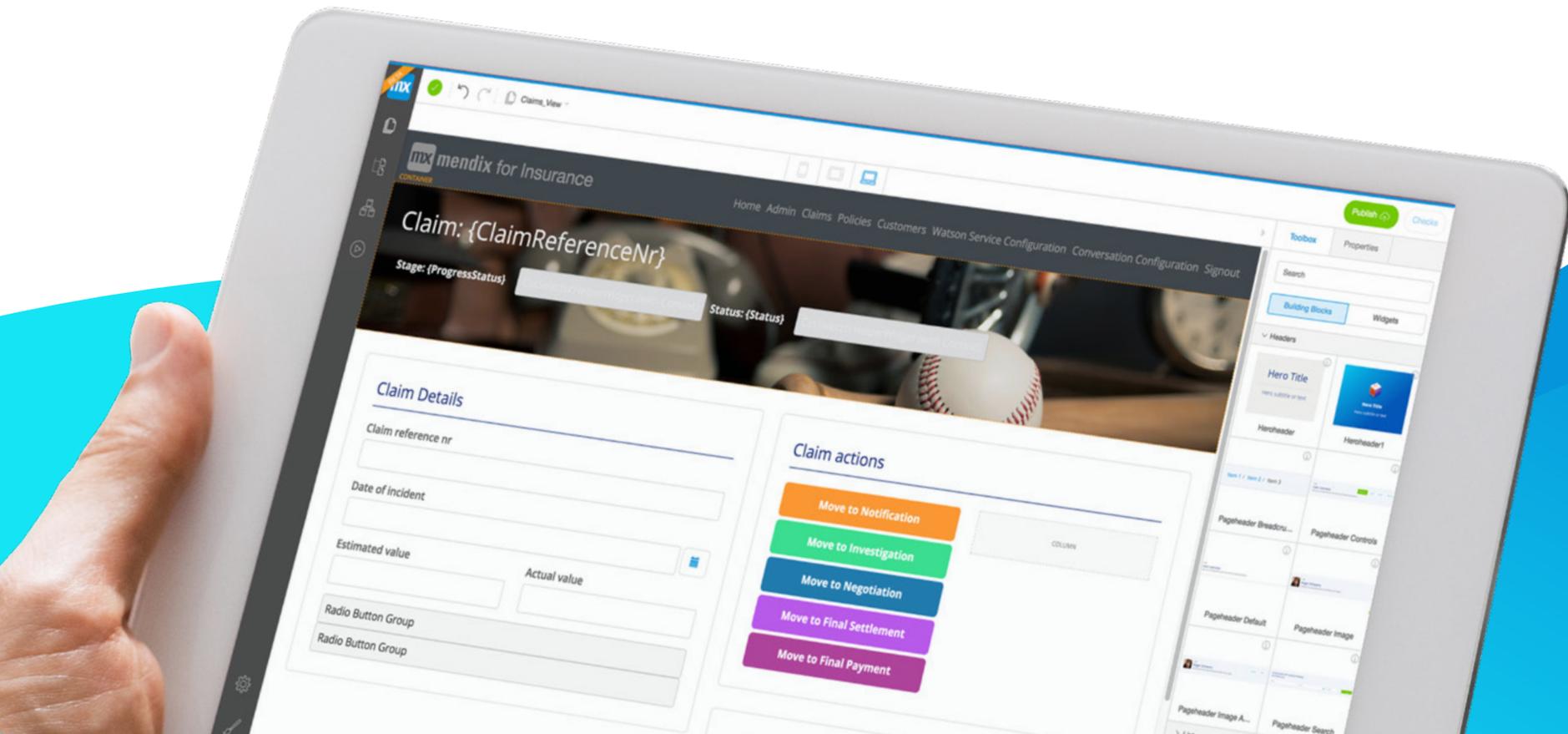


IBM and Mendix: Low-Code Development on a Cloud Built for You

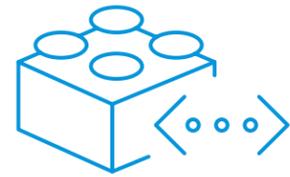


We live in a software-driven world.

Our software-defined world continues to drive demand for applications that enable enterprises to reach their digital business goals.



To stay ahead of the ever-increasing competition, companies are taking advantage of software to reimagine products, processes, roles and business models. To be successful, this digital transformation requires a holistic, end-to-end approach to intelligently connect people, businesses and things across the entire value chain.



A nexus of technologies like Cloud, Internet of Things (IoT), Big Data and Artificial Intelligence (AI) offer IT the opportunity to become a driver of business innovation and even a source of revenue.

Technical complexity and other roadblocks shouldn't prevent organizations from using these advanced cloud services. However, many businesses face challenges when trying to embrace these new technologies and achieve desired business outcomes.



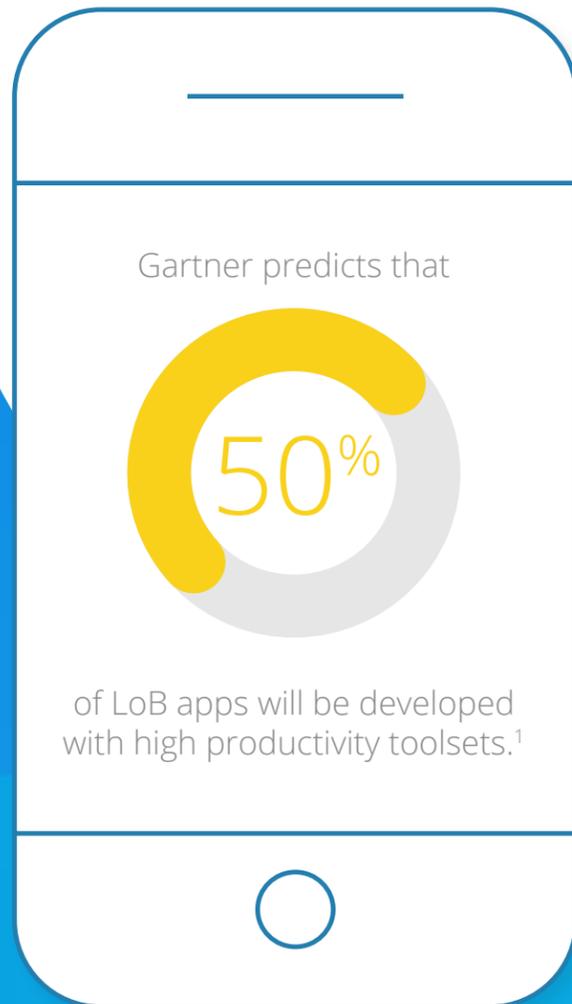
Lack of agility, as competitive and unique apps today require rapid experimentation and close collaboration among developers, data scientists, business analysts and IT teams.



Technical complexity, which often causes teams to struggle to master the increasingly complex landscape of app development.



A skills shortage, the demand for developers exceeds the supply. Many companies struggle to find the right skills when hiring, or cannot afford the increased resources required to keep up with demand.



Low code, a fast-growing category of app development, addresses these obstacles by bridging the gap between technology and business needs. Low-code development abstracts away from manual, low-level coding through visual development tools and reusable components, significantly reducing your time to deliver web and mobile apps. Gartner predicts that “by 2020, at least 50% of all new business applications will be created with high-productivity toolsets.”¹

IBM and Mendix are partnering to combine the ease of Mendix’s low-code environment with the advanced services available on IBM Cloud and from IBM Watson, including AI, blockchain, data analytics, mobile and Internet of things (IoT) services. This significantly accelerates the speed at which developers from all backgrounds, from highly skilled coders to citizen developers, can build and deploy cloud-native applications.

¹ Gartner, Inc., “Market Guide for Application Platforms,” November 23, 2016, Anne Thomas and Aashish Gupta

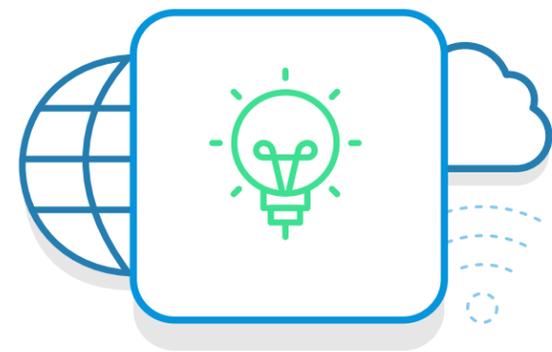
With business demand for custom applications soaring, it’s clear that traditional development approaches simply can’t keep pace. Across the board, we see customers building apps for four main use cases: Innovation, customer engagement, operational efficiency, and legacy migration. Let’s review each type of application to understand

their individual characteristics, the challenges of developing them with traditional methods, and how low-code platforms combat these challenges.

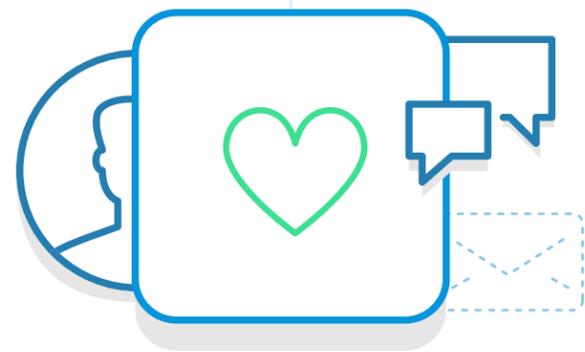
To be successful, this digital transformation requires a holistic, end-to-end approach...



Focus on building apps your users want and your business needs



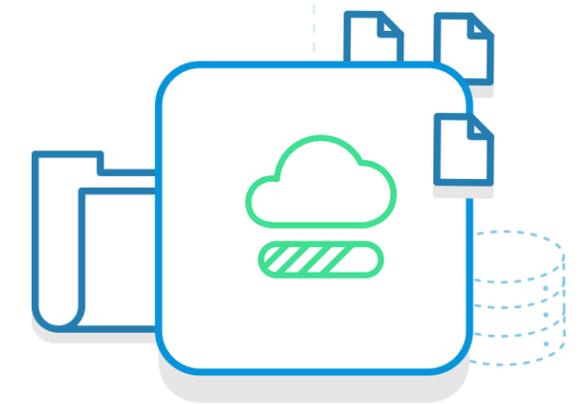
Innovation
apps



Customer
Engagement apps



Operational
Efficiency apps



Legacy
Migration apps



Innovation

An iterative, test and learn approach to developing innovation apps



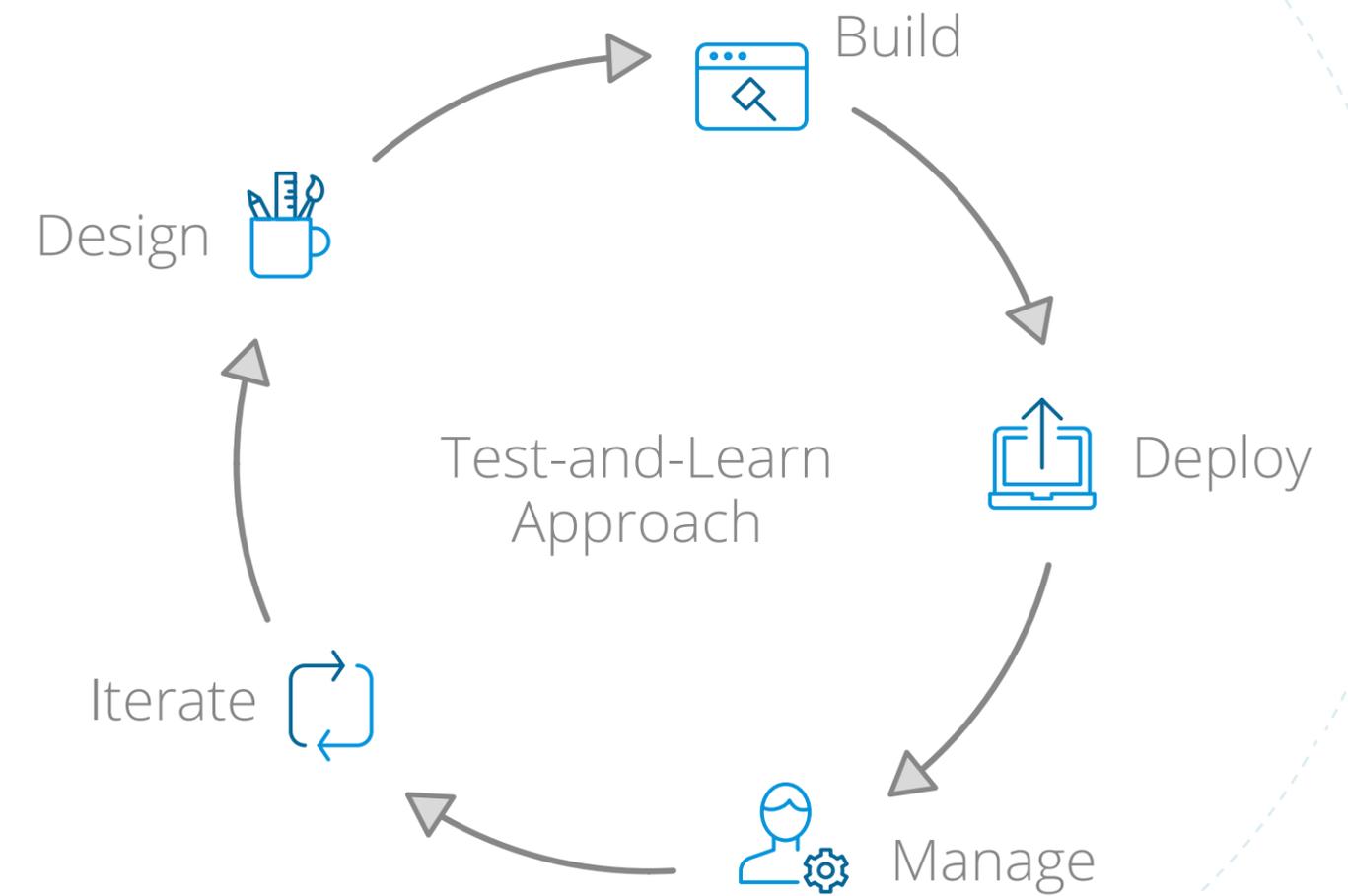
Innovation apps stem from ideas for new digital business models, products, and channels to help grow and differentiate the organization.

Often, they leverage emerging technologies like IBM Watson and IBM Blockchain to unlock new sources of value. Because innovation apps start as ideas, with loose and fuzzy requirements and a high rate of change, they require a high degree of business involvement throughout the entire development process to ensure they deliver their intended value.

Thus, the process for developing these applications is different from other types of apps. Not all of the ideas will be successful, but that's ok, as long as your team can explore new ideas, failing fast and moving on to the next idea or continuing to iterate toward optimal outcomes. With this in mind, applications need to start small as prototypes and quickly scale upon success. This type of development can pose challenges for many organizations.

Low-code platforms enable organizations to take a test-and-learn approach to innovation, exploring new ideas quickly and at low cost.

Business domain experts can build functional prototypes and collaborate seamlessly with development teams to extend apps with complex logic and integrations, allowing the organization to iterate toward optimal outcomes and quickly scale once ideas are proven.



Challenges of Developing Innovation Apps and their Low-Code Solutions

Length, cost and risk of traditional development

Within many enterprises, innovation projects often never get off the ground because of the length, cost and risk of using traditional development approaches. A low-code platform removes the impediments to experimentation, enabling a test-and-learn approach where new ideas can be vetted quickly and inexpensively.

Achieving the intended business value

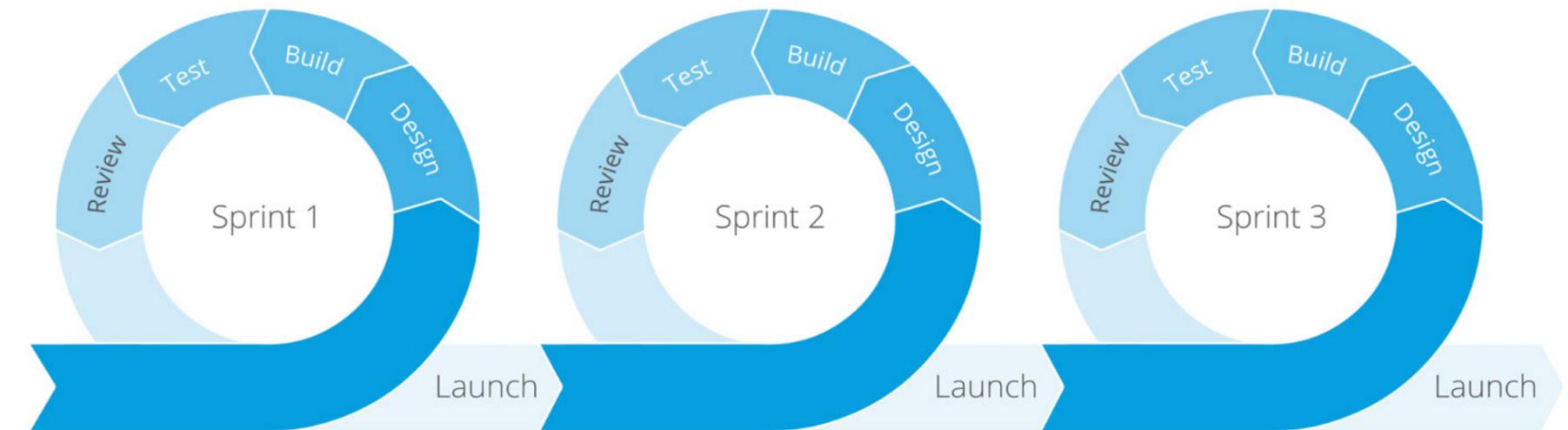
There is often a large gap between the business and IT in the traditional development process. The result of this disconnect is an app that doesn't deliver the intended business value. Low-code development empowers business domain experts to build prototypes leveraging advanced technologies and core systems, so the solution—and its intended value—can be refined before a full-on development process occurs. Look for a platform that enables business users to easily build prototypes, and enables developers to leverage emerging technologies and legacy systems with minimal dependencies on IT through leveraging out-of-the-box connectors.

IT Delivery Capacity

Business Demand

Fuzzy requirements

The nature of an innovation project is that it's impossible to know all the requirements up front. With traditional development, this often leads to the wrong functionality being built, resulting in an unsuccessful app. By using a low-code platform, you can implement an iterative design and delivery approach with feedback loops to ensure apps deliver their intended business value. Look for a low-code platform with an easy-to-use project portal with built-in agile project management to encourage iterative development while actively including the business and incorporating their feedback.



Scaling innovation projects

Many innovation apps never leave the prototype stage and don't get operationalized at scale. Using a low-code platform ensures that new apps can move from prototype to large-scale production once success is proven. Look for an enterprise-grade platform with cloud-native architecture, pluggable DevOps build chain for continuous integration and continuous delivery, and integration of enterprise-specific monitoring tools.

Innovation in action

A social security agency is experimenting with cognitive services to simplify proof of eligibility for social security benefits for people living abroad.

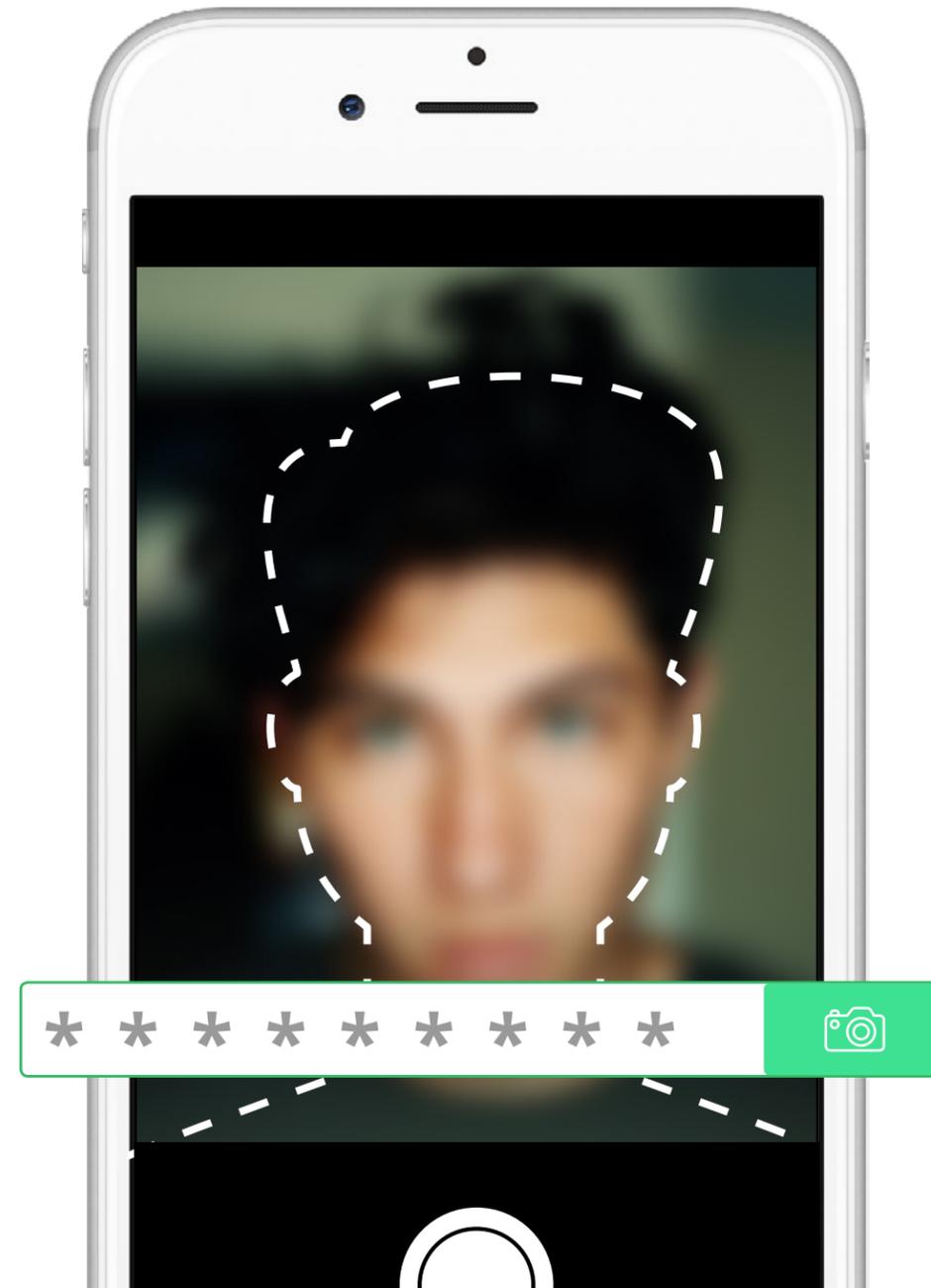
Thanks to the free movement of people, goods, services and capital in the EU, many people decide to settle abroad after retirement. Since they are benefiting from social security funds from their home country, people living abroad have to periodically prove their continued eligibility by proving that they are still alive. This is usually a cumbersome process, as citizens are requested to physically go to a local consulate. One social security agency is experimenting with digitizing this process using state-of-the-art cognitive services that leverage IBM Watson. Rather than going to a physical location, citizens can now complete the procedure online. A few smart features in the application help determine that the citizen is indeed alive.

The first step in the process is taking a picture of your passport photo and a selfie using your device or computer camera. An image recognition service will perform a

matching service to determine if the two pictures are from the same person.

In order to exclude the option for pre-taken photos to be submitted, a second step follows in which the citizen is asked to pronounce a random sentence on camera, which is populated real-time by the application. This video fragment is added to the submission and a speech-to-text service transforms the spoken sentence on video to text, where a matching engine determines if the populated text corresponds with the spoken sentence.

If the overall score is within margin, the agent will accept the submission and the citizen will be notified, saving him or her the trip to the consulate. The idea for this innovation came up during a hackathon organized by the Social Security Agency. The Minimum Viable Product (MVP) was built in just one day leveraging low-code development



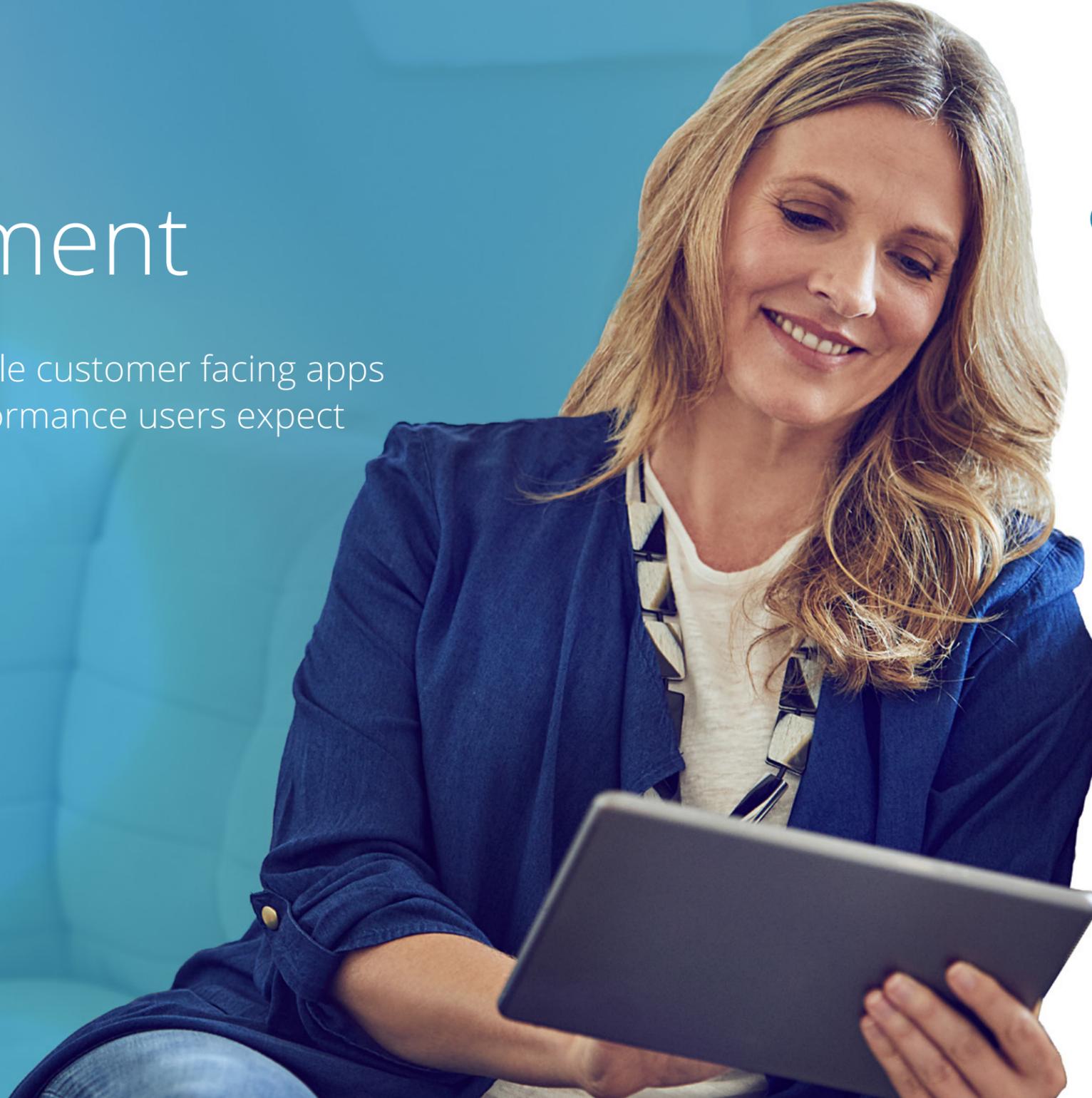
Low-code platforms enable organizations to take a test-and-learn approach to innovation, exploring new ideas quickly and at low cost.

and IBM Watson services, and the solution was so appealing that the agency decided to bring it forward and turn it into a prototype for live testing. This example shows that cloud and cognitive services have advanced to levels where innovation initiatives can be executed at minimum cost and risk.



Engagement

Rapidly build and scale customer facing apps while delivering performance users expect



Customer engagement apps enable customers and partners to better interact and/or transact with the business, improving satisfaction, retention, and revenue.

With these apps, the business has a fairly well-defined idea of the app, but the development team must adapt to unknowns revealed during the process. But users have high expectations for these apps in terms of both usability and seamless, multi-channel access. Also, there are often underlying operational improvements required to support better customer-facing processes, including tight integration with back-end systems to provide relevant information that can be leveraged in customer-facing scenarios like customer data, product and pricing data, and transaction data.

Recognizing that many enterprises lack sufficient UX resources, many low-code platforms include an integrated UI framework with out-of-the-box widgets and building blocks that make it easy for individuals without UX backgrounds to build highly usable,

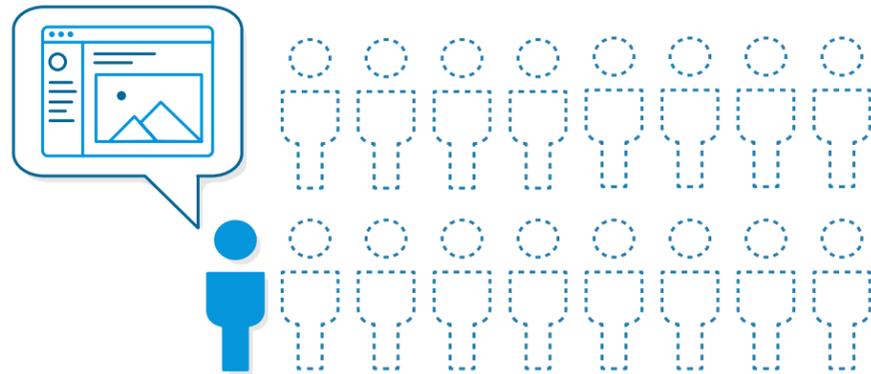
multi-channel apps. At the same time, a cloud-native architecture is key to enabling elastic scaling for large user bases and automatic failover for continuous operation of critical B2C apps or portals.

These applications are a great way for organizations to differentiate themselves from their competitors, but their development is met with three main challenges.

3 Challenges to Developing Customer Engagement Apps and the Low-Code Solutions

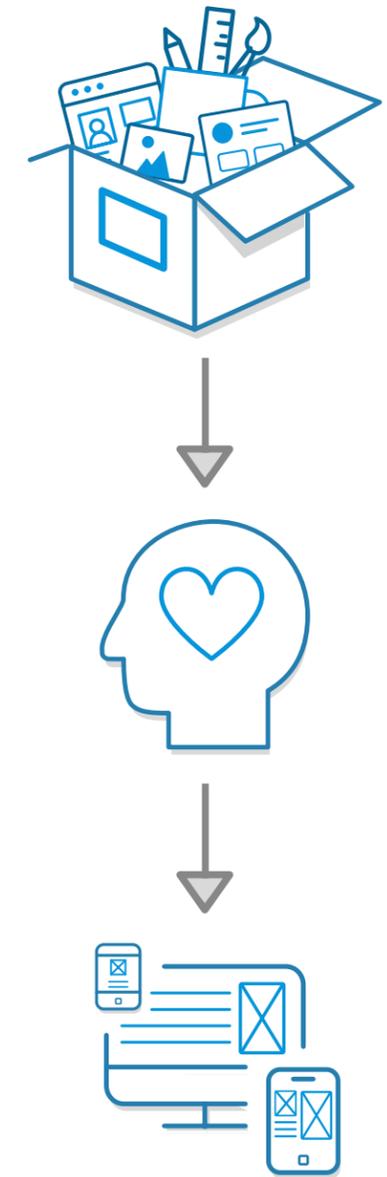
Limited budget and UX skills

Delivering an engaging user experience is challenging with limited UX resources. On average, enterprises have just one UX designer for every 17 developers, while 35 percent of organizations have no UX design competency at all. In contrast, many experts put the average designer-to-developer ratio for innovative consumer tech companies at 1:4.



Look for a low-code platform with a UI framework to enable people without front-end development or UI design skills to create beautiful, engaging and highly usable apps. As part of that framework, you should be able to create an enterprise design language that encompasses a unified set of UI/UX design rules and best practices, ensuring consistency and harmony across a portfolio of customer-facing apps.

With a low-code platform, the business is enabled to participate in the design process, supporting an iterative, user-centric approach (i.e. Design Thinking), which is key to ensuring the solution solves the right problems for users and has the right feature set/UX to ensure app usability and success.



Implementing the required process enhancements and automation

It's often challenging to integrate with back-end applications like your ERP, eCommerce or CRM system to implement the required process enhancements and automation. To alleviate these challenges, look for a low-code platform that provides out-of-the-box connectors to common business applications, enabling less technical developers to orchestrate core systems and automate workflows.

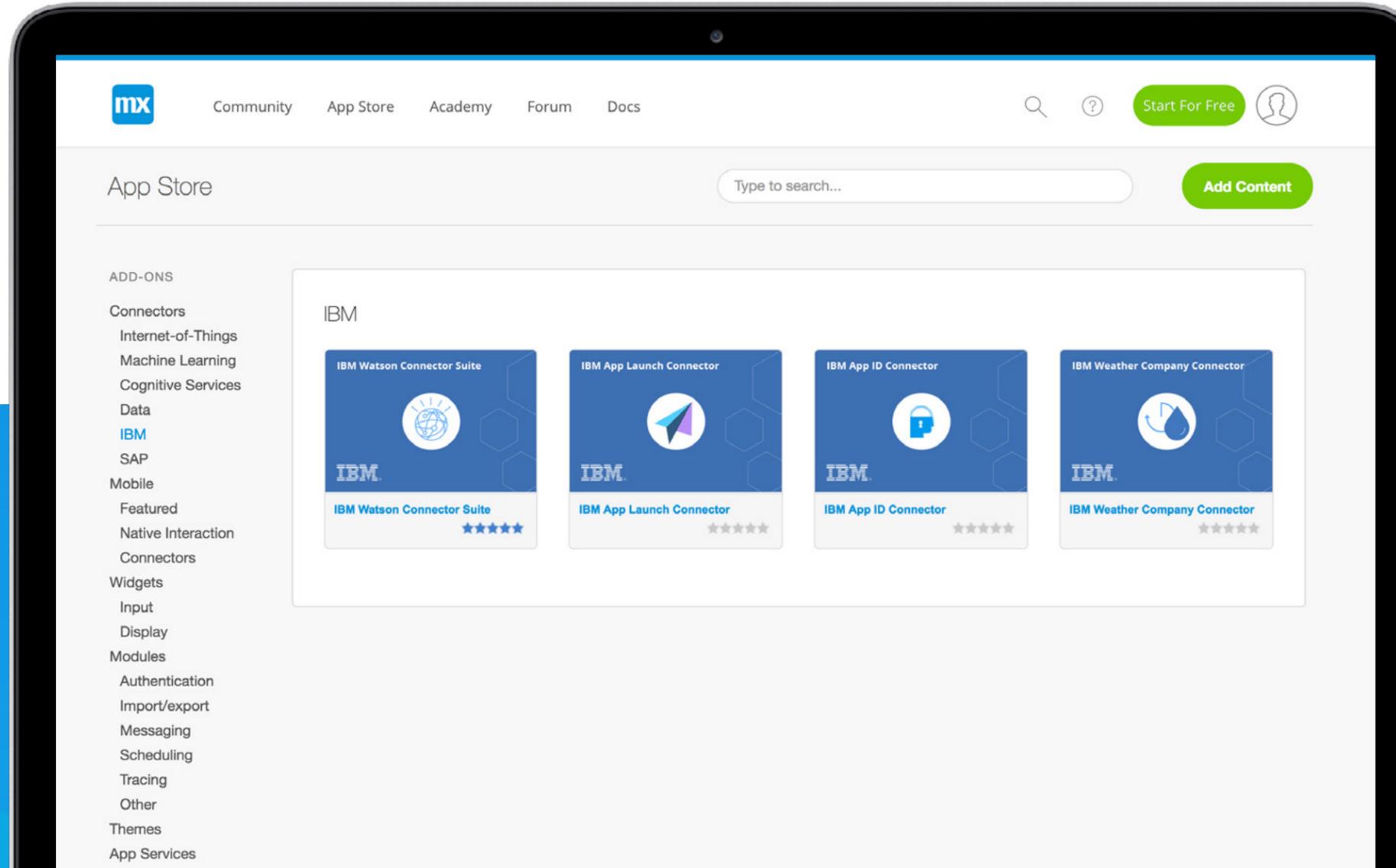
In addition, professional developers should be able to create their own connectors and make them available to less technical developers as native platform elements.

Scaling customer-facing apps while delivering the performance users expect

Apps delivered quickly won't scale and deliver the performance users expect. Customer-facing applications are inherently used by large amounts of people, particularly in B2C scenarios, making scalability and performance that much more important. Low-code platforms can marry rapid development with a web-scale run-time architecture.

Look for a low-code platform where you can take advantage of deep and rich back-end integration, out-of-the-box scalability and high availability, with the flexibility to run your apps on any cloud infrastructure that meets your needs. When thinking about scale, your low-code platform should offer the following:

- ✓ A cloud-native architecture to enable elastic scaling for large user bases
- ✓ On-demand scaling (vertically and horizontally)
- ✓ Leverage any best of breed CI/CID pipeline tools for seamless automation
- ✓ Migrate apps across clouds in the event you need to change directions
- ✓ Automatic failover for continuous operation of critical apps or portals



An Example of a Customer Engagement App Built on a Low-Code Platform

For insurers, the digital age presents both threats and opportunities. Customers are less loyal, and more InsurTechs are entering the market with disruptive ideas. To remain relevant, insurers must redefine their products, services and business models around the customer. But what if your back-end systems are silos and sometimes even stem from the seventies?

A Fortune 500 Insurer decided to break through the status quo and defined a digital strategy that combines establishing an engaging customer experience layer with a fundamental overhaul of its core architecture at the same time.

This insurer goes to market entirely through agents, and executes a nationwide growth strategy. One of the first projects they took on was a new quote-and-bind application for agents, which also allows them to quickly launch new products and services.

The results have been remarkable. The insurance lines that have moved to the new application are processing three times as many quotes as they were able to previously. More importantly, new products and services are experiencing up to 40% lift in sales over previously non-digital channels.



While the experience has improved between the agent and the insurer, the efficiency gain of digitizing the interaction also allows them to re-allocate 12 Full Time Equivalents (FTEs) that were previously dedicated to manually responding to quote requests, to higher-value work.

Thanks to its openness and rich integration capabilities, the low-code platform proves to be equally proficient at integrating to the organization's core systems (hosted on IBM mainframes), as it integrates to modern cloud services. This provides the option to digitize agent interactions immediately, while back-end services are modernized.

Low-code development also allowed them to unlock an untapped talent pool within the organization, as non-technical developers can now build sophisticated applications leveraging visual development and an app store with hundreds of building blocks.

The insurer now drives a culture of innovation, organizing regular hackathons to harvest ideas from mixed teams of both business and IT professionals. The winning app of a recently held low-code hackathon was an image recognition service that determines the level of damage to an automobile and gives the user feedback on the claims process, as well as routes the claim to the appropriate workflow. This is a perfect example of how innovation, customer engagement and operational efficiency go hand in hand.



Efficiency

Deliver operational efficiency with apps that easily integrate with core systems



Operational efficiency apps are employee- or partner-facing apps designed to lower costs by reducing or automating manual or paper-based processes.

Operational efficiency apps may support departmental, cross-departmental or company-wide processes, and are often driven by compliance needs (i.e. avoiding cost penalties), particularly in regulated industries.

These apps require deep domain knowledge and user focus to articulate the right feature-set and user experience. Moreover, because they support key business processes, they almost always integrate with core systems, and may also replace legacy systems that address parts of the process.

The closer the app is to the core of the business, the more critical operational robustness becomes. If the app will be used by the whole company, it becomes mission critical and has to deliver high scalability and performance. This can be challenging for many organizations. Enter the low-code platform!

Low-code platforms enable organizations to harness the knowledge of domain experts throughout the entire app lifecycle, enabling iterative design and development of operational efficiency apps. Moreover, platforms typically include out-of-the-box connectors or enable developers to build their own and make them available through a Private App Store, easing integration with systems of record.

3 Challenges to Developing Operational Efficiency Apps and the Low-Code Solutions

Misinterpreted requirements

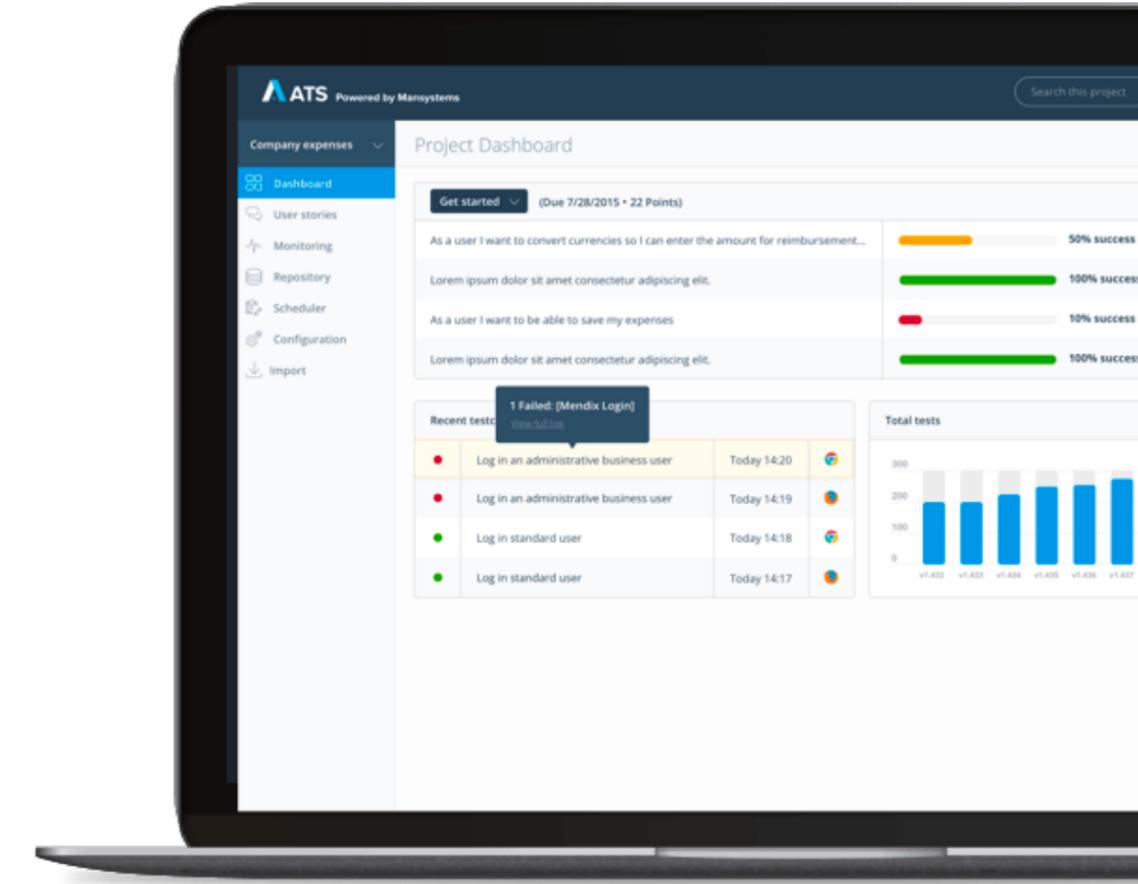
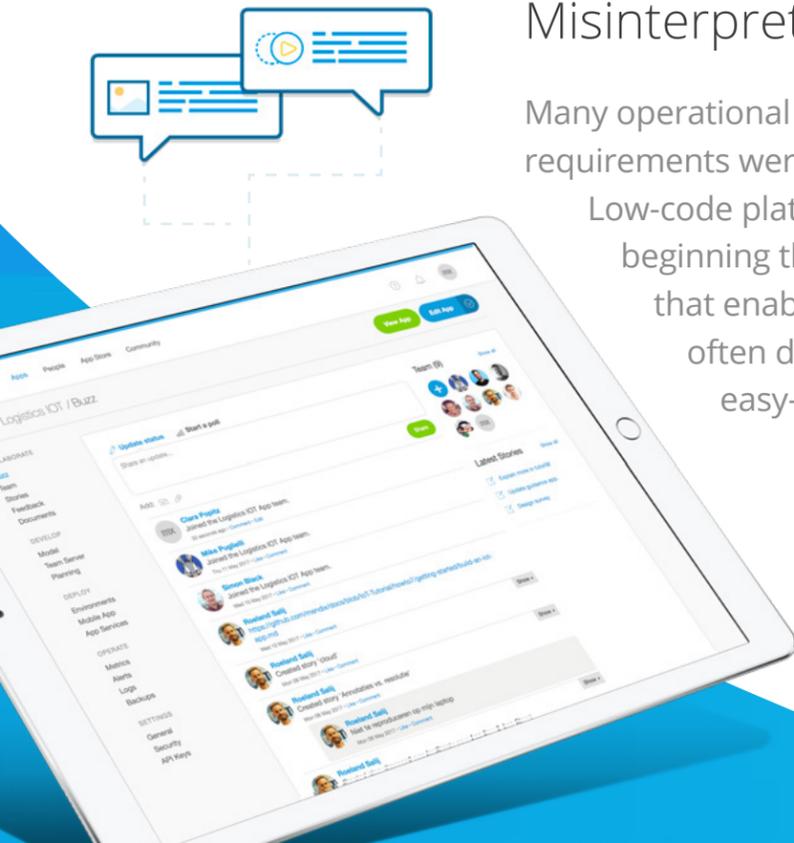
Many operational efficiency projects don't deliver their intended value because the requirements were misinterpreted and the development team didn't build the right thing. Low-code platforms harness the knowledge and feedback of the business from the beginning through to delivery and beyond. Visual models provide a shared language that enables business and IT to review, discuss, and validate functionality early and often during the development phase. In addition, look for a platform with an easy-to-use project portal where business users can create and track their own user stories. Also look for built-in agile project management to encourage iterative development while including the business and incorporating their feedback.

Dependencies on core systems

It's often challenging to integrate with Systems of Record due to the complexity of integrating with legacy and off-the-shelf solutions to implement the required process enhancements and automation. To alleviate these challenges, look for a low-code platform that provides out-of-the-box connectors to common business applications, enabling less technical developers to orchestrate core systems and automate workflows. In addition, professional developers should be able to create their own connectors and make them available to less technical developers as native platform elements with easy to use and visual integrations.

Managing an ever-increasing app portfolio

There's often a high cost of managing an ever-increasing and evolving app portfolio as organizations address operational efficiency across multiple departments and business units. Look for a low-code platform that applies *appropriate governance* without compromising time-to-value, including tools to automate testing and monitor quality and performance. Some low-code platforms will provide logging and controls out-of-the-box to ensure compliance and quality across your entire portfolio of apps.



One Company's Portfolio of Operational Efficiency Apps Built with Low-Code Development

A leading provider of services and technology for the mortgage and real estate industries drives operational excellence in real estate investment management. As a provider of end-to-end solutions for online real estate platforms, this publicly traded company continuously invests in delivering optimal services for their target customers and drives operational excellence.

On the lookout for ways to accelerate their technology initiatives and improve time-to-value, they discovered the power of low-code and decided to embark on a journey to enrich their portfolio of online services with new apps built at speed.

One of the first initiatives was to provide a new service for underwriters that allowed them to review properties on the market meeting specific criteria. They could then run financial analysis, schedule inspections, and ultimately track the property to the point of purchase. Previously, the process had been cumbersome as these tasks had to be completed using a combination of legacy systems and Excel spreadsheets.

Starting with a small budget, the company trained three internal team members and got some external help from experienced low-code developers. In just 30 days, the first MVP was ready, and the team took it all the

way to an initial launch. Having the process aggregated into a single app is bringing added productivity and a simplified process with more control and reporting.

The success of the first app sparked a light in the organization to define a portfolio of initiatives they will fulfill taking a low-code approach.

In just 30 days, the first MVP was ready, and the team took it all the way to an initial launch.





Legacy Migration

Successfully migrating legacy systems to improve performance and maintainability



There are two types of legacy migration projects: lift-and-shift and business transformation.

Lift-and-shift legacy migrations are typically initiated by IT because the underlying infrastructure or technology needs to be updated or replaced, often for cost or technology obsolescence reasons. In these scenarios, the IT organization is looking to rebuild the existing system on a one-to-one basis, and there is no compelling or urgent need for significant change on the side of the business. They simply want a new system that allows them to continue doing what they've been doing.

Most of the legacy migrations we see our customers undergo, on the other hand, are business transformation initiatives. Driven by the business, these apps are meant to replace legacy

systems that don't sufficiently support business processes to provide the right user experience. While these legacy migration projects require new functionality, they often must support current processes as well.

Low-code platforms enable organizations to take a user-first approach when replacing legacy systems, adding new functionality and improving the overall user experience. At the same time, to ensure they don't create tomorrow's legacy, such platforms support modern, microservices architectures, and include built-in capabilities for addressing quality and maintainability at each stage of the lifecycle.

3 Challenges of Developing Legacy Migration Apps, and Their Low-Code Solutions

Lack of flexibility creates tomorrow's legacy

Legacy migrations require organizations to build systems that remain flexible to adapt to changes. The last thing IT wants is for the new system to become tomorrow's legacy. Low-code platforms enable your organization to employ a modern app architecture that promotes agility by leveraging microservices. Look for a platform that enables easy creation of autonomous apps and services that can be recombined and shared—while facilitating fast, frequent change cycles so the system can evolve to meet new business needs. It's critical to take advantage of a future-proof platform so you aren't creating an unmaintainable set of apps or piles of machine-generated code.

Enabling developers to rapidly take advantage of best-of-breed modern technology stacks without having the expertise to be an expert in all of them will create a high level of flexibility that is fully documented and visually constructed.



Mission-critical apps fail to deliver at scale

Many core legacy systems fail to deliver the required performance at scale. Look for a low-code platform that can ensure the new solution can be deployed with the required resiliency and high availability for mission-critical use. A low-code platform with a cloud-native architecture enables automatic failover for continuous operation of business-critical apps, ensuring that they don't run into the same performance issues as legacy systems.

Inadequate oversight of quality

Due to the size and complexity of most legacy migration solutions, there is often an inadequate oversight of the quality of the app. It is important to be able to proactively monitor and address the quality of the applications to prevent technical debt and improve long-term maintainability. Look for a low-code platform that embeds *automated quality, testing, and performance monitoring within the development lifecycle*.

Usability is an afterthought

With this type of application, usability is often an afterthought, blunting ROI. Use low-code development to take a user-centric, design thinking approach when designing the new solution. Deeper understanding of the users and business context can help close process gaps that existed in the legacy system, delivering an end-to-end solution that drives substantial productivity gains. This level of understanding may also result in the incorporation of new capabilities that weren't available in the legacy system (e.g. mobile, conversational UI), or the removal of unused features.

Both help deliver a more focused and engaging user experience. Look for a platform that enables the business to participate in the design process to ensure app usability and success.

An example of a bank that drove award-winning legacy modernization with low-code



A financial institution, devoted exclusively to entrepreneurs, serves businesses through financing, advisory services and capital, with a focus on small- and medium-sized enterprises.



With the goal to become more nimble and customer centric, the bank decided to modernize its core lending system for loan origination, administration and disbursement to reduce processing time and overhead costs.



The organization adopted a low-code platform to foster collaboration between IT and business users. “IT is working with the business side-by-side, rather than throwing requirements over the fence and sending applications back that don’t meet their needs,” their CIO commented. “It makes a huge difference in terms of speed because we get it right the first time around when we’re both talking about what is needed.”

The entire workflow was redesigned with over 400 different integration points to take into account. Compared to the alternative traditional development approach that had been considered before, the development timeline was reduced from 30 months to 8 months—and with a team nearly a third of the size. The team got recognition for this approach, winning the prestigious OCTAS Innovation Award for Business Transformation.

The bank also piloted a new mobile lending platform that enables customer-facing account managers to sit side by side with clients to process paperless loan applications, with funds being disbursed as early as the next business day.



“It makes a huge difference in terms of speed because we get it right the first time around when we’re both talking about what is needed.”

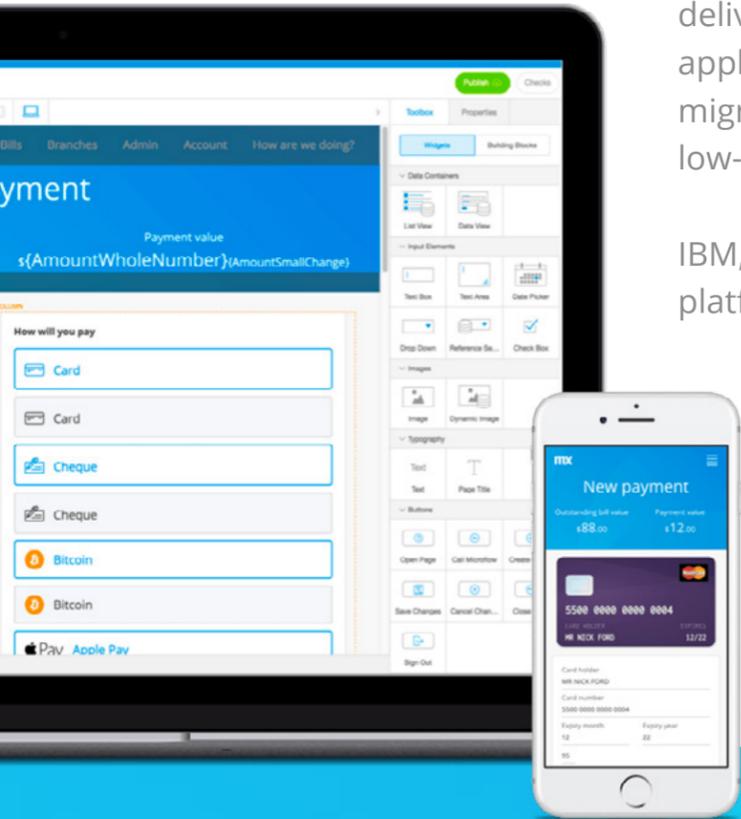
IBM and Mendix Join Forces

Low-code platforms enable organizations to take a test-and-learn approach to innovation, build and scale customer facing apps at speed and deliver performance users expect. Developers can more rapidly deliver applications that can easily integrate into core systems, and successfully migrate legacy systems to improve performance and scalability. But not all low-code platforms are created equally.

IBM, the leader in enterprise cloud, and Mendix, the leader in low-code platforms, partner to help enterprises shorten time to value by building applications that leverage their data to turn it into actionable insight and drive business outcomes. IBM Cloud is built for the enterprise -- the only cloud that integrates public, private, multi-cloud and on-premises data centers through a single architecture designed for cognitive workloads.

Mendix's visual development and full lifecycle support enables developers to deliver applications 10 times faster than traditional development approaches. Seamlessly integrate core systems and data, leverage Watson services, and run instantly on IBM Cloud. IBM offers a single point of contact for Mendix contracting and support, and a joint roadmap, so that enterprises can expect lasting ROI.

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