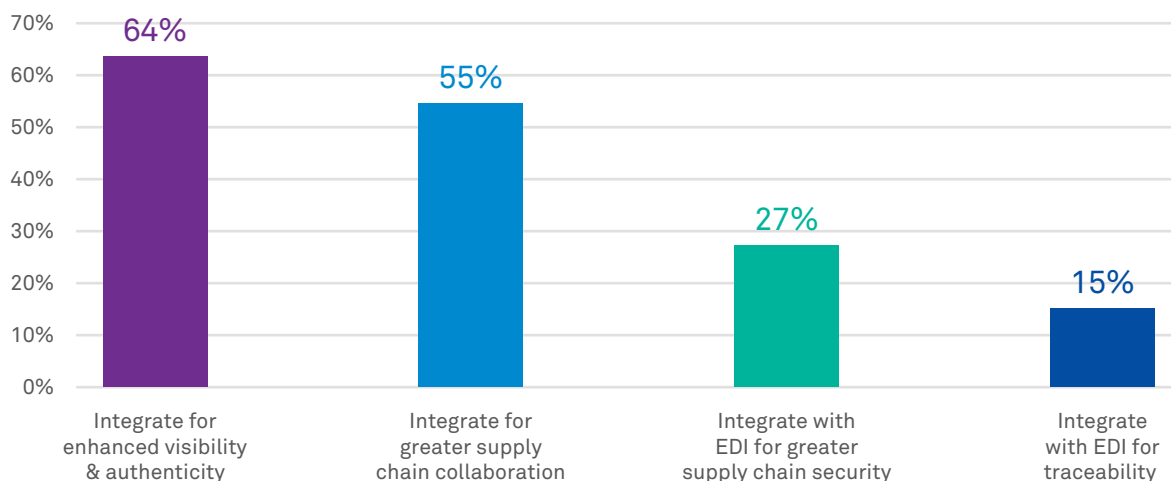


Chart 31

Strategizing business partner Integration

For a successful digital journey, it is imperative to wisely strategize business partner Integration. Organization should consider acquiring the following capabilities in their business partner Integration solution:

- **Business partner collaboration** should be a key goal, enabling processes like self-onboarding
- **APIs** should be an integral part to support new business channels
- **Business activity monitoring** will help to build pro-active business partner Integration solutions
- **Support for cloud deployment** to enable a scalable solution aimed at reducing time-to-market, keep pace with regulatory changes and lower costs



State of Industries through the lens of Digital Integration

- Banking
- Retail
- Manufacturing
- Airports
- Healthcare



Banking

When it comes to Digital Transformation banks have only been playing a protective game. The sights they've set have not been as high as they need to be to address today's digital disruptions. Banks have been overwhelmed with ever-changing customer preferences and technology disruption. They need integration strategies to leverage newer technologies and prepare for a brave new financial future.

Ask any millennial customer about what a bank means to them. The chances are that you're not going to hear about pen-and-paper forms, queues, tokens, buildings, bank statements in the mail or any of the traditional trappings of what banks have been thought to look like. You're more likely to hear about connected, intuitive possibilities, apps that make finances

hassle-free, payments that don't require anything more than a chat bot or a voice assistant conversation, a click, or a tap, or even a gesture, and ubiquitous banking that can happen from anywhere. Bankers need to combine digital speed and convenience with human caring and humane interactions at crucial customer touch-points.

Digital is fast being subsumed into the way we do business. The word is almost superfluous as Digital Transformation has become intrinsic to how we all do business and indeed stay relevant. It starts with the question of sustainability. In a digital world, it's the ability to 'adapt' to new situations, to exploit opportunities quickly, to experiment, to access to new technologies, etc. We are now generally well versed in 'experiential' design and the significance of customer experience. As we improve the experiences we in turn drive the traditional metrics —revenue, up/cross-sell, repeat business, retention and so on. The same applies to the employee experience. If we create the right environment for high quality engagement amongst our employees, we will attract and retain the right talent, and in turn drive better customer experience and the related benefits. A virtuous circle.

At AIB we're modernizing our technologies at pace and seeking the advantage that comes with microservices, APIs and cloud technologies for example. However we try not to get blinded by the tech as we need to modernize in step with our customer and employee experiences. For us this means picking our bets carefully so that we can cease and retire tech quickly (as required), and be able to scale quickly and efficiently, and crucially, to re-use our resources creatively.



» **Brian Farrelly,**
Head of Technology Partner Management,
Allied Irish Banks (AIB)



Questions that keep bankers awake:

- How to create an intelligent plug-and-play technology platform that can handle business model changes with almost nil marginal cost?
- Is it possible to streamline the process and create a funnel for providing meaningful access to data sitting on legacy banking systems to customers and third parties?
- What are the steps to be taken to collaborate across internal and external partners/organizations to unlock new revenue streams?
- How to monetize the data and the intelligence that the bank is sitting on?
- How to put the integration layer to work to modernize applications leveraging the benefits emerging technologies have created?
- How to convert to bank as a platform or bank as a service?

Not just banks, but all types of financial service providers face intense pressure to increase efficiencies and reduce costs. They need to cope with changes in business models and deliver next-generation digital services. Partnerships with financial technology (fintech) start-ups and similar non-traditional companies can give banks the agility they need to support Digital Transformation and create a digital ecosystem that will retain existing customers and attract new ones. Startups with new business ideas are meeting the needs of both the customer and the bank with channel integration and dynamic customer experiences. This makes banking easier to accomplish on the devices of the customer's choice. Some are even challenging traditional online, mobile banking and core banking solutions. The gospel truths of banking are being rewritten—especially those that govern customer loyalty, long-term relationships and overall increase in profitability.

Trends that are disrupting Banking as we know it

New "bankers" on the block: Some of banks' biggest competitors aren't even banks to begin with. Amazon Cash gives customers the ability to deposit cash directly to their Amazon accounts from more than 10,000 retail locations throughout the US, even as Amazon is lending billions to small businesses over the past 2 years. Chinese e-Commerce giant Alibaba has amassed the world's largest money-market fund and offers loans to small businesses based on their credit history with its own platform. Everyone from Google to Facebook to WhatsApp has a payments angle that completely bypasses the traditional need to go to a bank. The signs are clear; retail banking is being disrupted not only by nimble fintech startups, but by tech giants as well. Banks will need to up their digital game with a growth-focused mind-set.

Not just bankers: Banks are looking beyond cross-selling traditional banking products in order to offer greater value to customers and grow. This network of value spans across industries and creates "ecosystems" that provide the services customers want at lower cost and with greater convenience. Such services could be related to the geo-location of the customer, home moves, country moves and a host of other variables that leverage the bank's relationship with the customer.

Real-time payments: Real-time payments combine immediate funds availability, settlement, confirmation, and integrated information flows—in a matter of seconds. It will cause a major shift in the banking business paradigm, changing the economics and process latency benchmarks. Efforts are on to drastically reduce data latency in every area such as customer experience, transactions, services, clearing, settlement, risk and compliance, monitoring, finance, management information system, etc.

Banking for the digitally native: Depending on which part of the world you're in, 2 out of every 3 people are likely to be millennials. This generation of digital natives has grown up with the technology and devices that their elders find challenging. With this generation, technology has been democratized, apps are everywhere and convenience is the new luxury. Bankers now need to develop digitally-native experiences to suit the lifestyle of their new customers, with a focus on completely reimagining key journeys rather than digitizing existing products and services.

The disruptive habits of fintech: If there is one industry segment that has made bankers sit up and take notice, it is the fintech. Their refusal to accept status quo and put technology to work has shown banks a thing or two about how disruptive new business models can be. While only a handful of banks have invested in fintech-led partnerships, it has been enough to create a network effect. These banks have skewed industry growth in their favor and created a major challenge for the laggard banks.

Big data and cognitive computing: Two technologies that can reimagine the banking service catalogue are Big Data and Cognitive Computing. Banks are investing in using data to understand customer behavior based on their investment patterns, shopping trends, risk appetite, motivation to invest, and personal and financial backgrounds. The ability to draw these insights is the veritable gold dust of banking. It is poised to open up new revenue channels for banks.

The mother lode of data: Most banks have rich information on their customers. This may include key demographic details, where they live, what they spend on, how much they save and their lifestyle preferences. This data could drive an entire revolution in conversational banking and in voice and video based services. The challenge is the unstructured nature of this data. To make this work, Integration needs to build in capabilities to further include public data sets and non-demographic data to draw and deliver contextual insights.

Prime Digital Integration areas

The key business areas considered as prime Digital Transformation candidates are:

- Customer engagement and customer experience
- Participation and promotion of marketplace
- Low latency finance, risk, compliance and reporting
- Conversational UIs
- Integration with industry-level platforms such as blockchain

Integration in action: Conversational Banking

Millennials are seeking banking experiences with a smart voice assistant (like Alexa or Siri) through devices such as smart phones, smart watches, connected cars or home automation systems. From making payments, transferring funds to getting predictive and personalized advisory services—it's all happening over a conversation with an intelligent system. The integration of biometric authentication (voice, fingerprint, and heartbeat) is bringing in a new wave of touchpoints with banking.

When IoT devices, voice assistants, partners, fintechs, core banking systems and other financial institutions across hybrid and multi-cloud environments are integrated with robust and rapid AI-powered technology, we begin to see banking's true power unleashed. Banks are adopting an API and microservices ecosystem with cloud-native technologies. A robust Integration strategy helps to bring together data, IoT, SaaS, B2B and application integrations on their existing platform. Adopting iPaaS is another way of achieving similar results.

How Integration is helping the Banking industry

As banks work hard to bring their customer experience on par with other digital experiences, the need for Integration has never been felt more strongly. Integration helps adapt to emerging technologies and trends by digitizing services, product and processes. It helps harness data in a more meaningful way. Here is how Integration plays out in various banking fields.

Payment standardization: Payment standardization seeks to bridge the divides between payments firms, consumers and businesses. But it needs a slew of seemingly unconnected systems to work together across a variety of new environments—think messaging, mobile browsers, marketplaces and apps, over new channels such as voice and Augmented Reality. Standardization will allow them to talk to a payment terminal, get confirmation and status updates in real time—all this just as naturally as you would expect a customer to pull out a plastic card at a merchant. Behind the steel and glass facades of the bank headquarters, the industry is moving forward with standards like FIBO, IFX

and ISO 20022 and extending the standardization across applications by adopting some of the open standards like BIAN^{ix}.

Open API adoption: Banks need a robust Integration strategy to harness the power of APIs—a system that allows you, for instance, to access the bank’s transaction processing services from a corporate ERP environment. The adoption of open APIs has gained popularity as it helps disparate systems talk to each other. New channels like voice and smart chatbots are getting on-boarded seamlessly with the help of API management and the greater level of control it provides. Microservices, containers and orchestration platforms are leveraging their existing SOAs (for A2A and B2B scenarios) and are helping the organization to achieve real-time transaction with agility, scalability and resiliency.

New regulatory realities: Regulators globally are moving away from post-crisis reforms to building a new set of practices and priorities. Disruptive technology needs regulatory policies to keep pace. Questions are being asked about the use and ownership of data and about the

boundaries of regulation that could affect market conditions for growth and investment. European banks are responding with the implementation of open banking/PSD2 (second Payment Services Directive) as per the regulatory guidelines, with other regions slated to follow suit.

The State of Integration in Banking

We asked banks some critical questions on their Integration journey to get an idea of how far down the road they have travelled, what drives them and their expectations from Integration.

- **Well on the way to a true digital economy:** Our survey results indicate that most banks are well on their way to enterprise-wide Digital Transformation with multiple initiatives already in progress and a few completed (see Chart 32). Hybrid Integration is the leading choice due to infrastructure and platform diversification. It helps companies connect downstream applications seamlessly and securely provides the required data to the upstream system.

Q What is the current state of Digital Integration underway in your organization?

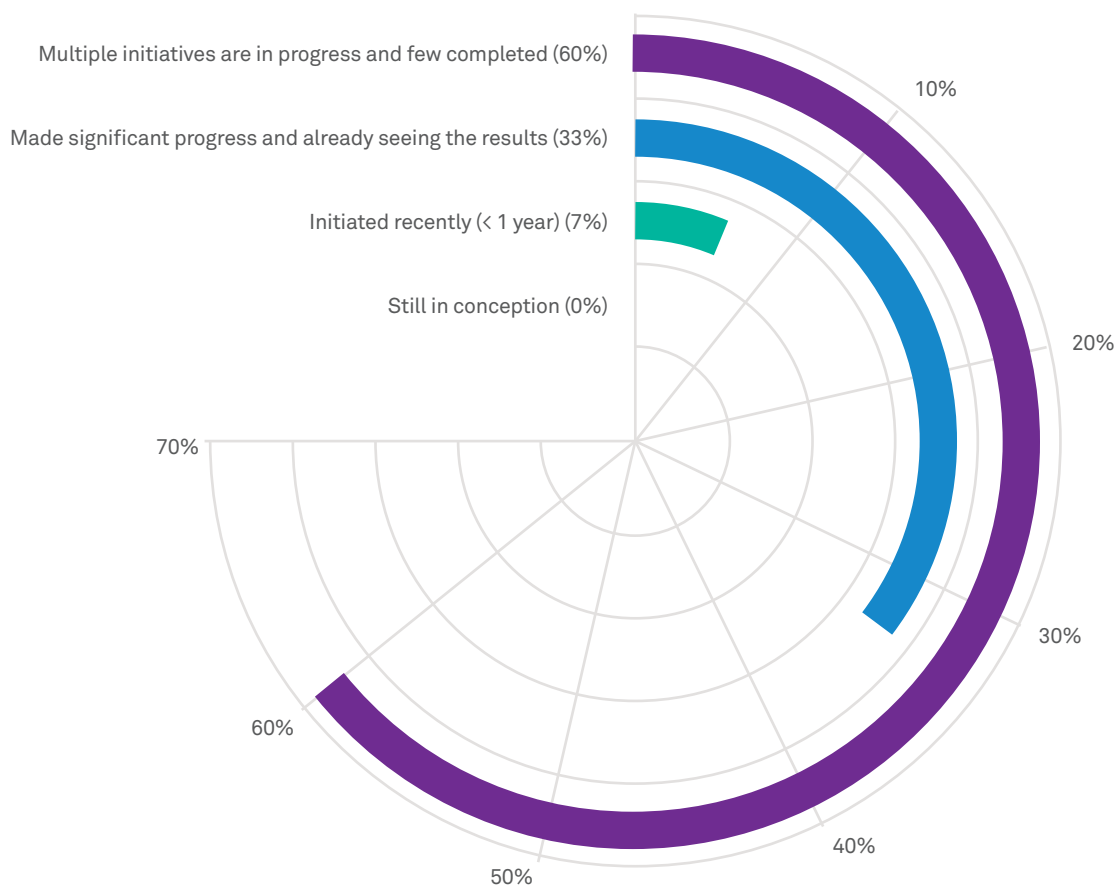


Chart 32

- Event streaming for winning over data volume:** Banks, much like other companies, are turning to microservices, an architecture paradigm that allows for the building of new capabilities. But the adoption of microservices architecture needs new Integration capabilities. We asked our respondents what they were betting on.

As it turns out, they are placing their bets on streaming data and Service-to-Service Integration using REST invocations. This is expected to redefine competition with its speed, scale and quality of the high volume data analysis (see Chart 33).

Q What new Integration capabilities do you see as important in microservices architecture?

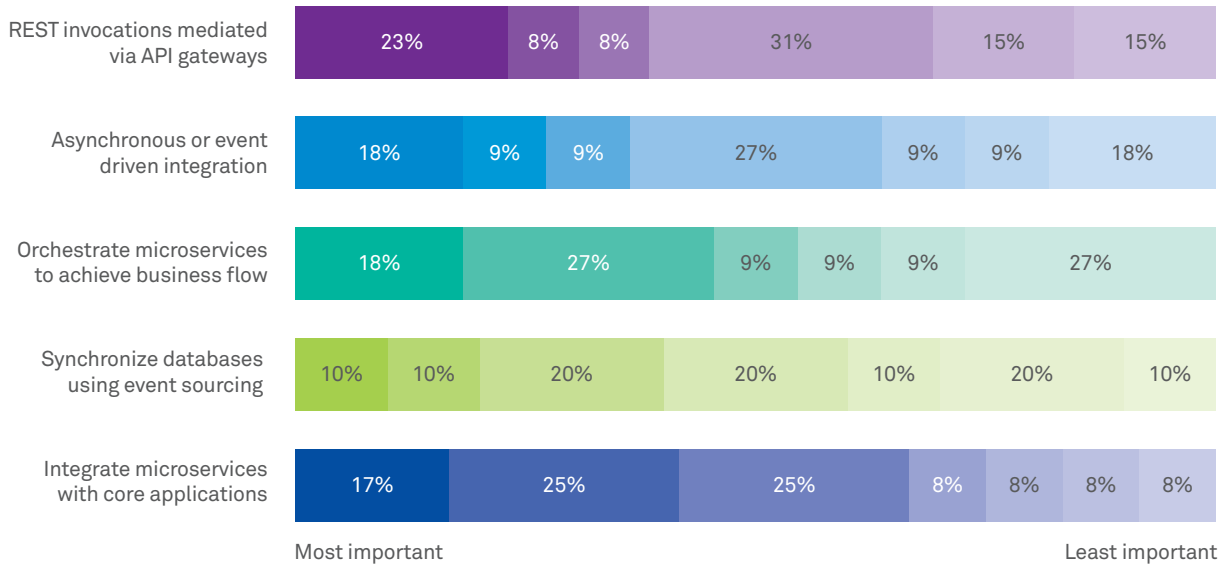


Chart 33

- Prioritizing legacy system modernization:** Banks are on the warpath to modernize their technology infrastructure, and Integration strategy is the spearhead of the effort. In response to a question on technology drivers influencing their Digital Integration strategy,

57% of respondents agreed that modernizing their legacy systems was their first priority. Providing application support to new and emerging touchpoints of banking was also mentioned as a key factor. (see Chart 34)

Q What are the key technology drivers in Banking Integration?

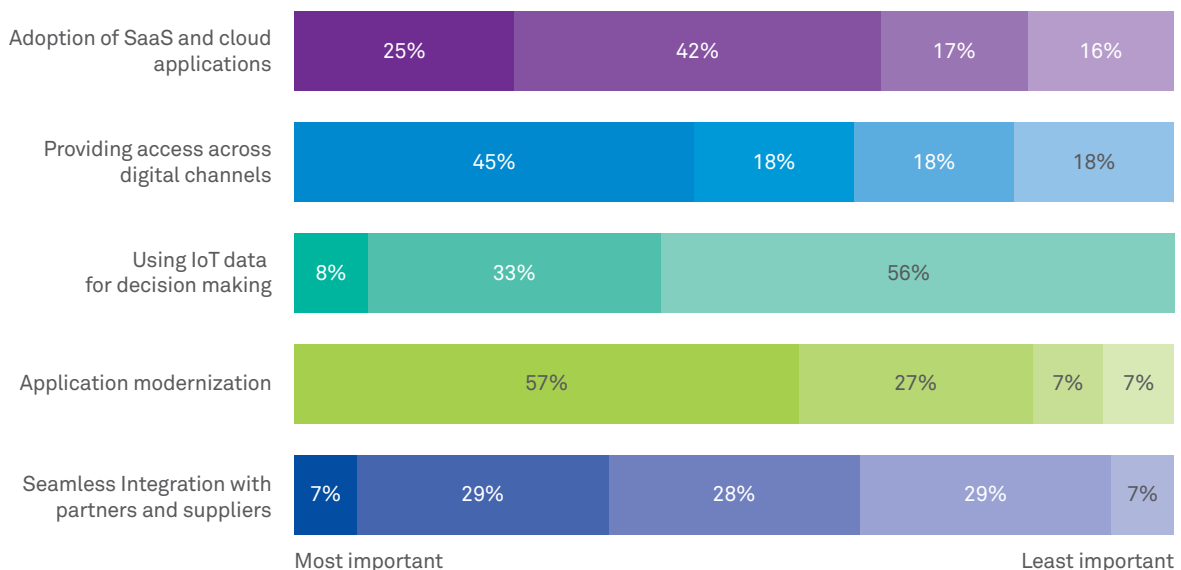


Chart 34

Payments industry is going through exciting times; industry is under significant disruption due to multiple factors ranging from changing customer demands, transformative nature of new regulations (PSD2, Open Banking) and formation of new business models. To address this changing landscape, Banks are re-shaping the future strategy.

We have made significant strides in transforming our architecture landscape to meet the needs of the industry and move towards the Bank of the Future.

Digital Integration plays a key role in this transformation as we move away from legacy systems towards modernized, API-enabled, microservices and Cloud based platform.

Future Banking will see an integrated ecosystem of Banks, Fintechs, and Utilities creating innovative products and services to drive value for customers. Agility and flexibility provided by digital integration will play a key role in this transformation.

» Programme Director, Payments,
a leading multi-national bank

Integration holds the key to Banking's future

The uncomfortable truth being discussed in Banking boardrooms is the sheer effort the Digital Transformation journey entails. Modernization of technology is a long and arduous path and returns on investment aren't going to be visible unless all the pieces of the puzzle fit together. The key to success is Integration strategy—one that brings all the legacy elements and future-focused technologies together. The fact is that banks do have the tools and inherent market advantages to push the boundaries of their existing and future business models. Integration strategies will serve to provide a structure for navigating this new landscape powered by bold and futuristic thinking.

Effective Integration strategy and implementation of emerging technologies helps the bank to digitize services, products and processes, and harness data eloquently to ensure personalized digital experience.

Retail is among the industries that have been most disrupted by Digital Transformation. Retailers are responding to the expectations of the digitally savvy shopper by putting Integration to work in bridging the digital and physical shopping experiences.

Imagine entering an apparel store and walking into a fitting room full of outfits only in your size. These are items you have reserved online, on the way to the store. They are based on your past purchases and preferences. You pick out a camping outfit for the weekend, but you're on your way to an evening out, so you choose to have them shipped home. As you enter home your Google Home gives you an update that the shipment is on its way and should reach you in time for the weekend trip. Around the world, retailers are using technology to make shopping this intuitive. Whether customers are searching online or in the physical world, retailers are tailoring experiences with this intuitive future in mind.

However, there is one major difference in retail when compared to other industries. No matter how digital retail becomes, in the end, it involves the transfer of real, physical goods to a consumer. You cannot download a new dress (yet) nor can you install a bowl of cereal onto a breakfast table before you go to work. This acts as an inhibitor, locking some retailers into believing that Digital Transformation will not impact them as much as it will impact other industries.

But that couldn't be further from the truth. The omni-channel shopper is ahead of the curve, and is driving the need to blend digital with in-store experiences in the quest for value. These shifts in the retail landscape are being further fueled by Internet of Things and virtual and augmented reality. The shopper today seeks a personalization of experience never before imagined. It ranges from the need to find and buy things lightning fast to the absolute opposite of having a laid back, immersive buying experience with digital technologies used for anything from smart

displays, contextual information to even music and ambiance.

The secret sauce that brings all of these together is Integration. It plays a key role in both local and global retailers' lives, where stores, inventory, supply chain and sales channels are playing for the same team and pulling in the same direction.

Roadblocks to Integration in Retail

Seamless Integration of systems is no walk in the park. Retailers have to first deal with legacy systems that have traditionally talked to each other through custom point-to-point interfaces and no common framework or unified data model. As businesses embrace digital, it becomes a nightmare to add more channels, such as wearable devices, voice-controlled systems or AR-based interfaces. The experiences are not just for customers; they could just as easily improve the efficiency of store associates or warehouse pickers.

When data comes in from disparate sources without a single source of truth, retailers have an unreliable view of the customer. This lack of a 360-degree view of the customer, her preferences, purchase history and habits holds back the ability to create a personalization that acts as a competitive differentiator.

While a number of processes could be automated, manual and offline business processes often stand in the way of offering reliable, accurate and timely information snapshots that help take smarter business decisions. Retailers typically face these issues in the cases of real-time data sync in file-based scenarios like store inventory, price to stores, etc., leading to lost opportunities.

Bringing legacy systems up to speed with Integration

Traditional Point of Sale (PoS) systems are hard to integrate and cannot adapt to the speed and efficiency with which new retail systems need to operate. Legacy PoS systems are disconnected from the supply chain and backend systems, a gap that leads to delays in delivery and payment reconciliation. Order visibility is often an issue leading to unhappy customers. PoS systems that are integrated in the cloud and offer scale is what retailers want to achieve. Backend legacy systems also need to be upgraded to harness the advantages of cloud-based solutions, such as lightweight Integration platforms that offer seamless connectivity to multiple systems with API-based Integration. Legacy systems used in supply chains need to also offer dramatically

superior communication between stores, distribution and fulfillment centers.

Integration in action in Retail

Here's a look at what integrated Retail will look like (see Figure 8). When it comes to the store experience both online and offline, all elements of product selection, ordering, checkout and payment will see a step up. API-based Integration will change the way customers search for product information, buy products and track their orders online. Recommendations to customers will be personalized, whether they're shopping on a smart phone, a tablet, smart TV or in person walking down the aisle. They will chat with intelligent systems bringing down the need for human interaction for routine inquiries.

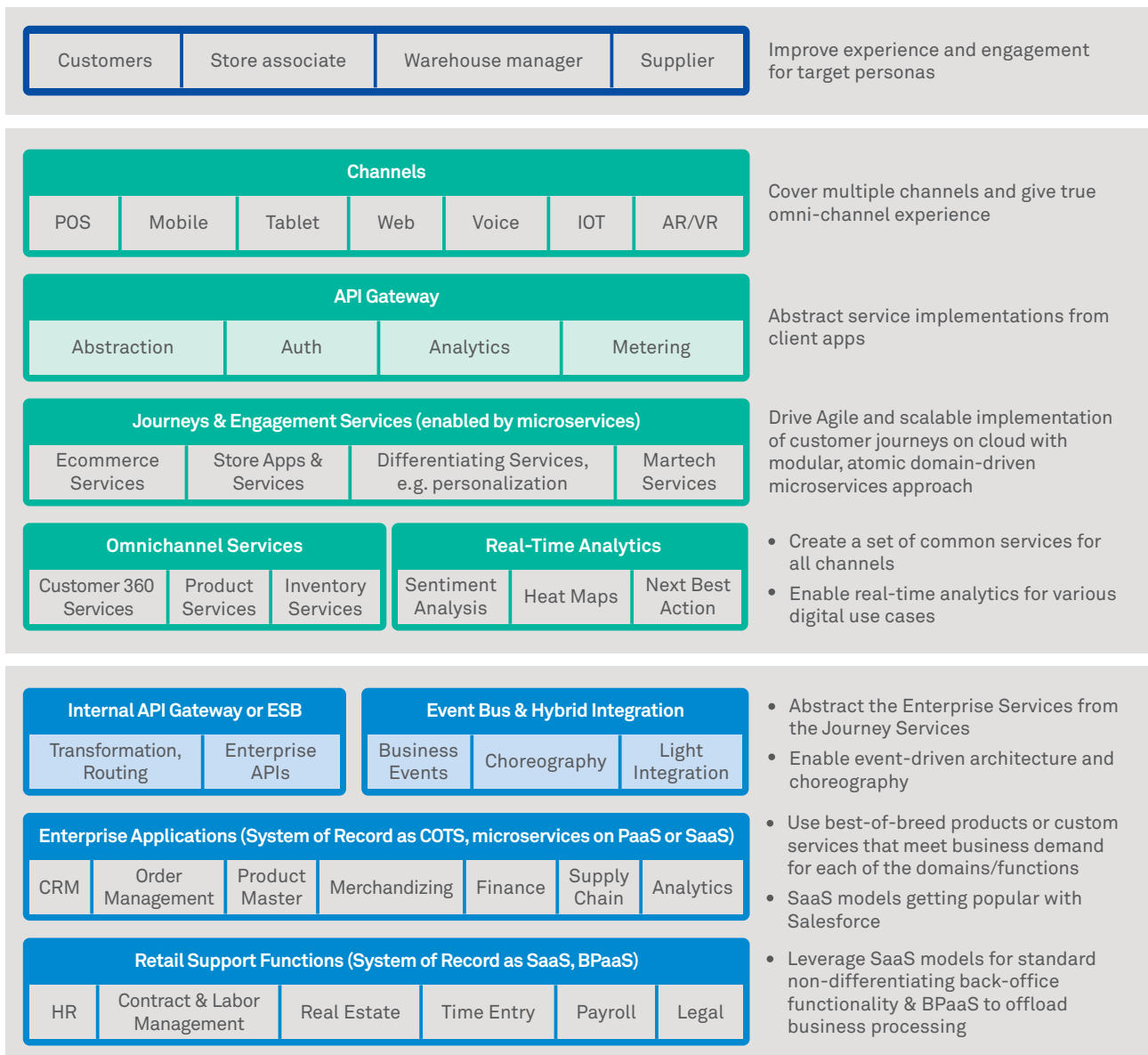


Figure 8: High level building blocks of the Retail Integration platform

Retail stores will up their engagement quotient in a way that brings multiple channels together with the power of API Integration. It will enable common inventory visibility that facilitates the delivery of items from other stores or warehouses with zero uncertainties in the system. Suppliers and transporters will be tightly integrated with the purchase cycle with specific functionalities being offered on SaaS platforms for their needs.

Messaging will become more reliable, even at high volumes, allowing retailers to analyze shopping trends and patterns in real time. The online shopping cart will be integrated with the PoS system, allowing the shopper to breeze through checkout. Social media listening will play a role in the after-sales experience with CRM systems going truly digital.

To facilitate efficient B2B Integration with partners like suppliers and transporters, modern cloud-based EDI solutions are replacing legacy tools, helping organizations introduce automation

in core businesses transactions with the larger community. Partners and logistics vendors are using platforms and tools powered by Event Driven Architecture (EDA) to generate real-time events on order, shipment, and fulfilment status, improving the planning and optimization of operations, etc.

EDA also makes it easier to glean insights into consumer behavior, inventory projections and sales forecasts in an integrated network. Robust end-to-end monitoring of supply chain processes will detect anomalies and prevent them even before they occur.

Systems of Record, Integration and Engagement will interact with each other through the range of digital services and provide flexible, scalable, fast and secure infrastructure leveraging innovative integration technologies and tools built on containerized microservices architecture to harness the power of cloud infrastructure.

As a multinational retailer, we are always looking to provide our customers with a better and more secure shopping experience. To enable this, we have been implementing technological changes that cater to changing customer behaviors and enterprise Application Integration is a key aspect of this implementation.

We have implemented a strong API authorization platform to appropriately manage the user's experience, backend system activity as well as the overall security. After implementation, we have been able to better personalize the customer experience as we can identify customers across channels, helping build a 360-view of the customer. This has also helped provide the customer with a friction-free API experience. Going forward, we would like to be able to build API integrations using a few clicks by leveraging workflow based self-service adoption.

» **Global Integration Manager,
a leading multi-national retailer**

The Integration roadmap: Strategies for Retailers

Retailers are pulling no punches when choosing the right technology, platforms, environments and architecture patterns (see Figure 9) on their Digital Transformation journey. They are opting for the best-of-breed and a hybrid approach, selecting the best product for each category of use cases and business functions. Organizations are being cautious about investing in products, taking care to spend time in due diligence on defining their integration strategy. It is important for retailers to leverage existing investments—for example in ESBs that connect legacy systems, even as they add new integration mechanisms.

The implementation roadmap must take into consideration the business priorities, set up governance around architecture assessment and build API/service management. Every Integration strategy decision must be evaluated from a cost perspective as well, taking into consideration the existing investments and how much of it can be leveraged before settling on the necessary investments with the expected ROI.

Retailers serious about remaining digitally relevant are listening to customers more closely. Retail operates in an incredibly challenging and exciting time. Embraced the right way, an integrated digital experience will give retailers the opportunity to know their customers and create deeper and more meaningful customer relationships.

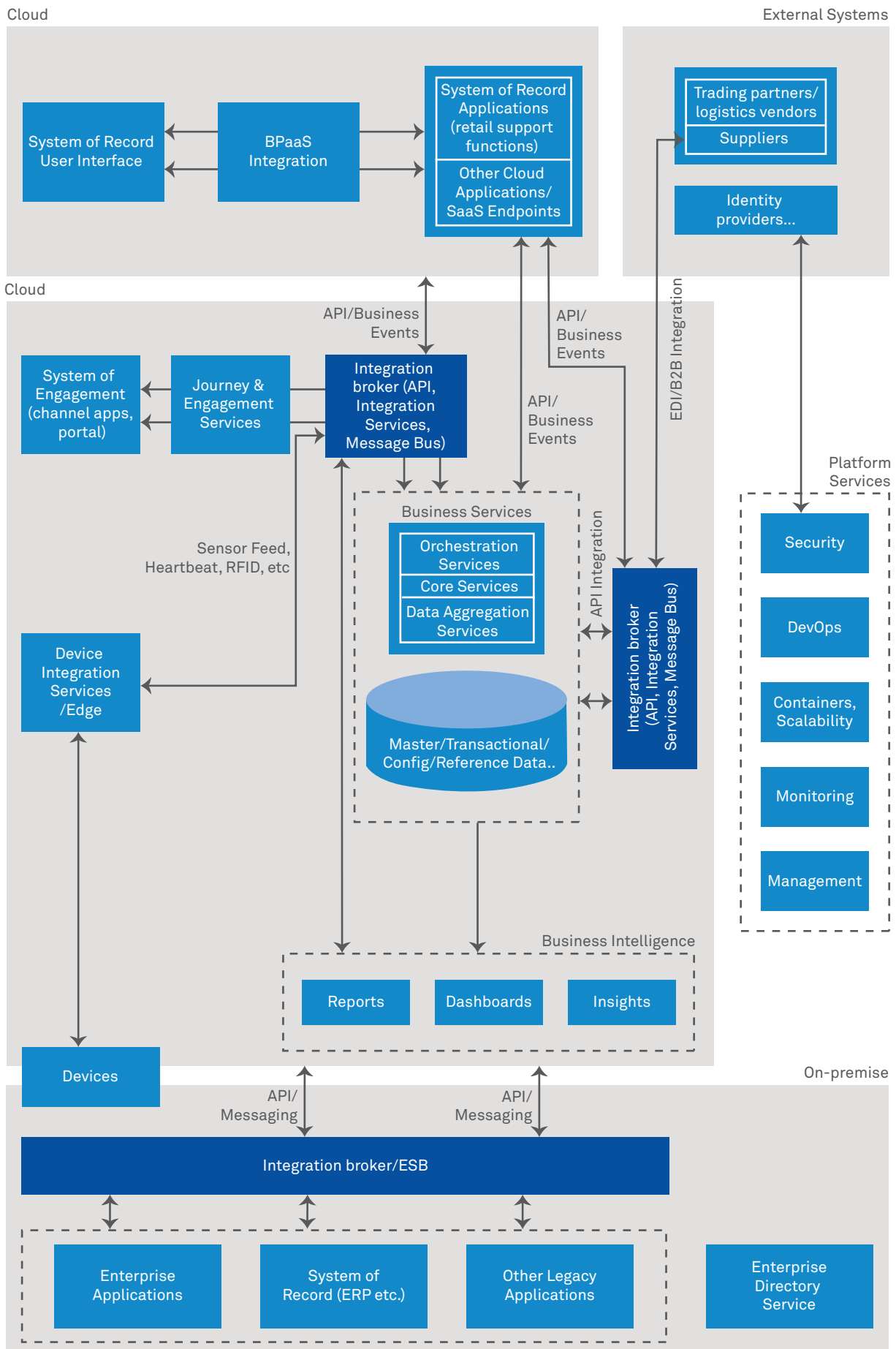


Figure 9: Integration architecture in retail

Manufacturing

It is hard to believe how fast the Manufacturing industry is changing. Industry 4.0, the next leap of the industrial revolution, is seeing companies grapple with a changing world—one where interconnectivity, automation, machine learning, 3D printing and real-time data are critical. Manufacturers around the globe are putting Digital Integration to work in a bid to step up efficiencies across processes, partners, products, and people.

The Industrial Internet of Things (IIoT) or smart manufacturing is bringing together physical production and operations with smart digital technology to create a more holistic and infinitely better connected ecosystem. This transformation demands product innovation and new types of products, and it also calls for new production methods and advanced technologies to improve production processes. The sheer pace of these changes means that companies have to shed the baggage of “how we used to do it until last year” and check in to “what’s it is going to be like tomorrow.”

New manufacturing is waking up to the smell of revolutionary coffee—the power of the right information, available at the right place, to the right people at the right time. When disparate systems are integrated and span processes across all departments and functions, an incredible amount of business value gets unlocked. This change impacts the entire product lifecycle—from design to production to after-sales service. Integrated digital manufacturing systems help teams get quicker access to accurate data. This improves process efficiency and sharpens the quality of organizational decision-making. The decisions will draw from data provided via technologies like IoT and robotization that will let manufacturers digitize and optimize the production process and enable game-changing initiatives like predictive maintenance.

The role of Integration in Manufacturing

Traditional companies have had an Achilles Heel—inter-departmental cooperation. But when digitally integrated, manufacturers can save hours on tasks that require two departments to share information. For example, when front and back office systems talk to each other, a sales executive gets real-time visibility into inventory, and can accurately tell the customer how quickly the order will be available even as they place it. Quick information flow helps a product manager place an order for the correct part as soon as it is needed from partner suppliers. File attachments and follow-up emails become a thing of the past to get a product design approved. Workflow processes ensure that the right person has the requisite information to take the decision. This cuts down the time and effort required to manage these tasks manually and it also cuts down errors associated with manual data entry while speeding up communication between departments and partners.

The technology disruptions in Manufacturing

New and exciting technology streams that are powering Industry 4.0 are disrupting the following areas:

1. **Digital supply chain management:** Digitization is making supply chain operations faster, more flexible, more granular, more accurate and more efficient. Data from various elements in the supply chain will power predictive analytics that will optimize inventory allocation and forecast demand more accurately, enabling automated replenishment solutions.

2. **Connected manufacturing ecosystems:** Connected, integrated digital ecosystems will allow for smarter manufacturing processes where floor managers will diagnose faults in their assembly lines with predictive diagnosis even before they happen. Automated, smart defect recognition will save time and money, while systematic root cause analysis will get to the bottom of production issues faster than ever before.

3. **Smarter aftermarket practices:** The aftermarket business scenarios are equally critical for business success, and companies are building solutions specific to the integration services segment in manufacturing. RFID and IoT devices and technologies like cloud and edge computing enabled by large API libraries are providing an entirely new capability to supply chains.

4. **Blockchain:** Blockchain can revolutionize manufacturing business models with higher visibility across every area of manufacturing starting from suppliers, procurement to shop floor operations. Supply chains can use the block-based approach to improve order accuracy, product quality, and track-and-traceability. Anti-counterfeiting solutions could use a unique product identifier in a shared ledger. The shared ledger concept can remove the redundant exchange of EDI documents.

What ails Manufacturing today?

As manufacturing companies mull over Integration strategies, they must first assess the

key challenges they face. Our experience shows that most are impacted, to varying degrees, by the following weaknesses:

Information silos and poor visibility

With traditional systems in place, manufacturers don't have complete visibility across the supply chain. The scapegoat is easy to find: unconnected, disparate systems deployed across departments at different times in the company's journey.

These departments often have non-uniform communication channels with each one maintaining their own records, leading to duplication of documents with no single source of truth. What this does, sadly, is simply increase the risk of supply chain operations, from high turnaround times, to the high cost of reconciliations and delayed invoice payments when disputes need to be resolved.

When disparate systems are integrated and span processes across all departments and functions, an incredible amount of business value gets unlocked. This change impacts the entire product lifecycle. Integrated digital manufacturing systems help teams get quicker access to accurate data and enable game-changing initiatives.

Data inconsistency and financial inefficiency

Financial institutions that partner manufacturers only deal with documents and not the actual goods (or services for that matter). This makes the efficiency and accuracy with which these documents are prepared absolutely critical to operations. Unfortunately, there is an acute lack of real-time multi-party tracking of trade finance documents such as the Bill of Lading. The data inconsistencies end up costing companies millions of dollars. This can be prevented with better integrated systems.

The Information and Operations Technology (IT-OT) Divide

The Industrial Internet of Things (IIoT) is bridging the divide between the worlds of IT and OT. The custodians of corporate data and information (financials, procurement, order management, HR) are beginning to work with the custodians of the plant, mill, production and quality. Senior leadership is driving home the point that IT-OT Integration is key to informed decision making (see Figure 10).

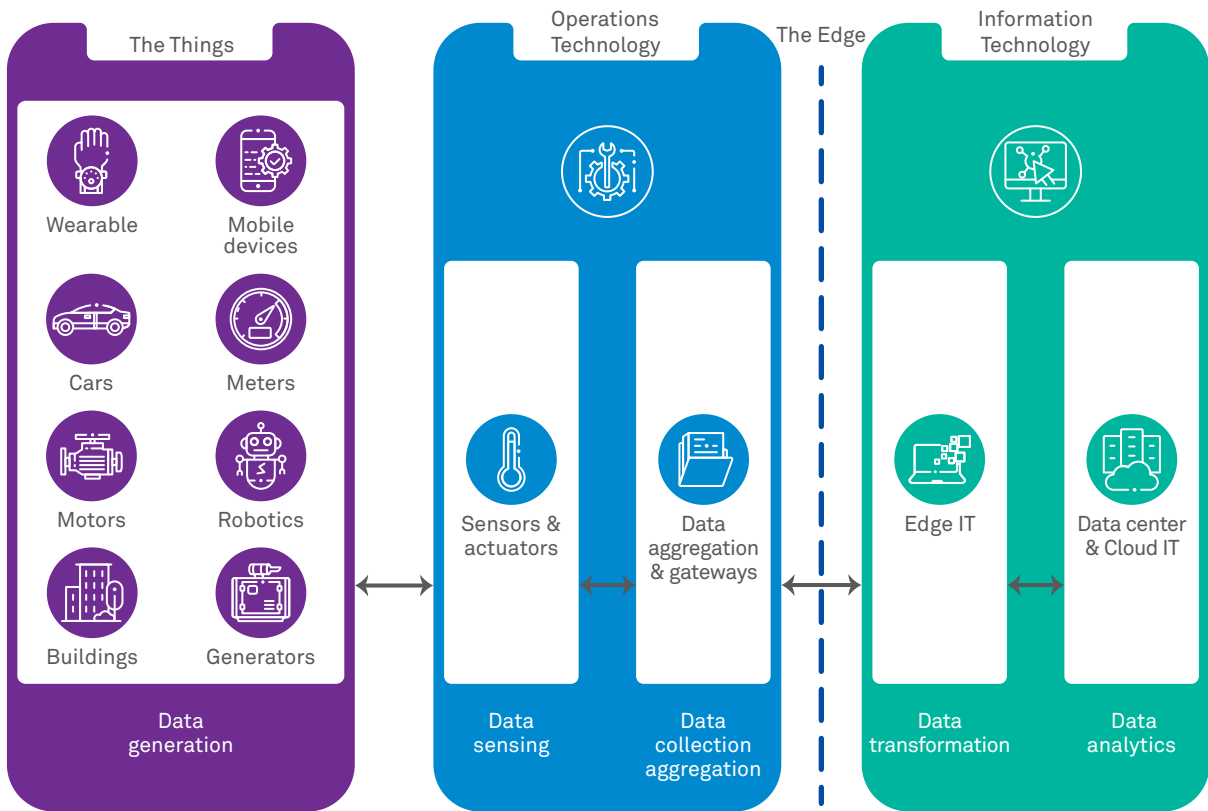


Figure 10: The IT-OT Integration frontier

Integration trends in Manufacturing

The purpose of Digital Integration platforms: Manufacturers are putting Digital Integration Platforms to use mainly for A2A, B2B and file-based batch integrations (see Chart 35).

Q What is your organization's Digital Integration Platform currently used for?

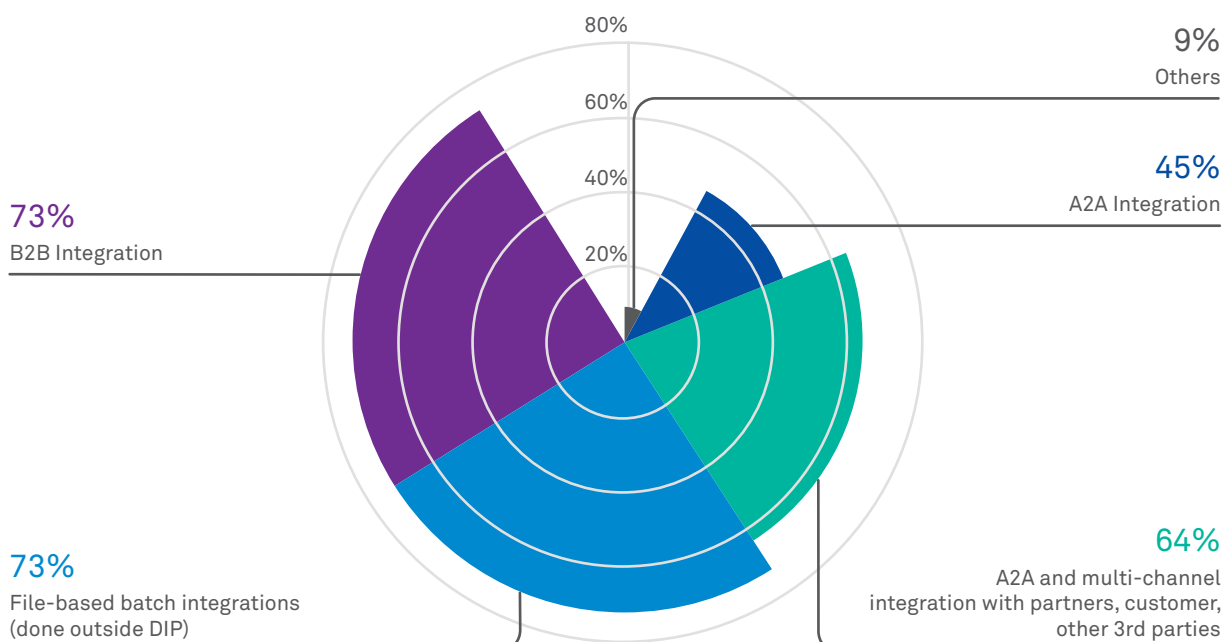


Chart 35

Hybrid architecture is here to stay: An overwhelming 64% of respondents said that their current ESB platform would co-exist with a cloud-based Integration platform of microservices, as hybrid Integration architecture (see Chart 36).

Q What are your plans for your existing ESB architecture?

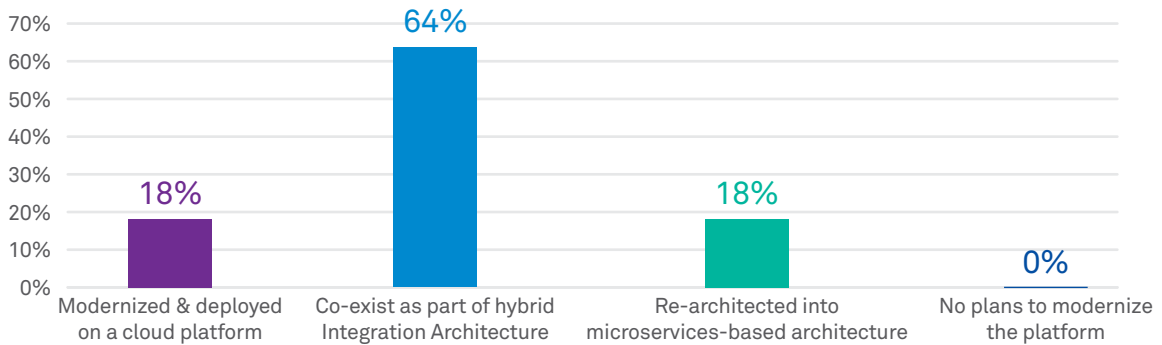


Chart 36

Supply chain leads the IoT thrust: 80% of respondents said that their IoT use cases were in the supply chain area, followed by 60% who said they were seeing IoT action in connected ecosystems (see Chart 37).

Q What use case areas do you use IoT in?

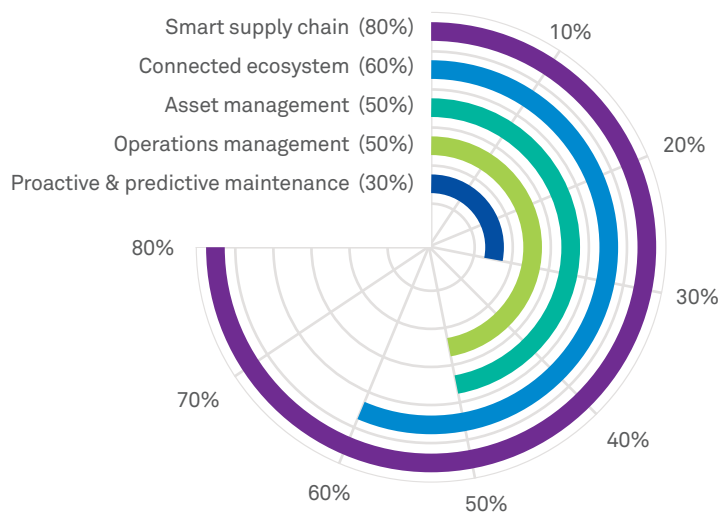


Chart 37

Blockchain comes to the party: Blockchain in B2B is being used by manufacturing companies for enhanced visibility and authenticity of business documents, and for greater collaboration between business partners in the supply chain (see Chart 38).

Q How is Blockchain being used in your Integration framework?

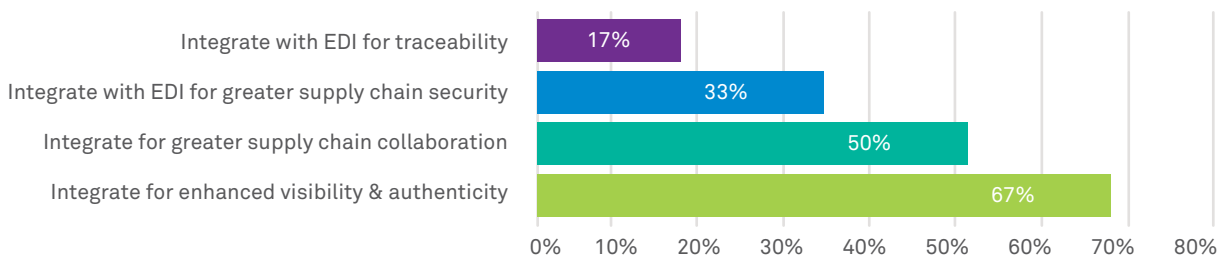


Chart 38

IoT in the Manufacturing setup

IoT data from production and warehouse facilities, when integrated in real time with internal enterprise systems, provides operations team and managers the ability to make timely and effective decisions. This helps in realizing a connected manufacturing ecosystem (see Figure 11) which enables:

- **Real-time KPI dashboards:** Using multiple data sources, the plant manager will be able to pull mission-critical information from his shop floor to a single dashboard and deploy a KPI-based algorithm to do better.

- **The Connected Factory:** IoT-enabled machinery will transmit operational information to OEMs and to field engineers, enabling operation managers and factory heads to remotely manage the factory units and take advantage of process automation and optimization.

- **Connected supply chains:** IoT-enabled supply chains will track, monitor and gain insights that will enable informed decisions across the chain. Inventory management solutions will give manufacturers precise visibility into the flow of raw materials and components, and work-in-progress and finished goods.

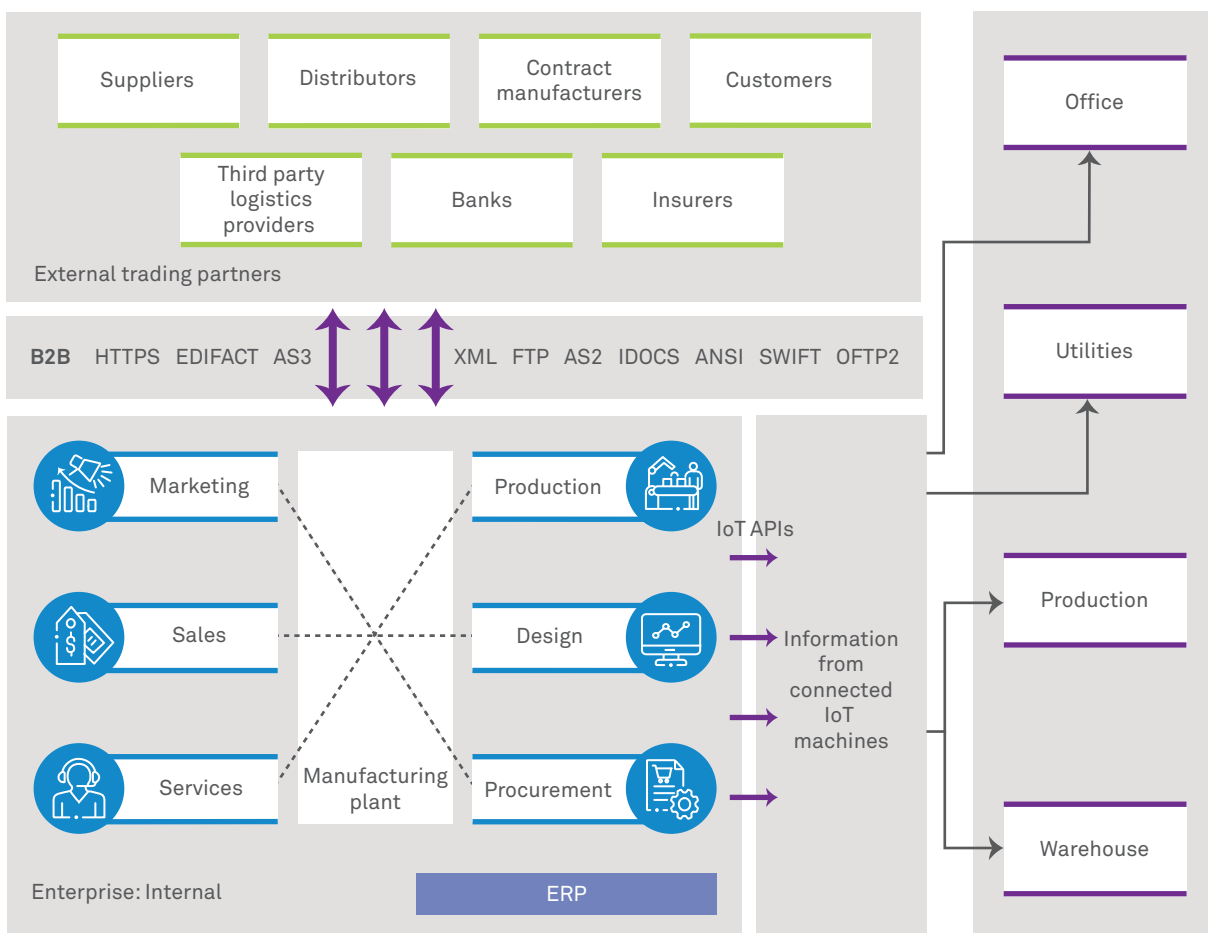


Figure 11: Manufacturing ecosystem through the lens of IoT

The Integration roadmap: Strategies for Manufacturers

On their journey to Industry 4.0 manufacturers are re-engineering their machines and enabling people to communicate with each other, thereby allowing operators to collect and visualize large volumes of data from their manufacturing

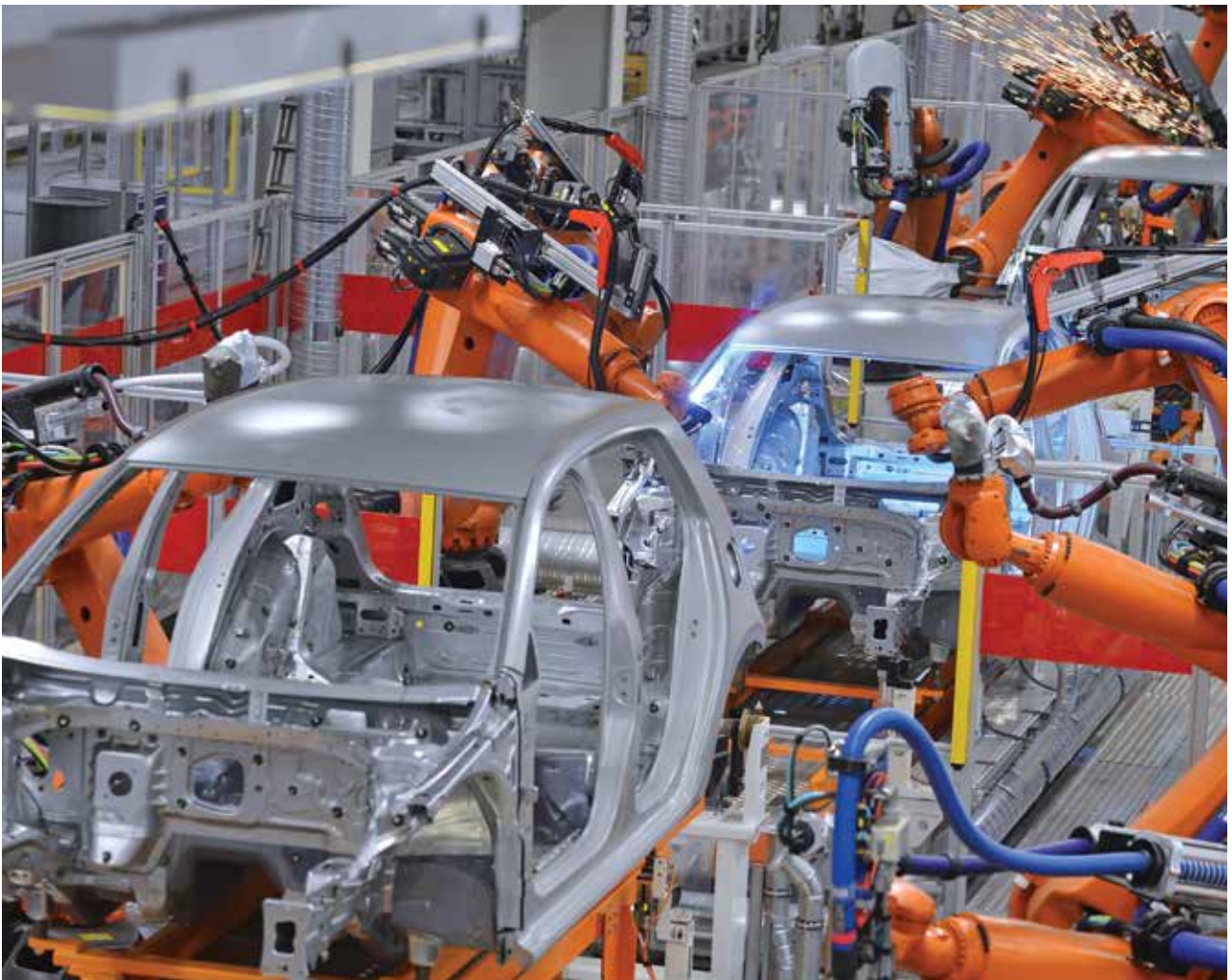
processes and giving them the ability to make decisions at short notice. This program for the digitalization of manufacturing seeks to catalyze business innovations, drive productivity and increase sustainability. To succeed, companies will need both horizontal and vertical integration of all technology elements. Integration is going to be the fulcrum on which the success of tomorrow's manufacturing companies will pivot.

We need to have complete visibility into our supply chain network. This actually involves integrating multiple on-premise systems and applications with partners, suppliers and logistic providers. Our Integration platforms are helping us integrate backend systems such as ERPs with external partners and suppliers, while providing an easy portal for onboarding new partners onto our supply chain network. Additionally our Integration platform aims to integrate enterprise systems and applications seamlessly.

We are also looking at moving to a hybrid and cloud Integration platform setup that can be deployed on both cloud and on-premise. The hybrid nature of deployment would help in reducing the operational costs while addressing latency. Furthermore, we are also looking at building IoT into our supply chains which will monitor and provide real-time insights that will enable timely actions and informed decisions across the chain. The infusion of AI and advanced manufacturing technology and processes is helping bridge the separation between man and machine, leading to increase in customer engagement and improved relationships with equipment end users.

As we step into the future, API management will become more important and the Integration platform will become more cognitive by adding abilities to compose integration flows in a few clicks. Finally we see the use of Blockchain technology becoming more prevalent to ensure trust among partners and for better collaboration between stakeholders.

» Director, Integration Services,
a leading manufacturer



Airports

The airport experience has had it rough: what should have been an enjoyable part for travelers is now seen as the worst part of the experience. However the explosion of digital technology offers airports the chance to redeem themselves by creating a seamless and smooth experience for passengers and adding value to their business partners and airlines. To harness this opportunity and deliver tangible outcomes, airports are investing in Digital Transformation strategies where Integration plays a key role.

If flying once conjured up an image of the fashionable, rich and powerful jet-setting across azure skies, it is now far from that. The democratization of flying has seen an explosion in the sheer number of passengers around the world but it has come with a slew of challenges that airports have to face to just keep things running. Airport management teams face many issues—their carbon footprint, a constant pressure to expand operations to keep up with demand, grappling with the growth in aviation and non-aviation revenue, erratic passenger satisfaction statistics, challenges in operational efficiency, automation and staffing. As if these were not enough, they need to take on cybercrime, terrorist threats and terminal security. As airports seek out and implement solutions to take on these challenges, they also need to explore the possibilities offered by digital technologies to solve these challenges.

Though it may not be apparent, IT was largely an afterthought in airport ecosystems. IT systems came into the picture once airports had been functional for several years. Aviation in general, and airports in particular, are guilty of implementing siloed IT systems that make it difficult for departments to interact with each other. As IT became critical to air travel, the need for integrated systems took off, quite literally. With the advent of cloud-led Digital Transformation and the rise of innovation projects that need enterprise data, it became imperative for airports to get integration right.

An integrated airport, which has the capability to connect its IT applications that are on-premises or on cloud, its OT systems, partners, tenants, customers and other agencies, will be able to substantially enhance the way it serves its users and operates its business.

Passenger experience: Airports are aiming to minimize traveler-agent interaction points with agent-free execution of key travel processes such as check-in, baggage tagging, baggage drop and boarding. The goal is to push the relevant data in real time to passengers over their smart phones—expected wait times at immigration or security queues, flight delays, changes in boarding gates, terminal transfers, baggage carrousel, etc. Passengers walk up to a boarding gate and facial recognitions software authenticates identity without the passenger having to fish out passports and boarding passes.

To improve the passenger experience, airports can go beyond the confines of kerbside and airside by providing taxi services linked to departure times, traffic updates from the passenger's location to the airport, parking options and reservations, even weather forecasts for the passenger's destination.

Airport process optimization: Technology can help predict the flow of passengers at immigration and help deploy queue-busting processes. The same holds true for check-in counters, duty-free stores and baggage belts. Integration helps optimize

operations to improve capacity utilization, reduce operational costs, improve physical security and reduce disruption in operations.

Asset lifecycle optimization: Physical assets such as airport buildings and energy and utility systems can be better maintained with automated solutions that regulate their usage and trigger predictive maintenance actions based on inputs from sensors. An integrated real-time view of asset and capacity utilization and predictive maintenance can drive major lifecycle savings in airport operations.

Revenue optimization: Airports are valuable retail spaces where targeted passenger segmentation, real-time dynamic passenger flow management, and personalized offers can increase non-aeronautical revenues dramatically. For example, if you knew a passenger of a certain demographic was headed for Hawaii, you could deliver a personalized offer on beachwear directly to the passenger's personal device as the passenger walks by the store in the terminal. Information on destination, movement pattern and prior purchase behavior can create contextualized offers that help retailers deliver and create superior value in the airport experience. Partnerships can be forged with airlines, retailers and government agencies like tourism departments to build revenues mutually.

Airports are looking at full-spectrum Integration

Major airports have already adopted Integration platforms that are capable of integrating on-premise applications. Many airports however still run on Airport Operations Suites (AOS). As they begin to feel the pressure to become smarter, they will break up functionality linked to the AOS and start adopting best-of-breed off-the-shelf systems, SaaS services or building custom applications. Before they can get to this target state, airports must augment their Integration platform capabilities that will enable them to tie new systems together.

There is a veritable deluge of data that airports have access to but have not been able to derive complete value of. This has been because of a lack of integration between their IT and OT systems. Airports have realized the value of getting a holistic picture of their operations and are putting in place technologies and processes that will achieve this goal. Answers to questions on how passengers behave between security check and boarding, how many steps they take, what stores they shop at, where they get coffee, how much they spend, etc., could allow airports to craft better passenger experiences.

Integration platform is the backbone of our airport enabling communications between systems related to passenger processing, baggage and aircraft movement. In alignment with our airport strategy to improve the passenger experience and operational efficiencies, we have set ourselves a roadmap to build a Digital Integration platform which helps us collaborate with airlines, airports and other partners and provides real-time visibility into the airport operations.



» **Michael Gould,**
Associate Director and Chief Architect,
Greater Toronto Airports Authority



An Integration strategy for smarter airports

Airports should adopt an Integration strategy that will allow them to:

- Reliably connect their core systems and processes—internal as well as external—located both on-premises and on the cloud, using systematic approaches
- Support adaptive requirements and enable rapid delivery of Integration services and APIs when needed
- Connect OT systems and endpoints with new and legacy IT applications
- Collate data from all of these systems and make them available to interested stakeholders, both internal as well as external, in real time
- Derive intelligence from the collated data and deliver this intelligence through multiple channels

An Integration platform (see Figure 12) that is built to deliver this strategy will have the following key components:

Service Fabric: Airports can establish an enterprise-wide Service Fabric that provides consistent access to the airport’s key internal IT and OT systems, and external and partner systems. The availability of this Service Fabric will make it easier for airports to compose and roll out new applications even as they tweak business processes in response to evolving passenger needs.

Data Fabric: Airports need a Data Fabric built by integrating real-time data from all of the airport’s systems to get a unified view of airport operations.

APIs to promote interoperability: Airports need to create and publish APIs to allow deep, real-time Integration with various stakeholders such as airlines, government agencies, ATC systems and retail partners. As standards like ACRIIS (Airport Community Recommended Information Services) emerge, they will define semantic models and descriptions, making systems more interoperable.

Event processing for real-time intelligence: Airports will find it easy to deliver real-time intelligence on passenger movement, asset utilization, flight schedules and other key parameters. Event streams generated from the connected IT and OT systems will unlock tangible business value for airports and their partners.

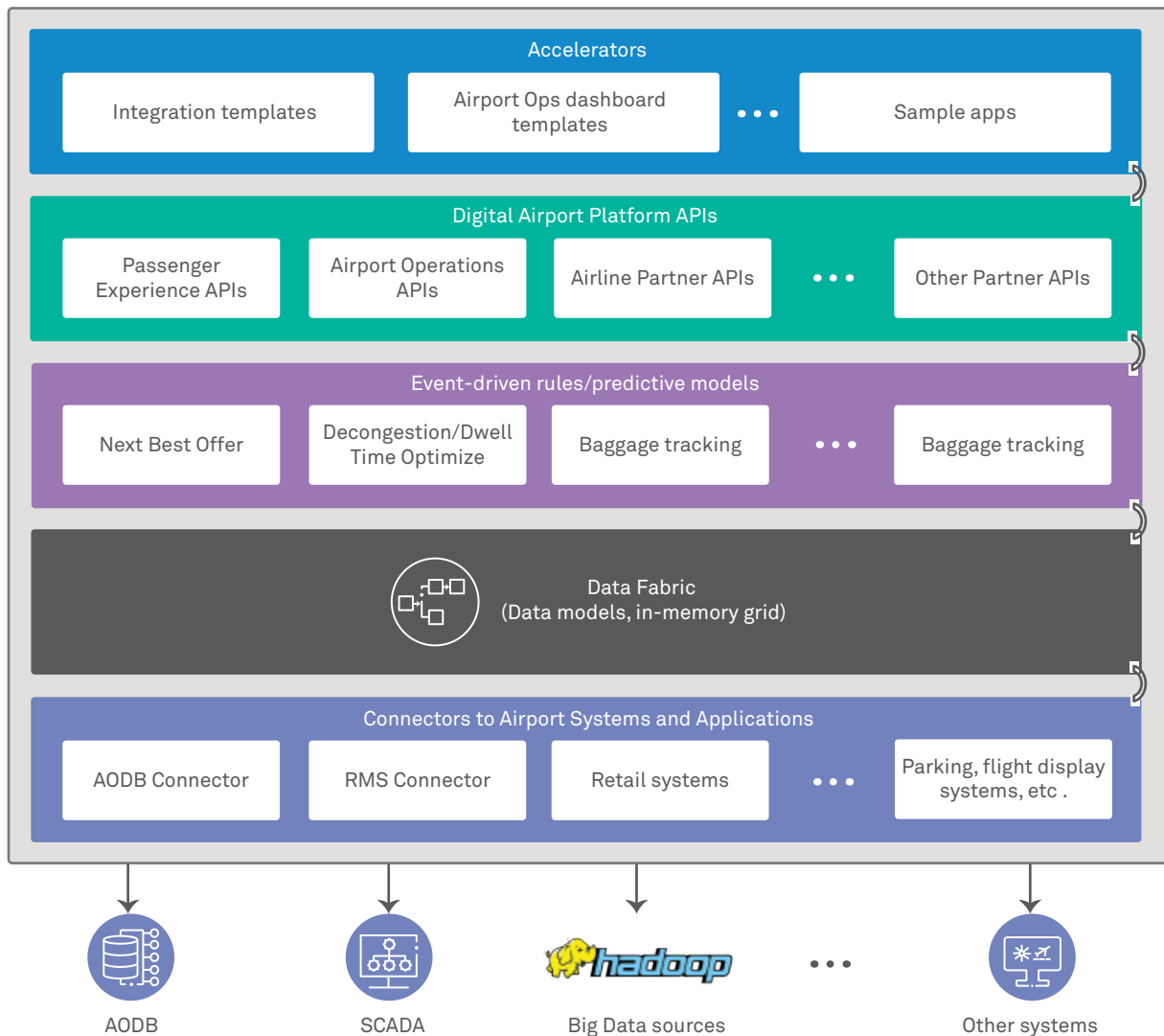


Figure 12: Digital Integration Platform for Airports

New technology and Digital Integration are heralding innovative ways to deliver value-based care to patients by driving interoperability that ties in payers, providers and patients in a way that is truly seamless. The time is ripe for healthcare organizations to revise their playbooks. Digital Integration is helping healthcare be more innovative while delivering value-based care over traditional forms of healthcare.

The change in attitude around the world to wellness comes from the social determinants of health that answer the question, “What keeps a person healthy?” Research tells us that only 10% of individuals’ health status is influenced by the healthcare they receive^{xv}. The remaining 90% comes from the genes they inherit, the behaviors and environments they are born into, grow in, live in, work out of and grow old in. Traditional healthcare systems have not taken this into consideration while designing delivery systems. But true value in wellness will be unlocked only when healthcare systems understand patients and their worlds better, evolving into wellness partners. This is why healthcare systems of the future will evolve to a partnership model among practitioners, patients, and their families, and better align with patient decisions and their wants, needs, and preferences. By collaborating and engaging with patients in the decision-making process, health providers can make better decisions regarding a patient’s path to wellness. The enabler to this journey is, quite unsurprisingly, the evolutions in technology.

The new paradigms of healthcare are centered on preventing the patient from falling sick. And in instances when someone does fall ill, it leverages digital technology to put the patient back in action with minimum disruption to life, at the lowest cost and using minimal healthcare resources. In other words, we are going beyond a wearable device that reports on calories burnt, heart rates and

sleep cycles. With ingestibles and other smart devices, we’re talking about dramatically better care for hypertension, diabetes and other chronic conditions. And with blood glucose meters and wrist cuff blood pressure monitors, we are able to wirelessly relay data to monitoring systems that can take preventive action before an episode becomes a crisis. And using digital twins, doctors allow us to run tests on the effects the prescribed dosage of medication will have.

Expert medical advice will no longer be confined to a doctor’s office: You could ask Alexa what to do if you’ve a headache, have her set up a video consultation with your doctor, or use advanced messaging services to interact with healthcare professionals who are alerted by a change in your vital signs.

The real-time exchange of data unlocks tremendous value by creating a responsive healthcare ecosystem. Tasks like eligibility check and claims processing can go from being bottlenecks to a competitive edge for companies. Processing no longer needs to wait for traditional, overnight batch processing, and can be settled in minutes, in a way that helps the patient’s care journey. Smart healthcare organizations, from drug manufacturers to payers and providers, are putting Integration to work to support real-time processing in the quest to become more responsive and agile.

Integration for interoperability: How APIs help

Traditional healthcare systems are in dire need of a set of standards that enable communication between multiple sources, to enable easy exchange of data. APIs play that role between healthcare entities. They enable the exchange and consolidation of healthcare information from prescriptions, medical histories and treatment records. When it comes to making a diagnosis or determining course of treatment, this ensures that healthcare professionals have all the information needed. If you want to access your own medical records over a smart phone app, APIs will come to your aid. This allows patients to take better care of themselves as treatments, lab results, and other healthcare communications could be easily accessed without a visit to a doctor's office.

An example of new-age Integration in action is the way HL7^{xvi} interfaces are getting transformed by APIs. Changing demands in healthcare and the need for immediate exchange of information is making this interface outdated. It doesn't allow non-clinical applications, such as mobile apps or SaaS applications to access the clinical and administrative data. APIs, however, allow hospitals and health systems to seamlessly connect between HL7 and any other type of clinical or non-clinical message standard, like JSON. This represents the next level of interoperability achieving large-scale data Integration across a variety of internal and external consumers, from public and private payers, to community care partners.

APIs also help in the following ways:

- **Data exchange tracking:** APIs enable better and robust tracking of health data and healthcare professionals can identify the source of the data with great accuracy
- **Security:** APIs provide data security without limiting access to patient data across devices and platforms. They also protect patient information from malware and other external threats while ensuring that health information is accessible to authorized users
- **Efficiency:** APIs allow developers to build applications faster and more efficiently while being less vulnerable to data breaches or security errors. API-based approaches to

APIs allow hospitals and health systems to seamlessly connect HL7 and any other type of clinical or non-clinical message standards, representing the next level of interoperability and achieving large-scale data Integration across a variety of partners.

interoperability have the advantage that they can be assembled to rapidly create different kinds of aggregate functions

- **Storage efficiency:** healthcare applications constantly exchange information with each other. An application constantly pulling data from multiple sources can take up a lot of space on a device. APIs save storage space on devices while decreasing the development time

Digital Integration in action

Here are a few examples of Digital Integration in action in the healthcare space:

Connected health: This is a network of intelligent communication and actionable insights that drive better health outcomes. Also called Technology Enabled Care (TEC), this holistic term encompasses modern healthcare delivery models such as telecare, telemedicine, digital health and eHealth services. It requires the integration of diverse technology areas, healthcare professionals, media and mobile telecommunications with microservices and APIs.

Healthcare data monetization: Used ethically, there is great value to be drawn from the customer data that healthcare organizations have mined over the years. But it does call for a secure integration mechanism to share data in a manner that allows value to be drawn from it. Organizations are addressing the challenges in collating, storing and sharing the data, largely with hybrid APIs.

Internet of Things (IoT) in healthcare

The applications of IoT in healthcare seem to be endless. They span remote monitoring and personal healthcare to smart sensors and medical device integration, drug manufacturing, healthcare insurance, robotics and smart pills (just for starters). It has the potential to keep patients safe and healthy and also improve how physicians deliver care. The future belongs to portable medical devices that enable diagnosis and provide cure and wellness inputs outside of hospital facilities. Health sensors will help individuals monitor

their health 24 hours a day, with automated interventions such as insulin injections in the case of diabetes patients. Technology will have the power to connect doctors and patients. Healthcare devices will increasingly join the realm of IoT and with the help and advanced use of AI, amassed data will be utilized to propel the trend towards tailor-made medicine and healthcare. This requires data from connected devices to be collated with IoT Integration playing a major role (see Figure 13). A few interesting use cases with IoT Integration at the core are discussed below.

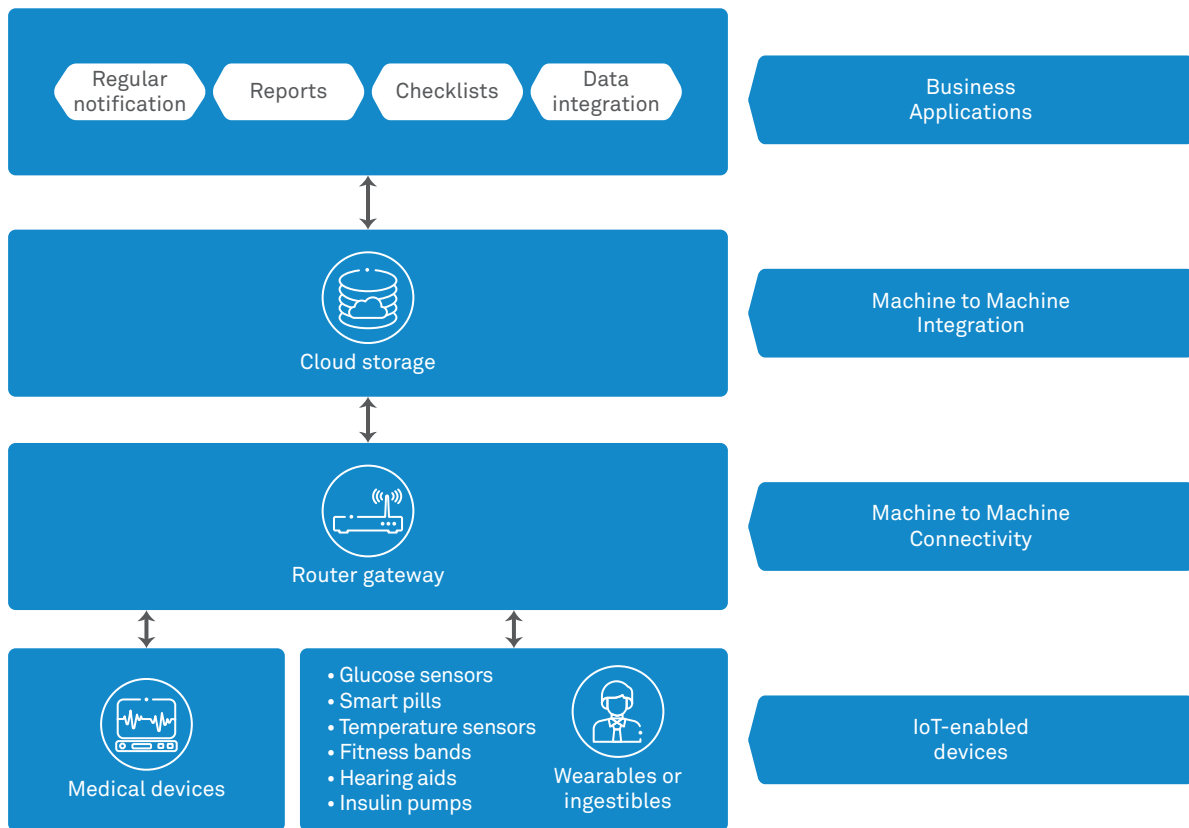


Figure 13: IoT-enabled healthcare

Connected medical devices: Imagine an insulin injection device that receives inputs from both a prescription and a blood glucose monitor in order to determine when a dose needs to be automatically administered. That’s the power of IoT in connected medical devices. IoT Integration of these connected devices for healthcare monitoring will significantly transform the healthcare industry.

Wearable smart devices: The future of healthcare is wearable, with devices precluding the need to get tests done. Contact lenses, glucose monitors, fitness bands, digital hearing

aids, blood pressure monitors and ingestible devices like smart pills will be IoT-integrated with apps in the cloud and could transmit the data that determines the care required.

Personalized care and precision medicine: healthcare organizations have started using smart applications and wearable devices to create a personalized healthcare experience for citizens. These smart apps and devices are digitally integrated to collate data for research purposes and provide personal and precision medical services to patients.

Moving data between internal and external systems is key for the healthcare industry. The data that we deal with is very critical, sensitive and highly protected as well. All we deal here is sharing and consuming data in near real-time in a simpler but at the same time with a more protected way.

The primary focus of integrated health systems is to provide seamless care or coordinated care for patients. System Integration is a term used for collaborative functioning of tasks within a system. As we know that a healthcare environment comprises of various professionals who work towards a specific goal of providing care and services to clients, this collaborative diverse group functioning is very important for the proper running of an organization. System Integration is a challenge which needs to be given utmost priority because it is the foundation of a healthcare setup. It requires optimal interconnection and interdepartmental harmony in work. System Integration involves good interpersonal communication between clinicians, technicians and other healthcare professionals. The concept of System Integration not only refers to connecting within the organization but also across the organization.

In the recent past, with the evolution of cloud platform, Integration has become simpler, more robust and highly secured. B2B Integration plays a vital role with more protected data flowing with multiple integration patterns and faces challenges around data encryption, the different levels of data encryption recommended by HIPAA to protect patient's data from unauthorized users. Also, SaaS models come with more challenges when it comes to moving data from and to on-premise, multiple cloud environments, etc.

» Senior Architect,
a leading healthcare services provider

Digital Integration holds the key to healthcare's future

Healthcare organizations seeking to enhance the patient experience are turning to a robust Integration strategy. Providers and payers as well as clinics and pharmacies are feeling the need to connect with their patients in new and engaging ways. Organizations are making sense of the explosion of data coming from sources as varied as personal fitness trackers, mobile

healthcare applications and other wearable devices. But for the data to be of value it needs to be in a standardized format, feeding into business processes and decision making systems. Used wisely, clinical and non-clinical data can deliver a superior, cost-effective healthcare experience to citizens. Digital Integration is the magic thread that's tying all these elements together and is transforming the way in which healthcare is delivered and managed.

Executing Digital Integration strategy



Our model has four maturity levels, starting from Ad hoc (lowest level) to Optimized (highest level). The goal should be to reach the highest level as quickly as possible.

The model defines five capability areas to assess organizational maturity:

- Integration strategy
- Technology and architecture used to deliver integrations
- Flexibility and reach of the Integration platform
- Ability to govern and operate simply and robustly
- Capabilities for observability and insights leading to continuous improvement and optimization

A maturity level assessment of our customers shows that most of them are “Consistent” with respect to the Integration platform and “Mature” in their monitoring capabilities (see Chart 39). It is also evident from our assessment that most of them are at the “Ad-hoc” Level, indicating that there is scope for improvement in their abilities on technology and architecture. Strategy, governance and operating models are addressed in a similar manner by most of those who find themselves at the “Consistent” Level.

Wipro’s Integration Maturity Model helps organizations assess and enable themselves on various aspects covering strategy to architecture, governance, operating model and observability.

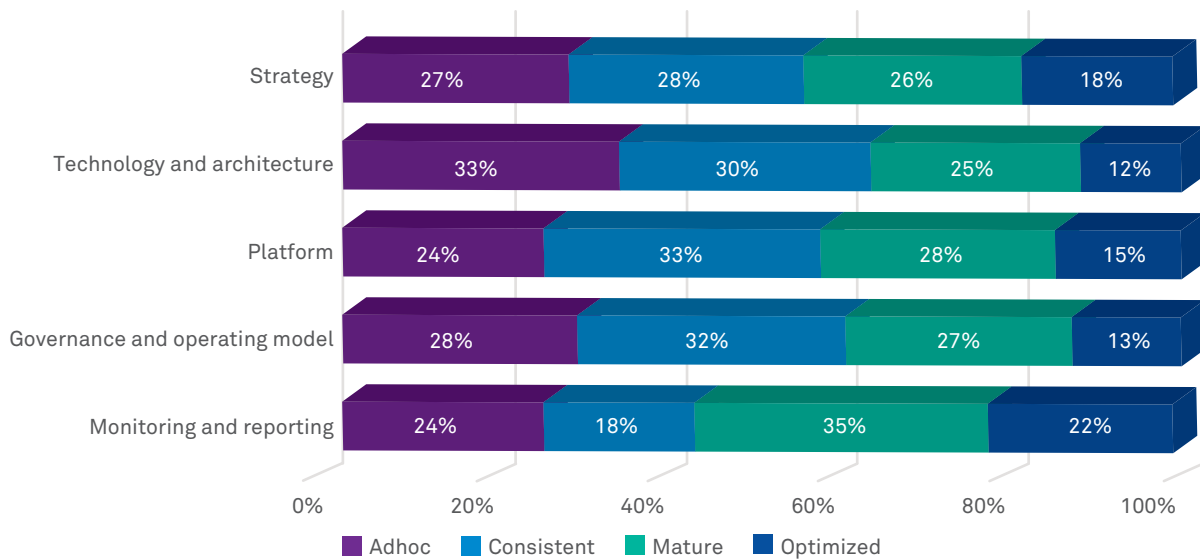


Chart 39: Maturity level assessment of Wipro’s customers

Delivery model for building Integration

Delivering integrations is about having the right process, organization and tools. We will look at how a Digital Integration Competency Center can help in delivery and governing integrations. Traditional integration development and testing was linear. It was fairly rigid, each phase being complete before the next one was undertaken. It used a Waterfall method that worked for projects where the requirements were finite and certain. In today’s digital and connected environment, nothing is certain; nothing can wait. Agile has taken over from Waterfall.

The journey of organizations consists of using Agile development supported and managed by a Digital Integration Competency Center (DICC), an operating

model with effective governance, DevOps practices with observability of Integration services.

The DICC has roles ranging from Architects, Business Analysts, Developers, Integration Product Specialists, Platform Specialists, etc. The DICC’s responsibilities include planning of Integration projects, architecture and design, development of Integration services and APIs, management and governance.

DICC, sometime called Integration Factory, is a familiar construct. It used to be the go-to group when Integration (such as ERP integration) was complex before the era of APIs and microservices. Its role today, however, has changed to providing governance and direction (see Figure 15 for the roles, functional and operational components of a typical DICC). It continues to reign as the key body for Integration projects with some evolutionary changes.

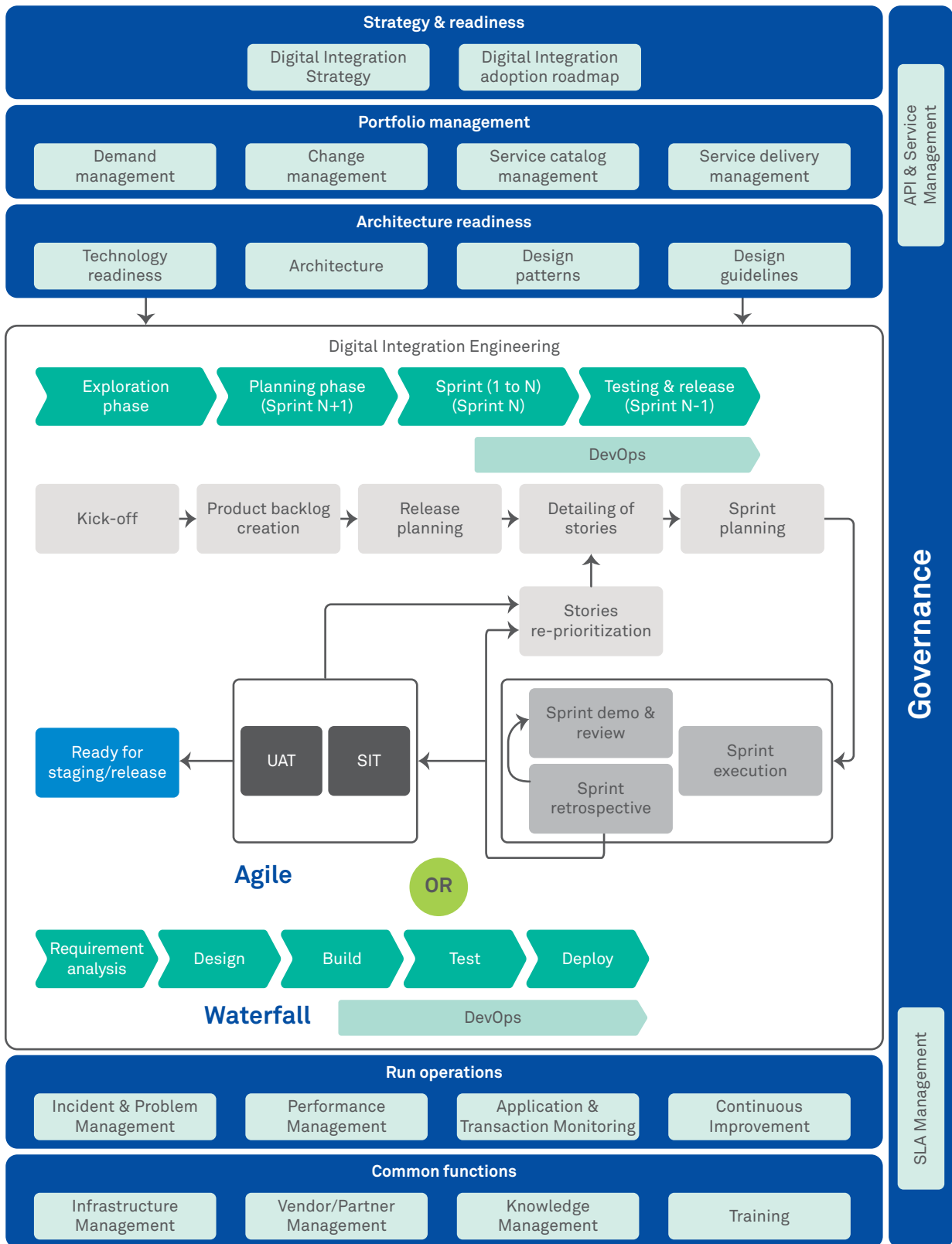


Figure 15: Operating model for delivering integration services

Typically, a DICC comprises a core team to drive continuity and provide expertise. This team is often called upon to perform multiple roles, based on needs. A “flex” team consisting of members who can be brought in to handle a surge in tasks is also part of the DICC.

Governing Integration

Integration governance is essential to the design, development and optimal management of Integration programs. Even if an organization doesn't have a DICC, it still needs governance so

that development adheres to the standards of the organization.

The governance team is usually comprised of members from Enterprise Architecture, Strategy Groups, PMO, IT and Digital Governance teams from across the organization. The DICC or the Integration CoE works in conjunction with

the governance teams to provide Integration governance across projects (see Figure 16). A combination of central and federated governance is the most prevalent organization structure for governance. The federated teams govern and take decisions while the central body sets directions and serves as an authority for granting exceptions.

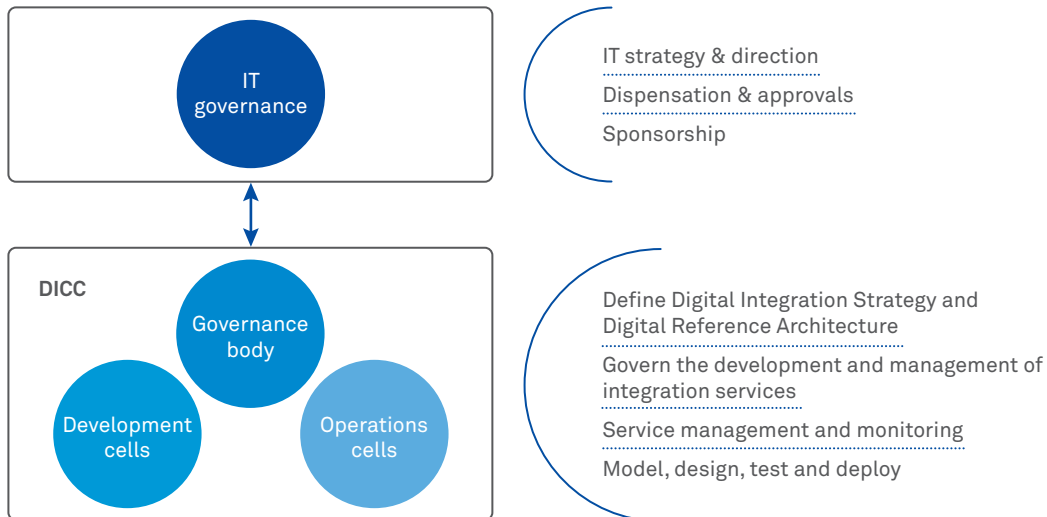


Figure 16: Governance levels and responsibilities

Our experience with customers and the survey results show that API and Integration services reuse is the most focused aspect of Integration

governance (see Chart 40). The optimal use of the Integration infrastructure is another area where governance plays a crucial role.

Q Integration governance is key to ensuring that business and IT objectives are met through the integrations developed. What aspect does your Integration governance cover?

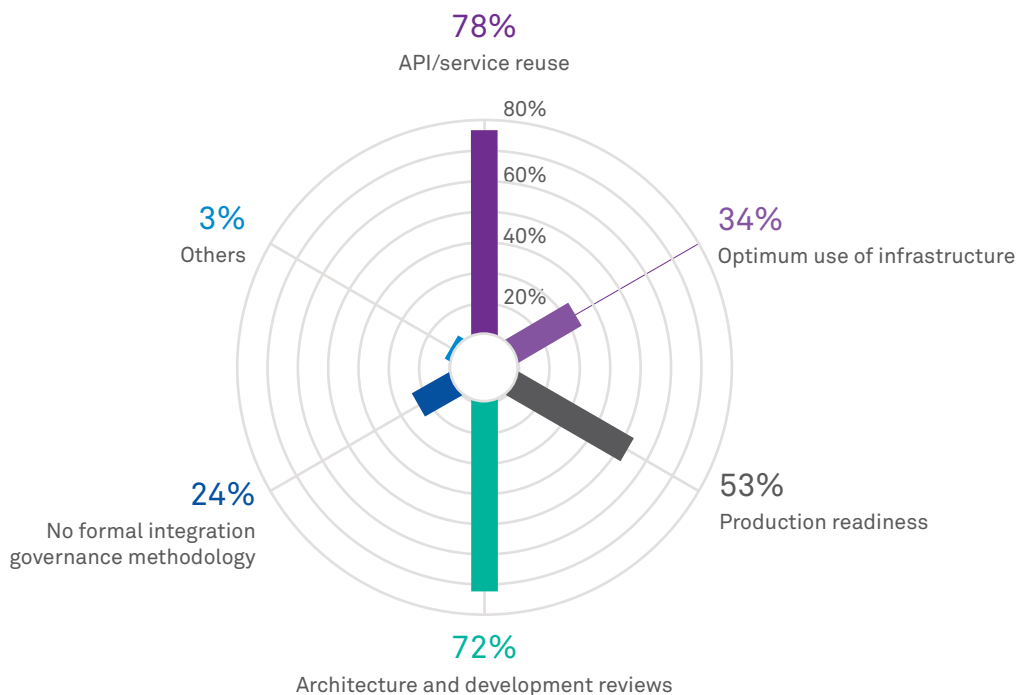


Chart 40

Culture: Team of Teams and the crowd

A motivated team with a learning culture is a dream. To achieve this, a way of working that is gaining in popularity is that of a Team of Teams. Here, teams are “cells” comprised of Architects, Business Analysts, Developers, Integration Product Specialists, Platform Specialists, etc., whose roles

are explicitly called out. These teams work together to deliver Integrations (see Figure 17).

With the growth in crowdsourcing—such as with Topcoder^{xvii} and its internal crowdsourcing platform TopGear—“cells” will become an integral part of the future operating model. Communities of experts from outside and within will be combined to develop Integration.

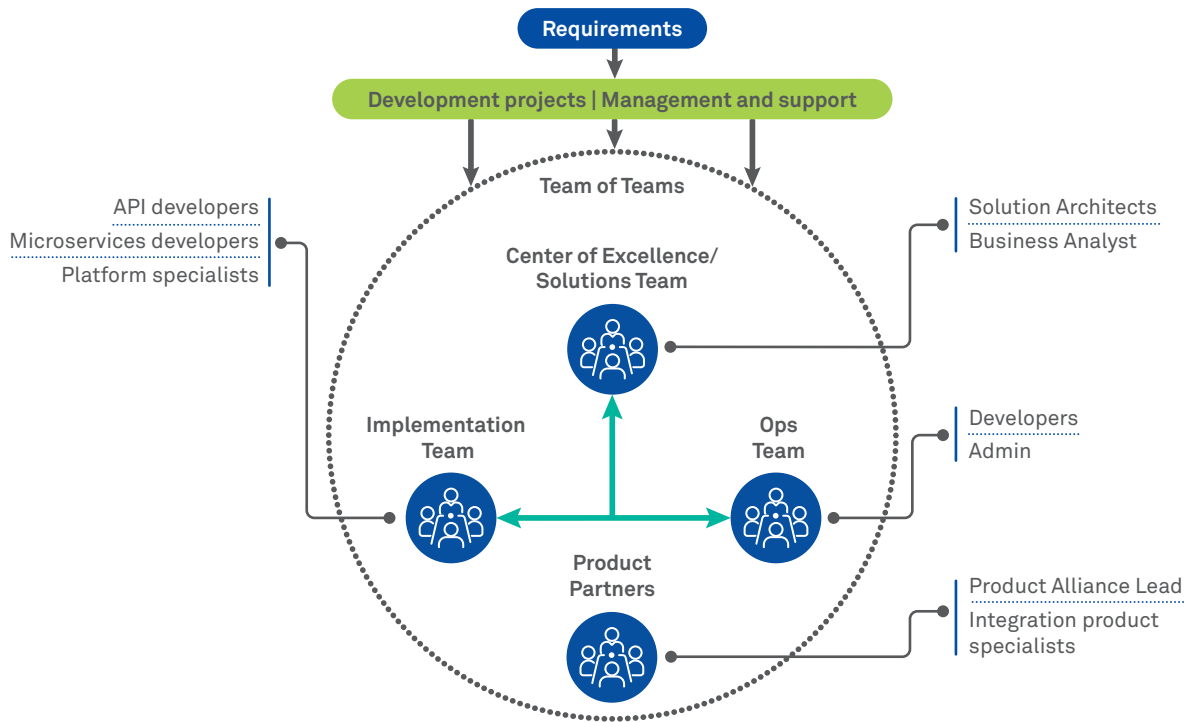


Figure 17: Integration development and management using the Team of Teams model

Agile stays leagues ahead

Our survey responses show that Agile is by far the most popular development methodology.

Waterfall is next, but it trails by a considerable measure. API-led connectivity is fast emerging as a development method of choice (see Chart 41).

Q What is the software development methodology/ies used for Integration in your organization?

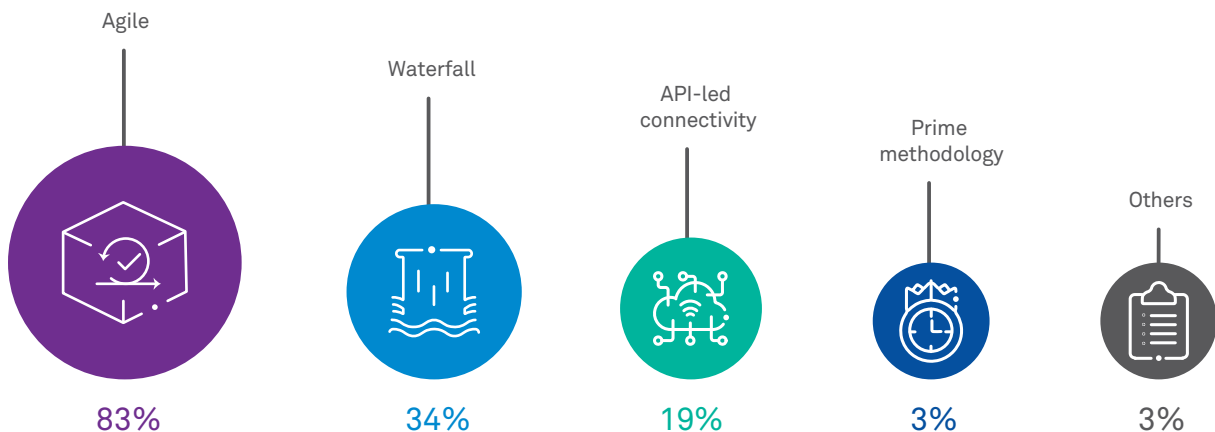


Chart 41

The changing people capabilities

In the past, Integration was viewed as a niche skill. This was partly because most Integration middleware such as brokers and ESBs were proprietary, despite being Java and XML-based. Now customers are adopting open technologies such as APIs and microservices. The skills required for proprietary products are fading and as our survey results show, the demand for expertise on web technologies such as JSON and REST and on Java frameworks is on the rise (see Chart 42).

The middleware skills required to develop a functional microservice and an Integration

microservice appear to be converging. While knowledge of Integration is a must-have, the ability to develop in proprietary product stacks is reducing, enabling developers and architects from other domains to work on Integration projects without difficulty.

Integration specialists should get skilled around cloud platforms, DevOps tools and processes, distributed architectures and cloud-native design principles. They should also be sensitized to the role, performance, scalability and security considerations of developing Integration microservices conforming to cloud-native architectures.

Q What skills do Integration developers and architects in your organizations possess?

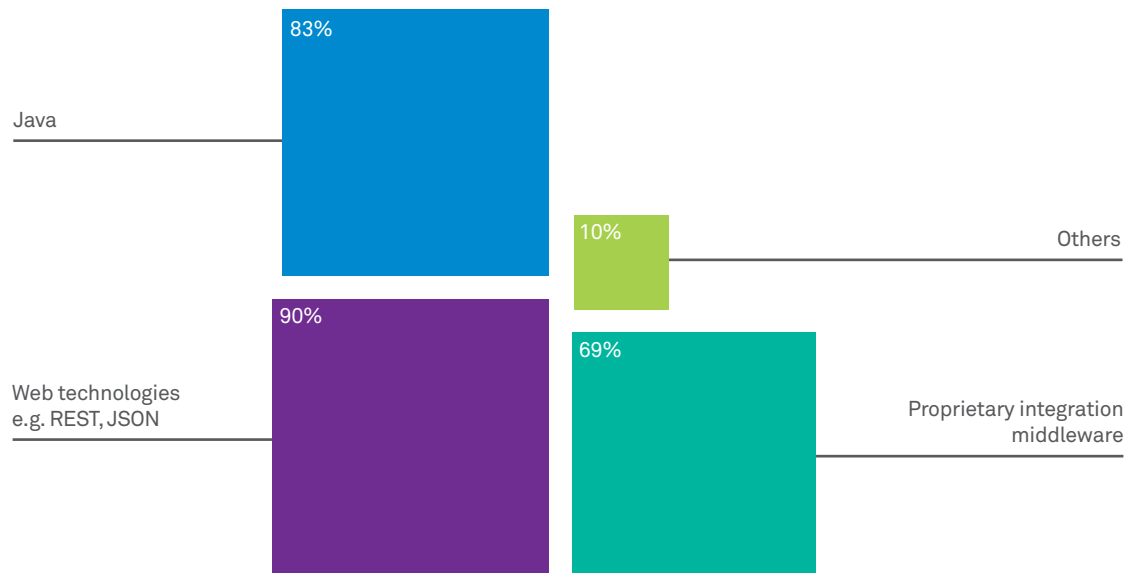


Chart 42

DevOps, the foundation of Digital Integration

DevOps underpins the operating model and the development processes of the DICC and Integration services development at large. With its ability to bridge stability and agility in IT by ensuring that development, testing and release happen rapidly and reliably, it has emerged as the backbone for digital experience initiatives. Security is part of the development lifecycle right from the beginning. It is not an afterthought. No critical program can be executed without a strong DevOps setup (to clarify, this is DevOps for CI within the development, not for A2A integration). Our survey shows that Integration projects also utilize DevOps's CI/CD pipeline (see Chart 43).

Developers design API implementations in the Integration product IDE with the required level of encryption and security policies, and check unit tested code into a source control repository. The pipeline is triggered and completes tasks such as testing, checking into source code repositories and deploying it on middleware servers. This improves developer productivity and helps them focus on core implementation tasks.

DevOps typically blends Agile processes leading to iterative development. When applications are developed in small chunks, it accelerates go-to-market and allows features to be progressively refined.

Q Which of the stages of the DevOps lifecycle does your organization employ in Integration development?

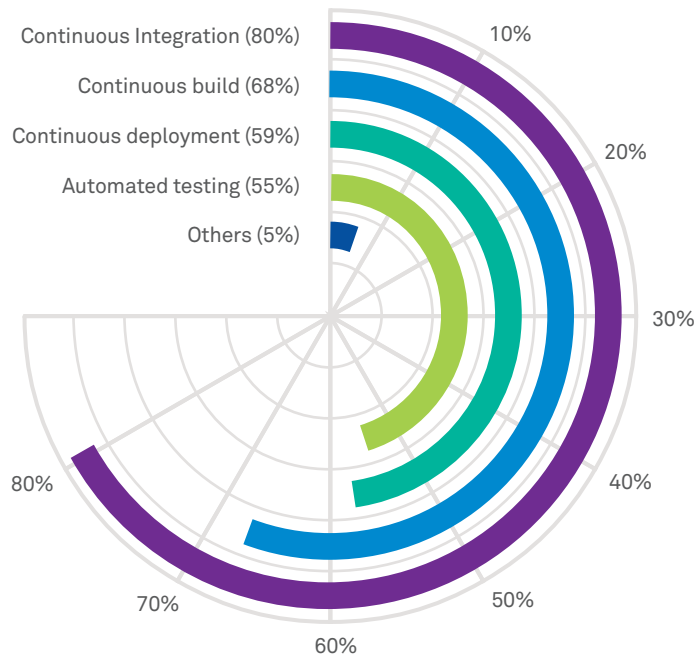


Chart 43

Observability: Completing the DevOps picture

With hybrid infrastructure, development and deployment span disparate environments. Here, DevOps tools are more effective when used alongside container-based platforms as the same platforms can be used to test on premises and deploy on cloud. This trend has streamlined deployment across cloud, on premise and hybrid environments but

necessitates strong observability. Observability (see Figure 18) provides a view on the overall health and functioning of the services along with insights and context. A new set of tools is becoming available with dashboards for observability. These deliver information on infrastructure usage, request traces, response times, etc. The dashboards support governance of the infrastructure and aid in making informed decisions related to operational costs.

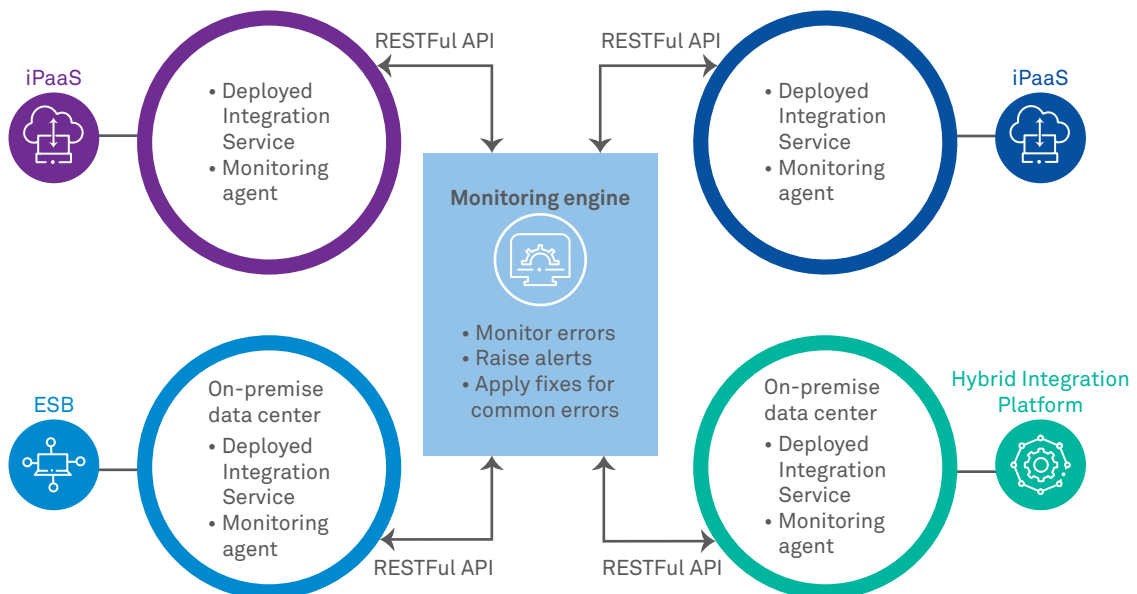


Figure 18: Observability for Integration Platforms

Intelligent Integrations with AI

AI, in conjunction with Machine Learning, is introducing entirely new levels of smartness that go into improving management of integrations. For instance, while monitoring integrations, it is now possible to generate alerts on errors and simultaneously apply fixes automatically, bringing in a level of self-healing. Similarly, rules can be defined to allocate more resources to an API implementation when the threshold increases a certain value. Machine Learning can also be used to push the edges of Integration development by leveraging it to provide suggestions on transformation rules and error handling based on development patterns.

AI and Machine Learning are introducing new levels of smartness in managing integrations. They enable self-healing by applying fixes automatically. The Machine Learning also keeps a track of commonly occurring patterns and predicts the next integration error.

One of the biggest challenges facing businesses and IT teams today is the disparate and siloed nature of applications and data sources. Today, data can come from anywhere and everywhere at different speeds, and one needs to figure out how to utilize its full potential at the edge, in the data center, or in the cloud.

To support this need, organizations need to employ hybrid or multi-cloud strategies rather than solely focusing on either cloud or on-premise environments. Integration solutions must be able to operate at the speed at which data is generated, AI-driven rules need to be applied at the right point, and an integration strategy that is cloud-native, API-led, and supports concepts such as microservices, FaaS, and containers must be deployed.

A big part of the conversation revolves around speed—how quickly teams can build reusable components and deploy new capabilities. Employees must be able to effectively build and deploy APIs and Integration flows, incorporate event-driven logic, and utilize both open source and commercial software to develop DevOps-driven solutions.

In the future, I expect organizations will look for flexibility and application neutrality in their API platform, decision management, and Integration tools, AI will become a more integrated component within these tools, and emerging frameworks such as Blockchain will play a prominent role in the ever-growing data ecosystem.



» Nelson Petracek,
Chief Technology Officer, TIBCO Software Inc.



Future of Digital Integration



New demands will be placed on Integration in a post-digital world. The accent will be on areas that dial up intelligence required for businesses to collaborate in boundaryless ecosystems and provide a personalized engagement without compromising privacy.

Enterprises are moving deeper into their Digital Transformation journey. The next stage of their evolution in a post-digital world is the exciting prospect of creating Smart X businesses: smart banking, smart manufacturing, smart airports, smart utilities and so on.

Smart X is about connecting and integrating every function and system to let intelligence run unfettered through the nervous system of the

enterprise. Synthesizing future constructs with the foundation that they are laying today will be the new playground for Integration experts. It will test their ingenuity and it will push the envelope of what Digital Integration can achieve.

In preparation for the future, glimpses of which are already visible, Integration teams must prime themselves for the post-digital opportunities arising from (see Figure 19):

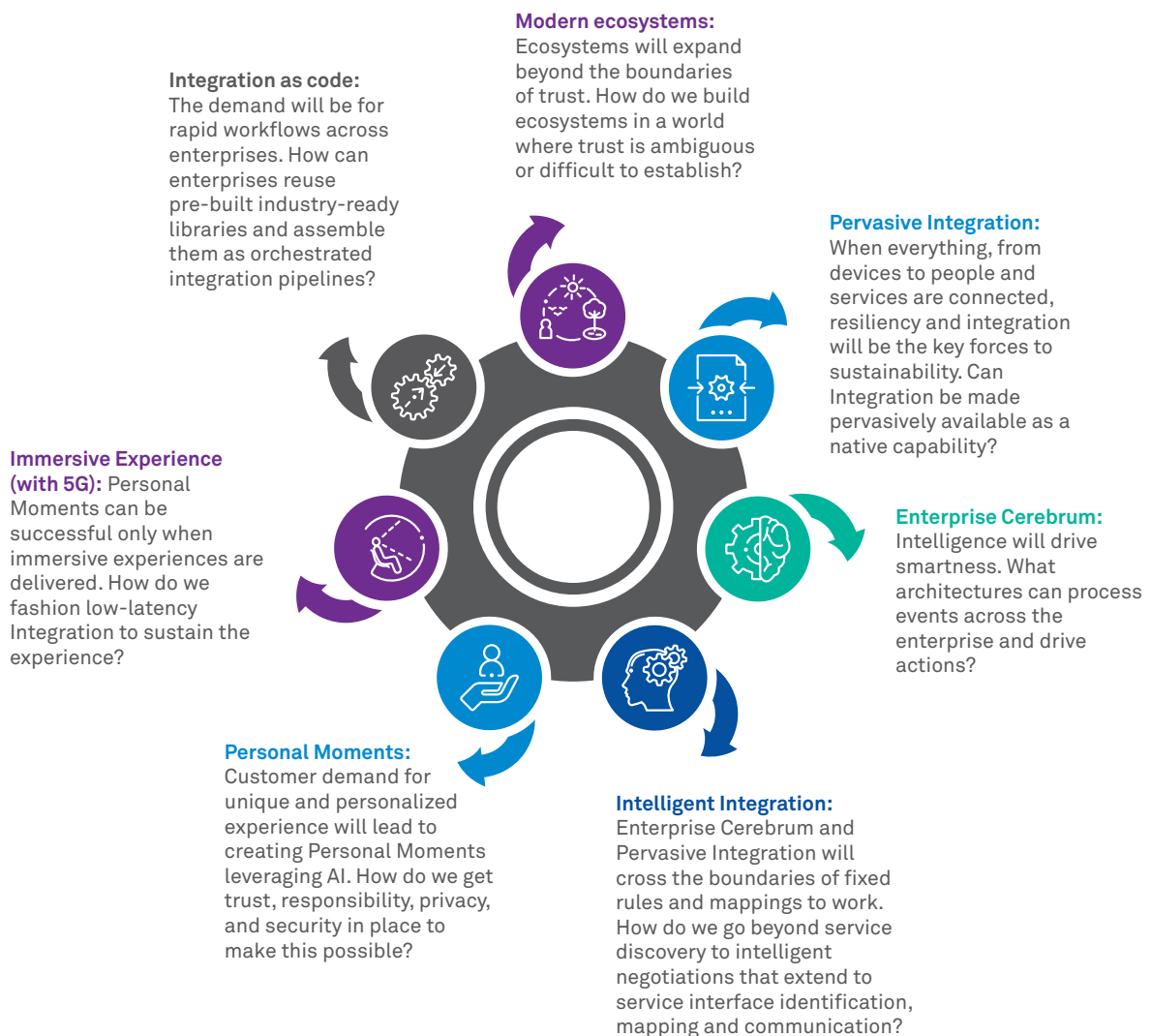


Figure 19: Integration gears to accelerate post-digital transformation

To the seasoned practitioner of Integration, these are deeply intriguing questions. The answers to them are rarely in black-and-white. But the prospect of how these could be addressed and leveraged is captivating and worthy of discussion.

Modern ecosystems

As enterprises extend beyond their datacenters and leverage multi-cloud capabilities, multiple business domains will converge into a boundaryless fabric and collaborate to create a seamless customer experience. Aggregation of services across business domains, to provide a coherent user experience, is critical. To become reality, all pervasive devices, edge layers, and enterprises will want trusted mechanisms. APIs and distributed ledger technologies like Blockchain will play a vital role in this context. Consider the scenario of a car buyer. The buyer's journey starts with browsing car reviews on various portals, followed by an immersive test drive in an automobile showroom, enquiry for car loan with a bank, enquiry for car insurance with an insurance provider and finally culminating in the car purchase. This is a combination of multiple enterprises and business domains integrated through Blockchain and smart contracts for seamless cross-domain interaction.

Pervasive Integration

With growth in bandwidth and connectivity, pervasive technologies will allow billions of devices to communicate reliably with humans as well as with machines. The fabric of Integration will be stretched to support large volumes and high velocity events generated by edge devices. Edge layers and smart payloads with self-healing sensors will acquire effective and smart Integration capabilities. Embedded devices with edge layers will be further integrated with enterprise systems resulting in micro Integration patterns. Simplifying these patterns will imply abstracting Integration complexities using low-code platforms. This will give rise to a new breed of experts—known as Citizen Integrators—where specialized skills will be

replaced with generic skills and where low-code tools (or even zero-code tools) will accelerate communication within enterprises.

Enterprise Cerebrum

With Pervasive Integration and modern ecosystems, enterprises will generate millions of heterogeneous events. These will be analyzed using smart architectures. Enterprises will then begin to use immersive and contextual knowledge to improve their responsiveness towards user interactions. One of the chief enablers will be reactive architectures that reconfigure processes based on the behavior of the ecosystem (for e.g., an automobile manufacturer will change processes based on the behavior of mobile networks, not the other way around!). Event meshes and mesh brokers will be necessary to provide regulated interactions across smart systems, generating high volumes of events. Event mesh will abstract technicalities of handling event structures, event correlation and event management enabling systems to focus on business events.

Smart X businesses are connecting and integrating every function and system to let intelligence run unfettered through the nervous system of the enterprise. Synthesizing future constructs with the foundation that they are laying today will be the new playground for Integration experts. It will push the envelope of what Digital Integration can achieve.

Another potential enabler is serverless computing. Serverless platforms include developer-friendly interfaces, high availability and multi-language interfaces resulting in interesting enterprise Integration scenarios. These platforms accelerate the Integration capabilities of existing systems. Google's serverless functions^{xviii} provide an excellent example of how these technologies could evolve in the near future, creating backends for telemetry collection, real-time track-and-trace requests and enabling correlation of requests in an Integration platform.

Intelligent Integration

Artificial Intelligence (AI) will influence every aspect of Integration. AI techniques will redefine enterprise Integration solutions through models that understand the behavior of systems and assemble intelligent orchestrations. For example, a system need not know all the protocols of sensors (say iOS, Android,

Windows and Bada) upfront, but will be able to quickly learn them when required, becoming extensible to the world. Other traditional aspects of enterprise Integration platforms such as business rules or analytics will also be redefined at the hands of AI. In order to sustain delivery velocity, intelligent contract negotiations will be driven by trust and context. These device-driven and context-driven contracts will impact the Integration development lifecycle while smart canonical models that drive service contracts will revolutionize Intelligent Integration.

Personal Moments

AI technologies like facial recognition, extended reality and digital twins will make it possible to predict and anticipate customer behavior. Integrated with data from social media platforms (Facebook, Instagram, Twitter, etc.) they will craft personalized experiences. With the abundance of data, maintaining the privacy and security of customers/users will become a key factor. This is where Intelligent Integration will be required to step in and create trusted Personal Moments. For example, facial recognition can trigger proximity marketing processes for retailers where customers are identified and offered discounts based on their interests. But the strategy will succeed only when users believe the integration can be trusted to maintain uncompromising and absolute privacy.

Immersive Experience (with 5G)

Immersive Experiences—that create powerful and compelling Personal Moments—are built using Extended Reality (ER), Augmented Reality (AR) and Virtual Reality (VR) with 5G capabilities. These technologies eliminate location dependency and reduce the distance between customers and services. However, in order to make these technologies work with heterogeneous ecosystems involving edge layers, sensors' and 5G networks' low latency Integration is the key factor. An emerging example of this is Audi that is experimenting with systems that allow customers to design and (virtually) experience their own custom vehicle^{xix}. This use case involves integration of Audi enterprise APIs deployed as serverless functions, sensors and AR/ER devices.

Integration as code

Modern ecosystems demand rapid Integration capabilities through reusable Integration pattern templates and industry-specific libraries. It also requires Integration pipelines which can be assembled on demand. Leveraging low-code platforms, container technologies, scripted frameworks and microservices tooling, enterprises will assemble Integration pipelines on demand. For example, frameworks like WSO2 Ballerina, Pulumi, along with Terraform and Ansible, could be leveraged to create Integration plugins and assemble them as a set of containers.

Way forward

By imbibing the principles of the enterprise digital journey, organizations can build an Integration strategy for the post-digital world. No matter what the current state of Integration, we recommend every organization assess their Integration maturity, which will help them to chart their Integration strategy. Organizations should look at how the facets of Integration fit into their strategic Digital Transformation and Customer Experience objectives and accordingly define and drive initiatives like API-first, Cloud-native Integration and Edge Integration. It is imperative that every organization ties their Integration strategy to their business model evolution in the specific industry verticals they operate in and accordingly prioritize these initiatives. Organization leaders are also recommended to look across the value stream and leverage Integration trends effectively by building capable ecosystems and digital business platforms. While technology is important in an Integration strategy, it is equally important to have the right model of Integration delivery and practices. That would require a significant organization-level change to adopt models such as DICC, or practices such as DevOps for Integration and upskilling developers to become full-stack with a domain orientation. Finally, no Integration strategy can be static, and organizations should continuously look out for opportunities to adopt emerging and disruptive approaches such as serverless computing, blockchain, integration as code in order to get the best of Digital Integration capabilities and stand differentiated in the market.



| Appendix



Methodology & demographics

This report is based on primary and secondary research conducted by Wipro.

The primary research involved an external online survey conducted in 2019 for a period of one month using a detailed questionnaire and research insights from our Digital Business Integration (DBI) Practice. Respondents to the online survey included Integration leads, sponsors, architects and practitioners representing Wipro customers from various industries (see Chart 44). The respondents were from geographies across the globe (see Figure 20).

The secondary research was conducted by a core team of analysts from Integration strategy, presales and center of excellence. They analyzed and referenced content from customer projects and requests (RFPs, RFIs, etc.) and industry sources, including expert and analyst interactions, domain standards, technology standards bodies, partner sites and academic papers from the Digital Integration domain.



Chart 44

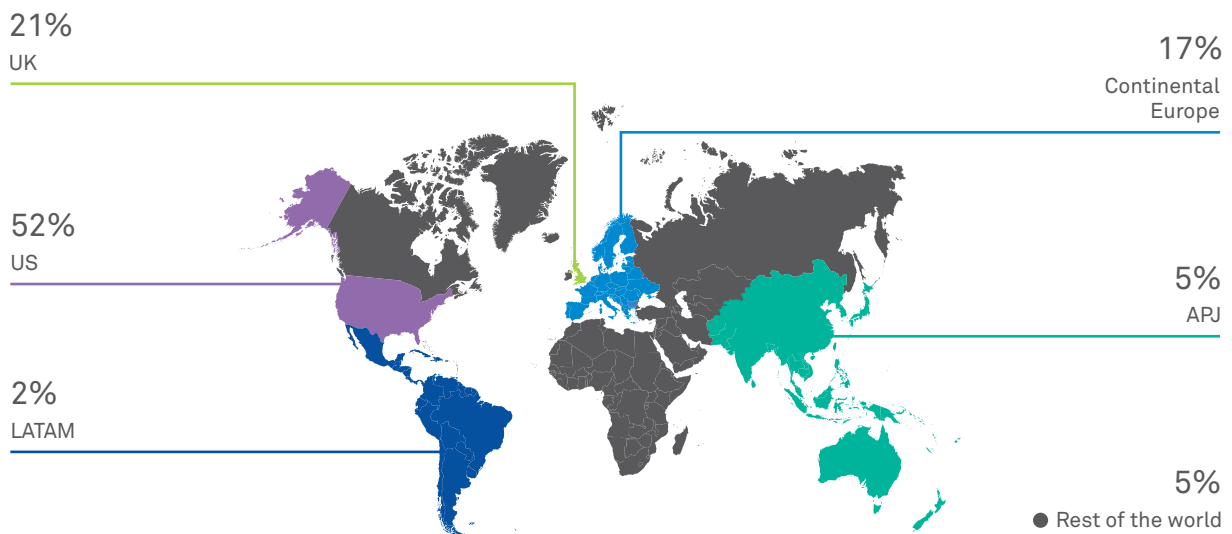


Figure 20

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Wipro's Digital Integration as a Service (DlaaS) offers services to build any-to-any Integrations, from businesses and applications to cloud and things. It comes with a choice of operating models and includes a self-service portal that provides a unified view of Integrations across the enterprise.

The DBI practice resides in Application Engineering & Modernization group, part of Modern Application Services unit.

If you wish to know more, visit our page - <https://www.wipro.com/applications/integration-/>

or

Scan this QR code



For further information about the insights and how Wipro can modernize your Integration landscape, please contact ask.dbi@wipro.com

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